92075

Haynes

Toyota
Pick-ups & 4Runner

Pick-ups (1979 thru 1995) □ **4Runner** (1984 thru 1995)
All compact models with a gasoline engine

Haynes Repair Manual

Based on a complete teardown and rebuild

PRINTED ON RECYCLED PAPER

Includes essential information for today's more complex vehicles

9207

TOYOTA PICK-UPS ('79 thru '95) & 4RUNNER ('84 thru '95)

HAYNES

92075

Toyota Pick-ups & 4-Runner Automotive Repair Manual

by John Raffa, Larry Warren and John H Haynes
Member of the Guild of Motoring Writers

Models covered:
All Toyota pick-ups and 4-Runner
1979 through 1995
Does not cover diesel engine, T-100 or Tacoma model information

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861 Lawrence Drive
Newbury Park
California 91320 USA

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.

Acknowledgements

We are grateful for the help of the Toyota Motor Company for its assistance with technical information, certain illustrations and vehicle photos.

A book in the Haynes Automotive Repair Manual Series

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Contents

Introductory pages

About this manual 0-2
Introduction to the Toyota pick-up and 4-runner 0-4
Vehicle identification numbers 0-5
Buying parts 0-6
Maintenance techniques, tools and working facilities 0-6
Booster battery Oump) starting 0-12
Jacking and towing 0-12
Automotive chemicals and lubricants 0-13
Conversion factors 0-14
Safety first! 0-15
Troubleshooting 0-16

Chapter 1
Tune-up and routine maintenance **1-1**

Chapter 2 Part A
Four-cylinder engines **2A·1**

Chapter 2 Part B
VS engine **28-1**

Chapter 2 Part C
General engine overhaul procedures **2C·1**

Chapter3
Cooling, heating and air conditioning systems **3-1**

Chapter4
Fuel and exhaust systems **4-1**

Chapters
Engine electrical systems **5-1**

Chapter6
Emissions control systems **6-1**

Chapter 7 Part A
Manual transmission **7A-1**

Chapter 7 Part B
Automatic transmission **78-1**

Chapter 7 Part C
Transfer case **7C-1**

Chapter 8
Clutch and driveline **8-1**

Chapter 9
Brakes **9-1**

Chapter 10 Part A
Suspension and steering systems (2WD) **10A-1**

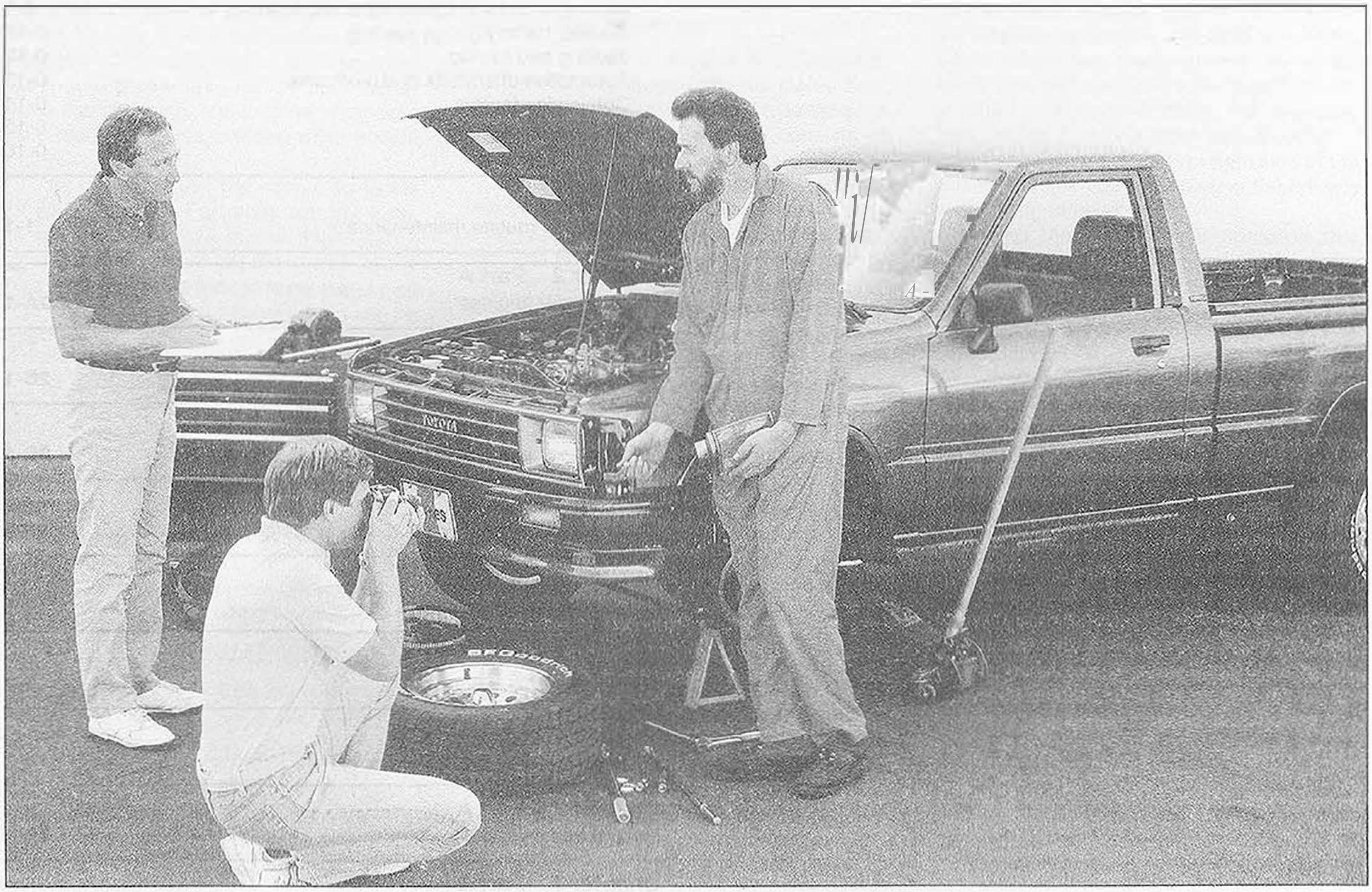
Chapter 10 Part B
Suspension and steering systems (4WD) **108-1**

Chapter 11
Body **11-1**

Chapter 12
Chassis electrical system **12-1**

Wiring diagrams **12-14**

Index **IND-1**



Haynes author, photographer and mechanic with Toyota pick-up

Introduction to the Toyota pick-ups and 4-runner

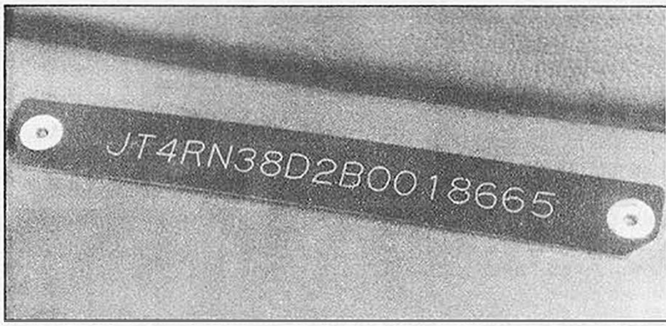
The Toyota pick-up truck and 4-runner vehicles are conventional front engine/rear wheel drive layout with four-wheel drive (4WD) available on some models.

The inline four-cylinder or V6 engines used in these vehicles are equipped with either a carburetor or port-type fuel injection. The engine drives the rear wheels through either a four or five-speed manual or automatic transmission via a driveshaft and solid rear axle. On 4WD models, a transfer case and driveshaft are used to drive the front wheels through independent driveaxles.

Front suspension is independent, featuring torsion bars, with power-assisted steering available on later models. Leaf springs are used in the rear.

Brakes are power assisted discs at the front and self-adjusting drums at the rear.

Vehicle identification numbers



The VIN number is **stamped into a metal plate that's fastened to the dashboard on the driver's side - it's visible through the windshield**

Modifications are a continuing and unpublicized part of 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)

The VIN is very important because it's used for title and registration purposes. The VIN is stamped into a metal plate fastened to the dashboard close to the windshield on the driver's side of the vehicle **(see illustration)** and on the right side f nder panel in the engine compartment **(see illustration)** It contains valuable information such as where and when the vehicle was manufactured, the model year and the body style.

Vehicle data plate

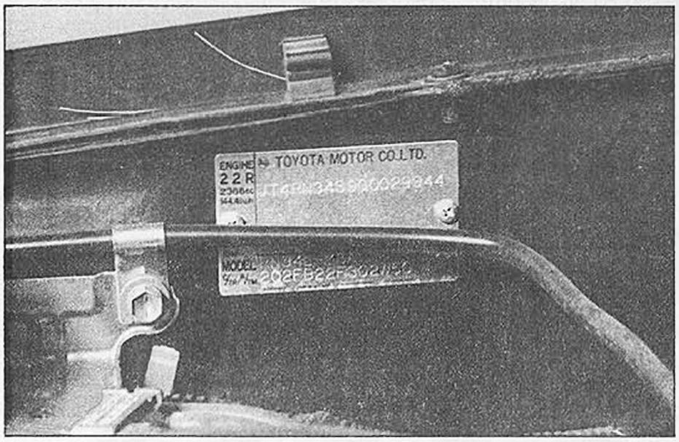
This metal plate, attached to the driver's side door post **(see illustration),** contains important information including the vehicle type, date of manufacture, GVWR, tire sizes, etc.

Engine identification numbers

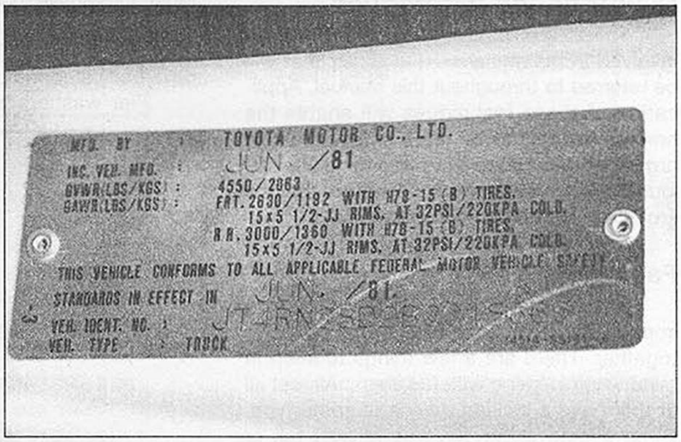
The engine identification number on four-cylinder engines is stamped on a pad on the left side of the block **(see illustration).** On the V6 engine, the ID number is found on the left (driver's) side of the block, just above the oil filter **(see illustration).**

Vehicle Emission Control Information label

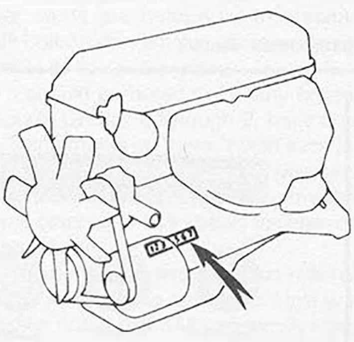
The Vehicle Emission Control Information label and vacuum hose diagram are attached to the underside of the hood **(see illustration).**



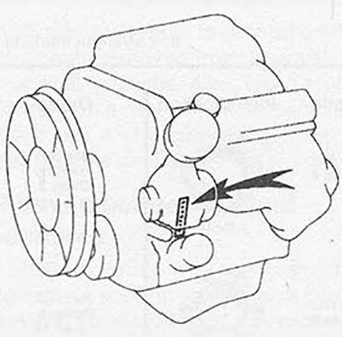
The VIN number is also on the plate fastened to the right (passenger) side of the fender panel in the engine compartment



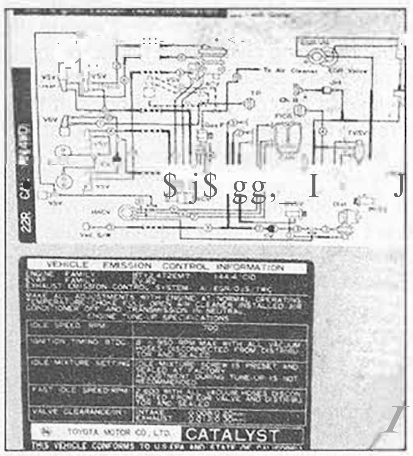
The vehicle data plate is attached to the driver's side door post



The four-cylinder engine identification number is stamped into the block on the driver's side



The V6 engine identification number can be found on the driver's side of the block, just above the oil filter



The vehicle emissions control information (VECI) label and vacuum hose diagram are located on the underside of the hood

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.

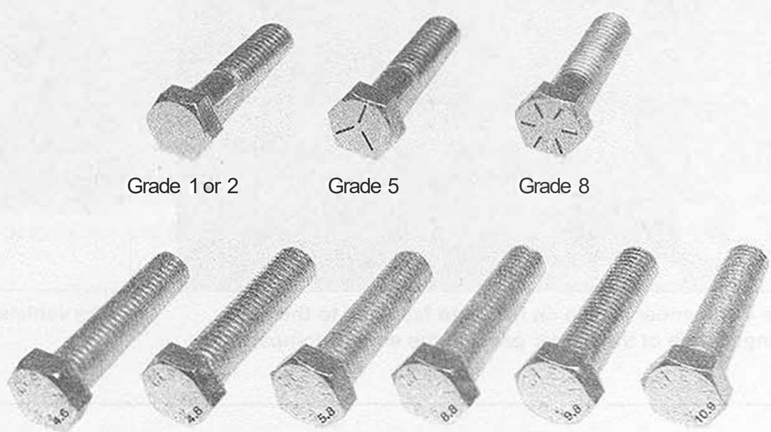
Fasteners

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.

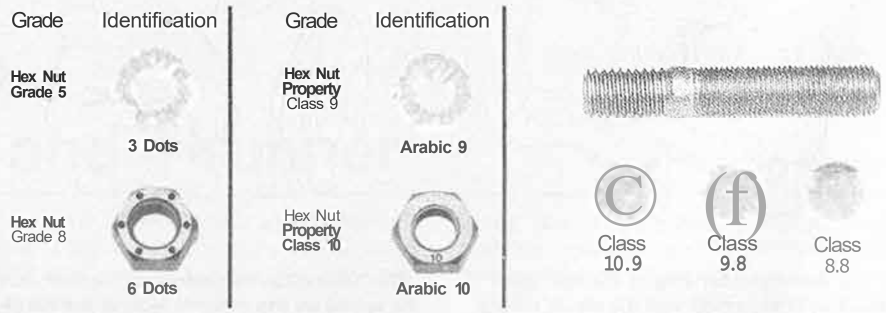
Rusted nuts and bolts should be treated with a penetrating fluid to ease removal and prevent breakage. Some mechanics use turpentine in a spout-type oil can, which works quite well. After applying the rust penetrant, let it work for a few minutes before trying to loosen the nut or bolt. Badly rusted 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.



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



Standard hex nut strength markings

Metric hex nut strength markings

Metric stud strength markings

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.

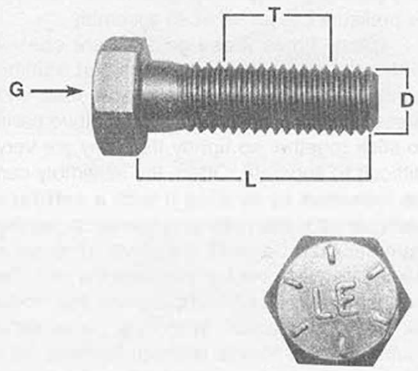
Metric studs are also marked on their ends according to property class (grade). Larger studs are numbered (the same as metric bolts), while smaller studs carry a geometric code to denote grade.

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.

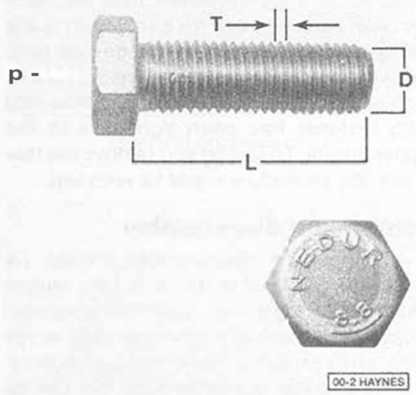
Since fasteners of the same size (both standard and metric) may have different strength ratings, be sure to reinstall any bolts, studs or nuts removed from your vehicle in their original locations. Also, when replacing a fastener with a new one, make sure that the new one has a strength rating equal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

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



Standard (SAE and USS) bolt dimensions/grade marks

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



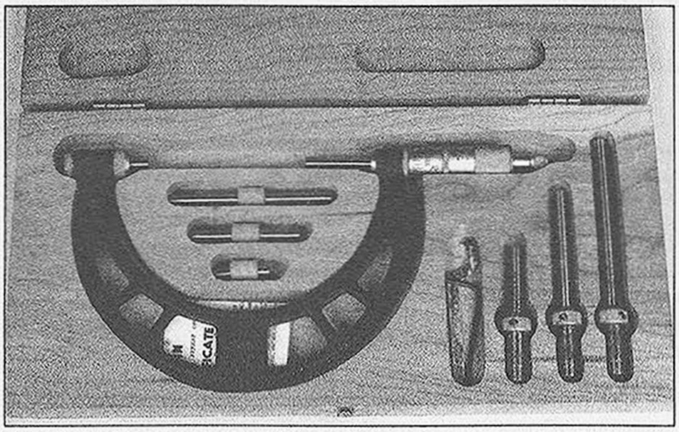
Metric bolt dimensions/grade marks

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

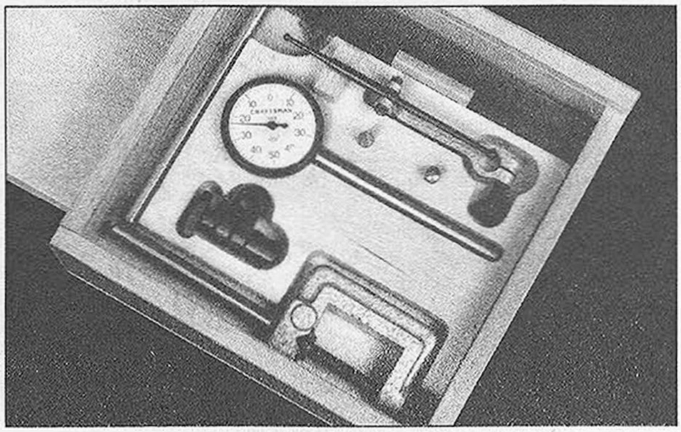
Tightening sequences and procedures

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 tight-



Micrometer set



Dial indicator set

ened 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.

Initially, the bolts or nuts should be assembled finger-tight only. Next, they should be tightened one full turn each, in a crisscross 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 AIC hoses without first having the system depressurized by a dealer seNice department or a seNice 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.

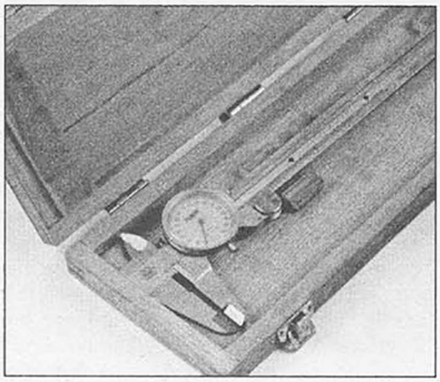
If a hose clamp is broken or damaged, do not reuse it. Wire-type clamps usually weaken with age, so it is a good idea to replace them with screw-type clamps whenever a hose is removed.

Tools

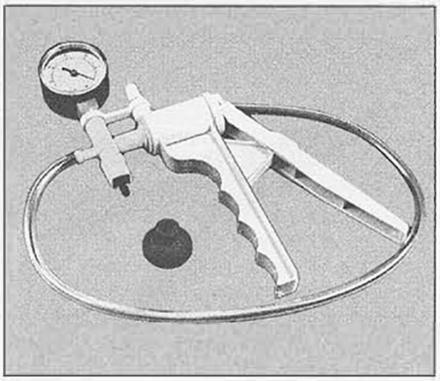
A selection of good tools is a basic requirement for anyone who plans to maintain and repair his or her own vehicle. For the owner who has few tools, the initial investment might seem high, but when compared to the spiraling costs of professional auto maintenance and repair, it is a wise one.

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*, *Repair/overhaul* and Special.

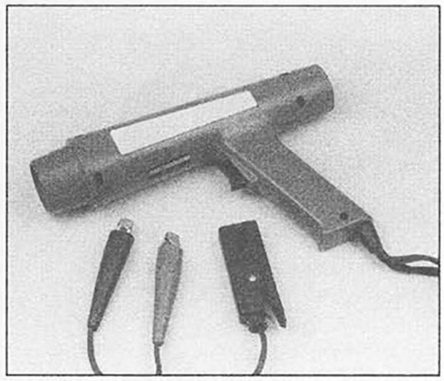
The newcomer to practical mechanics



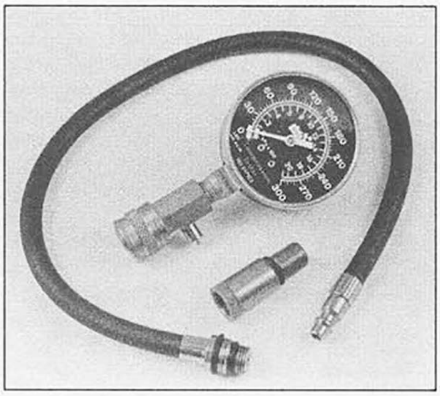
Dial caliper



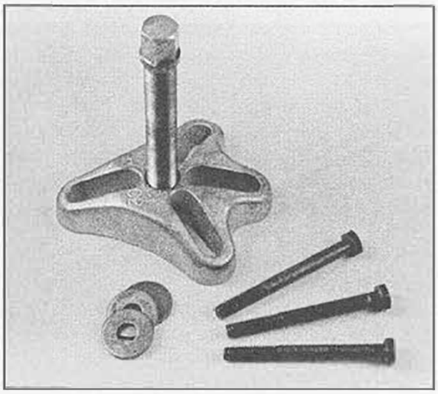
Hand-operated vacuum pump



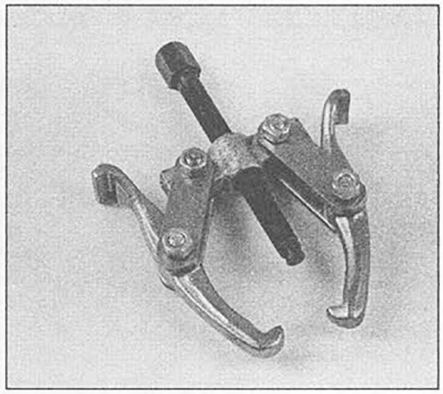
Timing light



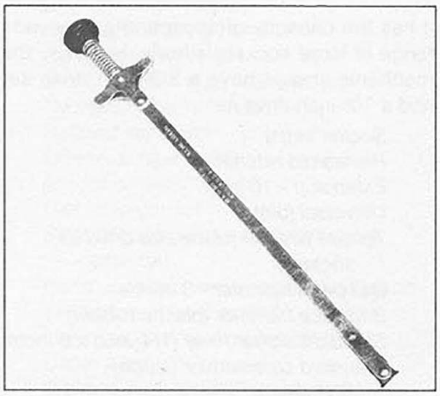
Compression gauge with spark plug hole adapter



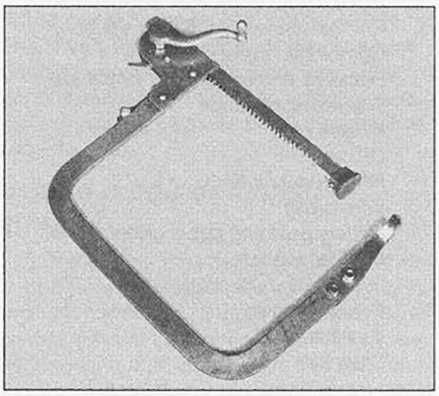
Damper/steering wheel puller



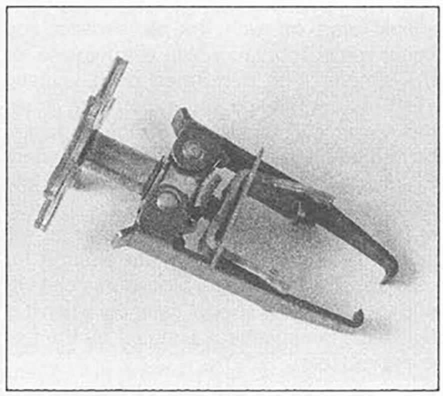
General purpose puller



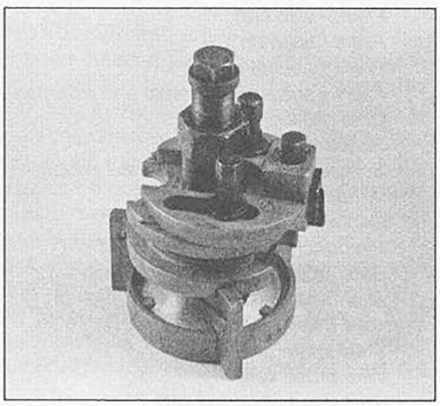
Hydraulic lifter removal tool



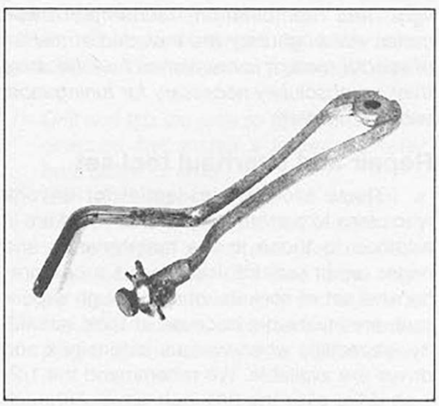
Valve spring compressor



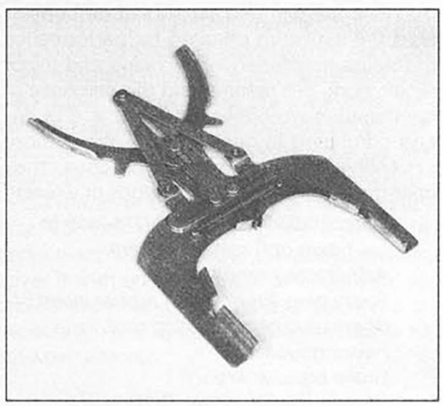
Valve spring compressor



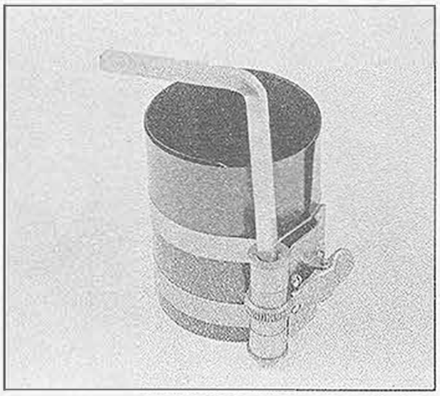
Ridge reamer



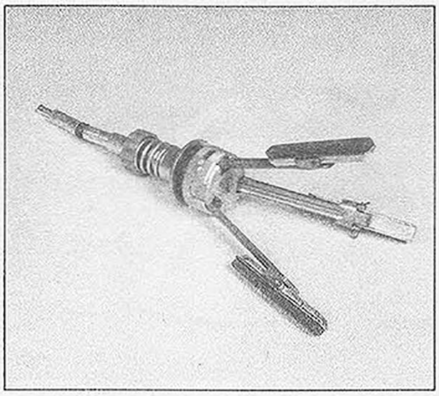
Piston ring groove cleaning tool



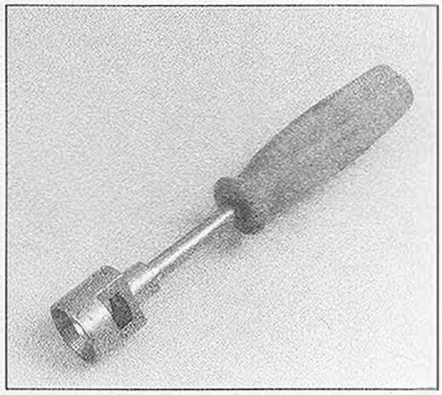
Ring removal/installation tool



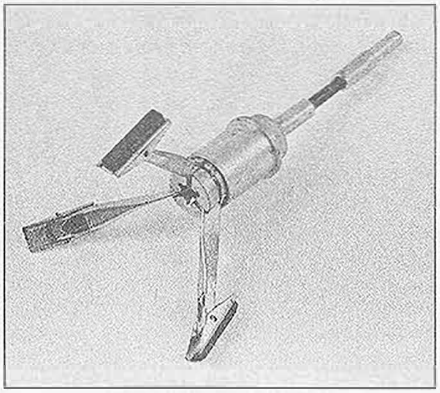
Ring compressor



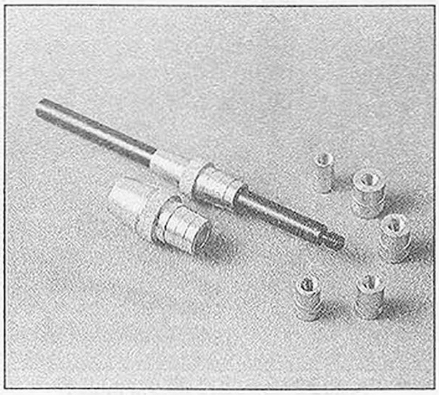
Cylinder hone



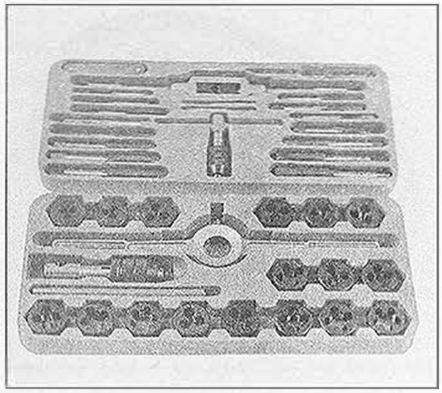
Brake hold-down spring tool



Brake cylinder hone



Clutch plate alignment tool



Tap and die set

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-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)
Standard screwdriver (1/4-inch x 6 inch)
Standard screwdriver (stubby - 5/16-inch)
Phillips screwdriver (No. 3 x 8 inch)
Phillips screwdriver (stubby - No. 2)
Pliers - vise grip
Pliers - lineman's
Pliers - needle nose
Pliers - snap-ring (internal and external)
Cold chisel - 1/2-inch
Scribe
Scraper (made from flattened copper tubing)
Centerpunch
Pin punches (1/16, 1/8, 3116-inch)
Steel rule/straightedge - 12 inch
Allen wrench set *(1/8 to 3/8-inch or 4 mm to 10mm)*
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 318-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
Bal/joint 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
Floorjack

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 hofe 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-Coi/ 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.

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) *Ensure that all electrical equipment (lights, heater, wipers etc.) are switched off.*

c) *Make sure that the booster battery is the same voltage as the discharged battery in the vehicle.*

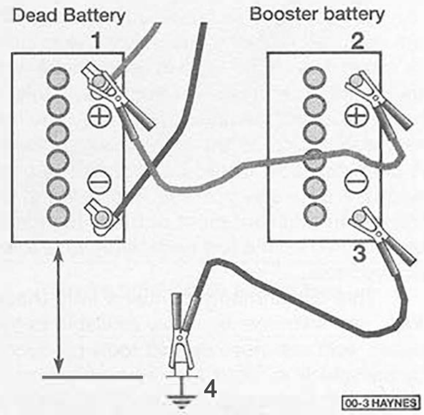
d) *If the battery is being jump started from the battery in another vehicle, the two vehicles MUST NOT TOUCH each other.*

e) *Make sure the transaxle is in Neutral (manual transaxle) or Park (automatic transaxle).*

◆ *Wear eye protection when jump starting a vehicle.*

Connect one jumper lead between the positive (+) terminals of the two batteries. Connect the other jumper lead first to the negative (-) terminal of the booster battery, then to a good engine ground on the vehicle to be started **(see illustration).** Attach the lead at least 18 inches from the battery, if possible. Make sure that the jumper leads will not contact the fan, drivebelt of other moving parts of the engine.

Start the engine using the booster battery and allow the engine idle speed to stabilize. Disconnect the jumper leads 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

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

All vehicles are supplied with a jack. It should be placed under the rear axle for raising the rear of the vehicle and under the front siderail (2WD) or front axle housing (4WD) for raising the front of the vehicle **(see illustrations).**

The vehicle should be on level ground with the wheels blocked and the transmission in Park (automatic) or Reverse (manual). On 4WD vehicles, the transfer case should be in the Neutral position. Pry off the hub cap (if equipped) using the tapered end of the lug wrench. Loosen the lug nuts one half turn and leave them in place until the wheel is raised off the ground.

Place the jack under the side of the vehicle in the indicated position. Use the supplied wrench to turn the jackscrew clockwise until the wheel is raised off the ground. Remove the lug nuts, pull off the wheel and replace it with the spare.

With the beveled side in, replace the lug nuts and tighten them until snug. Lower the vehicle by turning the jackscrew counterclockwise. Remove the jack and tighten the nuts in a diagonal pattern. Replace the hubcap by placing it in position and using the heel of your hand or a rubber mallet to seat it.

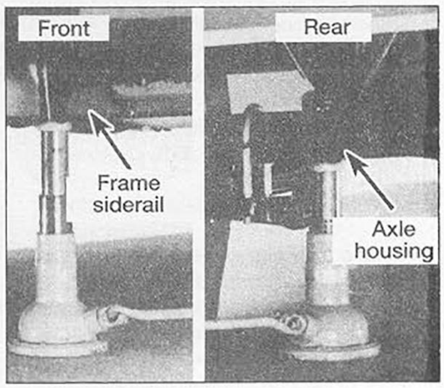
Towing

The vehicle can be towed with all four wheels on the ground, provided speeds do not exceed 35 mph and the distance is not over 50 miles, otherwise transmission damage can result.

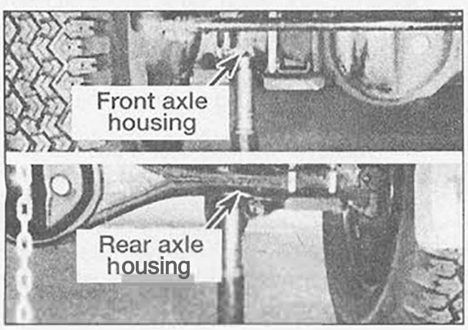
Towing equipment specifically designed for this purpose should be used and should be attached to the main structural members of the vehicle, not the bumper or brackets **(see illustrations).**

Safety is a major consideration when towing and all applicable state and local laws must be obeyed. A safety chain system must be used for all towing.

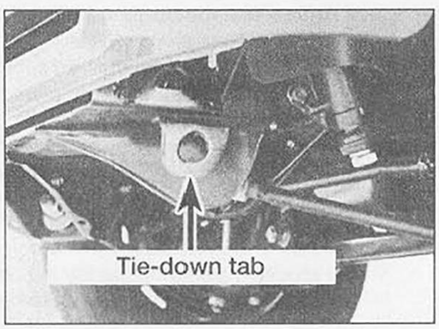
While towing, the parking brake should be released and the transmission and transfer case should be in Neutral. The steering must be unlocked (ignition switch in the Off position). Remember that power steering and power brakes will not work with the engine off.



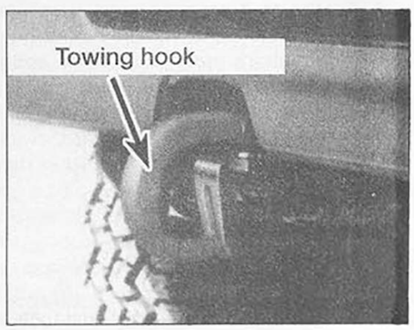
Recommended 2WD vehicle jacking locations



Recommended 4WD vehicle jacking locations



2WD vehicles have towing/tie-down tabs attached to the frame



4WD vehicles are equipped with heavy-duty tow hooks

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 O 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 SW-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 ant-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	= Millimetres (mm)	X	0.0394	"' Inches (In)
Feet (ft)	X	0.305	= Metres (m)	X	3.281	=Feet lftl
Miles	X	1.609	= Kliometres (km)	X	0.621	=MIIH

Volume (capacity)

Cubic Inches (cu In; In^3)	X	16.387	= C!lbic centimetres (cc; cm^1)	X	0.061	= Cubic Inch • (cu In;- In^1)
Imperial pints (Imp pt)	X.	0.568	= Litres (l)	X	1.76	= Imperial pint. (Imp pt)
Imperial qu(!rts (Imp qt)	X	1.137	= Litres (l)	X	0.88	= Imperial quart• (Imp qt)
Imperial quarts (Imp qt)	X	1.201	= US quarts (US qt)	X	0.833	= Imperial quam (Imp qt)
US quarts (US qt)	X	0.946	= Litres (l)	X	1.057	= US quart• (US qt)
Imperial gallons (Imp gal)	X	4.546	= Litres (l)	X	0.2-2	= Imperial gallons (Imp gel)
Imperial gallons (Imp gal)	X	1.201	= US gallons (US gal)	X	0.833	= Imperial gaUona (Imp gal)
US gallons (US gal)	X	3.785	= Litres (l)	X	0.26<4	= US gallona (US gal)

Mass (weight)

Ounces (oz)	X	28.35	= Grams (g)	X	0.036	= Ounces (0.1:)
Pounds (lb)	X	0.454	= Kllpgrams (kg)	X	2.206	= Pounds Ob)

Force

Ounces-force (ozf; oz)	X	0.278	= Newtons. (N)	X	3.6	= Ounces-force (oil; oz)
Pounds-force (lbf; lb)	X	4.448	= Newtons (N)	X	0.226	= Pounda-force (lbf; lb)
Newtons (N)	X	0.1	= Kilograms-force ikgf; 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 centimetre (kgf/cm^2; kwcm^2)	X	14.223	= Pounds-force per aquare In.ch (psi; lbf/In^2; lb/In')
Pounds-force per square Inch (psi: lbf/In^2; lb/In^2)	X	0.068	= Atmospheres (atm)	X	14.696	= Pounds-force per aquare Inch (psi; lbf/In^2; lb/10^2)
Pounds-force per square Inch.. (psi; lbf/In^2; lb/In^2)	X	0.069	= Bars	X	14.6	= Pounds-force per aquare inch (pai; lbf/In^2; lb/In^2)
Pounds-force per square Inch (psi; lbf/in^2; lb/In^2)	X	6.896	= Kilopascals (kPa)	X	0.146	= Pounds-force per aquare Inch (psi; lbf/In^2; lb/In^1)
Kllopascals (kPa)	X	0.0,	= Kilograms-force per aquare centimetre (k_gf/cm^2; kwcm^2)	X	98.1	= Kllopatcal• (kPa)

Torque (moment of force}

Pounds-force Inches (lbf In; lb In)	X	1.152	= Kilograms-force centimetre (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 metres (Nm)	X	8.85	= Pounds-force Inch41s (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 Ubf In; lb Inl
Pounds-force feet (lbf ft; lb ft)	X	0.138	= Kilograms-force metres (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 metres (Nm)	X	0.738	= Pounds-force feet (lbf ft; lb ft)
Newton metres (Nm)	X	0.102	= Kilograms-force metres (kgf m; kg m)	X	9.804	= NeW1on metres (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

Hore p wer (hp}	X	745.7	=Watts (WI	X	0.0013	= HorNpOWer (hp)

Velocity (speed)

Mlies per hour (miles/hr; mph)	X	1.609	= Kilometres per hour (km/hr; kph)	X	0.021	= Miles per hour (mIlel/hr; mph)

*Fuel consumption**

Miles per gallon, Imperial (mpg)	X	0.364	= Kilometres per litre (km/0	X	2.826	= Miles per gallon, Imperial (mpg)
Mlies per gallon, US (mpg)	X	0.426	= Kliometres per litre (km/l)	X	2.362	= Mlle• per gallon, US (mpg)

Temperature

Degrees Fahrenheit = (°C x 1.8) + 32

Degrees Celsius (Deg,eea Centigrade; °C) ""(° F - 32) x 0.56

**It is common prsct/cs to convert from milss psr gs/lon (mpg) to 1/tre:,/tOO kllolTlflt,.• (l/tOOlun), where mpg (Impsrisl) x 1/tOO km = 282 snd mpg (US) x 1/100 km = 236*

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

Contents

Symptom	Section
Engine and performance	
Alternator light fails to come on when key is turned on	13
Alternator light stays on	12
Battery will not hold a charge	11
Engine backfires	18
Engine diesels (continues to run) after being turned off	21
Engine hard to start when cold	4
Engine hard to start when hot	5
Engine lacks power	17
Engine 'lopes' while idling or idles erratically	8
Engine misses at idle speed	9
Engine misses throughout driving speed range	14
Engine rotates but will not start	2
Engine stalls	16
Engine starts but stops immediately	7
Engine surges while holding accelerator steady	19
Engine will not rotate when attempting to start	1
Excessive fuel consumption	24
Excessively high idle speed	10
Excessive oil consumption	23
Fuel odor	25
Hesitation or stumble during acceleration	15
Low oil pressure	22
Miscellaneous engine noises	26
Pinging or knocking engine sounds when engine is under load	20
Starter motor noisy or engages roughly	6
Starter motor operates without turning engine	3
Cooling system	
Abnormal coolant loss	31
Corrosion	33
External coolant leakage	29
Internal coolant leakage	30
Overcooling	28
Overheating	27
Poor circulation	32
Clutch	
Clutch pedal stays on floor when disengaged	39
Clutch slips (engine speed increases with no increase in vehicle speed)	35
Fails to release (pedal pressed to the floor - shift lever does not move freely in and out of Reverse)	34
Grabbing (chattering) as clutch is engaged	36
Squeal or rumble with clutch disengaged (pedal depressed)	38
Squeal or rumble with clutch engaged (pedal) released)	37
Manual transmission	
Difficulty engaging gears	45
Noise occurs while shitting gears	46
Noisy in all gears	41
Noisy in Neutral with engine running	40
Noisy in one particular gear	42
Oil leaks	44
Slips out of gear	43
Automatic transmission	
Engine will start in gears other than Park or Neutral	50
Fluid leakage	47
General shift mechanism problems	48
Transmission slips, shifts rough, is noisy or has no drive in forward or Reverse gears	51
Transmission will not downshift with the accelerator pedal pressed to the floor	49
Driveshaft	
Knock or clunk when transmission is under initial load Oust after, transmission is put into gear)	53
Leaks at front of driveshaft	52
Metallic grating sound consistent with vehicle speed	54
Scraping noise	56
Vibration	55
Whining or whistling noise	57
Rear axle and differential	
Knocking sound when starting or shifting gears	59
Noise - same when in drive as when vehicle is coasting	58
Noise when turning	60
Oil leaks	62
Vibration	61
Transfer case (4WD models)	
Difficult shitting	64
Gear jumping out of mesh	63
Noise	65
Brakes	
Brake pedal feels spongy when depressed	69
Brake pedal pulsates during brake application	72
Brakes drag (indicated by sluggish engine performance or wheels being very hot after driving)	73
Excessive brake pedal travel	68
Excessive effort required to stop vehicle	70
Noise (high-pitched squeal)	67
Pedal travels to the floor with little resistance	71
Rear brakes lock up under heavy brake application	75
Rear brakes lock up under light brake application	74
Vehicle pulls to one side during braking	66
Suspension and steering	
Excessively stiff steering	80
Excessive pitching and/or rolling around corners or during braking	78
Excessive play in steering	81
Excessive tire wear (not specific to one area)	87
Excessive tire wear on inside edge	89
Excessive tire wear on outside edge	88
Lack of power assistance	82
Miscellaneous noises	86
Noisy power steering pump	85
Shimmy, shake or vibration	77
Steering effort not the same in both directions (power system)	84
Steering wheel fails to return to straight-ahead position	83
Tire tread worn in one place	90
Vehicle pulls to one side	76
Wandering or general instability	79

This Section provides an easy reference guide to the more common problems that may occur during the operation of your vehicle. Various symptoms and their probable causes are grouped under headings denoting components or systems, such as Engine, Cooling system, etc. They also refer to the Chapter and/or Section that deals with the problem.

Remember that successful troubleshooting isn't a mysterious 'black art' practiced only by professional mechanics, it's simply the result of knowledge combined with an intelligent, systematic approach to a problem. Always use 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're exempt from such oversights.

Finally, always establish a clear idea 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 all other connections in the system to make sure they don't fail as well. If a particular fuse continues to blow, find out why - don't just go on replacing fuses. Remember, failure of a small component can often be indicative of potential failure or incorrect functioning of a more important component or system.

Engine and performance

1 Engine will not rotate when attempting to start

1 Battery terminal connections loose or corroded. Check the cable terminals at the battery; tighten cable clamp and/or clean off corrosion as necessary (see Chapter 1).
2 Battery discharged or faulty. If the cable ends are clean and tight on the battery posts, turn the key to the On position and switch on the headlights or windshield wipers. If they won't run, the battery is discharged .
3 Automatic transmission not engaged in park (P) or Neutral (N).
4 Broken, loose or disconnected wires in the starting circuit. Inspect all wires and connectors at the battery, starter solenoid and ignition switch (on steering column).
5 Starter motor pinion jammed in flywheel ring gear. If manual transmission, place transmission in gear and rock the vehicle to manually turn the engine. Remove starter (Chapter 5) and inspect pinion and flywheel (Chapter 2) at earliest convenience.
6 Starter solenoid faulty (Chapter 5).
7 Starter motor faulty (Chapter 5).
8 Ignition switch faulty (Chapter 13}.
9 Engine seized. try to turn the crankshaft with a large socket and breaker bar on the pulley bolt.

2 Engine rotates but will not start

1 Fuel tank empty.
2 Battery discharged (engine rotates slowly}. Check the operation of electrical components as described in previous Section.
3 Battery terminal connections loose or corroded. See previous Section .
4 Fuel not reaching carburetor or fuel injector. Check for clogged fuel filter or lines and defective fuel pump. Also make sure the tank vent lines aren't clogged (Chapter 4).
5 Choke not operating properly (Chapter 1).
6 Faulty distributor components. Check the cap and rotor (Chapter 1).
7 Low cylinder compression. Check as described in Chapter 2.
8 Valve clearances not properly adjusted (Chapter 1).
9 Water in fuel. Drain tank and fill with new fuel.
10 Defective IC ignition unit (Chapter 5).
11 Dirty or clogged carburetor jets or fuel injector. Carburetor out of adjustment.
12 Wet or damaged ignition components (Chapters 1 and 5).
13 Worn, faulty or incorrectly gapped spark plugs (Chapter 1).
14 Broken, loose or disconnected wires in the starting circuit (see previous Section).
15 Loose distributor (changing ignition timing). Turn the distributor body as necessary to start the engine, then adjust the ignition timing as soon as possible (Chapter 1).
16 Broken, loose or disconnected wires at the ignition coil or faulty coil (Chapter 5).
17 Timing belt or chain failure or wear affecting valve timing (Chapter 2).

3 Starter motor operates without turning engine

1 Starter pinion sticking. Remove the starter (Chapter 5) and inspect.
2 Starter pinion or flywheel/driveplate teeth worn or broken. Remove the inspection cover on the left side of the engine and inspect.

4 Engine hard to start when cold

1 Battery discharged or low. Check as described in Chapter 1.
2 Fuel not reaching the carburetor or fuel injectors. Check the fuel filter and lines (Chapters 1 and 4).
3 Choke inoperative (Chapters 1 and 4). 4 Defective spark plugs (Chapter 1).

5 Engine hard to start when hot

1 Air filter dirty (Chapter 1).
2 Fuel not reaching carburetor or fuel injectors (see Section 4). Check for a vapor lock situation, brought about by clogged fuel tank vent lines. 3 Bad engine ground connection.
4 Choke sticking (Chapter 1).
5 Defective pick-up coil in distributor (Chapter 5). 6 Float level too high.

6 Starter motor noisy or engages roughly

1 Pinion or flywheel/driveplate teeth worn or broken. Remove the inspection cover on the left side of the engine and inspect.
2 Starter motor mounting bolts loose or missing.

7 Engine starts but stops immediately

1 Loose or damaged wire harness connections at distributor, coil or alternator.
2 Intake manifold vacuum leaks. Make sure all mounting bolts/nuts are tight and all vacuum hoses connected to the manifold are attached properly and in good condition.

8 Engine 'lopes' while idling or idles erratically

1 Vacuum leaks. Check mounting bolts at the intake manifold for tightness. Make sure that all vacuum hoses are connected and in good condition. Use a stethoscope or a length of fuel hose held against your ear to listen for vacuum leaks while the engine is running. A hissing sound will be heard. A soapy water solution will also detect leaks. Check the intake manifold gasket surfaces.
2 Leaking EGR valve or plugged PCV valve (see Chapters 1 and 6).
3 Air filter clogged (Chapter 1).
4 Leaking head gasket. Perform a cylinder compression check (Chapter 2).
5 Timing chain or belt worn or (Chapter 2).
6 Camshaft lobes worn (Chapter 2).
7 Valve clearance out of adjustment (Chapter 1}. Valves burned or otherwise leaking (Chapter 2).
8 Ignition timing out of adjustment (Chapter 1).
9 Ignition system not operating properly (Chapters 1 and 5).
10 Thermostatic air cleaner not operating properly (Chapter 1).
11 Choke not operating properly (Chapter 1).
12 Dirty or clogged injectors. Carburetor dirty, clogged or out of adjustment (Chapter 4).
13 Idle speed out of adjustment (Chapters 1 and 4).

9 Engine misses at idle speed

1 Spark plugs faulty or not gapped properly (Chapter 1).
2 Faulty spark plug wires (Chapter 1).
3 Wet or damaged distributor components (Chapter 1).
4 Short circuits in ignition, coil or spark plug wires.
5 Sticking or faulty emissions systems (see Chapter 6).
6 Clogged fuel filter and/or foreign matter in fuel. Remove the fuel filter (Chapter 1) and inspect.
7 Vacuum leaks at intake manifold or hose connections. Check as described in Section 8.
8 Incorrect idle speed (Chapter 1) or idle mixture.
9 Incorrect ignition timing (Chapter 1).
10 Low or uneven cylinder compression. Check as described in Chapter 2.
11 Choke not operating properly (Chapter 1).
12 Clogged or dirty fuel injectors (Chapter 4).

10 Excessively high idle speed

1 Sticking throttle linkage (Chapter 4).
2 Choke opened excessively at idle (Chapter 4).
3 Idle speed incorrectly adjusted (Chapter 1).
4 Valve clearances incorrectly adjusted (Chapter 1).
5 Dash pot out of adjustment (Chapter 6).

11 Battery will not hold a charge

1 Alternator drivebelt defective or not adjusted properly (Chapter 1).
2 Battery cables loose or corroded (Chapter 1).
3 Alternator not charging properly (Chapter 5).
4 Loose. broken or faulty wires in the charging circuit (Chapter 5).
5 Short circuit causing a continuous drain on the battery (Chapter 12).
6 Battery defective internally.
7 Faulty regulator (Chapter 5).

12 Alternator light stays on

1 Fault in alternator or charging circuit (Chapter 5).
2 Alternator drivebelt defective or not properly adjusted (Chapter 1).

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

1 Faulty bulb (Chapter 12).
2 Defective alternator (Chapter 5).
3 Fault in the printed circuit, dash wiring or bulb holder (Chapter 12).

14 Engine misses throughout driving speed range

1 Fuel filter clogged and/or impurities in the fuel system. Check fuel filter (Chapter 1) or clean system (Chapter 4).
2 Faulty or incorrectly gapped spark plugs (Chapter 1).
3 Incorrect ignition timing (Chapter 1).
4 Cracked distributor cap, disconnected distributor wires or damaged distributor components (Chapter 1) .
5 Defective spark plug wires (Chapter 1).
6 Emissions system components faulty (Chapter 6).
7 Low or uneven cylinder compression pressures. Check as described in Chapter 2.
8 Weak or faulty ignition coil (Chapter 5).
9 Weak or faulty ignition system (Chapter 5).
10 Vacuum leaks at intake manifold or vacuum hoses (see Section 8).
11 Dirty or clogged carburetor or fuel injector (Chapter 4).
12 Leaky EGR valve (Chapter 6).
13 Carburetor out of adjustment (Chapter 4).
14 Idle speed out of adjustment (Chapter 1).

15 Hesitation or stumble during acceleration

1 Ignition timing incorrect (Chapter 1).
2 Ignition system not operating properly (Chapter 5).
3 Dirty or clogged carburetor or fuel injector (Chapter 4).
4 Low fuel pressure. Check for proper operation of the fuel pump and for restrictions in the fuel filter and lines (Chapter 4).
5 Carburetor out of adjustment (Chapter 4).

16 Engine stalls

1 Idle speed incorrect (Chapter 1)..
2 Fuel filter clogged and/or water and impurities in the fuel system (Chapter 1).
3 Choke not operating properly (Chapter 1).
4 Damaged or wet distributor cap and wires.
5 Emissions system components faulty (Chapter 6).
6 Faulty or incorrectly gapped spark plugs (Chapter 1). Also check the spark plug wires (Chapter 1).
7 Vacuum leak at the carburetor, intake manifold or vacuum hoses. Check as described in Section 8.
8 Valve clearances incorrect (Chapter 1).

17 Engine lacks power

1 Incorrect ignition timing (Chapter 1).
2 Excessive play in distributor shaft. At the same time check for faulty distributor cap, wires, etc. (Chapter 1).
3 Faulty or incorrectly gapped spark plugs (Chapter 1).
4 Air filter dirty (Chapter 1).
5 Spark timing control system not operating properly (Chapter 6).
6 Faulty ignition coil (Chapter 5).
7 Brakes binding (Chapters 1 and 9).
8 Automatic transmission fluid level incorrect, causing slippage (Chapter 1).
9 Clutch slipping (Chapter 8).
10 Fuel filter clogged and/or impurities in the fuel system (Chapters 1 and 4).
11 EGR system not functioning properly (Chapter 6).
12 Use of sub-standard fuel. Fill tank with proper octane fuel.
13 Low or uneven cylinder compression pressures. Check as described in Chapter 2.
14 Air leak at carburetor or intake manifold (check as described in Section 8).
15 Dirty or clogged carburetor jets or malfunctioning choke (Chapter 1).

18 Engine backfires

1 EGR system not functioning properly (Chapter 6).
2 Ignition timing incorrect (Chapter 1)
3 Thermostatic air cleaner system not operating properly (Chapter 6).
4 Vacuum leak (refer to Section 8).
5 Valve clearances incorrect (Chapter 1).
6 Damaged valve springs or sticking valves (Chapter 2).
7 Intake air leak (see Section 8).
8 Carburetor float level out of adjustment.

19 Engine surges while holding accelerator steady

1 Intake air leak (see Section 8).
2 Fuel pump not working properly.

20 Pinging or knocking engine sounds when engine is under load

1 Incorrect grade of fuel. Fill tank with fuel of the proper octane rating .
2 Ignition timing incorrect (Chapter 1)
3 Carbon build-up in combustion chambers. Remove cylinder head(s) and clean combustion chambers (Chapter 2).
4 Incorrect spark plugs (Chapter 1).

21 Engine diesels (continues to run) after being turned off

1 Idle speed too high (Chapter 1).
2 Ignition timing incorrect (Chapter 1) .
3 Incorrect spark plug heat range (Chapter 1).
4 Intake air leak (see Section 8).
5 Carbon build-up in combustion chambers. Remove the cylinder head(s) and clean the combustion chambers (Chapter 2).
6 Valves sticking (Chapter 2).
7 BCDD or FICO system not operating properly (Chapter 6).
8 Valve clearance incorrect (Chapter 1).
9 EGR system not operating properly (Chapter 6).
10 Fuel shut-off system not operating properly (Chapter 6).
11 Check for causes of overheating (Section 27).

22 Low oil pressure

1 Improper grade of oil.
2 Oil pump regulator valve not operating properly (Chapter 2).
3 Oil pump worn or damaged (Chapter 2).
4 Engine overheating (refer to Section 27).
5 Clogged oil filter (Chapter 1).
6 Clogged oil strainer (Chapter 2).
7 Oil pressure gauge not working properly (Chapter 2).

23 Excessive oil consumption

1 Loose oil drain plug.
2 Loose bolts or damaged oil pan gasket (Chapter 2).
3 Loose bolts or damaged front cover gasket (Chapter 2).
4 Front or rear crankshaft oil seal leaking (Chapter 2).
5 Loose bolts or damaged rocker arm cover gasket (Chapter 2).
6 Loose oil filter (Chapter 1).
7 Loose or damaged oil pressure switch (Chapter 2).
8 Pistons and cylinders excessively worn (Chapter 2).
9 Piston rings not installed correctly on pistons (Chapter 2).
10 Worn or damaged piston rings (Chapter 2).
11 Intake and/or exhaust valve oil seals worn or damaged (Chapter 2):
12 Worn valve stems.
13 Worn or damaged valves/guides (Chapter 2).

24 Excessive fuel consumption

1 Dirty or clogged air filter element (Chapter 1).
2 Incorrect ignition timing (Chapter 1).
3 Incorrect idle speed (Chapter 1).
4 Low tire pressure or incorrect tire size (Chapter 10).
5 Fuel leakage. Check all connections, lines and components in the fuel system (Chapter 4).
6 Choke not operating properly (Chapter 1).
7 Dirty or clogged carburetor jets or fuel injectors (Chapter 4).

25 Fuel odor

1 Fuel leakage. Check all connections, lines and components in the fuel system (Chapter 4).
2 Fuel tank overfilled. Fill only to automatic shut-off.
3 Charcoal canister filter in Evaporative Emissions Control **system** clogged (Chapter 1).
4 Vapor leaks from Evaporative Emissions Control system lines (Chapter 6).

26 Miscellaneous engine noises

1 A strong dull noise that becomes more rapid as the engine accelerates indicates worn or damaged crankshaft bearings or an unevenly worn crankshaft. To pinpoint the trouble spot, remove the spark plug wire from one plug at a time and crank the engine over. If the noise stops, the cylinder with the removed plug wire indicates the problem area. Replace the bearing and/or service or replace the crankshaft (Chapter 2).
2 A similar (yet slightly higher pitched) noise to the crankshaft knocking described in the previous paragraph, that becomes more rapid as the engine accelerates, indicates worn or damaged connecting rod bearings (Chapter 2). The procedure for locating the problem cylinder is the same as described in Paragraph 1.
3 An overlapping metallic noise that increases in intensity as the engine speed increases, yet diminishes as the engine warms up indicates abnormal piston and cylinder wear (Chapter 2).To locate the problem cylinder, use the procedure described in Paragraph 1.
4 A rapid clicking noise that becomes faster as the engine accelerates indicates a worn piston pin or piston pin hole. This sound will happen each time the piston hits the highest and lowest points in the stroke (Chapter 2). The procedure for locating the problem piston is described in Paragraph 1.
5 A metallic clicking noise coming from the water pump indicates worn or damaged water pump bearings or pump. Replace the water pump with a new one (Chapter 3).
6 A rapid tapping sound or clicking sound that becomes faster as the engine speed increases indicates "valve tapping" or improperly adjusted valve clearances. This can be identified by holding one end of a section of hose to your ear and placing the other end at different spots along the �ocker arm cover. The point where the sound is loudest indicates the problem valve. Adjust the valve clearance (Chapter 1).
7 A steady metallic rattling or rapping sound coming from the area of the timing chain cover indicates a worn, damaged or out-of-adjustment timing chain. Service or replace the chain and related components (Chapter 2).

Cooling system

27 Overheating

1 Insufficient coolant in system (Chapter 1).
2 Drivebelt defective or not adjusted properly (Chapter 1).
3 Radiator core blocked or radiator grille dirty and restricted (Chapter 3)
4 Thermostat faulty (Chapter 3).
5 Fan not functioning properly (Chapter 3).
6 Radiator cap not maintaining proper pressure. Have cap pressure tested by gas station or repair shop.
7 Ignition timing incorrect (Chapter 1).
8 Defective water pump (Chapter 3).
9 Improper grade of engine oil.
10 Inaccurate temperature gauge (Chapter 12).

28 Overcooling

1 Thermostat faulty (Chapter 3).
2 Inaccurate temperature gauge (Chapter 12).

29 External coolant leakage

1 Deteriorated or damaged hoses. Loose clamps at hose connections (Chapter 1).
2 Water pump seals defective. If this is the case, water will drip from the weep hole in the water pump body (Chapter 3).
3 Leakage from radiator core or header tank. This will require the radiator to be professionally repaired (see Chapter 3 for removal procedures) .
4 Engine drain plugs or water jacket freeze plugs leaking (see Chapters 1 and 2).
5 Leak from coolant temperature switch (Chapter 3).
6 Leak from damaged gaskets or small cracks (Chapter 2).
7 Damaged head gasket. This can be verified by checking the condition of the engine oil as noted in Section 30.

30 Internal coolant leakage

Note: *Internal coolant leaks can usually be detected by examining the oil. Check the dipstick and inside the rocker arm cover for*

water deposits and an oil consistency like that of a milkshake.
1 Leaking cylinder head gasket. Have the system pressure tested or remove the cylinder head (Chapter 2) and inspect.
2 Cracked cylinder bore or cylinder head. Dismantle engine and inspect (Chapter 2).
3 Loose cylinder head bolts (tighten as described in Chapter 2).

31 Abnormal coolant loss

1 Overfilling system (Chapter 1).
2 Coolant boiling away due to overheating (see causes in Section 27).
3 Internal or external leakage (see Sections 29 and 30).
4 Faulty radiator cap. Have the cap pressure tested.
5 Cooling system being pressurized by engine compression. This could be due to a cracked head or block or leaking head gasket(s).

32 Poor coolant circulation

1 Inoperative water pump. A quick test is to pinch the top radiator hose closed with your hand while the engine is idling, then release it. You should feel a surge of coolant if the pump is working properly (Chapter 3).
2 Restriction in cooling system. Drain, flush and refill the system (Chapter 1). If necessary, remove the radiator (Chapter 3) and have it reverse flushed or professionally cleaned.
3 Loose water pump drivebelt (Chapter 1).
4 Thermostat sticking (Chapter 3).
5 Insufficient coolant (Chapter 1).

33 Corrosion

1 Excessive impurities in the water. Soft, clean water is recommended. Distilled or rainwater is satisfactory.
2 Insufficient antifreeze solution (refer to Chapter 1 for the proper ratio of water to antifreeze).
3 Infrequent flushing and draining of system. Regular flushing of the cooling system should be carried out at the specified intervals as described in Chapter 1.

Clutch

Note: *All clutch related service information is located in Chapter 8, unless otherwise noted.*

34 Fails to release {pedal pressed to the floor - shift lever does not move freely in and out of Reverse)

1 Clutch contaminated with oil. Remove clutch plate and inspect.
2 Clutch plate warped, distorted or otherwise damaged.
3 Diaphragm spring fatigued. Remove clutch cover/pressure plate assembly and inspect.
4 Leakage of fluid from clutch hydraulic system. Inspect master cylinder, operating cylinder and connecting lines.
5 Air in clutch hydraulic system. Bleed the system.
6 Insufficient pedal stroke. Check and adjust as necessary.
7 Piston seal in operating cylinder deformed or damaged.
8 Lack of grease on pilot bushing.
9 Damaged transmission input shaft splines.

35 Clutch slips (engine speed increases with no increase in vehicle speed}

1 Worn or oil soaked clutch plate.
2 Clutch plate not broken in. It may take 30 or 40 normal) starts for a new clutch to seat.
3 Diaphragm spring weak or damaged. Remove clutch cover/pressure plate assembly and inspect.
4 Flywheel warped or scored (Chapter 2).
5 Debris in master cylinder preventing the piston from returning to its normal position.
6 Clutch hydraulic line damaged.

36 Grabbing (chattering) as clutch is engaged

1 Oil on clutch plate. Remove and inspect. Repair any leaks.
2 Worn or loose engine or transmission mounts. They may move slightly when clutch is released. Inspect mounts and bolts.
3 Worn splines on transmission input shaft. Remove clutch components and inspect.
4 Warped pressure plate or flywheel. Remove clutch components and inspect.
5 Diaphragm spring fatigued. Remove clutch cover/pressure plate assembly and inspect.
6 Clutch linings hardened or warped.
7 Clutch lining rivets loose.
8 Engine and transmission not in alignment. Check for foreign object between bellhousing and engine block. Check for loose bellhousing bolts .

37 Squeal or rumble with clutch engaged (pedal released)

1 Improper pedal adjustment. Adjust pedal free play.
2 Release bearing binding on transmission shaft. Remove clutch components and check bearing. Remove any burrs or nicks, clean and relubricate before reinstallation.
3 Clutch rivets loose.
4 Clutch plate cracked.
5 Fatigued clutch plate torsion springs. Replace clutch plate.

38 Squeal or rumble with clutch disengaged (pedal depressed)

1 Worn or damaged release bearing.
2 Worn or broken pressure plate diaphragm fingers.
3 Worn or damaged pilot bearing.

39 Clutch pedal stays on floor when disengaged

1 Binding linkage or release bearing. Inspect linkage or remove clutch components as necessary.
2 Linkage springs being over extended. Adjust linkage for proper free play. Make sure proper pedal stop (bumper) is installed.

Manual transmission

Note: *All manual transmission service information is located in Chapter 7, unless otherwise noted.*

40 Noisy in Neutral with engine running

1 Input shaft bearing worn.
2 Damaged main drive gear bearing.
3 Insufficient transmission oil (Chapter 1).
4 Transmission oil in poor condition. Drain and fill with proper grade oil. Check old oil for water and debris (Chapter 1).
5 Noise can be caused by variations in engine torque. Change the idle speed and see if noise disappears.

41 Noisy in all gears

1 Any of the above causes, and/or:
2 Worn or damaged output gear bearings or shaft.

42 Noisy in one particular gear

1 Worn, damaged or chipped gear teeth.
2 Worn or damaged synchronizer.

43 Slips out of gear

1 Transmission loose on clutch housing.
2 Stiff shift lever seal.
3 Shift linkage binding.
4 Broken or loose input gear bearing retainer.

5 Dirt between clutch lever and engine housing.
6 Worn linkage.
7 Damaged or worn check balls, fork rod ball grooves or check springs.
8 Worn mainshaft or countershaft bearings.
9 Loose engine mounts (Chapter 2).
10 Excessive gear end play.
11 Worn synchronizers.

44 Oil leaks

1 Excessive amount of lubricant in transmission (see Chapter
1 for correct checking procedures). Drain lubricant as required.
2 Side cover loose or gasket damaged.
3 Rear oil seal or speedometer oil seal damaged.
4 To pinpoint a leak, first remove all built-up dirt and grime from the transmission. Degreasing agents and/or steam cleaning will achieve this. With the underside clean, drive the vehicle at low speeds so the air flow will not blow the leak far from its source. Raise the vehicle and determine where the leak is located.

45 Difficulty engaging gears

1 Clutch not releasing completely.
2 Loose or damaged shift linkage. Make a thorough inspection, replacing parts as necessary.
3 Insufficient transmission oil (Chapter 1).
4 Transmission oil in poor condition. Drain and fill with proper grade oil. Check oil for water and debris (Chapter 1).
5 Worn or damaged striking rod.
6 Sticking or jamming gears.

46 Noise occurs while shifting gears

1 Check for proper operation of the clutch (Chapter 8).
2 Faulty synchronizer assemblies. Measure balk ring-to-gear clearance. Also, check for wear or damage to balk rings or any parts of the synchromesh assemblies.

Automatic transmission

Note: *Due to the complexity of the automatic transmission, it's difficult for the home mechanic to properly diagnose and service. For problems other than the following, the vehicle should be taken to a reputable mechanic.*

47 Fluid leakage

1 Automatic transmission fluid is a deep red color, and fluid leaks should not be confused with engine oil which can easily be blown by air flow to the transmission.
2 To pinpoint a leak, first remove all built-up dirt and grime from the transmission. Degreasing agents and/or steam cleaning will achieve this. With the underside clean, drive the vehicle at low speeds so the air flow will not blow the leak far from its source. Raise the vehicle and determine where the leak is located. Common areas of leakage are:

a) ***Fluid pan:*** *tighten mounting bolts and/or replace pan gasket as necessary (Chapter 1).*
b) ***Rear extension:*** *tighten bolts and/or replace oil seal as necessary.*
c) ***Filler pipe:*** *replace the rubber oil seal where pipe enters transmission case.*
d) ***Transmission oil lines:*** *tighten fittings where lines enter transmission case and/or replace lines.*
e) ***Vent pipe:*** *transmission overfilled and/or water in fluid (see checking procedures, Chapter 1).*
f) ***Speedometer connector:*** *replace the O-ring where speedometer cable enters transmission case.*

48 General shift mechanism problems

Chapter 7 deals with checking and adjusting the shift linkage on automatic transmissions. Common problems which may be caused by out of adjustment linkage are:

a) *Engine starting in gears other than P (park) or N (Neutral).*
b) *Indicator pointing to a gear other than the one actually engaged.*
c) *Vehicle moves with transmission in P (Park) position.*

49 Transmission will not downshift with the accelerator pedal pressed to the floor

Chapter 7 deals with adjusting the kick-down switch to enable the transmission to downshift properly.

50 Engine will start in gears other than Park or Neutral

Chapter 7 deals with adjusting the Neutral start switch installed on automatic transmissions.

51 Transmission slips, shifts rough, is noisy or has no drive in forward or Reverse gears

1 There are many probable causes for the above problems, buit the home mechanic should concern himself only with *one* possibility; fluid level .
2 Before taking the vehicle to a shop, check the fluid level and condition as described in Chapter 1. Add fluid, if necessary, or change the fluid and filter if needed. If problems persist, have a professional diagnose the transmission.

Driveshaft

52 Leaks at front of driveshaft

Defective transmission rear seal. See Chapter 7 for replacement procedure. As this is done, check the splined yoke for burrs or roughness that could damage the new seal. Remove burrs with a fine file or whetstone.

53 Knock or clunk when transmission is under initial load Oust after transmission is put into gear)

1 Loose or disconnected rear suspension components. Check all mounting bolts and bushings (Chapters 1 and 11).
2 Loose driveshaft bolts. Inspect all bolts and nuts and tighten them securely.
3 Worn or damaged universal joint bearings. Replace driveshaft (Chapter 8).
4 Worn sleeve yoke and mainshaft spline.
5 Defective center bearing or insulator.

54 Metallic grating sound consistent with vehicle speed

Pronounced wear in the universal joint bearings. Replace U-joints or driveshafts, as necessary.

55 Vibration

Note: *Before blaming the driveshaft, make sure the tires* are *perfectly balanced and perform the following test.*
1 Install a tachometer inside the vehicle to monitor engine speed as the vehicle is driven. Drive the vehicle and note the engine speed at which the vibration (roughness) is most pronounced. Now shift the transmission to a different gear and bring the engine speed to the same point.
2 If the vibration occurs at the same engine speed (rpm) regardless of which gear the transmission is in, the driveshaft is NOT at fault since the driveshaft speed varies.
3 If the vibration decreases or is eliminated when the transmission is in a different gear at the same engine speed, refer to the following probable causes.
4 Bent or dented driveshaft. Inspect and replace as necessary.
5 Undercoating or built-up dirt, etc. on the

driveshaft. Clean the shaft thoroughly.
6 Worn universal joint bearings. Replace the U-joints or driveshaft as necessary.
7 Driveshaft and/or companion flange out of balance. Check for missing weights on the shaft. Remove driveshaft and reinstall 180i from original position, then recheck. Have the driveshaft balanced if problem persists.
8 Loose driveshaft mounting bolts/nuts.
9 Defective center bearing, if so equipped.
10 Worn transmission rear bushing (Chapter 7).

56 Scraping noise

Make sure the dust cover on the sleeve yoke isn't rubbing on the transmission extension housing.

57 Whining or whistling noise

Defective center bearing, if so equipped.

Rear axle and differential

Note: *For differential servicing information, refer to Chapter 8, unless otherwise specified.*

58 Noise - same when in drive as when vehicle is coasting

1 Road noise. No corrective action available.
2 Tire noise. Inspect tires and check tire pressures (Chapter 1).
3 Front wheel bearings loose, worn or damaged (Chapter 1).
4 Insufficient differential oil (Chapter 1).
5 Defective differential.

59 Knocking sound when starting or shifting gears

Defective or incorrectly adjusted differential.

60 Noise when turning

Defective differential.

61 Vibration

See probable causes under Driveshaft. Proceed under the guidelines listed for the driveshaft. If the problem persists, check the rear wheel bearings by raising the rear of the vehicle and spinning the wheels by hand. Listen for evidence of rough (noisy) bearings. Remove and inspect (Chapter 8).

62 Oil leaks

1 Pinion oil seal damaged (Chapter 8).
2 Axleshaft oil seals damaged (Chapter 8).
3 Differential cover leaking. Tighten mounting bolts or replace the gasket as required.
4 Loose filler or drain plug on differential (Chapter 1).
5 Clogged or damaged breather on differential.

Transfer case (4WD models)

Note: *All transfer case service information is located in Chapter 7C unless otherwise noted.*

63 Gear jumping out of mesh

1 Incorrect control lever free play.
2 Interference between the control lever and the console.
3 Play or fatigue in the transfer case mounts.
4 Internal wear or incorrect adjustments.

64 Difficult shifting

1 Lack of oil (Chapter 1).
2 Internal wear, damage or incorrect adjustment.

65 Noise

1 Lack of oil in transfer case (Chapter 1).
2 Noise in 4H and 4L, but not in 2H indicates cause is in the front differential or front axle.
3 Noise in 2H, 4H and 4L indicates cause is in rear differential or rear axle.
4 Noise in 2H and 4H but not in 4L, or in 4L only, indicates internal wear or damage in transfer case.

Brakes

Note: *Before assuming a brake problem exists, make sure the tires are in good condition and inflated properly, the front end alignment is correct and the vehicle is not loaded with weight in an unequal manner. All service procedures for the brakes are included in Chapter 9, unless otherwise noted.*

66 Vehicle pulls to one side during braking

1 Defective, damaged or oil contaminated brake pad on one side. Inspect as described in Chapter 1. Refer to Chapter 9 if replacement is required.
2 Excessive wear of brake pad material or disc on one side. Inspect and repair as necessary.
3 Loose or disconnected front suspension components. Inspect and tighten all bolts securely (Chapters 1 and 11).
4 Defective caliper assembly. Remove caliper and inspect for stuck piston or damage.
5 Brake pad to disc adjustment needed. Inspect automatic adjusting mechanism for proper operation.
6 Scored or out of round disc.
7 Loose caliper mounting bolts.
8 Incorrect wheel bearing adjustment.

67 Noise (high-pitched squeal)

1 Front brake pads worn out. This noise comes from the wear sensor rubbing against the disc. Replace pads with new ones immediately!
2 Glazed or contaminated pads.
3 Dirty or scored disc.
4 Bent support plate.

68 Excessive brake pedal travel

1 Partial brake system failure. Inspect entire system (Chapter 1) and correct as required.
2 Insufficient fluid in master cylinder. Check (Chapter 1) and add fluid - bleed system if necessary.
3 Air in system. Bleed system.
4 Excessive lateral disc play.
5 Brakes out of adjustment. Check the operation of the automatic adjusters.
6 Defective check valve. Replace valve and bleed system.

69 Brake pedal feels spongy when depressed

1 Air in brake lines. Bleed the brake system.
2 Deteriorated rubber brake hoses. Inspect all system hoses and lines. Replace parts as necessary.
3 Master cylinder mounting nuts loose. Inspect master cylinder bolts (nuts) and tighten them securely.
4 Master cylinder faulty.
5 Incorrect shoe or pad clearance.
6 Defective check valve. Replace valve and bleed system.
7 Clogged reservoir cap vent hole.
8 Deformed rubber brake lines.
9 Soft or swollen caliper seals.
10 Poor quality brake fluid. Bleed entire system and fill with new approved fluid.

70 Excessive effort required to stop vehicle

1 Power brake booster not operating properly.
2 Excessively worn linings or pads. Check and replace if necessary.
3 One or more caliper pistons seized or sticking. Inspect and rebuild as required.
4 Brake pads or linings contaminated with oil or grease. Inspect and replace as required.
5 New pads or linings installed and not yet seated. It'll take a while for the new material to seat against the disc or drum.
6 Worn or damaged master cylinder or caliper assemblies. Check particularly for frozen pistons.
7 Also see causes listed under Section 69.

71 Pedal travels to the floor with little resistance

Little or no fluid in the master cylinder reservoir caused by leaking caliper piston(s) or loose, damaged or disconnected brake lines. Inspect entire system and repair as necessary.

72 Brake pedal pulsates during brake application

1 Wheel bearings damaged, worn or out of adjustment (Chapter 1).
2 Caliper not sliding properly due to improper installation or obstructions. Remove and inspect.
3 Disc not within specifications. Remove the disc and check for excessive lateral runout and parallelism. Have the discs resurfaced or replace them with new ones. Also make sure that all discs are the same thickness.
4 Out of round rear brake drums. Remove the drums and have them turned or replace them with new ones.

73 Brakes drag (indicated by sluggish engine performance or wheels being very hot after driving)

1 Output rod adjustment incorrect at the brake pedal.
2 Obstructed master cylinder compensator. Disassemble master cylinder and clean.
3 Master cylinder piston seized in bore. Overhaul master cylinder.
4 Caliper assembly in need of overhaul.
5 Brake pads or shoes worn out.
6 Piston cups in master cylinder or caliper assembly deformed. Overhaul master cylinder.
7 Disc not within specifications (Section 72).
8 Parking brake assembly will not release.
9 Clogged brake lines.
10 Wheel bearings out of adjustment (Chapter 1).
11 Brake pedal height improperly adjusted.
12 Wheel cylinder needs overhaul.
13 Improper shoe to drum clearance. Adjust as necessary.

74 Rear brakes lock up under light brake application

1 Tire pressures too high.
2 Tires excessively worn (Chapter 1).
3 Defective LSPB valve.

75 Rear brakes lock up under heavy brake application

1 Tire pressures too high.
2 Tires excessively worn (Chapter 1).
3 Front brake pads contaminated with oil, mud or water. Clean or replace the pads.
4 Front brake pads excessively worn.
5 Defective master cylinder or caliper assembly.

Suspension and steering

Note: *All service procedures for the suspension and steering* systems *are included in Chapter 10,* unless *otherwise noted.*

76 Vehicle pulls to one side

1 Tire pressures uneven (Chapter 1).
2 Defective tire (Chapter 1).
3 Excessive wear in suspension or steering components (Chapter 1).
4 Front end alignment incorrect.
5 Front brakes dragging. Inspect as described in Section 73.
6 Wheel bearings improperly adjusted (Chapter 1).
7 Wheel lug nuts loose.
8 Worn upper or lower link or tension rod bushings.

77 Shimmy, shake or vibration

1 Tire or wheel out of balance or out of round. Have them balanced on the vehicle.
2 Loose, worn or out of adjustment wheel bearings (Chapter 1).
3 Shock absorbers and/or suspension components worn **or** damaged. Check for worn bushings in the upper and lower links.
4 Wheel lug nuts loose.
5 Incorrect tire pressures.
6 Excessively worn or damaged tire.
7 Loosely mounted steering gear housing.
8 Steering gear improperly adjusted.
9 Loose, worn or damaged steering components.
10 Damaged idler arm.
11 Worn balljoint.

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

1 Defective shock absorbers. Replace as a set.
2 Broken or weak springs and/or suspension components.
3 Worn or damaged stabilizer bar or bushings.
4 Worn or damaged upper or lower links or bushings.

79 Wandering or general instability

1 Improper tire pressures.
2 Worn or damaged upper and lower link or strut bar bushings.
3 Incorrect front end alignment.
4 Worn or damaged steering linkage or upper or lower link.
5 Improperly adjusted steering gear.
6 Out of balance wheels.
7 Loose wheel lug nuts.
8 Worn rear shock absorbers.
9 Fatigued or damaged rear leaf springs.

80 Excessively stiff steering

1 Lack of lubricant in power steering fluid reservoir, where appropriate (Chapter 1).
2 Incorrect tire pressures (Chapter 1).
3 Lack of lubrication at balljoints (Chapter 1).
4 Front end out of alignment.
5 Steering gear out of adjustment or lacking lubrication.
6 Improperly adjusted wheel bearings.
7 Worn or damaged steering gear.
8 Interference of steering column with turn signal switch.
9 Low tire pressures.
10 Worn or damaged balljoints.
11 Worn or damaged steering linkage.
12 See also Section 79.

81 Excessive play in steering

1 Loose wheel bearings (Chapter 1).
2 Excessive wear in upper or lower link or strut bar bushings (Chapter 1).
3 Steering gear improperly adjusted.
4 Incorrect front end alignment.
5 Steering gear mounting bolts loose.
6 Worn steering linkage.

82 Lack of power assistance

1 Steering pump drivebelt faulty or not

adjusted properly (Chapter 1).
2 Fluid level low (Chapter 1).
3 Hoses or pipes restricting the flow. Inspect and replace parts as necessary.
4 Air in power steering system. Bleed system.
5 Defective power steering pump.

83 Steering wheel fails to return to straight-ahead position

1 Incorrect front end alignment.
2 Tire pressures low.
3 Steering gears improperly engaged.
4 Steering column out of alignment.
5 Worn or damaged balljoint.
6 Worn or damaged steering linkage.
7 Improperly lubricated idler arm.
8 Insufficient oil in steering gear.
9 Lack of fluid in power steering pump.

84 Steering effort not the same in both directions (power system)

1 Leaks in steering gear.
2 Clogged fluid passage in steering gear.

85 Noisy power steering pump

1 Insufficient oil in pump.
2 Clogged hoses or oil filter in pump.
3 Loose pulley.
4 Improperly adjusted drivebelt (Chapter 1).
5 Defective pump.

86 Miscellaneous noises

1 Improper tire pressures.
2 Insufficiently lubricated balljoint or steering linkage.
3 Loose or worn steering gear, steering linkage or suspension components.
4 Defective shock absorber.
5 Defective wheel bearing.
6 Worn or damaged upper or lower link or strut bar bushing.
7 Damaged spring.
8 Loose wheel lug nuts.
9 Worn or damaged rear axleshaft spline.
10 Worn or damaged rear shock absorber mounting bushing.
11 Incorrect rear axle end play.
12 See also causes of noises at the rear axle and driveshaft.
13 Worn or damaged driveaxle joints (4WD models).

87 Excessive tire wear (not specific to one area)

1 Incorrect tire pressures.
2 Tires out of balance. Have them balanced on the vehicle.
3 Wheels damaged. Inspect and replace as necessary.
4 Suspension or steering components worn (Chapter 1).

88 Excessive tire wear on outside edge

1 Incorrect tire pressure.
2 Excessive speed in turns.
3 Front end alignment incorrect (excessive toe-in and/or camber).

89 Excessive tire wear on inside edge

1 Incorrect tire pressure.
2 Front end alignment incorrect (toe-out and/or negative camber).
3 Loose or damaged steering components (Chapter 1).

90 Tire tread worn in one place

1 Tires out of balance. Have them balanced on the vehicle.
2 Damaged or buckled wheel. Inspect and replace if necessary.
3 Defective tire.

Chapter 1
Tune-up and routine maintenance

Contents

	Section
Air filter replacement	30
Automatic transmission fluid and filter change	42
Automatic transmission fluid level check	5
Battery check and maintenance	10
Brake check	22
Brake pedal check and adjustment	9
Carburetor choke check	38
Chassis lubrication	14
Clutch pedal free play check and adjustment	29
Cooling system check	11
Cooling system servicing (draining, flushing and refilling)	36
Differential oil change	43
Differential oil level check	26
Distributor cap and rotor check and replacement	35
Drivebelt check, adjustment and replacement	16
Engine oil and filter change	15
Exhaust system check	13
Fluid level checks	4
Front wheel bearing check, repack and adjustment (2WD models only)	23
Front wheel bearing check, repack and adjustment (4WD models only)	24
Fuel Evaporative Control (EVAP) system canister replacement	32
Fuel filter replacement	40
Fuel tank cap gasket replacement	28
Fuel system check	20
Idle speed check and adjustment	17
Ignition timing check and adjustment	39
Introduction	2
Maintenance schedule	1
Manual transmission oil change	41
Manual transmission oil level check	25
Oxygen sensor replacement	45
PCV valve check and replacement	31
Power steering fluid level check	6
Spark plug replacement	33
Spark plug wire check and replacement	34
Suspension and steering check	19
Thermostatic air cleaner check	37
Tire and tire pressure checks	7
Tire rotation	21
Transfer case oil change	44
Transfer case oil level check	27
Tune-up general information	3
Underhood hose check and replacement	12
Valve clearance check and adjustment (four-cylinder (engine only)	18
Wiper blade check and replacement	8

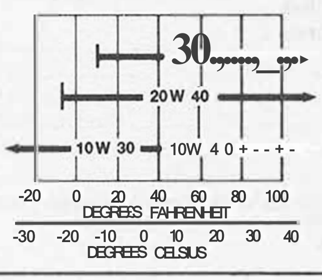
Specifications

Recommended lubricants and fluids

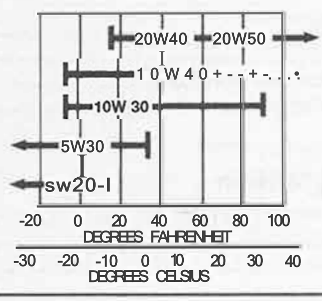
Note: *The fluids and lubricants listed here are those recommended by the manufacturer at the time this manual was published. Vehicle manufacturers occasionally upgrade their fluid and lubricant specifications. Check with your local auto parts store for the most current fluid and lubricant recommendations for your vehicle.*

Engine oil	
Type	API grade SF or SF/CC
Viscosity	SEE ACCOMPANYING CHART
Coolant	Ethylene glycol based anti-freeze
Brake fluid	DOT3
Clutch fluid	DOT 3 brake fluid
Automatic transmission fluid	
1979 through 1983	Type F ATF
1984 on	DEXRON II ATF
Power steering fluid	DEXRON II ATF
Suspension and steering balljoint grease (2WD)	Molybdenum-disulfide lithium base, NLGI no. 1 or 2 (DO NOT use multi-purpose or chassis grease)
Suspension and steering component grease (4WD)	
Steering knuckle	Molybdenum-disulfide lithium base, NLGI no. 2
Drag link and steering shaft slide yoke	Lithium base chassis grease, NLGI no. 0

ENGINE OIL VISCOSITY CHART



MANUAL TRANSAXLE LUBRICANT VISCOSITY CHART



11-A1 HAYNES

Recommended lubricants and fluids (continued)

Driveshaft	
U-joints and slide yokes	Lithium base multi-purpose, NLGI no. 1
Double cardan U-joints	Molybdenum-disulfide base, NLGI no. 2
Steering gearbox oil	API GL-4 (90 weight)
Wheel bearing grease	Lithium base multi-purpose, NLGI no. 2
Manual transmission oil	API GL-4 SAE 75W90 or 80W90 gear oil
Differential oil	API GL-5 SAE 80W90 hypoid gear oil
Transfer case oil	
1985 and earlier	API GL-4 or GL-5 SAE 75W90 gear oil
1986 thru 1989	
Manual transmission	API GL-4 or GL-5 SAE 75W90 gear oil
Automatic transmission	Dexron II ATF
1990 and later	
4-cylinder engine	API GL-4 or GL-5 SAE 75W90 gear oil
V6 engine	Dexron II ATF

Capacities*

Engine oil (with filter change)	4.5 qts
Automatic transmission	
With 4-cylinder	2.5 qts
With V6 engine	4.8 qts
Manual transmission (fill to overflow)	4 to 7 pts
Differential	
Rear axle	2.5 qts
Front axle	2.0 qts
Transfer case	3.4 qts
Cooling system	
1979 through 1992	9.0 qts
1993 and later	10.5 qts

**All capacities approximate. Add as necessary to bring appropriate level.*

Brakes

Pedal	
Height	
1979 through 1983	6-3/16 to 6-9/16 inches
1984	5-15/16 in to 6-9/64 inches
1985 and 1986	5-43/64 to 5-7/8 inches
1987 on	
2WD	5-29/32 to 6-3/32 inches
4WD	5-43/64 to 5-7/8 inches
Free play	1/8 to 1/4 in
Reserve distance (at 110 lbs)	
1979 through 1981	
2WD	3-5/32 inches
4WD	3-11/32 inches
1982 and 1983	
2WD	3 inches
4WD	3-11/32 inches
1984 and 1985	
2WD	2-9/16 inches
4WD	2-23/64 inches
1986 on (2WD)	
1/2-ton models	2-9/16 inches
22R-TE engine	2-61/64 inches
1986 on (4WD)	
22R engine	2-11/64 inches
22R-TE engine	1-31/32 inches
Disc brake pad lining thickness (minimum)	1/8 in
Drum brake shoe lining thickness (minimum)	1/16 in

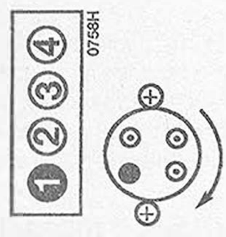
Drivebelt (fan belt) tension

Through 1987	
New belt	125 ± 25 lbs
Used belt	80 ± 20 lbs

1988 on (four-cylinder engines)	
V-ribbed type	
Alternator (with air pump)	
With air conditioning	
New belt	160 ± 20 lbs
Used belt	100 ± 20 lbs
Without air conditioning	
New belt	105 ± 25 lbs
Used belt	85 ± 20 lbs
Conventional type	
New belt	125 ± 25 lbs
Used belt	80 ± 20 lbs
1989 on (V6 engines)	
Alternator	
New belt	160 ± 20 lbs
Used belt	100 ± 20 lbs
Power steering pump	
New belt	125 ± 25 lbs
Used belt	80 ± 20 lbs
Air conditioning	
New belt	125 ± 25 lbs
Used belt	80 ± 20 lbs

Engine

Idle speed	Refer to the *Emission Control Information* label in the engine compartment
Valve clearances (four-cylinder engine only - hot)	
Intake	0.008 in (0.2 mm)
Exhaust	0.012 in (0.3 mm)
Spark plug type and gap	
Four-cylinder engines	ND W16EXR-U (or equivalent)@ 0.031 in
V6 engines	
1989 and earlier	ND Q16R-U (or equivalent)@ 0.031 in
1990 and later	ND K16R-U (or equivalent)@ 0.031 in
Spark plug wire resistance	Less than 25000 ohms
Ignition timing	Refer to the *Emission Control Information* label in the engine compartment
Firing order	
Four-cylinder engines	1-3-4-2
V6 engine	1-2-3-4-5-6



Cylinder location and distributor rotation - four-cylinder engines

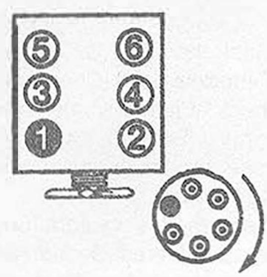
Clutch

Pedal free play	13/64 to 39/64 in
Pedal height	
1979 through 1983	5-63/64 to 6-3/8 in
1984	5-15/16 to 6-3/8 in
1985 and 1986	5-43/64 in
1987 on	6-13/64 in

Torque specifications

	Ft-lbs
Wheel lug nuts	65 to 87
Front wheel bearing adjusting nut'	
2WD	
1979 through 1983	22
1984 on	25
4WO (manual locking hub only}	43
Spark plugs	
Four-cylinder engines	11 to 15
V6 engine	18
Fuel filter banjo bolts (EFI only)	22
Automatic transmission fluid pan bolts	3 to 4
Automatic transmission filter/strainer bolts	6
Oxygen sensor nuts	14

'Initial torque only - see text (Sections 23 and 24) for complete tightening procedure



Cylinder location and distributor rotation - V6 engine

The blackened terminal shown on the distributor cap indicates the Number One spark plug wire position

1 Toyota pick-up and 4-runner Maintenance schedule

The following maintenance intervals are based on the assumption that the vehicle owner will be doing the maintenance or service work, as opposed to having a dealer service department do the work. Although the time/mileage intervals are based on factory recommendations, most have been shortened to ensure, for example, that such items as lubricants and fluids are checked/changed at intervals that promote maximum engine/driveline service life. Also, subject to the preference of the individual owner interested in keeping the vehicle in peak condition at all times and with the vehicle's ultimate resale in mind, many of the maintenance procedures may be performed more often than recommended in the following schedule. We encourage such owner initiative.

Every 250 miles/weekly, whichever comes first

Check the engine oil level (Section 4)
Check the coolant level (Section 4)
Check the windshield washer fluid level (Section 4)
Check the brake and clutch fluid levels (Section 4)
Check the battery electrolyte level (Section 4)
Check tt,e automatic transmission fluid level (Section 5)
Check the power steering fluid level (Section 6)
Check the tires and tire pressures (Section 7)

Every 7500 miles/12 months, whichever comes first

All items listed above plus:

Inspect/replace the windshield wiper blades (Section 8)
Check/adjust the brake pedal (Section 9)
Check and service the battery (Section 10)
Check the cooling system (Section 11)
Inspect/replace all underhood hoses (Section 12)
Inspect the exhaust system (Section 13)
Lubricate the chassis components (Section 14)
Change the engine oil and filter (Section 15)

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

All items listed above plus:

Check/adjust the engine drivebelts (Section 16)
Check/adjust the engine idle speed (Section 17)
Check the Throttle Positioner (TP) (1979 through 1981 models only) (Chapter 6)
Check/adjust the valve clearances (four-cylinder engine only) (Section 18)
Inspect the suspension and steering components (Section 19)
Check the fuel system (Section 20)
Rotate the tires (Section 21)
Check the brakes (Section 22)
Check and repack the front wheel bearings (Sections 23 and 24)
Check the manual transmission oil level (Section 25)
Check the differential oil level (Section 26)
Check the transfer case oil level (Section 27)

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

All items listed above plus:

Replace the fuel tank cap gasket (1985 through 1987 models only) (Section 28)
Check the clutch pedal free play (Section 29)
Replace the air filter (Section 30)
Replace the PCV valve (Section 31)
Replace the EVAP system canister(s) (Section 32)
Replace the spark plugs (Section 33)
Check/replace the spark plug wires (Section 34)
Check/replace the distributor cap and rotor (Section 35)
Service the cooling system (drain, flush and refill) (Section 36)
Check the thermostatic air cleaner (Section 37)
Check the carburetor choke operation (Section 38)
Check/adjust the ignition timing (Section 39)
Check the Spark Control (SC) system (Chapter 6)
Check the Air Injection (AI) system (Chapter 6)
Replace the fuel filter (Section 40)
Change the manual transmission oil (Section 41)
Change the automatic transmission fluid (Section 42)
Change the differential oil (Section 43)
Change the transfer case oil (Section 44)

Every 60,000 miles/24 months, whichever comes first

Replace the fuel tank cap gasket (1988 models) (Section 28)
Replace the oxygen sensor (four-cylinder Federal models with fuel injection) (Section 45)
Check/adjust the V6 engine valve clearances (dealer service item)

Severe operating conditions

Severe operating conditions are defined as follows:

A) Pulling a trailer
B) Repeated short trips
C) Driving on rough or muddy roads
D) Driving on dusty roads
E) Operating in extremely cold weather and/or driving in areas using road salt
F) Repeated short trips in extremely cold weather

If your vehicle is operated under severe conditions, the maintenance schedule must *be amended* as *follows:*

Every 3750 miles or 3 months, whichever occurs first:

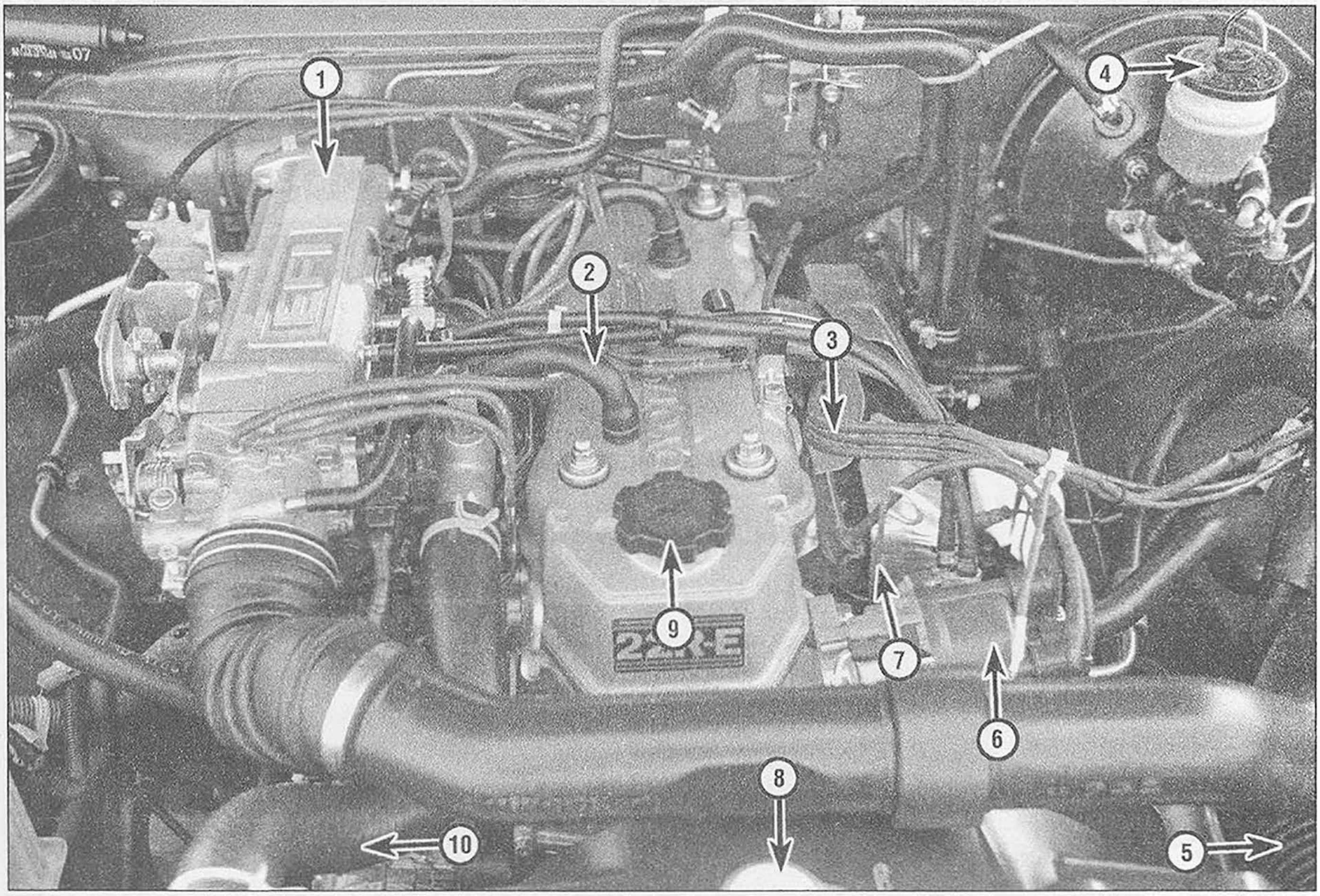
Check the air filter if condition D exists (Section 30)
Change the engine oil and filter if condition(s) A, D, F exist (Section 15)
Check the steering linkage, gearbox oil and steering wheel free play if condition C exists (Section 19)
Check the balljoints and dust covers (2WD vehicles) if conditions C, D, E exist (Section 19)
Lubricate the steering knuckle and chassis if condition C exists (Section 14)

Every 7500 miles or 6 months, whichever occurs first:

Check the exhaust pipes and brackets if conditions(s) A, B, C, E exist (Section 13)
Check the brake linings and drums if condition(s) A, B, C, D, exist (Section 38)
Lubricate the driveshaft (4WD vehicles) if condition(s) A and C exist (Section 14)

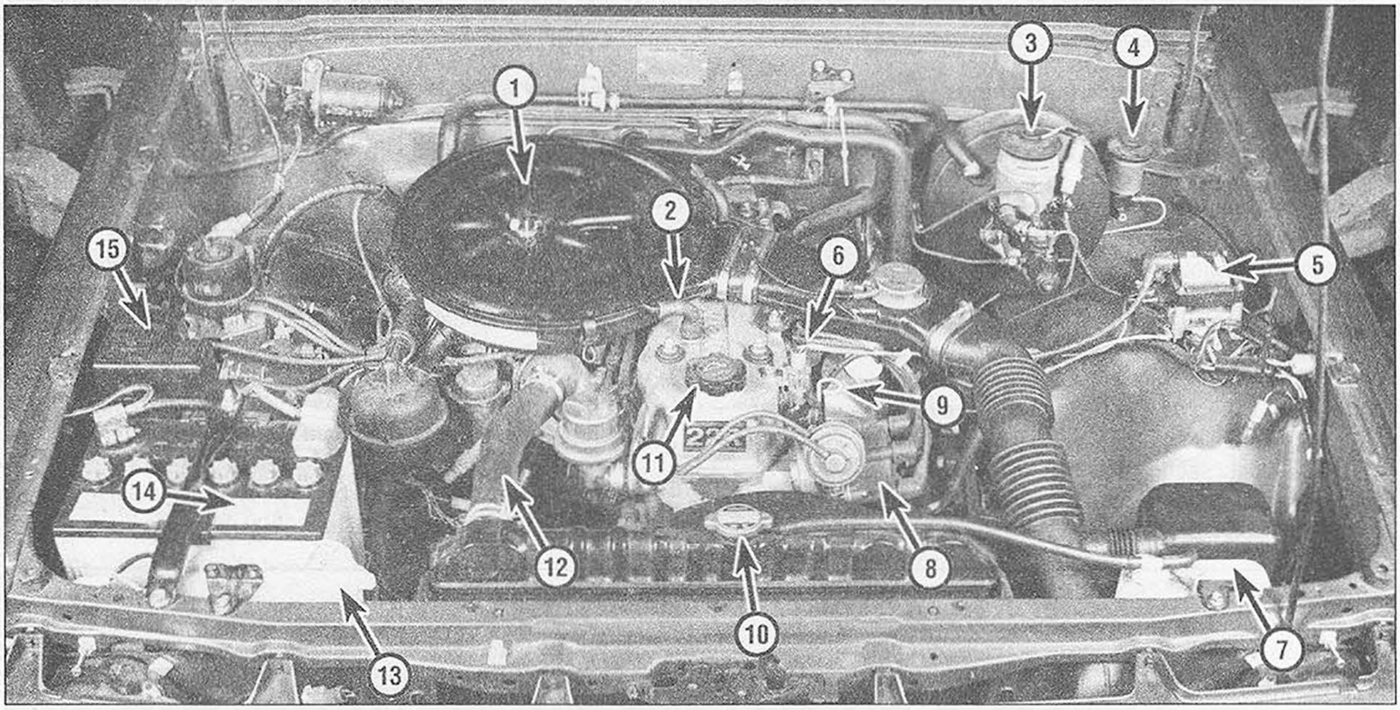
Every 15,000 miles or 12 months, whichever occurs first:

Replace the air filter if condition D exists (Section 14)
Check the spark plug wires if condition E exists (Section 34)
In areas where road salt is used, inspection of the distributor cap should be performed annually, just after the snow season ends (Section 35)
Change the manual transmission lubricant if condition(s) A and C exist (Section 41)
Change the automatic transmission fluid if condition(s) A and C exist (Section 42)
Change the differential lubricant if condition(s) A and C exist (Section 43)
Change the transfer case lubricant (4WD vehicles) if condition(s) A and C exist (Section 44)



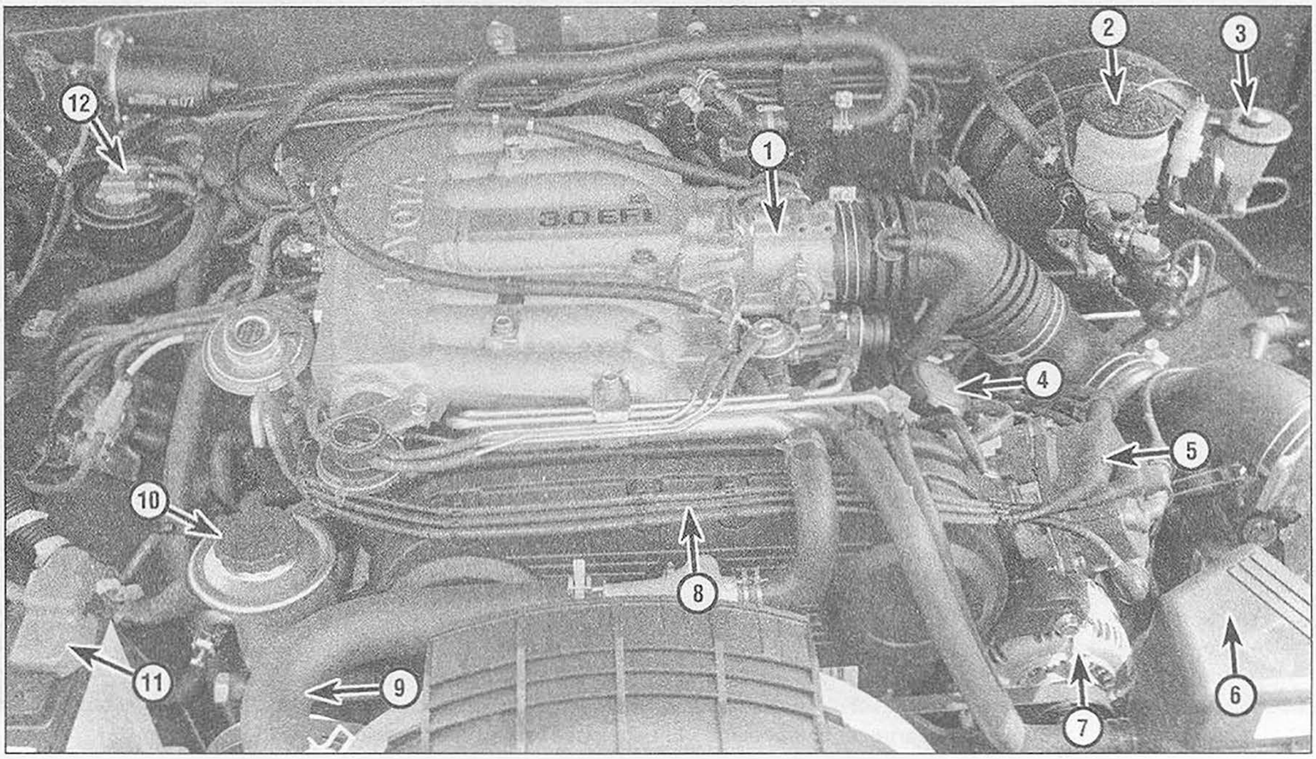
Engine compartment components - EFI equipped four-cylinder engine (typical)

1 *Fuel injection unit*
2 *PCVhose*
3 *Spark plug wires*
4 *Brake fluid reseNoir*
5 *Air filter housing*
6 *Distributor*
7 *Engine oil dipstick*
8 *Radiator cap*
9 *Engine oil filler cap*
10 *Upper radiator hose*



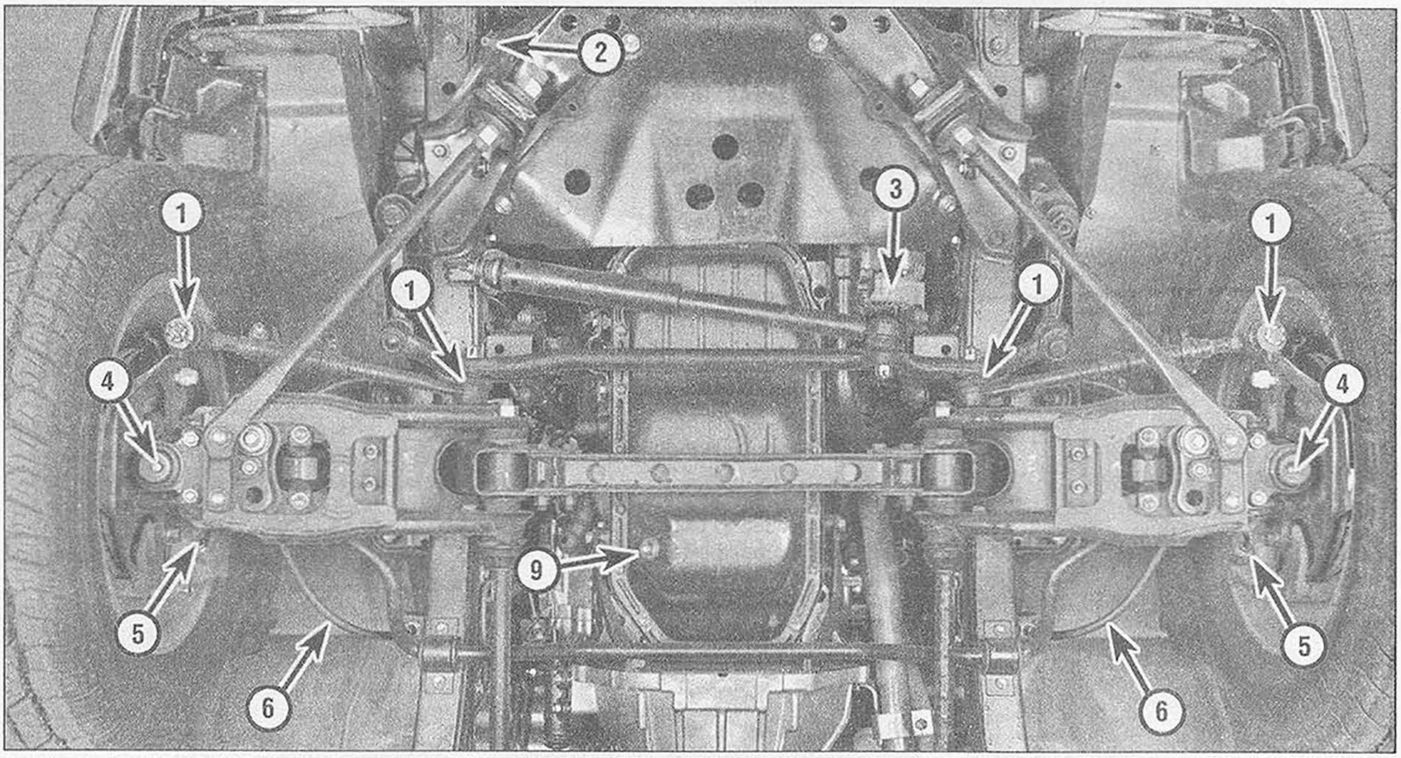
Engine compartment components - carburetor equipped four-cylinder engine (typical)

1 Air filter housing
2 PCVhose
3 Brake fluid reservoir
4 Clutch fluid reservoir
5 Ignition coil
6 Spark plug wire.s
7 Coolant reservoir
8 Distributor
9 Engine oil dipstick
10 Radiator cap
11 Engine oil filler cap
12 Upper radiator hose
13 Windshield washer fluid reservoir
14 Battery
15 Fuse box



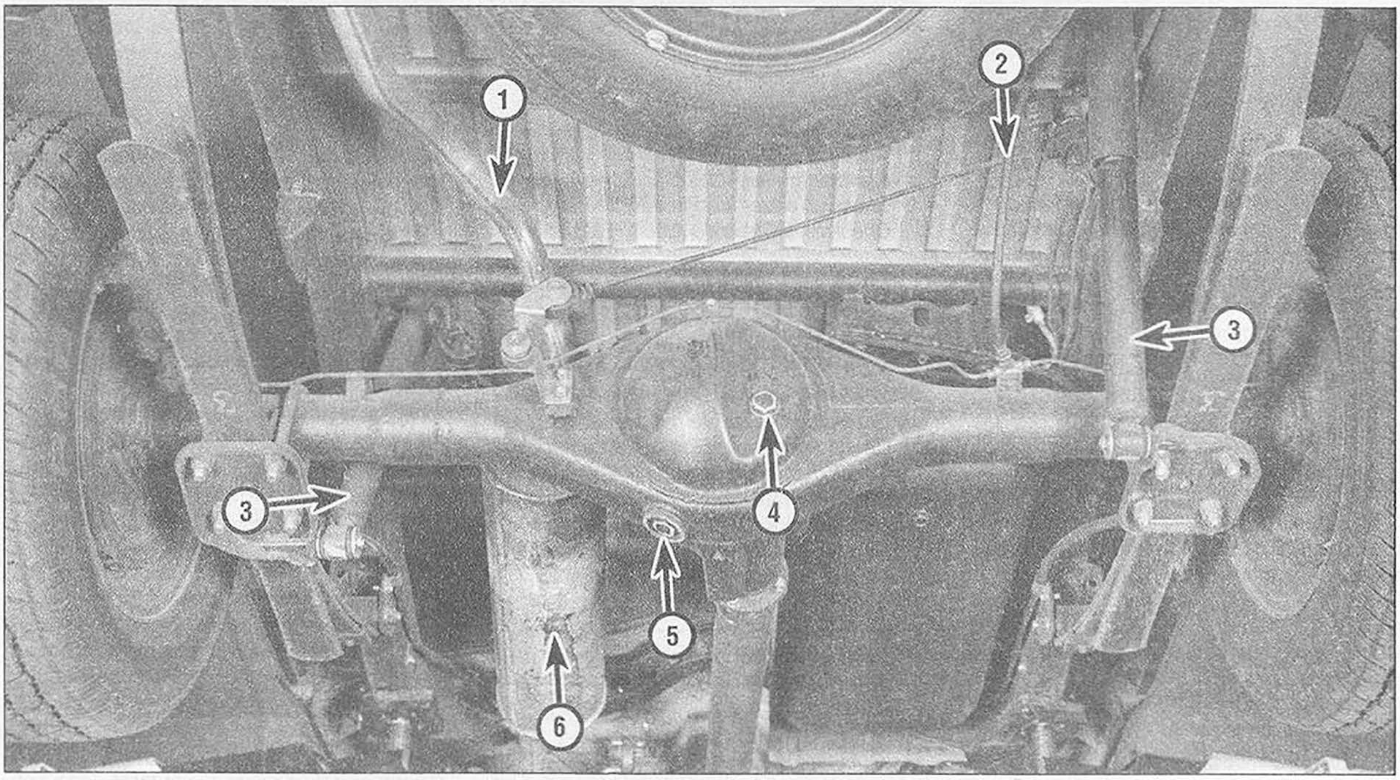
Engine compartment components - V6 engine

1 Fuel injection unit
2 Brake fluid reservoir
3 Clutch fluid reservoir
4 Engine oil filler cap
5 Distributor
6 Air cleaner housing
7 Alternator
8 Spark plug wires
9 Upper radiator hose
10 Power steering fluid reservoir
11 Battery
12 EVAP system canister



Under side view of engine compartment components - typical 2WD

1 *Steering balljoints*
2 *Radiator drain*
3 *Alternator*
4 *Suspension bat/joint*
5 *Brake caliper*
6 *Brake hose*
7 *Manual transmission oil check/fill plug*
8 *Manual transmission drain plug*
9 *Engine oil drain plug*



Under side view of the components at the rear of the vehicle - typical 2WD

1 *Exhaust pipe*
2 *Brakehose*
3 *Shock absorber*
4 *Differential oil check/fill plug*
5 *Differential drain plug*
6 *Muffler*

2 Introduction

This Chapter is designed to help the home mechanic maintain the Toyota pick-up/4-runner with the goals of maximum performance, economy, safety and reliability in mind.

Included is a master maintenance schedule (page 36), followed by procedures dealing specifically with each item on the schedule. Visual checks, adjustments, component replacement and other helpful items are included. Refer to the accompanying. illustrations of the engine compartment and the under side of the vehicle for the locations of various components.

Servicing your vehicle in accordance with the planned mileage/time maintenance schedule and the step-by-step procedures should result in maximum reliability and extend the life of your vehicle. Keep in mind that it's a comprehensive plan - maintaining some items but not others at the specified intervals will not produce the same results.

As you perform routine maintenance procedures, you'll find that many can, and should, be grouped together because of the nature of the procedures or bec.ause of the proximity of two otherwise unrelated components or systems.

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

The first step in this maintenance program is to prepare yourself before the actual work begins. Read through all the procedures you're planning to do, then gather up all the parts and tools needed. If it looks like you might run into problems during a particular job, seek advice from a mechanic or experienced do-it-yourselfer.

3 Tune-up general information

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

If, from the tim< 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 pur0hased. In such cases, an engine tune-up will be needed outside of the regular routine maintenance intervals.

The first step in any tune-up or diagnostic procedure to help correct a poor running engine is a cylinder compression check. A compression check (see Chapter 2 Part C) will help determine the condition of internal engine components and should be used as a guide for tune-up and repair procedures. If, for instance, a compression check indicates serious internal engine wear, a conventional tune-up will not improve the performance of the engine and would be a waste of time and money. Because of its im·portance, the compression check should be done by someone with the right equipment and the knowledge to use it properly.

The following prncedures 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 refated fluids
Clean and check the battery (Section 10)
Check and adjust the drivebelts (Section 16)
Replace the spark plugs (Section 33)
Check the cylinder compression (Chapter 2)
Inspect the distributor cap and rotor (Section 35)
Inspect the spark plug and coil wires (Section 34)
Replace the air filter (Section 30)
Check and adjust the idle speed (Section 17)
Check and adjust the ignition timing (Section 39)
Replace the fuel filter' (Section 40)
Check all underhood hoses *(Section 12)*
Check the PCV valve (Section 31)
Adjust the valve clearances (Section 18)
Check and service the cooling system *(Section 11)*

Major tune-up

All items listed under Minor'tune-up plus

Check the EGR system *(Chapter 6)*
Check the charging system (Chapter 5)
Check the ignition system *(Chapter 5)*
Check the fuel system *(Section 20 and Chapter4)*
Replace the spark plug wires, distributor cap and rotor (Sections 34 and 35)

4 Fluid level checks

Note: *The following are fluid level checks to be done on a 250 mile or weekly basis. Additional fluid level checks can be found in* specific *maintenance procedures which follow. Regardless of how often the fluid levels are checked, watch for puddles under the vehicle - if leaks are noted, make repairs immediately.*

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

Engine oil

Refer to illustrations 4.4 and 4.6

2 The engine oil level is checked with a dipstick that extends through a tube and into the oil pan at the bottom of the engine.

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, resulting in an inaccurate reading on the dipstick.

4 Pull the dipstick out of the tube (see the underhood component illustrations at the front of this Chapter) and wipe all the oil from the end with a clean rag or paper towel. Insert the clean dipstick all the way back into the tube, then pull it out again. Note the oil at the end of the dipstick. Add oil as necessary to keep the level between the L (low) mark and the F (full) mark on the dipstick **(see illustration).**

5 Don't overfill the engine by adding too much oil since this may result in oil fouled spark plugs, oil leaks or oil seal failures.

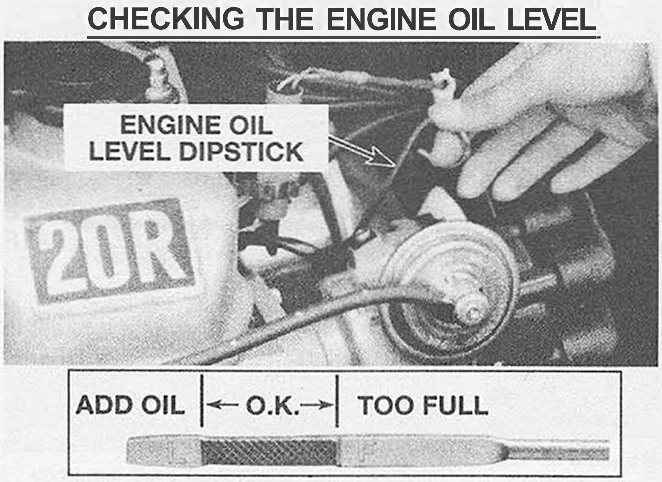
6 Oil is added *to* the engine after removing a threaded cap from the rocker arm cover **(see illustration). A** funnel will help reduce spills.

7 Checking the oil level is an important preventive maintenance step. **A** consistently low oil level indicates oil leakage through damaged seals, defective gaskets or past worn rings or valve guides. **If** the oil looks milky in color or has water droplets in it, the cylinder head gasket(s) may be blown or the head(s) or block may be cracked. The engine should be checked immediately. The condition of the oil should also be checked. Whenever 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 (Section 15).

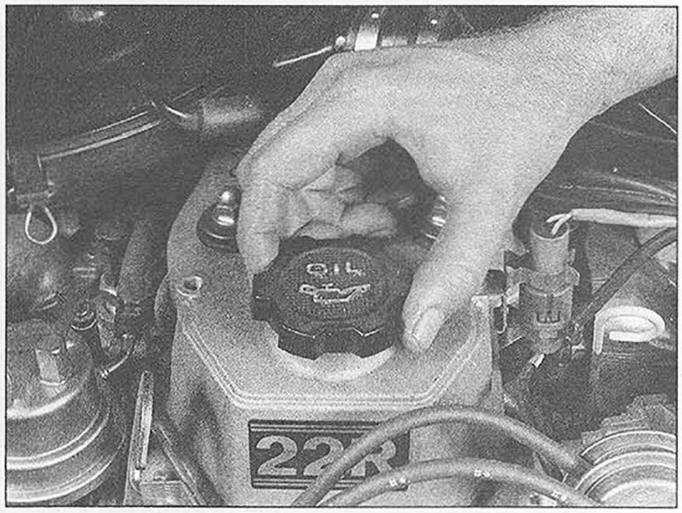
Engine coolant

Refer to illustrations 4.9a and 4.9b

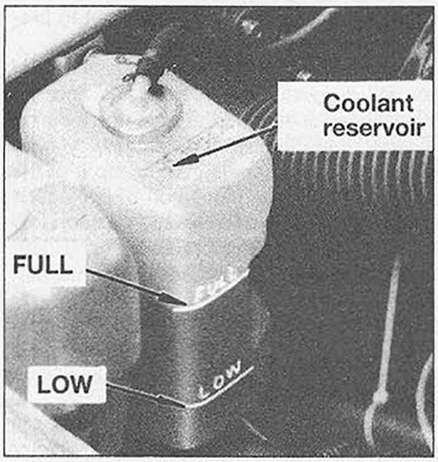
Warning: *Don't allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Flush contaminated* areas *immediately with plenty of water. Don't store new coolant or leave old coolant lying around where it's accessible to children or pets - they're attracted by its sweet taste. Ingestion of even a small amount of coolant can be fatal! Wipe up garage floor and drip pan coolant* spills *immediately. Keep antifreeze containers covered and repair leaks in your*



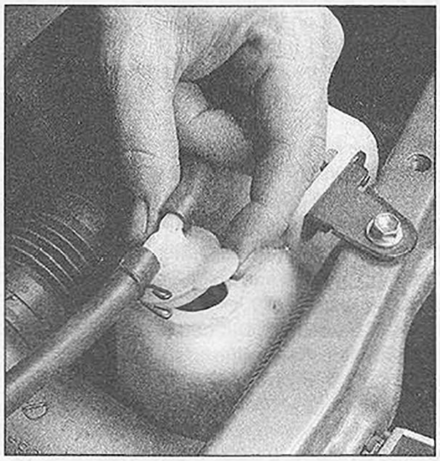
4.4 The engine oil level MUST be kept between the Low and Full marks on the dipstick or serious and costly engine damage could occur!



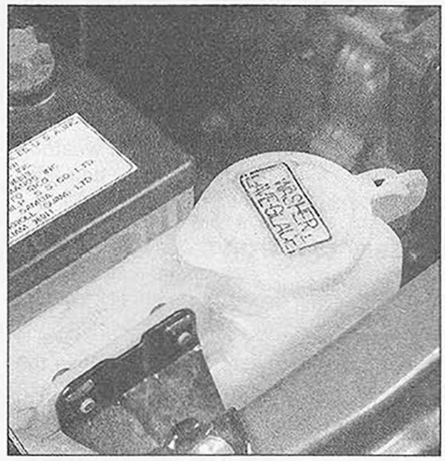
4.6 Oil can be added to the engine after unscrewing the filler cap on the rocker arm cover - use a funnel to prevent spills



4.9a If the coolant level in the reservoir isn't between the two marks . . .



4.9b . . . pry up on the cap to remove it and add more coolant to the reservoir - DO NOT overfill it!



4.14 The windshield washer fluid level **should be kept near the top of the reservoir - don't confuse the windshield washer and engine coolant reservoirs**

cooling system as *soon as they are noticed.*

8 All vehicles covered by this manual are equipped with a pressurized coolant recovery system. A white plastic coolant reservoir located in the engine compartment is connected by a hose to the radiator filler neck. If the engine overheats, coolant escapes through a valve in the radiator cap and travels through the 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. **Warning:** *Do not remove the radiator cap to check the coolant level when the engine is warm.* The level in the reservoir varies with the temperature of the engine. When the engine is cold, the coolant level should be at or slightly above the Low mark on the reservoir. Once the engine has warmed up, the level should be at or near the Full mark **(see illustration).** If it isn't, allow the engine to cool, then remove the cap from the reservoir and add a 50/50 mixture of ethylene g1lycol-based antifreeze and water **(see illustration).**

10 Drive the vehicle and recheck the coolant level. 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 antifreeze and water solution. In order to maintain the proper ratio of antifreeze and water, always top up the coolant level with the correct mixture. An empty plastic milk jug or bleach bottle makes an excellent container for mixing coolant. Do not use rust inhibitors or additives.

11 If the coolant level drops consistently, there may be a leak in the system. Inspect the radiator, hoses, filler cap, drain plugs and water pump (see Section 11). If no leaks are noted, have the radiator cap pressure tested by a service station.

12 If you have to remove the radiator cap, wait until the engine has cooled, then wrap a thick cloth around the cap and turn it to the first stop. If coolant or steam escapes, let the engine cool down longer, then remove the cap.

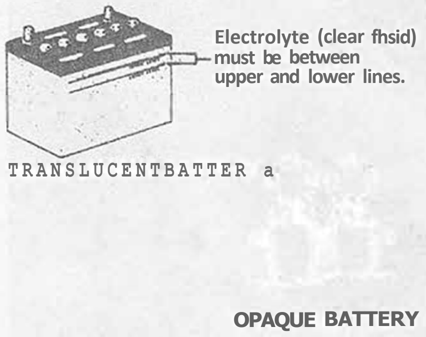
13 Check the condition of the coolant as well. It should be relatively clear. If it's brown or rust colored, the system should be drained, flushed and refilled. Even if the coolant appears to be normal, the corrosion inhibitors wear out, so it must be replaced at the specified intervals.

Windshield washer fluid

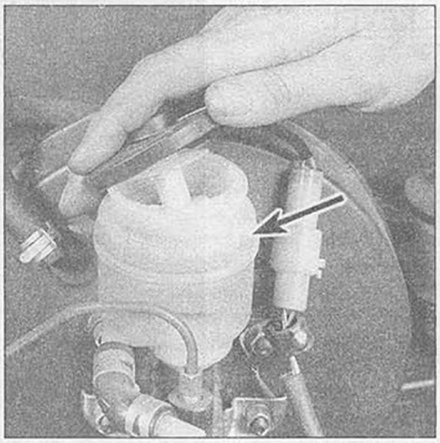
Refer to illustration 4.14

14 Fluid for the windshield washer system is stored in a plastic reservoir located near the battery **(see illustration).** If necessary, refer to the underhood component illustration(s) at the beginning of this Chapter to locate the reservoir.

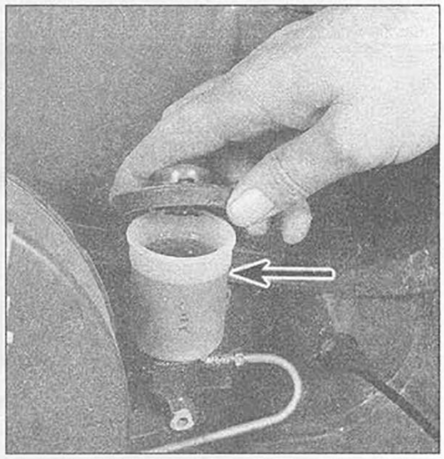
15 In milder climates, plain water can be used in the reservoir, but it should be kept no more than 2/3 full to allow for expansion if the water freezes. In colder climates, use windshield washer system antifreeze, available at



4.17 On original equipment batteries, the electrolyte level can be checked without removing the cell caps • it must be maintained between the lines on the case



4.19a The brake fluid level should be kept near the upper **(MAX)** mark on the **reservoir - it's translucent so the cover doesn't have to be removed for the check**



4.19b The clutch fluid level should be maintained at the line on the reservoir

any auto parts store, to lower the freezing point of the fluid. Mix the antifreeze with water in accordance with the manufacturer's directions on the container. **Caution:** *Don't use cooling* system *antifreeze - it will damage the vehicle's paint.*

16 To help prevent icing in cold weather. warm the windshield with the defroster before using the washer.

Battery electrolyte

Refer to illustration 4.17

17 To check the electrolyte level in the battery, remove all of the cell caps. If the level is low, add distilled water until it's above the plates. Original equipment batteries are usually translucent so the electrolyte level can be checked by looking at the side of the case **(see illustration).** Most aftermarket replacement batteries have a split-ring indicator in each cell to help you judge when enough water has been added - don't overfill the cells!

Brake and clutch fluid

Refer to illustrations 4.19a and 4.19b

18 The brake master cylinder is mounted on the front of the power booster unit in the engine compartrn nt. The clutch cylinder used on manual transmissions is mounted adjacent to it on the firewall.

19 The fluid inside is readily visible. The level should be between the MIN and MAX marks on the reservoirs **(see illustrations).** If a low level is indicated, be sure to wipe the top of the reservoir cover with a clean rag to prevent contamination of the brake and/or clutch system before removing the cover.

20 When adding fluid, pour it carefully into the reservoir to avoid spilling it onto surrounding painted surfaces. Be sure the specified fluid is used, since mixing different types of brake fluid can cause damage to the system. See *Recommended lubricants and fluids* at the front of this Chapter or your owner's manual. **Warning:** *Brake fluid can harm your eyes and damage painted surfaces,* so *be very careful when handling or pouring it. Don't use brake fluid that's 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 brake efficiency.*

21 At this time the fluid and master cylinder can be inspected for contamination. The system should be drained and refilled if deposits, dirt particles or water droplets are seen in the fluid.

22 After filling the reservoir to the proper level, make sure the cover is on tight to prevent fluid leakage.

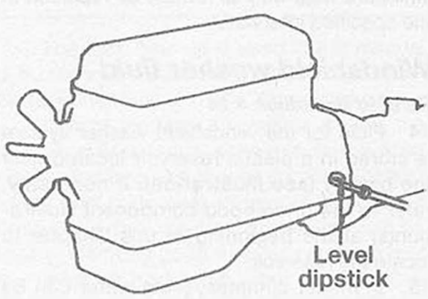
23 The brake fluid level in the master cylinder will drop slightly as the pads and the brake shoes at each wheel wear down during normal operation. If the master cylinder requires repeated additions to keep it at the proper level, it's an indication of leakage in the brake system, which should be corrected immediately. Check all brake lines and connections (see Section 22 for more information).

24 If, upon checking the master cylinder fluid level, you discover one or both reservoirs empty or nearly empty, the brake system should be bled (Chapter 9).

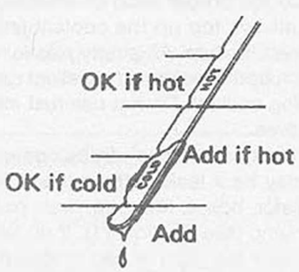
5 Automatic transmission fluid level check

Refer to illustrations 5.3 and 5.6

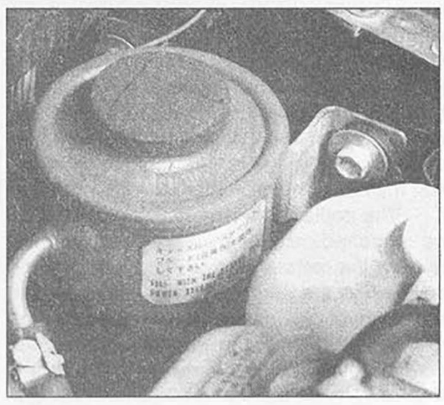
1 The automatic transmission fluid level should be carefully maintained. Low fluid level can lead to slipping or loss of drive,



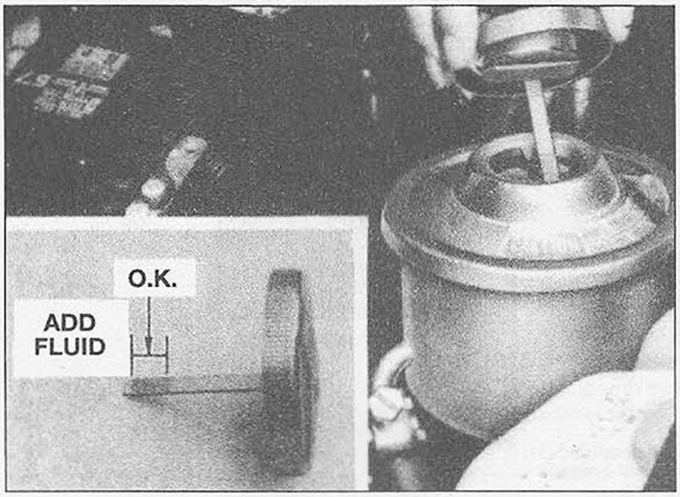
5.3 The automatic transmission fluid dipstick is located at the rear of the engine, on the driver's side



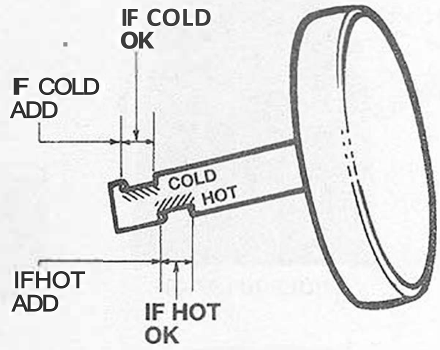
5.6 The fluid level on the dipstick will change, depending on the temperature of the transmission and fluid



6.2 On most models, the power steering pump reservoir is mounted on the driver's side fender panel in the engine compartment



6.6a On 1979 and 1980 models, check the power steering fluid level only when it's at normal operating temperature - it should be in the etched area on the dipstick



6.6b On 1981 and later models, the power steering fluid dipstick has marks for checking the fluid level hot or cold

while overfilling can cause foaming and loss of fluid.
2 With the parking brake set, start the engine, then move the shift lever through all the gear ranges, ending in Park. The fluid level must be checked with the vehicle level and the engine running at idle. **Note:** *Incorrect fluid level readings will result if the vehicle* has *just been driven at high* speeds *for an extended period, in hot weather in city traffic, or if it* has *been pulling* a *trailer. If any of* these *conditions apply, wait until the fluid* has *cooled (about 30 minutes).*
3 With the transmission at normal operating temperature, remove the dipstick from the filler tube. The dipstick is located at the rear of the engine compartment, usually on the driver's side (see illustration).
4 Carefully touch the fluid at the end of the dipstick to determine if it's cool (86 to 122-degrees F) or hot (123 to 176-degrees F). Wipe the fluid from the dipstick with a clean rag and push it back into the filler tube until the cap seats.
5 Pull the dipstick out again and note the fluid level.
6 If the fluid felt cool, the level should be within the COLD range (between the cutouts) **(see illustration).** If the fluid was hot, the level should be within the HOT range.
7 If additional fluid is required, add it directly into the tube using a funnel. It takes about one pint to raise the level from the L mark to the H mark with a hot transmission, so add the fluid a little at a time and keep checking the level until it's correct.
8 The condition of the fluid should also be checked along with the level. If the fluid at the end of the dipstick is a dark reddish-brown color, or **if it** smells burned, it should be changed. If you are in doubt about the condition of the fluid, purchase some new fluid and compare the two for color and smell.

6 Power steering fluid level check

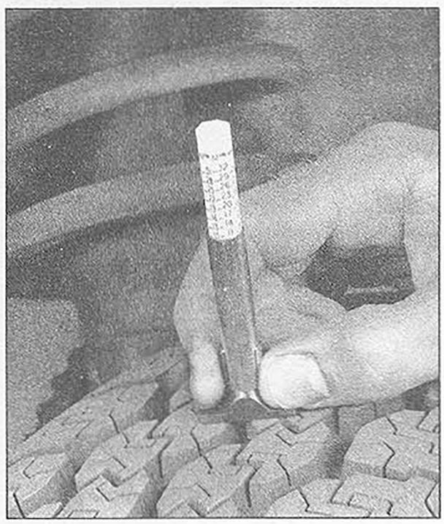
Refer to illustrations 6.2, 6.6a and 6.6b

1 Unlike manual steering, the power steering system relies on fluid which may, over a period of time, require, replenishing.
2 The fluid reservoir for the V6 engine power steering pump is located on the pump body at the front of the engine. On vehicles with a four-cylinder engine, the reservoir is separate from the pump and is mounted on the driver·s side inner fender panel **(see illustration).**
3 For the check, tine front wheels should be pointed straight ahead and the engine should be off. The engine and power steering fluid should be warm on 1979 and 1980 models (operating temperature). On 1981 and later models the level can be checked with the fluid hot (normal engine operating temperature) or cold. The fluid can be considered cold if the engine hasn't been run for at least five hours.
4 Use a clean rag to wipe off the reservoir cap and the area around it. This will help prevent any foreign ma·tter from entering the reservoir during the check.
5 Twist off the cap - it has a dipstick attached to it.
6 Wipe off the fluid with a clean rag, reinsert the dipstick, then withdraw it and note the fluid level. The level should be within the range marked on the dipstick **(see illustrations).** Never allow **the** fluid level to drop below the lower range mark.
7 If additional fluid is required, pour the specified type directly into the reservoir, using a funnel to prevent spills.
8 If the reservoir requires frequent fluid additions, all power steering hoses, hose connections and the power steering pump should be carefully checked for leaks.

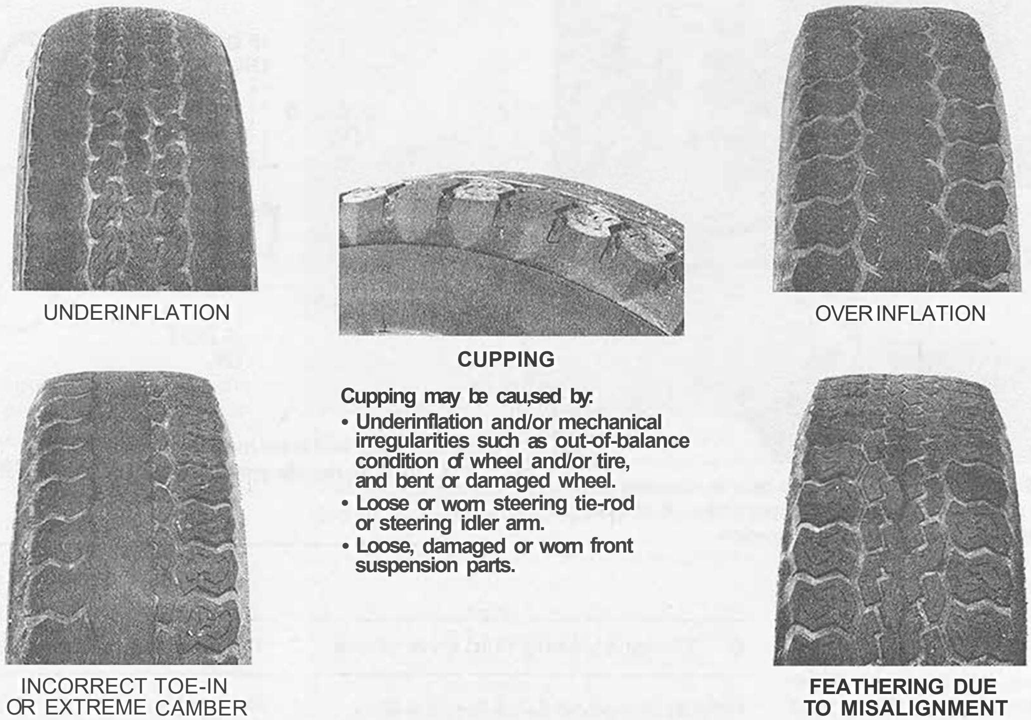
7 Tire and tire pressure checks

Refer to illustrations 7.2, 7.3, 7.4a, 7.4b and 7.8

1 Periodic inspection of the tires may spare you the inconvenience of being stranded with a flat tire. It can also provide you with vital information regarding possible problems in the steering and suspension systems before major damage occurs.
2 The original tires on this vehicle are equipped with wear indicator bars that will appear when tread depth reaches a predetermined limit, usually 1/16-inch, but they don't appear until the tires are worn out. Tread wear can be monitored with a simple, inexpensive device known as a tread depth indicator **(see illustration).**



7.2 A tire tread depth indicator should be used to monitor tire wear - they're available at auto parts stores and service stations and cost very little



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

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

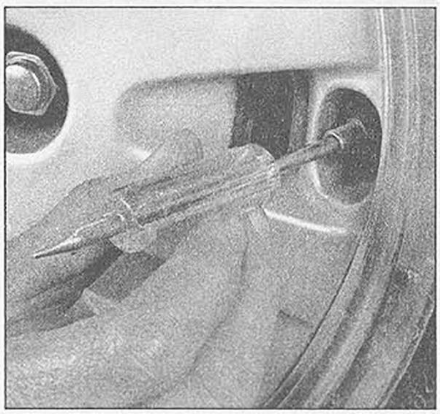
4 Look closely for cuts, punctures and embedded nails or tacks. Sometimes a tire will hold air pressure for a short time or leak down very slowly after a nail has embedded itself in the tread. If a slow leak persists, check the valve stem core to make sure it's tight **(see illustration).** Examine the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

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

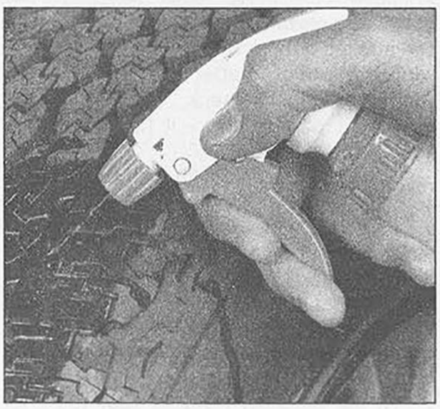
6 Correct air pressure adds miles to the life span of the tires, improves mileage and enhances overall ride quality. Tire pressure cannot be accurately estimated by looking at a tire, especially if it's a radial. A tire pressure gauge is essential. Keep an accurate gauge in the vehicle. The pressure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

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

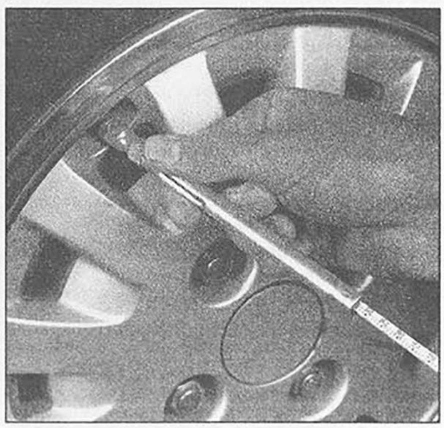
8 Unscrew the valve cap protruding from



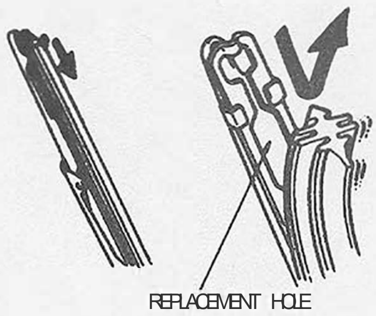
7.4a If a tire loses air on a steady basis, check the valve core first to make sure it's snug (special inexpensive wrenches are commonly available at auto parts stores)



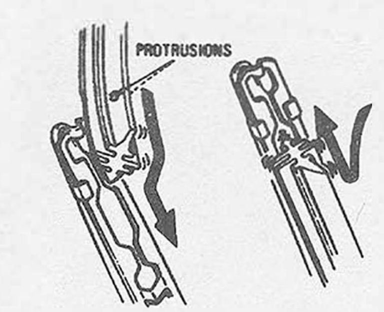
7.4b If the valve core is tight, raise the corner of the vehicle with the low tire and spray a soapy water solution **onto the tread as the tire is turned - slow leaks will** cause small bubbles **to appear**



7.8 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!)



8.5 Pull the wiper blade element out of **the** end slot, then through the replacement hole



8.6 Insert the **end of the new** blade element **with the protrusions** into the replacement hole and slide the element **into place**

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

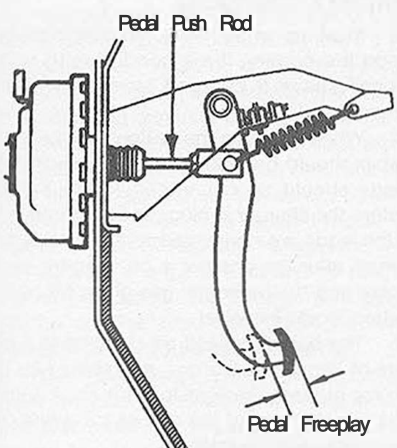
9 Don't forget to keep the spare tire inflated to the specified pressure (refer to your owner's manual or the tire sidewall).

8 Wiper blade check and replacement

Refer to illustrations 8.5 and 8.6

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 and water solution.



9.8 Brake pedal freeplay **adjustment details**

3 The action of the wiping mechanism can loosen the 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 (sometimes called inserts) are cracked, worn or warped, they should be replaced with new ones.

5 Pull the top of the rubber element in until it's free of the end slot, revealing the replacement hole **(see illustration).** Pull the rubber blade element out of the hole.

6 To install the new one, insert the end of the element with the small protrusions into the replacement hole and work the rubber along the slot into the frame **(see illustration).** Once the entire blade is in the frame slot, allow it to expand and fill in the end.

9 Brake pedal check and adjustment

Pedal height

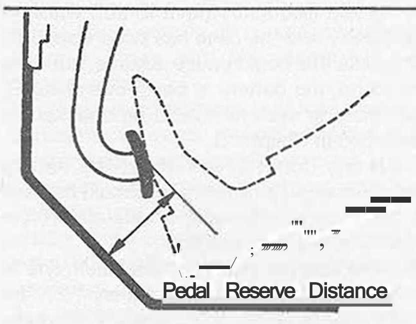
Refer to illustration 9. 1

1 Make sure the pedal height is correct by measuring the distance from the floor board to the top of the pedal **(see illustration).** See the Specifications at the front of this Chapter. If incorrect, adjust the pedal height.

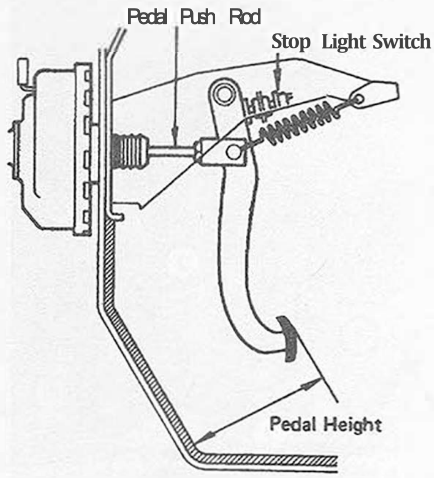
2 Loosen the stop light switch.

3 Adjust the pedal height by turning the pushrod until the specified height is attained.

4 Tighten the stop light switch until the



9.13 Brake pedal reserve distance must be as specified



9.1 Brake pedal height adjustment details

switch body lightly contacts the pedal stop.

5 After adjusting the pedal height, check and adjust the pedal free play.

Pedal free play

Refer to illustration 9.8

6 With the engine off, depress the brake pedal several times until there is no more vacuum left in the booster.

7 Depress the pedal by hand until resistance is felt.

8 Measure the distance the pedal travels before resistance is felt **(see illustration).** Compare the results to the Specifications.

9 If incorrect, adjust the pedal free play by turning the pushrod.

10 Start the engine and confirm that the pedal free play is correct.

11 After adjusting the pedal free play, recheck the pedal height.

12 On 1992 models, recheck the clearance between the stop light switch and the pedal stop. There should be a clearance of 0.02 to 0.09 inch. If adjustment is necessary, loosen the stop light switch locknut and turn the stop light switch body until the correct amount is obtained. Tighten the locknut.

Pedal reserve

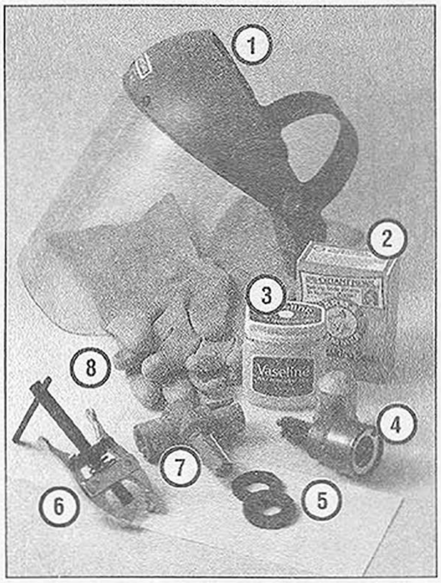
Refer to illustration 9. 13

13 With the brake pedal fully depressed, measure the distance from the floor board to a line parallel with the floor board at the center of the brake pedal **(see illustration).** Confirm that this measurement is within the specified limits.

10 Battery check and maintenance

Refer to illustrations 10.1, 10.5a, 10.5b, 10.5c and 10.5d

Warning: *Several precautions must be followed when checking and seNicing the battery. Hydrogen gas, which is highly flam-*



10.1 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 batte,y 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, wilt 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 toot 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!*

mable, is always present in the battery cells, so keep lighted tobacco and all other open flames and sparks away from the battery. The electrolyte in the cells is actually dilute sulfuric acid, which will cause injury if splashed on your skin or in your eyes. It'll also ruin clothes and painted surfaces. When removing the battery cables, always detach the negative cable fls t and hook it up last!

Check

1 Battery maintenance is an important procedure which will help ensure that you aren't stranded because of a dead battery.

10.5a Battery terminal corrosion usually appears as light, fluffy powder

Several tools are required for this procedure **{see illustration}.**

2 The electrolyte level should be checked every week (see Section 4).

3 Periodically clean the top and sides of the battery. Remove all dirt and moisture. This will help prevent corrosion and ensure that the battery doesn't become partially discharged by leakage through moisture and dirt. Check the case for cracks and distortion.

4 Check the tightness of the battery cable bolts to ensure good electrical connections. Inspect the entire length of each cable, looking for cracked or abraded insulation and frayed conductors. Battery cable removal and installation is covered in Chapter 5.

5 If corrosion, which usually appears as white, fluffy deposits, is evident, remove the cables from the terminals, clean them with a battery brush and reinstall them (see illustrations}. Corrosion can be kept to a minimum by applying a layer of petroleum jelly to the terminals after the cables are in place.

6 Make sure the battery carrier is in good condition and the holddown clamp is tight. If the battery is removed, make sure that nothing is in the bottom of the carrier when it's reinstalled and don't overtighten the clamp nuts.

7 The freezing point of electrolyte depends on its specific gravity. Since freezing can ruin a battery, it should be kept in a fully charged state to protect against freezing.

8 If you frequently have to add water to the battery and the case has been inspected for cracks that could cause leakage, but none are found, the battery is being overcharged; the charging system should be checked as described in Chapter 5.

9 If any doubt exists about the battery state of charge, a hydrometer should be used to test it by withdrawing a little electrolyte from each cell, one at a time.

10 The specific gravity of the electrolyte at 80-degrees F will be approximately 1.270 for a fully charged battery. For every 10-degrees F that the electrolyte temperature is above 80-degrees F, add 0.04 to the specific gravity. Subtract 0.04 if the temperature is below 80-degrees F.

10.5b Removing the cable from the battery post **with a** wrench - sometimes a **special battery pliers is required for this procedure if corrosion has caused deterioration of the nut hex (always remove the ground cable first and hook it up last!)**

11 A specific gravity reading of 1.240 with an efectrolyte temperature of 80-degrees F indicates a half-charged battery.

12 Some of the common causes of battery failure are:

a) *Accessories, especially headlights, left on overnight or for several hours.*
b) *Slow average driving speeds for short intervals.*
c) *The electrical toad of the vehicle being more than the alternator output. This is very common when several high draw accessories are being used simultaneously (such as radio/stereo, air condi- tioning, window defoggers, tights, etc.).*
d) *Charging system problems such as short circuits, slipping drivebelt, defective alternator or faulty voltage regulator.*
e) *Battery neglect, such as loose or corroded terminals or loose battery ho/d-down ctamp.*

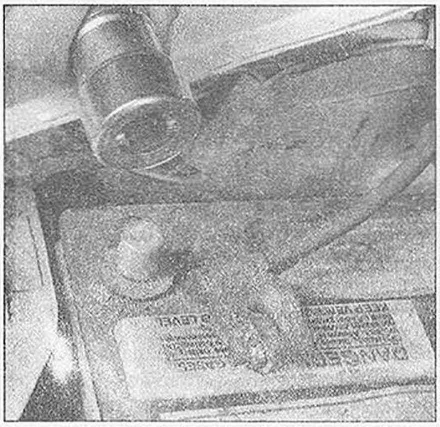
Battery charging

13 In winter when heavy demand is placed upon the battery, it's a good idea to occasionally have it charged from an external source.

14 When charging the battery, the negative cable should be disconnected. The charger leads should be connected to the battery before the charger is plugged in or turned on. If the leads are connected to the battery terminals after the charger is on, a spark could occur and the hydrogen gas given off by the battery could explode!

15 The battery should be charged at a low rate of about 4 to 6 amps, and should be left on for at least three or four hours. A trickle charger charging at the rate of 1.5 amps can be safely used overnight.

16 Special rapid boost charges which are claimed to restore the power of the battery in a short time can cause serious damage to the battery plates and should only be used in an



10.Sc Regardless of the type of tool used to clean the battery posts, a clean, shiny surface should be the result

emergency situation.

17 The battery should be left on the charger only until the specific gravity is brought up to a normal level. Don't overcharge the battery! **Note:** Some *battef'J chargers will automatically shut off after the battery is fully charged, making it unnecessary to keep a close watch on the state of charge.*

18 When disconnecting the charger, unplug it before disconnecting the charger leads from the battery.

11 Cooling system check

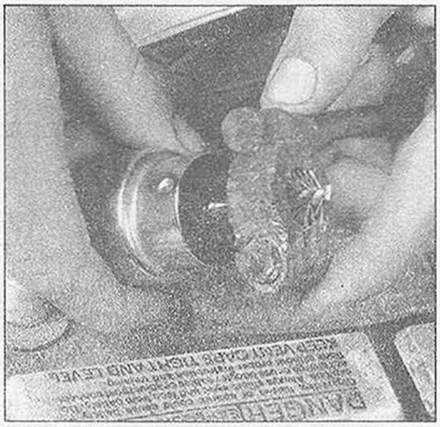
Refer to illustration 11.4

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

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

3 Remove the radiator cap by turning it counterclockwise until it reaches a stop. If you hear a hissing sound (indicating there's still pressure in the system), wait until it stops. Now press down on the cap with the palm of your hand and continue turning until it 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 (Section 36). If the coolant level is not up to the top, add additional anti-freeze/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's cracked, swollen or deteriorated. Cracks may become more apparent if the



10.Sd When cleanin91 the cable clamps, all corrosion must be removed (the inside of the clamp is tapered to match the taper of the post, so don't remove too much material)

hose is squeezed (see **illustration).** Regardless of condition, it's a good idea to replace hoses with new ones every two years.

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.

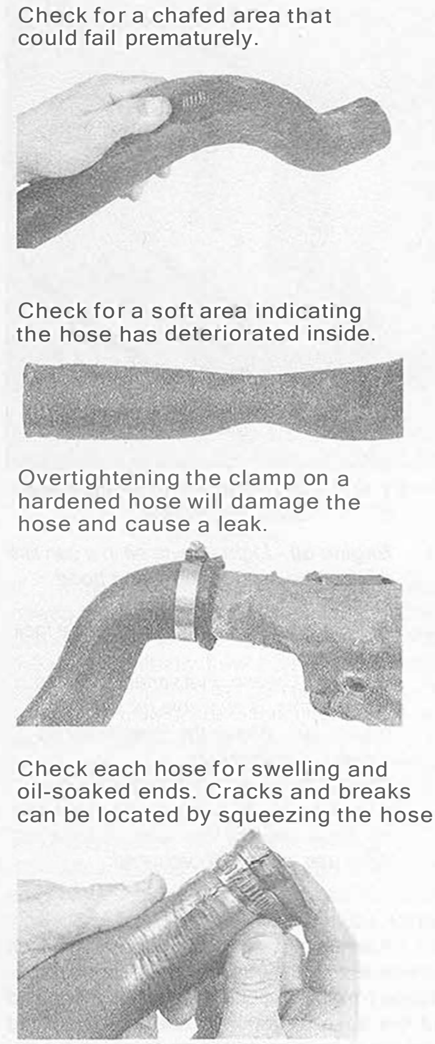
12 Underhood hose check and replacement

General

1 **Caution:** *Replacement of air conditioning hoses must be left to a dealer service department or air conditioning shop that has the equipment to depressurize the system safely. Never remove air conditioning components or hoses until the system has been depressurized.*

2 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. Information specific to the cooling system hoses can be found in Section 11.

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



11.4 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

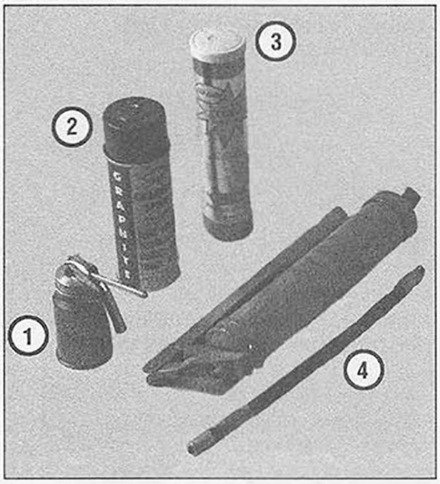
aren't used, make sure the hose has not expanded and/or hardened where it slips over the fitting, allowing it to leak.

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 thicknesses, 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.

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,



14.1 Materials required for chassis and body lubrication

1 **Engine oil** - *Light engine oil in a can like this can be used for door and hood hinges*
2 **Graphite spray** - *Used to lubricate lock cylinders*
3 **Grease** - *Grease, in a variety of types and weights, is available for use in a grease gun. Check the Specifications for your requirements*
4 **Grease gun** - *A common grease gun, shown here with a detachable hose and nozzle, is needed for chassis lubrication. After use, clean it thoroughly!*

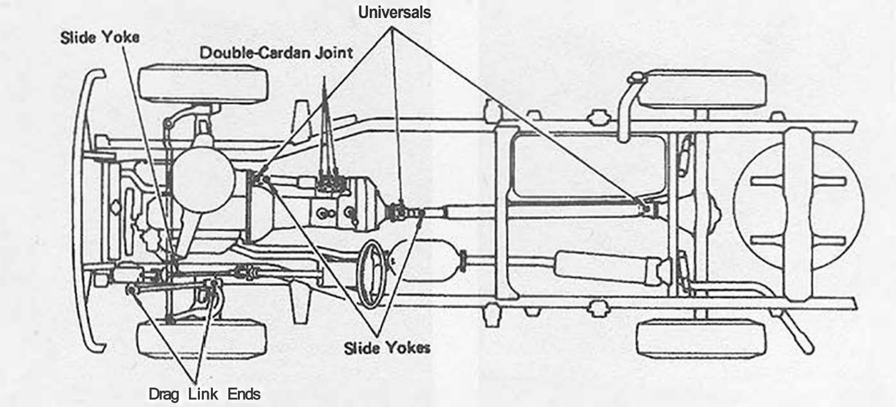
which could cause leakage.
7 A small piece of vacuum hose (1/4-inch inside diameter) can be used as a stethoscope to detect vacuum leaks. Hold one end of the hose to your ear and probe around vacuum hoses and fittings, listening for the "hissing" sound characteristic of a vacuum leak. **Warning:** *When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

Fuel hose

Warning: *There are certain precautions which must be taken when inspecting or servicing fuel system components. Work in a well ventilated area and don't allow open flames (cigarettes, appliance pilot lights, etc.) or bare light bulbs near the work area. Mop up any spills immediately and don't store fuel soaked rags where they could ignite. On vehicles equipped with fuel injection, the fuel system is under pressure, so if any fuel lines are to be disconnected, the pressure in the system must be relieved first (see Chapter 4 for more information).*
8 Check all rubber fuel lines for deterioration and chafing. Check carefully for cracks in areas where the hose bends and where it's attached to fittings.
9 High quality fuel line, usually identified by the word Fluroelastomer printed on the hose, should be used for fuel line replacement. **Warning:** *Never, under any circumstances, use unreinforced vacuum line, clear plastic tubing or water hose for fuel lines!*
10 Spring-type clamps are commonly used on fuel lines. They often lose their tension over a period of time, and can be "sprung" during removal. Replace all spring-type clamps with screw clamps whenever a hose is replaced.

Metal lines

11 Sections of metal line are often used for fuel line between the fuel pump and carburetor or fuel injection unit. Check carefully to be sure the line has not been bent or crimped and look for cracks.
12 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.
13 Check the metal brake lines where they enter the master cylinder and brake proportioning unit (if used) **for** cracks in the lines and loose fittings. Any sign of brake fluid leakage means an immediate thorough inspection of the brake system should be done.



14.3 Chassis lubrication points (2WD shown)

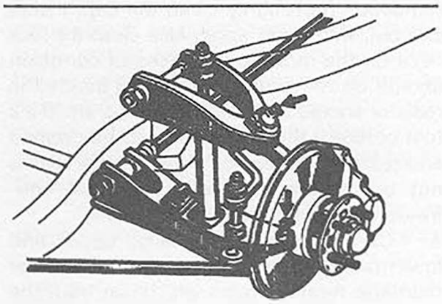
13 Exhaust system check

1 With the engine cold (at least three hours after the vehicle has been driven), check the complete exhaust system from the manifold to the end of the tailpipe. Be careful around the catalytic converter, which may be hot even after three hours. 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 signs of leakage and/or corrosion indicating a potential failure. Make sure that all brackets and hang;ers are in good condition and tight.
3 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 sealant or body putty.
4 Rattles and other noises can often be traced to the exhaust system, especially the hangers, mounts and heat shields. Try to move the pipes, mufflers and catalytic converter. If the components can come in contact with the body or suspension parts, secure the exhaust system with new brackets and hangers.

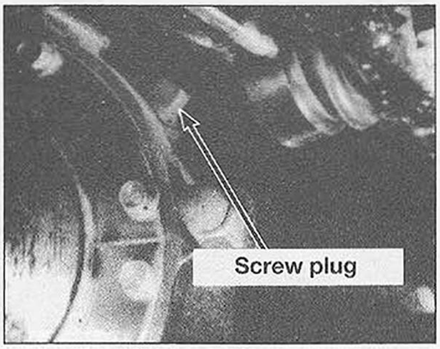
14 Chassis lubrication

Refer to illustrations 14.1, 14.3, 14.5 and 14.6

1 A grease gun and cartridge filled with the recommended grease are the only items required for chassis lubrication other than some clean rags and equipment needed to raise and support the vehicle safely **(see illustration).**
2 For easier access under the vehicle, raise it with a jack and place jackstands under the frame. Make sure the vehicle is safely supported by the stands!
3 Locate the grease fittings on the chassis and driveline components **(see illustration).**
4 Force a little of the grease out of the nozzle to *remove* any dirt from the end of the gun, then wipe it off with a rag.
5 To lubricate the suspension balljoints (2WD vehicles). remove the threaded plug and install a grease fitting in each hole, then pump grease into the balljoints **(see illustra-**



14.5 Suspension balljoint grease fitting locations - you may have to unscrew the plugs and install fittings



• 14.6 Remove the **4WD** screw plugs to **lubricate the** steering **knuckles - tater** models **have two** plugs **per wheel**

tion). If the grease seeps out around the gun nozzle, the fitting is clogged or the nozzle isn't seated all the way. Resecure the gun nozzle to the fitting and try again. If necessary, use another grease fitting.

6 On 4WD vehicles only, remove the threaded plug from each steering knuckle and repack them with lubricant **(see illustration).** Reinstall the screw plugs. Lubricate the remaining chassis components **(see illustrati?n 14.3).** Before pumping in any grease, wipe mud and dust off the grease fittings. **Note:** *To lubricate the driveshaft U-joints, use the grease charger attachment ;ncluded with the vehicle tool kit.*

7 Wipe excess grease from the components and grease fittings.

8 While you're under the vehicle, clean and lubricate the parking brake cable, cable guides and levers.

9 Lower the vehicle to the ground.

10 Open the hood and smear a little chassis grease on the hood latch mechanism. Have an assistant pull the release knob from inside the vehicle as you lubricate the cable at the latch.

11 Lubricate all the hinges {door, hood, tailgate} with a few drops of light engine oil.

12 The key lock cylinders can be lubricated with spray-on graphite, which is available at auto parts stores.

15 Engine oil and filter change

Refer to illustrations 15.3, 15.9, 15.14 and 15.18

1 Frequent oil changes are the most important preventive maintenance procedures that can be done by the home mechanic. As engine oil ages, it becomes diluted and contaminated, which leads to premature engine wear.

2 Although some sources recommend oil !ilter changes every other oil change, the minimal cost of an oil filter and the fact that it's easy to install dictate that a new filter be used every time the oil is changed.

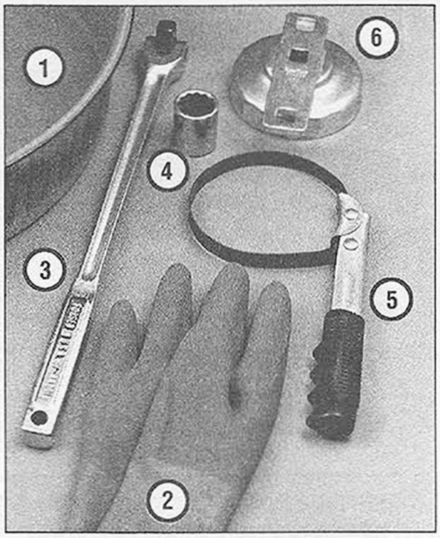
3 Gather all necessary tools and materials before beginning this procedure **(see illustration).**

4 You should have plenty of clean rags and newspapers handy to mop up any spills. 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!*

5 If this is your first oil change, get under the vehicle and 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 note how they're situated to avoid touching them when working under the vehicle.

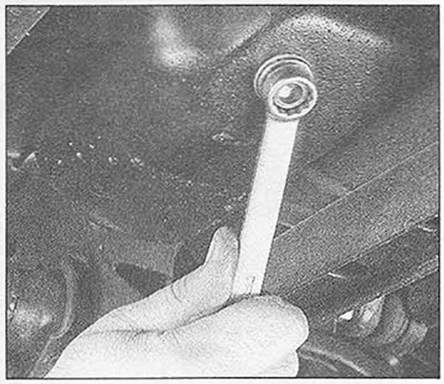
6 Warm the engine to normal operating temperature. If the new oil or any tools are needed, use the warm-up time to obtain everything necessary for the job. The correct oil for your application can be found in *Recommended lubricants and fluids* at the beginning of this Chapter.

7 With the engine oil warm (warm engine oil will drain better and more built-up sludge will be removed with it}, raise and support the vehicle. Make sure it's safely supportted!



15.3 These tools are required when changing the engine oil **and filter**

1 ***Drain pan*** *- It should be fairly shallow in depth, but wide in order to prevent spills*
2 ***Rubber gloves*** *- When removing the drain plug and filter it is inevitable that you will get oil on your hands (the gloves will prevent burns)*
3 *Breaker bar - Sometimes the oil drain plug is pretty 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)*



15.9 The engine oil drain plug is located at the bottom of the pan and should be removed with a box-end wrench or socket - DO NOT use an open-end wrench, as the corners on the bolt hex are easily rounded off

8 Move all necessary tools, rags and newspapers under the vehicle. Set the drain pan under the drain plug. Keep in mind that the oil will initially flow from the pan with some force; position the pan accordingly.

9 Being careful not to touch any of the hot exhaust components, use a wrench to remove the drain plug near the bottom of the oil pan **(see illustration).** Depending on how hot the oil is, you may want to wear gloves while unscrewing the plug the final few turns.

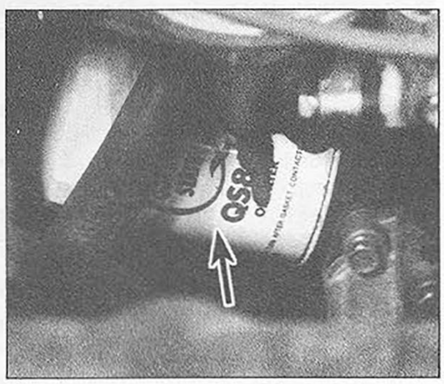
10 Allow the old oil to drain into the pan. It may be necessary to move the pan as the oil flow slows to a trickle.

11 After all the oil has drained, wipe off the drain plug with a clean rag. Small metal particles may cling to the plug and would immediately contaminate the new oil.

12 Clean the area around the drain plug opening and reinstall the plug. Tighten the plug securely **with** the wrench. If a torque wrench is available, use it to tighten the plug.

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

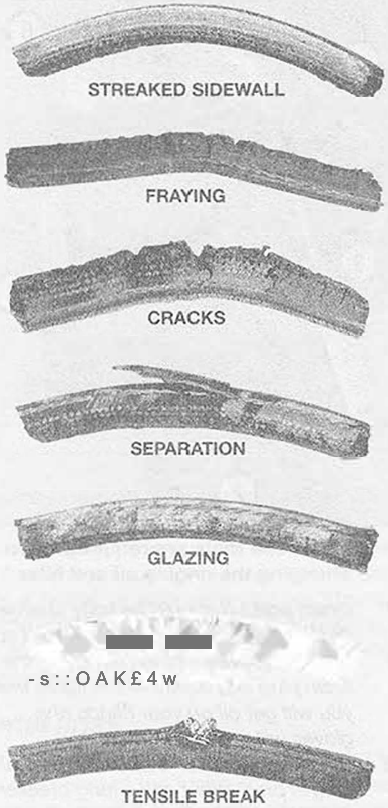
14 Use the filter wrench to loosen the oil filter (see **illustration).** Chain or metal band filter wrenches may distort the filter canister but it doesn't matter since the filter will b� discarded anyway.



15.14 The four-cylinder engine oil filter is located on the right side of the block (arrow)

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

15 Completely unscrew the old filter. Be careful; it's full of oil. Empty the oil inside the filter into the drain pan.
16 Compare the old filter with the new one to make sure they're the same type.
17 Use a clean rag to remove all oil, dirt and sludge from the area where the oil filter mounts to the engine. Check the old filter to make sure the rubber gasket isn't stuck to the engine. If the gasket is stuck to the engine, remove it.
18 Appiy a light coat of clean oil to the rubber gasket on the new oil filter **(see illustration).**
19 Attach the new filter to the engine, following the tightening directions printed on the filter canister or packing box. Most filter manufacturers recommend against using a filter wrench due to the possibility of overtightening and damage to the seal.
20 Remove all tools, rags, etc. from under the vehicle, being careful not to spill the oil in the drain pan, then lower the vehicle.
21 Move to the engine compartment and locate the oil filler cap.
22 Pour the fresh oil through the filler cap opening. A funnel may be needed to avoid spills.
23 Pour three or four 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 above the L mark, start the engine and allow the new oil to circulate.
24 Run the engine for only about a minute and then shut it off. Immediately look under the vehicle and check for leaks at the oil pan drain plug and around the oil filter. If either one is leaking, tighten it a little more.
25 With the new oil circulated and the filter now completely full, recheck the level on the dipstick and add more oil as necessary.
26 During the first few trips after an oil change, make it a point to check frequently for leaks and correct oil level.
27 The old oil drained from the engine cannot be reused in its present state and should be disposed of. Oil reclamation centers, auto repair shops and gas stations will normally



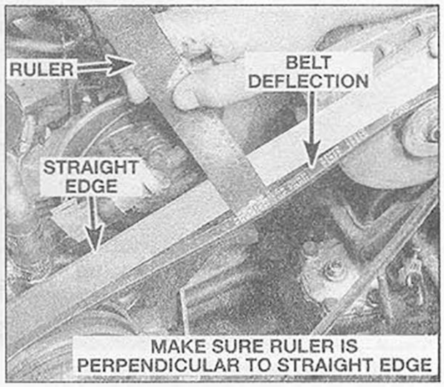
16.3 Here are some of the more common problems associated with drivebelts (check the belts very carefully to prevent an untimely breakdown)

accept the oil, which can be refined and used again. After the oil has cooled it can be poured into a container (capped plastic jugs or bottles, milk cartons, etc.) for transport to a disposal site.

16 Drivebelt check, adjustment and replacement

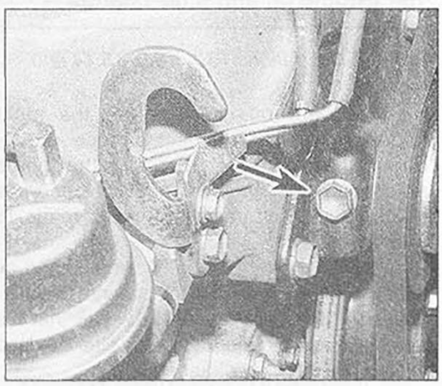
Refer to illustrations 16.3, 16.5 and 16.6

1 The drivebelts, or V-belts as they are often called, are located at the front of the engine and play an important role in the overall operation of the engine and accessories. Due to their function and material makeup, 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, smog pump, power steering pump, water pump and air conditioning compressor. Depending on the pulley arrangement, more than one of the components may be driven by a single belt.
3 With the engine off, locate the drivebelts at the front of the engine. Using your fingers (and a flashlight, if necessary), move along the belts checking for cracks and separation

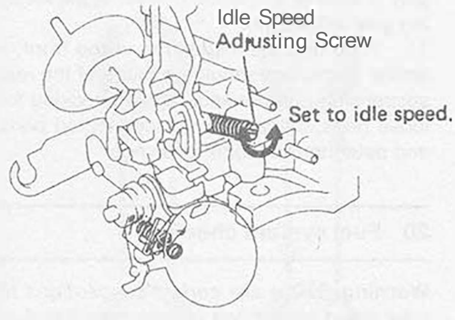


16.5 Measuring drivebelt deflection with a straightedge and ruler

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'll have to twist each belt to check the underside. Check the pulleys for nicks, cracks, distortion and corrosion.
4 To check the tension of each belt in accordance with factory recommendations, install a drivebelt tension gauge. Measure the tension in accordance with the tension gauge instructions and compare your measurement to the specified drivebelt tension for either a used or new belt. **Note:** *A "new" belt is defined as any belt which has not been run; a "used" belt is one that has been run for more than ten minutes.*
5 The special gauge is the most accurate way to check belt tension. However, if you don't have a gauge, and cannot borrow one, the following "rule-of-thumb" method is recommended as an alternative. Lay a straightedge across the longest free span (the distance between two pulleys) of the belt. Push down firmly on the belt at a point half way between the pulleys and see how much the belt moves (deflects). Measure the deflection with a ruler **(see illustration).** The belt should deflect 1/8 to 1/4-inch if the distance from pulley center-to-pulley center is less than 12-inches; it should deflect from 1/8 to 3/8-inch if the distance from pulley center-to-pulley center is over 12-inches.



16.6 Some components have an adjusting bolt that can be used to tension the drivebelt very accurately



17.7 Carburetor idle speed adjusting screw location

6 If adjustment is needed, either to make the belt tighter or looser, it's done by moving the belt-driven accessory on the bracket. Each component usually has an adjusting bolt and a pivot bolt. Both bolts must be loosened slightly to enable you to move the component. Some components have an adjusting bolt that can be turned to change the belt tension after the lock bolt is loosened **(see illustration).**

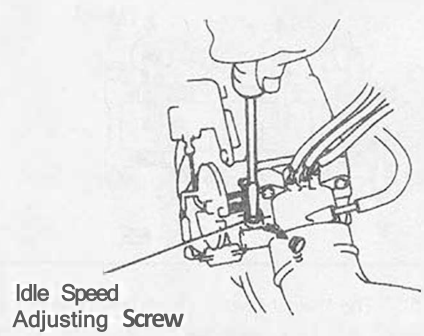
7 After the two bolts have been loosened, move the component away from the engine to tighten the belt or toward the engine to loosen the belt. Hold the accessory in position and check the belt tension. If it's correct, tighten the two bolts until just snug, then recheck the tension. If the tension is correct, tighten the bolts.

8 You may have to use some sort of pry bar to move the accessory while the belt is adjusted. If this must be done to gain the proper leverage, be very careful not to damage the component being moved or the part being pried against (especially the smog pump).

9 To replace a belt, follow the above procedures for drivebelt adjustment but 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. Mark each belt and the corresponding pulley grooves so the replacement belts can be installed properly.

10 Take the old belts with you when purchasing new ones in order to make a direct comparison for length, width and design.

11 Adjust the belts as described earlier in this Section.



17.10 EFI idle speed adjusting screw location

17 Idle speed check and adjustment

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

2 To get an accurate reading, a hand-held tachometer must be used when adjusting idle speed. The exact hook-up for these meters depends on the manufacturer, so follow the directions included with the tachometer.

3 Apply the parking brake and block the wheels. Be sure the transmission is in Neutral (manual transmission) or Park (automatic transmission).

4 Turn off the air conditioner (if equipped), the headlights and all other accessories.

5 Start the engine and allow it to reach normal operating temperature.

Carburetor equipped models

Refer to illustration 17.7

6 Check the engine idle speed with the tachometer and compare it to the VECI label under the hood.

7 If the idle speed is incorrect, turn the idle speed adjusting screw to change it **(see illustration).**

Fuel injected models

Refer to illustration 17.10

8 Run the engine at 2500 rpm for about two minutes, then allow it to return to idle.

9 Check the engine idle speed with the tachometer and compare it to the VECI label under the hood.

10 If the idle speed is incorrect, remove the rubber plug (if equipped) from the throttle body and turn the idle speed adjusting screw to change it **(see illustration).**

18 Valve clearance check and adjustment (four-cylinder engine only)

Refer to illustrations 18.5, 18.7 and 18.10

1 Start the engine and allow it to reach normal operating temperature, then shut it off.

2 Remove the air cleaner (Chapter 4) and the rocker arm cover (Chapter 2).

3 Position the number one piston at TDC on the compression stroke (Chapter 2).

4 Make sure the rocker arms for the number one cylinder valves are loose and number four are tight. If they aren't, the number one piston is not at TDC on the compression stroke.

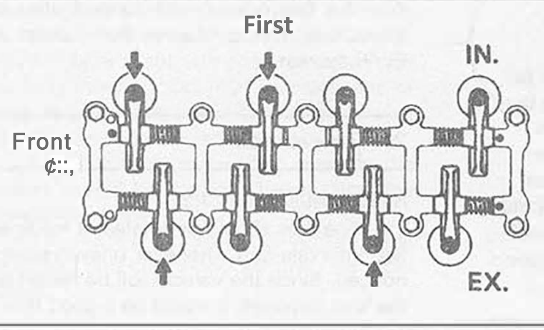
5 Check/adjust only the valves indicated by arrows in **illustration 18.5.** The valve clearances can be found in the Specifications at the beginning of this Chapter.

6 The clearance is measured by inserting the specified size feeler gauge between the end of the valve stem and the adjusting screw. You should feel a slight amount of drag when the feeler gauge is moved back-and-forth.

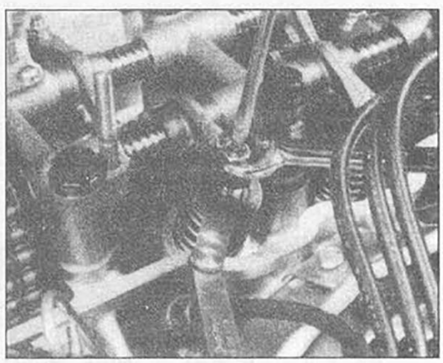
7 If the gap is too large or too small, loosen the locknut and turn the adjusting screw to obtain the correct gap **(see illustration).**

8 Once the gap has been set, hold the screw in position with a screwdriver and retighten the locknut. Recheck the valve clearance - sometimes it'll change slightly when the locknut is tightened. If so, readjust it until it's correct.

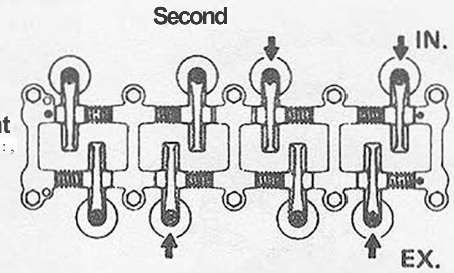
9 Repeat the procedure for the remaining valves **(see illustration 18.5),** then turn the crankshaft one complete revolution (360-degrees) and realign the notch in the pulley with the zero on the engine.



18.5 Adjust the valves indicated by the arrows with the number one piston at TDC on the compression stroke



18.7 The valve clearance can be changed by turning the adjusting screw with a screwdriver - once the clearance is set, tighten the locknut with a wrench and withdraw the feeler gauge



18.10 Turn the crankshaft one complete revolution (360"), then adjust the valves marked here with an arrow

10 Adjust the valves indicated by the arrows in illustration 18.10.
11 Reinstall the rocker arm cover and the air cleaner assembly.

19 Suspension and steering check

Refer to illustration 19.6

1 Whenever the front of the vehicle is raised for any reason, it's a good idea to visually check the suspension and steering components for wear.
2 Indications of steering or suspension problems include excessive play in the steering wheel before the front wheels react, excessive swaying around corners or body movement over rough roads and binding at some point as the steering wheel is turned.
3 Before the vehicle is raised for inspection test the shock absorbers by pushing dow'n aggressively at each corner. If the vehicle doesn't come back to a level position within one or two bounces, the shocks are worn and should be replaced. As this is done listen for squeaks and other noises from the suspension components. Information on shock absorber and suspension components can be found in Chapter 10.
4 Raise the front end of the vehicle and support it on jackstands. Make sure it's safely supported!
5 Crawl under the vehicle and check for loose bolts, broken or disconnected parts and deteriorated rubber bushings on all suspension and steering components. Look for grease or fluid leaking from around the steering gear assembly and shock absorbers. If equipped, check the power steering hoses and connections for leaks. On 1986 and later 4WD models, check the balljoint dust covers and driveshaft boots for damage.
6 The balljoint seals should be checked at this time. This includes not only the upper and lower suspension balljoints, but those connecting the steering linkage parts as well. After cleaning around the balljoints, inspect the seals for cracks and damage. Check the balljoints (2WD vehicles) for wear **(see illustration).**
7 Grip the top and bottom of each wheel and try to move it in and out. It won't take a lot of effort to be able to feel any play in the wheel bearings. If the play is noticeable it would be a good idea to adjust it right away or it could confuse further inspections.
8 Grip each side of the wheel and try rocking it laterally. Steady pressure will, of course, turn the steering, but back and forth pressure will reveal a loose steering joint. If some play is felt it would be easier to get assistance from someone so while one person rocks the wheel from side-to-side, the other can look at the joints, bushings and connections in the steering linkage.
9 To check the steering box, first make sure the bolts holding the steering box to the frame are tight. Then get another person to help examine the mechanism. One should look at, or hold onto, the arm at the bottom of the steering box while the other turns the steering wheel a little from side to side. The amount of lost motion between the steering wheel and the gear arm indicates the degree of wear in the steering box. Check the gearbox oil level as well. On 2WD models it should be about 1-inch from the top. On 4WD models it should be about 1/2-inch from the top. Refer to the *Recommended lubricants and fluids* section in the Specifications if oil is needed.
10 Moving to the vehicle interior, check the play in the steering wheel by turning it slowly in both directions until the wheels can Just be felt turning. The steering wheel free play should be less than 1-1/8 inch. Excessive play is another indication of wear in the steering gear or linkage.
11 Following the inspection of the front, a similar inspection should be made of the rear suspension components, again checking for loose bolts, damaged or disconnected parts and deteriorated rubber bushings.

20 Fuel system check

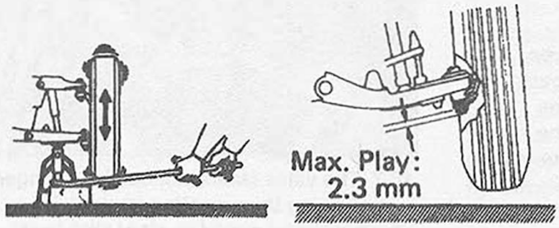
Warning: *There are certain precautions to take when inspecting or servicing the fuel system components. Work in a well ventilated area and don't allow open flames (cigarettes, appliance pilot lights, etc.) in the work area. Mop up spills immediately and don't store fuel soaked rags where they could ignite. On fuel injection equipped models the fuel system is under pressure. No components should be disconnected until the pressure has been relieved* (see Chapter 4).

1 On most models the main fuel tank is located at the rear of the vehicle.
2 The fuel system should be checked with the vehicle raised on a hoist so the components underneath the vehicle are readily visible and accessible.
3 If the smell of gasoline is noticed while driving or after the vehicle has been in the sun, the system should be thoroughly inspected immediately.
4 Remove the gas tank cap and check for damage, corrosion and an unbroken sealing imprint on the gasket. Replace the cap or gasket with a new one if necessary.
5 With the vehicle raised, check the gas tank and filler neck for punctures, cracks and other damage. The connection between the filler neck and the tank is especially critical. Sometimes a rubber filler neck will leak due to loose clamps or deteriorated rubber, problems a home mechanic can usually rectify.
Warning: *Do not, under any circumstances, try to repair a fuel tank yourself (except rubber components). A welding torch or any open flame can easily cause the fuel vapors to explode if the proper precautions are not taken!*
6 Carefully check all rubber hoses and metal lines leading away from the fuel tank. Look for loose connections, deteriorated hoses, crimped lines and other damage. Follow the lines to the front of the vehicle, carefully inspecting them all the way. Repair or replace damaged sections as necessary.
7 If a fuel odor is still evident after the inspection, refer to Chapter 6 and check the EVAP system.

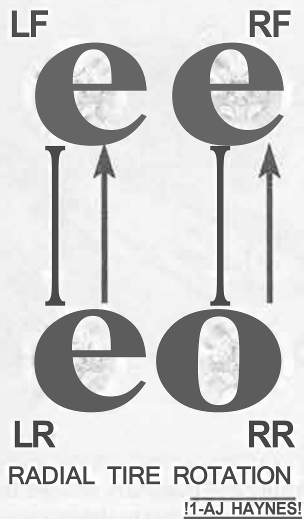
21 Tire rotation

Refer to illustration 21. 2

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, it would be a good time to



19.6 Check the suspension balljoints for wear by prying up on the tires as shown here - note that the lower control arm must be supported by a jackstand and the tire must be off the ground



21.2 Tire rotation diagram

check the brakes and repack the wheel bearings as well.

2 Refer to the accompanying illustration for the preferred tire rotation pattern.

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, don't apply the parking brake as stated. Make sure the tires are blocked to prevent the vehicle from rolling as it's raised.

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

5 After rotation, check and adjust the tire pressures as necessary and be sure to check the lug nut tightness.

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

22 Brake check

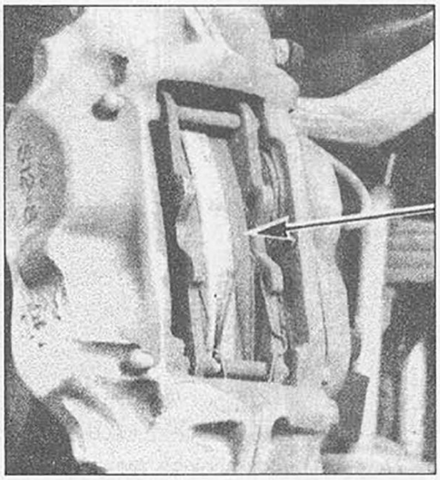
Refer to illustrations 22.6a, 22.6b, 22.10, 22.11, 22.12 and 22.14

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

Warning: *Brake system dust contains 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 solvents to remove the dust. Use brake system cleaner or denatured alcohol only!*

1 In addition to the specified intervals, the brakes should be inspected every time the wheels are removed.

2 To check the brakes, the vehicle must be raised and supported securely on jackstands.



22.6a To check the brake pads on early models, remove the inspection cover and note the thickness of the pad lining (arrow) on both pads in each caliper

Disc brakes

3 Disc brakes are used on the front wheels. Extensive rotor damage can occur if the pads are allowed to wear beyond the specified limit.

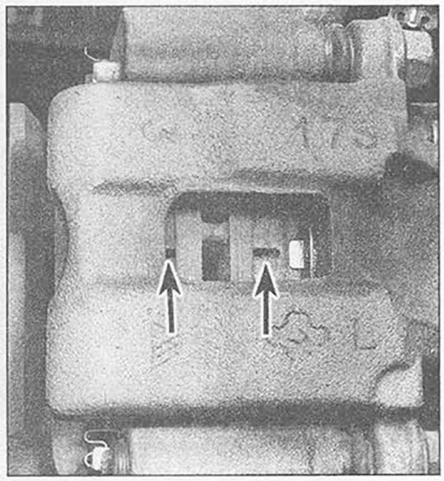
4 Raise the vehicle and support it securely on jackstands, then remove all four wheels (see *Jacking and towing* at the front of the manual if necessary).

5 The disc brake calipers, which contain the pads, are visible with the wheels removed. There's an outer pad and an inner pad in each caliper. All four pads should be inspected.

6 Each caliper has an opening, which will allow you to inspect the pads **(see illustrations).** If the pad material has worn to about 1/8-inch or less, **the** pads should be replaced.

7 If you're unsure about the exact thickness of the remaining lining material, remove the pads for further inspection or replacement (refer to Chapter 9).

8 Before installing the wheels, check for leakage and/or damage (cracks, splitting, etc.) around the brake hose connections. Replace the hose or fittings as necessary, referring to Chapter 9.



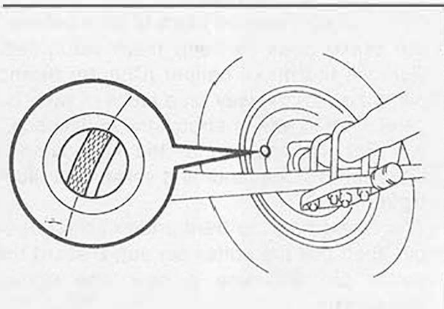
22.6b Later model calipers don't have an inspection cover - the pad lining material (arrows) is visible through the large opening

9 Check the condition of the rotor. Look for score marks, deep scratches and burned spots. If these conditions exist, the hub/rotor assembly should be removed for servicing.

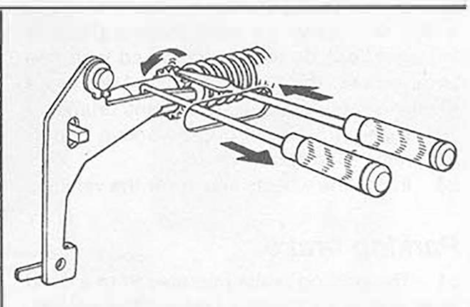
Drum brakes

10 **Note:** *On later models, the brake shoe lining thickness can be checked without removing the drum - simply pry the inspection hole plug out of the backing plate* **(see illustration)** *and check the lining through the hole. A comprehensive inspection requires removal of the brake drum as described below.* Remove the drum by pulling it off the axle and brake assembly. If it's stuck, make sure the parking brake is released, then squirt penetrating oil into the joint between the hub and drum. Allow the oil to soak in and try to pull the drum off again.

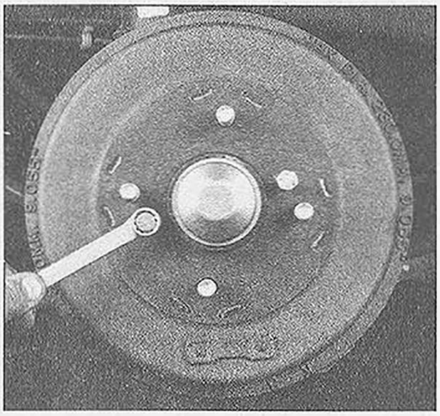
11 If the drum still can't be pulled off, the brake shoes will have to be adjusted. This is done by first removing the dust cover from the backing plate. With the cover removed, use a small screwdriver to turn the star wheel, which will move the brake shoes away from the drum (see illustration).



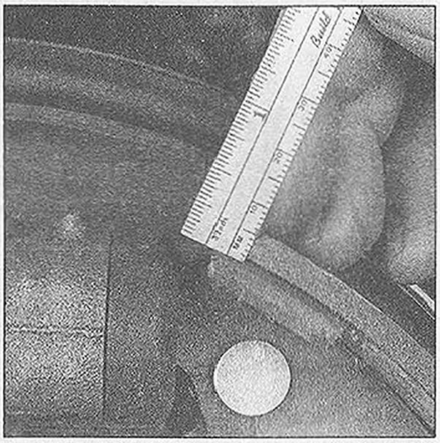
22.10 Remove the plug and look through the inspection hole with a flashlight to check the rear brake lining thickness (later models only)



22.11 Hold the locking lever out of the way with a hooked tool and turn the star wheel with a screwdriver to move the brake shoes away from the drum



22.12 The **rear brake drums can be removed by screwing bolts into the threaded** holes **and tightening them a little at a time**



22.14 On bonded linings, measure the distance to the backing plate - on riveted linings, measure the depth of the rivet hole to determine the amount of lining remaining

12 As a last resort, thread a bolt into each of the holes in the drum **(see illustration)** and tighten the bolts a little at a time to force the drum off.

13 With the drum removed, be careful not to touch any brake dust (see the Warning at the beginning of this Section).

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

15 Make sure that all the brake assembly springs are connected and in good condition.

16 Check the brake components for signs of fluid leakage. Carefully pry back the rubber cups on the wheel cylinders located at the top of the brake shoes with your finger. Any leakage is an indication that the wheel cylinders should be overhauled immediately (Chapter 9). Also check the brake hoses and connections for leakage.

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

18 Check the inside of the drum for cracks, score marks, deep scratches and hard spots, which will appear as small discolorations. If imperfections cannot be removed with fine emery cloth, the drum must be taken to a machine shop equipped to turn the drums.

19 If all parts are in good working condition, reinstall the brake drum.

20 Install the wheels and lower the vehicle.

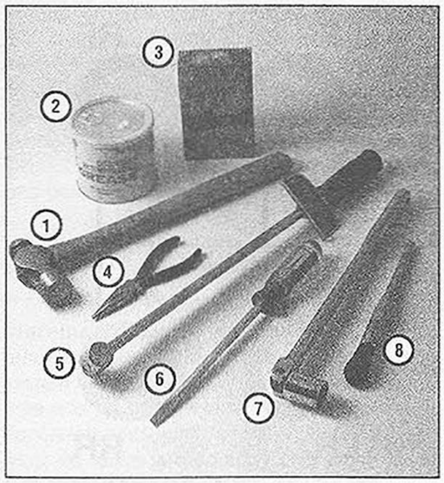
Parking brake

21 The parking brake operates from a hand lever and locks the rear brakes. The easiest, and perhaps most obvious method of periodically checking the operation of the parking brake assembly is to park the vehicle on a steep hill with the parking brake set and the transmission in Neutral. If the parking brake cannot prevent the vehicle from rolling, it's in need of adjustment (see Chapter 9).

23 Front wheel bearing check, repack and adjustment (2WD models only)

Refer to illustrations 23. 1, 23. 6, 23. 11, 23. 15, 23.19, 23.23 and 23.24

1 In most cases the front wheel bearings will not need servicing until the brake pads are changed. However, the bearings should be checked whenever the front of the vehicle is raised for any reason. Several items, including a torque wrench and special grease, are required for this procedure (see **illustration).**



23.1 Tools and materials needed for front wheel bearing maintenance

1 **Hammer** - *A common hammer will do just fine*

2 **Grease** - *High-temperature grease which is formulated specially for front wheel bearings should be used*

3 **Wood block** - *If you have a scrap piece of 2x4, it can be used to drive the new seal into the hub*

4 **Needle-nose pliers** - *Used to straighten and remove the cotter pin in the spindle*

5 **Torque wrench** - *This is very important in this procedure; if the bearing is too tight, the wheel won't turn freely - if it is too loose, the wheel will "wobble' on the spindle. Either way, it could mean extensive damage*

6 **Screwdriver** - *Used to remove the seal from the hub (a long screwdriver would be preferred)*

7 **Socket/breaker bar** - *Needed to loosen the nut on the spindle if it is extremely tight*

8 **Brush** - *Together with some clean solvent, this will be used to remove old grease from the hub and spindle*

2 With the vehicle securely supported on jackstands, spin each wheel and check for noise, rolling resistance and free play.

3 Grasp the top of each tire with one hand and the bottom with, the other. Move the wheel in-and-out on the spindle. If there's any noticeable movement, the bearings should be checked and then repacked with grease or replaced if necessary.

4 Remove the wheel(s).

5 Fabricate a wood block to slide between the brake pads to keep them separated. Remove the brake caliper (Chapter 9) and hang it out of the way on a piece of wire. Be careful not to kink or stretch the brake hose.

6 Pry the cap out of the hub using a screwdriver or hammer and chisel **(see illustration).**

7 Straighten the bent ends of the cotter pin, then pull the cotter pin out. Discard the cotter pin and use a new one during reassembly.

8 Remove the nut lock, adjusting nut and thrust washer from the end of the spindle.

9 Pull the hub out slightly, then push it back into its original position. This should force the outer wheel bearing off the spindle enough so it can be removed.

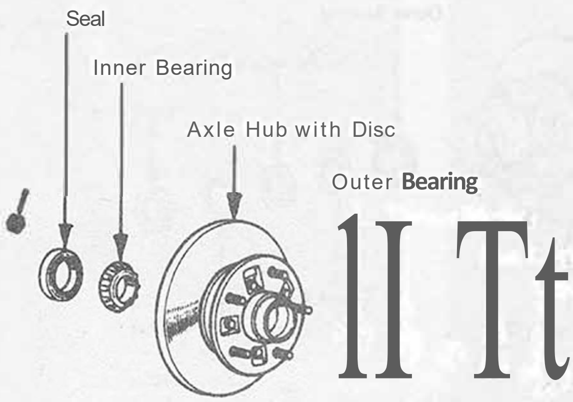
10 Pull the hub/disc assembly off the spindle.

11 Use a screwdriver *to* pry the seal out of the rear of the hub (see illustration). As this is done, note how the seal is installed.

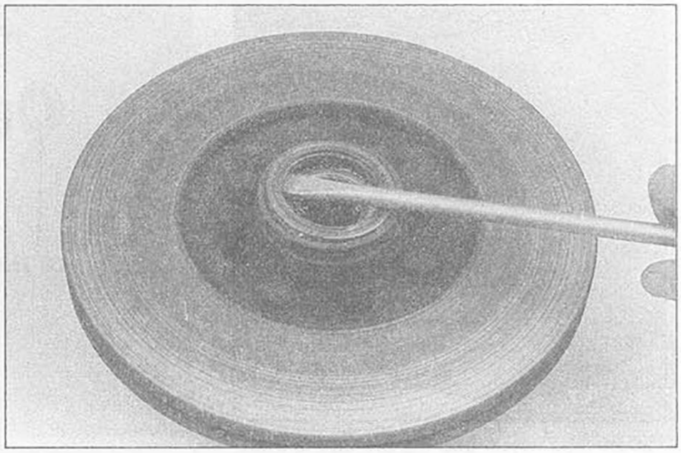
12 Remove the inner wheel bearing from the hub.

13 Use solvent to remove all traces of the old grease from the bearings, hub and spindle. A small brush may prove helpful; however make sure no bristles from the brush embed themselves inside the bearing rollers. Allow the parts to air dry.

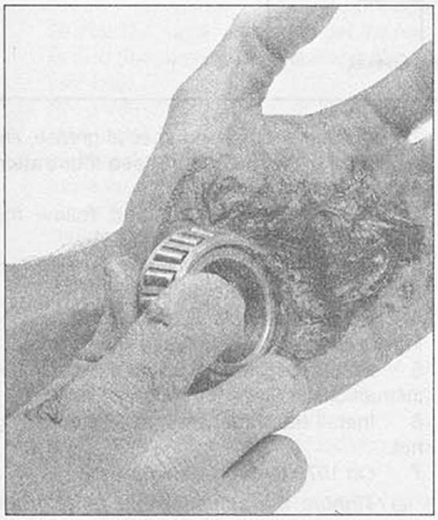
14 Carefully inspect the bearings for cracks, heat discoloration, worn rollers, etc. Check the bearing races inside the hub for wear and damage. If the bearing races are defective, the hubs should be taken to a machine shop with the facilities to remove the old races and press new ones in. Note



23.6 Front wheel bearing components - exploded view (2WD models)



23.11 Use a large screwdriver to pry the seal out of the rear of the hub



23.15 Work clean grease of the recommended type into each bearing until it's full

that the bearings and races come as matched sets and old bearings should never be installed on new races.

15 Use high-temperature front wheel bearing grease to pack the bearings. Work the grease completely into the bearings, forcing it between the rollers, cone and cage from the back side **(see illustration).**

16 Apply a thin coat of grease to the spindle at the outer bearing seat, inner bearing seat, shoulder and seal seat.

17 Put a small quantity of grease behind each bearing race inside the hub. Using your finger, form a dam at these points to provide for extra grease and to keep thinned grease from flowing out of the bearing.

18 Place the grease-packed inner bearing into the rear of the hub and put a little more grease outside of the bearing.

19 Place a new seal over the inner bearing and tap the seal evenly into place with a hammer and block of wood until it's flush with the hub **(see illustration).**

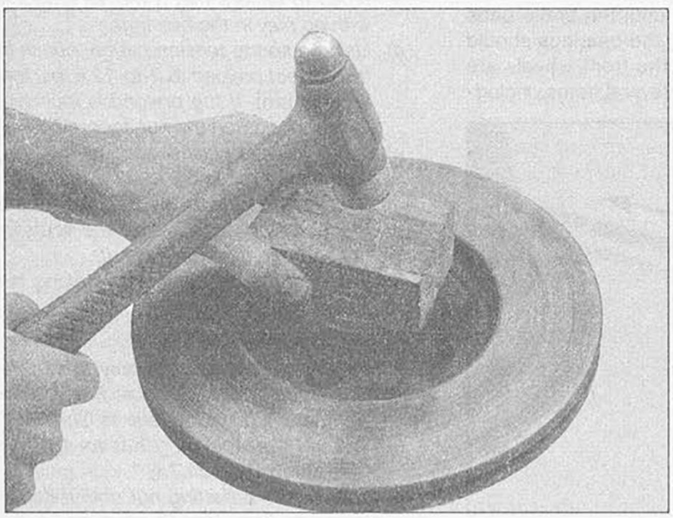
20 Carefully place the hub assembly onto the spindle and push the grease-packed outer bearing into position.

21 Install the thrust washer and adjusting nut. Tighten the nut to the initial specified torque.

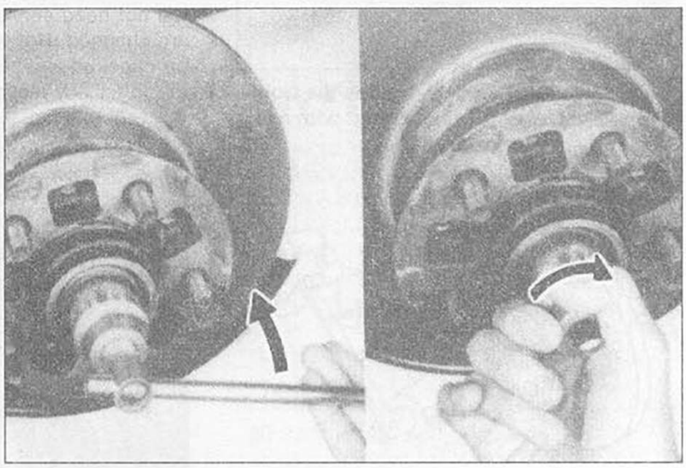
22 Spin the hub in a forward direction to seat the bearings and remove any grease or burrs which could cause excessive bearing play later.

23 On 1979 through 1983 models, unscrew the nut until it can be turned by hand. Using a socket only (do not use a ratchet or breaker bar), tighten the nut as much as possible by hand **(see illustration).** Using a spring tension gauge, check for the specified preload. It should be 1.3 to 4.0 pounds. If the preload is incorrect, loosen or tighten the nut accordingly to obtain the specified preload. The nut should not be loosened at this point any more than one-half flat to install the new cotter pin.

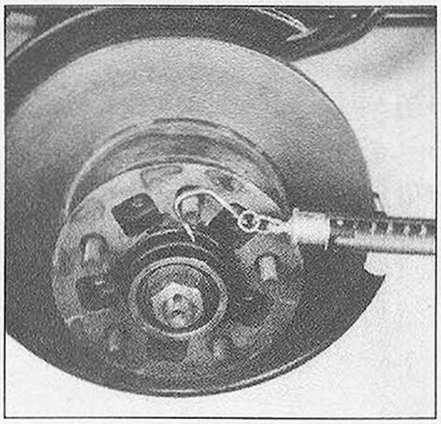
24 On 1984 and later models, loosen the nut until there is 0.020 to 0.039-inch axial (in-and-out) play in the hub. Attach a spring scale to one of the lug bolts and measure the force required to start the hub turning **(see**



23.19 Tap the seal into place with a block of wood and a hammer



23.23 On 1979 through 1983 2WD models, the wheel bearing adjusting nut should be retightened (after the initial torque figure has been reached and the nut has been loosened) by turning the socket by hand only - DO NOT use a tool on the socket!

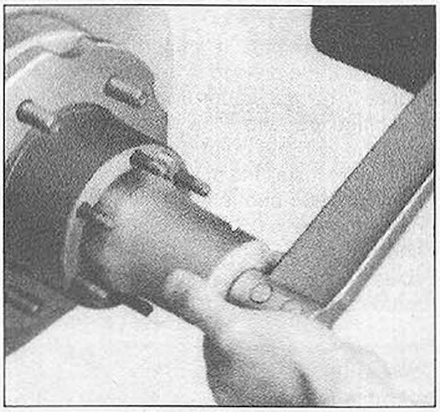


23.24 The wheel bearing preload is then checked with a spring scale as shown here

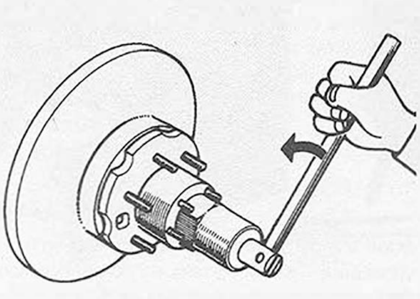
illustration). This is the oil seal frictional drag. Record the measurement. Tighten the nut until the bearing preload is 1.3 to 4.0 pounds greater than the oil seal frictional drag. The bearing preload is the force required to start the hub turning (as measured with the spring scale). The hub axial play should be less than 0.002-inch.

25 Install the nut lock and a new cotter pin.

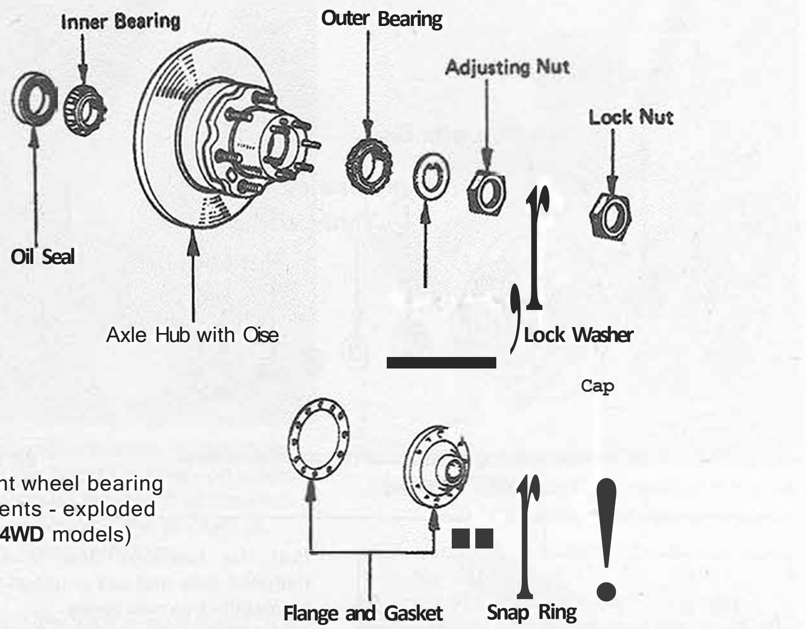
26 Bend the ends of the cotter pin until they're flat against the nut. Cut off any extra length which could interfere with the dust cap.



24.7a On 4WD models, tighten the front wheel bearing adjusting nut with a torque wrench . . .



24.7b . . . then loosen the nut again until it can just be turned by hand . . .



24.4 Front wheel bearing components - exploded **view (4WD** models)

27 Install the dust cap. Tap it into place with a hammer.

28 Place the brake caliper near the rotor and carefully remove the wood spacer. Install the caliper (Chapter 9).

29 Install the wheel and tighten the lug nuts.

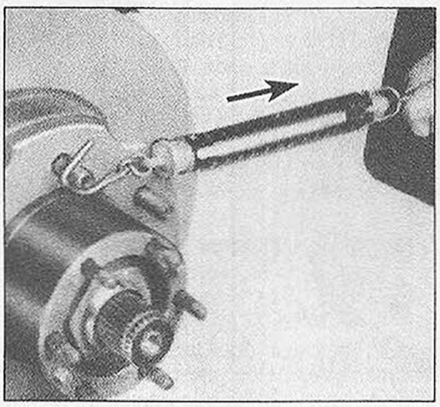
30 Grasp the top and bottom of the tire and check the bearings in the manner described earlier in this Section.

31 Lower the vehicle.

24 Front wheel bearing check, repack and adjustment (4WD models only)

Refer to illustrations 24.4, 24. 7a, 24. 7b and 24.7c

1 In most cases, the front wheel bearings will not need servicing until the brake pads are changed. However, the bearings should be checked whenever the front wheels are raised for any reason. Several items, including a torque wrench and special grease, are required for this procedure **(see illustration 23.1).**



24.7c . . . and check the bearing preload with a spring scale

2 Refer to Section 23 and follow the instructions in Steps 2 through 5.

3 Remove the free-wheel or locking hub assembly (see Chapter 8).

4 Remove the locknut, lock washer, adjusting nut and thrust washer **(see illustration).**

5 Refer to Section 23 and follow the instructions in Steps 9 through 20.

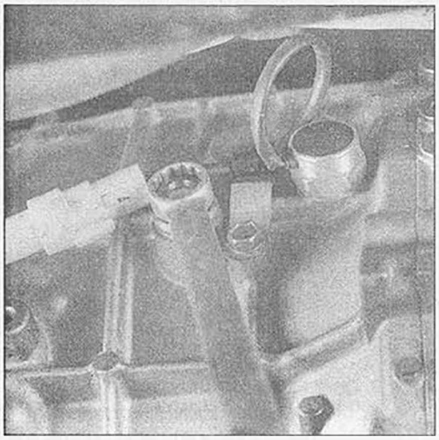
6 Install the thrust washer and adjusting nut.

7 On 1979 through 1985 models:

a) *Tighten the adjusting nut to 43 ft-lbs (see illustration).*
b) *Loosen the adjusting nut until it can be turned by hand* **(see illustration).**
c) *Retighten the adjusting nut to 35-to-60 in-lbs, then turn the hub two or three times to ensure that it moves smoothly with no play in the bearings.*
d) *Using a spring tension gauge, check for the correct preload (6.2-to-12.6 lbs)* **(see illustration).** *If the preload is incorrect, loosen or tighten the nut accordingly.*
e) *Install the lock washer and locknut.*
f) *Tighten the nut to 58-to-72 ft-lbs.*
g) *Secure the locknut by bending one of the Jock washer tabs over the adjusting nut and one over the locknut.*
h) *Reinstall the free-wheel or Jocking hub assembly (Chapter 8).*

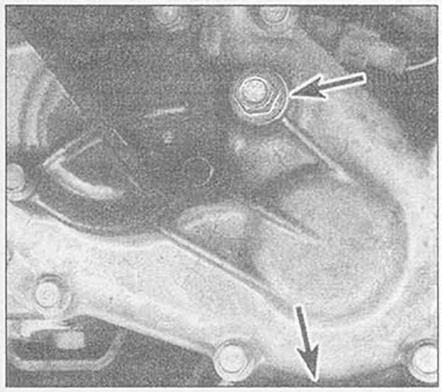
8 On 1986 and later models:

a) *This procedure applies only to vehicles with manual Jocking hubs. For vehicles with automatic hubs, refer to Chapter 8.*
b) *Tighten the adjusting nut to 43 ft-lbs* **(see illustration 24.7a).**
c) *Loosen the adjusting nut until it can be turned by hand* **(see illustration 24.7b).**
d) *Using a spring scale attached to one of the lug bolts, measure the frictional drag*



25.1 The manual transmission check/fill plug is accessible from under the vehicle

26.2 Remove the check/fill plug to determine the differential oil level



27.1 The transfer case check/fill plug (upper arrow) and drain plug (lower arrow) are accessible from under the vehicle (typical)

of the oil seal and record it for use later in the procedure **(see illustration 24.7c).** *The force required to get the hub to turn (measured on the scale) is the oil seal drag.*

e) Retighten the adjusting nut to 18 ft-lbs, then install the Jock washer and locknut. Tighten the locknut to 33 ft-lbs.

f) Make sure the bearing has no play, then check the preload with the spring scale. Preload is the force required to get the hub to turn. It should be 6.4-to-12.6 ft-lbs greater than the oil seal drag. If the pre/oad is not as specified, tighten or loosen the adjusting nut as required.

g) Secure the locknut by bending one of the lock washer tabs over the adjusting nut and one over the locknut.

h) Reinstall the free-wheel or locking hub assembly (Chapter 8).

9 Refer to Section 23 and follow the instructions in Steps 28 through 31.

25 Manual transmission oil level check

Refer to illustration 25. 1

1 Manual transmissions don't have a dipstick. The oil level is checked by removing a plug from the side of the transmission case **(see illustration).** Locate the plug and use a rag to clean the plug and the area around it. If the vehicle is raised to gain access to the plug, be sure to support it safely on jackstands - DO NOT crawl under the vehicle when it's supported only by a jack!

2 With the engine and transmission cold, remove the plug. If lubricant immediately starts leaking out, thread the plug back into the transmission - the level is correct. If it doesn't, completely remove the plug and reach inside the hole with your little finger. The level should be even with the bottom of the plug hole.

3 If the transmission needs more lubricant, use a syringe or small pump to add it through the plug hole.

4 Thread the plug back into the transmission and tighten ii securely. Drive the vehicle, then check for leaks around the plug.

26 Differential oil level check

Refer to illustration 26.2

1 The differential has a check/fill plug which must be removed to check the oil level. If the vehicle is raised to gain access to the plug, be sure to support it safely on jackstands - DO NOT crawl under the vehicle when it's supported only by a jack!

2 Remove the oil check/fill plug from the differential **(see illustration).**

3 The oil level should be at the bottom of the plug opening. If not, use a syringe to add the recommended lubricant until it just starts to run out of the opening.

4 Install the plug and tighten it securely. Check for leaks after the first few miles of driving.

27 Transfer case oil level check

Refer to illustration 27.1

1 The transfer case oil level is checked by removing a plug from the side of the case **(see illustration).** Remove the rock guard (if equipped}, then locate the plug and use a rag to clean the plug and the area around it. If the vehicle is raised to gain access to the plug, be sure to support it safely on jackstands - DO NOT crawl under the vehicle when it's supported only by a jack!

2 With the engine and transfer case cold, remove the plug. If lubricant immediately starts leaking out, thread the plug back into the case - the level is correct. If it doesn't, completely remove the plug and reach inside the hole with your little finger. The level should be within 3/16-inch of the bottom of the plug hole.

3 If more oil is needed, use a syringe or small pump to add it through the opening.

4 Thread the plug back into the case and tighten it securely. Drive the vehicle, then check for leaks around the plug. Install the rock guard.

28 Fuel tank cap gasket replacement

1 This procedure applies to 1985 and later models only. Obtain a new gasket.

2 Remove the tank cap and carefully pry the old gasket out of the recess. Be very careful not to damage the sealing surface inside the cap.

3 Work the new gasket into the cap recess.

4 Install the cap, then remove it and make sure the gasket seals all the way around.

29 Clutch pedal free play check and adjustment

1 On vehicles equipped with a manual transmission, the clutch pedal height and free play must be correctly adjusted.

2 The height of the clutch pedal is the distance the pedal sits off the floor (measured from the center of the rubber pad). The distance should be as specified. If the pedal height is not within the specified range, loosen the locknut on the pedal stop and turn the stop in or out until the pedal height is correct. Retighten the locknut.

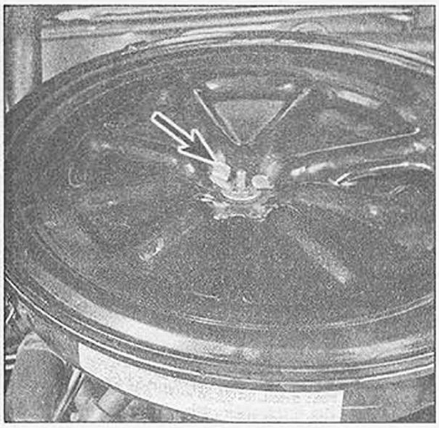
3 The free play is the pedal slack, or the distance the pedal can be depressed before it begins to have any effect on the clutch. The distance should be as specified. If it isn't, loosen the locknut on the clutch master cylinder pushrod, turn the pushrod until the free play is correct, then retighten the locknut.

30 Air filter replacement

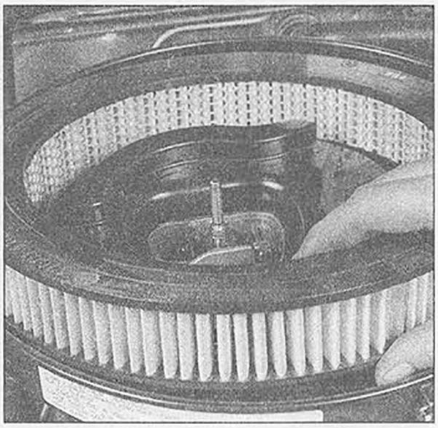
Carburetor equipped models

Refer to illustrations 30.3 and 30.4

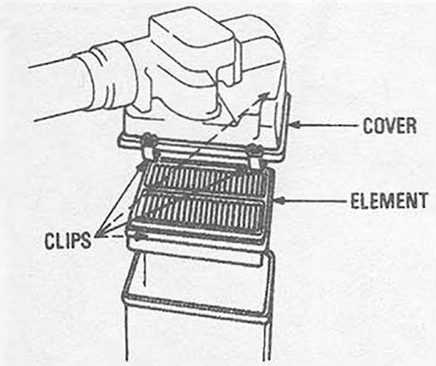
1 At the specified intervals, the air filter



30.3 Release the spring clips and remove the wing nut (arrow) to detach the air cleaner top plate . . .



30.4 . . . then lift out the filter element



30.8 On EFI (or **MPI)** equipped vehicles, **the air filter element can be removed after releasing the spring clips and pulling the housing cover up**

should be replaced with a new one. A thorough program of preventive maintenance would also call for the filter to be inspected periodically between changes, especially if the vehicle is often driven in dusty conditions.

2 The air filter is located inside the air cleaner housing, which is mounted on top of the carburetor or throttle body.

3 Remove the wing nut that holds the top plate.to the air cleaner body, release the clips and lift it off **(see illustration).**

4 Lift the air filter out of the housing **(see illustration).** If it's covered with dirt, it should be replaced.

5 Wipe the inside of the air cleaner housing with a rag.

6 Place the old filter (if in good condition) or the new filter (if replacement is necessary) into the air cleaner housing.

7 Reinstall the top plate on the air cleaner and make sure the arrow on the top plate is aligned with the arrow on the housing snorkel. Tighten the wing nut, then snap the clips into place.

Fuel injected models

Refer to illustration 30.8

8 The air filter case is located in the front corner of the engine compartment. Release the wire clips and carefully lift up on the cover to expose the filter element (see **illustration).**

9 Remove the filter and clean the seat area, then install the new filter. Make sure it's properly seated in the case.

10 Reposition the cover and fasten the clips to hold it in place.

31 PCV valve check and replacement

Refer to illustration 31.2

1 The PCV valve is usually located in the rocker arm cover.

2 With the engine idling at normal operating temperature, pull the valve (with hose attached) from the rubber grommet in the cover **(see illustration).**

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

4 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.

5 To replace the valve, release the clamp and pull it from the end of the hose, noting its installed position and direction.

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

7 Push the valve into the end of the hose until it's seated, then reposition the clamp.

8 Inspect the rubber grommet for damage and replace it with a new one if necessary.

9 Push the PCV valve and hose into the grommet until the valve is seated.

32 Fuel Evaporative Control (EVAP) system canister replacement

Note: *Refer to Chapter 6 for illustrations showing the EVAP system canister location(s).*

1 The function of **the** EVAP system is to draw fuel vapors from the tank and carburetor, store them in a charcoal canister and route them to the cylinders to be burned during normal engine operation. Depending on the vehicle year and model, more than one canister may be used (one for the fuel tank and one for the carburetor).

2 The canister(s) should be replaced at the specified intervals. However, if a fuel odor is detected, the canister(s) and system hoses should be inspected immediately.

3 Locate the canister(s) by tracing the lines from the carburetor and/or fuel tank.

4 Remove the canister(s) after disconnecting the hoses (mark the hoses and fittings to ensure correct installation).

5 Reinstall the canister(s) by reattaching the hoses.

6 The EVAP system is explained in more detail in Chapter 6.

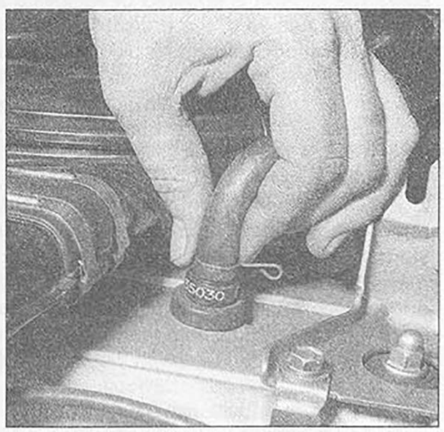
33 Spark plug replacement

Refer to illustrations 33.2, 33.Sa, 33.Sb, 33.6 and 33.10

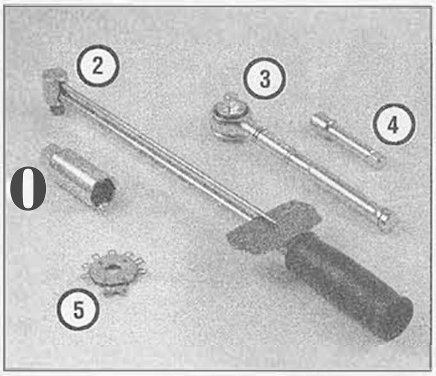
1 Replace the spark plugs with new ones at the intervals recommended in the *Routine maintenance schedule.*

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 gaps on the new plugs **(see illustration).** A special plug wire removal tool is available for separating the wire boots from the spark plugs, but it isn't absolutely necessary. A torque wrench should be used to tighten the new 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 them one at a time. When buying the new spark plugs, be sure to obtain the correct plug type for your particular engine. This



31.2 The PCV valve is located in the rocker arm cover



33.2 Tools required for changing spark plugs

1 ***Spark plug socket*** *- This will have special padding inside to protect the spark plug porcelain insulator*
2 ***Torque wrench*** *- Although not mandatory, use of this tool is the best way to ensure that the plugs are tightened properly*
3 ***Ratchet*** *- Standard hand tool to fit the plug socket*
4 ***Extension*** *- Depending on model and accessories, you may need special extensions and universal ioints 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*

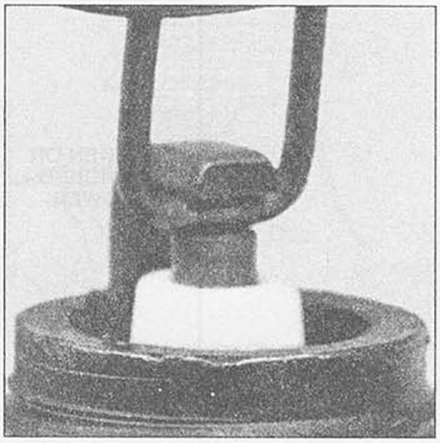
information can be found on the *Emission Control Information* label located under the hood and in the factory owner's manual. If differences exist between the plug specified on the emissions label and in the owner's manual, assume the emissions label is correct.

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

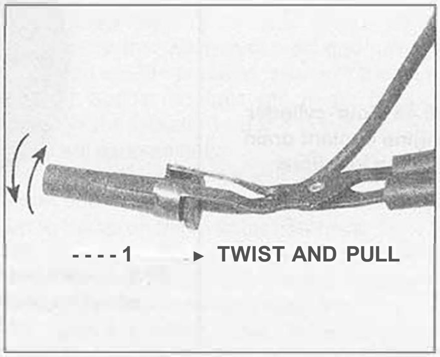
5 The gap is checked by inserting the proper thickness gauge between the electrodes at the tip of the plug **(see illustration).** The gap between the electrodes should be the same as the one specified on the *Emissions Control Information* label. The wire should just slide between the electrodes with 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 shouldn't be used).

6 With the engine cool, remove the spark plug wire from one spark plug. Pull only on the boot at the end of the wire - don't pull on the wire. A plug wire removal tool should be used if available **(see illustration).**

7 If compressed air is available, use it to



33.Sa Spark plug manufacturers recommend using a wire-type gauge when checking the gap - if the wire doesn't slide between the electrodes with a slight drag, adjustment is required



33.6 When removing the spark plug wires, grip the boot only and use a twisting/pulling motion

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.

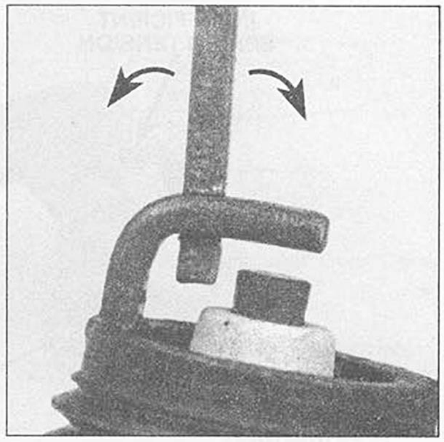
8 Place the spark plug socket over the plug and remove it fronn the engine by turning it in a counterclockwise direction.

9 Compare the spark plug to those shown in the photos on page 57 to get an indication of the general running condition of the engine.

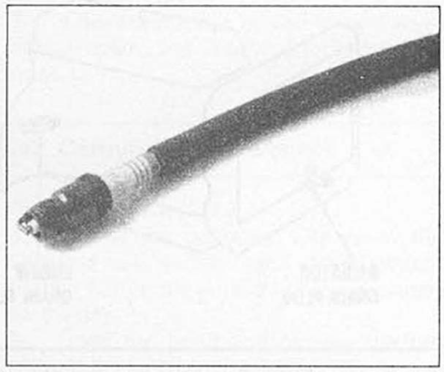
10 Thread one of the new plugs into the hole until you can no longer turn it with your fingers, then tighten it with a torque wrench (if available) or the ratchet. It might be a good idea to slip a short length of rubber hose over the end of the plug to use as a tool to thread it into place **(see illustration).** 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 the end of the plug, inspect it following the procedures outlined in Section 34.

12 Attach the plug wire to the new spark plug, again using a twisting motion on the



33.Sb 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



33.10 A length of 3/16-inch ID rubber hose will save time and prevent damaged threads when installing the spark plugs

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.

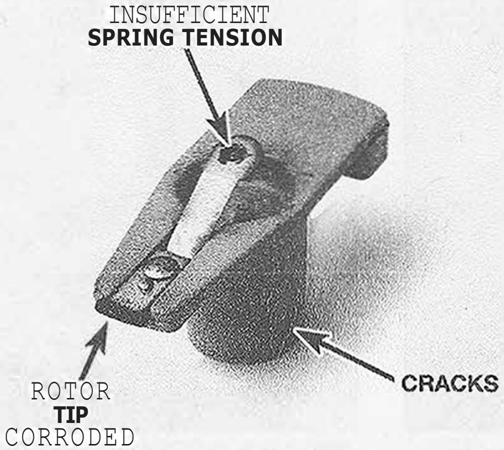
34 Spark plug wire check and replacement

1 The spark plug wires should be checked at the recommended intervals and whenever new spark plugs are installed in the engine.

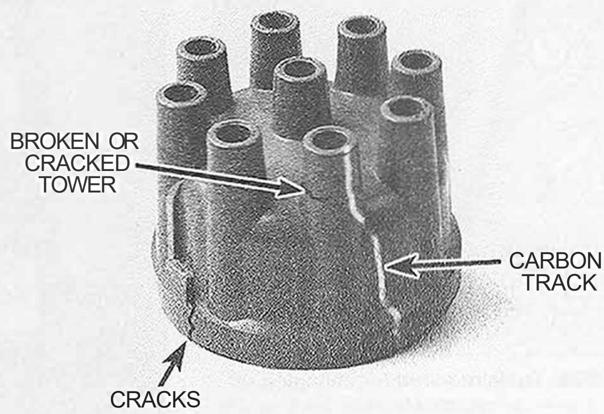
2 The wires should be inspected one at a time to prevent mixing up the order, which is essential for proper engine operation.

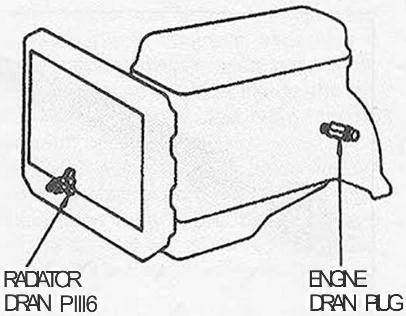
3 Disconnect the plug wire from one spark plug. To do this, grab the rubber boot, twist slightly and pull the wire free. Do not pull on the wire itself, only on the rubber boot **(see illustration 33.6).**

4 Check inside the boot for corrosion, which will look like a white crusty powder. Push the wire and boot back onto the end of the spark plug. It should be a tight fit on the plug. If it isn't, remove the wire and use a pair of pliers to carefully crimp the metal connec-

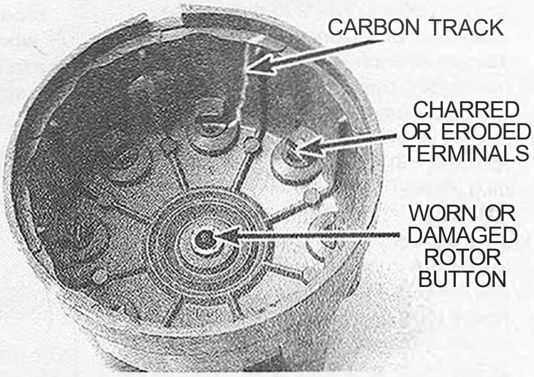


35.4 The ignition rotor should be checked for wear and corrosion as indicated here [If in doubt about its condition, buy a new one)





36.4a Four-cylinder engine coolant drain plug locations



35.6 Shown here are some of **the** common defects to look for when inspecting the distributor cap (if in doubt about its condition, buy a new one)

tor inside the boot until it fits securely on the end of the spark plug.

5 Using a clean rag, wipe the entire length of the wire to remove any built-up dirt and grease. Once the wire is clean, check for holes, burned areas, cracks and other damage. Don't bend the wire excessively or the conductor inside might break.

6 Disconnect the wire from the distributor cap (and plug, if still attached). Again, pull only on the rubber boot. Check for corrosion and a tight fit in the same manner as the spark plug end. Using an ohmmeter, check the resistance of the plug wire and compare it to the Specifications. If it's greater than specified, replace the wire with a new one (it would be a good idea to replace all of the wires, even if only one is bad).

7 Check the remaining spark plug wires one at a time, making sure they are securely fastened at the distributor and the spark plug when the check is complete.

8 If new spark plug wires are required, purchase a new set for your specific engine model. Wire sets are available pre-cut, with the rubber boots already installed. Remove and replace the wires one at a time to *avoid* mix-ups in the firing order. The wire routing is extremely important, so be sure to note exactly how each wire is situated before removing it.

35 Distributor cap and rotor check and replacement

Refer to illustrations 35.4 and 35.6

Note: *It's common practice to install a new distributor cap and rotor whenever new spark plug wires are installed.*

1 Although the breakerless distributor used on these vehicles requires much less maintenance than a conventional distributor, periodic inspections should be performed at the intervals specified in the routine maintenance schedule and whenever any work is performed on the distributor.

2 Disconnect the ignition coil wire from the coil, then loosen the screws that hold the cap to the distributor body. Detach the distributor cap and wires.

3 Place the cap, with the spark plug and coil wires still attached, out of the way. Use a length of wire or rope to secure it, if necessary.

4 The rotor is now visible on the end of the distributor shaft. Check it carefully for cracks and carbon tracks. Make sure the center terminal spring tension is adequate and look for corrosion and wear on the rotor tip **(see illustration).** If in doubt about its condition, replace it with a new one.

5 If replacement is required, detach the rotor from the shaft and install a new one. The rotor is indexed to the shaft so it can only be installed one way.

6 Check the distributor cap for carbon tracks, cracks and other damage. Closely examine the terminals on the inside of the cap for excessive corrosion and damage **(see illustration).** Slight deposits are normal. Again, if in doubt about the condition of the cap, replace it with a new one. Apply a small dab of silicone lubricant to each terminal before installing the cap. Also, make sure the carbon brush (center terminal) is correctly installed in the cap - a wide gap between the brush and rotor will result in rotor burn-through and/or damage to the distributor cap.

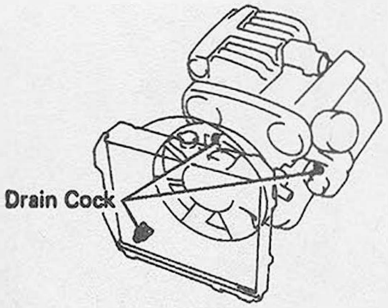
7 When replacing the cap, simply transfer the spark plug and coil wires, one at a time, from the old cap to the new cap. Be very careful not to mix up the wires!

8 Reattach the cap to the distributor, then tighten the screws.

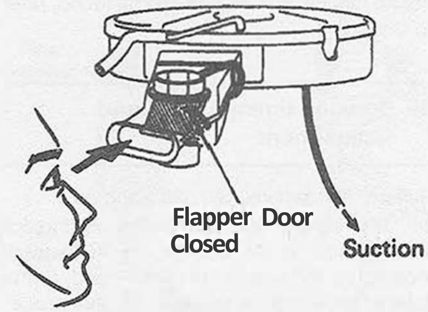
36 Cooling system servicing (draining, flushing and refilling)

Refer to illustrations 36.4a and 36.4b

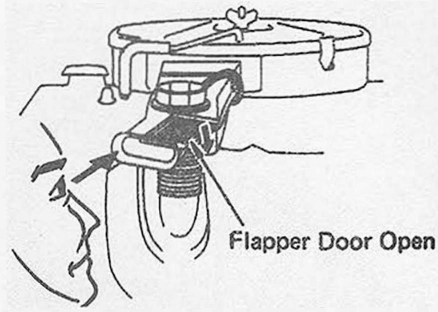
Warning: *Antifreeze is a corrosive and poisonous solution, so be careful not to spill any of the coolant mixture on the vehicle's paint or your skin. If you do, rinse it off immediately with plenty of clean water. Consult local*



36.4b V6 engine coolant drain plug locations



37.4 Position of the thermostatically controlled flapper door with the engine cold



37.6 Position of the thermostatically controlled flapper door with the engine **at** normal operating temperature

authorities regarding proper disposal of antifreeze before draining the cooling system. *In many* areas, *reclamation centers have been established to collect used oil and coolant mixtures.*

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. When the cooling system is serviced, all hoses and the radiator cap should be checked and replaced if necessary.

2 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.

3 Once the engine is completely cool, remove the radiator cap. Place the heater temperature control in the maximum heat position.

4 Move a large container under the radiator drain to catch the coolant, then unscrew the drain plug (a pair of pliers may be required to turn it) (see **illustrations).**

5 After the coolant stops flowing out of the radiator, *move* the container under the engine block drain plug (see **illustrations** 36.4a **and 36.4b).** Remove the plug{s) and allow the coolant in the block to drain.

6 While the coolant is draining, check the condition of the radiator hoses, heater hoses and clamps {refer to Section 11 if necessary).

7 Replace any damaged clamps or hoses.

8 Once the system is completely drained, flush the radiator with fresh water from a garden hose until it runs clear at the drain. The flushing action of the water will remove sediments from the radiator but will not remove rust and scale from the engine and cooling tube surfaces.

9 These deposits can be *removed* with a chemical cleaner. Follow the procedure outlined in the manufacturer's instructions. If the radiator is severely corroded, damaged or leaking, it should be removed (Chapter 3) and taken to a radiator repair shop.

10 Remove the overflow hose from the coolant recovery reservoir. Drain the reservoir and flush it with clean water, then reconnect the hose.

11 Reinstall and tighten the radiator drain plug. Install and tighten the block drain plug(s).

12 slowly add new coolant (a 50/50 mixture of water and antifreeze) to the radiator until it's full. Add coolant to the reservoir up to the lower mark.

13 Leave the radiator cap 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).

14 Turn the engine off and let it cool. Add more coolant mixture to bring the level back up to the lip on the radiator filler neck.

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

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

37 Thermostatic air cleaner check

Refer to illustrations 37.4 and 37.6

1 All models are equipped with a thermostatically controlled air cleaner, which draws air to the carburetor from different locations depending on engine temperature.

2 This is a simple visual check. However, if access is tight, a small mirror may have to be used.

3 Open the hood and find the air control valve {flapper door) in the air cleaner assembly. It's located inside the long snorkel portion of the air cleaner housing.

4 If there's a flexible air duct attached to the end of the snorkel, disconnect it so you can look through the end of the snorkel and see the flapper door inside **{see illustration).** A mirror may be needed if you can't safely look directly into the end of the snorkel.

5 The check should be done when the engine and outside air are cold. Start the engine and watch the flapper door, which should move up and close off the snorkel air passage. With the door closed, air can't enter through the end of the snorkel, but instead enters the air cleaner through the hot air duct attached to the exhaust manifold.

6 As the engine warms up to operating temperature, the door should open to allow air through the snorkel end (see illustration). Depending on outside air temperature, this may take 10 to 15 minutes. To speed up the check you can reconnect the snorkel air duct, drive the vehicle and then check ihe position of the flapper door.

7 If the thermostatic air cleaner isn't operating properly, see Chapter 6 for more information.

38 Carburetor choke check

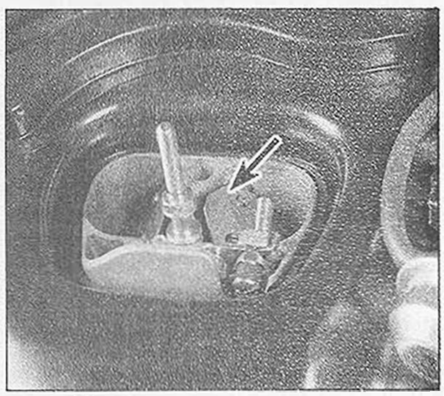
Refer to illustration 38.3

1 The choke operates only when the engine is cold, so this check should be performed before the engine has been started for the day.

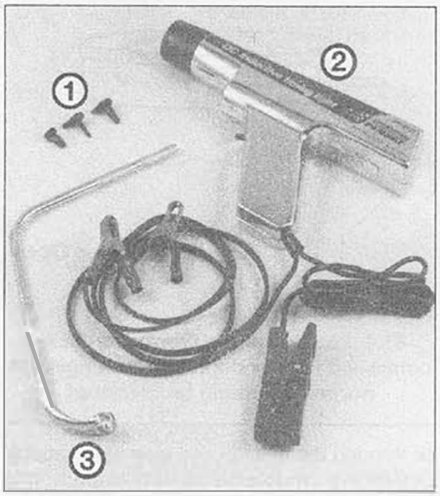
2 Open the hood and *remove* the top plate of the air cleaner assembly. It's held in place by a wing nut (or nuts) at the center and several spring clips around the edge. If any vacuum hoses must be disconnected, tag them to ensure reinstallation in their original positions.

3 Look at the center of the air cleaner housing. You'll notice a flat plate at the carburetor opening **{see illustration).**

4 Have an assistant press the throttle pedal to the floor. The plate should close completely. Start the engine while you watch the plate at the carburetor. Don't position your face near the carburetor, as the engine



38.3 The carburetor choke plate (arrow) is visible after removing the air cleaner top plate



39.1 Tools needed to check and adjust the ignition timing

1 **Vacuum plugs** - *Vacuum hoses will, in most 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*

could backfire, causing serious burns! When the engine starts, the choke plate should open slightly.

5 Allow the engine to continue running at an idle speed. As the engine warms up to operating temperature, the plate should slowly open, allowing more air to enter through the top of the carburetor.

6 After a few minutes, the choke plate should be completely open to the vertical position. Blip the throttle to make sure the fast idle cam disengages.

7 You'll notice that engine speed corresponds to the plate opening. With the plate closed, the engine should run at a fast idle speed. As the plate opens and the throttle is moved to disengage the fast idle cam, the engine speed will decrease.

8 With the engine off and the throttle held half-way open, open and close the choke several times. Check the linkage to see if it's hooked up correctly and make sure it doesn't bind.

9 If the choke or linkage binds, sticks or works sluggishly, clean it with choke cleaner (an aerosol spray available at auto parts stores). If the condition persists after cleaning, replace the troublesome parts.

10 Visually inspect all vacuum hoses to be sure they're securely connected and look for cracks and deterioration. Replace as necessary.

11 If the choke fails to operate normally, but no mechanical causes can be found, refer to Chapter 4.

39 Ignition timing check and adjustment

Refer to illustrations 39.1, 39.2 and 39.6

1 The proper ignition timing setting for your vehicle is printed on the VECI label located on the underside of the hood. Some special tools will be required for this procedure (see illustration).

2 Locate the timing plate on the front of the engine, near the crankshaft pulley **(see illustration).** The O mark is Top Dead Center (TDC). To locate which mark the notch in the pulley must line up with for the timing to be correct, count back from the O mark the number of degrees BTDC (Before Top Dead Center) noted on the VECI label.

3 Locate the timing notch in the pulley and mark it with a dab of paint or chalk so it'll be visible under the strobe light. To locate the notch it may be necessary to have an assistant temporarily turn the ignition off and on in short bursts to turn the crankshaft. **Warning:** *Stay clear of all moving engine components if the engine is turned in this manner!*

4 Before attempting to check/adjust the timing, make sure the air gap is correct (Chapter 5).

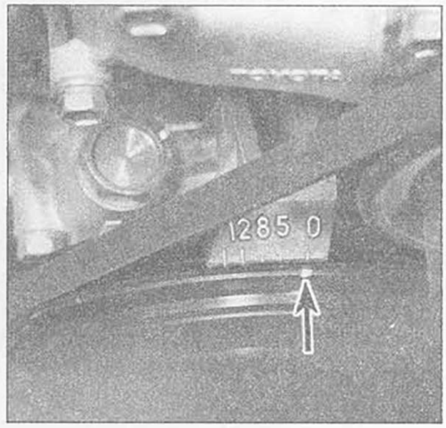
5 Connect a tachometer according to the manufacturer's instructions and make sure the idle speed is correct. Adjust it if necessary as described in Section 17. **Note:** *The tachometer may be connected to the Ig terminal of the check connector* (see illustration **39.6)**

6 Allow the engine to reach normal operating temperature. Be sure the air conditioner, if equipped, is off. On some models, as noted on the VECI label, you must disconnect the distributor vacuum advance hose and plug it or connect a jumper wire between terminals TE1 and E1 of the check connector **(see illustration).**

7 With the ignition switch off, connect the pick-up lead of the timing light to the number one spark plug wire. On four-cylinder engines, it's the front one. On V engines it's the first spark plug on the right side as viewed from the driver's seat. Use either a jumper lead between the wire and plug or an inductive-type pick up. Don't pierce the wire or attempt to insert a wire between the boot and plug wire. Connect the timing light power leads according to the manufacturer's instructions.

8 Make sure the wiring for the timing light is clear of all moving engine components, then start the engine. Race the engine two or three times, then allow it to idle for a minute.

9 Point the flashing timing light at the timing marks, again being careful not to come in contact with moving parts. The marks you highlighted should appear stationary. If the marks are in alignment, the timing is correct. If the marks aren't aligned, turn off the engine.



39.2 The timing plate and pulley notch (arrow) are located low on the front of the engine - be careful of moving engine parts when checking the timing!

10 Loosen the distributor locknut until the distributor can be rotated.

11 Start the engine and slowly rotate the distributor until the timing marks are aligned.

12 Shut off the engine and tighten the distributor locknut, being careful not to move the distributor.

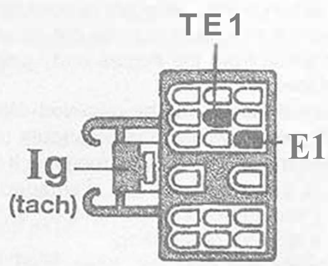
13 Restart the engine and recheck the timing to make sure the marks are still in alignment.

14 Disconnect the timing light.

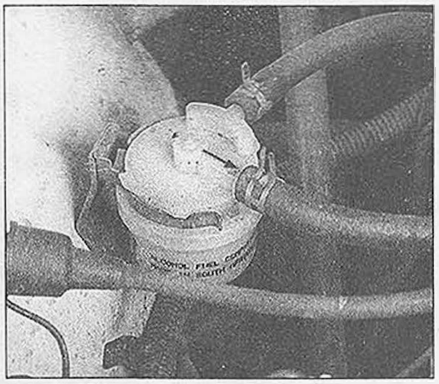
15 Race the engine two or three times, then allow it to run at idle. Recheck the idle speed with the tachometer. If it has changed from the correct setting readjust it.

16 Drive the vehicle and listen for "pinging" noises. They'll be noticeable when the engine is hot and under load (climbing a hill, accelerating from a stop). If you hear engine pinging, the ignition timing is too far advanced (Before Top Dead Center). Reconnect the timing light and turn the distributor to move the mark 1-degree or 2-degrees in the retard direction (clockwise). Road test the vehicle again to check for proper operation.

17 To keep "pinging" at a minimum, yet still allow you to operate the vehicle at the specified timing setting, use gasoline of the same octane at all times. Switching fuel brands and octane levels can decrease performance and economy, and possibly damage the engine.



39.6 Connect a jumper **wire** between terminals TE1 and E1 before checking or adjusting timing on later models



40.5 The arrow on the fuel filter indicates the outlet side (carburetor equipped models)

40 Fuel filter replacement

Warning: *Gasoline is extremely flammable, so extra safety precautions must be observed when working on the fuel system. DO NOT smoke or allow open flames or bare light bulbs near the vehicle. Also, don't perform fuel system maintenance procedures in a garage where a natural gas type appliance, such as a water heater or clothes dryer, is present.*

1 This job should be done with the engine cold {after sitting at least three hours). Place a metal container, rags or newspapers under the filter to catch spilled fuel.

Carburetor equipped models

Refer to illustration 40.5

2 The fuel filter is located under the vehicle, near the gas tank or in the engine compartment. If the vehicle must be raised to change the filter, be sure to support it safely on jackstands!

3 To replace the filter, release the clamps and slide them down the hoses, past the fittings on the filter.

4 Carefully twist and pull on the hoses to separate them from the filter. If the hoses are in bad shape, now would be a good time to replace them with new ones. Slide off the old clamps and install new ones.

5 Pull the filter out of the clip and install the new one, then hook up the hoses and reposition the clamps. Note that the arrow on the filter must point in the direction of fuel flow (toward the carburetor) **(see illustration)**. Start the engine and check carefully for leaks at the filter hose connections.

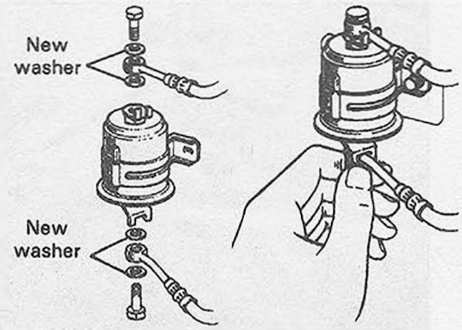
Fuel injected models

Refer to illustration 40.6

Warning: *Refer to Chapter 4 and depressurize the fuel system before removing the filter!*

Note: *On four-cylinder models, the fuel filter is located under the intake manifold. Starter removal may be required to access the filter (see Chapter 5). On V6 fuel injected engines, the fuel filter is located on the passenger's side frame rail.*

6 Loosen the banjo bolts on both ends of



40.6 EFI fuel filter mounting details - always tighten the banjo bolts by hand before using a wrench

the fuel filter (see **illustration)** with a flare nut wrench. Disconnect both lines.

7 Remove both bracket bolts and detach the old filter and the filter support bracket.

8 Remove the filter clamp bolt and separate the old filter from the bracket. Note that the inlet and outlet lines are clearly labeled and that the flanged end of the filter faces down.

9 Install the new filter and bracket assembly and tighten the bracket bolts securely. Make sure that the new filter is installed flanged *end* down.

10 Using the new crush washers - two per banjo fitting - provided by the filter manufacturer, install the inlet and outlet banjo bolts and tighten them to the specified torque.

11 The remainder of installation is the reyerse of the removal procedure.

41 Manual transmission oil change

Refer to illustration 41.3

1 *Drive* the vehicle for a few miles to thoroughly warm up the transmission oil.

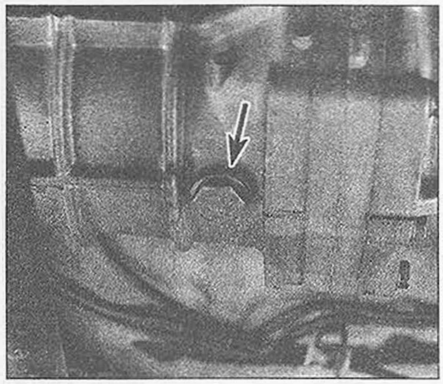
2 Raise the vehicle and support it securely on jackstands.

3 *Move* a drain pan, rags, newspapers and a wrench under the vehicle. With the drain pan and newspapers in position under the transmission, use the wrench to remove the check/fill plug from the side of the transmission **(see illustration 25.1).** Loosen the drain plug located in the bottom of the transmission case **(see illustration).**

4 Once loosened, carefully unscrew it with your fingers until you can remove it from the transmission. Allow all of the oil to drain into the pan. If the plug is too hot to touch, use the wrench to *remove* it.

5 If the transmissior:i is equipped with a magnetic drain plug, see if there are bits of metal clinging to it. If there are, it's a sign of excessive internal wear, indicating that the transmission should be carefully inspected in the near future. If the transmission isn't equipped with a magnetic drain plug, allow the oil in the pan to cool, then feel with your hands along the bottom of the drain pan for debris.

6 Clean the drain plug, then reinstall it in the transmission and tighten it securely.



41.3 The manual transmission drain plug is located at the bottom of the case (arrow)

7 Using a hand pump or syringe, fill the transmission with the correct amount and grade of oil (see Specifications), until the level is just at the bottom of the plug hole (see Section 25).

8 Reinstall the check/fill plug and tighten it securely.

42 Automatic transmission fluid change

Refer to illustrations 42.5, 42.6, 42.7 and 42.8

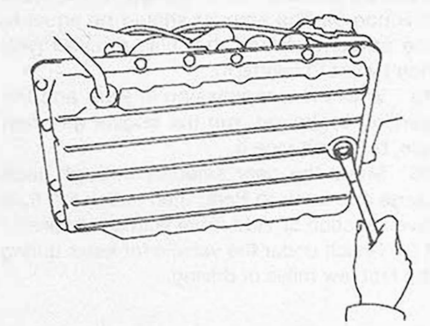
1 At the specified time intervals, the transmission fluid should be drained and replaced and a new filter installed. Since the fluid should be hot when it's drained, drive the vehicle for 15 or 20 minutes before proceeding.

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

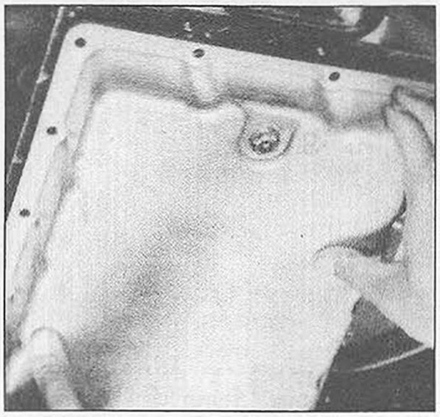
3 Other tools necessary for this job include jackstands to support the vehicle in a raised position, a drain pan capable of holding at least eight pints, newspapers and clean rags.

4 Raise the vehicle and support it securely on jackstands.

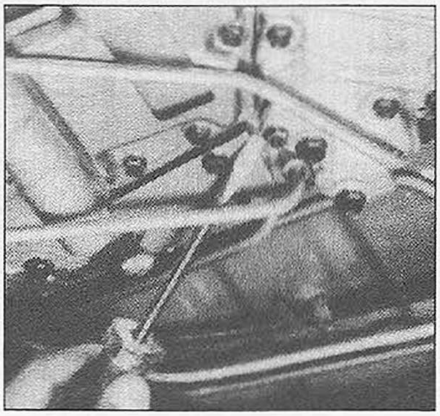
5 With a drain pan in place, remove the



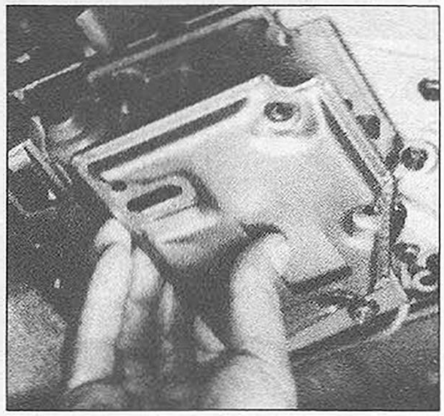
42.5 The automatic transmission fluid can be drained by removing the plug from the pan



42.6 Lower the pan carefully - it'll still have some fluid in it



42.7 Use a screwdriver to carefully pry the tubes loose



42.8 The filter is held in place with several bolts

plug and let the fluid drain into the pan **(see illustration)** Be careful not to burn yourself on anything- it may be wise to wear gloves.

6 Remove the bolts and detach the transmission pan and filler tube **(see illustration).** Discard the gasket. If the pan must be pried off, be very careful not to distort the pan or damage the transmission gasket surface!

7 Carefully pry the tubes loose with a screwdriver **(see illustration).**

8 Remove the bolts and detach the filter/strainer from the transmission **(see illustration).**

9 Install the new filter/strainer and tighten the bolts securely, then press the tubes into place very carefully by hand only.

10 Carefully clean the gasket surface of the transmission to remove all traces of the old gasket and sealant.

11 Drain the fluid from the transmission pan, clean it with solvent and dry it with compressed air.

12 Apply a thin layer of RTV sealant to the transmission case side of the new gasket.

13 Make sure the gasket surface on the transmission pan is clean, then apply a thin layer of RTV sealant to it and position the new gasket on the pan. Put the pan in place against the transmission, install the bolts and, working around the pan, tighten each bolt a little at a time until the final torque figure is reached.

14 Lower the vehicle and add new automatic transmission fluid through the filler tube (Section 5). The amount should be equal to the amount of fluid that was drained (you don't want to overfill it).

15 With the transmission in Park and the parking brake set, run the engine at a fast idle, but don't race it.

16 Move the gear selector through each range and back to Park, then check the fluid level (Section 5). Add more fluid as required.

17 Check under the vehicle for leaks during the first few miles of driving.

43 Differential oil change

Note: *The following procedure can be used for the rear differential as well as the front differential on 4WD vehicles.*

1 Drive the vehicle for several miles to warm up the differential oil, then raise the vehicle and su.pport it securely on jackstands.

2 Move a drain pan, rags, newspapers and a wrench under the vehicle.

3 With the drain pan under the differential, use the wrench to loosen the drain plug. It's the lower of the two plugs **(see illustration 26.2).**

4 Once loosened, carefully unscrew it with your fingers until you can remove it from the case.

5 Allow all of the oil to drain into the pan, then replace the drain plug and tighten it securely.

6 Feel with your hands along the bottom of the drain pan for any metal bits that may have come out with the oil. If there are any, it's a sign of excessive wear, indicating that the internal components should be carefully inspected in the near future.

7 Remove the differential check/fill plug (see Section 26). Using a hand pump, syringe or funnel, fill the differential with the correct amount and grade of oil (see the Specifications) until the level is just at the bottom of the plug hole.

8 Reinstall the plug and tighten it securely.

9 Lower the vehicle. Check for leaks at the drain plug after the first few miles of driving.

44 Transfer case oil change

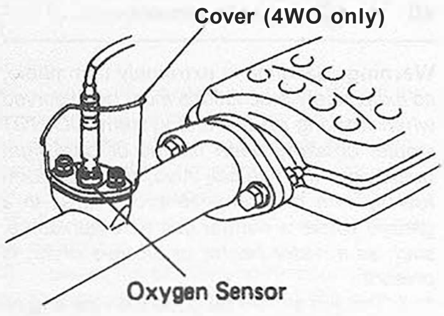
1 Drive the vehicle for at least 15 minutes in 4WD to warm up the oil in the case.

2 Raise the vehicle and support it securely on jackstands. Remove the rock guard (if equipped).

3 Move a drain pan, rags, newspapers and a breaker bar or ratchet (to fit the square drive hole in the transfer case drain plug) under the vehicle.

4 Remove the check/fill plug **(see illustration 27.1).**

5 Remove the drain plug from the lower part of the case and allow the old oil to drain completely.



45.2 Typical oxygen sensor mounting details

6 Carefully clean and install the drain plug after the case is completely drained. Tighten the plug securely.

7 Fill the case with the specified lubricant until it's level with the lower edge of the filler hole.

8 Install the check/fill plug and tighten it securely.

9 Install the rock guard, then lower the vehicle.

10 Check carefully for leaks around the drain plug after the first few miles of driving.

45 Oxygen sensor replacement

Refer to illustration 45.2

1 The oxygen (exhaust gas) sensor (Federal model fuel injected four-cylinder engines) should be replaced at the specified intervals.

2 The sensor is mounted in the exhaust manifold and can be identified by the wires attached to it **(see illustration).** Replacement consists of disconnecting the wire harness and removing the mounting nuts. Detach the old sensor (and gasket), position the new one over the studs, along with a new gasket, then install the mounting nuts. Tighten the nuts to the specified torque, then reconnect the wire harness.

3 The sensor operation/feedback control should be checked by a dealer service department.

Chapter 2 Part A
Four-cylinder engines

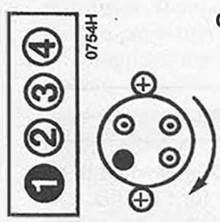
Contents

	Section
Camshaft and bearings - inspection	11
Camshaft - removal and installation	10
Crankshaft pulley - removal and installation	13
Cylinder compression check	See Chapter 2C
Cylinder head - installation	12
Cylinder head - removal	9
Drivebelt check, adjustment and replacement	See Chapter 1
Engine mounts - replacement	21
Engine oil and filter change	See Chapter 1
Engine overhaul - general information	See Chapter 2C
Engine - removal and installation	See Chapter 2C
Exhaust manifold - removal and installation	6
Flywheel/driveplate - removal and installation	19
Front crankshaft oil seal - replacement	14
General information	1
Intake manifold - removal and installation	5
Oil pan - removal and installation	17
Oil pump and pick-up tube - removal, inspection and installation	18
Pilot bearing - inspection, removal and installation	See Chapter 8
Rear crankshaft oil seal - replacement	20
Repair operations possible with the engine in the vehicle	2
Rocker arm assembly - inspection	8
Rocker arm assembly - removal and installation	7
Rocker arm cover - removal and installation	4
Spark plug replacement	See Chapter 1
Timing chain and sprockets - removal, inspection and installation	16
Timing chain cover - removal and installation	15
Top Dead Center (TDC) for number one piston - locating	3
Valves servicing	See Chapter 2C
Water pump - removal and installation	See Chapter 3

Specifications

General

Cylinder numbers (front-to-rear)	1-2-3-4
Firing order	1-3-4-2



Cylinder location and distributor rotation

The blackened terminal shown on the distributor cap indicates the Number One spark plug wire position

Manifold warpage limits

Intake	0.008 in (0.2 mm)
Exhaust	0.028 in (0.7 mm)

Rocker arm assembly

Rocker arm-to-shaft (oil) clearance	
Standard	0.0004 to 0.0020 in (0.01 to 0.05 mm)
Service limit	0.0031 in (0.08 mm)

Camshaft

End play	
Standard	0.0031 to 0.0071 in (0.08 to 0.18 mm)
Service limit	0.0098 in (0.25 mm)
Bearing journal diameter	1.2984 to 1.2992 in (32.98 to 33.00 mm)
Bearing oil clearance	
Standard	0.0004 to 0.0020 in (0.01 to 0.05 mm)
Service limit	0.004 in (0.1 mm)
Runout limit	0.008 in (0.2 mm)
Lobe height	
Intake	1.6783 to 1.6819 in (42.63 to 42.72 mm)
Exhaust	1.6807 to 1.6842 in (42.69 to 42.78 mm)

Timing chain and sprockets

Length (1 7 links)	5.787 in (147 mm) maximum
Minimum sprocket diameters (with chain meshed in teeth)	
Camshaft sprocket	4.480 in (113.8 mm)
Crankshaft sprocket	2:339 in (59.4 mm)
Minimum tensioner slipper thickness	0.433 in (11.0 mm)
Minimum damper thickness **{see illustration 16.11}**	
No. 1	0.197 in (5.0 mm)
No. 2	0.177 in (4.5 mm)

Oil pump

Driven gear-to-oil pump body clearance	
Standard	0.0035 to 0.0059 in (0.09 to 0.15 mm)
Service limit	0.008 in (0.2 mm)
Driven gear-to-crescent clearance	
Standard	0.0059 to 0.0083 in (0.15 to 0.21 mm)
Service limit	0.012 in (0.3 mm)
Drive gear-to-crescent clearance	
Standard	0.0087 to 0.0098 in (0.22 to 0.25 mm)
Service limit	0.012 in (0.3 mm)
Gear side clearance	
Standard	0.0012 to 0.0035 in (0.03 to 0.09 mm)
Service limit	0.0059 in (0.15 mm)

Torque specifications

	Ft-lbs
Intake manifold bolts/nuts	14
Exhaust manifold bolts/nuts	33
Camshaft bearing cap bolts	14
Cylinder head bolts	58
Camshaft sprocket bolt	58
Crankshaft pulley bolt	116
Timing chain cover bolts	
8mm	9
10mm	29
Oil pan bolts	
1979 through 1984	4.5
1985on	9
Oil pump mounting bolts (see illustration 18.17)	
Bolt A	18
Bolt B	14
Bolt C	9
Oil pick-up tube mounting bolts	9
Flywheel/driveplate mounting bolts	80

1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the 20R, 22R and 22R-E four-cylinder engines. Information concerning engine removal and installation, as well as engine block and cylinder head overhaul, is 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 included in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the engines and procedures in this Part. The Specifications necessary for rebuilding the block and cylinder head are found in Part C.

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 pressure washer before any work is done. It'll make the job easier and help keep dirt out of the internal areas of the engine.

Remove the hood to improve access to the engine as repairs are performed (refer to Chapter 12 if necessary).

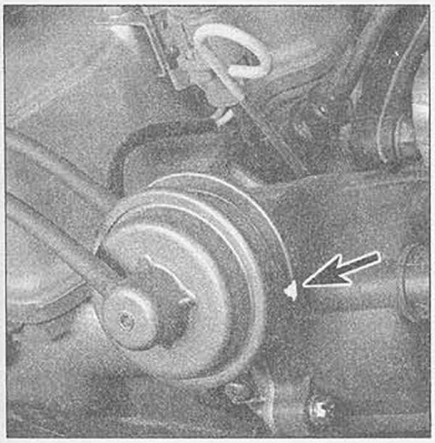
If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The oil pan gasket. cylinder head gasket, intake and exhaust manifold gaskets, timing chain cover gaskets and the crankshaft oil seals are accessible with the engine in place.

Exterior engine components, such as the water pump, the starter motor, the alternator, the distributor and the fuel system components, as well as the intake and exhaust manifolds, can be removed for repair with the engine in place.

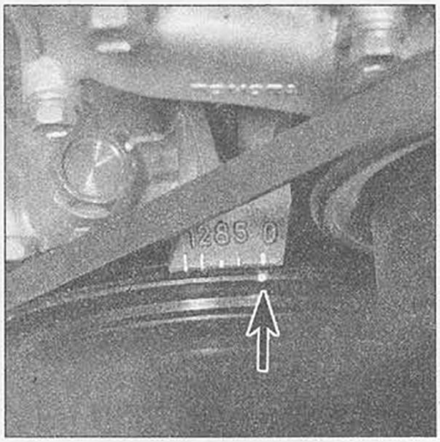
Since the cylinder head can be removed without pulling the engine, camshaft and valve component servicing can also be accomplished with the engine in the vehicle.

Replacement of, repairs to or inspection of the timing chain and sprockets and the oil pump are all possible with the engine in place.

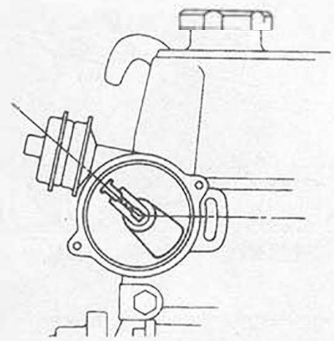
In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is possible with the engine in the vehicle. However, this practice is not recommended because of the cleaning and preparation work that must be done to the components involved.



3.4 Make a mark on the distributor directly below the number one spark plug wire terminal on the cap (arrow) . . .



3.5 . . . then align the notch in the crankshaft pulley **with** the O(zero) on the **timing plate . . .**



3.6 . . . and see if the rotor is pointing at the mark on the distributor - if it is, the number one piston is at TDC on the compression stroke

3 Top Dead Center (TDC) for number one piston - locating

Refer to illustrations 3.4, 3.5 and 3.6

1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up-and-down when 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. The timing marks on the pulley installed on the front of the crankshaft are referenced to the number one piston at TDC on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as camshaft and timing chain/sprocket removal and distributor removal.

3 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. **Warning:** *Before beginning this procedure, be sure to place the transmission in Neutral. Also, detach the coil wire from the center terminal of the distributor cap and ground in on the block with a jumper wire.*

- *a) The preferred method is to turn the crankshaft with a large socket and breaker bar attached to the crankshaft pulley hub bolt threaded into the front of the crankshaft.*
- *b) A remote starter switch, which may save some time, can also be used. Attach the switch leads to the solenoid terminals. Once the piston is close to TDC, use a socket and breaker bar 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. Use a socket and breaker bar as described in Paragraph a) to complete the procedure.*

4 Note the position of the terminal for the number one spark plug wire on the distributor cap. Use a felt-tip pen or chalk to make a mark on the distributor directly under the terminal **(see illustration).** Detach the cap from the distributor and set it aside.

5 Turn the crankshaft (see Paragraph 3 above) until the notch in the crankshaft pulley is aligned with the O on the timing plate (located at the front of the engine) (see illus**tration).**

6 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 terminal for the number four spark plug, the number one piston is at TDC on the exhaust stroke.

7 To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360°) 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 ignition timing marks are aligned, the number one piston is at TDC on the compression stroke.

8 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 180° at a time and following the firing order.

4 Rocker arm cover - removal and installation

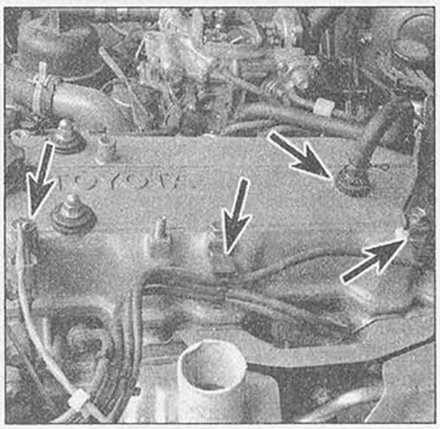
Refer to illustrations 4.3a and 4.3b

1 On carburetor equipped vehicles, remove the air cleaner (Chapter 4). Disconnect the negative battery cable from the battery.

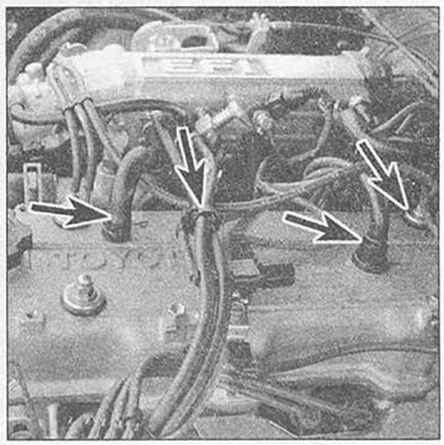
2 Remove the spark plug wire supports from the rocker arm cover. Don't disconnect the wires from the supports.

3 Label and disconnect all vacuum hoses, wires and PCV hoses attached to the rocker arm cover. Remove the bolts and detach the throttle cable bracket **(see illustrations).**

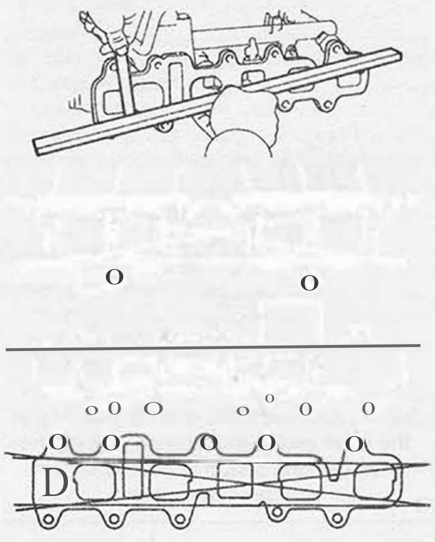
4 Remove the rocker arm cover mounting bolts.



4.3a Detach the PCV hose, spark plug wire holders, ignition system primary wire and throttle cable bracket (arrows) before attempting to remove the rocker arm cover



4.3b On fuel injected models, remove the vacuum and breather hoses as well (arrows)



5.9 Use a straightedge and feeler gauges to check the intake manifold for warpage - make the check lengthwise and diagonally

5 Detach the rocker arm cover. Caution: *If the cover is stuck to the head, bump the end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur, leading to oil leaks in the future.*

6 The mating surfaces of the head and rocker arm cover must be perfectly 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 sealant or oil on the mating surfaces when the cover is installed, oil leaks may develop.

7 Apply a thin, uniform layer of sealant to the head mating surface of the cover and the surface of the new gasket that will be against the head.

8 Place the new gasket in position with the sealant against the cylinder head, then place the rocker arm cover on the gasket. While the sealant is still wet, install the mounting bolts and tighten them securely. Use new rubber seals on the bolts.

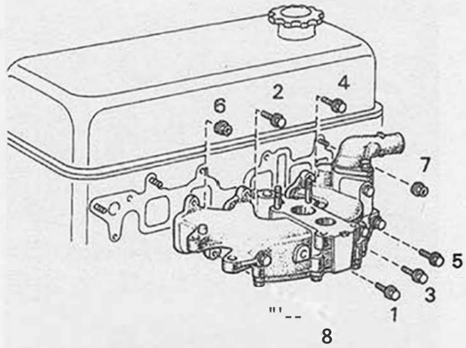
9 Complete the installation by reversing the removal procedure.

5 Intake manifold - removal and installation

Refer to illustrations 5.9 and 5.12

Removal

1 Refer to Chapter 4 and relieve the fuel system pressure, then remove the throttle body and plenum (fuel injected vehicles only). The carburetor does not have to be removed



5.12 Intake manifold bolt TIGHTENING sequence

from the manifold.

2 Disconnect the cable from the negative terminal of the battery.

3 Drain the cooling system (refer to Chapter 1), then detach the upper radiator hose.

4 Loosen the clamp on the air injection check valve (see Chapter 6). Remove the EGA valve and vacuum modulator (see Chapter 6).

5 Label and detach all hoses and **wires** attached to the manifold and/or carburetor. Don't forget the throttle cable.

6 Remove the bolts and nuts that attach the manifold to the head. Start at the ends and work toward the middle, loosening each one a little at a time until they can be removed.

7 Move the manifold up and down to break the gasket seal, then detach it from the head.

Installation

Note: *The mating surfaces of the cylinder head and manifold must be perfectly clean when the manifold is installed. Gasket removal solvents in aerosol cans are available at most auto parts stores and may be helpful when removing old gasket material that's stuck to the head and manifold (since they're made of aluminum, aggressive scraping can cause damage). Be sure to follow the directions printed on the container.*

8 Use a gasket scraper to remove all traces of sealant and old gasket material, then clean the surfaces with lacquer thinner or acetone. If there is old sealant or oil on the mating surfaces when the manifold is installed, vacuum leaks may develop.

9 Check the manifold-to-cylinder head gasket surface for warpage. Lay a straightedge along the manifold and try to slip a feeler gauge between the manifold and the straightedge at each runner **(see illustration).** If the manifold is warped beyond the specified limit, it must be resurfaced or replaced with a new one.

10 Check the manifold for corrosion (at the coolant passages), cracks and other damage. If defects are found, have the manifold repaired or replaced as necessary. If a new manifold is installed, transfer all brackets and fittings to the new one. Be sure to use **a new** thermostat (Chapter 3).

11 Use a tap of the correct size to chase the threads in the bolt holes, then use compressed air (if available) to remove the debris from the holes. **Warning:** *Wear safety glasses or a face shield to protect your eyes when using compressed air! Clean the stud threads with a die.*

12 Apply a thin, uniform layer of RTV sealant to the manifold mating surfaces and the cylinder head side of the gasket. Slip one bolt into place at each end of the manifold, hang the new gasket over the bolts, then position the manifold on the head and thread the bolts into place. Install the remaining bolts/nuts, then tighten them to the specified torque in the recommended sequence **(see** illustration). Work up to the final torque in three steps.

13 The rest of installation is the reverse of removal.

6 Exhaust manifold - removal and installation

Refer to illustrations 6.6, 6.7 and 6.11

Note: *This procedure applies to non-turbo models only. For turbo model information, refer to Chapter 4.*

1 Make sure the engine is completely cool before beginning this procedure.

2 Refer to Chapter 4 and remove the air cleaner assembly (carburetor equipped vehicles only).

3 Raise the front of the vehicle and support it on jackstands.

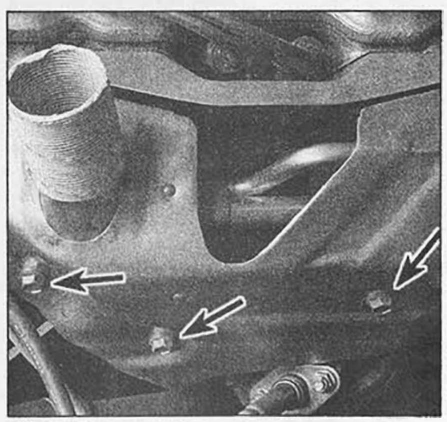
4 Disconnect the front exhaust pipe from the exhaust manifold.

5 Unplug the oxygen sensor wire (if so equipped) (Chapter 6).

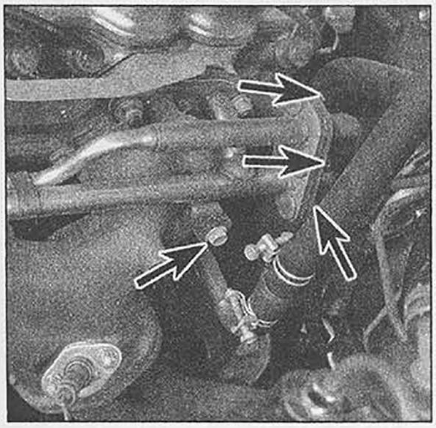
6 Remove the bolts and detach the heat shield **(see illustration).**

7 Remove the air injection tube bolts/nuts (not all models) **(see illustrations),** but don't separate the tube assembly from the manifold.

8 Loosen the bolts and nuts that retain the exhaust manifold to the cylinder head. Work



6.6 Remove the bolts **(arrows)** and detach the heat shield from the **exhaust manifold**



6.7 Remove the air injection tube mounting bolts (arrows), but don't separate the tube assembly from the manifold

from the ends toward the center in a spiral pattern.

9 Remove the bolts/nuts and detach the exhaust manifold and air injection tube assembly. Remove the inner heat shield (if equipped).

10 Before installing the manifold, remove all traces of the old gasket with a scraper. Clean the mating surfaces with lacquer thinner or acetone.

11 Using a straightedge and feeler gauge, check the manifold-to-cylinder head mating surface for warpage **(see illustration).** If it's warped beyond the service limit, the manifold must be resurfaced or replaced with a new one.

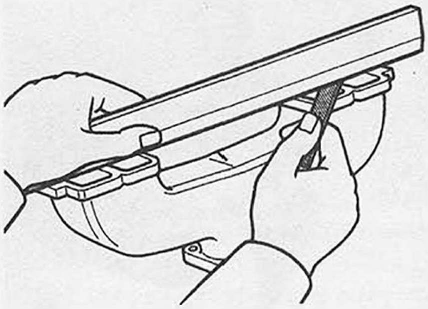
12 Check for corrosion, cracks and other damage. Repair *or* replace the manifold as necessary.

13 Place a new exhaust manifold gasket in position on the cylinder head, then hold the manifold in place and install the mounting bolts/nuts finger tight.

14 Tighten the mounting bolts/nuts. in three or four steps, to the specified torque. Work from the center out toward the ends to prevent distortion of the manifold.

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

16 Start the engine and check for exhaust leaks between the manifold and cylinder head and between the manifold and exhaust pipe.



6.11 The exhaust manifold can be checked for warpage by trying to slip a feeler gauge under a straightedge as shown here

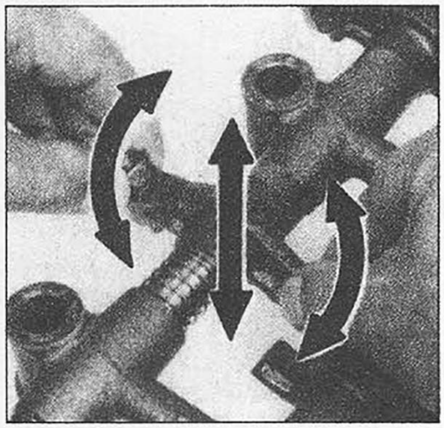
7 Rocker arm assembly - removal and installation

The head bolts also hold the rocker arm assembly in place, so the removal and installation procedure is part of cylinder head removal and installation (Sections 9 and 12). If the rocker arm assembly is detached for any reason, be sure to remove the head as well so a new gasket can be installed. Once the head bolts are loosened, the seal between the head and block is compromised and leaks could result if a new gasket isn't installed.

8 Rocker arm assembly - inspection

Refer to illustrations 8.1, 8.2 and 8.4

1 Move each rocker arm back-and-forth on the shaft (see illustration). Very little play should be detected. If excessive play is evident, disassemble tlhe rocker arms and shafts. Note: If the parts are removed from the shafts, be sure to mark them or lay them out in the correct order - they MUST be reinstalled in their original locations and with the same orientation.



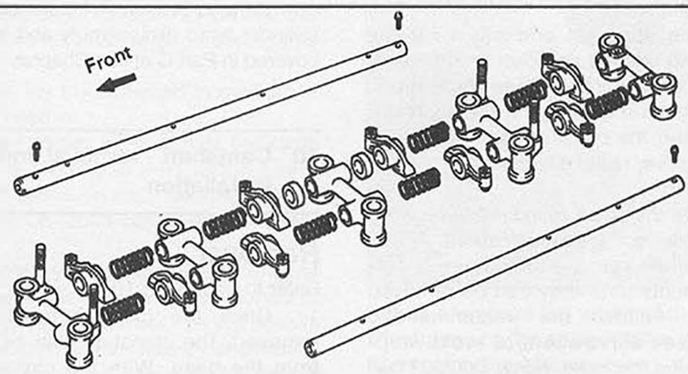
8.1 Che<k for play in the rocker arms

2 Remove the spring clips or bolts from the rear of the shafts and the bolts from the front shaft support. Slide the shaft supports, rocker arms and springs off the shafts, but keep all the parts in order so they can be returned to their original locations during reassembly **(see illustration).** The shaft supports have different configurations and must not be interchanged.

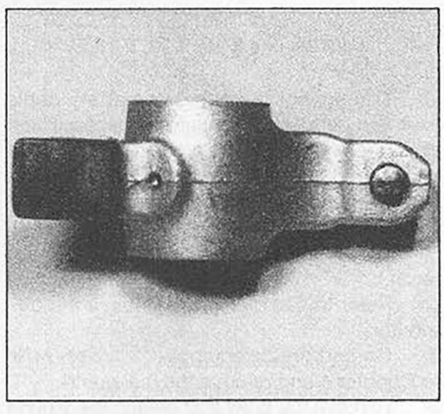
3 Using a 0-to-1 inch micrometer and a small telescoping gauge, measure the diameter of the shafts (where each rocker arm makes contact) and the rocker arm bore diameters. Subtract the shaft diameter from the corresponding rocker arm bore diameter to obtain the rocker arm oil clearance. Repeat the procedure for each rocl<er arm and compare the results to the Specifications.

4 Check the rocker arm faces (that contact the camshaft lobes) and the ends of the adjusting screws (that contact the valve stems) for pitting, excessive wear and roughness **(see illustration).** Check the adjusting screw threads for damage. Make sure they can be threaded in and out of the rocker arms.

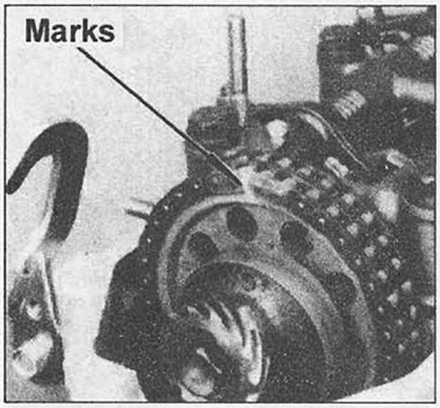
5 Any damaged or excessively worn parts



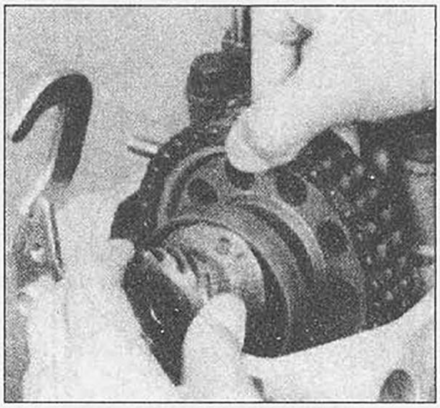
8.2 Rocker arms and shafts - exploded view



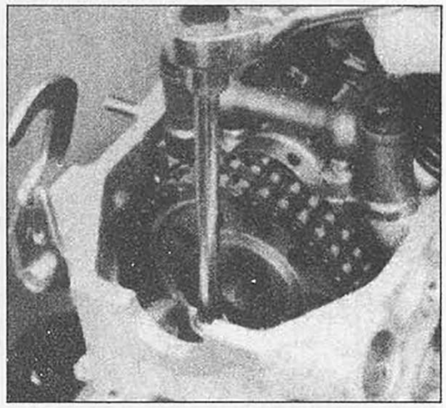
8.4 Check the rocker arm pads and the ends of the adjusting screws for wear and damage



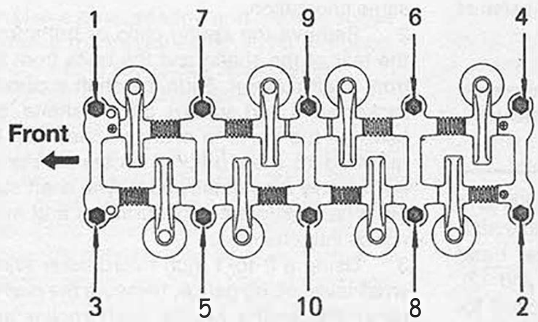
9.10 Alignment marks should be painted on the sprocket and chain before removing the sprocket from the camshaft



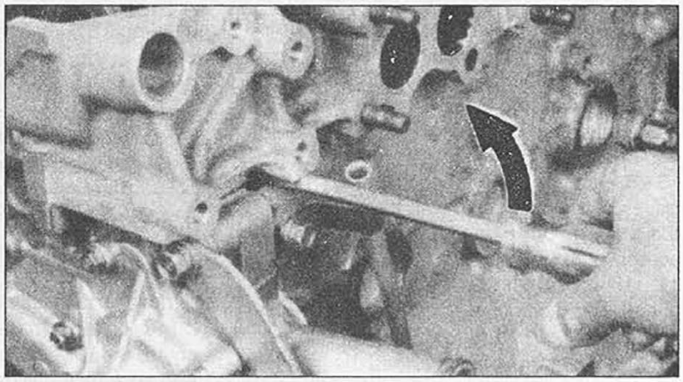
9.12 Pull the sprocket off the camshaft and rest it on the upper ends of the chain dampers - leave the chain meshed with the sprocket



9.13 Don't forget to remove the small cylinder head-to-timing chain cover bolt from the front of the head



9.14 Cylinder head bolt LOOSENING sequence



9.15 Pry up on the cylinder head at this point only - DO NOT insert a pry bar or screwdriver between the head and block!

should be replaced with new ones. It should be noted th t the rocker arm bores have bushings in them that can be replaced with new ones (a job which should be done by an automotive machine shop). If the bushings are replaced, make sure the oil holes in each rocker arm and bushing are aligned before assembling the rocker arm components.

9 Cylinder head - removal

Refer to Illustrations 9.10, 9.12, 9.13, 9.14 and 9.15

1 Disconnect the negative battery cable fo m the battery, then refer to Chapter 1 and drain the engine oil. The cooling system must be drained as well - be sure to use a clean container so the coolant can be reused.

2 Remove the rocker arm cover (Section 4).

3 Detach the upper radiator hose (Chapter 3).

4 Refer to Chapter 5 and remove the distributor.

5 On carburetor equipped vehicles, refer to Chapter 4 and remove the fuel pump.

6 Remove the bolts and detach the ground cables from the front and rear of the head.

7 Refer to Chapter 10 and remove the power steering pump. Leave the hoses attached and position the pump upright, out of the way.

8 Remove the intake and exhaust manifolds.

9 Position the number one piston at TDC on the compression stroke (Section 3).

10 Use a permanent marker or white paint to mark the camshaft sprocket and chain **(see illustration).**

11 Remove the half circle rubber seal from the front of the head, then unscrew the camshaft sprocket bolt and detach the distributor drive gear and fuel pump eccentric (carburetor equipped models only) from the end of the camshaft.

12 Pull the sprocket and chain off the camshaft and rest the sprocket on the upper ends of the chain dampers **(see illustration).** Leave the chain meshed with the sprocket. **Note:** *Support the chain so that it does not fall into the cover using a wedge tool or small block of wood.*

13 Remove the small cylinder head-to-timing chain cover bolt **(see illustration).**

14 Loosen the cylinder head bolts in 1/4-turn increments until they can be removed by hand. Follow the recommended sequence **(see illustration)** to avoid warping or cracking the head. **Note:** *DO NOT pull the bolts out of the rocker arm shaft supports. Once all of the bolts are loose, lift up on the shafts to remove the rocker arms, shafts and bolts as an assembly.*

15 Lift the head off the engine. If it's stuck, DO NOT pry between the head and block - damage to the mating surfaces will result! Instead, position a pry bar or large screwdriver as shown in the **accompanying illustration** and pry the head loose.

16 The timing chain and camshaft sprocket will remain in place, resting on the chain dampers.

17 Place the head on blocks of wood to prevent damage to the gasket surface. Remove the head gasket from the block.

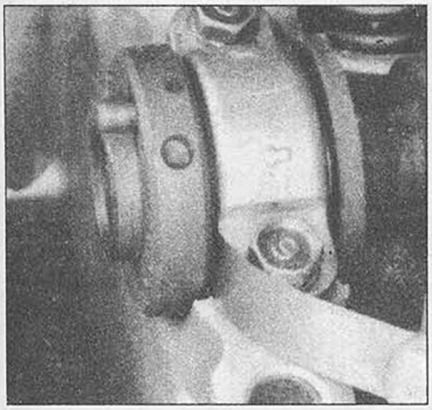
18 Refer to Section 10 for camshaft removal. Cylinder head disassembly and inspection is covered in Part C of this Chapter.

10 Camshaft - removal and installation

Removal

Refer to illustration 10. 1

1 Once the cylinder head has been removed, the camshaft can be separated from the head. With the camshaft still in place, check the end play with a feeler gauge or dial indicator **(see illustration).** If it's



10.1 Camshaft end play can be checked with feeler gauges

greater than specified, a new cylinder head will be required.

2 Remove the bolts and detach the bearing caps from the head, then lift out the camshaft. Be careful not to nick or gouge the bearing surfaces in the caps or head.

3 Reinstall the bearing caps in their original locations and thread the bolts in finger tight.

4 Camshaft and bearing inspection procedures are covered in Section 11 .

Installation

Refer to illustrations 10. 10, 10. 11 and 10. 12

5 If the inspection reveals no excessive wear or damage, the cam bearing oil clearance should be checked before deciding to reinstall the original camshaft. **Note:** *The cylinder head should be thoroughly cleaned before checking the bearing oil clearance but* it's *not absolutely necessary if extra ca◆e is taken during the following steps.*

6 Clean the camshaft and bearing caps with solvent and dry them thoroughly.

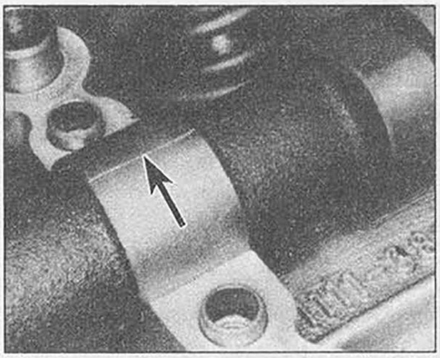
7 The bearing oil clearances should be checked with Plastigage, which is available at auto parts stores. Type HPG-1 (green) should be used for this procedure.

8 Make sure the cam bearing journals and the bearing surfaces in the caps and cylinder head are clean and oil free (if the cylinder head hasn't been cleaned as described in Chapter 2, Part C, wipe the bearing surfaces with a clean lint-free cloth). **Note:** *DO NOT apply oil or any other lubricant to the cylinder head, camshaft or bearing caps during this procedure.*

9 Carefully lay the camshaft in position in the cylinder head.

10 Cut three pieces of Plastigage the same length as the bearing journal width. Lay a piece of Plastigage on each bearing journal, parallel to the camshaft centerline **(see illustration).**

11 Install the bearing caps in their original locations with the marks facing forward. Tighten the bolts in each cap very gradually (about 1/4-turn at a time), alternating between the two until the specified torque is reached **(see illustration). Note:** *DO NOT*



10.10 Lay a strip of Plastigage on each camshaft bearing journal . . .

turn the camshaft at any time during this procedure!

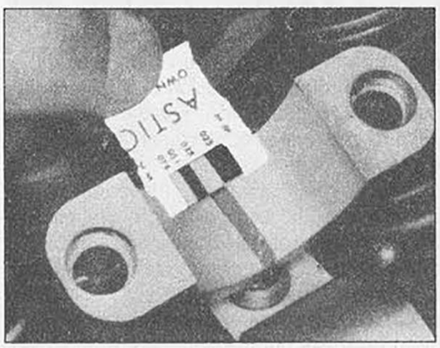
12 Remove the bolts (loosen them gradually to avoid distortion of the caps), lift off the caps and compare the widest portion of the crushed Plastigage on each bearing journal to the scale printed on the Plastigage envelope. Locate the line on the scale that's the same width as the Plastigage, then read the number opposite the line. This number in thousandths of an inch, is the bearing' oil clearance **(see illustratfon).**

13 If the oil clearance is greater than the service limit, the bearing surfaces in the head and caps are excessively worn. Since the cylinder head must be replaced with a new one to restore the oil clearances, check with your dealer for advice before proceeding.

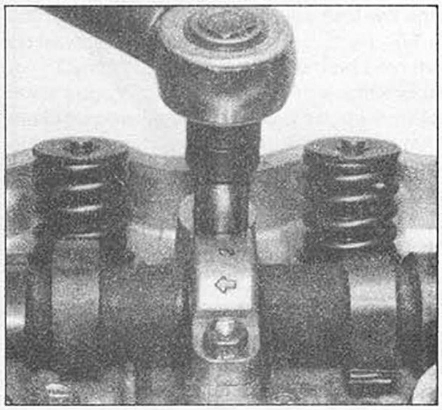
14 Once the procedure is complete, remove all traces of the Plastigage material from the cam journals and the bearing caps. Use a soft, blunt instrument such as a piece of hardwood (a credit card also works well) to avoid scratching the bearings. Clean the journals and the bearing •caps with solvent to complete the clean-up.

15 Prior to final installation of the camshaft, lubricate the bearing s1Urfaces and the lobes with moly-base grease or engine assembly lube.

16 Carefully lay the camshaft in the head. Make sure the bearing surfaces in the caps are clean, then install them on the head. They should be numbered one through three



10.12 Compare the width of the crushed Plastigage to the scale on the envelope to determine the oil clearance - always take the measurement at the widest point



10.11 . . . then install the caps and tighten the bolts to the specified torque - 0 0 NOT tum the camshaft

(front-to-rear) and the arrows must point toward the front of the engine.

17 Install and tighten the bolts as described in Step 11.

18 After the cap bolts have been tightened, turn the camshaft by hand and check for obvious binding.

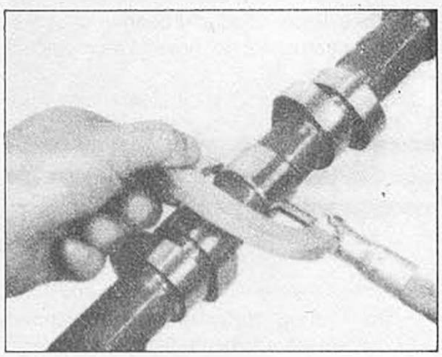
11 Camshaft and bearings - inspection

Refer to illustrations 11.3 and 11.5

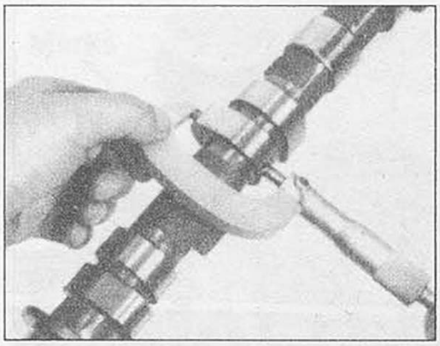
1 Clean the camshaft with solvent and dry it with compressed air. Clean the bearing surfaces in the head and caps as well.

2 Inspect the camshaft bearing journals for excessive wear and evidence of seizure. If the journals are damaged, the bearing surfaces in the head and bearing caps are probably damaged as well. Both the camshaft and cylinder head (as well as the bearing caps) will have to be replaced with new parts.

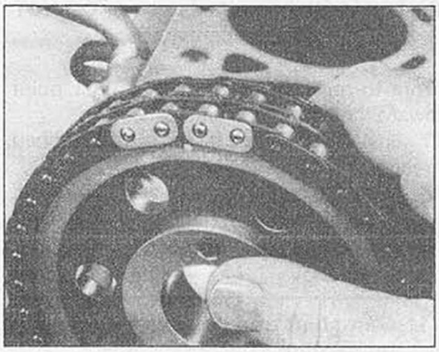
3 Using a 1-to-2 inch micrometer, measure the diameter of each of the cam bearing journals **(see illustration).** Take the measurement at two locations on each journal (90-degrees apart). If the journal diameters are less than the service limit, the camshaft must be replaced with a new one.



11.3 Measure each camshaft bearing journal with a micrometer



11.5 Measure the height of each camshaft lobe with a micrometer



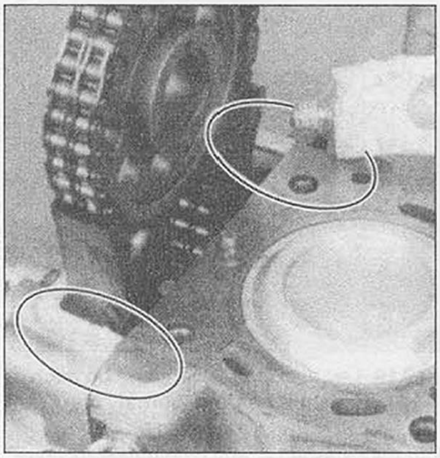
12.6 Install the camshaft sprocket with the two bright chain links on either side of the dot (arrow) and the groove or hole at the top (12 o'clock position) so it fits the dowel in the camshaft

4 The camshaft runout should also be checked (to determine if it's bent). This measurement requires a dial indicator and a special jig (or V-blocks) so it should be done by an automotive machine shop.
5 Check the cam lobes for pitting, grooves, scoring or flaking. Measure the cam lobe height and compare it to the Specifications **(see illustration).** If the lobe height is less than the minimum specified, and/or the lobes are damaged, a new camshaft must be obtained.
6 Examine the bearing surfaces in the head and the bearing caps. Look for scoring, galling and burned areas. If damage is evident, the cylinder head and bearing caps (as well as the camshaft) will have to be replaced with new ones.
7 Check the bearing oil clearances with Plastigage when the camshaft is installed (Section 10).

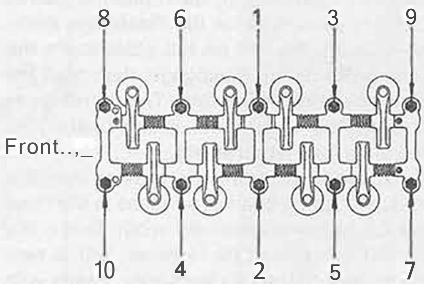
12 Cylinder head - installation

Refer to illustrations 12.4, 12.5, 12.6 and 12.8

1 The mating surfaces of the cylinder head and block must be perfectly clean when the head is installed. 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

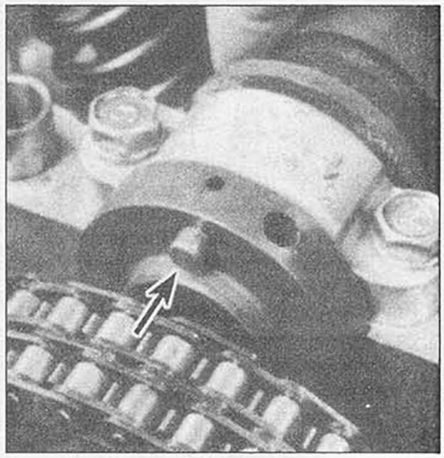


12.4 Apply sealant to the cylinder head at the designated locations (circles)

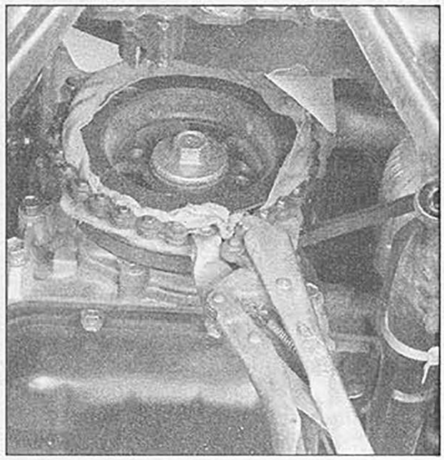


12.8 Cylinder head bolt TIGHTENING sequence

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 any debris that falls into the cylinders.
2 Check the block and 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.
3 Use a tap of the correct size to chase the threads in the head bolt holes. Mount each bolt in a vise and run a die down the threads to remove corrosion and restore the threads. Dirt, corrosion, sealant and damaged threads will affect torque readings.
4 Apply sealant to the two front corners of the block **(see illustration).** Place the gasket in place over the engine block dowel pins. If the camshaft sprocket has been removed, reattach it to the chain with the marks aligned. Make sure the number one piston is still at TDC, then carefully lower the cylinder head onto the engine, over the dowel pins and the gasket. Be careful not to move the gasket.
5 Turn the camshaft to position the dowel at the top **(see illustration).**

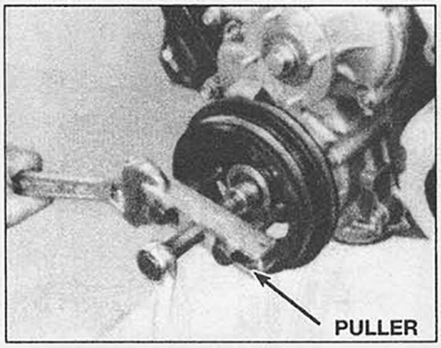


12.5 Position the camshaft with the dowel pin (arrow) at the top (12 o'clock position)



13.5 When using a chain wrench to keep the crankshaft from turning, protect the pulley with a rag - if the pulley is nicked or otherwise damaged, it will destroy the drivebelts

6 While holding up on the sprocket and chain, turn the crankshaft until the cam sprocket groove or hole is at the top **(see illustration).**
7 Place the rocker arm shaft/head bolt assembly over the dowels on the cylinder head. Thread the head bolts in by hand.
8 Tighten the head bolts in four equal steps to the specified torque. Be sure to follow the recommended sequence **(see illustration).**
9 Install the timing chain cover-to-head bolt and tighten it to the specified torque.
10 Align the groove or hole with the dowel and attach the sprocket to the camshaft. **Note:** *If the chain doesn't seem long enough, turn the crankshaft back-and-forth while pulling up on the chain and sprocket until the sprocket fits over the dowel.*
11 Place the distributor drive gear (and fuel pump eccentric) over the sprocket and tighten the bolt to the specified torque.
12 Adjust the valves (see Chapter 1).
13 Install the fuel pump (see Chapter 4)
14 Install the distributor (see Chapter 5).



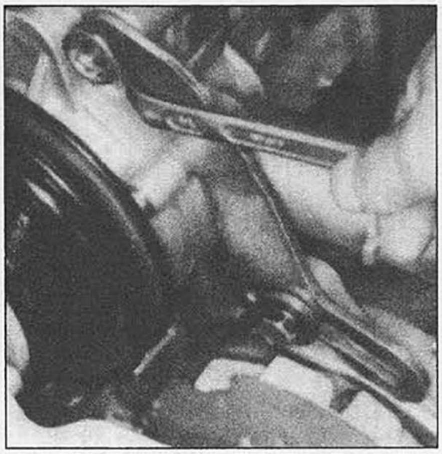
13.6 Use the recommended tool to remove the crankshaft pulley - if a puller that applies force to the ou1er edge is used, the pulley may be damaged

15 Adjust the spark plug gaps and install and tighten the spark plugs to the specified torque.
16 Install the rear air suction pipe (if so equipped).
17 Attach the exhaust pipe to the exhaust manifold and tighten the three nuts.
18 Connect the accelerator linkage.
19 Connect the TV cable (automatic transmission).
20 Reconnect all hoses and wires (see Section 9).
21 Apply RTV sealant to the front and rear half circle rubber seals and install them in the cylinder head.
22 Pour four quarts of oil of the specified grade over the distributor gear and sprocket assembly, allowing it to drain into the oil pan.
23 Install the rocker arm cover, the parts removed from it and the air cleaner (see Section 4).
24 Fill the radiator with the specified coolant.
25 Connect the battery cable.
26 Start the engine and allow it to reach normal operating temperature.
27 Reset the timing (see Chapter 1).
28 Readjust the valves (see Chapter 1).

13 Crankshaft pulley - removal and installation

Refer to illustrations 13.5 and 13.6

1 Disconnect the negative battery cable from the battery.
2 Remove the radiator and shroud (Chapter 3).
3 Unbolt the splash shield (if equipped).
4 Remove the drivebelts {Chapter 1) .
5 On manual transmission equipped models, put the transmission in High gear and apply the parking brake. On automatics, use a chain wrench so the crankshaft doesn't turn **(see illustration).** Remove the pulley mounting bolt. They're usually very tight, so use a six-point socket and a 1/2-inch drive breaker bar.
6 Use a puller to remove the pulley from

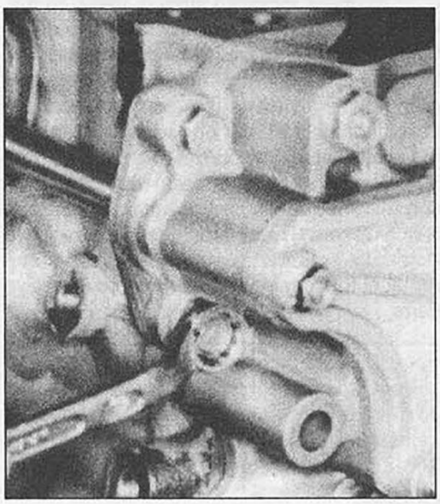


15.8 The alternator adjusting bracket must be moved to detach the timing chain cover

the crankshaft **(see illustration).** DO NOT use a gear puller that applies force to the outer edge of the pulley!
7 Installation is the reverse of removal. Be sure to apply moly-base grease or clean engine oil to the seal contact surface on the pulley hub before installing the pulley on the crankshaft. Also, be sure to align the keyway in the pulley hub with the key in the crankshaft or the pulley won't slide into place.
8 Tighten the pulley bolt to the specified torque.

14 Front crankshaft oil seal - replacement

1 Remove the pulley (Section 13).
2 Carefully pry the oil seal out of the timing chain cover with a seal removal tool or screwdriver. Don't scratch the cover bore or damage the crankshaft in the process (if the



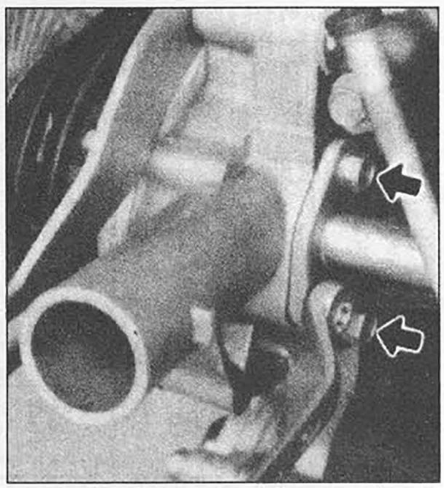
15.9a Remove the coolant bypass tube bolts

crankshaft is damaged the new seal will end up leaking).
3 Clean the bore in the cover and coat the outer edge of the new seal with engine oil or multi-purpose grease. 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. If a socket isn't available, a short section of large diameter pipe will work. Check the seal after installation to be sure that the spring didn't pop out of place.
4 Reinstall the pulley.
5 The parts removed to gain access to the pulley can now be reinstalled.
6 Run the engine and check for leaks.

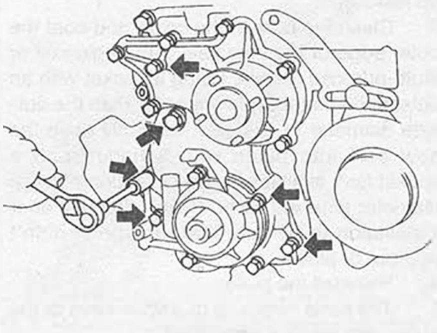
15 Timing chain cover - removal and installation

Refer to illustrations 15.8, 15.9a, 15.9b, 15.10 and 15.12

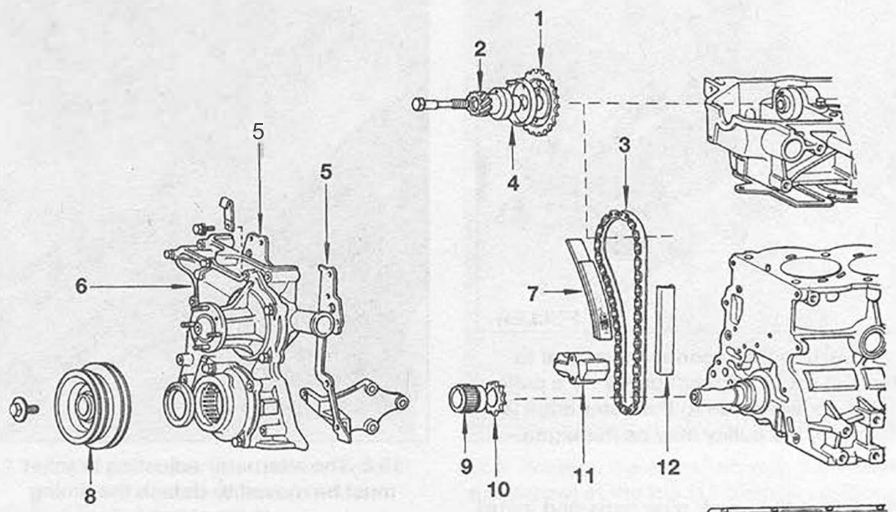
1 Remove the cylinder head (see Section 9).
2 Remove the oil pan.
3 Remove the drivebelts (see Chapter 1).
4 Remove the crankshaft pulley (see Section 13).
5 Remove the air pump and brackets (see Chapter 6).
6 On air conditioning-equipped models, unbolt the compressor and set it aside without disconnecting the hoses.
7 Remove the two front bolts from the right engine mount bracket and loosen the two rear bolts.
8 Remove the bolt holding the alternator adjusting bracket to the timing chain cover **(see illustration),** then move the bracket toward the alternator.
9 Remove the two coolant bypass tube bolts **(see illustration).** On 20R engines only, two heater tube bolts must also be removed from the rear of the cover **(see illustration).**



15.9b Remove the heater tube bolts (arrows) from the rear of the timing chain cover (20R engines only)



15.10 Timing chain cover bolt locations (arrows)



15.12 Timing chain and related components - exploded **view**

1	*Camshaft sprocket*	7	*Chain damper No. 2*
2	*Distributor dr;ve gear*	8	*Crankshaft pulley*
3	*Chain*	9	*Pump drive spline*
4	*Fuel pump drive cam*	10	*Crankshaft sprocket*
5	*Gasket*	11	*Chain tensioner*
6	*Chain cover assembly*	12	*Chain damper No. 1*

10 Remove the timing chain cover mounting bolts **(see illustration).** Note that different length bolts are used - they must be returned to their original locations! Tap on the cover with a soft-face hammer to separate it from the engine block. If the cover is stuck, recheck for any remaining bolts. DO NOT pry the cover off - the gasket surfaces are easily damaged and oil leaks could result!

11 Remove all traces of gasket material and sealant from the cover and block, then clean the surfaces with lacquer thinner or acetone. Be careful not to nick or gouge the timing chain cover with the gasket scraper.

12 Apply a thin layer of RTV sealant to the *block* side of the new gaskets, then position them on the block. The dowel pins will hold them in place. Apply a thin layer of RTV sealant to the timing chain cover gasket surfaces, then attach the cover to the block. Don't disturb the gaskets and make sure the oil pump drive spline engages in the pump **(see illustration).**

13 Install the bolts and tighten them in 1/4-turn increments until the specified torque is reached.

14 The remaining installation steps are the reverse of removal.

16 Timing chain and sprockets - removal, inspection and installation

Removal

1 Position the number one piston at TDC on the compression stroke (Section 3).

2 Remove the timing chain cover (Section 15).

3 Remove the camshaft sprocket bolt and detach the distributor drive gear and fuel pump eccentric (if equipped).

4 Pull the sprocket and chain off the camshaft, disengage the chain from the tensioner and dampers and remove it from the crankshaft sprocket .

5 Remove the oil pump drive spline and crankshaft sprocket from the end of the crankshaft **(see illustration 15.12). A** puller may be needed if they're tight.

Inspection

Refer to illustrations 16.6, 16.7, 16.10 and 16.11

6 To check for chain stretch, measure the length of 17 links with the chain stretched tight **(see illustration),.** Repeat the measurement on three other chain areas selected at random. If the measurement exceeds the specified limits at any one location, replace the chain with a new one.

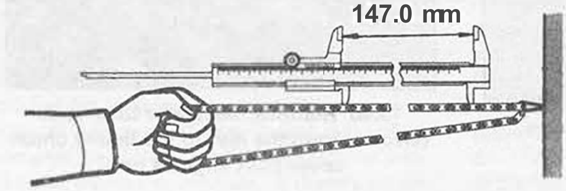
7 Wrap the chain around the camshaft sprocket and measure the outside diameter with a dial or vernier caliper **(see illustration).** If it's less than the specified minimum, replace the chain and sprocket with new parts.

8 Repeat the measurement with the chain wrapped around the crankshaft sprocket.

9 Check the chain tensioner slipper for wear and damage. The slipper should move in and out of the bore without binding or excessive play .

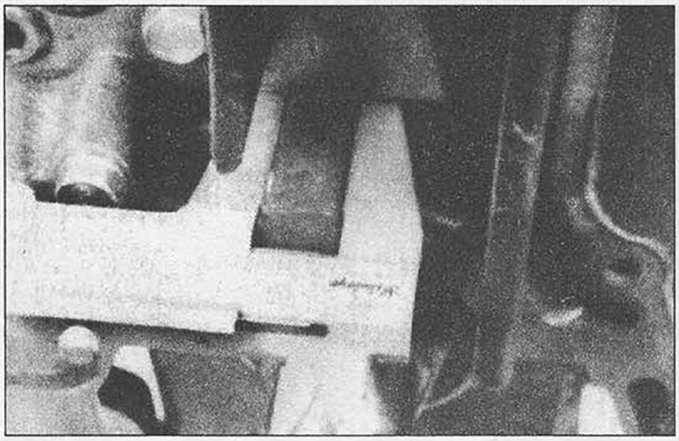
10 Measure the thickness of the slipper **(see illustration). If** it's less than specified, replace the tensioner.

11 Check the dampers for wear and damage. Measure the thickness of each damper with a micrometer **(see illustration).** If they're worn beyond the specified limits, install new ones. **Note:** *If new dampers are installed, make sure the top of the left damper (no. 2) is all the way to the left before tightening the bolt (the bolt should be in the right end of the slot).*

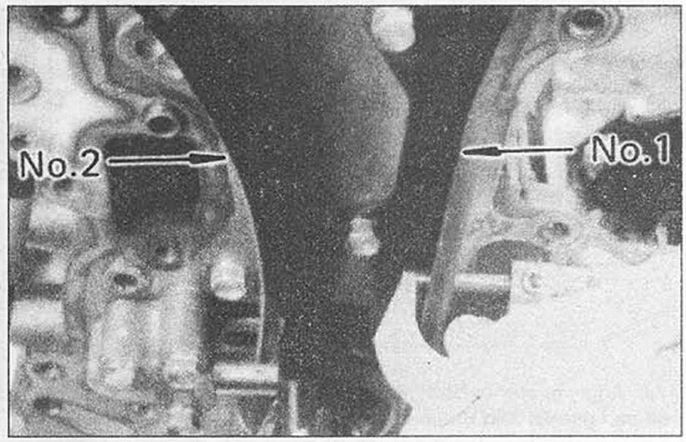


16.6 Checking for timing chain stretch

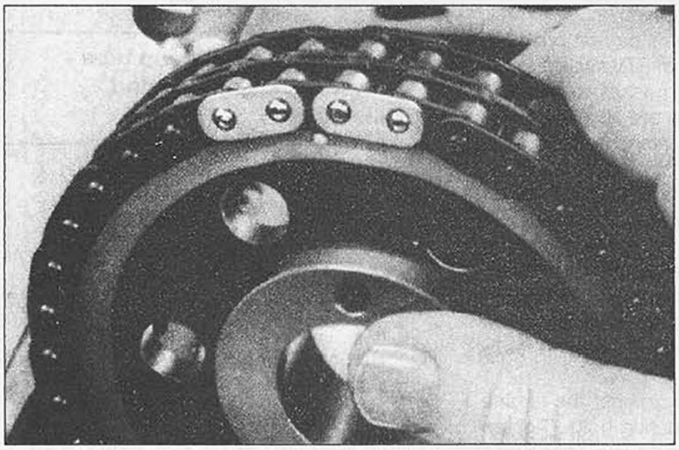
16.7 Measure the sprocket diameter with the chain in place **to check** tor **wear**



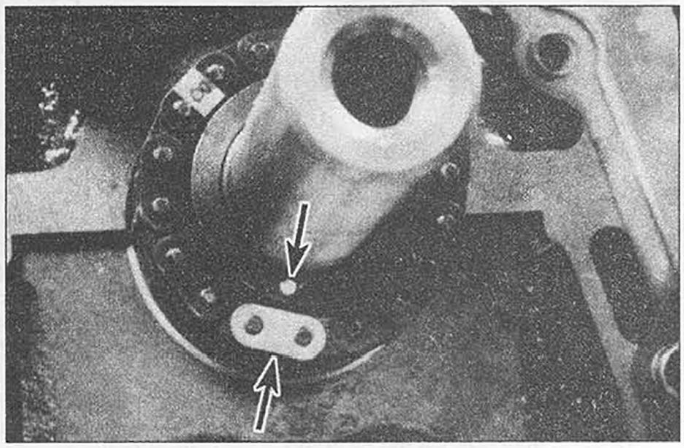
16.10 If the tensioner slipper is worn beyond the minimum thickness, install a new tensioner



16.11 Measure the timing chain dampers with a micrometer to check for excessive wear



16.14 Align the two bright chain links with the timing mark on the camshaft sprocket



16.15 Align the single bright link on the chain with the timing mark on the crankshaft sprocket (arrows)

Installation

Refer to illustrations 16.14 and 16.15

12 Before installing the chain and sprockets, make sure the key in the crankshaft is in the 12 o'clock position (facing up).

13 Install the sprocket and oil pump drive spline on the crankshaft. **Note:** *The sprocket must be installed with the hub collar facing in (against the engine).*

14 Mesh the timing chain and camshaft sprocket. The mark on the sprocket must be between the two bright chain links **(see illustration). Note:** *Some models may be equipped with a single bright link. If this is the case, align the bright link with the timing mark on the camshaft sprocket.*

15 Align the bright link on the chain with the timing mark on the crankshaft sprocket **(see illustration),** then attach the chain to the sprocket.

16 Position the chain between the dampers and engage the tensioner, then attach the sprocket to the camshaft and tighten the bolt (see Section 10). Make sure the fuel pump eccentric (if used) and the distributor drive gear are in place before installing the bolt.

17 Turn the camshaft sprocket counterclockwise to take up the slack in the chain.

18 Double-check to make sure the timing marks on the sprockets and the bright links on the chain are aligned properly.

19 Install the timing chain cover.

17 Oil pan - removal and installation

Refer to illustrations 17.4 and 17.8

Note 1: *On 1979 through 1985 4WD models, it will be necessary to separate the front stabilizer bar, leaf springs, shock absorbers, front driveline and lower the front axle assembly for additional clearance.*

Note 2: *On 1986 and later 4WD models, it will be necessary to separate the front differential mounts and lower the axle/differential assembly for additional clearance.*

1 Drain the engine oil.

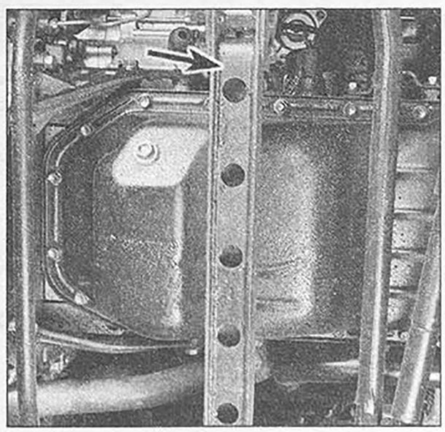
2 Raise the front of the vehicle and support it on jackstands placed under the frame.

3 Remove the splash shield, if equipped.

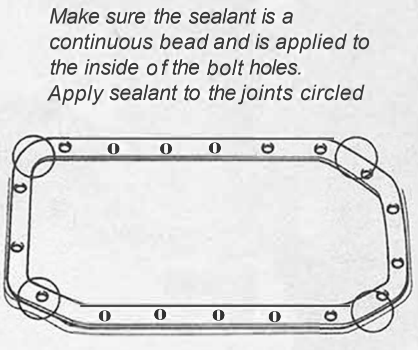
4 Disconnect the idler arm and Pitman arm **(see illustration)** and let the steering linkage hang down, then remove the front crossmember.

5 Remove the bo,lts and detach the oil pan. Don't pry between the block and pan *or* damage to the sealing surfaces may result and oil leaks could develop. Use a block of wood and a hammer to dislodge the pan if it's stuck.

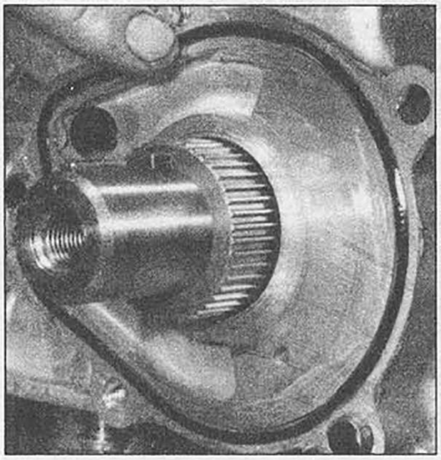
6 Use a scraper to remove all traces of old gasket material and sealant from the block, timing chain cover, rear oil seal housing and oil pan. Clean the gasket sealing surfaces with lacquer thinner or acetone and make sure the bolt holes in the block are clean.



17.4 The steering linkage must be disconnected and the crossmember (arrow) must be removed to gain access to the oil pan

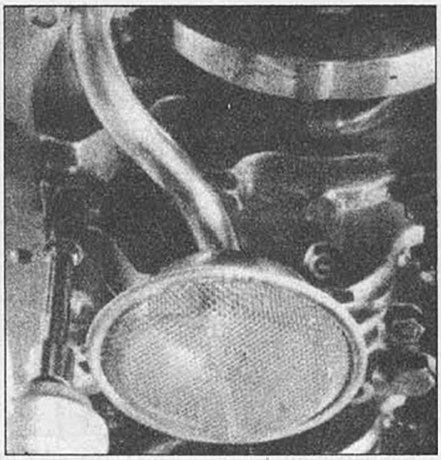


17.8 Apply sealer to both sides of the new oil pan gasket and the joints in the block



18.5 . . . then remove the oil pump drive spline

7 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.



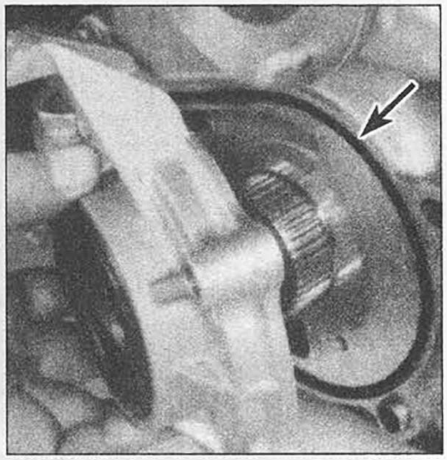
18.2 The oil pick-up screen is held in place by three bolts

8 Before installing the oil pan on pre-1985 models, apply a thin coat of RIV sealant to the flange. Attach the new gasket to the pan (make sure the bolt holes are aligned). **Note:** *The oil pan on 1985 and later models doesn't require a gasket - liquid sealant, available at most auto parts stores, is used instead. Cut the nozzle on the sealant tube to provide a 3/16-inch opening, then apply the sealant to the pan and block* **(see illustration).** *Avoid excessive amounts of sealant and be sure to attach the oil pan within five minutes or the sealant will have to be scraped off and reapplied.*

9 Position the oil pan against the engine block and install the mounting bolts. Tighten them to the specified torque in a criss-cross pattern.

10 Wait at least 30 minutes before filling the engine with oil, then start the engine and check the pan for leaks.

11 Reinstall the parts removed for access to the oil pan.



18.4 Detach the oil pump assembly and remove the 0-ring (arrow) . . .

18 Oil pump and pick-up tube - removal, inspection and installation

Refer to illustrations 18.2, 18.4, 18.5, 18.6, 18.8, 18.9, 18.10, and 18.17

1 Remove the oil pan (see Section 17).

2 Remove the bolts and detach the oil pick-up tube **(see illustration).**

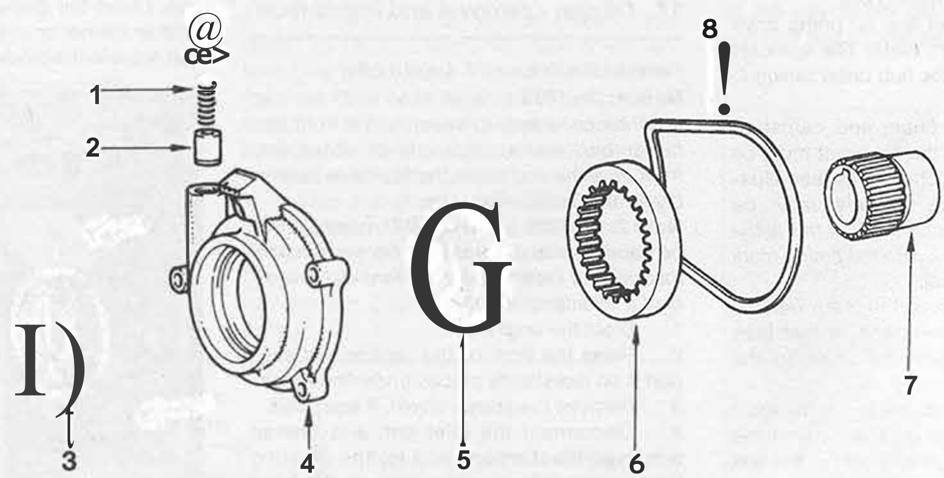
3 Remove the crankshaft pulley (see Section 13).

4 Remove the bolts and detach the oil pump assembly from the timing chain cover **(see illustration).**

5 Remove the O-ring and oil pump drive spline **(see illustration).**

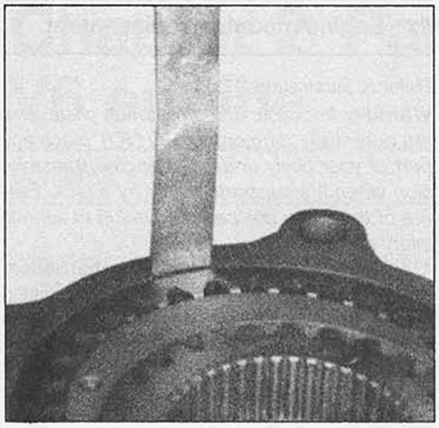
6 Unscrew the plug and remove the spring and relief valve from the oil pump **(see illustration).**

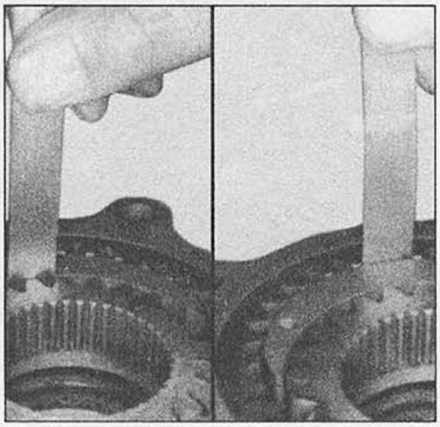
7 Check the drive spline, drive gear, driven gear, pump body and timing chain cover for wear and damage. If wear or darn-

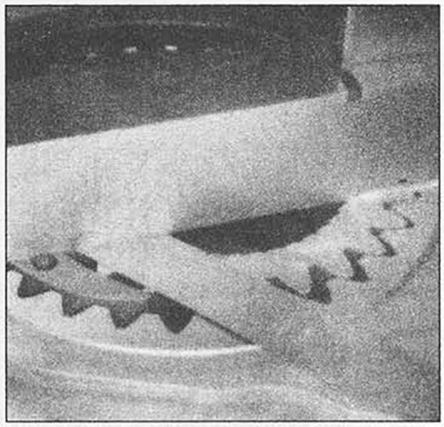


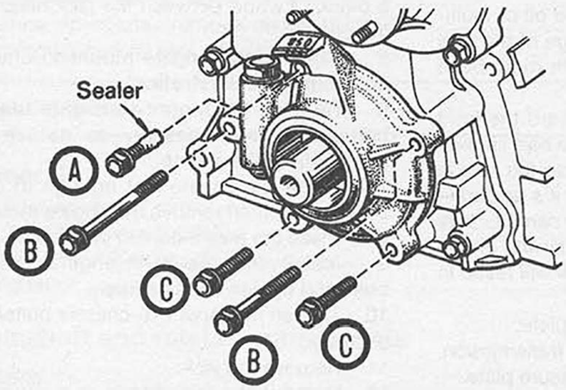
18.6 Oil pump components - exploded view

1 *Relief valve spring*
2 *Relief valve*
3 *Oi/seal*
4 *Oil pump body*
5 *Drive gear*
6 *Driven gear*
7 *Drive spline*
8 *O-ring*

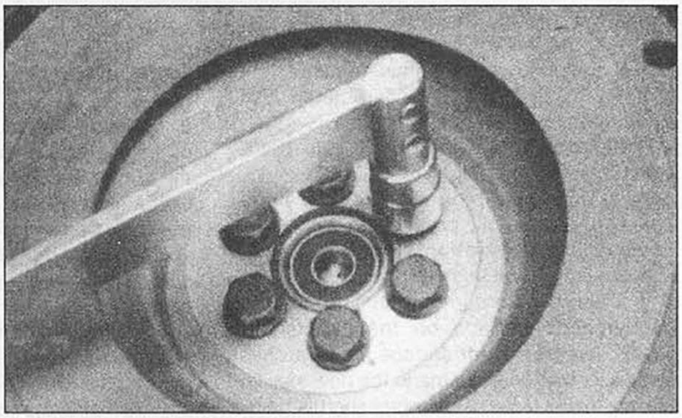

18.8 Measuring the clearance between the driven gear and oil pump body


18.9 Measuring the clearance between the drive gear {left} and driven gear (right) and the crescent in the pump body


18.10 Measuring the oil pump gear side clearance



18.17 Apply sealant to the upper left bolt and tighten bolts **A, B** and C to different torque figures (see the Specifications)


19.10 Apply Loc-tite to the flywheel/driveplate bolts and be sure to tighten them to the specified torque

age is found, replace the pump with a new one.
8 Measure the clearance between the driven gear and body with a feeler gauge (see illustration). If the clearance is greater than the specified maximum, replace the pump with a new one.
9 Measure the clearance between both gears and the crescent with feeler gauges **(see illustration).** If the clearance is greater than the specified maximum, replace the pump with a new one.
10 measure the side clearance with a straightedge and feeler gauge **(see illustration).** If the clearance is greater than the specified maximum, replace the pump.
11 Check the relief valve piston and bore for scuffing and score marks. Make sure the valve moves freely in the bore without excessive side play. If any defects are found, replace the appropriate parts with new ones .
12 Check the oil seal for wear and damage. If a new one is required, pry out the old one and install a new one as described in Section 14.
13 To reassemble the pump, lubricate and insert the relief valve piston and spring, then install the plug (with a new gasket).
14 Coat them with clean oil, then insert the drive and driven gears into the pump body.
15 Slide the pump drive spline onto the crankshaft.
16 Place the O-ring in the groove.
17 Apply sealant to the upper oil pump bolt, then install the pump and the mounting bolts **(see illustration).** Tighten the bolts to the specified torque in a criss-cross pattern.
18 Clean and install the oil pick-up tube and screen.
19 Reinstall the oil pan.
20 Install the crankshaft pulley.
21 Install the drivebelts and add engine oil.

19 Flywheel/driveplate - removal and installation

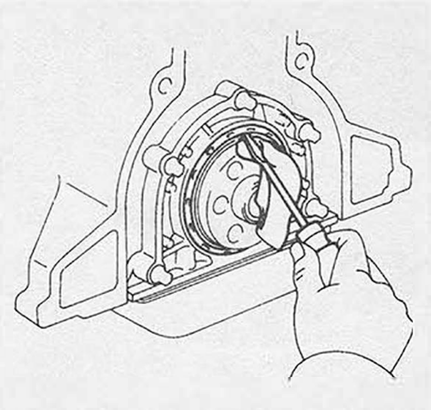
Refer to illustration 19. 1O

1 If the engine is in the vehicle, remove the transmission, pressure plate and clutch disc as described in Chapters 7 and 8, or the automatic transmission as described in Chapter 7.
2 Flatten the lockplate tabs (if used} and remove the bolts that secure the flywheel/driveplate to the crankshaft rear flange. Be careful, the flywheel is very heavy and should not be dropped. If the crankshaft turns as the bolts are loosened, wedge a screwdriver in the starter ring gear teeth.
3 Detach the flywheel/driveplate from the crankshaft flange.
4 If the engine is being disassembled for an overhaul, unbolt and remove the rear plate.
5 If the teeth on the flywheel/driveplate starter ring gear are badly worn, or if some are missing, install a new flywheel or driveplate.
6 Refer to Chapter 8 for the flywheel inspection procedure and the pilot bearing check and replacement procedure.
7 Before installing the flywheel/driveplate, clean the mating surfaces.
8 If removed, reinstall the rear plate.
9 Position the flywheel/driveplate against the crankshaft and install the mounting bolts. Use Loc-tite on the bolts.
10 Tighten the bolts in a criss-cross pattern to the specified torque **(see illustration).**
11 The remainder of installation is the reverse of removal.

20 Rear crankshaft oil seal - replacement

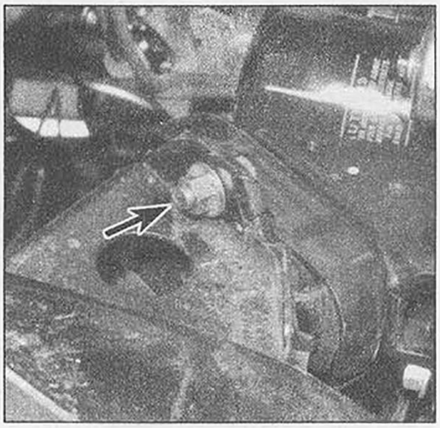
Refer to illustration 20.5

1 The rear crankshaft oil seal can be replaced without removing the oil pan or



20.5 When removing the rear crankshaft oil seal from the housing, wrap the screwdriver to protect the crankshaft

crankshaft.
2 Remove the transmission (Chapter 7).
3 If equipped with a manual transmission, remove the pressure plate and clutch disc (Chapter 8).
4 Remove the flywheel or driveplate (Section 19).
5 Using a seal removal tool or a large screwdriver, carefully pry the seal out of the housing **(see illustration).** Don't scratch or nick the crankshaft in the process!
6 Clean the bore in the housing and the seal contact surface on the crankshaft. Check the crankshaft surface for scratches and nicks that could damage the new seal lip and cause oil leaks. If the crankshaft is damaged, the only alternative is a new or different crankshaft.



21.5 Remove the mount-to-chassis bolts/nuts and the mount-to-engine bracket bolt/nut (arrows) to detach the engine mount

7 Apply a light coat of engine oil or multi-purpose grease to the outer edge of the new seal. Lubricate the seal lip with moly-base grease.
8 The seal lip must face toward the front of the engine. Carefully work the seal lip over the end of the crankshaft and tap the seal in with a hammer and punch until it's seated in the bore. **Caution:** Be *extremely careful - take your time and drive the seal gently and evenly into place. Damaging a new seal will result in an oil leak.*
9 Install the flywheel or driveplate.
10 If equipped with a manual transmission, reinstall the clutch disc and pressure plate.
11 Reinstall the transmission as described in Chapter 7.

21 Engine mounts - replacement

Refer to illustration 21.5

Warning: *Improper lifting methods or devices are potentially dangerous. DO NOT place any part of your body under the engine/transmission when it's supported only by a jack. Failure of the lifting device could result in* serious *injury or death.*
1 If the rubber mounts have hardened, cracked or separated from the mefal backing plates, they must be replaced. This operation may be carried out with the engine/transmission still in the vehicle.
2 Disconnect the negative cable from the battery.
3 Raise the front of the vehicle and support it securely on jackstands. Apply the parking brake and block the rear wheels.
4 Support the engine with a jack. Position a block of wood between the jack head and the oil pan.
5 Remove the engine mount-to-chassis bolts/nuts **(see illustration).**
6 Remove the mount-to-engine bracket bolts; It's not necessary to detach the bracket from the engine.
7 Raise the engine just enough to clear the bracket, then remove the engine mount.
8 Place the new mount in position.
9 Install the mount-to-engine bracket bolts and tighten them securely.
10 Tighten the mount-to-chassis bolts/nuts securely.
11 Remove the jack.
12 Remove the jackstands and lower the vehicle.

Chapter 2 Part B
V6 engine

Contents

	Section
Camshafts and lifters - removal, inspection and installation	11
Camshaft oil seal - replacement	10
Cylinder compression check	See Chapter 2C
Cylinder head covers - removal and installation	4
Cylinder heads - removal and installation	12
Drivebelt check, adjustment and replacement	See Chapter 1
Engine mounts - check and replacement	17
Engine oil and filter change	See Chapter 1
Engine overhaul - general information	See Chapter 2C
Engine - removal and installation	See Chapter 2C
Exhaust manifolds - removal and installation	6
Flywheel/driveplate - removal and installation	15
Front crankshaft oil seal - replacement	9
General information	1
Intake manifold - removal and installation	5
Oil pan - removal and installation	13
Oil pump - removal, inspection and installation	14
Pilot bearing - inspection, removal and installation	See Chapter 8
Rear crankshaft oil seal - replacement	16
Repair operations possible with the engine in the vehicle	2
Spark plug replacement	See Chapter 1
Thermostat replacement	See Chapter 3
Timing belt - removal, installation and adjustment	8
Top Dead Center (TDC) for number one piston - locating	3
Vibration damper - removal and installation	7
Water pump - removal and installation	See Chapter 3

Specifications

General

Cylinder numbers (front-to-rear)	
Right (passenger) side	1-3-5
Left (driver's) side	2-4-6
Firing order	1-2-3-4-5-6

Camshaft and related components

Lifters

Outside diameter	1.4930 to 1.4934 in (37.922 to 37.932 mm)
Bore diameter	1.4945 to 1.4951 in (37.960 to 37.975 mm)
Lifter-to-bore clearance	
Standard	0.0011 to 0.0021 in 0.028 to 0.053 mm)
Service limit	0.004 in (0.1 mm)

Camshaft

Valve clearances (engine cold)	
Intake	0.007 to 0.011 in (0.18 to 0.28 mm)
Exhaust	0.009 to 0.Q13 in (0.2 mm to 0.32 mm)
Bearing journal diameter	1.3370 to 1.3376 in (33.959 to 33.975 mm)
Bearing oil clearance	
Standard	0.0010 to 0.0026 in (0.025 to 0.066 mm)
Service limit	
1989	0.0051 in (0.13 mm)
1990 on	0.0039 in (0.1 mm)
Lobe height	
Standard	
1989	1.8842 to 1.8882 in (47.86 to 47.96 mm)
1990 on	1.8830 to 1.8870 in (47.83 to 47.93 mm)
Service limit	1.8701 in (47.50 mm)
Endplay	
Standard	0.0031 to 0.0075 in (0.08 to 0.19 mm)
Service limit	0.0098 in (0.25 mm)
Runout limit (total indicator reading)	0.0024 in (0.06 mm)

Timing belt tension spring free length

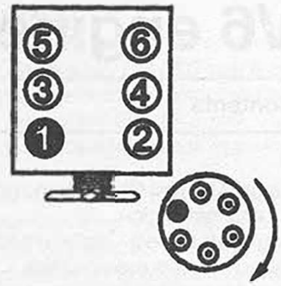
1989	2.15 in (54.6 mm)
1990 through 1992	2.22 in (56.3 mm)

Oil pump

Driven gear-to-pump body clearance	
Standard	0.0039 to 0.0069 in (0.100 to 0.175 mm)
Service limit	0.0118 in (0.30 mm)

Oil pump (continued)

Gear-to-gear clearance	
Standard	0.0043 to 0.0094 in (0.11 to 0.24 mm)
Service limit	0.0138 in (0.35 mm)
Gear side clearance	
Standard	0.0012 to 0.0035 in (0.03 to 0.09 mm)
Service limit	0.0059 in (0.15 mm)



Cylinder location and distributor rotation

The blackened terminal shown on the distributor cap indicates the Number One spark plug wire position

Torque specifications	**Ft-lbs** (unless otherwise noted)
Intake manifold bolts/nuts	13
Exhaust manifold nuts	29
Vibration damper bolt	181
Timing belt cover bolts	
No. 1 (lower) cover	48 in-lbs
No. 2 (upper) cover	48 in-lbs
No. 3 (rear) cover	74 in-lbs
Fan pulley bracket bolts	30
Moveable timing belt idler pulley (tensioner) bolt	27
Camshaft sprocket bolts	80
Camshaft bearing cap bolts	12
Camshaft timing belt tensioner bolts (1993-on)	20
Cylinder head bolts	
Step 1	33
Step 2	Turn an additional 90-degrees (1/4-turn)
Step 3	Turn an additional 90-degrees (1/4-turn)
Cylinder head bolt A	27
Oil pan bolts	52 in-lbs
Oil pump mounting bolts	14
Oil strainer tube mounting bolts	61 in-lbs
Flywheel/driveplate bolts	65
Rear crankshaft oil seal retainer mounting bolts	69 in-lbs

•Apply Loc-tite to the threads before 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.

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 pressure washer before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

Remove the hood, if necessary, to improve access to the engine as repairs are performed (refer to Chapter 11 if necessary).

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, cylinder head cover 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 (and the oil pump), the water pump, the starter motor, the alternator, the distributor and the fuel system components can be removed for repair with the engine in place.

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 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 possiblle 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.

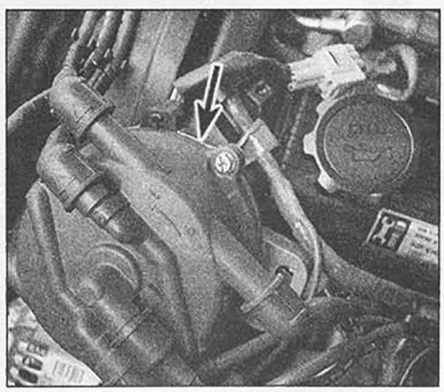
3 Top Dead Center (TDC) for number one piston - locating

Refer to illustrations 3.4 and 3.6

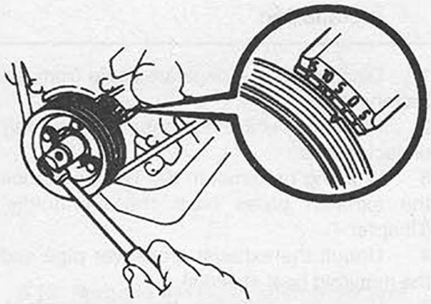
1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up-and-down when the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke. The timing marks on the vibration damper installed on the front of the crankshaft are referenced to the number one piston at TDC on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as cylinder head removal, timing belt and sprocket replacement and distributor removal.

3 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



3.4 Mark the distributor housing (arrowed) directly below the number one cylinder spark plug wire terminal in the distributor cap



3.6 When the notch in the pulley is aligned with the zero on the timing plate as shown here and the rotor is pointing at the number one cylinder spark plug wire terminal in the distributor cap, the number one piston is at TDC on the compression stroke

is clockwise. **Warning:** *Before beginning this procedure, be sure to place the transmission in Neutral and unplug the wire connector at the distributor to disable the ignition system.*

- a) *The preferred method is to turn the crankshaft with a large socket and breaker bar attached to the vibration damper bolt threaded into the front of the crankshaft.*
- b) *A remote starter switch, which may save some time, can also be used. Attach the switch leads to the S (switch) and B (battery) terminals on the starter solenoid. Once the piston is close to TDC, use a socket and breaker bar 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. Use a socket and breaker bar as described in Paragraph a) to complete the procedure.*

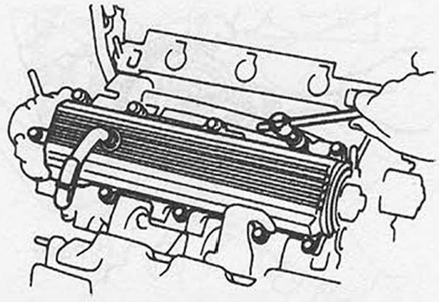
4 Make a mark on the distributor housing directly below the number one spark plug wire terminal on the distributor cap **(see illustration).**

5 Remove the distributor cap as described in Chapter 1.

6 Turn the crankshaft (see Paragraph 3 above) until the line on the vibration damper is aligned with the zero mark on the timing plate **(see illustration).** The timing plate and vibration damper are located low on the front of the engine, combined with the pulley that turns the drivebelt.

7 The rotor should now be pointing directly at the mark on the distributor housing. If it isn't, the piston is at TDC on the exhaust stroke.

8 To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360°) clockwise. The rotor should now be pointing at the mark. When the rotor is pointing at the number one spark plug wire terminal in the distributor cap (which is indicated by the mark on the housing) and the ignition timing marks are aligned, the number one piston is at TDC on the compression stroke.



4.3 The cylinder head covers are held in place with several bolts around the edge

9 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining cylinders can be located by turning the crankshaft 120° at a time and following the firing order (refer to the Specificati ens).

4 Cylinder head covers - removal and installation

1 Disconnect the negative cable from the battery.

Removal

Right side cover

Refer to illustration 4.3

2 Remove the air intake chamber and related components as described in Chapter 4.

3 Remove the mounting bolts **(see illustration).**

4 Detach the cover from the head. **Caution:** *If the cover is stuck to the head, bump one end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur (leading to oil leaks in the future).*

Left side cover

Refer to illustration 4.5

5 Remove the breather hose from the cover **(see illustration).**

6 Remove the air cleaner-to-throttle body tube (Chapter 4).

7 Remove the engine wire brackets that overlap the cover.

8 Remove the mounting bolts and lift off the cover. Read the **Caution** in Step 4.

Installation

9 The mating surfaces of each cylinder head and cover must be perfectly clean when the covers are 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 sealant or oil on the mating surfaces when the cover is installed, oil leaks may develop.

10 Clean the mounting bolt threads with a die to remove any corrosion and restore damaged threads. Make sure the threaded holes in the head are clean - run a tap into them to remove corrosion and restore damaged threads.

11 Position a new gasket on the cylinder head.

12 Carefully position the cover on the head and install the bolts.

13 Tighten the bolts in three or four steps until they're snug. Don't overtighten them or oil leaks could develop.

14 The remaining installation steps are the reverse of removal.

15 Start the engine and check carefully for oil leaks as the engine warms up.

5 Intake manifold - removal and installation

Removal

1 Remove the air intake chamber (Chapter 4).

2 Disconnect the negative cable from the battery.

3 Drain the cooling system (Chapter 1).

4 Remove any remaining hoses, wires or cables attached to the manifold or its components.

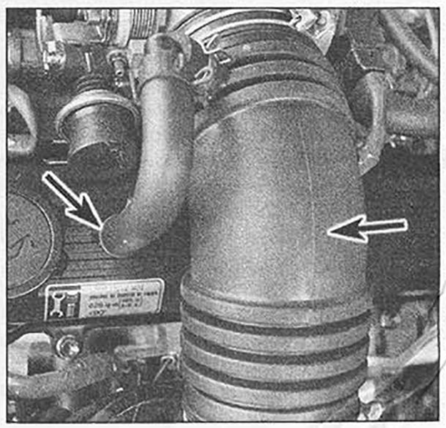
5 Loosen the manifold mounting bolts/nuts in 1/4-turn increments until they can be removed by hand.

6 The manifold will probably be stuck to the cylinder heads and force may be required to break the gasket seal. **Caution:** *Don't pry between the manifold and the heads or damage to the gasket sealing surfaces may occur, leading to vacuum leaks.*

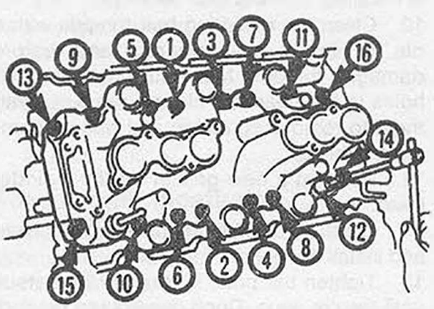
Installation

Refer to illustration 5.12

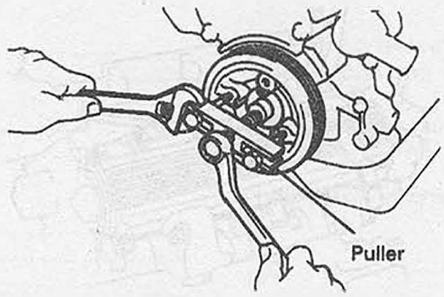
Note: *The mating surfaces of the cylinder heads and manifold must be perfectly clean when the manifold is installed. Gasket*



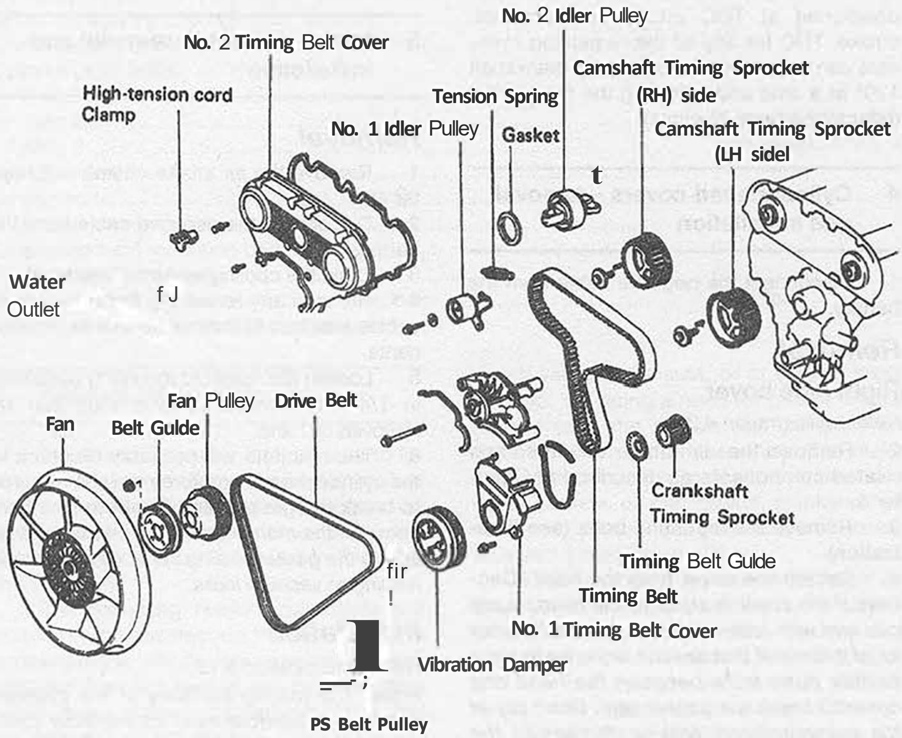
4.5 Detach the air intake tube and breather hose (arrowed) before attempting to remove the left side cylinder head cover



5.12 Tighten the intake manifold bolts/nuts from the center out in a criss-cross pattern



7.6 Use the recommended puller to remove the vibration damper - if a puller that applies force to the outer edge is used, the damper may be damaged!



8.9 Timing belt and related components - exploded view

removal solvents in aerosol cans are available at most auto parts stores and may be helpful when removing old gasket material that's stuck to the heads and manifold (since they're made of aluminum, aggressive scraping can cause damage). Be sure to follow the directions printed on the container.

7 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 old sealant or oil on the mating surfaces when the manifold is installed, oil or vacuum leaks may develop. Use a vacuum cleaner to remove any material that falls into the intake ports in the heads.

8 Wse a tap of the correct size to chase the threads in the bolt holes, then use compressed air (if available) to remove the debris from the holes. **Warning:** *Wear safety* glasses *or a face shield to protect your* eyes *when using compressed air!*

9 Position the gaskets on the cylinder heads. No sealant is required; however, follow the instructions included with the new gaskets.

10 Make sure all intake port openings, coolant passage holes and bolt holes are aligned correctly.

11 Carefully set the manifold in place. **Caution:** *Don't disturb the gaskets.*

12 Install the bolts/nuts and tighten them to the specified torque following the recommended sequence **(see illustration).** Work up to the final torque in two steps.

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

6 Exhaust manifolds - removal and installation

1 Disconnect the negative cable from the battery.

2 Raise the vehicle and support it securely on jackstands.

3 Working underneath the vehicle, unbolt the exhaust pipes from the manifold(s) (Chapter 4).

4 Unbolt the exhaust crossover pipe and the manifold heat shield(s).

5 If you're removing the *left* manifold, detach the air cleaner-to-throttle body tube.

6 If you're removing the *right* manifold, detach the EGA tube and air suction reed *valve* (see Chapter 6).

7 Apply penetrating oil to the threads, then remove the mounting nuts and detach the manifold from the lead.

8 Prior to installation of either manifold, clean all gasket mating surfaces.

9 Install a new gasket on the studs.

10 Install the manifold and tighten the nuts to the specified torque. Work from the center of the manifold to the ends in a spiral pattern.

11 Installation of the remaining components is the reverse of removal.

7 Vibration damper - removal and installation

Refer to illustration 7.6

1 Disconnect the negative cable from the battery.

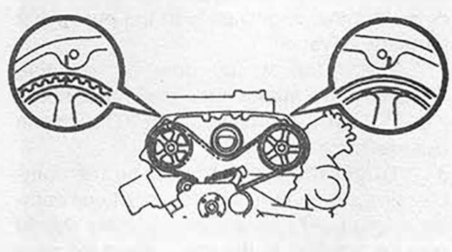
2 Remove the fan shroud and radiator (Chapter 3).

3 Remove the drivebelts (Chapter 1).

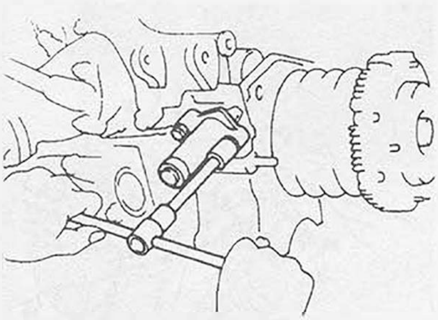
4 Remove the bolts and detach the power steering pump pulley.

5 Remove the starter bolts and push the starter away from the flywheel gear. Wedge a pry bar between the flywheel/driveplate teeth to prevent the crankshaft from turning while loosening the large vibration damper bolt.

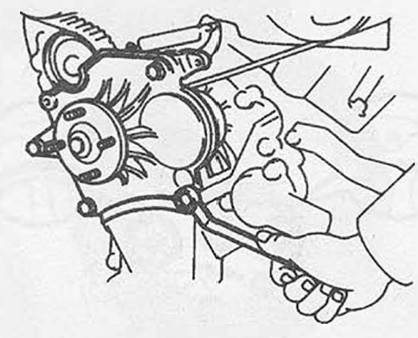
6 Leave the damper bolt in place to provide the gear puller with something to push against. Use a puller to remove the damper **(see illustration). Caution:** *Don 't use a puller with jaws that grip the outer edge of the damper! The puller must be the type shown in*



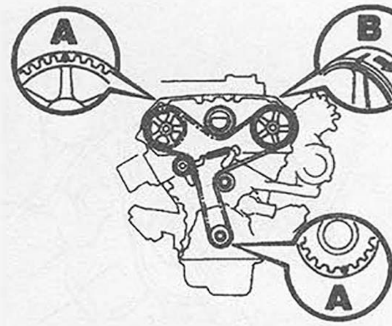
8.11 Align the marks on the rear cover with the marks on the sprockets before removing the belt



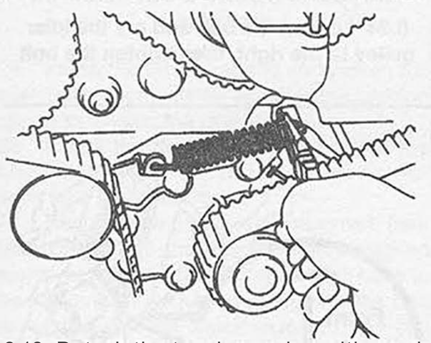
8.12 Remove the bolts alternately and remove the timing belt tensioner



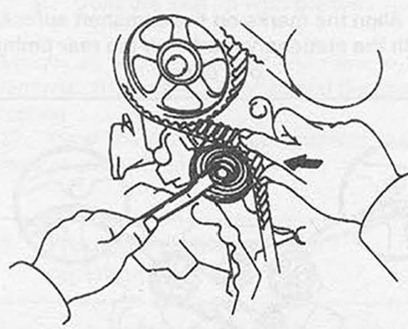
8.13 Remove the fan pulley bracket



8.15 Make match marks on the belt and sprockets (A) and apply an arrow (B) to the timing belt indicating normal direction of rotation



8.16 Detach the tension spring with a pair of needle nose pliers



8.17 Loosen the idler pulley bolt and shift the pulley to the left as far as possible

the illustration that utilizes bolts to apply force to the damper hub only.

7 To install the damper, position it on the nose of the crankshaft, align the keyway and install the bolt. Tighten the bolt to the specified torque.

8 The remaining installation steps are the reverse of the removal procedure.

8 Timing belt - removal and installation

Removal

Refer to illustrations 8.9, 8.11, 8.12, 8.13, 8.15, 8.16 and 8.17

1 Disconnect the negative cable from the battery.

2 Remove the radiator and shroud as described in Chapter 3.

3 On vehicles so equipped, remove the power steering pulley and drivebelt (see Chapter 10) and unbolt the pump from the brackets without disconnecting the hoses. Set the pump aside.

4 Remove the spark plugs (see Chapter 1).

5 Disconnect the air hoses from the air pipe.

6 Remove the water outlet from the engine (see Chapter 3).

7 On air conditioned models, remove the compressor drivebelt (see Chapter 1).

8 Detach the alternator drivebelt, belt guide and fan pulley (see Chapter 5). Remove the fan/clutch assembly (see Chapter 3).

9 Detach the spark plug wire looms from the top edge of the no. 2 timing belt cover, then remove the bolts and detach the cover **(see illustration).**

10 Position the number one piston at TDC on the compression stroke (see Section 3). **Caution:** *Once this has been done, DO NOT turn the crankshaft until the sprockets and timing belt have been reinstalled!*

11 Be sure that the marks on the camshaft sprockets and rear timing belt cover are aligned **(see illustration).**

12 On 1993 and later models, loosen the two bolts a little at a time and r.emove the timing belt tensioner **(see illustration).**

13 Remove the fan pulley bracket **(see illustration).**

14 Remove the crankshaft pulley, vibration damper (see Section 7) and the number one timing belt cover.

15 If the timing belt is to be reused, mark the belt position at each camshaft sprocket, mark the belt at the crankshaft sprocket and apply an arrow indicating the direction of rotation **(see illustration).**

16 On 1992 and earlier models, remove the timing belt guide and tension spring **(see illustration).**

17 On 1992 and later models, to relieve the timing belt tension, loosen the bolt and shift the idler pulley to the left as far as it will go, then temporarily retighten the bolt **(see illustration).**

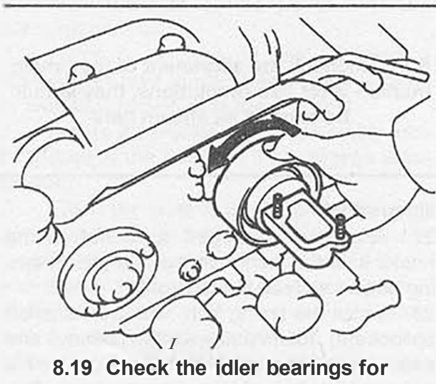
18 Slip the timing belt off the sprockets. If you plan to reuse the belt, check it carefully for wear and damage and make sure it hasn't been contaminated with oil, fuel or coolant. Don't twist, bend or turn the belt inside out. **Caution:** *It's a ve,y good idea to install a new belt rather than reuse the old one, regardless of it's condition. If the belt fails during engine operation, extensive damage may occur!*

Inspection

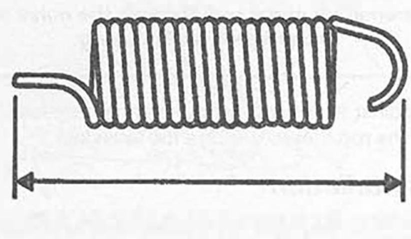
Refer to illustrations 8.19 and 8.20

19 Check the idler and fan pulley bearings to see if they turn smoothly **(see illustration).**

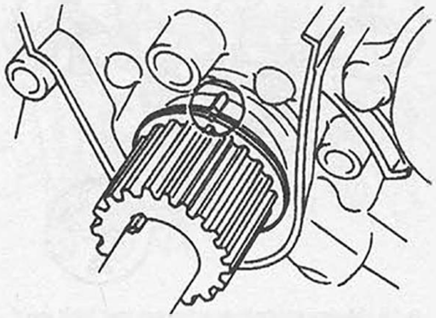
20 On 1992 and earlier models, measure the free length of the tension spring **(see illustration).** Compare your measurements with this Chapter's Specifications. Replace the spring if it's not as specified. On 1993 and later models, try to force the rod into the tensioner housing (press the rod firmly



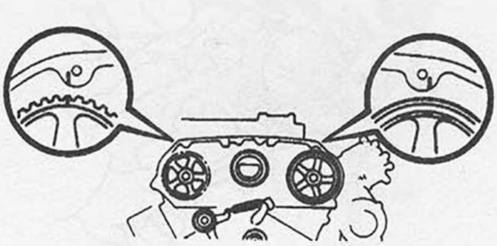
8.19 Check the idler bearings for smooth operation



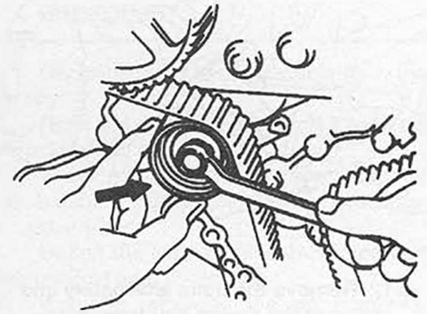
8.20 Measure the tension spring free length



8.21 Align the groove in the crankshaft sprocket with the mark on the oil pump

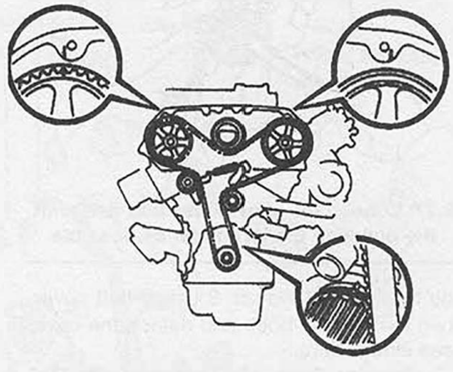


8.22 Align the marks on the camshaft sprockets with the stationary marks on the rear timing belt cover

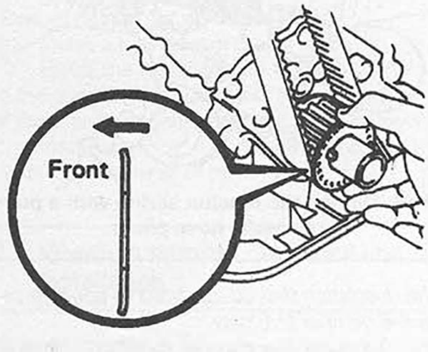


8.24 Loosen the bolt and pry the idler pulley to the right, then tighten the bolt

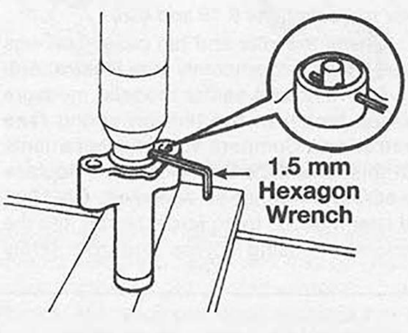
8.26 Slowly turn the crankshaft through two complete revolutions . . .



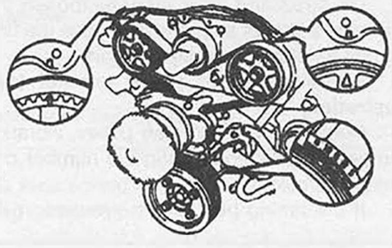
8.27 . . . then recheck the alignment of the marks - after exactly two revolutions, they should be aligned as shown here



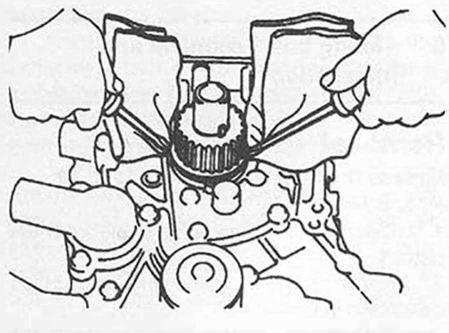
8.28 Be sure the curved lip on the timing belt guide faces away from the belt



8.29 Press the timing belt tensioner pushrod in and install a 1.5 mm Allen wrench (or metal rod) through the holes in the pushrod and housing



8.31 Recheck the alignment of the timing marks - after two revolutions, they should be aligned as shown here



9.3 Cushion the oil pump housing with shop rags, then carefully pry the sprocket off the end of the crankshaft (a puller may be needed)

against the floor or workbench, if necessary). If the rod moves, replace the tensioner.

Installation

Refer to illustrations 8.21, 8.22, 8.24, 8.26, 8.27, 8.28, 8.29 and 8.31

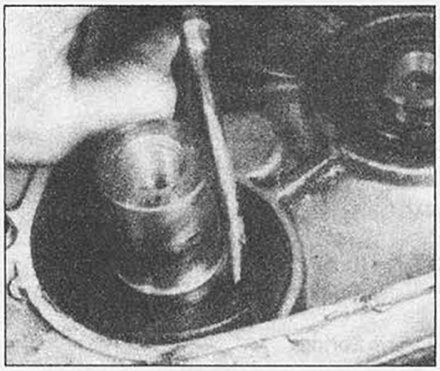
21 Align the groove in the crankshaft sprocket with the mark on the oil pump (see illustration).

22 Align the camshaft sprocket timing marks with the marks on the rear (no. 3) timing belt cover (see illustration).

23 Install the timing belt over the camshaft sprockets, idler pulleys, fan pulley and crankshaft sprocket. **Note:** *If the old belt is being reinstalled, align the marks made during removal and make sure the arrow* (see illustration 8.15) *is pointing in the direction of crankshaft rotation (clockwise).*

1992 and earlier

24 Loosen the idler pulley bolt and pry the idler pulley to the right, as far as it will go, then temporarily tighten the bolt (see illustration).

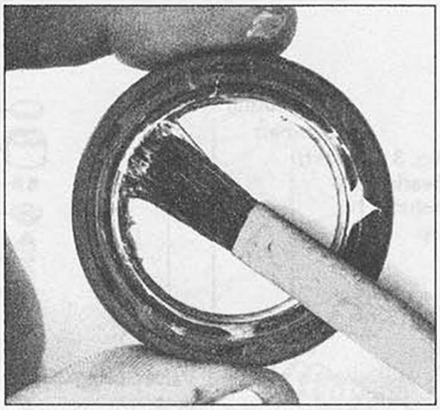


9.6 Pry out the seal with a screwdriver - be careful not to scratch or nick the crankshaft!

25 Install the tension spring and loosen the idler pulley bolt slightly to allow the tension spring to tension the idler.
26 Install the damper bolt and rotate the crankshaft clockwise, two complete revolutions **(see illustration).**
27 Recheck the timing mark alignment (see **illustration).** If the marks aren't aligned exactly as shown, the timing belt will have to be removed, the pulleys realigned, the belt reinstalled and the check redone. Once you are satisfied the belt is installed properly, tighten the idler/tensioner pulley bolt to the torque listed in this Chapter's specifications, remove the crankshaft damper bolt and install the timing belt guide **(see illustration 8.28),** the number one timing cover and the fan pulley bracket. Install the vibration damper and tighten the damper bolt to the torque listed in this Chapter's Specifications. Install the remaining components in the reverse order of removal.

1993 and later

28 On 1993 and later models it is necessary to install the timing belt tensioner before rotating the crankshaft. Install the timing belt guide **(see illustration),** the number one timing belt cover, the fan pulley bracket and the vibration damper. While holding the crankshaft perfectly still, tighten the damper bolt to the torque listed in this Chapter's Specifications.
29 The tensioner rod must be depressed and locked into position before it can be installed. Using a hydraulic press, slowly press the pushrod in until the hole in the pushrod is aligned with the hole in the housing (it takes anywhere from 200 to 225 ft-lbs of force to press the rod in). Insert a 1.5 mm hex wrench (or equivalent) through the holes to hold the pushrod in **(see illustration).**
30 Install the tensioner and alternately tighten the bolts to the torque listed in this Chapter's Specifications. Using a pair of pliers pull the hex wrench from out of the tensioner.
31 Using the damper bolt, rotate the crankshaft clockwise two complete revolutions. Recheck the timing mark alignment **(see illustration),** If the marks aren't aligned



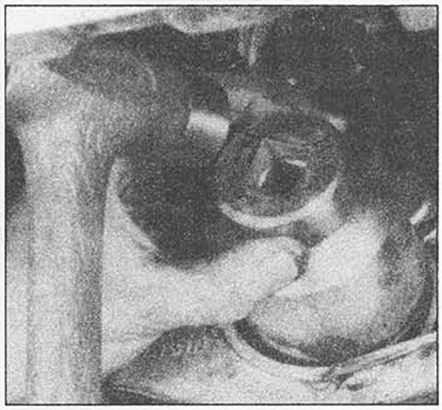
9.7 Coat the seal lip with grease . . .

exactly as shown, the belt will have to be removed, the pulleys realigned and the check redone.
32 Install the remaining components in the reverse order of removal.

9 Front crankshaft oil seal - replacement

Refer to illustrations 9.3, 9.6, 9.7 and 9.8

1 Disconnect the negative cable from the battery.
2 Remove the fan shroud and radiator (Chapter 3), drivebelts (Chapter 1), vibration damper (Section 7) and timing belt (Section 8).
3 Wedge two screwdrivers behind the crankshaft sprocket **(see illustration).** *Carefully pry the sprocket off the crankshaft.* Some timing belt sprockets can be pried off easily with screwdrivers. Others are more difficult to remove because corrosion fuses them to the nose of the crankshaft. If the sprocket on your engine is difficult to pry off, don't try to get it all the way off with screwdrivers. instead, slide it off just far enough to grip it with a puller.
4 Once there's enough space between the sprocket and the oil pump housing to install a small gear puller, thread the vibration damper bolt into the nose of the crankshaft and install the puller. The bolt provides something solid for the puller screw to push against and protects the crankshaft threads.
5 Turn the bolt of the puller until the sprocket comes off.
6 Carefully pry the oil seal out with a screwdriver **(see illustration).** Don't scratch or nick the crankshaft in the process!
7 Before installation, apply assembly lube or grease to the inside of the seal **(see illustration).**
8 Clean the bore in the oil pump housing and coat the outer edge of the new seal with grease. Using a socket with an outside diameter slightly smaller than the outside diameter of the seal, carefully drive the seal into place with a hammer **(see illustration).** If a socket isn't available, a short section of pipe will also work.



9.8 . . . then drive the new seal into the opening with a large socket and hammer - DO NOT damage the seal in the process!

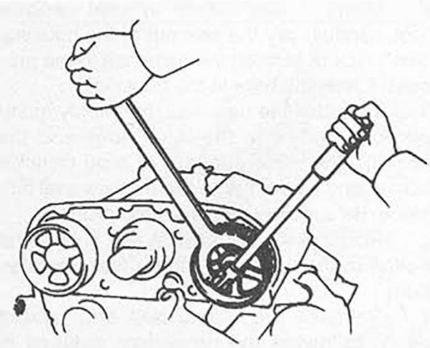
9 Make sure the Woodruff key is in place in the crankshaft.
10 Apply a thin coat of assembly lube *to* the inside of the crankshaft sprocket and slide it onto the crankshaft. If necessary, tap it into place with a section *of* pipe and a hammer.
11 Installation of the remaining components is the reverse of removal. Tighten all bolts to the specified torque.

10 Camshaft oil seal - replacement

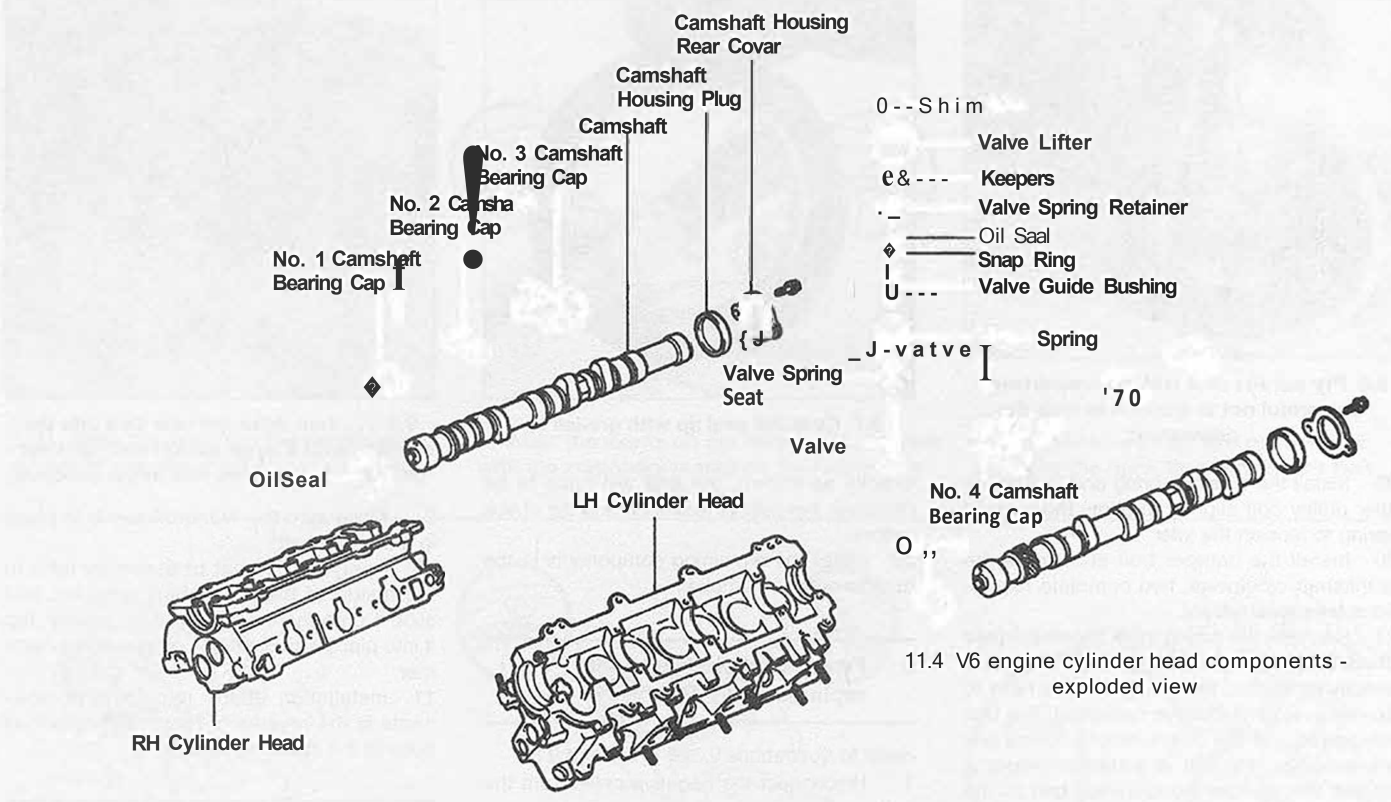
Refer to illustrations 10.3 and 10.6

Note: *Replace both camshaft oil* seals *at the* same *time. If one seal has failed. the other one will probably fail soon.*

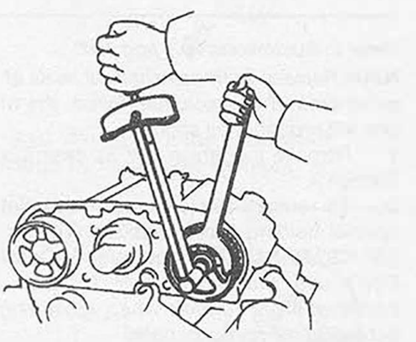
1 Remove the timing belt as described in Section 8.
2 To remove the camshaft sprockets a special holding tool is needed (Toyota no. SST 09278-54012 or equivalent). **Caution:** *Don't use the timing belt to keep the camshaft from turning when loosening or tightening the sprocket bolts!*
3 While holding the sprocket with the special tool, remove the mounting bolt **(see illustration)** and detach the sprocket. **Note:** *Do one side at a time* so *the sprockets don't get mixed up.*



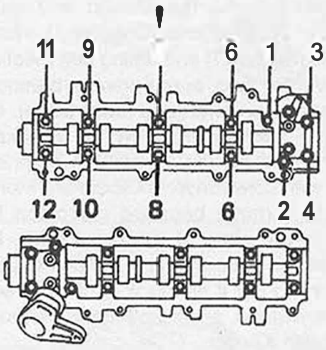
10.3 Use the special tool when loosening the sprocket bolt - DO NOT use the timing belt to prevent the sprocket from moving!



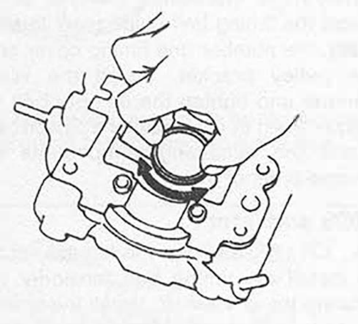
11.4 V6 engine cylinder head components - exploded view



10.6 Be sure to tighten the sprocket bolt with a torque wrench - note the special tool used to hold the sprocket



11.5 LOOSEN the camshaft bearing cap bolts a little at a time in the sequence shown here



11.8 Turn the lifters back-and-forth while pulling them out

4 Using a screwdriver or seal removal tool, carefully pry the seal out of the housing. Don't nick or scratch the camshaft in the process: Clean the bore in the housing.

5 To install the new seal, first apply multi-purpose grease to the outer edge and the seal lip, then use a length of pipe or large socket and a hammer to tap the new seal into place. Be sure the seal is seated properly.

6 Reinstall the sprocket(s) and tighten the bolt(s) to the specified torque **(see illustration).**

7 Reinstall the timing belt and related parts, following the procedure outlined in Section 8.

8 Run the engine and check for oil leaks.

11 Camshafts and lifters - removal, inspection and installation

Removal

Refer to illustrations 11.4, 11.5 and 11.8

1 Remove the cylinder head cover(s) as described in Section **4.**

2 Remove the timing belt (see Section 8).

3 Remove the camshaft sprockets as described in Section 10.

4 Remove the two bolts and detach the rear cover(s) **(see illustration).**

5 Loosen the bearing cap bolts in 1/4-turn increments. Follow the factory recommended sequence **(see illustration).**

6 Remove the camshaft bearing caps, camshaft housing plug and oil seal, then lift out the camshaft **(see illustration 11.4).**

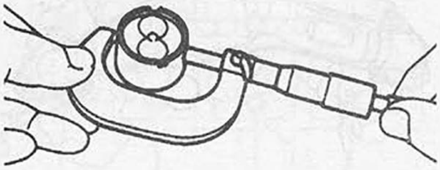
7 Obtain a divided storage container, such as an empty egg carton, for the valve lifters and shims. Mark the container so the lifters will be returned to their original locations during installation.

8 Grasp each lifter and work it back-and-forth while pulling it out **(see illustration).** Store the lifters and shims in the divided container.

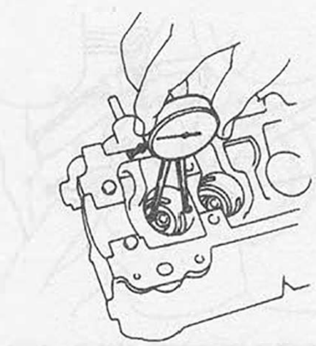
Inspection

Refer to illustrations 11. 10a, 11. 10b, 11. 14, 11.15, 11.16, 11.17 and 11.19

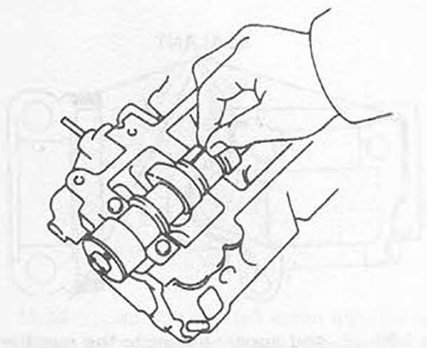
9 Clean the lifters and shims with solvent and dry them thoroughly without mixing them up.



11.10a Measure the lifter diameter at several points . . .



11.10b . . . then measure the corresponding lifter bore inside diameter - subtract the lifter diameter from the bore diameter to obtain the clearance



11.14 Lay a strip of Plastigage on each camshaft bearing journal, parallel to the camshaft centerline

10 Check each lifter wall, shim and shim seat for scuffing, score marks and uneven wear. Measure the diameter of each lifter and the corresponding lifter bore in the head (see illustrations). Compare the results to the Specifications.

11 Clean the camshaft and bearing caps with solvent and dry them. Inspect the bearing journals for uneven wear, pitting and evidence of seizure. The camshaft runout should also be checked (to determine if it's bent). This measurement requires a special jig (or V-blocks) and a dial indicator, so it should be done by an automotive machine shop.

12 If the bearing journals appear to be in good condition, measure them with a micrometer (see illustration 11.3 in Chapter 2, Part A) to determine their sizes and whether or not they're out-of-round.

13 Using a micrometer, measure the cam lobe height (see illustration 11.5 in Chapter 2, Part A). Compare the results to the Specifications.

14 To measure camshaft bearing oil clearance, place the camshaft in the cylinder head dry (without lubrication). Don't install the lifters. Place a strip of Plastigage across each bearing journal (see illustration).

15 Install the bearing caps with the arrow on each cap pointing toward the front (RH head) or rear (LH head) and in numerical order from front-to-rear (see illustration).

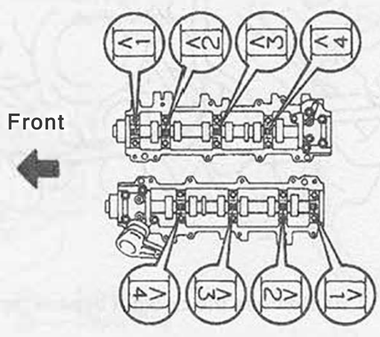
16 Install and tighten the cap bolts following the recommended sequence (see illustration). Work up to the specified torque in three steps. **Caution:** *DO NOT turn the camshaft at any time during this procedure!*

17 Remove the caps and measure the Plastigage at its widest point (see illustration). Compare the readings to the Specifications.

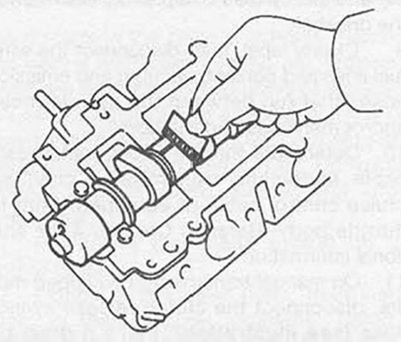
18 Remove the Plastigage with a fingernail or the edge of a credit card. Lubricate the journals with moly-base grease or engine assembly lube and reinstall the bearing caps.

19 Using a dial indicator, check the end play by moving the camshaft back-and-forth (see illustration). Compare the measurement to the Specifications.

20 If any parts fail the inspection, replace them as necessary.



11.15 Install the bearing caps with the arrow on each cap pointing toward the front (RH head) or rear (LH head)



11.17 Compare the width of the crushed Plastigage to the scale on the Plastigage envelope to obtain the clearance -be sure to use the correct scale (inch and metric scales are included)

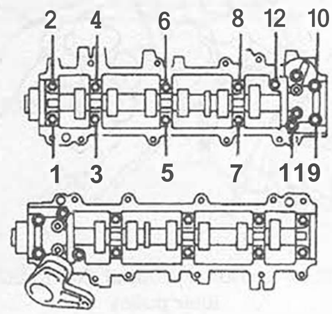
Installation

Refer to illustrations 11.22 and 11.23

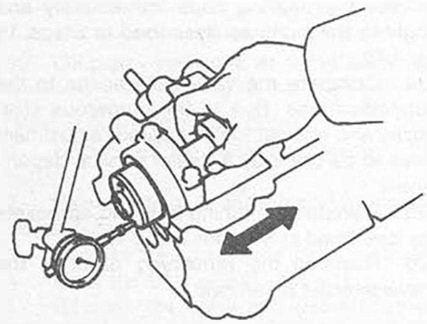
21 The lifters and shims must be returned to their original bores. Coat them with moly-base grease or engine assembly lube and install them in the head.

22 Coat the camshaft and the lip of the new seal with moly-base grease or assembly lube. Place the camshaft in the head. Install the oil seal (see illustration) and camshaft housing plug.

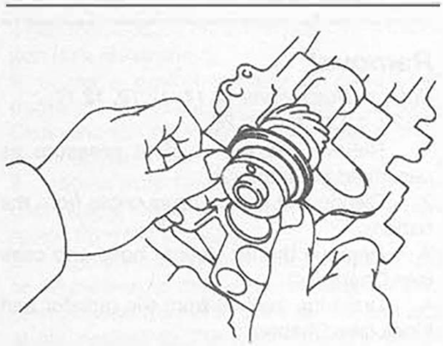
23 Apply a bead of sealant (Toyota no.



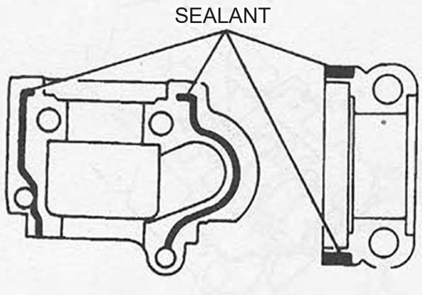
11.16 Camshaft bearing cap bolt TIGHTENING sequence



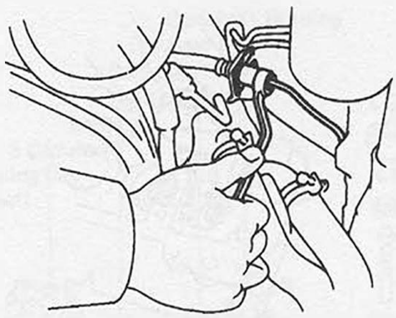
11.19 Move the camshaft back-and forth and read the end play on the dial indicator



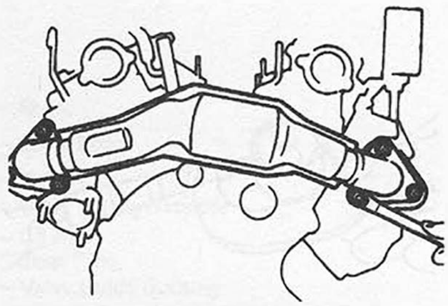
11.22 Before installing the camshafts, slip the oil seals into place . . .



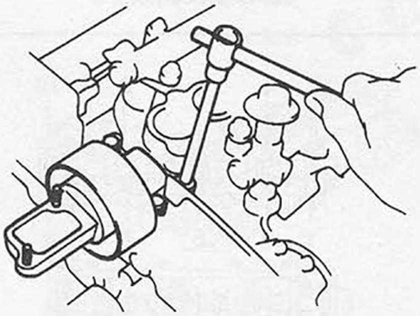
11.23 . . . and apply sealant to the number one and three caps



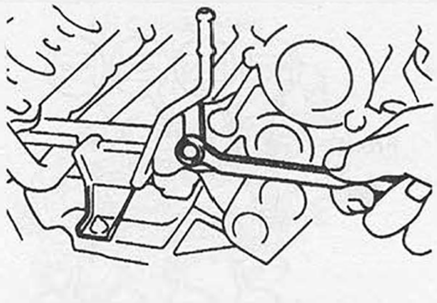
12.11 Disconnect the clutch release cylinder hose at the rear of the engine



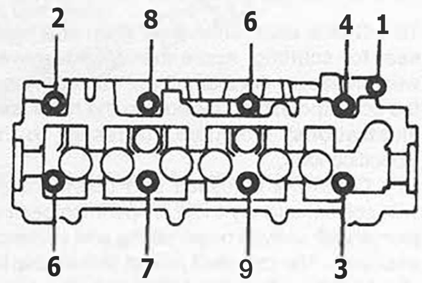
12.12 The crossover pipe, viewed here from the firewall looking **forward,** connects both exhaust manifolds



12.17 Unbolt the upper timing belt idler pulley



12.20 Remove the coolant bypass pipe



12.25 Cylinder head bolt LOOSENING sequence

08826-00080 or equivalent) to the number one and three bearing caps **(see illustration).** Install the bearing caps immediately and tighten the bolts as described in Steps 15 and 16.

24 Compare the valve clearances to the Specifications. Due to the numerous shim sizes and special tools required, adjustment should be done by a dealer service department.

25 Reinstall the timing belt and sprockets as described in Sections 8 and 10.

26 Reinstall the remaining parts in the reverse order of removal.

12 Cylinder heads - removal and installation

Removal

Refer to illustrations 12 11, 12 12, 12 17, 12.20, 12.25 and 12.26

1 Relieve the fuel system pressure as described in Chapter 4.

2 Disconnect the negative cable from the battery.

3 Remove the air cleaner hose and case (see Chapter 4).

4 Drain the coolant from the radiator and block (see Chapter 1).

5 Remove the radiator (see Chapter 3).

6 If you're removing the right head, detach the power steering pump (see Chapter 10).

7 Remove the air conditioning drivebelt, if equipped (see Chapter 1).

8 Remove the cooling fan/clutch assembly and pulley (see Chapter 3), then remove the drivebelt.

9 Clearly label, then disconnect the wires, fuel lines and coolant, vacuum and emissions hoses that run between the cylinder heads and/or manifolds and the body.

10 Detach the throttle cable, transmission cable (automatic transmission only) and cruise control cable (if equipped) from the throttle body. Refer to Chapter 4 for additional information

11 On manual transmission equipped models, disconnect the clutch release cylinder hose **(see illustration).** Place a drain pan under it to catch the fluid.

12 Disconnect the exhaust crossover pipe **(see illustration)** from the exhaust manifolds.

13 Remove the timing belt as described in Section 8.

14 Remove the distributor (Chapter 5) and the spark plug wires (Chapter 1).

15 Remove the air intake chamber (see Chapter 4).

16 Unbolt and remove the rear center (no. 4) timing belt cover.

17 Remove the upper (no. 2) idler pulley **(see illustration).**

18 Remove the rear main (no. 3) timing belt cover.

19 Remove the intake manifold (see Section 5).

20 Unbolt the coolant bypass tube from the front of the left cylinder head **(see illustration).**

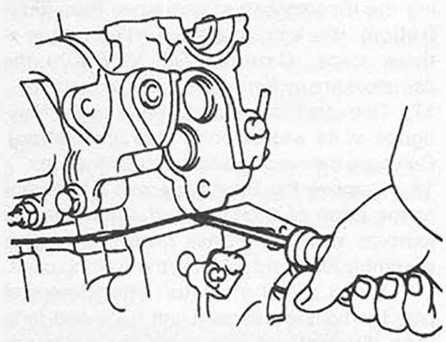
21 If you're removing the left cylinder head, remove the alternator (see Chapter 5) and unbolt the dipstick tube.

22 The exhaust manifold(s) may be removed at this point, if desired (see Section 6). The cylinder heads will be easier to remove if the manifolds are detached.

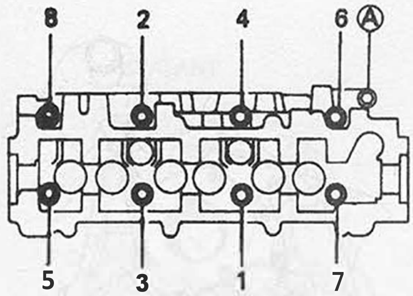
23 Remove the cylinder head cover(s) as described in Section 4.

24 Remove the camshaft(s), following the procedure outlined in Section 11.

25 Using a 12-point socket and a breaker bar, loosen the head bolts in 1/4-turn increments until they can be removed by hand. Follow the factory recommended sequence **(see illustration). Caution:** *The head could warp or crack if the sequence isn't followed.*

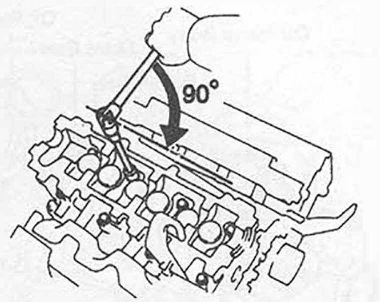


12.26 Pry only on the cast protrusions to dislodge the cylinder head - DO NOT pry between the gasket surfaces!

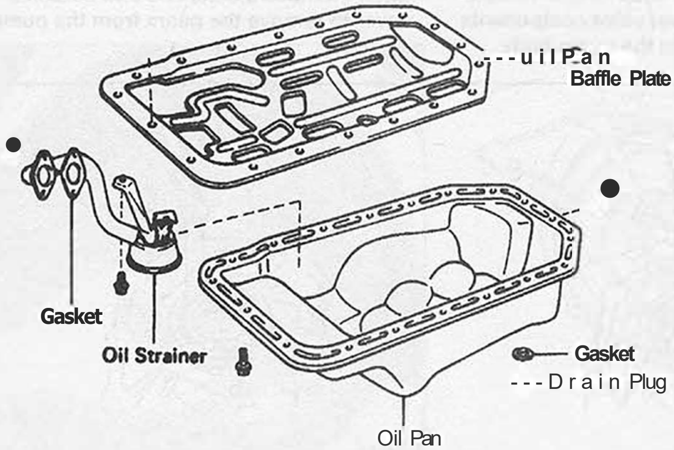


12.32 Cylinder head bolt TIGHTENING sequence

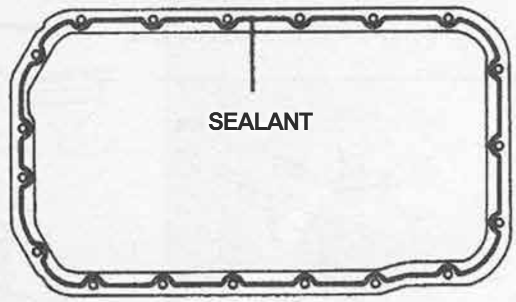
12.33 Apply a dab of paint to the front of each head bolt . . .



12.34 . . . so you can tell when they have been turned an additional 180-degrees total (in two 90-degree steps)



13.5 Oil pan and related components



13.8 Apply sealant to the oil pan (and baffle) flanges - make sure it goes around the inside of the bolt holes

26 Remove the cylinder head(s). If resistance is felt, double-check to make sure all bolts have been removed, then try to dislodge the head by striking it with a wood block and hammer. If prying is required, be very careful not to damage the head or block gasket surfaces **(see illustration).**

27 Refer to Section 11 for the camshaft and lifter removal and installation procedure. Cylinder head disassembly, inspection and reassembly is covered in Part C of Chapter 2.

Installation

Refer to illustrations 12.32, 12.33 and 12.34

28 The mating surfaces of the cylinder head(s) and block must be perfectly clean when the head is installed. 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 may develop. Use a vacuum cleaner to remove any debris that falls into the cylinders.

29 Check the block and 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.

30 Use a tap of the correct size to chase the threads in the head bolt holes. Remove the debris with compressed air. **Warning:** *Wear eye protection when using compressed air! Mount each bolt in* ***a*** *vise and run a die down the threads to remove corrosion and restore damaged threads. Dirt, corrosion, sealant and damaged threads will affect torque readings.*

31 Position a new head gasket on the engine block.

32 Lightly oil the head bolts, then install them in their original locations. Using a 12point socket, tighten the bolts to the Specified torque in three steps. Follow the recommended sequence **(see illustration).** Don't tighten bolt A at this time.

33 Apply a dab of paint to the front of each head bolt (except bolt A) **(see illustration).**

34 Following the same tightening sequence, turn each head bolt an additional 90° (1/ 4-turn) **(see illustration).**

35 As a final step, turn each bolt yet another 90° (1 /4-turn), so that each numbered head bolt has been turned a total of 180° (1/2-turn).

36 Tighten bolt A.

37 Reinstall the remaining parts in the reverse order of removal.

38 Change the oil and filter (see Chapter 1) and check all fluid levels. Run the engine and check for leaks and proper operation.

13 Oil pan - removal and installation

Refer to illustrations 13.5 and 13.8

1 Disconnect the negative cable from the battery.

2 Raise the vehicle and support it securely on jackstands.

3 Remove the undercover (belly-pan).

4 Drain the engine oil (Chapter 1).

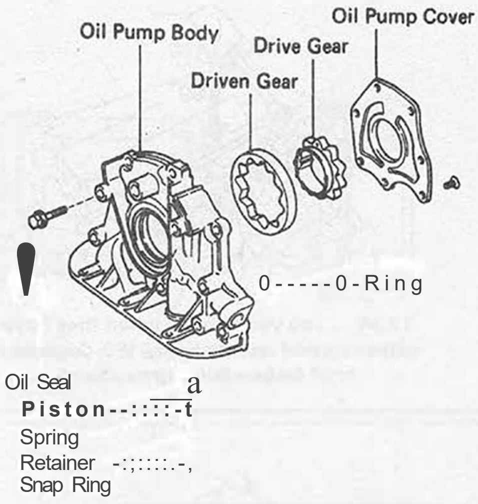
5 Remove the bolts and detach the oil pan. Don't pry between the pan and the block or damage to the sealing surfaces may result and oil leaks could develop. If the pan is stuck, dislodge it with a block of wood and a hammer. Detach the baffle plate from the oil pan **(see illustration).**

6 Use a gasket scraper to remove all traces of old sealant from the pan and block. Clean the mating surfaces with lacquer thinner or acetone.

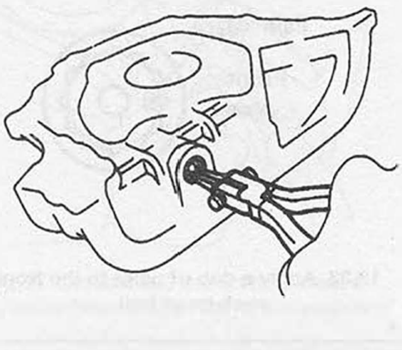
7 Make sure the holes in the block are clean (use a tap to remove any sealant or corrosion from the threads).

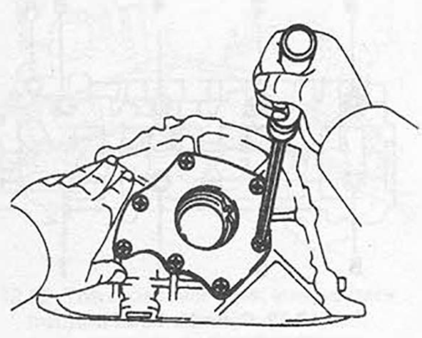
8 Apply sealant (Toyota no. 08826-00080 or equivalent) to the oil pan mating surface, then position the baffle plate on the pan and apply sealant to the baffle plate-to-block mating surface (a 3 mm wide bead should be sufficient) **(see illustration).**

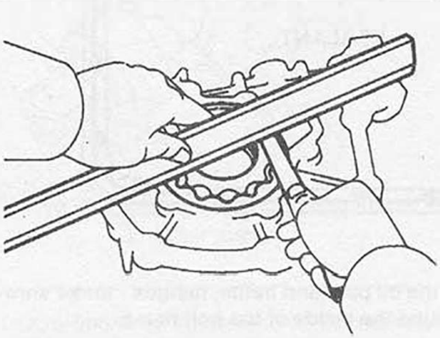
9 Position the pan against the block and

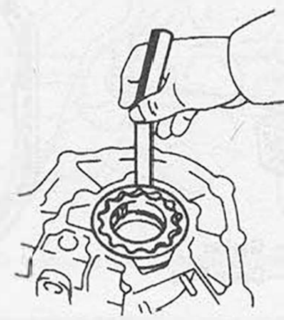


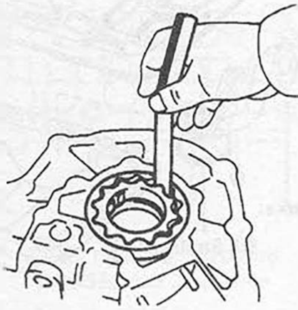
14.3 Oil pump components - exploded view


14.7a Remove the snap-ring to release the oil pressure relief valve components from the bore in the pump body


14.7b Remove the screws and detach the cover to remove the gears from the pump


14.10a Measuring gear side clearance with a precision straightedge and feeler gauge


14.10b Measuring driven gear-to-pump body clearance with a feeler gauge


14.10c Measuring drive gear-to-driven gear clearance with a feeler gauge

install the bolts. Tighten the bolts in three or four steps, working from the center of the pan toward the ends in a spiral pattern.
10 The remaining installation steps are the reverse of removal.

14 Oil pump - removal, inspection and installation

Removal

Refer to illustration 14.3

1 Remove the timing belt as described in Section 8. Remove the crankshaft sprocket (Section 9).
2 Remove the oil pan, baffle and oil strainer (see Section 13).
3 Remove the oil pump-to-engine block bolts **(see illustration).**
4 Use a block of wood and a hammer to break the oil pump gasket seal, then detach the pump from the block.
5 Remove the O-ring **(see illustration 14.3).**
6 Use a scraper to remove old sealant from the oil pump and engine block mating surfaces. Clean them with lacquer thinner or acetone.

Inspection

Refer to illustrations 14.7a, 14.7b, 14.10a, 14.10b and 14.10c

7 Remove the snap-ring and slide out the retainer, spring and oil pressure relief valve piston **(see illustration).** Use a large Phillips screwdriver to remove the screws holding the oil pump cover to the body **(see illustration).** Lift out the gears.
8 Clean all components with solvent, then inspect them for wear and damage.
9 Lubricate the oil pressure relief valve piston with oil and see if it falls smoothly into the bore by its own weight.
10 Check the following clearances with a feeler gauge **(see illustrations)** and compare the measurements to the Specifications:

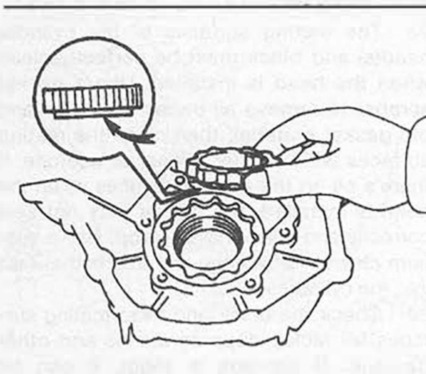
Gear side clearance
Driven gear-to-pump body
Drive gear-to-driven gear

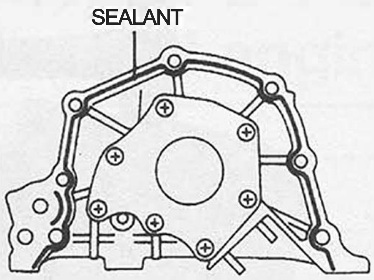
If the clearances aren't as specified, install a new oil pump.

Installation

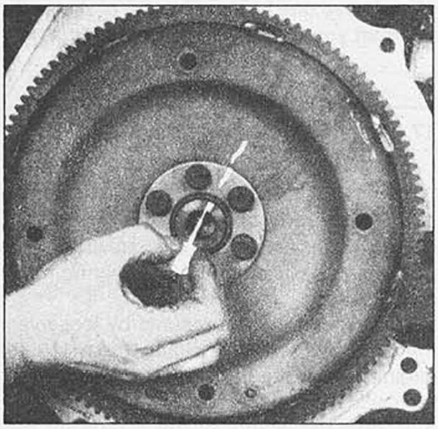
Refer to illustrations 14.13, 14.14, 14.15 and 14.16

11 Pry out the oil seal with a large screwdriver.
12 Apply multi-purpose grease to the outer edge of the new seal. Lay the oil pump body on a workbench and carefully drive the seal into place with a large socket and hammer.
13 Position the drive and driven gears in the oil pump body **(see illustration).** Pack the cavities around the gears with petroleum jelly and install the cover.
14 Apply a 2 mm wide bead of sealant (Toyota no. 08826-00080 or equivalent) to the pump-to-block mating surface **(see illustration).**


14.13 Be sure the drive gear is installed with the shoulder facing in



14.14 Apply sealant to the oil pump body-to-engine block mating surface before installing the pump



15.3 To ensure proper balance, mark the flywheel/driveplate in relationship to the crankshaft

15 Install a new O-ring in the engine block groove **(see illustration).**

16 Install the oil pump over the crankshaft with the spline teeth engaged with the oil pump drive gear **(see illustration).**

17 Install the oil pump bolts and tighten them to the Specified torque in a criss-cross pattern.

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

19 Be sure to add oil, then run the engine and check for oil leaks.

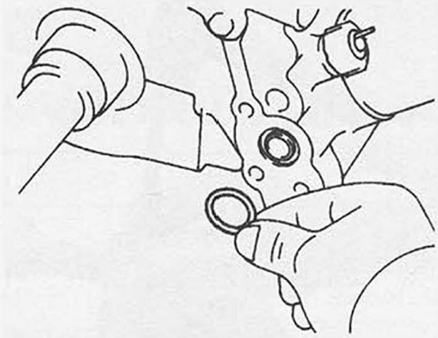
15 Flywheel/driveplate - removal and installation

Refer to illustrations 15.3 and 15.9

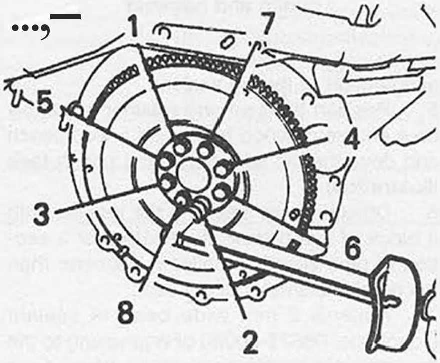
1 Raise the vehicle and support it securely on jackstands, then refer to Chapter 7 and remove the transmission.

2 Remove the pressure plate assembly and clutch disc (Chapter 8) (manual transmission equipped vehicles).

3 Use paint to draw a line from the flywheel to the end of the crankshaft for correct alignment during reinstallation **(see illustration).**



14.15 Use heavy grease to hold the O-ring in the block groove ...



15.9 Flywheel/driveplate bolt TIGHTENING sequence

4 Remove the bolts that secure the flywheel to the crankshaft rear flange. If difficulty is experienced in removing the bolts due to movement of the crankshaft, wedge a screwdriver through the starter opening to keep the flywheel from turning.

5 Remove the flywheel/driveplate from the crankshaft flange.

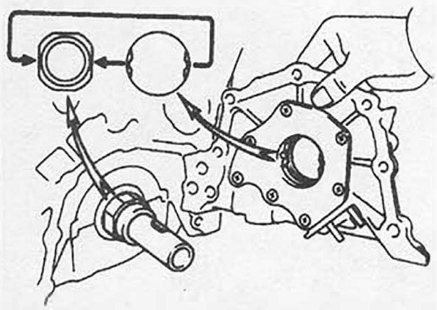
6 Clean any grease or oil from the flywheel. Inspect the surface of the flywheel for rivet grooves, burned areas and score marks. Light scoring can be removed with emery cloth. Check for cracked or broken teeth. Lay the flywheel on a flat surface and use a straightedge to check for warpage.

7 Clean the mating surfaces of the flywheel/driveplate and the crankshaft.

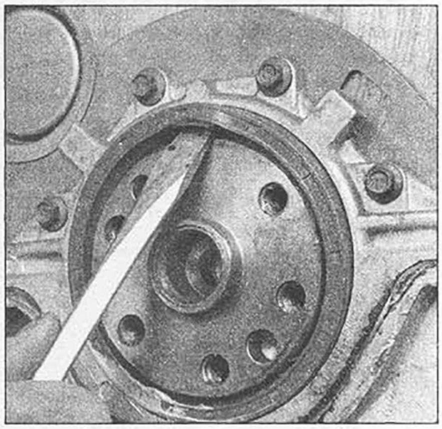
8 Position the flywheel/driveplate against the crankshaft, matching the alignment marks made during removal. Before installing the bolts, apply Loe-Tile to the threads.

9 Wedge a screwdriver through the starter motor opening to keep the flywheel from turning. Tighten the bolts to the specified torque in two or three steps. Follow the recommended sequence **(see illustration).**

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



14.16 ... then align the crankshaft and drive gear flats and install the oil pump



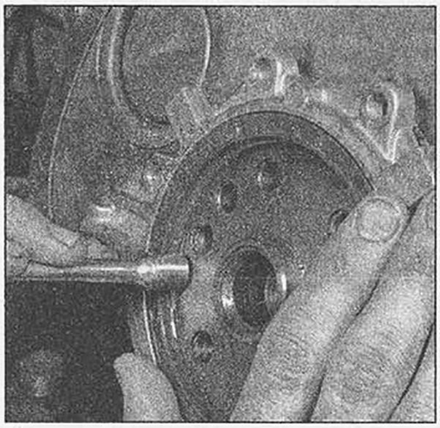
16.2a The quick and dirty way to replace the rear crankshaft oil seal is to simply pry the old one out with a screwdriver and push the new one into the retainer bore - the trouble is, the seal lip is pretty stiff and can easily be damaged during installation if you're not careful

16 Rear crankshaft oil seal - replacement

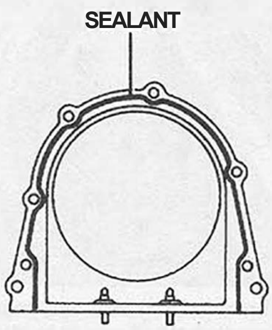
Refer to illustrations 16.2a, 16.2b, 16.5, 16.6 and 16.7

1 The transmission must be removed from the vehicle for this procedure (see Chapter 7) and the flywheel/driveplate must be separated from the engine (see Section 15).

2 The seal can be replaced without dropping the oil pan or removing the seal retainer. However, this method is not recommended because the lip of the seal is quite stiff and it's possible to cock the seal in the retainer bore or damage it during installation. If you want to take the chance, pry out the old seal with a screwdriver **(see illustration).** Apply moly-base grease to the crankshaft seal journal and the lip of the new seal and carefully push the new seal into place. The lip is stiff, so carefully work it onto the crankshaft with a smooth object like the end of an extension **(see illustration)** as you tap the seal into place. Don't rush it or you may damage the seal.



16.2b The seal is quite stiff and won't slide over the end of the crankshaft very easily, so lubricate the lip with moly base grease and carefully work it over the crankshaft journal with a smooth, blunt object to avoid damaging it



16.7 Apply sealant to the oil seal retainer-to-block mating surface before bolting it to the engine

3 The following method is recommended but requires removal of the oil pan (see Section 1 3) and the seal retainer.

4 After the oil pan has been removed, remove the bolts, detach the seal retainer and peel off all the old sealant.

5 Position the seal and retainer assembly on a couple of wood blocks on a workbench and drive the old seal out with a punch **(see illustration).**

6 Drive the new seal into the retainer with a block of wood **(see illustration)** or a section of pipe slightly smaller in diameter than the outside diameter of the seal.

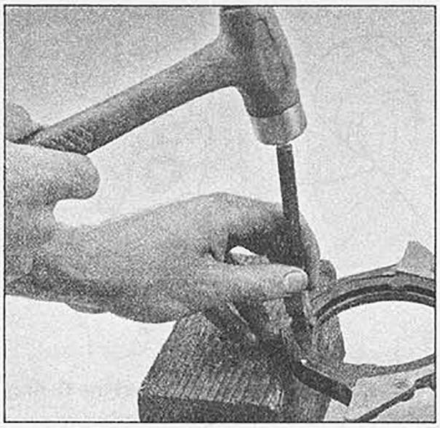
7 Apply a 2 mm wide bead of sealant (Toyota no. 08826-00080 or equivalent) to the seal retainer-to-block mating surface **(see illustration).**

8 Lubricate the crankshaft seal journal and the li of the new seal with moly base grease.

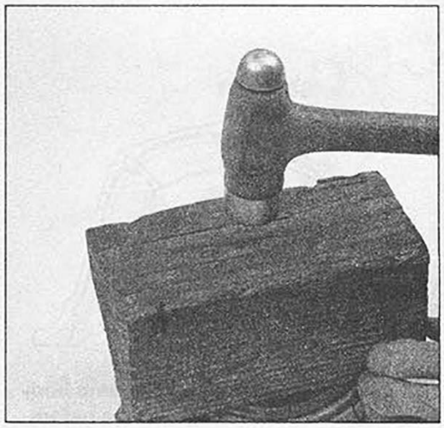
9 Slowly and carefully push the seal onto the crankshaft. The seal lip is stiff, so work it onto the crankshaft with a smooth object such as the end of an extension **(see illustration 16.2b)** as you push the retainer against the block.

10 Install and tighten all the retainer bolts to the specified torque.

11 The remaining steps are the reverse of removal.



16.5 After removing the retainer from the engine, support it on a couple of wood blocks and drive out the old seal **with a** punch and hammer



16.6 Drive the new seal into the retainer with a block of wood or a section of pipe, if you have one large enough - make sure that you don't cock the seal in the retainer bore

17 Engine mounts - check and replacement

1 Engine mounts should be periodically inspected for hardening or cracking of the rubber and separation of the rubber from the metal backing.

2 Replace the front mounts by loosening the nuts and bolts retaining them to the engine mounting bracket and chassis on both sides of the engine.

3 Take the weight of the engine off the mounts by placing a jack and wooden block under the oil pan. Carefully raise the engine enough to allow removal of the mount(s). Extreme caution should be exercised during this procedure.

4 If you intend to use the old mounts again, mark them clearly to ensure that they're installed, right side up, on the same side as before. Remove the nuts and bolts retaining the mounts and detach the mounts, noting the correct installed position.

5 Installation is the reverse of the removal procedure.

Chapter 2 Part C
General engine overhaul procedures

Contents

	Section
Crankshaft - inspection	18
Crankshaft - installation and main bearing oil clearance check	22
Crankshaft - removal	13
Cylinder head - cleaning and inspection	9
Cylinder head - disassembly	8
Cylinder head - reassembly	11
Cylinder compression check	3
Cylinder honing	16
Engine block - cleaning	14
Engine block - inspection	15
Engine overhaul - disassembly sequence	7
Engine overhaul - general information	2
Engine overhaul - reassembly sequence	20
Engine rebuilding alternatives	6
Engine - removal and installation	5
Engine removal - methods and precautions	4
General information	1
Initial start-up and break-in after overhaul	25
Main and connecting rod bearings - inspection and main bearing selection	19
Piston/connecting rod assembly - inspection	17
Piston/connecting rod assembly - installation and rod bearing oil clearance check	24
Piston/connecting rod assembly - removal	12
Piston rings - installation	21
Rear main oil seal installation	23
Valves - servicing	10

Specifications

Four-cylinder engines

General

Oil pressure	
At idle	4.3 psi minimum
At 3000 rpm	36 to 71 psi
Compression pressure	
Four-cylinder	
Non-turbo	
Standard	171
Minimum	128
Turbo	
Standard	149
Minimum	121

Camshaft and rocker arms — See Chapter 2, Part A

Cylinder head warpage limit

Block surface	0.0059 in (0.15 mm)
Manifold surface	0.0079 in (0.20 mm)

Valves

Valve stem diameter	
Intake	
1979 and 1980	0.3138 to 0.3146 in (7.970 to 7.990 mm)
1981 through 1983	0.3138 to 0.3145 in (7.970 to 7.985 mm)
1984 on	0.3138 to 0.3144 in (7.970 to 7.985 mm)
Exhaust (all years)	0.3136 to 0.3142 in (7.965 to 7.980 mm)
Valve face angle	44.5-degrees
Valve margin width	
Non-turbo	0.024 in (0.6 mm)
Turbo	
Intake	0.035 in (0.9 mm)
Exhaust	0.043 in (1.1 mm)
Valve spring free length	
Through 1984	1.803 in (45.8 mm)
1985 on	1.909 in (48.5 mm)
Valve spring installed height	1.594 in (40.5 mm)
Valve spring out-of-square limit	
20R engine	0.075 in (1.9 mm)
22R, 22R-E engines	0.063 in (1.6 mm)

Four-cylinder engines (continued)

Valves (continued)

Valve guide inside diameter	
20R engine	0.319 to 0.337 in (8.1 to 8.3 mm)
22R, 22R-E engines	0.3154 to 0.3161 in (8.01 to 8.03 mm)
Valve stem-to-guide clearance	
Standard	
Intake	
Through 1985	0.0008 to 0.0024 in (0.02 to 0.06 mm)
1986 on	0.0010 to 0.0024 in (0.025 to 0.06 mm)
Exhaust	
20R and 1984 22R engine	0.0012 to 0.0028 in (0.03 to 0.07 mm)
1981 through 1983 22R; 1985 through 1991 22R, 22R-E engine	0.0012 to 0.0026 in (0.03 to 0.07 mm)
Limit	
Intake	0.0031 in (0.08 mm)
Exhaust	0.0039 in (0.10 mm)
Valve seat	
Angle	45-degrees
Width	0.047 to 0.063 in (1.2 to 1.6 mm)

Engine block

Deck distortion limit	0.002 in (0.05 mm)
Cylinder bore diameter	
20R engine	3.4842 to 3.4854 in (88.50 to 88.53 mm)
22R engine (through 1988)	3.6220 to 3.6232 in (92.00 to 92.03 mm)
22R, 22R-E engine (1989 on)	3.6220 to 3.6224 in (92.00 to 92.01 mm)
Cylinder bore out-of-round limit	0.0008 in (0.02 mm)
Cylinder bore taper limit	
Through 1987 and 1990	0.0008 in (0.02 mm)
1988 and 1989	0.0004 in (0.01 mm)
Piston-to-bore clearance	
20R engine	0.0012 to 0.0020 in (0.03 to 0.05 mm)
22R engine	
Through 1984	0.0020 to 0.0028 in (0.052 to 0.072 mm)
1985	0.0012 to 0.0020 in (0.03 to 0.05 mm)
1986	
22R, 22R-E	0.0012 to 0.0020 in (0.03 to 0.05 mm)
22R-TE	0.0022 to 0.0030 in (0.055 to 0.075 mm)
1987 and 1988	
22R, 22R-E	0.0008 to 0.0016 in (0.02 to 0.04 mm)
22R-TE	0.0022 to 0.0030 in (0.055 to 0.075 mm)
1989 on	0.0006 to 0.0014 in (0.015 to 0.035 mm)

Pistons and rings

Diameter	
20R engine	3.4827 to 3.4839 in (88.46 to 88.49 mm)
22R, 22R-E, 22R-TE engines	
Through 1985	3.6196 to 3.6208 in (91.938 to 91.968 mm)
1986	
22R, 22R-E	3.6205 to 3.6216 in (91.960 to 91.990 mm)
22R-TE	3.6195 to 3.6207 in (91.935 to 91.965 mm)
1987 and 1988	
22R, 22R-E	3.6209 to 3.6220 in (91.970 to 92.000 mm)
22R-TE	3.6195 to 3.6207 in (91.935 to 91.965 mm)
1989 on	3.6211 to 3.6214 in (91.975 to 91.985 mm)
Piston ring end gap	
20R engine	0.004 to 0.012 in (0.1 to 0.3 mm)
22R, 22R-E, 22R-TE engines	
1981 and 1982	
Top compression ring	0.009 to 0.014 in (0.2 to 0.4 mm)
Second compression ring	0.007 to 0.015 in (0.2 to 0.4 mm)
1983 through 1985	
Top compression ring	0.009 to 0.015 in (0.24 to 0.39 mm)
Second compression ring	0.007 to 0.017 in (0.18 to 0.42 mm)
Oil ring	0.008 to 0.032 in (0.20 to 0.82 mm)
1986	
Top compression ring	0.014 to 0.022 in (0.35 to 0.57 mm)
Second compression ring	0.010 to 0.019 in (0.25 to 0.47 mm)
Oil ring	0.008 to 0.032 in (0.20 to 0.82 mm)

1987 on	
Top compression ring	0.010 to O.D19 in (0.25 to 0.47 mm)
Second compression ring	0.024 to 0.032 in (0.60 to 0.82 mm}
Oil ring	0.008 to 0.022 in (0.20 to 0.57 mm)
Piston ring side clearance (maximum}	0.008 in (0.2 mm)

Crankshaft, connecting rods and main bearings

Connecting rod end play (side clearance)	
Standard	0.0063 to 0.0102 in (0.16 to 0.26 mm)
Limit	0.0118 in (0.30 mm)
Crankshaft end play	
Standard	0.0008 to 0.0080 in (0.02 to 0.20 mm)
Limit	0.0118 in (0.30 mm)
Crankshaft runout limit	0.004 in 19.1
Main bearing journal diameter	2.3614 to 2.3622 in (59.98 to 60.00 mm)
Connecting rod journal diameter	2.0861 to 2.0866 in (52.99 to 53.00 mm)
Journal taper/out-of-round limit	0.0004 in (0.01 mm)
Main bearing oil clearance	
Standard	
20R engine	0.0010 to 0.0022 in (0.025 to 0.055 mm)
22R engine	
Thru 1983	0.0006 to 0.0020 in (0.016 to 0.050 mm)
1984 on	0.0010 to 0.0022 in (0.025 to 0.055 mm)
Limit	0.0031 in (0.08 mm)
Connecting rod bearing oil clearance	
Standard	
20R engine	0.0012 to 0.0028 in (0.03 to 0.07 mm)
22R engine	
Thru 1983	0.0008 to 0.0020 in (0.02 to 0.05 mm)
1984 on	0.0010 to 0.0022 in (0.025 to 0.055 mm)
Limit	0.004 in (0.1 mm)
Flywheel runout limit	0.008 in (0.2 mm)

Torque specifications*	**Ft-lbs**
Main bearing cap bolts	76
Connecting rod cap nuts	
Thru 1985	46
1986	43
1987 on	51

'**Note:** *Refer to Part A for additional torque specifications.*

V6 engine

General

Oil pressure	
At idle	4.3 psi
At 3000 rpm	36 to 71 psi
Compression pressure at 300 rpm	
Standard	171 psi
Minimum	142 psi
Maximum difference between cylinders	14 psi
Camshaft and lifters	See Chapter 2, Part B
Cylinder head warpage limit	0.004 in (0.10 mm)

Valves and seats

Valve stem diameter	
Intake	0.3138 to 0.3144 in (7.970 to 7.985 mm)
Exhaust	0.3136 to 0.3142 in (7.965 to 7.980 mm)
Valve guide inside diameter	0.3154 to 0.3161 in (8.01 Oto 8.030 mm)
Valve stem-to-guide clearance	
Standard	
Intake	0.0010 to 0.0024 in (0.025 to 0.060 mm)
Exhaust	0.0012 to 0.0026 in (0.040 to 0.073 mm)
Limit	
Intake	0.0031 in (0.08 mm)
Exhaust	0.0039 in (0.10 mm)
Valve margin width limit	0.051 in (1.3 mm)
Valve length	4.094 to 4.106 in (104.0 to 104.3 mm)
Valve stem end grinding limit	0.020 in (0.5 mm)

V6 engine (continued)

Valves and seats (continued)

Valve spring free length	
1989	1.8197 in (46.22 mm)
1990 on	1.8508 in (47.01 mm)
Valve spring pressure/height	1.575 in@ 57.0 lbs (40.0 mm@ 26 Kg)
Valve spring out-of-square limit	0.0634 in (1.61 mm)
Valve spring installed height	1.575 in (40.0 mm)
Valve seats	
Angle (intake and exhaust)	45-degrees
Width	0.047 to 0.063 in (1.2 to 1.6 mm)

Engine block

Deck distortion limit	0.0020 in (0.05 mm)
Cylinder bore	
Diameter (standard)	
Grade no. 1 - std. size	3.4449 to 3.4453 in (87.500 to 87.510 mm)
Grade no. 2	3.4453 to 3.4457 in (87.511 to 87.520 mm)
Grade no. 3	3.4457 to 3.4461 in (87.520 to 87.530 mm)
Wear limit	0.008 in (0.2 mm)
Taper/out-of-round limit	0.0008 in (0.02 mm)

Pistons and rings

Piston diameter	
1989 through 1991	
Grade no. 1 - std. size	3.4413 to 3.4417 in (87.410 to 87.420 mm)
Grade no. 2	3.4418 to 3.4421 in (87.421 to 87.430 mm)
Grade no. 3	3.4422 to 3.4425 in (87.431 to 87.440 mm)
1992 on	
Grade no. 1 - std. size	3.4394 to 3.4398 in (87.360 to 87.370 mm)
Grade no. 2	3.4398 to 3.4402 in (87.370 to 87.380 mm)
Grade no. 3	3.4402 to 3.4406 in (87.380 to 87.390 mm)
Piston-to-bore clearance	
1989 through 1991	0.0031 to 0.0039 in (0.080 to 0.1 mm)
1992 on	0.0051 to 0.0059 in (0.13 to 0.15)
Piston ring side clearance (compression rings only)	
Standard	0.2 to 0.0028 in (0.03 to 0.07 mm)
Limit	0.0079 in (0.2 mm)
Piston ring end gap	
Top compression ring	
1989 through 1992	
Standard	0.0091 to 0.0130 in. (0.23 to 0.33 mm)
Limit	0.0327 in. (0.83 mm)
1993 on	
Standard	0.0110 to 0.0197 in. (0.28 to 0.50 mm)
Limit	0.0433 in. (1.10 mm)
Second compression ring	
1989 through 1992	
Standard	0.0150 to 0.0189 in. (0.38 to 0.48 mm)
Limit	0.0366 in. (0.93 mm)
1993 on	
Standard	0.0150 to 0.0236 in. (0.38 to 0.60 mm)
Limit	0.0472 in. (1.20 mm)
Oil control ring	
1989 through 1992	
Standard	0.0059 to 0.0157 in. (0.15 to 0.40 mm)
Limit	0.0354 in. (0.90 mm)
1993 on	
Standard	0.0059 to 0.0197 in. (0.15 to 0.50 mm)
Limit	0.0433 in. (1.10 mm)

Crankshaft and connecting rods

Connecting rod end play (side clearance)	
Standard	0.0059 to 0.0130 in (0.15 to 0.33 mm)
Limit	o·50 in (0.38 mm)
Crankshaft end play	
Standard	0.0008 to 0.0098 in (0.02 to 0.22 mm)
Limit	0.8 in (0.30 mm)
Main journal diameter	
Grade no. 0	2.5195 to 2.5197 in (63.996 to 64.000 mm)

Grade no. 1	2.5193 to 2.5195 in (63.990 to 63.995 mm)
Grade no. 2	2.5191 to 2.5193 in (63.985 to 63.990 mm)
Connecting rod journal diameter	2.1648 to 2.1654 in (54.987 to 55.000 mm)
Journal taper/out-of-round limit	0.0008 in (0.020 mm)
Crankshaft runout limit	0.0024 in (0.06 mm)
Main bearing oil clearance	
Standard	0.0009 to 0.0017 in (0.024 to 0.042 mm)
Limit	0.0031 in (0.080 mm)
Connecting rod bearing oil clearance	
Standard	0.0009 to 0.0021 in (0.024 to 0.054 mm)
Limit 0.0031 in (0.080 mm)	

Torque specifications*	**Ft-lbs** (unless otherwise indicated)
Main bearing cap bolts	
Step 1	45
Step 2	Turn an additional 90° (1/4-turn)
Connecting rod cap nuts	
Step 1	18
Step 2	Turn an additional 90° (1/4-turn)
Rear oil seal retainer bolts	69 in-lbs

'**Note:** *Refer to Part B for additional torque specifications.*

1 General information

Included in this portion of Chapter 2 are the general overhaul procedures for the cylinder head(s) 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 Part A or B of this Chapter and Section 7 of this Part.

The Specifications included here in Part C are only those necessary for the inspection and overhaul procedures which follow. Refer to Parts A and B for additional Specifications.

2 Engine overhaul - general information

Refer to illustration 2.4

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.

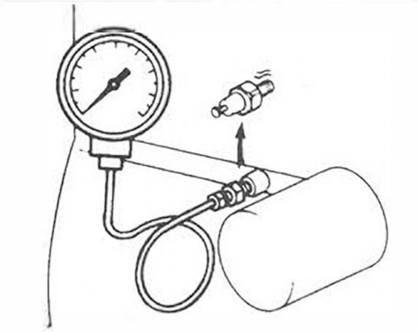
Excessive oil consumption is an indication that piston rings, valve seals and/or valve guides are in need of attention. Make sure that oil leaks aren't responsible before deciding that the rings and/or guides are bad. Have a cylinder compression or leakdown test performed by an experienced tune-up mechanic to determine the extent of the work required.

If the engine is making obvious knocking or rumbling noises, the connecting rod and/or main bearings may be at fault. Check the oil pressure with a gauge installed in place of the oil pressure sending unit **(see illustration)** and compare it to the Specifications. If it's extremely low, the bearings and/or oil pump are probably worn out.

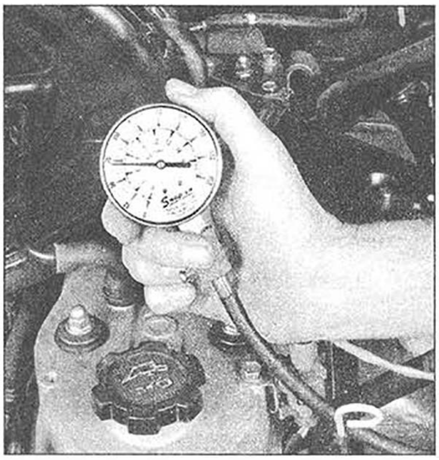
Loss of power, rough running, excessive valve train noise and nigh fuel consumption rates may also point to the need for an overhaul, especially if they're all present at the same time. If a complete tune-up doesn't remedy the situation, major mechanical work is the only solution.

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 (rebored and/or honed). If a rebore is done, new pistons are required. The main and connecting rod 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 MUST 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; if in doubt, replace it with a new one. Also, we don't recommend overhauling the oil pump - always install a new one 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



2.4 The oil pressure can be checked by removing the oil pressure switch (adjacent to the oil filter) and installing a pressure gauge in the hole



3.4 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 - be sure to open the throttle and choke valves as far as possible during the compression check!

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.

3 Cylinder compression check

Refer to illustration 3.4

1 A compression check will tell you what mechanical condition the upper end (pistons, rings, valves, head gaskets) of your engine 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. Also, if the engine is equipped with a carburetor, the choke valve must be all the way open to get an accurate compression reading (if the engine's warm, the choke should be open).*

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. Remove all of the spark plugs from the engine (Chapter 1)

3 Block the throttle wide open. Detach the large coil wire from the distributor cap and ground it on the engine block. Use a heavy jumper wire with alligator clips at both ends to ensure a good ground.

4 With the compression gauge in the number one spark plug hole **(see illustration),** depress the accelerator pedal all the way to the floor to open the throttle valve. Crank the engine over at least four 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). Record the highest gauge reading obtained.

5 Repeat the procedure for the remaining cylinders and compare the results to the Specifications.

6 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.

7 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 incorrect clearances, burned valve seats and/or faces or warped, cracked or bent valves.

8 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.

9 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.

10 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 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 accessories. 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 beforehand all of the operations possible without it. 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.

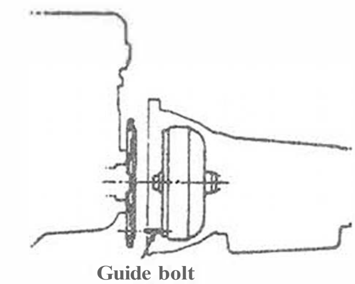
5 Engine - removal and installation

Removal

1 The engine can be removed from the vehicle in one of two ways. One is with the engine and transmission handled as a unit. The other is with the engine separated from the transmission before removal from the vehicle. The procedure outlined here is for removing the engine and transmission as a unit. If you choose to remove only the engine. leaving the transmission in place in the vehicle, refer to Chapter 7 for the procedure to follow when separating the engine from the transmission.

2 Before proceeding, read Section 4, *Engine removal - methods and precautions.*

3 The following sequence of operations doesn't have to be performed in any specific order. It's simply a checklist of everything that must be disconnected or removed before the engine and transmission can be lifted out of the vehicle. It's very important that all linkages. electrical wires, hoses and cables be removed or disconnected before attempting to lift the engine out, so double-check everything carefully. **Warning:** *If the vehicle is equipped with air conditioning, have the system discharged by a service station before disconnecting any of the lines. DO NOT attempt it at home - serious injury or*



5.29 Use guide bolts to ensure correct alignment of the engine and transmission

damage could result!

4 Scribe or paint around the hood hinge brackets on the hood (to ensure proper alignment of the hood during reinstallation). Remove the bolts and lift the hood carefully away from the vehicle (with the help of an assistant) (see Chapter 11).

5 Raise the vehicle and support it on jackstands. Remove the belly pan.

6 Disconnect both battery cables from the battery (negative first, then positive), remove the battery hold-down and lift the battery out of the vehicle. Disconnect the battery cable from the starter motor terminal.

7 Drain the engine oil and the transmission lubricant (see Chapter 1).

8 Remove the fan shroud and radiator (see Chapter 3).

9 If the vehicle is equipped with power steering or air conditioning, remove the drivebelt and pump or compressor mounting bolts. Lay the pump or compressor aside without disconnecting the hoses.

10 Remove the fan, fan pulley and drivebelt (see Chapter 3).

11 Remove the air cleaner (refer to Chapter 4).

12 On fuel injected models, relieve the fuel system pressure (see Chapter 4).

13 Clearly label, then detach all coolant, vacuum, fuel and emissions hoses, electrical wires and ground straps that connect the engine/transmission to the vehicle.

14 Clearly label and disconnect all control cables and linkages from the carburetor or throttle body and the transmission. Refer to Chapters 4 and 7 as necessary.

15 Remove the driveshaft (see Chapter 8).

16 Disconnect the speedometer cable.

17 Disconnect the exhaust pipe clamp from the transmission housing.

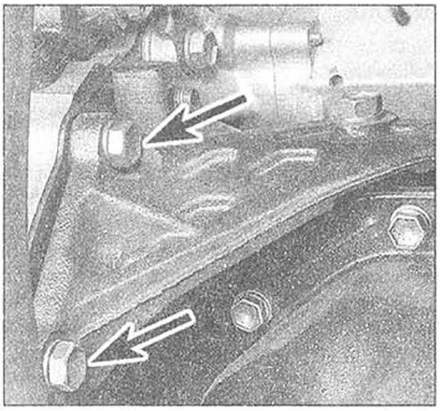
18 Disconnect the exhaust pipe from the exhaust manifold (see Chapter 4).

19 Disconnect the shift lever linkage (automatic transmission).

20 Remove the clutch release cylinder and hose bracket mounting bolts (manual transmission) and lay the cylinder alongside the frame.

21 Remove the bolts from the mounts at the front of the engine.

22 Position a jack under the transmission. Be sure to place a block of wood between the jack and the transmission to prevent damage.



5.33 The stiffener plates are attached to the transmission with two bolts (arrows)

23 Unbolt the rear engine mount bracket from the crossmember-

24 Attach the engine hoist chain to the engine's lift brackets.

25 Slowly and carefully lift the engine out of the vehicle. Make sure that all wires and hoses are disconnected.

Separating the engine and transmission

Automatic transmission

Refer to illustration 5.29

26 Remove the starter motor.

27 Remove the cover and stiffener plates from the lower part of the converter housing.

28 Make sure the transmission fluid is completely drained, then remove the six bolts that attach the torque *converter* to the driveplate. The bolts are accessible through the opening in the lower half of the converter housing and can only be removed one at a time. The driveplate will have to be rotated by turning the crankshaft pulley bolt with a wrench.

29 Cut the heads **off** two bolts and thread them into two of the holes vacated by the converter bolts **(see illustration).**

30 Remove the bolts that attach the converter housing to the engine block.

31 Using one guide bolt as a pivot, insert a screwdriver between the engine rear plate and the bolt and pry the transmission away from the engine. A detailed and illustrated description of automatic transmission removal is included in Chapter 7, Part B.

Manual transmission

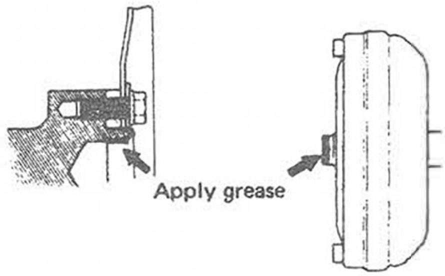
Refer to illustration 5.33

32 Remove the mounting bolts and separate the starter motor from the bellhousing.

33 Remove the bolts attaching the transmission to the engine block and stiffener plates (see **illustration).**

34 Support the transmission near the front and pull straight back until it's free. Don't let the transmission slip and fall, as damage to the input shaft could result.

35 Refer to Chapter 8 and remove the clutch assembly from the flywheel. A detailed and illustrated description of manual transmission removal is included in Chapter 7, Part A.



5.39 Apply grease to the areas indicated before rejoining the engine and **automatic transmission**

Rejoining the engine and transmission

Automatic transmission

Refer to illustration 5.39

36 This procedure is basically the reverse of removal.

37 Make sure the torque converter is properly installed in the converter housing. The driveplate mounting bosses should be the specified distance from the housing-to-engine block mating surface.

38 Install one of the guide bolts (used when separating the tr11nsmission from the engine) in one of the lower torque converter-to-driveplate bolt ho!es.

39 Apply a layer of multi-purpose grease to the recess in the end of the crankshaft **(see illustration).**

40 Support the transmission and carefully guide it into position on the engine. The guide bolt should pass through the lower driveplate hole and the torque converter should enter the crankshaft recess.

41 Align the engine block dowel pins with the holes in the housing, then install the mounting bolts and tighten them securely.

42 Install the torque converter-to-driveplate mounting bolts and tighten them in several steps, using a criss-cross pattern, to the specified torque. Turn the crankshaft as required to expose the bolts.

43 Install the cover and stiffener plates and tighten the bolts securely.

44 Attach the starter motor to the housing and tighten the bolts securely.

Manual transmission

45 This procedure is basically the reverse of removal. Refer to Chapter 8 and attach the clutch assembly to the flywheel before proceeding.

46 Apply multi-purpose grease to the splines of the transmission input shaft, then carefully guide the input shaft into the clutch assembly until the bellhousing seats against the engine block. The splines on the shaft must mesh with the splines in the clutch disc and the end of the shaft must fit into the pilot bearing in the crankshaft.

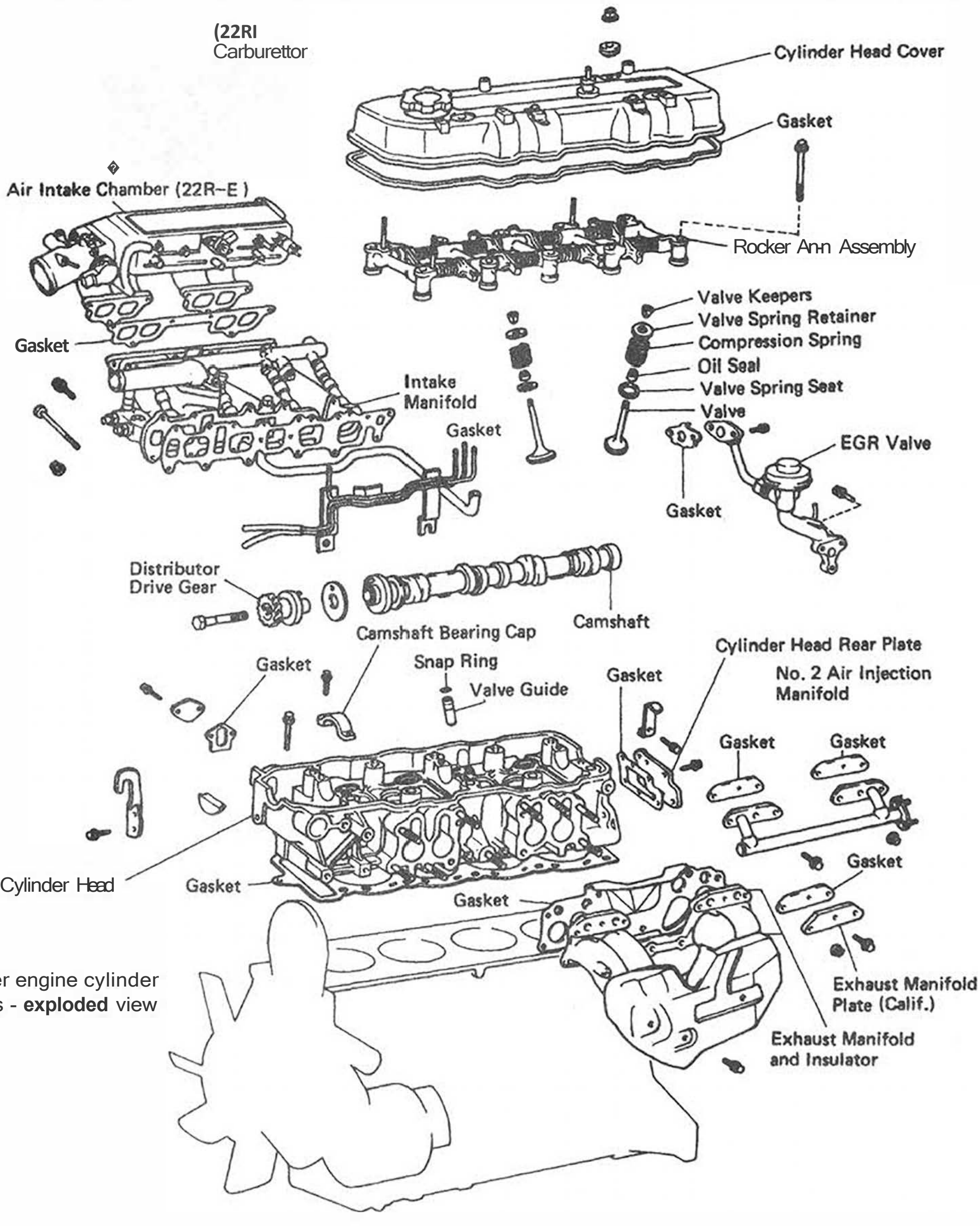
47 Install the bolts securing the bellhousing to the engine and tighten them securely.
48 Attach the starter motor and tighten the bolts.
49 Install and tighten the stiffener plate bolts.

Installation

50 Raise the vehicle and support it securely on jackstands.
51 Attach the engine to the hoist just like it was during removal and raise the engine until it clears the front of the vehicle. Don't let the engine swing freely.
52 Angle the transmission steeply toward the back of the vehicle and carefully lower the engine into place. Work slowly and use the transmission and hoist to direct the engine to its proper location on the motor mounts.
53 With the engine in place (still attached to the hoist). support the transmission with a jack and install the front motor mount bolts. Tighten them finger tight only.
54 Remove the hoist and move it out of the way.
55 Install the transmission support crossmember by raising or lowering the jack as necessary. Tighten the nuts attaching the transmission to the crossmember and the bolts holding the crossmember to the frame.
56 Tighten the motor mount bolts securely.
57 Install and connect the remaining parts in the reverse order of removal.
58 Refill the crankcase with oil and add coolant as outlined in Chapter 1. Refill the transmission as required.
59 Run the engine and check for proper operation and leaks.
60 Recheck all fluid levels.

6 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,



7.5a Four-cylinder engine cylinder head components - **exploded** view 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.

Crankshaft kit - This rebuild package consists of a reground crankshaft and a matched set of pistons and connecting rods. The pistons will already be installed on the connecting rods. Piston rings and the necessary bearings will be included in the kit. These kits are commonly available for standard cylinder bores, as well as for engine blocks which have been bored to a regular oversize.

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 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), cylinder head cover(s), camshaft(s) and valve train components, timing sprockets and chain or belt and timing chain 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.

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.

7 Engine overhaul - disassembly sequence

Refer to illustrations 7.Sa, 7.Sb, 7.Sc. 7.Sd and 7.Se

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 nrental yard. Before **the** engine is mounted on a stand, the flywheel/driveplate 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 a sturdy workbench or 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:

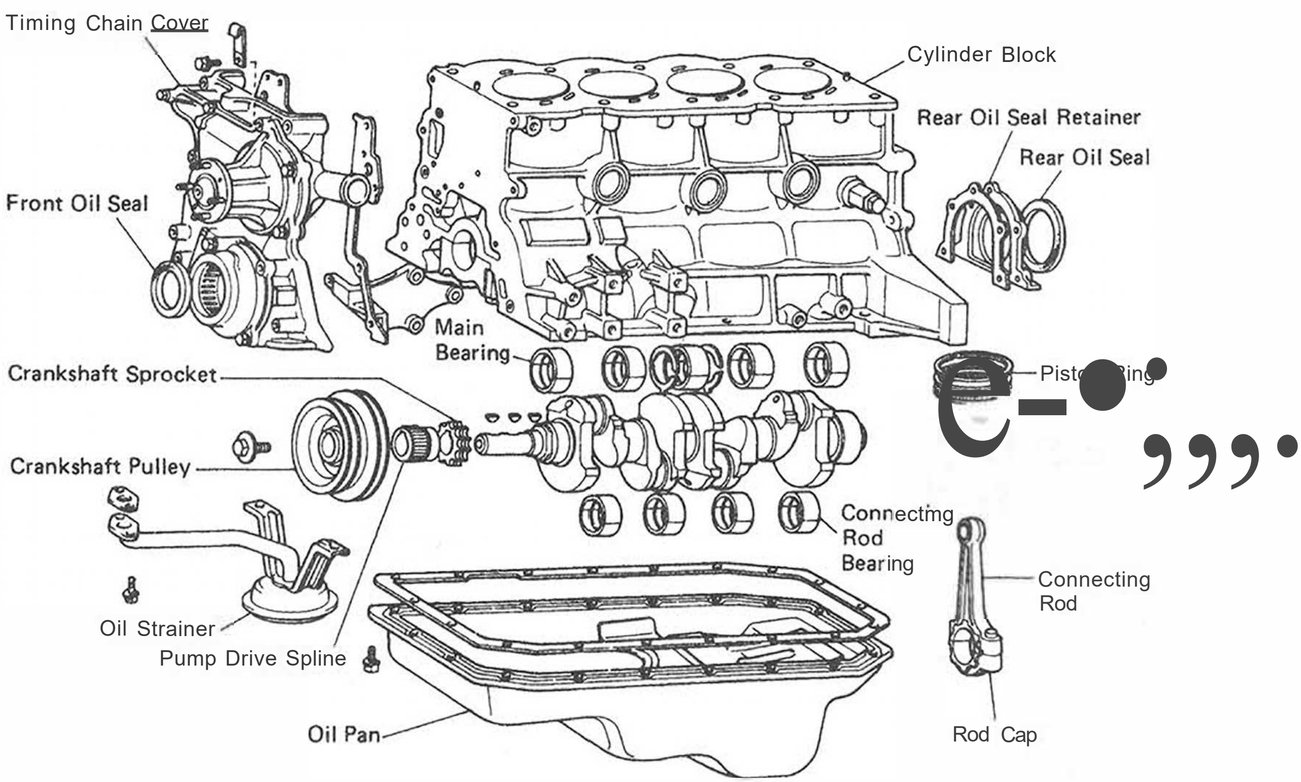
Alternator and brackets
AIC compressor and brackets
Power-steering pump and brackets
Emissions control components
Distributor, spark plug wires and spark plugs
Thermostat and housing cover
Water pump
Fuel injection components or carburetor
Intake/exhaust manifolds
Oil filter
Engine mounts
Clutch and f/ywheel/driveplate

Note: *When removing the external components from the engine, pay close attention to 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 **(see illustrations):**

Rocker arm/cylinder head cover(s)
Intake and exhaust manifolds

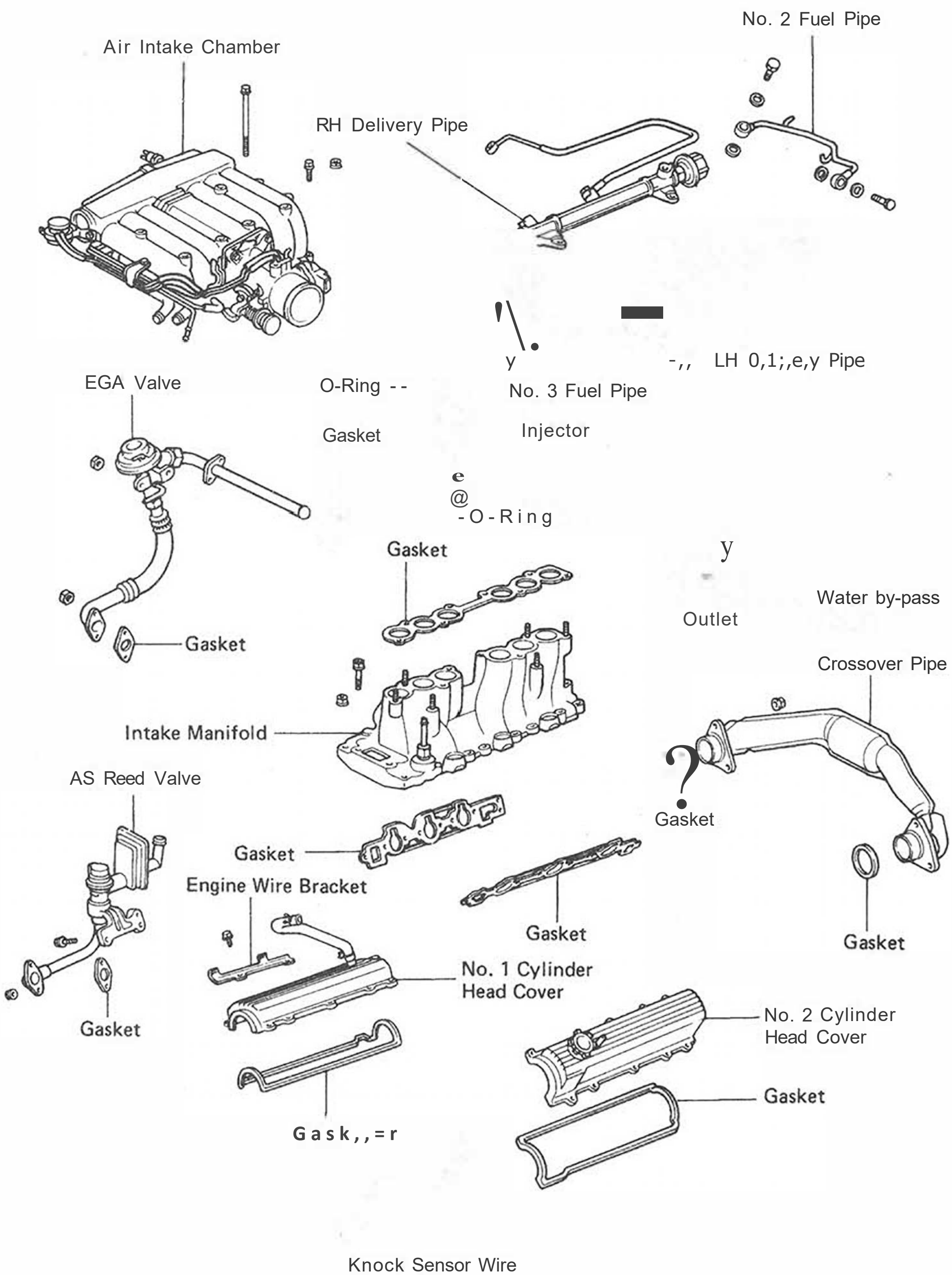


7.5b Four-cylinder engine lower end components - exploded view

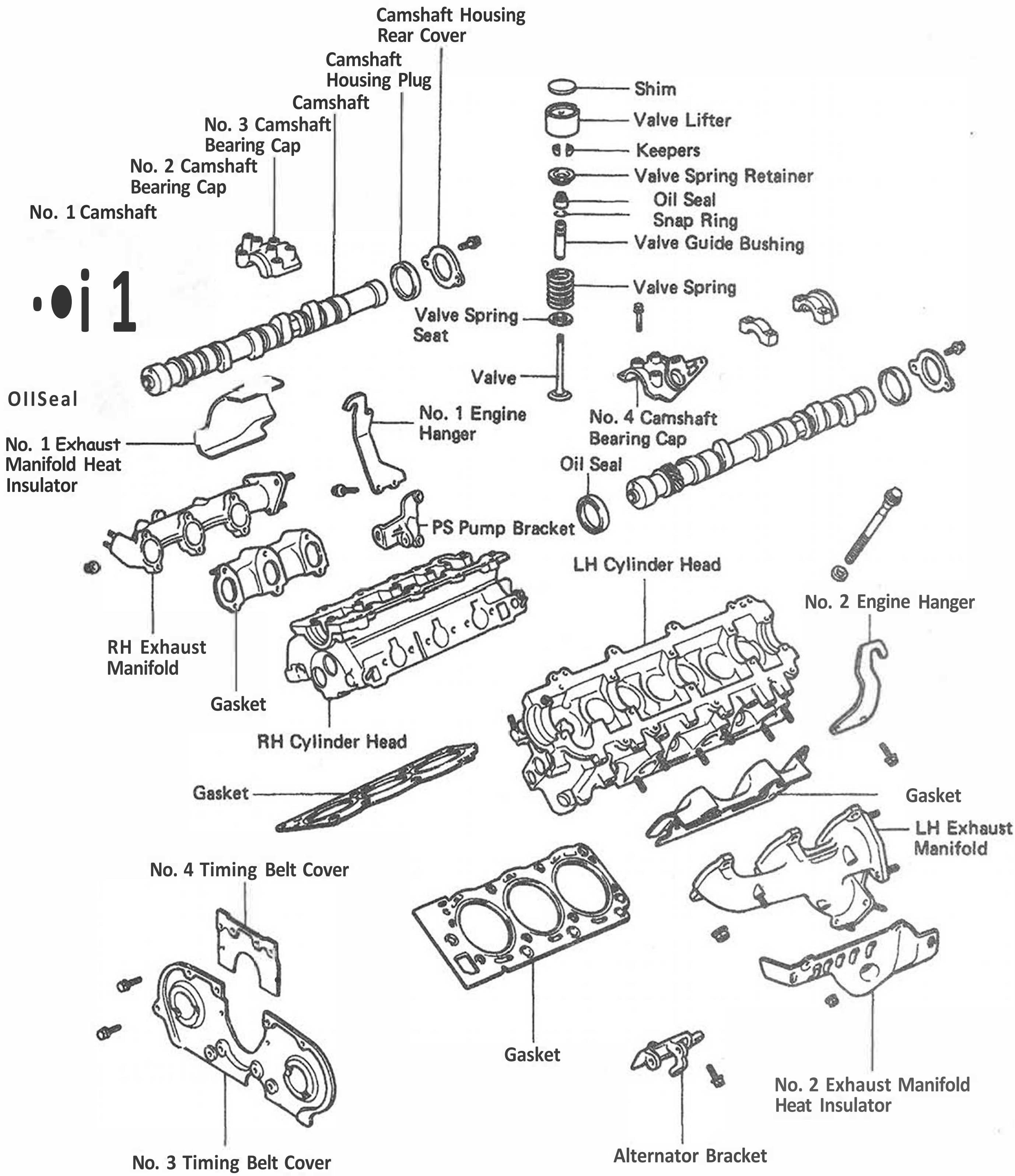
Timing belt cover(s) (V6 engine)
Timing chain cover (four-cylinder engines)
Camshaft drive components (chain or belt and sprockets)
Cylinder head(s)
Oil pan
Oil pump
Piston/connecting rod assemblies
Crankshaft and main bearings

6 Before beginning the disassembly and overhaul procedures, make sure the following items are available:

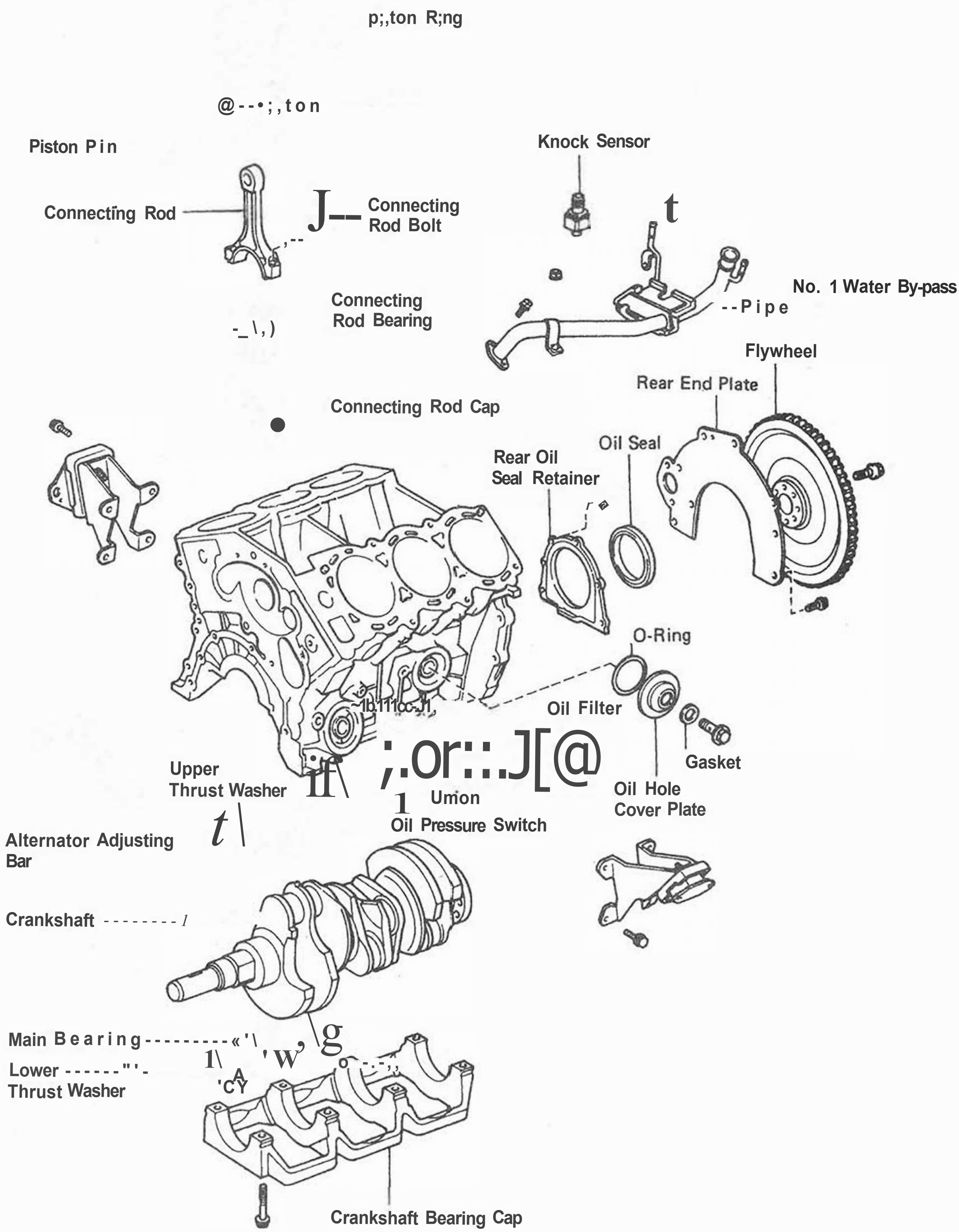
Common hand tools
Small cardboard boxes or plastic bags for storing parts
Gasket scraper
Ridge reamer
Vibration damper puller
Micrometers
Telescoping gauges
Dial indicator set
Valve spring compressor
Cylinder surfacing hone
Piston ring groove cleaning tool
Electric drill motor
Tap and die set
Wire brushes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



7.5c V6 engine external components - exploded view

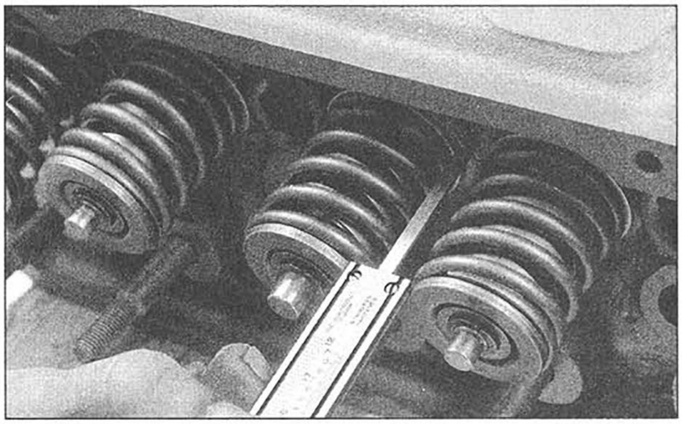


7.5d V6 engine cylinder head components - exploded view



7.5e V6 engine lower end components - exploded view

8.2a 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



8.2b Be sure to check the valve spring installed height (the distance from the bottom of the spring to the under side of the retainer)

8 Cylinder head - disassembly

Refer to illustrations 8.2a, 8.2b and 8.3

Note: *New and rebuilt cylinder heads are usually 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 originals).*

1 Cylinder head disassembly involves removal of the intake and exhaust valves and related components. It's assumed that the rocker arm shaft assemblies (four-cylinder engine only) and camshaft(s) have been removed from the head(s) (see Part A or B as needed).

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)** Also, measure the installed height for each valve and compare it to the Specifications **(see illustration).** If the valves and seats are reground, the springs may have to be shimmed during reassembly to restore the installed height.

3 Compress the springs on the first valve with a spring compressor and remove the keepers **(see illustration).** Carefully release the valve spring compressor and remove the retainer, the springs and the spring seat. **Caution:** *If you re working on a V6 engine, be very careful not to nick or otherwise damage the lifter bores when compressing the valve springs!* Next, remove the oil seal from the guide, then pull the valve out of the head. If the valve binds in the guide (won't pull through), push it back into the head and deburr the area around the keeper groove with a fine file or whetstone.

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

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

9 Cylinder head - cleaning and inspection

Refer to illustrations 9. 12, 9.14, 9. 17, 9. 18 and 9.19

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. If not already done, refer to Part A or B and remove the camshaft (and lifters on the V6 engine) from the head(s).

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.

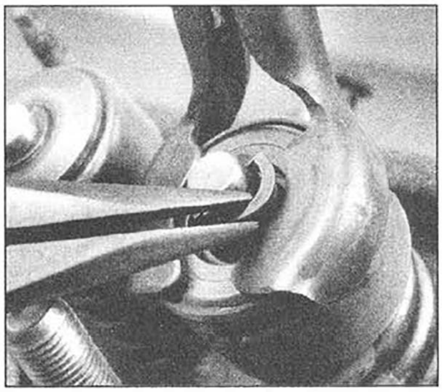
3 Remove all built up scale from the coolant passages.

4 Run a stiff wire brush through the various holes to remove deposits that may have formed in them.

5 Run an appropriate size tap into each of the threaded holes to remove corrosion and thread sealant that may be present. If compressed 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 or a die.

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.*



8.3 Compress the spring until the keepers can be removed

8 Clean all the valve springs, keepers and retainers with solvent and dry them thoroughly. Do the components from one valve at a time to avoid mixing up the parts.

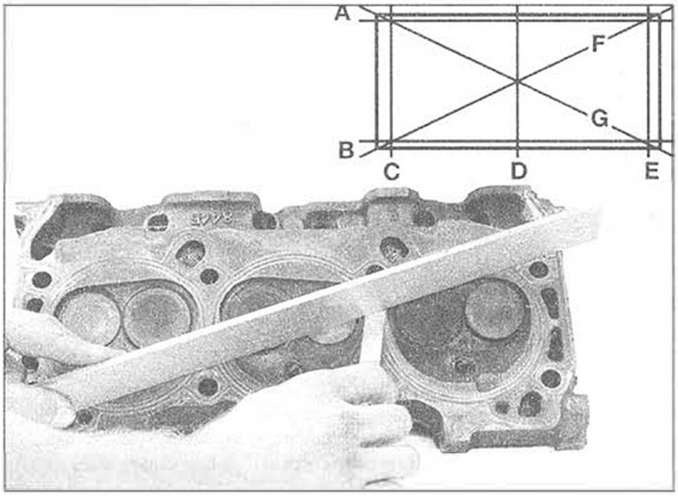
9 Scrape off any heavy deposits that may have formed on the valves, then use a motorized wire brush to remove deposits from the valve heads and stems. Again, make sure the valves don't get mixed up.

10 The cleaning and inspection procedures for the rocker arm/shaft assembly components (four-cylinder engines) can be found in Part A of this Chapter. If you're working on a V6 engine, refer to Part B for the lifter and bore cleaning and inspection procedures. Camshaft inspection is included in Parts A and B as well.

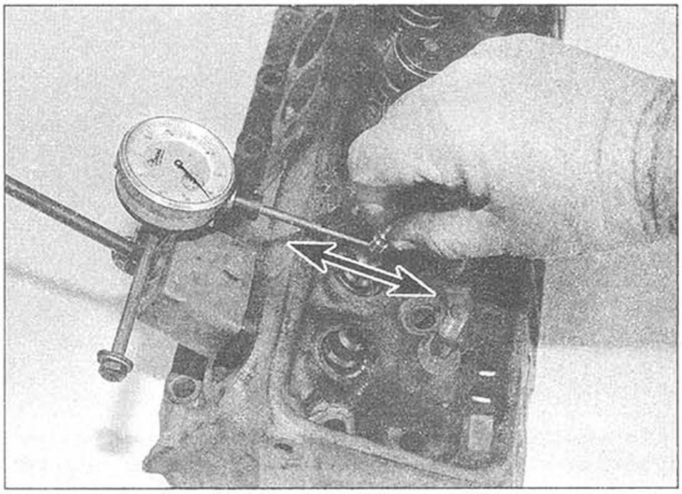
Inspection

Cylinder head

11 Inspect the head very carefully for



9.12 Check the cylinder head gasket surface 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)



9.14 A dial indicator can be used to determine the valve stem-to-guide clearance (move the valve stem as indicated by the arrows)

cracks, evidence of coolant leakage and other damage. If cracks are found, a new cylinder head should be obtained.

12 Using a precision straightedge and feeler gauge, check the head gasket mating surface for warpage **(see illustration).** If the warpage exceeds the specified limit, the head can be resurfaced at an automotive machine shop. **Note:** *If the V6 engine heads are resurfaced, the intake manifold flanges may also require machining. If the cylinder head is resurfaced, make sure the camshaft rotates freely by hand. If resistance is felt as the cam is turned, replace the head with a new one.*

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 deflection parallel to the rocker arm with a dial indicator attached securely to the head (see illustration). **Note:** *This may prove to be very difficult on V6 engine heads. If so, have an automotive machine shop measure the valves and guides to determine the clearance.* 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. If it exceeds the specified limit, the valve stem-to-guide clearance should be checked by an automotive machine shop (the cost should be minimal).

15 Refer to Part A or B of Chapter 2 and inspect the camshaft bearing surfaces in the cylinder head(s).

Valves

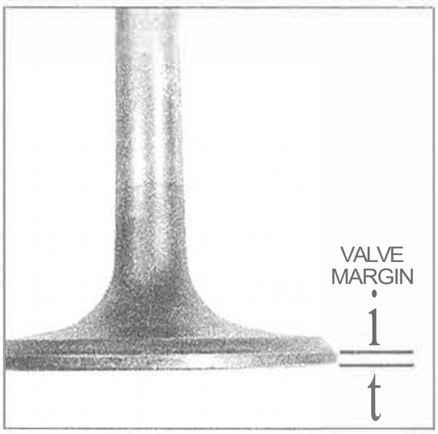
16 Carefully inspect each valve face for uneven wear, deformation, cracks, pits and burned areas. Check the valve stem for scuffing and galling and the neck tor cracks. Rotate the valve and check for any obvious indication that it's bent. Look for pits and excessive wear on the end of the stem. The presence of any of these conditions indicates the need for valve service by an automotive machine shop.

17 Measure the margin width on each valve **(see illustration).** Any valve with a margin narrower than about 1/32-inch will have to be replaced with a new one.

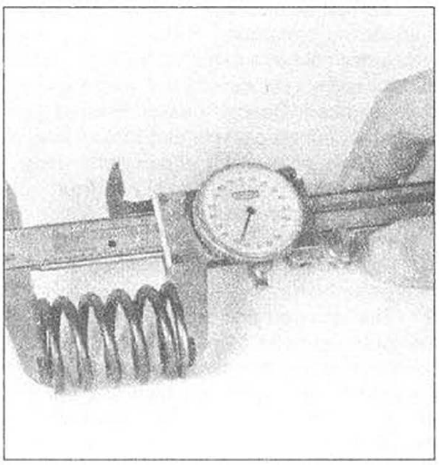
Valve components

18 Check each valve spring for wear (on the ends) and pits. Measure the free length and compare it to the Specifications **(see illustration).** Any springs that are shorter than specified have sagged and should not be reused. The tension of all springs should be 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).

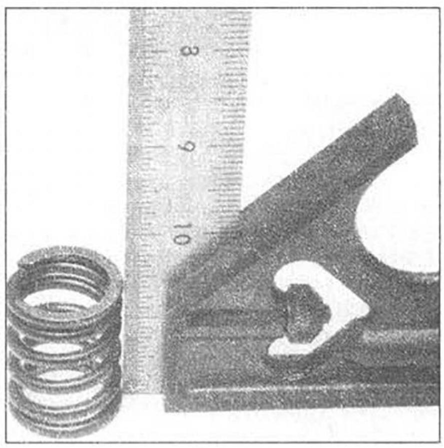
19 Stand each spring on a flat surface and check it for squareness **(see illustration).** If



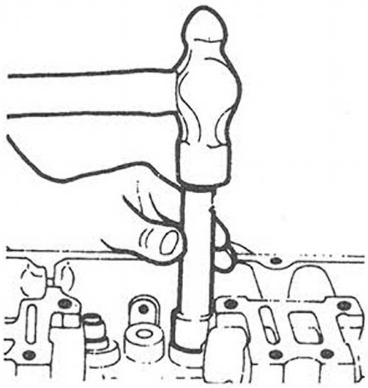
9.17 The margin width on each valve must be as specified (if no margin exists, the valve cannot be reused)



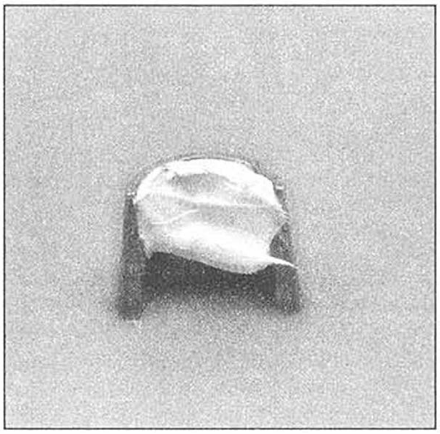
9.18 Measure the free length of each valve spring with a dial or vernier caliper



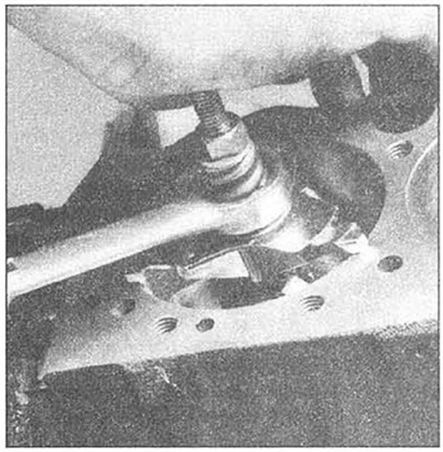
9.19 Check each valve spring for squareness



11.4 Gently tap the valve seals into place with a deep socket and hammer



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



12.1 A ridge reamer is required to remove the ridge from the top of the cylinder - do this before removing the pistons!

any of the springs are distorted or sagged, replace all of them with new parts.

20 Check the spring retainers and keepers 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.

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 10 for valve servicing recommendations.

22 If the inspection turns up no excessively worn parts, and if the valve faces and seats are in good condition, the valve train components can be reinstalled in the cylinder head without major servicing. Refer to the appropriate Section for the cylinder head reassembly procedure.

10 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, is best left to a professional.

2 The home mechanic can remove and disassemble each head, do the initial cleaning and inspection, then reassemble and deliver it to a dealer service department or an automotive machine shop for the actual valve servicing.

3 The dealer service department, or automotive machine shop, will remove the valves and springs, recondition or replace the valves and valve seats, recondition or replace the valve guides, check and replace the valve springs, spring retainers and keepers (as necessary), replace the valve seals with new ones, reassemble the valve components and make sure the installed spring height is correct. 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 will be in like new condition. When the head is returned, be sure to clean it 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.

11 Cylinder head - reassembly

Refer to illustrations 11.4 and 11.7

1 Regardless of whether or not the head was sent to an automotive repair 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. Begin the reassembly procedure with Step 8.

3 Install the valve spring seats (where applicable) prior to valve seal installation.

4 Install new seals on each of the valve guides. **Note:** *Intake and exhaust valves require different seals-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 intake valve seals once they're seated or you may damage them. Don't twist or cock the seals during installation or they won't seal properly on the valve stems.*

5 Apply moly-base grease or engine assembly lube to the first valve and install it in the head. Don't damage the new valve guide oil seal. Set the retainer and keepers in place. Check the installed spring height by lifting up on the retainer until the valve is seated. Measure the distance between the top of the spring seat(s) and the underside of the retainer **(see illustration 8.2b).** Compare your measurement to the specified installed height. Add shims on top of the spring seat, if necessary, to obtain the specified height.

6 Once the correct height is established, remove the keepers and retainer and install the valve springs.

7 Compress the springs and retainer with a valve spring compressor and slip the keepers into place. If you're working on a V6 engine head, be very careful not to damage the lifter bore with the spring compressor! Release the compressor and make sure the keepers are seated properly in the valve stem groove. If necessary, grease can be used to hold the keepers in place as the compressor is released **(see** illustration).

8 Double-check the installed valve spring height for each valve and compare it to the specified installed height. If it was correct prior to reassembly, it should still be within the specified limits. If it isn't, you must install more shims until it's correct. **Caution:** *Don't, under any circumstances shim the springs to the point where the installed height is less than specified!*

9 Install the camshaft and rocker arm components or lifters as described in Part A or B.

10 Store the head in a clean plastic bag until you're ready *to* install it.

12 Piston/connecting rod assembly - removal

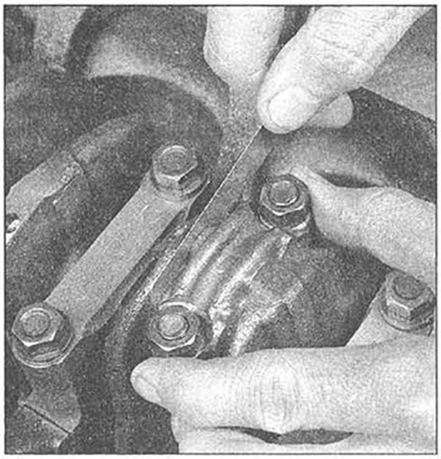
Refer to illustrations 12.1, 12.3, 12.4 and 12.5

Note: *Prior to removing the piston/connecting rod assemblies, remove the cylinder head (s), the oil pan and the oil pump by referring to the appropriate Sections in Chapter 2, Part A or B.*

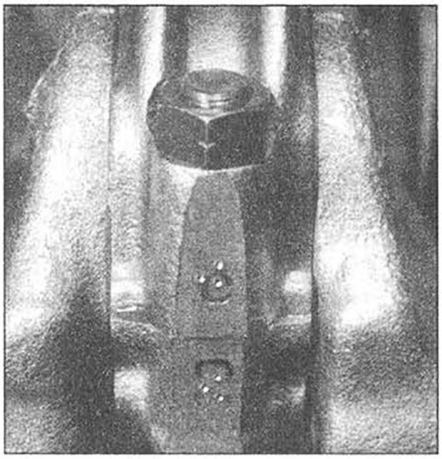
1 Completely remove the ridge *at* the top of each cylinder with a ridge reaming tool **(see illustration).** Follow the manufacturer's instructions provided with the tool. Failure to remove the ridge before attempting to remove the piston/connecting rod assemblies may result in piston breakage.

2 After the cylinder ridges have been removed, turn the engine upside-down so the crankshaft is facing up.

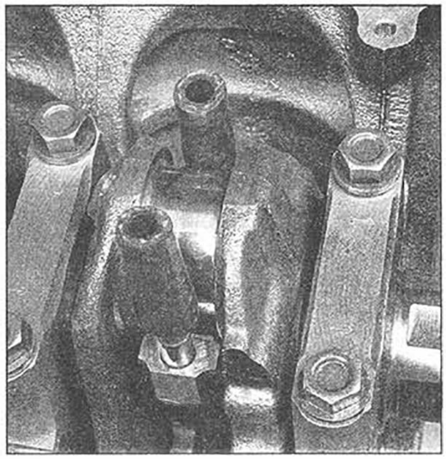
3 Before the connecting rods are removed, check the end play with feeler



12.3 Check the connecting rod side clearance with a feeler gauge as shown here



12.4 The connecting rods and caps should be marked to indicate which cylinder they're installed in - if they aren't, mark them with a center punch to avoid confusion during reassembly



12.5 To prevent damage to the crankshaft journals and cylinder walls, slip sections of hose over the rod bolts before removing the pistons

gauges. Slide them between the connecting rod and the crankshaft throw until the play is removed **(see illustration).** The end play is equal to the thickness of the feeler gauge(s). If the end play exceeds the service limit, new connecting rods will be required. If new rods (or a new crankshaft) are installed, the end play may fall under the specified minimum (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.

4 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 -4 or 6, depending on the engine type and cylinder they're associated with) **(see illustration).**

5 Loosen each of the connecting rod cap nuts 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. Slip a short length of plastic or rubber hose over each connecting rod cap bolt to protect the crankshaft journal and cylinder wall as the piston is removed **(see illustration).** Push the connecting rod/piston assembly out through the top of the engine. Use a wooden hammer handle to push on the upper bearing insert in the connecting rod. If resistance is felt, double-check to make sure that all of the ridge was removed from the cylinder.

6 Repeat the procedure for the remaining cylinders. 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.

13 Crankshaft - removal

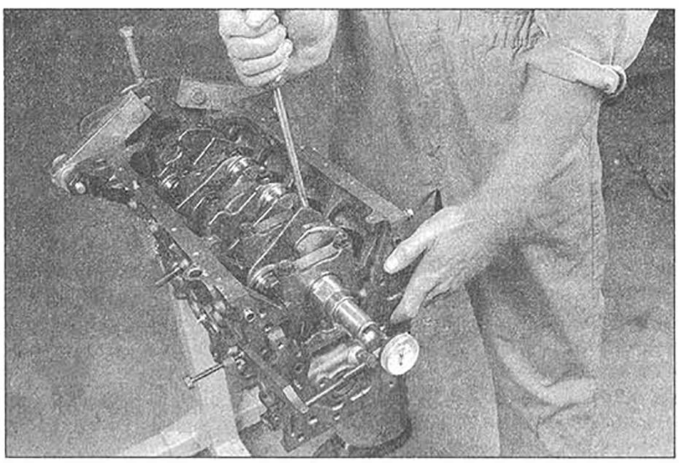
Refer to illustrations 13.1, 13.3 and 13.4

Note: *The crankshaft can be removed only after the engine has been removed from the vehicle. It s assume·d that the flywheel or driveplate, vibration damper, timing chain or belt, oil pan, oil pick-up tube and strainer, oil pump, timing chain cover/four-cylinder engines) and piston/connecting rod* assem*blies have already been removed. The rear main oil seal retainer also must be unbolted and separated from the block before proceeding with crankshaft removal.*

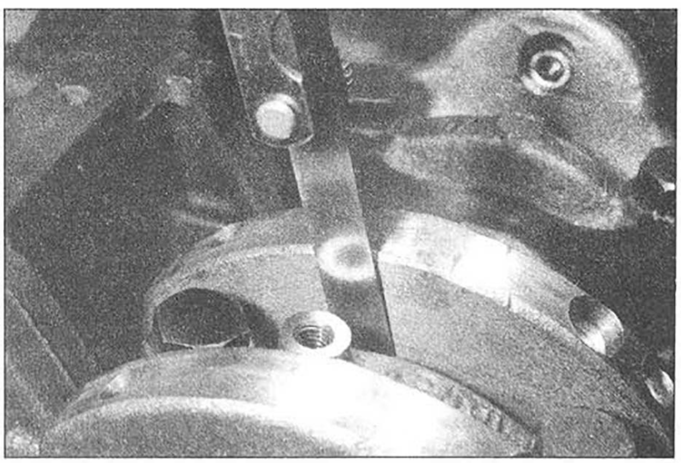
1 Before the crankshaft is removed, check the end play. Mount a dial indicator with the stem in line with the crankshaft and just touching one of the crank throws (see illus**tration).**

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 end play. If it's greater than specified, check the crankshaft thrust surfaces for wear. If no wear is evident, new thrust washers should correct the end play.

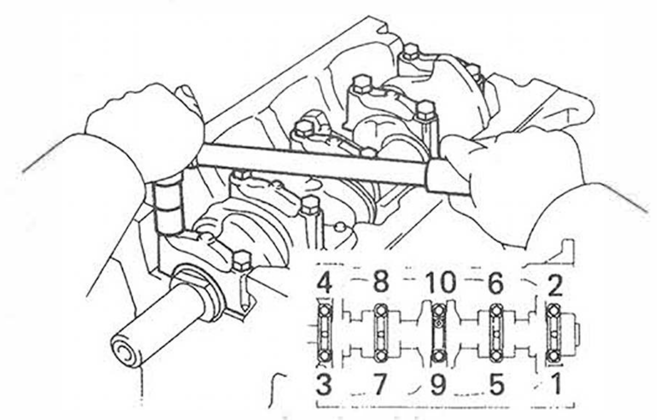
3 If a dial indicator isn't available, feeler gauges can be used. Gently pry or push the crankshaft all the way to the front of the engine. Slip feeler gauges between the



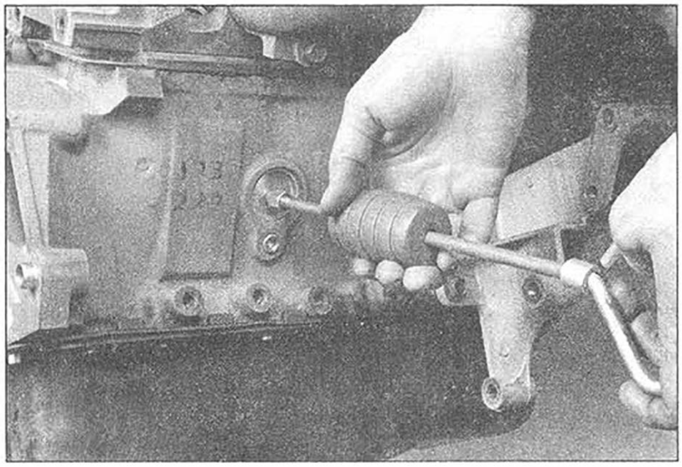
13.1 Checking crankshaft end play with a dial indicator



13.3 Checking crankshaft end play with a feeler gauge



13.4 Loosen the main bearing cap bolts in this numerical sequence (four-cylinder engines only)



14.1 The core plugs should be removed with a puller• if they're driven into the block they may be impossible to retrieve

crankshaft and the front face of the thrust main bearing to determine the clearance **(see illustration).** The thrust bearing on four-cylinder engines is number three (center), while on the V6 engine it's number two.

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 in the recommended sequence **(see illustration),** until they can be removed by hand.

5 Gently tap the. caps with a soft-face hammer, then separate them from the engine block. If necessary, use the bolts as levers to remove the caps. Try not to drop the bearing inserts if they come out with the caps. The main bearing caps on the V6 engine are a one-piece assembly, which may have to be carefully pried away from the block.

6 Lift the crankshaft out of the engine. With the bearing inserts in place in the engine block and main bearing caps or cap assembly, install the caps on the engine block and tighten the bolts finger tight.

14 Engine block - cleaning

Refer to illustrations 14.1, 14.7 and 14.9

Note: *The core plugs (also known as freeze or soft plugs) may be difficult or impossible to retrieve if they're driven into the block coolant passages.*

1 Drill a small hole in the center of each core plug and pull them out with an auto body type dent puller **(see illustration).** Remove all threaded plugs from the block

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

3 Remove 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.

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

5 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 preventative 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!*

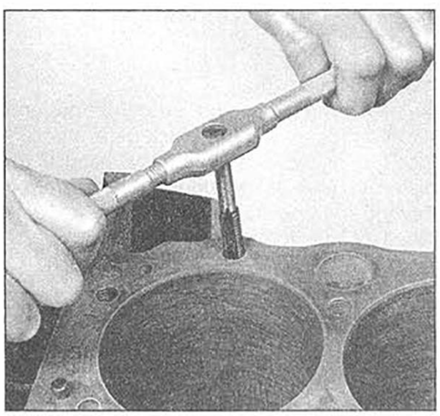
6 If the block isn't extremely dirty or sludged up, you can do an adequate cleaning job with hot soapy water and a stiff brush. Take plenty of time and do a thorough job. Regardless of the cleaning method used, be sure to clean all oil holes and galleries very thoroughly, dry the block completely and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

7 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 any rust, corrosion, thread sealant or sludge and to 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.

8 Reinstall the main bearing caps or cap assembly and tighten the bolts finger tight.

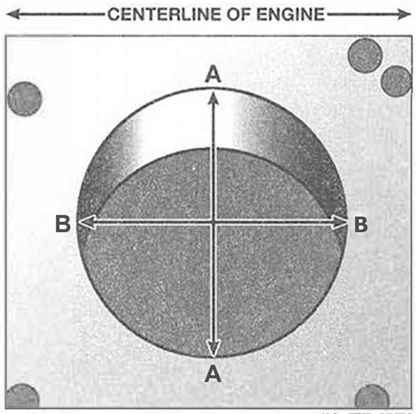
9 After coating the sealing surfaces of the new core plugs with RTV sealant, install them in the engine block (see illustration). Make sure they're driven in straight and seated properly or leakage could result. Special tools are available for this purpose, but equally good results can be obtained using a large socket, with an outside diameter that will just slip into the core plug, a 1/2-inch drive extension and a hammer.

10 If the engine isn't going to be reassem-

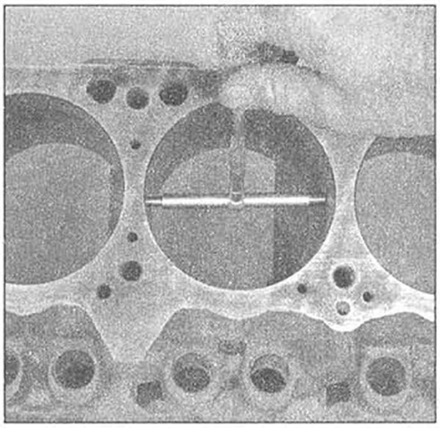


14.7 All bolt holes in the block· particularly the main bearing cap and head bolt holes • should be cleaned and restored with a tap (be sure to remove debris from the holes after this is done)

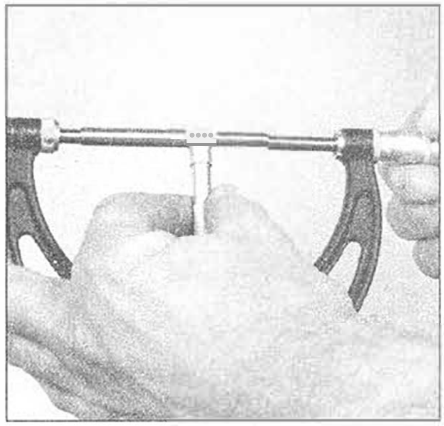
14.9 A large socket on an extension can be used to drive the new core plugs into the bores



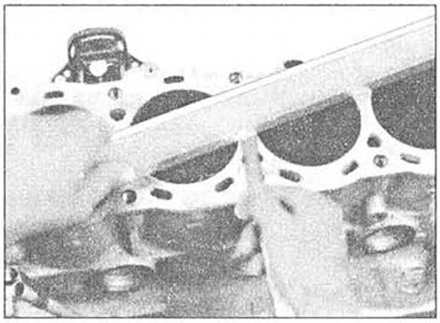
15.4a Measure the diameter of each cylinder just under the wear ridge **(A)**, at the center (B) and at the bottom



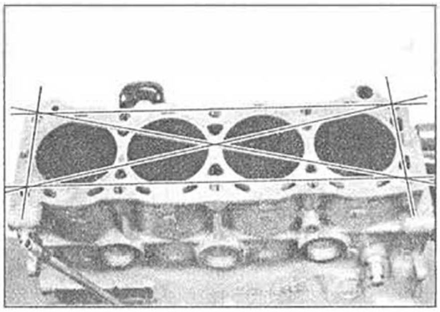
15.4b The ability to "feel" when the telescoping gauge is at the correct point will be developed over time, so work slowly and repeat the check until you're satisfied that the bore measurement is accurate



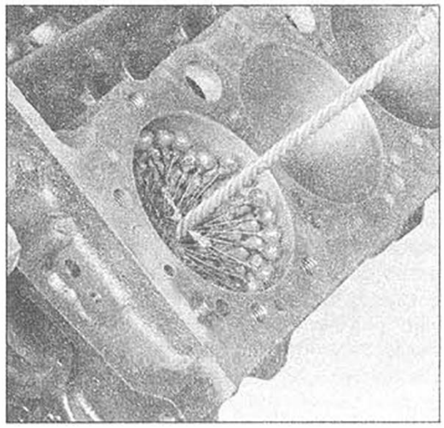
15.4c The gauge is then measured with a micrometer to determine the bore size



15.6a Check the block deck {both banks on a V6 engine) for distortion with a precision straightedge and feeler gauges



15.6b Lay the straightedge across the block, diagonally and from end-to-end when making the check



16.3a A "bottle brush" hone will produce better results if you have never done cylinder honing before

bled right away, cover it with a large plastic trash bag to keep it clean.

15 Engine block - inspection

Refer to illustrations 15.4a, 15.4b, 15.4c, 15.6a and 15.6b

1 Before the block is inspected, it should be cleaned as described in Section 1 4. Double-check to make sure the ridge at the top of each cylinder has been completely removed.

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. 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 fjust under the ridge area), center and bottom of the cylinder bore, parallel to the crankshaft axis (see illustrations). Next, measure each cylinder's diameter at the same three locations across the crankshaft axis. Compare the results to the Specifications. If the cylinder walls are badly scuffed or scored, or if they're out-of-round or tapered beyond the limits given in the 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.

5 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 (Section 16).

6 Using a precision straightedge and feeler gauge, check the block deck (the surface that mates with the cylinder head[s]) for distortion **(see illustrations).** If it's distorted beyond the specified limit, it can be resurfaced by an automotive machine shop.

16 Cylinder honing

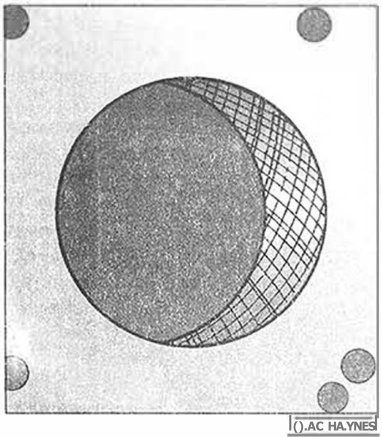
Refer to illustrations 16.3a 'bnd 16.3b

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.*

2 Before honing the cylinders, install the main bearing caps or cap assembly (without bearing inserts) and tighten the bo!ts to the specified torque.

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 plenty of light oil or honing oil, some rags and an electric drill motor. Proceed as follows:

- a) *Mount the hone in the drill motor, compress the* stones *and slip it into the first cylinder (see illustration).* Be *sure to wear safety goggles or a face shield!*
- b) *Lubricate the cylinder with plenty of 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° angle* **(see** illustration). *Be sure to* use *plenty of lubricant and don't take off any more material than* is *absolutely necessary to produce the desired finish.* Note: *Piston ring manufacturers may*



16.3b The cylinder hone should leave a smooth, crosshatch pattern with the lines intersecting at approximately a 60-degree angle

specify a smaller crosshatch angle than the traditional 60° - 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 white cloth-dampened with clean engine oil-used to wipe them down 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.

17 Piston/connecting rod assembly - inspection

Refer to illustrations 17.4a, 17.4b, 17.10 and 17.11

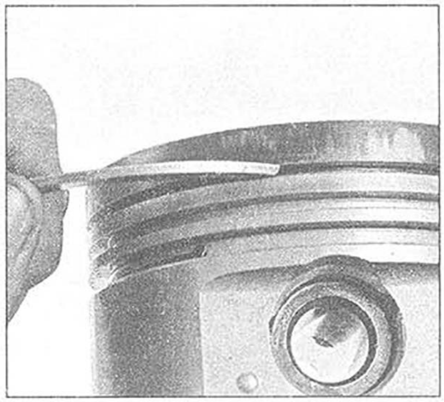
1 Before the inspection process can be carried out, the piston/connecting rod assemblies must be cleaned and the original piston rings removed from the pistons. **Note:** *Always use new piston rings when the engine is reassembled.*

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 don't nick or scratch the sides of the ring grooves **(see illustrations).**

17.4a The piston ring grooves can be cleaned **with** a special **tool. as shown here . . .**



17.4b . . . or a section of a broken ring

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 piston 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 isn't rebored or replaced, 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, on the other hand, should always be used when an engine is rebuilt.

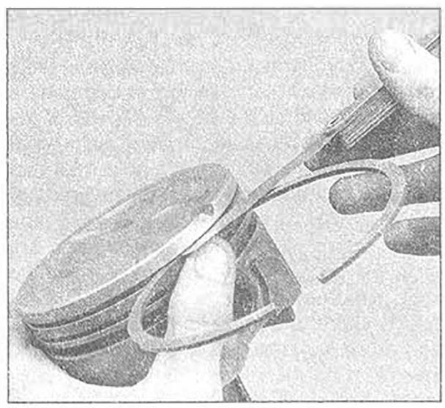
7 Carefully inspect each piston for cracks around the skirt, at the pin bosses and at the ring lands.

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

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

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

11 Check the piston-to-bore clearance by measuring the bore (see Section 15) and the piston diameter. Make sure the pistons and bores are correctly matched. Measure the piston across the skirt, at a 90° angle to the piston pin, the specified distance down from the top of the piston or the center of the pin



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

17.11 Measure the piston diameter at a 90-degree angle to the piston pin - the pistons must be measured at a precise point:

***1979 and 1980 four-cylinder models** = 1.02-inch below pin centerline*
***1981 and later four-cylinder models** = 1.39-inch below piston top*
***1989 through 1991 V6 models** = 0.91-inch below piston top*
***1992 and later V6 models** = 1.02-inch below piston top*

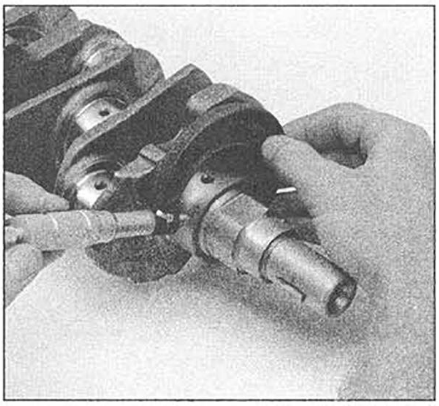
(see illustration). Subtract the piston diameter from the bore diameter to obtain the clearance. If it's greater than specified, the block will have to be rebored and new pistons and rings installed.

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

13 If the pistons must be removed from the connecting rods for any reason, they should be taken to an automotive machine shop. While they are there have the connecting rods checked for bend and twist, since automotive machine shops have special equipment for this purpose. **Note:** *Unless new pistons and/or connecting rods must be installed, do not disassemble the pistons and connecting rods.*

14 If you're working on a V6 engine, see if the nut on each connecting rod bolt can be turned by hand all the way to the end of the threads. If not, measure the outer diameter of the bolt (over the threads) at a point 16.4-mm from the bolt end. If the bolt diameter is not as specified, use new nuts when the piston/connecting rod assemblies are installed or have an automotive machine shop install new rod bolts.

15 Check the connecting rods for cracks and other damage. 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 nuts finger tight.



18.2 Measure the diameter of each crankshaft journal at several points to detect taper and out-of-round conditions

18 Crankshaft - inspection

Refer to illustration 18.2

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. Check the main and connecting rod bearing journals for uneven wear, scoring, pits and cracks. Check the rest of the crankshaft for cracks and other damage.

2 Using a micrometer, measure the diameter of the main and connecting rod journals and compare the results to the 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.

3 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 access to them, a machine shop will do it.

4 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.

5 Check the oil seal contact surfaces on both ends of the crankshaft. If they're scratched, nicked or otherwise damaged, the oil seals may leak when the engine is reassembled. Repair may be possible (ask at an automotive machine shop), but a new crankshaft may be required.

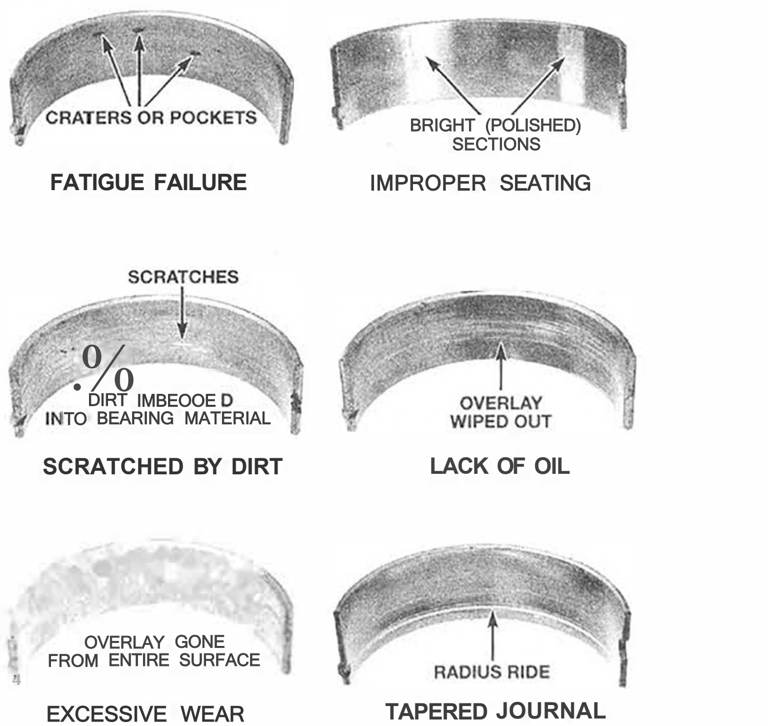
6 Refer to Section 19 and examine the main and rod bearing inserts.

19 Main and connecting rod bearings - inspection and main bearing selection

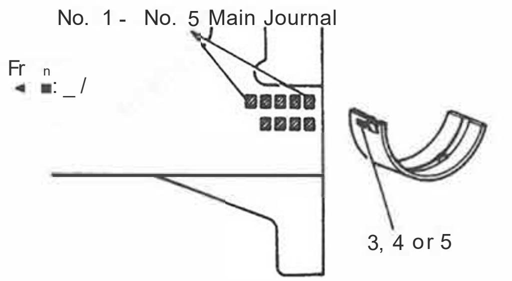
Inspection

Refer to illustration 19.1

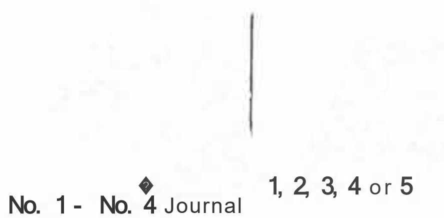
1 Even though the main and connecting rod bearings should be replaced with new ones during the engine overhaul, the old



19.1 When inspecting the main and connecting rod bearings, look for these problems



19.9a Main bearing journal grade number ! cations (four-cylinder engine)



19.9b Main bearing journal grade number locations (V6 engine)

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 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 inter-related 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. Full throttle, low speed operation (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 (1986 and later four-cylinder and all V6 engines)

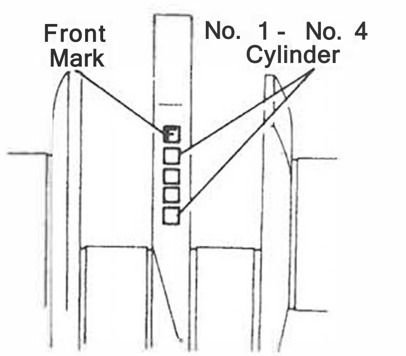
Refer to illustrations 19.9a, 19.9b, 19 10, 19.11a, 19.11b 19.12a, 19.12b, 19.12c 19.12d and 19.12e

8 If the original main bearings are worn or damaged, or if the oil clearances are incorrect (Section 22), the following procedure should be used to select the correct new bearings for engine reassembly. However, if the crankshaft has been reground, new undersize bearings must be installed - the following procedure should not be used if undersize bearings are required. The automotive machine shop that reconditions the crankshaft will provide or help you select the correct size bearings. Regardless of how the bearing sizes are determined, use the oil clearance, measured with Plastigage (Section 22), as a guide to ensure the bearings are the right size.

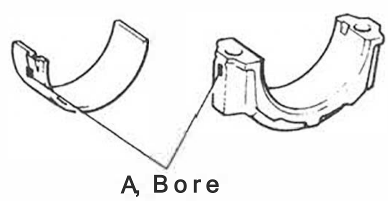
9 Locate the main journal grade numbers punched into the oil pan mating surface on the engine block **(see illustrations).**

10 If you're working on a V6 engine, locate the main journal grade numbers on the crankshaft as well **(see illustration).**

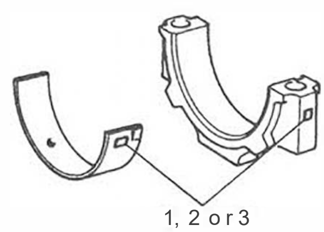
11 To determine connecting rod bearing sizes, check the caps and bearing inserts for a letter (A, B or C) or number (1, 2 or 3) **(see illustrations).**



19.10 On V6 engines, bearing codes are stamped into the crankshaft



19.11 a Four-cylinder engine connecting rod bearings and caps are marked A, B or C to indicate their size



19.11b V6 engine connecting rod bearings and caps are marked 1, 2 or 3 (don't confuse them with cylinder numbers)

Size	Big End Inner Diameter	Crank Pin Diameter	Bearing Center Wall Thickness
A	66.000 - 56.006 (2.2047 - 2.2050}	52.988 - 53.000 (2.0861 - 2.0866)	1.484 - 1.488 (0.0584 - 0.0586)
8	56.006 - 56.012 (2.2050 - 2.2052)		1.488 - 1.492 (0.0586 - 0.0587)
C	56.012 - 56.018 (2.2052 - 2.2054)		1.492 - 1.496 (0.0587 - 0.0589)
U/S 0.25	56.000 - 56.018 (2.2047 - 2.20541	62.701 - 52.711 (2.0748 - 2.0752)	1.626- 1.636 (0.0640 - 0.0644)

19.12a Four-cylinder engine connecting rod bearing selection chart

Size	Cylinder Block Main Journal Bore	Main Journal Diameter	Searing Center Wall Thickness
3	64.004 - 64.010 (2.5198 - 2.5201)	59.984 - 60.000 (2.3616 - 2.3622)	1.988 - 1.992 (0.0783 - 0.0784)
4	64.010 - 64.016 (2.5201 - 2.6203)		1.992 - 1.996 10.0784 - 0.0786)
5	64.016 - 64.022 (2.5203 - 2.5205)		1.996 - 2.000 (0.0786 - 0.0787)
UIS 0.25	64.004 - 64.022 (2.5198 - 2.5205)	59.701 - 69.711 (2.3504 - 2.3508)	2.126-2.136 (0.0837 - 0.0841)

19.12b Four-cylinder engine main bearing selection chart

Size	Big End Inner Diameter	Crank Pin Diameter	Bearing Center Wall Thickness
1	58.000 - 58.008 12.2835 - 2.2838)	64.987 - 66.000 (2.1648 - 2. 1654)	1.484 - 1.488 (0.0584 - 0.0586)
2	58.009 - 58.ot6 (2.2838 - 2.2841 I		1.489-1.492 (0.0588 - 0.0587}
3	5ao11 - 68.024 (2.2⁸4 3 - 2.2844)		1.493 - 1.496 (0.0588 - 0.0689)
UIS 0.26	58.000 - 68.024 (2.2835 - 2.2844)	54.746 - 54.755 (2.1553- 2.1557)	1.606 - 1.611 (0.0632 - 0.0634)
U/S 0.60		54.495 - 64.506 (2.1465- 2.1459)	1.730-1.736 (0.0681 - 0.0683)

19.12c V6 engine connecting rod bearing selection chart

Size	Cylinder Block Main Journal Bore	Mein Journal Diameter	Bearing Center Wall Thickness
0	-	63.996 - 64.000 (2.5195 - 2.5197)	-
1	68.010 - 68.016 (2.6776 - 2.6778}	63.990 - 63.995 (2.5193 - 2.5195)	1.989 - 1.992 (0.0783 - 0.0784)
2	68.017 - 68.022 12.6778 - 2.6780)	63.985 - 63.990 (2.6191 - 2.5193)	1.993 - t.995 (0.0785 - 0.0785)
3	68.023 - 68.028 (2.6781 - 2.6783)	-	1.996 - 1.998 (0.0786 - 0.0787)
4	-	-	1.999 - 2.001 (0.0787 - 0.0788)
6	-	-	2.002 - 2.004 (0.0788 - 0.0789)
UIS 0.25	68.010 - 68.028 (2.6776 - 2.6783)	63.745 - 63.755 (2.5096 - 2.5100)	2.110 - 2.116 (0.0831 - 0.0833)
UIS 0.50		63.495 - 63.505 (2.4998 - 2.6002)	2.235 - 2.241 (0.0880 - 0.0882)

19.12d V6 engine main bearing selection chart

Cylinder Block No.	1	2	1	3	2	1	3	2	3
Crankshaft No.	0	0	1	0	1	2	1	2	2
Bearing No.	1	2	2	3	3	3	4	4	5

19.12e On V6 engines, if the number of the bearing can't be determined, select a bearing from the table by cross referencing the numbers on the block and crankshaft

12 Use the accompanying charts to determine the correct bearings for each journal (**see illustrations**) When replacing a standard size bearing, use a new bearing with the same size mark as the cap.

13 Remember, the oil clearance is the final judge when selecting new bearing sizes. If you have any questions or are unsure which bearings to use, get help from a Toyota dealer parts or service department.

20 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
Sllort *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*
RTV-type gasket sealant
Thread locking compound

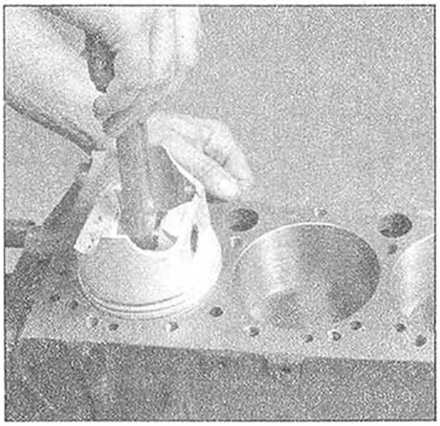
2 In order to save lime and avoid problems, engine reassembly must be done in the following general order:

Four-cylinder engines

Piston rings (Part CJ
Crankshaft and main bearings (Part CJ
Piston/connecting rod assemblies (Part C)
Rear main oil seal (Part C)
Camshaft (Part A)
Cylinder head and rocker arm assembly (Part AJ
Timing chain and sprockets (Part A)
Timing chain cover (Part A)
Oil strainer (Part A)
Oil pump (Part AJ
Oil pan (Part A)
Intake and exhaust manifolds (Part A)
Rocker arm cover (Part A)
Flywheel!driveplate (Part A)

V6 engine

Piston rings (Part CJ
Crankshaft and main bearings (Part C)
Piston/connecting rod assemblies *(Part C)*
Rear main oil seal/retainer (Part C)
Oil pump (Part B)
Oil pan (Part BJ
Cylinder heads (Part B)
Camshafts and lifters (Part B)
Timing belt and sprockets (Part B)
Timing belt covers (Part B)
Intake and exhaust manifolds (Part B)
Cylinder head covers (Part BJ
Flywheel/driveplate (Part B)



21.3 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)

21 Piston rings - installation

Refer to illustrations 21.3, 21.4, 21.9a, 21.9b and 21.12

1 Before installing the new piston rings, the ring end gaps must be checked. It's assumed that the piston ring side clearance has been checked and verified correct (Section 17).

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 the Specifications. If the gap is larger or smaller than specified, double-check to make sure you have the correct rings before proceeding.

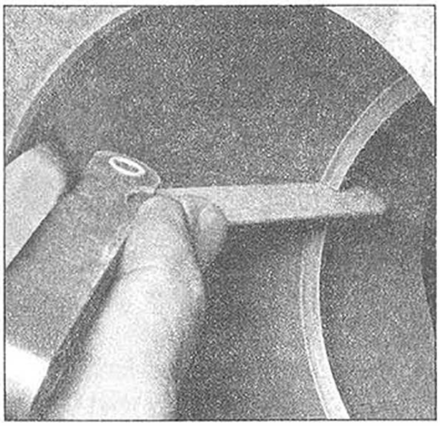
5 If the gap is too small, replace the rings-DO NOT file the ends to increase the clearance.

6 Excess end gap isn't critical unless it's greater than 0.040inch. Again, double-check to make sure you have the correct rings for your engine.

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 installed first. On most models 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. 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.



21.4 With the ring square in the cylinder, measure the end gap with a feeler gauge

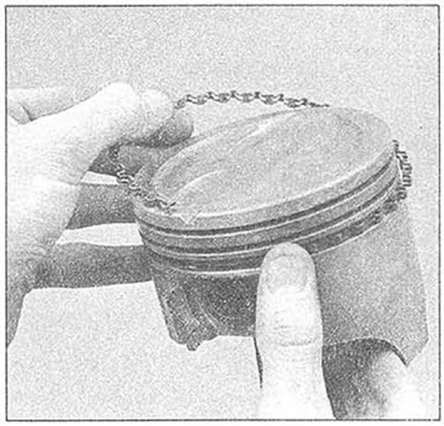
10 After the three oil ring components have been installed, check to make sure that both the upper and lower side rails can be turned smoothly in the ring groove.

11 The number two (middle) ring is installed next. It's stamped with a mark which must face up, toward the top of the piston. **Note:** *Always follow* tile *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 make sure the 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 is necessary to slide it over the piston.

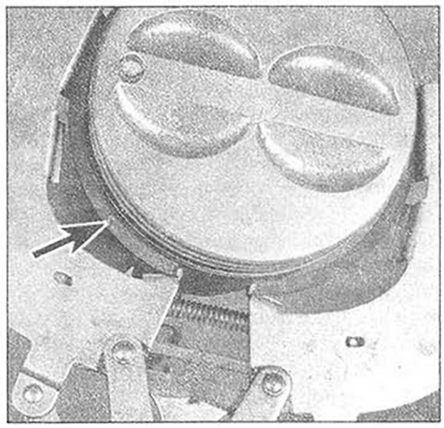
13 Install the number one (top) ring in the same manner. Make sure the mark is facing up. Be careful not to confuse the number one and number two rings.

14 Repeat the procedure for the remaining pistons and rings.



21.9a Installing the spacer/expander in the oil control ring groove

21.9b DO NOT use a piston ring installation tool when installing the oil ring side rails



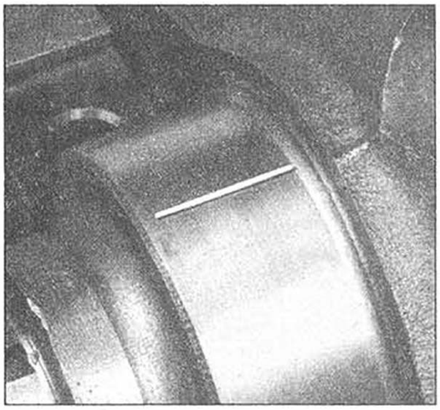
21.12 Installing the compression rings with a ring expander - the mark must face up

22 Crankshaft - installation and main bearing oil clearance check

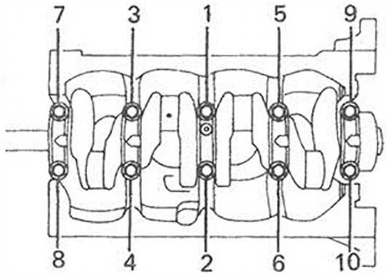
Refer to illustrations 22.10, 22.12a, 22.12b, 22.12c, 22.12d, 22.14, 22.19a, 22.19b and 22.19c

Note: *On 1993 and later V6 models, the main bearing insert for the No 1 cylinder is wider than all other bearing inserts. Be sure to install the 22* mm *wide main bearing* insert *in the No. 1 cylinder location in the engine block and all remaining 20* mm *wide bearing inserts in the remaining locations.*

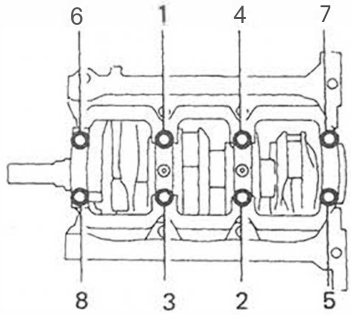
1 Crankshaft installation is the first major step in engine reassembly. It's assumed at this point that the engine block and crankshaft have been cleaned, inspected and repaired or reconditioned.



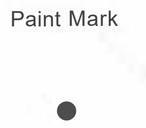
22.10 Lay the Plastigage strips on the main bearing journals, parallel to the crankshaft centerline



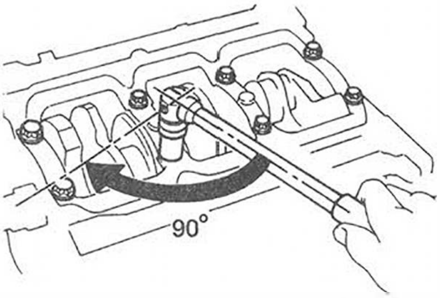
22.12a Main bearing bolt tightening sequence - four cylinder engines



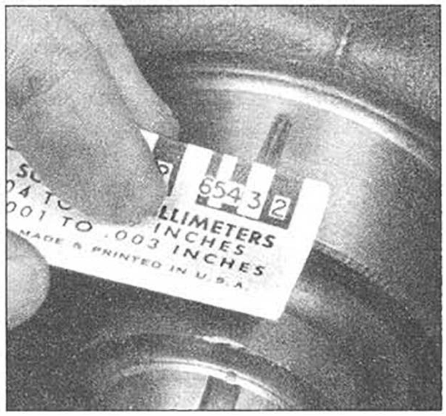
22.12b Main bearing bolt tightening sequence - V6 engines



22.12c On V6 engines only, after reaching the specified torque, mark the front side of each bolt with paint as shown here . . .



22.1 2d . . . then turn the bolts an additional 1/4-turn 190-degrees)



22.14 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

2 Position the engine with the bottom facing up.

3 Remove the main bearing cap bolts and lift out the caps or cap assembly. Lay the caps out in the proper order to ensure correct installation.

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!

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. 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 If you're working on a V6 engine, the thrust bearings (washers) must be installed in the number two cap and saddle. On four-cylinder engines, the thrust bearings (washers) must be installed in the number three (center) cap.

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 pointing toward the front of the engine. If you're working on a V6 engine, carefully lay the main bearing cap assembly in place. Don't disturb the Plastigage. Apply a light coat of oil to the bolt threads and the under sides 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 specified torque. Don't rotate the crankshaft at any time during this operation! **Note:** *On V6 engines only, after reaching the specified torque, tighten each bolt an additional 90° (114 turn)* **(see illustrations).**

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 19). 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 18).

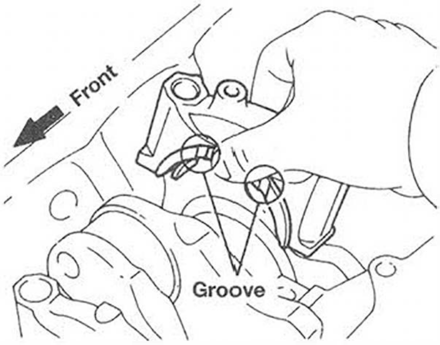
16 Carefully scrape all traces of the Plastigage material off the main bearing journals and/or the bearing faces. Don't nick or scratch the bearing faces.

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-base grease or engine assembly lube to each of the bearing surfaces. Coat the thrust washers as well.

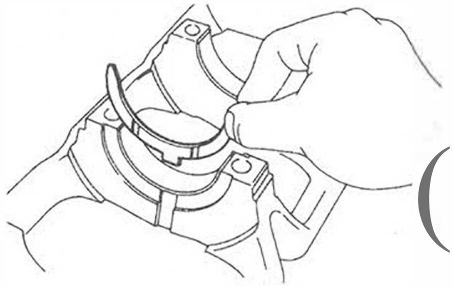
18 Lubricate the crankshaft surfaces that contact the oil seals with moly-base grease, engine assembly lube or clean engine oil.

19 Make sure the crankshaft journals are clean, then lay the crankshaft back in place in

22.19a Rotate the thrust washer into position on the number three crankshaft journal with the oil grooves facing out (four-cylinder engines only)



22.19b On four-cylinder engines, install the thrust washer in the number three cap with the oil grooves facing out



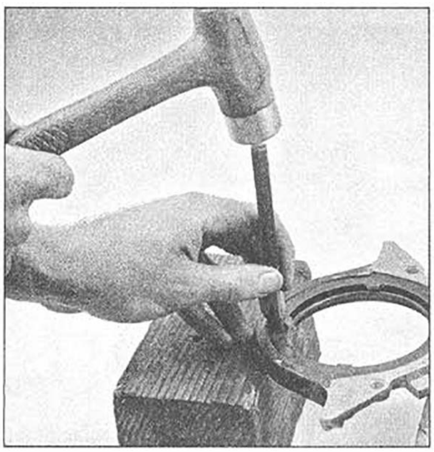
22.19c On V6 engines, install the thrust washers in the number two bearing cap and saddle with the tang in the notch in the main bearing cap assembly (be sure the oil grooves face out)

the block. Clean the faces of the bearings in the caps or cap assembly, then apply lubricant to them. Install the caps in their respective positions with the arrows pointing toward the front of the engine. **Note:** *Be sure to install the thrust washers* **(see illustrations).**

20 Apply a light coat of oil to the bolt threads and the under sides of the bolt heads, then install them. On four-cylinder engines only, tighten all except the center (number three) cap bolts (the one with the thrust washers) to the specified torque (work from the center out and approach the final torque in three steps). Tighten the center cap bolts to 10-to-12 ft-lbs. Tap the ends of the crankshaft forward and backward with a lead or brass hammer to tine up the thrust washer and crankshaft surfaces. Retighten all main bearing cap bolts to the specified torque, following the recommended sequence.

21 On manual transmission equipped models, install a new pilot bearing in the end of the crankshaft (see Chapter 8).

22 Rotate the crankshaft a number of times by hand to check for any obvious binding.



23.3 After removing the retainer from the block, support it on a couple of wood blocks and drive out the old seal with a punch or screwdriver and hammer

23 Check the crankshaft end play with a feeler gauge or a dial indicator as described in Section 13. The end play should be correct if the crankshaft thrust faces aren't worn or damaged and new thrust washers have been installed.

24 Install a new rear main oil seal, then bolt the retainer to the block (Section 23).

23 Rear main oil seal installation

Refer to illustrations 23.3, 23.5 and 23.6

1 The crankshaft must be installed first and the main bearing caps or cap assembly bolted in place, then the new seal should be installed in the retainer and the retainer bolted to the block.

2 Check the seal contact surface on the crankshaft very carefully for scratches and nicks that could damage the new seal lip and cause oil leaks. If the crankshaft is damaged. the only alternative is a new or different crankshaft.

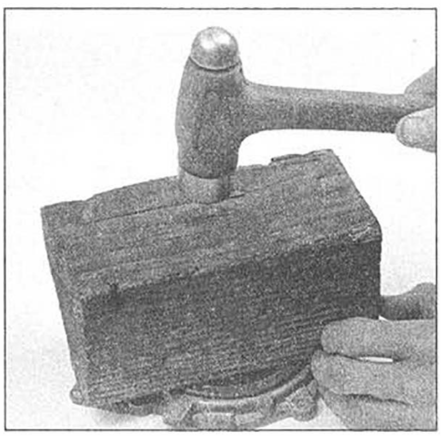
3 The old seal can be removed from the retainer by driving it out from the back side with a hammer and punch **(see illustration).** Be sure to note how far it's recessed into the bore before removing it; the new seal will have to be recessed an equal amount. Be very careful not to scratch or otherwise damage the bore in the retainer or oil leaks could develop.

4 Make sure the retainer is clean, then apply a thin coat of engine oil to the outer edge of the new seal. The seal must be pressed squarely into the bore, so hammering it into place isn't recommended. If you don't have access to a press, sandwich the housing and seal between two smooth pieces of wood and press the seal into place with the jaws of a large vise. The pieces of wood must be thick enough to distribute the force evenly around the entire circumference of the seal. Work slowly and make sure the seal enters the bore squarely.

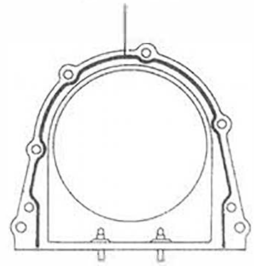
5 As a last resort, the seal can be tapped into the retainer with a hammer. Use a block of wood to distribute the force evenly and make sure the seal is driven in squarely **(see illustration).**

6 The seal lips must be lubricated with clean engine oil or moly-based grease before the seal/retainer is slipped over the crankshaft and bolted to the block. On four-cylinder engines, use a new gasket-and sealant - and make sure the dowel pins are in place before installing the retainer. On V6 engines, no gasket is required. Instead, apply a 2mm wide bead of the proper sealant, available at auto parts stores, to the retainer-to-block surface **(see illustration).**

7 Tighten the bolts a little at a time until they're all at the specified torque.



23.5 Drive the new seal into the retainer with a block of wood or a section of pipe, if you have one large enough - make sure that you don't cock the seal in the retainer bore



23.6 Apply sealant to the retainer before bolting it to the block

24 Piston/connecting rod assembly - installation and rod bearing oil clearance check

Refer to illustrations 24.3, 24.5, 24.8a, 24.8b, 24.9, 24.11, 24.12 and 24.13

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 connecting rod cap from the end oi the number one connecting rod. Remove the old 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.

3 Clean the back side of the new upper bearing half, then lay it in place in the connecting rod. Make sure the tab on the bearing fits into the recess in the rod so the oil holes line up **(see illustration).** 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 remaining 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 are perfectly clean and oil free when they're assembled.

5 Position the piston ring gaps at staggered intervals around the piston **(see illustration),** then slip a section of plastic or rubber hose over each connecting rod cap bolt.

6 Lubricate the piston and rings with clean engine oil and attach a piston ring compressor to the piston. Leave the skirt protruding to guide the piston into the cylinder. The rings must be compressed until they're flush with the piston.

7 Rotate the crankshaft until the number one connecting rod journal is at BOC (bottom dead center) and apply a coat of engine oil to the cylinder walls.

8 With the notch (four-cylinder engines) or the dimple on top of the piston (V6 engine) **(see illustrations)** 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. Tap the top edge of the ring compressor to make sure it's contacting the block around its entire circumference.

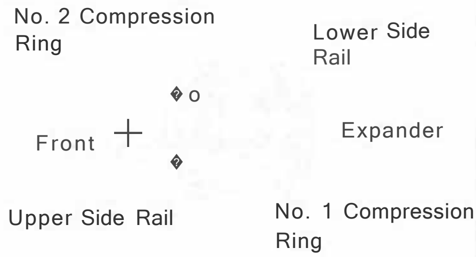
9 Carefully tap on the top of the piston with the end of a wooden hammer handle (see illustration) while guiding the end of the connecting rod into place on the crankshaft journal. The piston rings may try to pop out of the ring compressor just before entering the cylinder bore, so keep some downward 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. Do not, for any reason, force the piston into the cylinder, as you might break a ring and/or the piston!

10 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.

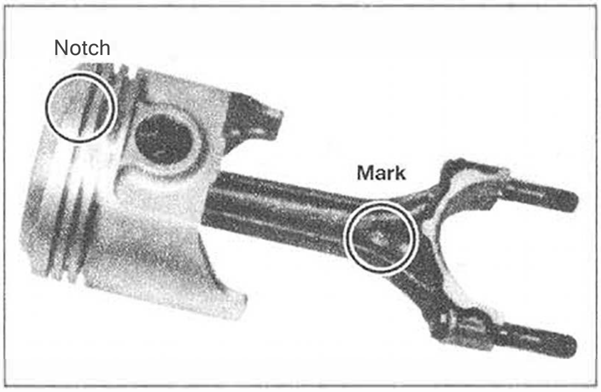
11 Cut a piece of the appropriate size Plastigage slightly shorter than the width of the connecting rod bearing and lay it in place on the number one connecting rod journal, parallel with the journal axis **(see illustration).**

12 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. If you're working on a V6 engine, check the cap to make sure the front mark is facing the front of the engine **(see illustration).** Apply a light coat of oil to the under sides of the nuts, then install and tighten them to the

24.3 Align the oil hole in the bearing with the oil hole in the rod



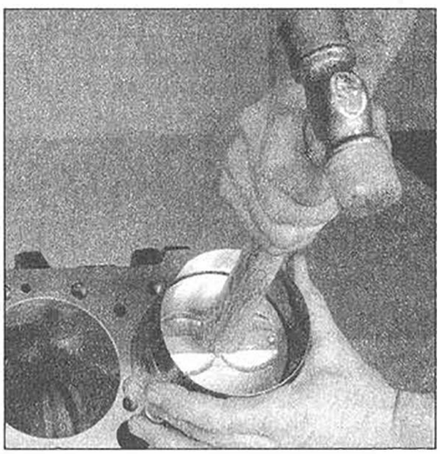
24.5 Stagger the ring end gaps before installing the pistons



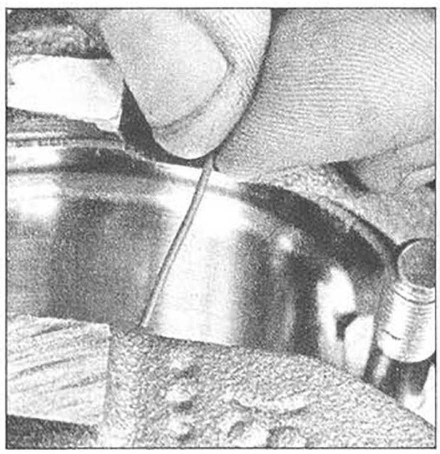
24.8a Check to be sure both the notch in the piston and the mark on the connecting rod face the front of the engine (four-cylinder shown - V6 similar)

6

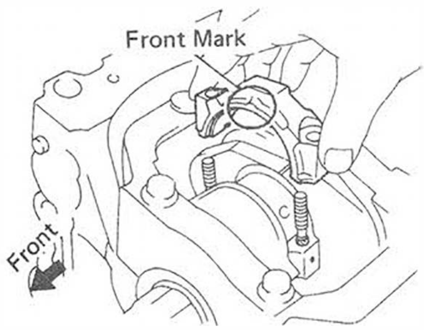
24.8b V6 pistons are marked for right and left banks



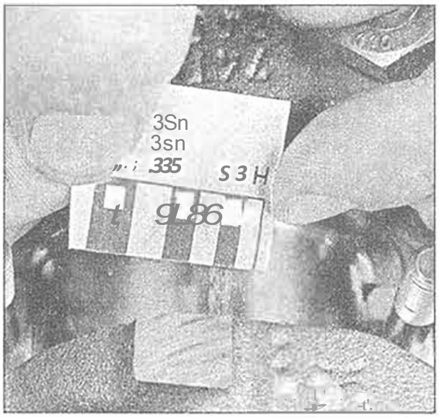
24.9 The piston can be driven (gently) into the cylinder bore with the end of a wooden hammer handle



24.11 Lay the Plastigage strips on each rod bearing journal, parallel to the crankshaft centerline



24.12 Install the connecting rod caps with the front mark facing forward (V6 engine)



24.13 Measuring the width **of** the crushed Plastigage to determine tha rod bearing oil ciearance (be sure to use the correct scale - standard and metric scales are included)

specified torque. Use a thin-wall socket to avoid erroneous torque readings that can result if the socket is wedged between the rod cap and nut. Do not rotate the crankshaft at any time during this operation! **Note:** *It you're working on a V6 engine, after reaching the specified torque, tighten each nIlt an additional 90° (1/4-turn).*

13 Remove the rod cap, being very careful not to disturb the Plastigage. 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 the Specifications to make sure the clearance is correct. 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 18).

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

15 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 specified torque.

16 Repeat the entire procedure for the remaining piston/connecting rod assemblies. Keep the back sides of the bearing inserts and the inside of the connecting rod and cap perfectly clean when assembling them. Make sure you have the correct piston for the cylinder and that the mark on the piston faces to the front of the engine when the piston is installed. Remember, use plenty of oil to lubricate the piston before installing the ring compressor. Also, when installing the rod caps for the final time, be sure to lubricate the bearing faces adequately.

17 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.

18 As a final step, the connecting rod end play must be checked. Refer to Section 12 for this procedure. Compare the measured end play to the 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 end play may be too small. If so, the rods will have to be removed and taken to an automotive machine shop for resizing.

25 Initial start-up and break-in after overhaul

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 disabled (see Section 3), crank the engine until oil pressure registers on the gauge.

3 Install the spark plugs, hook up the plug wires and restore the ignition system functions (Section 3).

4 Start the engine. tt may take a few moments for the gasoline to reach the carburetor or injectors, 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 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 at full throttle 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. Don't pamper it or abuse it.

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

Notes

Chapter 3
Cooling, heating and air conditioning systems

Contents

	Section
Air conditioning accumulator - removal and installation	14
Air conditioning and heater control assembly - removal and installation	12
Air conditioning compressor - removal and installation	15
Air conditioning condenser - removal and installation	16
Air conditioning system - check and maintenance	13
Antifreeze - general information	2
Blower unit - removal and installation	10
Coolant level check	See Chapter 1
Coolant reservoir - removal and installation	6
Coolant temperature sending unit - check and replacement	9
Cooling system check	See Chapter 1
Cooling system servicing (draining, flushing and refilling)	See Chapter 1
Drivebelt check, adjustment and replacement	See Chapter 1
Engine cooling fan and clutch - check and replacement	4
General information	1
Heater core - removal and installation	11
Radiator - removal and installation	5
Thermostat - check and replacement	3
Underhood hose check and replacement	See Chapter 1
Water pump - check	7
Water pump - removal and installation	8

Specifications

General

Coolant capacity	See Chapter 1
Radiator cap pressure rating	10.7 to 14.9 psi

Torque specifications

	Ft-lbs
Air conditioner mounting bolts	20
Thermostat housing cover bolts - V6 engine	14
Water pump-to-block bolts - V6 engine	13

1 General information

The cooling system used on Toyota trucks, as referred to in this Chapter, comprises the radiator, water pump, cooling fan and its fluid drive clutch, coolant reserve system and thermostat.

The radiator is of conventional vertical flow design, mounted behind the vehicle's front grille. Two coolant hoses join it to the engine block.

The water pump is located at the front of the engine and is driven through a pulley and belt which also drives the alternator.

The fan clutch is located at the front of the water pump pulley and is attached to the pulley/water pump assembly by four nuts which secure it to studs screwed into the face of the water pump drive flange. The fan clutch serves to conserve engine power by disengaging the fan at high engine speeds, causing the fan to free-wheel. As engine speeds drop to a predetermined level, the fluid drive re-engages and the fan resumes driven rotation. The fan is attached to studs protruding from the front of the fan clutch.

The coolant reserve tank, which serves to make the cooling system a closed one, is located near the front of the engine compartment and is attached to the radiator through a hose that connects with an outlet just below the radiator cap.

The thermostat is located in a housing atop the intake manifold. In its closed position, it serves to keep coolant in the cylinder block and head until the engine has reached an efficient operating temperature. As this temperature is reached, the thermostat opens, allowing coolant to pass from the head into the top radiator hose and into the radiator tank.

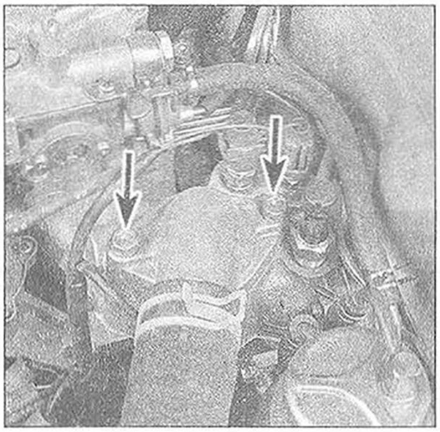
The heater utilizes heat generated from circulated engine coolant by drawing air through a passenger compartment-mounted heater core. 4-Runner models are equipped with a rear heater in addition to the dash mounted unit. Heater controls are mounted in the vehicle's dashboard and the system's blower employs an electric motor mounted in the under-dash located central heater unit. The blower circulates air through the system's heat and defroster ducts.

Air conditioning is an available option. Most of the system's components, except the evaporator/expansion valve (cooling unit) and controls, which are contained in the passenger compartment, are mounted in the engine compartment. Special refrigerant lines transfer freon, the cooling agent, back and forth between the passenger and engine compartment components.

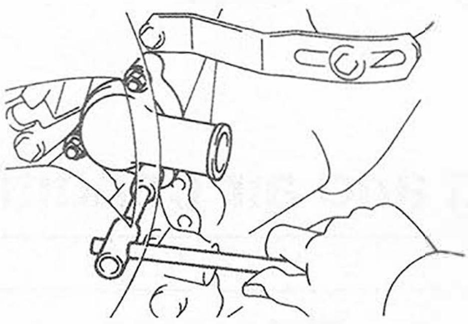
Warning: *If any component of the air conditioning system needs to be removed, the system must be depressurized first. Do not attempt to discharge the system yourself, as the system contains freon gas under vety high pressure. This could result in physical injury as well as damage to the system.*

2 Antifreeze - general information

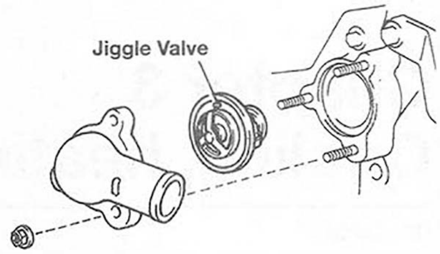
Warning: *Don't allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Flush contacted areas immediately with plenty of water. Don't store new coolant or leave old coolant Laying around where it's easily accessible to children and pets - they are attracted by its sweet taste. Ingestion of even a small amount can be fatal. Wipe up garage floor and drip pan coolant spills immediately. Keep antifreeze containers covered and repair leaks in your cooling sys-*



3.9a **View** of typical four cylinder **thermostat** housing **shows location of bolts (arrows)**



3.9b V6 thermostat housing is located adjacent to the water pump



3.12 V6 thermostat - exploded view {four-cylinder similar)

tem immediately.

The cooling system should be filled with a water/ethylene glycol based antifreeze solution which will prevent freezing down to at least -20-degrees F. It also provides protection against corrosion and increases the coolant boiling point.

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

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

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

3 Thermostat - check and replacement

Refer to illustrations 3.9a, 3.9b and 3.12

Note: *Don't drive the vehicle without a thermostat! Models equipped with oxygen sensors will stay in open loop and emissions and fuel economy will suffer.*

Check

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

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

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

4 If the upper radiator hose is hot, it means the coolant is circulating and the thermostat is open. Refer to the trouble-shooting section for the cause of overheating.

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

Replacement

Warning: *The engine must be completely cool before beginning this procedure!*

6 Disconnect the negative battery cable from the battery.

7 Drain about two quarts of coolant from the cooling system (Chapter 1),

8 Loosen the hose clamp and detach the upper radiator hose from the thermostat housing cover fitting.

9 Remove the bolts, then detach the thermostat housing cover and gasket **(see illustrations). Note:** *If the cover is difficult to remove, tap it gently with a soft-face hammer or a block of wood. Don't try to pry the cover loose or damage to the gasket sealing surfaces may result and leaks could develop.*

10 Note how it's installed (which end is facing up), then lift out the thermostat.

11 Remove all traces of old gasket material and sealant from the housing and cover with a gasket scraper, then clean the gasket mating surfaces with lacquer thinner or acetone.

12 Apply a thin layer of RTV sealant to the gasket mating surfaces of the housing and cover, then install the new thermostat in the housing. Make sure the correct end faces up - the spring is normally directed into the housing (see illustration).

13 Position a new gasket on the housing and make sure the bolt holes line up.

14 Carefully position the cover on the housing and install the bolts. Tighten them a little at a time to the specified torque-don't overtighten them or the cover may be distorted!

15 Reattach the radiator hose to the cover fitting and tighten the hose clamp. Now may be a good time to check and replace all of the cooling system hoses and clamps (see Chapter 1).

16 Refer to Chapter 1 and refill the system, then run the engine and check carefully for leaks.

4 Engine cooling fan and clutch - check and replacement

Refer to illustrations 4.4 and 4.7

Note: *Do not attempt to repair fan blades - replace any fan which is damaged.*

Check

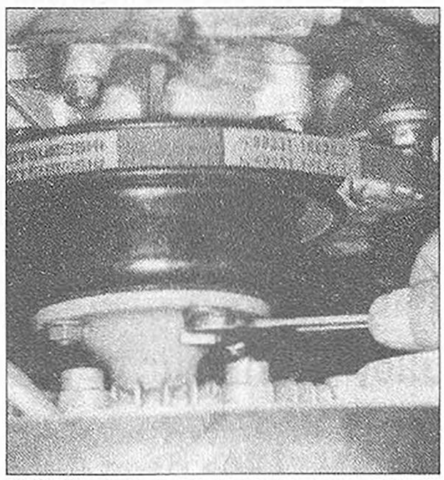
1 With the engine off and ignition key removed, rock the fan back and forth by hand to check for excessive bearing play. Visually inspect for substantial fluid leakage. Either problem calls for replacement of the clutch assembly.

2 With the engine fully warmed up, shut off the engine and remove the key for safety. Turn the fan by hand. Some drag should be evident. If the fan freewheels too easily or is completely locked up, replace the fan clutch.

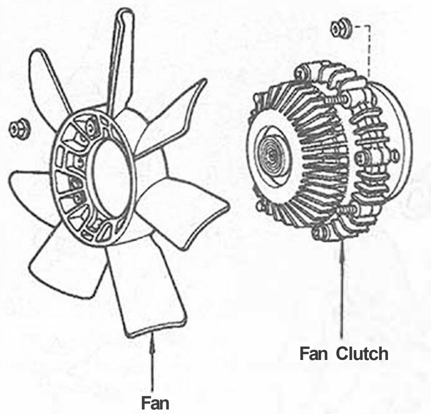
Replacement

3 Disconnect the negative cable from the battery.

4 Remove the nuts attaching the fan/clutch assembly to the water pump hub (see illustration).



4.4 Removing the clutch-to-pulley bolts (four-cylinder shown, V6 similar)



4.7 Typical fan/clutch assembly - exploded view. Arrows show locations of fan mounting studs

5 Lift the fan/clutch assembly out of the engine compartment. If the shroud interferes, unbolt it and lift it out with the fan.
6 Carefully inspect the fan blades for any damage or defects. Replace if necessary.
7 At this point, the fan may be unbolted from the clutch, if desired **(see illustration).**
8 Installation is the reverse of removal. It may be necessary to temporarily loosen the drivebelt (see Chapter 1) in order to start the fan clutch hub nuts. Tighten clutch-to-water pump nuts securely.

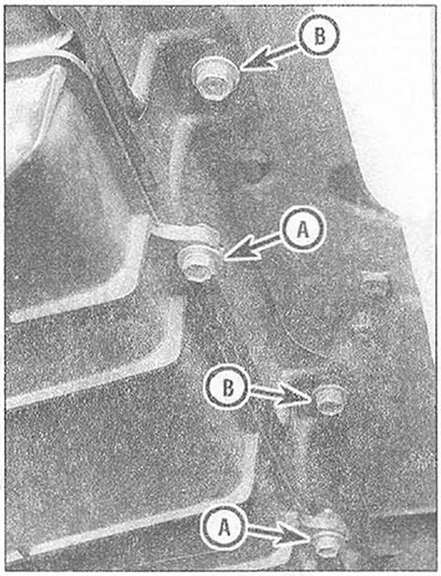
5 Radiator - removal and installation

Refer to illustration 5.4

Warning: *Allow the engine to cool to room temperature before starting this procedure.*
1 Remove the sheet metal belly pan, if equipped.
2 Drain the cooling system (see Chapter 1).
3 Disconnect the coolant hoses and overflow hose from the radiator.
4 Remove the fan shroud attaching bolts **(see illustration)** and lay the shroud back over the fan.
5 On vehicles with automatic transmissions, place a drain pan under the radiator and disconnect the transmission cooler lines from the radiator.
6 Unbolt the mounting brackets and lift the radiator from the vehicle.
7 Installation is the reverse of removal.
8 Refill the cooling system and on automatic transmission models, check transmission fluid level (see Chapter 1).

6 Coolant reservoir - removal and installation

Refer to illustration 6.1

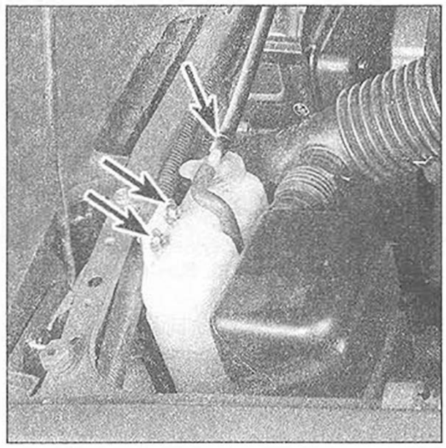


5.4 Right side view of radiator shows:
A Location of shroud bolts
B Location of radiator mounting bolts

1 Disconnect the coolant overflow hose at the radiator neck **(see illustration).**
2 Remove the screws attaching the reservoir to the inner fender.
3 Lift the reservoir straight up off its mounting bracket.
4 Installation is the reverse of removal.

7 Water pump - check

1 Water pump failure can cause overheating of and serious damage to the engine. There are three ways to check the operation of the water pump while it's installed on the eng.ine. If any one of the three following quick checks indicates water pump failure, it should be replaced immediately.
2 Start the engine and warm it up to normal operating temperature. Squeeze the upper radiator hose. If the water pump is working properly, a pressure surge should be felt as the hose is released.
3 A seal protects the water pump impeller shaft bearing from contamination by engine coolant. If the seal fails, weep holes in the top and bottom of the water pump snout will leak coolant under the vehicle. If the weep hole is leaking, shaft bearing failure will follow. Replace the water pump immediately.
4 Besides contamination by coolant after a seal failure, the water pump impeller shaft bearing can also be prematurely worn out by an improperly tensioned drivebelt. When the bearing wears out, it emits a high pitched squealing sound. If noise is coming from the water pump during engine operation, the shaft bearing has failed. Replace the water pump immediately.
5 To identify excessive bearing wear



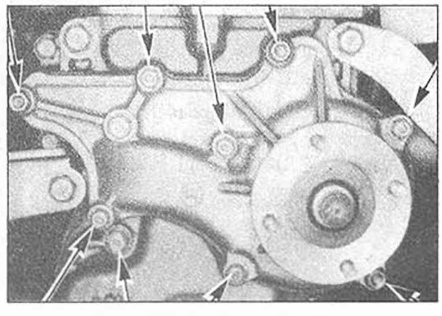
6.1 **View** of typical coolant reservoir **shows locations of overflow hose and mounting bolts (arrows)**

before the bearing actually fails, grasp the water pump pulley and try to force it up-and-down or from side-to-side. If the pulley can be moved either horizontally or vertically, the bearing is nearing the end of its service life. Replace the water pump.

8 Water pump - removal and installation

Refer to illustrations 8.8a, 8.8b, 8.10a and 8.10b

1 Disconnect the negative cable from the battery.
2 Drain the cooling system (see Chapter 1).
3 Remove the cooling fan (Section 4) and lift the shroud out of the engine compartment.
4 Remove the drivebelts (see Chapter 1). On V6 models, remove the timing belt (see Chapter 2B).
5 Disconnect the coo!ant hoses from the water pump.
6 Remove any accessory brackets from the water pump.
7 Remove the water pump pulley (4 cylinder models).
8 Unbolt and remove the water pump, noting the length and types of bolts as they are removed to ensure correct installation **(see illustrations).**



8.8a Arrows point to bolt locations on four-cylinder models

9 Thoroughly clean all gasket surfaces.

10 Position a new gasket onto the engine (four cylinder models), or a bead of sealer (Toyota no. 08826-00100 or equivalent) on V6 models **(see illustrations).**

11 Install the pump and tighten the bolts to the proper torque specifications.

12 Reinstall all parts removed in the reverse order of removal.

13 Refill the cooling system and check belt tension (see Chapter 1). Run the engine and check for leaks.

9 Coolant temperature sending unit - check and replacement

Refer to illustrations 9.9a and 9.9b

Warning: *The engine must be completely cool before removing the sending unit. Antifreeze-coo/ant is toxic, keep it away from children and pets.*

Check

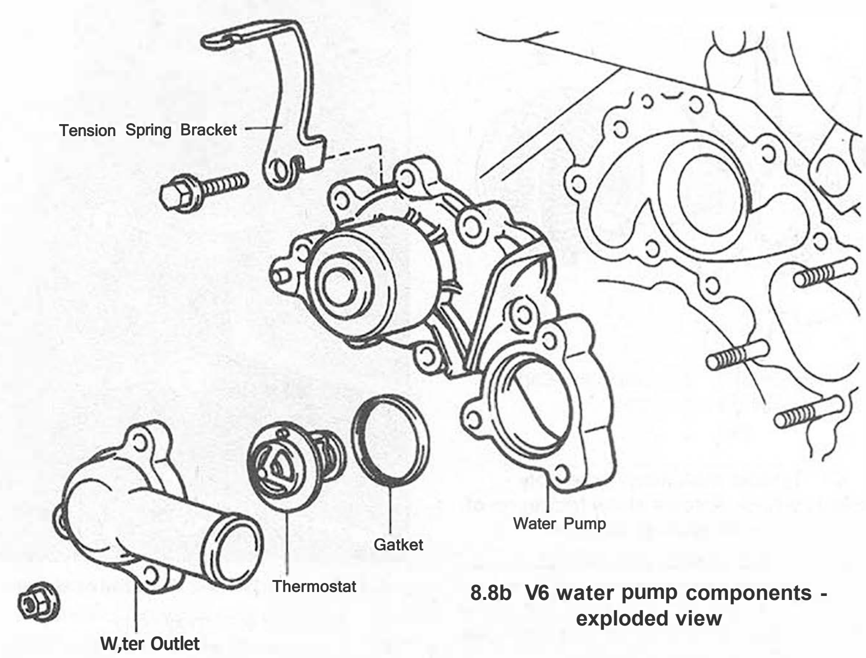
1 If the coolant temperature gauge is inoperative, check the fuses first (Chapter 12).

2 If the temperature gauge shows excessive temperature after running a while, see the Troubleshooting Section in the front of the manual.

3 If the temperature gauge indicates "Hot" shortly after the engine is started cold, disconnect the wire at the coolant temperature sensor. 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 checked out OK, shut off the engine. Disconnect the wire at the sending unit and using a jumper wire, connect it to a clean ground on the engine. Turn on the ignition without starting the engine. If the gauge now indicates "Hot", replace the sending unit.

5 If the gauge still does not work, the circuit may be open or the gauge may be faulty, see Chapter 12 for additional information.



8.8b V6 water pump components - exploded view

Replacement

6 With the engine completely cool, *remove* the cap from the radiator to release any pressure and then replace the cap. This reduces coolant loss during sender replacement.

7 Disconnect the wiring connector from the sending unit.

8 Prepare the new sending unit for installation by applying a light coating of sealer to the threads.

9 Unscrew the sending unit from the engine **(see illustrations)** and quickly install the new one to prevent coolant loss.

10 Tighten the switch securely and connect the wiring plug.

11 Refill the cooling system and run the engine. Check for leaks and proper gauge operation.

10 Blower unit - removal and installation

Refer to illustration 10.2

1 Locate the main heater unit, which is readily accessible beneath the dashboard of your vehicle. On early models, the blower is above the throttle pedal; later models have the unit mounted below the glove box.

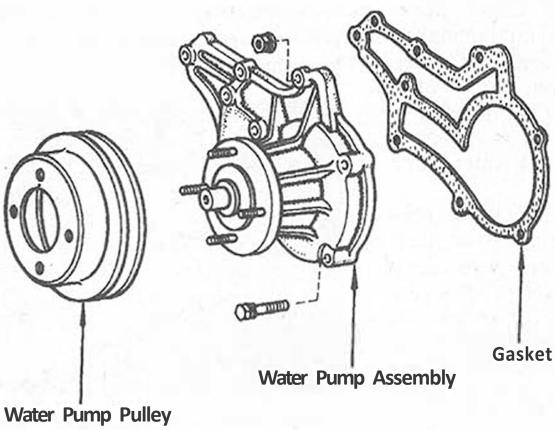
2 The blower motor is located on the left side of the heater unit **(see illustration).**

3 Disconnect the blower motor electrical connector.

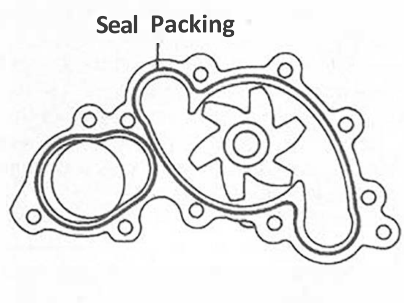
4 Remove the three screws holding the blower motor to the heater unit housing. Remove the kick panel if it is in the way.

5 If you are replacing the motor, detach the fan and transfer it to the new motor.

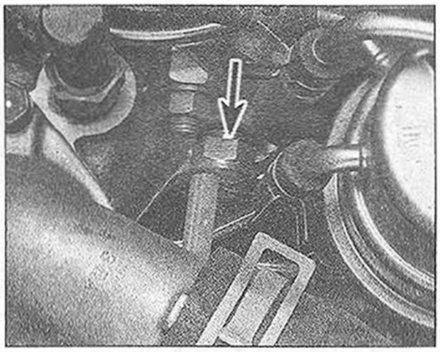
6 Installation procedures are the reverse of those for removal. Run the fan and check for proper operation.



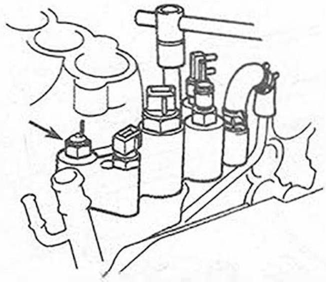
8.10a Four-cylinder water pump components - exploded view



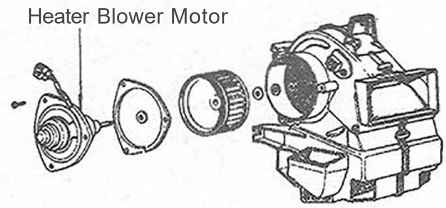
8.10b Apply sealer as shown to V6 water pump



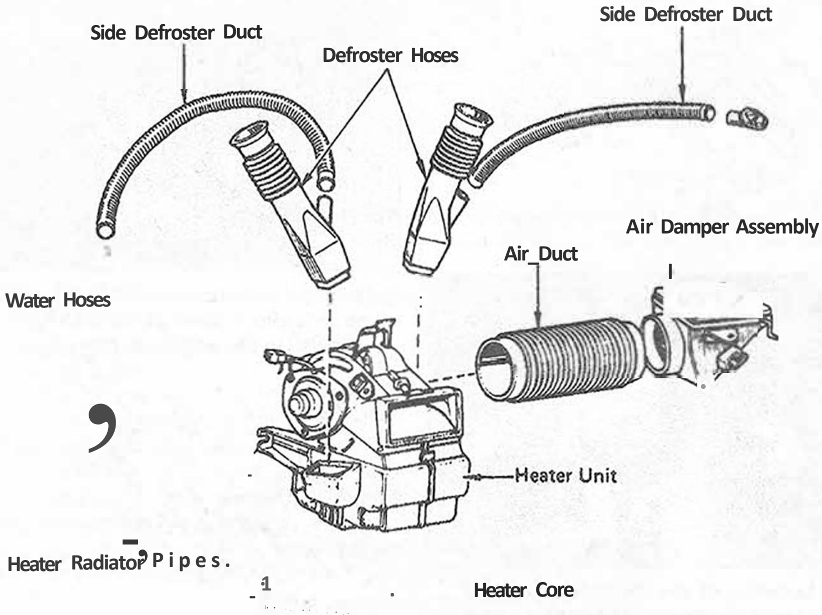
9.9a Four-cylinder coolant temperature sending unit is located in front of intake manifold (arrow)



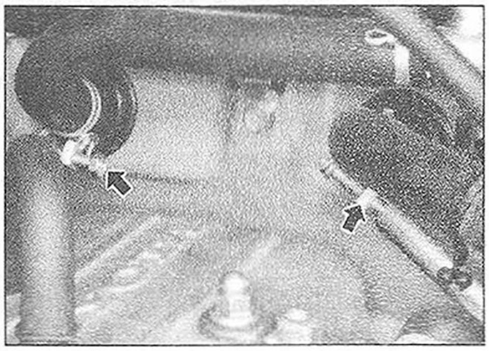
9.9b **V6** Coolant temperature sending unit is located at the front of the intake manifold (arrow)



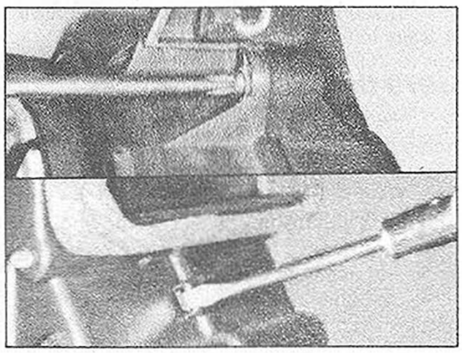
10.2 Typical heater blower unit - exploded view



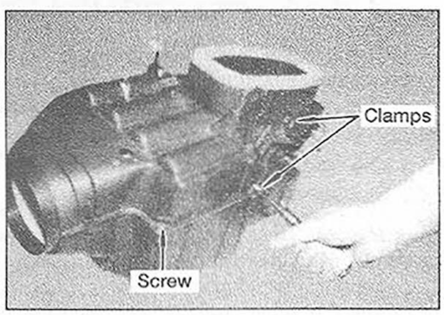
11.4 Typical heater assembly - exploded view



11.9 The heater hoses connect to the heater core on the engine side of the firewall. Arrows point to the clamps



11.12a Locations of screws and clips on heater housing (typical)



11.12b Locations of screws and clips on heater housing (typical)

11 Heater core - removal and installation

Refer to illustrations 11.4, 11.9, 11. 12a and 11.12b

1 Disconnect the cable from the negative battery terminal.

2 Open the radiator drain cock and drain the coolant into a suitable container (see Chapter 1).

3 Remove the glove compartment by removing the retaining screws.

4 Under the dash, locate the defroster hoses on either side of the heater unit and remove them by pulling straight up (see illustration).

5 locate the air damper assembly under the dash on the right side.

6 Remove the air damper by removing the retaining screws, then pull the air duct from the air damper and heater unit inlets.

7 Remove the two side defroster ducts.

8 Remove the heater control assembly as described in Section 12.

9 Locate the two heater hoses on the engine compartment side of the firewall and disconnect them by unscrewing their retaining clamps **(see illustration).**

10 Remove the heater unit by removing the three retaining bolts. The heater unit should be removed from the passenger side of the vehicle.

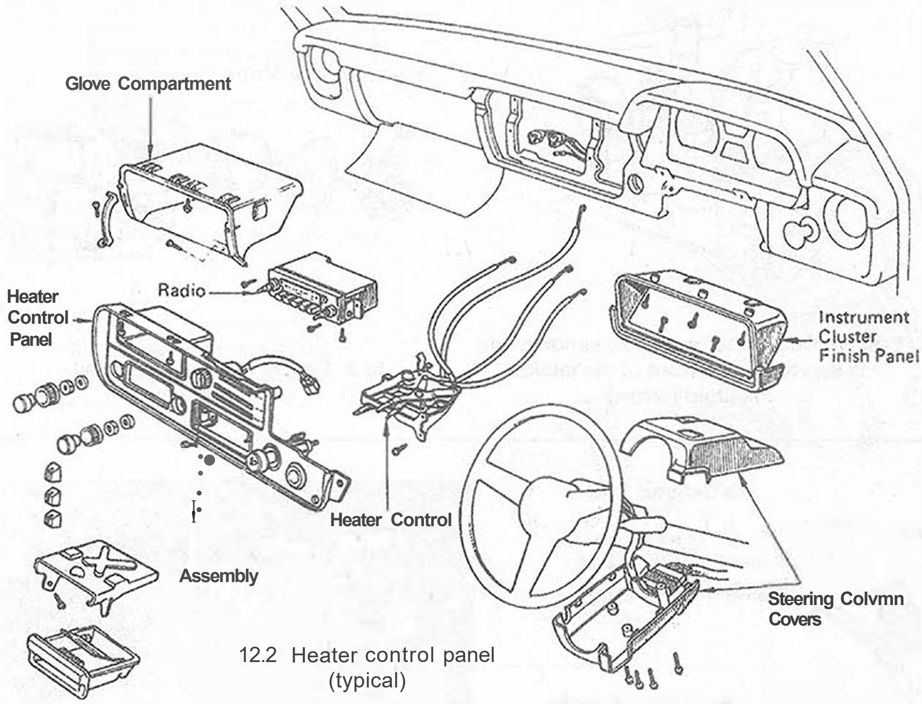
11 Unclamp and remove the two pipes leading to the heater core.

12 Remove the set screw and unfasten the six clips from the heater unit housing **(see illustrations).**

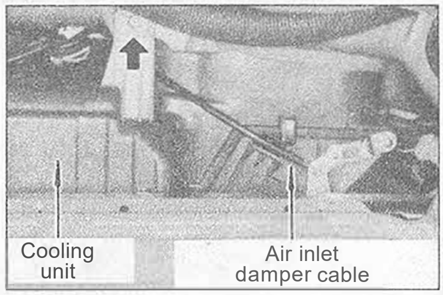
13 Pull the heater core from the heater unit.

14 Installation procedures are the reverse of those for removal.

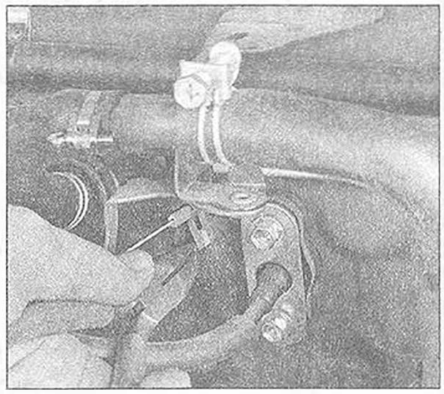
15 Refill the cooling system, run the engine and check for proper operation and leaks.



12.2 Heater control panel (typical)



12.6 Location of air inlet damper cable behind glove box (typical)


12.7 The control valve cable is held in place by a clip located at the middle of the firewall in the engine compartment

12 Air conditioning and heater control assembly - removal and installation

Refer to illustrations 12.2, 12.6, 12.7, 12.8 and 12.10

1 Disconnect the cable from the negative battery terminal.

1979 through 1988

2 Remove the steertng column *cover* by removing the retaining screws (see **illustration).**

3 Remove the radio by pulling off the volume and tuning knobs and removing the retaining screws (two at the side mounting tabs and one from underneath).

4 Disconnect the four heater control cables from their clamps. Note the positions of the cables relative to the clamps to facilitate proper installation.

5 Unplug the air conditioning control switch, if equipped.

6 Remove the cable leading to the air inlet damper (see illustration).

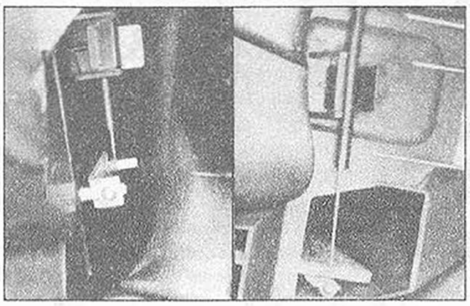
7 Remove the cable leading to the water control valve **(see illustration).**

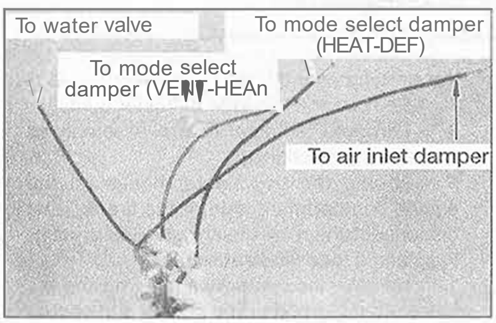
8 Remove the vent/heat mode select damper cable **(see illustration).**

9 Remove the heat/defroster mode select cable.

10 Remove the two screws holding the heater control assembly, then remove the assembly (see illustration).

11 Before installing the heater control, lubricate the cables with penetrating oil and the pivot points of the heater control valves with multipurpose grease.


12.8 Location of ve11t/heat selector cable (left) and heat/defroster selector cable (right) - typical



12.10 Heater control assembly- typical

12 To install the controls, connect the four cables to the heater control assembly.

13 Install the heater control assembly.

14 To complete the installation, reverse the steps above.

15 Test the control cable operation by moving the control levers back and forth, checking for stiffness, binding and proper operation through the levers' full range.

1989on

16 Detach the cable from the negative battery terminal.

17 Pull off the heater control knobs.

18 If the vehicle has air conditioning, pry off the A/C switch.

19 Using a screwdriver, pry out the heater control plate.

20 Remove the mounting screws and pull out the heater and air conditioner control assembly. Unplug all connectors and remove the control assembly.

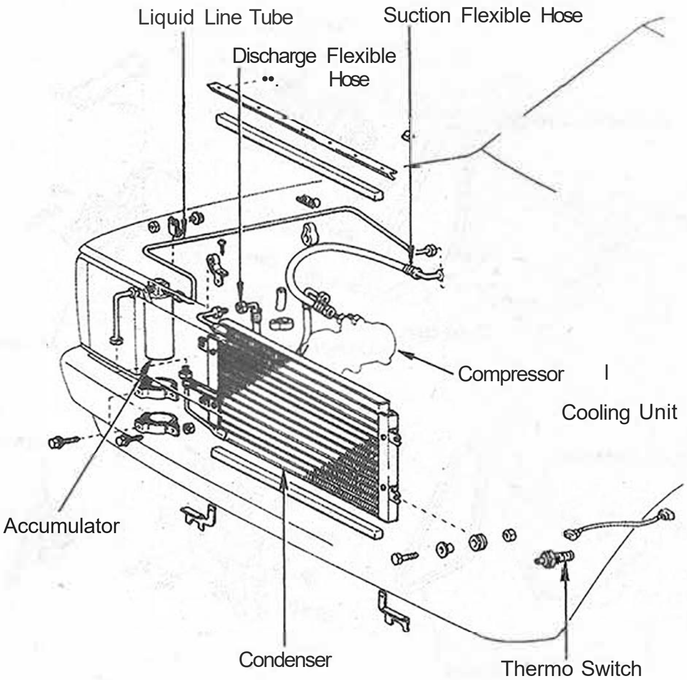
21 Installation is the reverse of removal.

13 Air conditioning system - check and maintenance

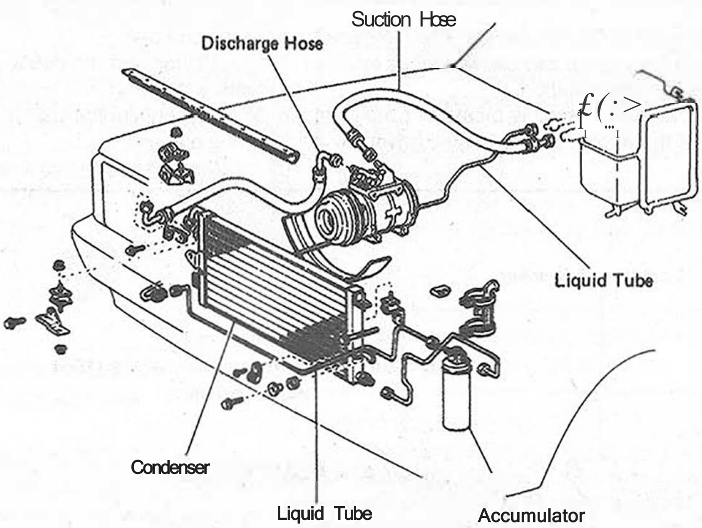
Refer to illustrations 13.3a and 13.3b

Warning: *If any component of the air conditioning system requires removal, the system must first be depressurized by a qualified technician. Because the system contains refrigerant under ve,y high pressure, do not attempt to disconnect any part of the system yourself This could result in physical inju,y as well as damage to the system.*

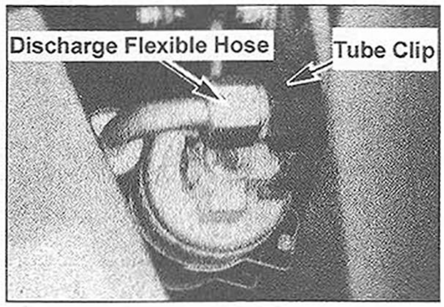
Caution: *The air conditioning system on 1995 models uses the non-ozone depleting refrigerant, referred to as R- 134a. The R- 134a refrigerant and its lubricating oil are not compatible with the R-12 system, and under no circumstances should the two types of refrigerant and/or lubricating oils be intermixed. If*



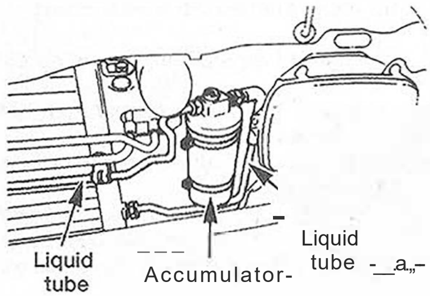
13.3a Air conditioning system components - first version



13.3b Air conditioning system components - second version



14.1a The accumulator is mounted on the firewall on earlier models



14.1 b Later models have the accumulator mounted next to the condenser

mixed, it could result in costly compressor failure due to improper lubrication.

Because of the special tools, equipment and skills required to service air conditioning systems, and the differences between the various systems that may be installed on vehicles, air conditioner servicing cannot be covered in this manual.

We will cover component removal, as the home mechanic may realize a substantial savings in repair costs if he removes components himself, takes them to a professional for repair, and/or replaces them with new or rebuilt ones.

These vehicles are equipped with air conditioning systems available from a number of different sources. This and the following Sections will deal with the factory installed system only (see illustrations).

Determine what type of system is on your vehicle by looking at the data plate usually found on the compressor. If you can't find the type of system, it would be best to consult an air conditioning specialty shop for repair information or help. Problems in the air conditioning system should be diagnosed, and the system refrigerant evacuated, by an air conditioning technician.

Once the new or reconditioned component has been installed, the system should then be charged and checked by an air conditioning technician.

Before indiscriminately removing air conditioning system components, get more than one estimate of repair costs from reputable air conditioning service centers. You may find it cheaper and less trouble to let the entire operation be performed by someone else.

The following maintenance steps should be performed on a regular basis to ensure that the air conditioner continues to operate at peak efficiency.

a) *Check the tension of the drivebelt and adjust it if necessary (Chapter 1).*
b) *Check the condition of the* hoses. *Look for cracks, hardening and deterioration.* **Warning:** *Don't replace A/C* hoses *until the system* has *been discharged by a dealer service department or repair shop.*
c) *Check the fins of the condenser for leaves, bugs and any other foreign material. A soft brush and compressed air can be used to remove them.*
d) *Maintain the correct refrigerant charge.*

The system should be run for about 10 minutes at least once a month. This is particularly important during the winter months because long term non-use can cause hardening and failure of the seals.

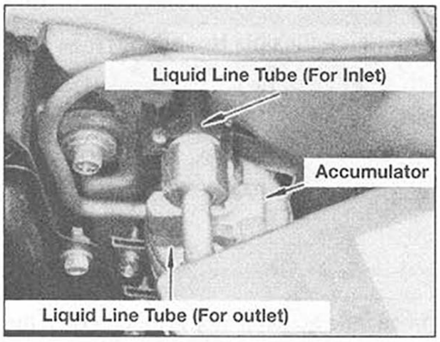
14 Air conditioning accumulator - removal and installation

Refer to illustrations 14.1a, 14.1b and 14.3

Warning: *Before removing the accumulator, the* system *must be discharged by an air conditioning technician. Do not attempt to do this yourself. The refrigerant in the system can cause serious injury and respiratory irritation.*

1 The accumulator, which acts as a reservoir and filter for the refrigerant, is the canister-shaped object mounted in the right front fender well or to the left of the condenser (see **illustrations)** in the engine compartment.

2 Disconnect the two liquid lines from the accumulator. Cap the open fittings immedi-



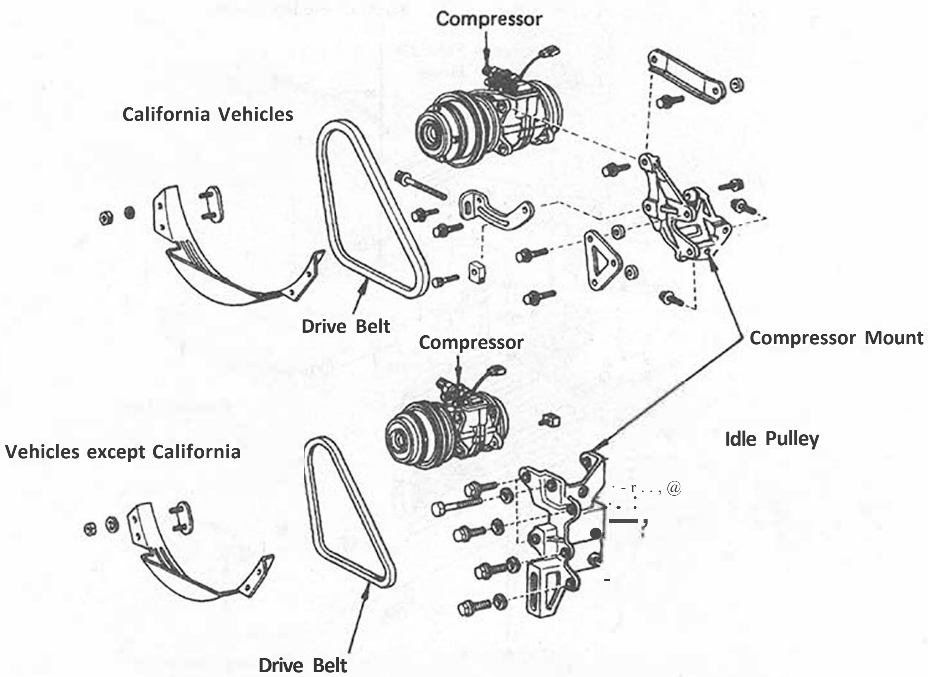
14.3 After system discharge, disconnect the liquid (refrigerant) lines (arrows)

ately to prevent moisture from entering the system.

3 Remove the accumulator from its bracket **(see illustration).**

4 Installation procedures are the reverse of those for removal.

5 Have the system evacuated, charged and leak tested. If a new accumulator was installed, add 0.7 fluid ounce of refrigerant oil.



15.6a Compressor mounting details through 1983 - exploded view

15 Air conditioning compressor - removal and installation

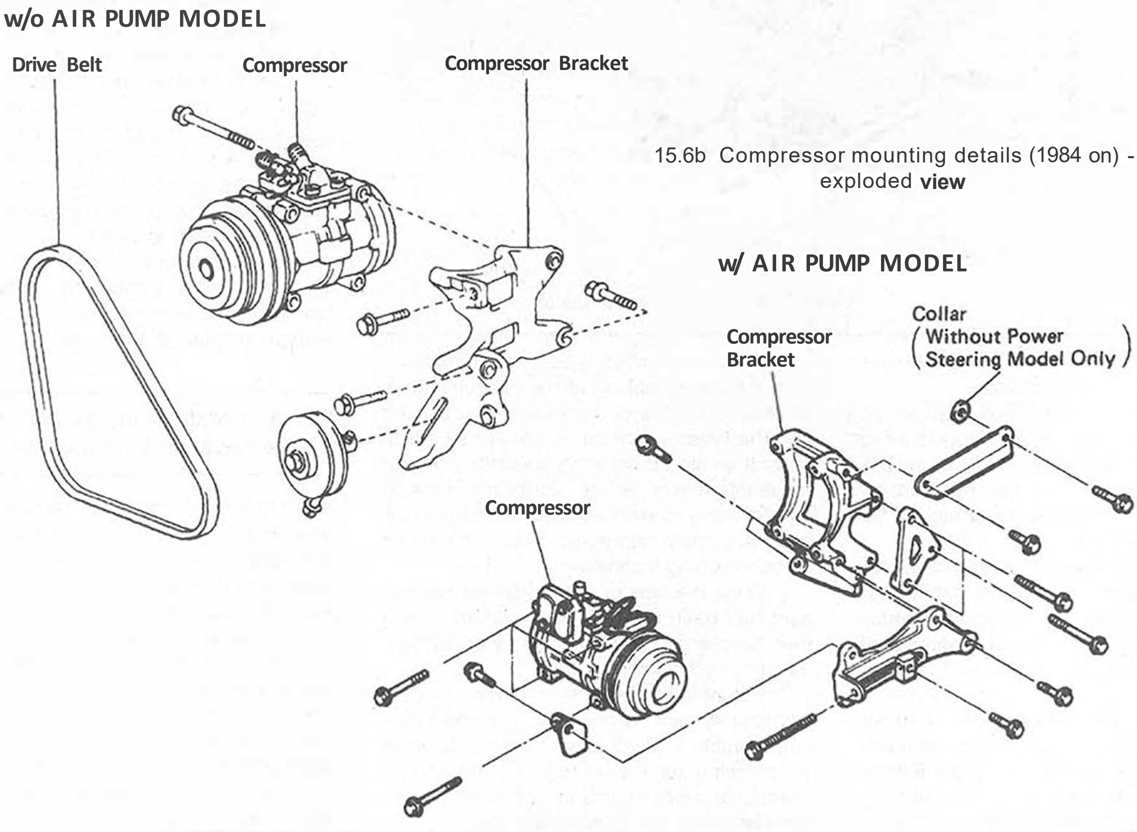
Refer to illustration 15.6a, 15.6b and 15.6c

Warning: *For this operation, the refrigerant must be discharged. You must have this done by a qualified air conditioning technician. Do not attempt to do this yourself. The refrigerant used in the system can cause serious injuries and respiratory irritation.*

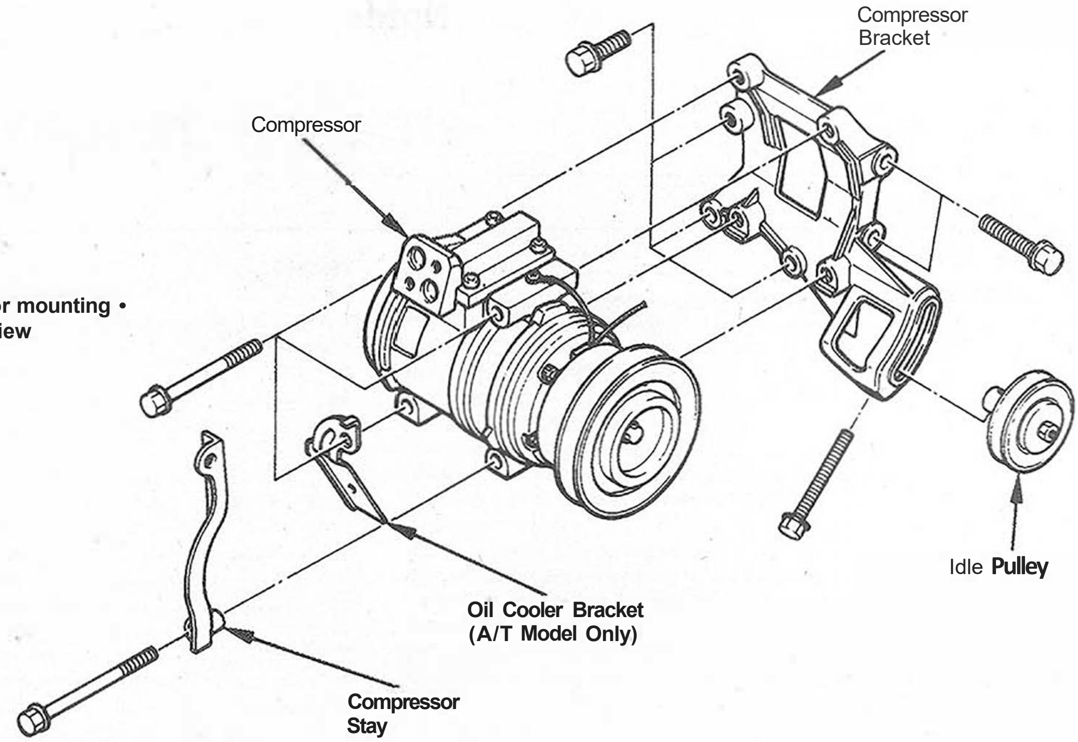
1 The compressor is located at the right side of the engine and is engine driven by a pulley and belt.

2 Disconnect the cable from the negative battery terminal.

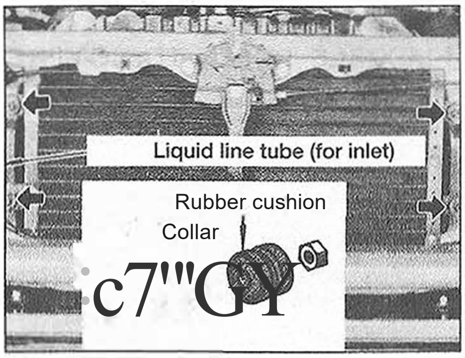
3 Disconnect the clutch lead wire from the wiring harness.



15.6b Compressor mounting details (1984 on) - exploded **view**



15.6c V6 compressor mounting • exploded view



16.6 Arrows indicate locations of condenser mounting bolts

4 Disconnect the two flexible hoses from the compressor service valves. Cap the openings immediately to prevent moisture from entering the system.

5 Loosen the drivebelt by loosening the adjustment and pivot bolts on the compres· sor mount. Unbolt the fan shroud and move it aside if necessary.

6 Remove the compressor mounting bolts and the compressor **(see illustrations on page 129).**

7 Installation procedures are the reverse of those for removal.

8 Have the system evacuated, charged and leak tested by the shop that discharged it.

16 Air conditioning condenser - removal and installation

Refer to illustration 16.6

1 For this operation, the refrigerant must be discharged. You must have this done by a qualified air conditioning technician. Do not attempt to do this yourself.

Warning: *The refrigerant used in the system can cause serious injuries and respiratory irritation.*

2 The condenser is located in front of the radiator.

3 Remove the front grille (see Chapter 11) and the hood lock brace, if necessary.

4 Disconnect the flexible discharge hose from the condenser.

5 Disconnect the liquid line tube from the condenser, and remove the tube clip. **Note:** *Cap the open fittings immediately to prevent moisture from entering the system.*

6 Remove the four bolts holding the condenser to the front panel, making note of the cushion and collar arrangement **(see illustration)** so that proper installation of the condenser is assured. Carefully lift the condenser out of the vehicle; do not bend the cooling fins or coil.

7 Installation procedures are the reverse of those for removal.

8 Have the system evacuated, charged and leak tested. If the condenser was replaced with a new one, add 1.4 to 1.7 ounces of refrigerant oil.

Notes

Chapter 4
Fuel and exhaust systems

Contents

	Section
Air cleaner assembly (carburetor) - removal and installation	5
Air filter replacement	See Chapter 1
Airflow meter - check and replacement	14
Air intake chamber - removal and installation	20
Air valve - check and replacement	15
Automatic choke system	See Chapter 6
Auxiliary accelerator pump (AAP) system	See Chapter 6
Carburetor choke check	See Chapter 1
Carburetor - on-vehicle adjustments	8
Carburetor - removal and installation	7
Carburetor - servicing and overhaul	6
Cold start injector - check and replacement	18
EFI components - general description	11
EFI system - Electronic Control System	13
EFI system - general information and special precautions	9
Engine idle speed check and adjustment	See Chapter 1
Exhaust system - check	See Chapter 1
Exhaust system - servicing	23
Fuel filter replacement	See Chapter 1
Fuel lines - repair and replacement	12
Fuel pressure relief procedure	10
Fuel pump - removal and installation	4
Fuel system check	See Chapter 1
Fuel tank - cleaning and repair	3
Fuel tank - removal and installation	2
General information	1
Injector - check and replacement	21
Pressure regulator - check and replacement	19
Throttle body - check, removal, adjustment and installation	17
Throttle position sensor - check and replacement	16
Turbocharger - inspection. removal and installation	22

Specifications

Carburetor

Fast idle speed	
1979 and 1980	2400 rpm
1981 through 1987	2600 rpm
1988-on	3000 rpm
Dash pot setting speed (1985 through 1987 vehicles)	3000 rpm
Idle mixture adjusting screw (initial setting)	
1979	1-3/4 turns
1980	1-1/2 turns
1981 and 1982	2-1/2 turns
1983	4 turns
1984	4-1/2 turns
1985-on	3-1/2 turns
Idle mixture speed	
1979 and 1980	
Manual transmission in Neutral	870 rpm
Automatic transmission in Neutral	920 rpm
1981	
Manual or automatic (Federal 4-speed)	740 rpm
Automatic (except Federal 4-speed)	790 rpm
1982 through 1987	
Manual	740 rpm
Automatic	790 rpm
1988-on	740 rpm
Idle speed	
1979 and 1980	
Manual transmission	800 rpm
Automatic transmission	850 rpm
1981	
Manual and automatic (Federal 4-speed)	700 rpm
Automatic (except Federal 4-speed)	750 rpm
1982 through 1987	
Manual	700 rpm
Automatic	750 rpm
1988-on	700 rpm

Electronic fuel injection

Fuel pressure	
Four cylinder engine (through 1988)	
Ignition switch On, engine off	33to 38 psi
Engine idling	
Vacuum sensing hose detached	33 to 38 psi
Vacuum sensing hose attached	27 to 31 psi
V6 engine (and 1989-on four-cylinder engine)	
Ignition switch On, engine off	38 to 44 psi
Engine idling	
Vacuum sensing hose detached	38 to 44 psi
Vacuum sensing hose attached	33 to 37 psi
Fuel injector resistance	
1984 through 1986	1.5 to 3.0 ohms
1987	
Non-turbo	1.5 to 3.0 ohms
Turbo	1.1 to 2.0 ohms
1988	
Four cylinder engine (non-turbo)	1.0 to 2.5 ohms
Four cylinder engine (turbo)	1.1 to 2.0 ohms
V6	1.2 to 2.2 ohms
1989-on all models	13.4 to 14.2 ohms
Turbocharger pressure	5.3 to 7.1 psi at 2400 rpm

Torque specifications

	Ft-lbs
Throttle body mounting nuts/bolts	13
Cold start injector tube banjo bolt	13
Pressure regulator locknut	
1984 models	18 to 21
1985 and later models	22
Delivery pipe (tuel rail) bolts	
1984 models	12 to 16
1985 and later models	14
Delivery pipe (fuel rail) nuts (V6)	9
Pulsation damper	33
Turbocharger	
Exhaust manifold-to-turbo nuts	29
Turbine outlet elbow nuts	19
Turbo oil pipe	
Mounting nuts	14
Banjo bolt	20
Exhaust manifold mounting nuts	33
Exhaust pipe to turbine outlet elbow flange nuts	32

1 General information

The fuel system consists of a rear mounted tank, combination metal and rubber fuel hoses, an engine-mounted mechanical pump or an in-tank electric pump, and either a two-stage, two-venturi carburetor or an electronic fuel injection system.

The exhaust system is composed of an exhaust manifold or manifolds, the catalytic converter and a combination muffler and tailpipe assembly.

The emissions control systems modify the functions of both the exhaust and fuel systems. There will be many cross-references throughout this Chapter to Sections in Chapter 6 because the emissions control systems are integral to the induction and exhaust systems.

Extreme caution should be exercised when dealing with either the fuel or the exhaust system. Fuel is a primary element for combustion. Be very careful! The exhaust system is also an area for exercising caution as it operates at very high temperatures, particularly with the use of emissions control systems. Serious burns can result from even momentary contact with any part of the exhaust system and the fire potential is ever present.

2 Fuel tank - removal and installation

Refer to illustration 2 1

1 The fuel tank **(see illustration)** is mounted at the rear of the vehicle. If it becomes necessary to work on it or its associated fittings, either in or out of the vehicle, the ignition switch must be Off and the battery ground cable disconnected. Before removing the tank, unscrew the drain plug and empty any remaining fuel into a suitably sized container.

2 Disconnect the wiring connector from the fuel sending unit and (if your vehicle is fuel injected), the fuel pump.

3 Disconnect the emission, outlet and return hoses.

4 Disconnect the two filler pipes from the fuel tank.

5 Remove the fuel tank shield.

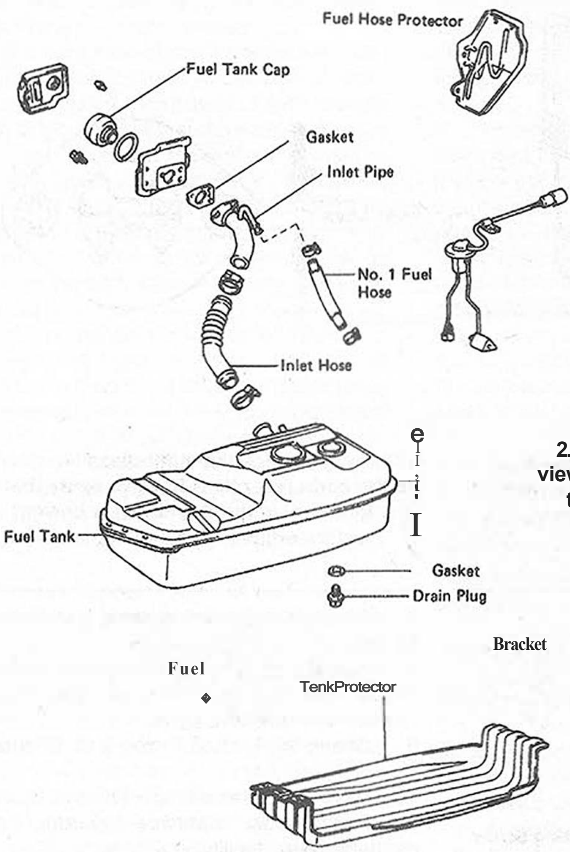
6 Remove the six retaining bolts at the ends of the tank and carefully remove it.

7 Installation is the reverse of the removal procedures. Be sure to tighten all bolts, clamps and the plug securely.

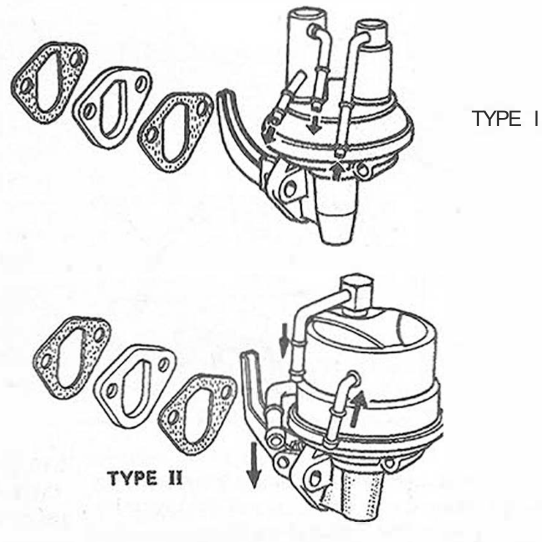
3 Fuel tank - cleaning and repair

1 Repairs to the fuel tank or filler neck should be performed by a professional with the proper training to carry out this critical and potentially dangerous work. Even after cleaning and flushing, explosive fumes can remain and could explode during repair of the tank.

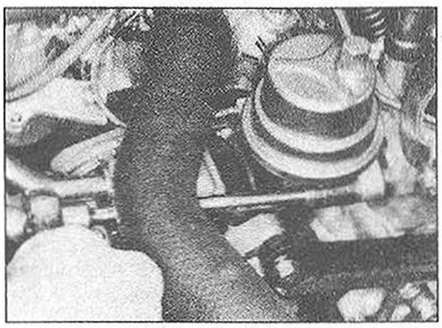
2 If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside garages where a natural gas appliance is located because the pilot light could cause an explosion.



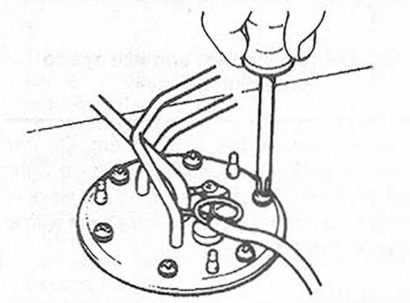
2.1 An exploded view of a typical fuel tank assembly



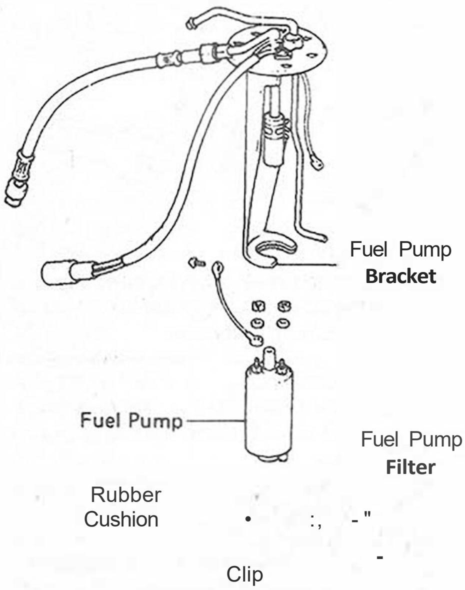
4.4a An exploded view of the Type I and Type II mechanical fuel pumps



4.4b Removing the mounting bolts from a typical mechanical fuel pump (Type II shown)



4.9 To remove the fuel pump/sending unit assembly from the fuel tank, remove all bolts from the flange in the top of the fuel tank



4.1 O An exploded view of the fuel pump/sending unit assembly

4 Fuel pump - removal and installation

Note: *If the required pressure gauge is available, hook it up to the pump outlet with a T-fitting and check the pump outlet pressure before removing it from the engine.*

Warning: *Gasoline* **is** *extremely flammable* **so** *extra precautions must be taken when working on any part of the fuel system. Do not smoke or allow open flames or bare light bulbs near the work area. Also, do not work in a garage if a natural gas type appliance with a pilot light is present.*

Mechanical (carbureted vehicles)

Refer to illustrations 4.4a and 4.4b

1 Remove the air cleaner (see Section 5).

2 Exercise caution regarding flammable fuel and mark the location of the fuel hoses before performing the following step.

3 Remove the fuel pump line clamps and lines.

4 Remove the two bolts holding the fuel pump and heat shield to the cylinder head **(see illustrations).**

5 Remove the fuel pump and gasket.

6 Installation is the reverse of removal. Use new gaskets when installing the fuel pump. Check for oil leaks at the pump-to-cylinder head mating surface and for fuel leaks at the pipe-to-hose connections.

Electric pump (fuel-injected vehicles)

Refer to illustrations 4.9, 4.10, 4.11 and 4. 12

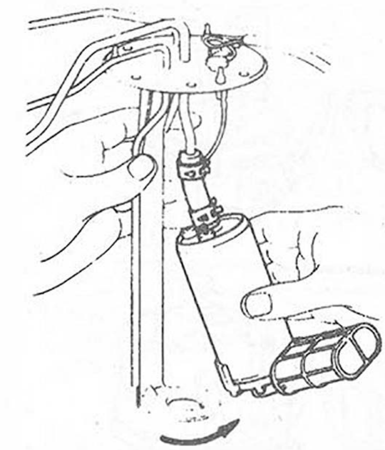
7 Drain all fuel from the fuel tank (see Section 2).

8 Remove the fuel tank (see Section 2).

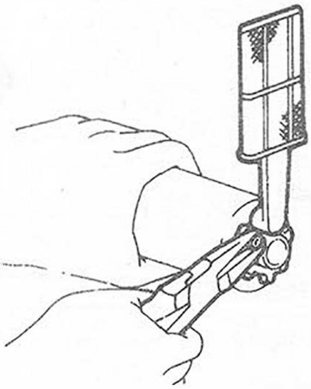
9 Remove the bolts from the fuel pump/sending unit mounting flange **(see illustration)** and pull the pump/sending unit assembly from the fuel tank.

10 Remove the two nuts **(see illustration)** and detach the wires from the fuel pump.

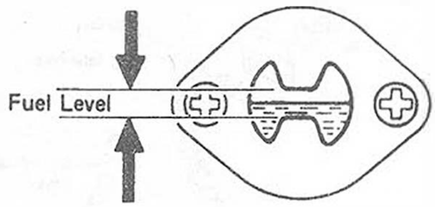
11 Pull the lower end of the pump from the



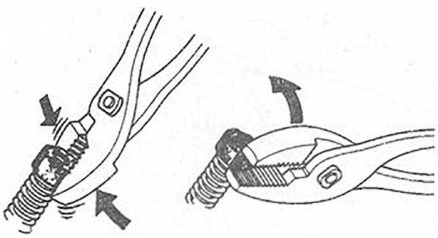
4.11 To detach the fuel pump from the pump/sending unit bracket, pull the lower end of the pump away from the bracket



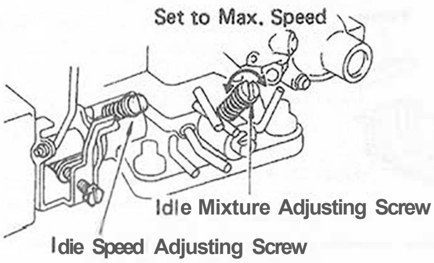
4.12 To detach the fuel pump filter from the pump, remove the rubber cushion, remove the clip with a pair of pliers and pull out the filter



8.1 Always check the sight glass window on the carburetor float bowl to verify that the fuel level in the float bowl is correct before adjusting the idle speed



8.2 Use pliers to break off the limiter caps on the idle mixture and idle adjusting screws



8.3 The idle mixture and idle speed adjusting screws

bracket **(see illustration).**

12 Remove the rubber cushion, remove the clip and pull out the filter from the fuel pump **(see illustration).**

13 Installation is the reverse of *removal.*

5 Air cleaner assembly (carburetor) - removal and installation

Note: See *Chapter 1 for air filter replacement procedures.*

1 Disconnect the cable from the negative terminal of the battery.

2 Disconnect and label the emission control hoses at the base of the air cleaner.

3 Disconnect the air intake hoses.

4 Remove the mounting nuts and the wing nut from the air cleaner.

5 Lift the air cleaner off the carburetor.

6 Installation is the reverse of the removal procedures.

6 Carburetor - servicing and overhaul

Warning: *Gasoline is extremely flammable so extra precautions must be taken when working on any part of the fuel* system. *Do not smoke or allow open flames or bare light bulbs* near *the work area.* Also, *do not work in a garage if a natural gas type appliance with a pilot light is present.*

Servicing

1 A thorough road test and check of carburetor adjustments should be done before any major carburetor service. Specifications for some adjustments are listed on the vehicle Emissions Control Information label found in the engine compartment.

2 Some performance complaints directed at the carburetor are actually a result of loose, misadjusted or malfunctioning engine or electrical components. Others develop when vacuum hoses leak, are disconnected or are incorrectly routed. The proper approach analyzing carburetor problems should include a routine check of the following areas:

3 Inspect all vacuum hoses and devices for leaks and proper installation (see Chapter 6, *Emission control* systems).

4 Tighten the intake manifold nuts and carburetor mounting nuts evenly and securely.

5 Perform a cylinder compression test.

6 Clean or replace the spark plugs as necessary.

7 Check the spark plug wires (see Chapter 1).

8 Inspect the ignition primary wires and check the vacuum advance operation. Replace any defective parts.

9 Check the ignition timing (see Chapter 1).

10 Have the carburetor idle fuel/air mixture checked by a dealer service department or reputable repair facility.

11 Inspect the hot air intake system in the air cleaner for proper operation (see Chapter 6).

12 Remove the carburetor air filter element and blow out any dirt with compressed air. If the filter is extremely dirty, replace it with a new one (see Chapter 1).

13 Inspect the crankcase ventilation system (see Chapter 6).

14 Carburetor problems usually show up as flooding, hard starting, stalling, severe backfiring, poor acceleration and lack of response to idle mixture screw adjustments. A carburetor that is leaking fuel and/or *covered* with wet looking deposits definitely needs attention.

15 Diagnosing carburetor problems may require that the engine be started and run with the air cleaner removed. While running the engine without the air cleaner it is possible that it could backfire. A backfiring situation is likely to occur if the carburetor is malfunctioning, but removal of the air cleaner alone can lean the air/fuel mixture enough to produce an engine backfire. **Warning:** *Do not place your face or any parts of your body directly over the carburetor during diagnosis.*

16 Once it is determined that the carburetor is indeed at fault, it should be either replaced with a new or factory-rebuilt unit or *overhauled* using new parts where necessary.

Overhaul

17 If you are going to overhaul the carburetor yourself, first obtain a good quality carburetor rebuild kit (which will include all necessary gaskets, internal parts, instructions and a parts list). You will also need some solvent

and a means of blowing out the internal passages of the carburetor with air.

18 Because carburetor designs are constantly modified by the manufacturer in order to meet emissions regulations, it isn't feasible for us to do a step-by-step overhaul of each type. You'll receive a detailed set of instructions with any quality carburetor overhaul kit. They will apply in a more specific manner to the carburetor on your vehicle.

19 An alternative is to obtain a new or rebuilt carburetor. They are readily available from dealers and auto parts stores. Make sure the exchange carburetor is identical to the original. A tag is usually attached to the top of the carburetor. It will aid in determining the exact type of carburetor you have. When obtaining a rebuilt carburetor or a rebuild kit, take time to make sure that the kit or carburetor matches your application exactly. Seemingly insignificant differences can make a large difference in the performance of your engine.

20 If you choose to overhaul your own carburetor, allow enough time to disassembly the carburetor carefully, soak the necessary parts in the cleaning solvent (usually for at least one-half day or according to the instructions listed on the carburetor cleaner) and reassemble it, which will usually take much longer than disassembly. When disassembling the carburetor, match each part with the illustration in the carburetor **kit** and lay the parts out in order on **a** clean work surface.

7 Carburetor - removal and installation

Warning: *Gasoline is extremely flammable so extra precautions must be taken when working on any part of the fuel system. Do not smoke or allow open flames or bare fight bulbs near the work area. Also, do not work in a garage if a natural gas type appliance with a pilot light is present.*

1 Remove the air cleaner (see Section 5)

2 Disconnect the accelerator linkage from the carburetor.

3 On automatic transmission equipped models, disconnect the throttle cable linkage from the carburetor (see Chapter 7A).

4 From the carburetor, disconnect and label the emission control hoses; the two coolant hoses from the choke housing (1979 and 1980 models); the PCV hose from the flange; the fuel hose(s); and the wiring connectors.

5 Remove the mounting flange nuts and bolts and lift off the carburetor. *Cover* the inlet hole of the intake manifold with a cloth.

6 Installation is the reverse of the removal procedure, but make sure that the flange surfaces are clean and that a new gasket is used. Be sure to tighten the carburetor mounting bolts/nuts securely. After installation, perform all of the adjustments described in this Chapter and Chapter 1. Also, install the air cleaner, start the engine and check carefully for fuel leaks.

8 Carburetor - on-vehicle adjustments

Refer to illustrations 8.1, 8.2, 8.3, 8.9, 8.12 and 8.14

1979 and 1980 vehicles

Idle speed and idle mixture

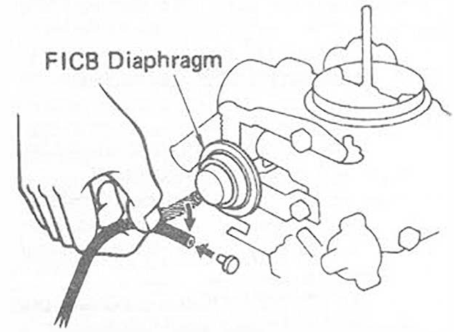
1 The following conditions should be met before beginning the adjustment:

- a) *Air cleaner installed.*
- b) *Choke valve fully open.*
- c) Accessories *switched Off.*
- d) *All vacuum lines connected.*
- e) *Ignition timing set correctly (see Chapter 5).*
- f) *Transmission in Neutral (parking brake set and wheels blocked to prevent movement).*
- g) *Engine idling at normal operating temperature.*
- h) *A hand-held tachometer attached according to the manufacturer's recommendations.*
- i) *Fuel level correct in sight glass* **(see illustration).**

2 If idle limiter caps are installed on the idle mixture and idle speed adjusting screws, break them off **(see illustration).**

3 Turn the idle mixture adjusting screw **(see illustration)** to obtain the maximum engine rpm.

4 Turn the idle speed adjusting screw until



8.9 Detach the vacuum hose from the fast idle cam breaker (FICB) diaphragm and plug the hose end

the specified idle mixture speed is obtained.

5 Repeat the two Steps above until engine rpm cannot be increased by turning the idle mixture adjusting screw.

6 Turn the idle mixture adjusting screw until the idle speed listed in the Specifications is obtained.

7 If originally so equipped, install new limiter caps on the idle mixture and idle speed adjusting screws.

Fast idle

8 Stop the engine and *remove* the air cleaner.

9 If so equipped, disconnect and plug the hose from the fast idle cam breaker diaphragm and plug the hose end **(see illustration).**

10 Disconnect the hose(s) from the distributor and plug the hose end(s), cutting out the vacuum advance.

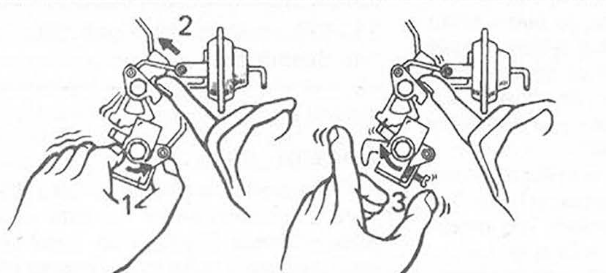
11 Disconnect the hose from the EGR *valve,* shutting off the EGR system.

12 While holding the throttle *valve* slightly open, pull up the fast idle cam linkage fully, then release the throttle **(see illustration).**

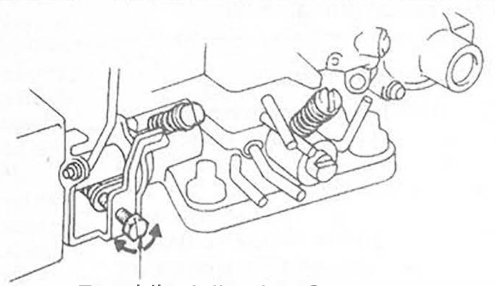
13 Start the engine, but do not touch the accelerator pedal.

14 Check that the engine is operating at its specified fast idle speed. If not, turn the fast idle adjustment screws **(see illustration)** until the specified speed is reached.

15 Disconnect the tachometer and reconnect the distributor, EGR and fast idle cam breaker (if so equipped) hoses. When the hoses are reconnected, the engine speed should drop noticeably. If it does not, check



8.12 During the fast idle check, hold the throttle valve slightly open (1) while pulling up on the fast idle cam linkage (2), then release the throttle valve (3)



8.14 The fast idle adjusting screw is located next to the idle speed and idle mixture screws the choke opener diaphragm and fast idle linkage.

1981 through 1988 vehicles

Idle speed

16 Follow the preliminary instructions for idle speed adjustment (see Chapter 1).
17 The same conditions mentioned in Step 1 must be met before beginning the readjustment. Make sure the EBCV is off (Chapter 6) if your vehicle is a California model.
18 Set the idle speed to the specified rpm by turning the idle speed adjusting screw.
19 With the tachometer still attached, stop the engine and remove the air cleaner (see Section 5).
20 Disconnect the hoses and plug the connections for the HAI and MC systems (on vehicles so equipped) to prevent rough idling.
21 Disconnect the hose from the choke opener diaphragm and plug the hose end, shutting off the choke opener system.
22 Disconnect the hoses from the distributor sub-diaphragm and main diaphragm and plug the hose ends, cutting out the vacuum advance.
23 Disconnect the vacuum hose from the choke opener diaphragm and EGR valve, shutting off the EGR system. Plug the hose end.
24 While holding the throttle valve slightly open, push the choke valve closed and hold it as you release the throttle valve - this sets the fast idle cam.
25 Start the engine, but do not touch the accelerator.
26 Set the fast idle speed by turning the fast idle adjusting screw until the speed is as specified.
27 Reconnect the vacuum hoses.

Idle mixture adjustment

28 To conform with Federal emissions regulations, the idle mixture adjusting screw is pre-adjusted, then plugged with a steel plug, by the manufacturer. Normally, this steel plug should not be removed. When incorrect idle mixture is suspected as the cause of a rough idle, check all other possible causes before taking the vehicle to a qualified dealer or repair facility.

9 EFI system - general information and special precautions

General information

Note: *On all 1993 and later models, the designation for the fuel injection system was changed from Electronic Fuel Injection (EFI) to Multiport Fuel Injection (MFI). The fuel injection system is identical in all aspects of operation, only the name has been changed.*

Some 1984 through 1988 pickups are equipped with an Electronic Fuel Injection (EFI) system. Electronic fuel injection provides optimum mixture ratios at all stages of combustion, and this, together with the immediate response characteristics of fuel injection, permits the engine to run on the weakest possible fuel/air mixture, which vastly reduces exhaust emissions. The EFI system is interrelated with and works in conjunction with the emission control and exhaust systems.

The EFI system consists of three subsystems; the fuel system, the air induction system and the electronic control system. The various components that make up the entire EFI system are detailed later in another Section.

Fuel from the tank is delivered under pressure from the electric fuel pump, through the filter and, to avoid pulsation, is fed through a mechanical damper. After passing through the damper and a pressure regulator, it is injected into the intake manifold. The pressure regulator is designed to maintain a constant pressure difference between the fuel line pressure and the intake manifold vacuum. Where manifold conditions are such that the fuel pressure would be beyond that specified, the pressure regulator returns surplus fuel to the tank.

An injection of fuel occurs once every rotation of the crankshaft. Because the injection signal comes from the control unit, all injectors operate simultaneously and independent of the engine stroke. Each injection supplies half the amount of fuel required by the cylinder and the length of the injection period is determined by information fed to the control unit by the various sensors included in the system.

Elements affecting the injection duration include engine rpm, quantity and temperature of the intake air, throttle valve opening, temperature of the engine coolant, position of the ignition switch, intake manifold vacuum and amount of oxygen in the exhaust gases.

Because the EFI system operates at high fuel pressure, a slight leak can affect system efficiency and present a serious fire risk. Also, since the intake air flow is critical to the operation of the system, even a slight air leak will cause wrong air/fuel mixtures to occur.

The electric fuel pump in the EFI system uses two relays located in the passenger compartment. This set-up is designed so that if the engine accidentally stops, causing the alternator to turn off and the oil pressure to drop, the fuel pump will not operate:

Special precautions

Warning: *Gasoline is extremely flammable, so extra precautions must be taken when working on any part of the fuel system. Do not smoke or allow open flames or bare light bulbs in the work area. Also, do not work in a garage where a natural gas-type appliance that has a pilot light is present.*

Prior to any operation in which a fuel line will be disconnected the pressure in the fuel system must first be eliminated. This procedure is described later in this Chapter.

Prior to removing an EFI component be sure the ignition switch is off and the negative battery cable is disconnected.

The EFI wiring harness should be kept at least eight inches away from adjacent harnesses. This includes a CB antenna feeder cable as well. This will prevent electrical pulses in other systems from interfering with the EFI operation.

Be sure all ignition and EFI wiring connections are clean and secure.

Check carefully for intake air leaks and make sure ignition system components are in good condition before assuming that the EFI system is malfunctioning. The drivebelt tension must be properly maintained and the battery must be kept fully charged as well.

Do not use a high pressure washer to clean the engine compartment. Water and caustic detergents may damage or corrode EFI system components.

Handle all EFI components with care when removing and installing them. The oxygen sensor is particularly susceptible to damage from impact.

While some basic checks of the EFI components are included in this Chapter, the complexity of the system prevents many problems from being accurately diagnosed by the home mechanic. If a problem develop$ in the system which cannot be pinpointed by the checks listed here, take the vehicle to a Toyota dealer to locate the fault.

10 Fuel pressure relief procedure

Warning: *Gasoline is extremely flammable, so extra precautions must be taken when working on any part of the fuel system. Do not smoke or allow open flames or bare light bulbs in the work area. Also, do not work in a garage where a natural gas-type appliance that has a pilot light is present.*

1 Before servicing any component on a fuel injected vehicle, it is necessary to relieve the fuel pressure to minimize the risk of fire or personal injury.
2 Start the engine and allow it to idle.
3 Disconnect the wiring harness to the fuel pump (white wire with black tracer and light blue wire).
4 Wait for the engine to stall, then crank it over two or three more times.
5 Turn the ignition switch off and reconnect the fuel pump wires. The fuel system is now ready to be serviced.

11 EFI components • general description

Refer to illustration 11. 1

Control unit

The control unit (or ECU) **(see illustration)** is mounted under the right side kick panel in the cab. The essential role of this unit is to generate a pulse to the injectors. Upon receiving an electrical signal from each sensor, the control unit generates a pulse whose duration (injector open time period) is controlled to provide the exact amount of fuel, according to engine operating characteristics at that particular time.

Airflow meter

The airflow meter measures the volume and temperature of the intake air and sends the signal to the control unit. This is achieved by a potentiometer which is linked to the air intake flap shaft. The more air that enters the flow meter the further the flap valve rotates which in turn rotates the potentiometer wiper through a variable resistance coil. This increasing or decreasing resistance (depending on the flap signal} changes the signal to the control unit. In order to dampen excessive movement of the flap due to vacuum depressions in the intake manifold a helical spring and compensating plate in a damper chamber are provided. Also built into the airflow meter is an air temperature sensor which senses air temperature and sends a signal to the control unit. This signal will define the duration of the injection time. Air that flows into the meter is first passed through the air cleaner assembly.

Air valve

The air valve bypasses the throttle valve to control the quantity of air required for increasing the engine idle speed when starting the engine at a coolant temperature below a predetermined level. A bimetal spring and heater are built into the valve. When the ignition switch is turned to the Start position, or when the engine is running electric current, flows through the heater and the bimetal spring. As the heater warms up, the bimetal spring will close the air passage. The air passage will remain closed until the engine is stopped or the coolant temperature drops below the predetermined level.

Injectors

An injector is mounted on each branch of the intake manifold. Each injector is actuated by a small solenoid valve built into the injector body. Actuating the solenoid valve pulls a needle valve into the open position to allow the fuel to inject. The duration of the pulse sent from the control unit defines the period of time that the solenoid valve is actuated.

Air intake chamber

The air intake chamber is mounted over the intake manifold and is equipped with a valve which controls the intake airflow in response to accelerator pedal movement. The shaft of this valve is connected to the throttle position sensor. The valve remains closed during engine idling and the air required for idling passes through a bypass port, into the intake manifold. Idle adjustment is made by the idle speed adjusting screw. A second line in the air intake chamber passes air through the air valve into the intake manifold when the engine is started cold.

Fuel pump

The fuel pump is mounted in the fuel tank at the right side of the vehicle. Built into the outlet pipe of the pump is a check valve. The check valve prevents abrupt drops in fuel pressure when the engine is stopped.

Throttle position sensor

The throttle position sensor is attached to the throttle body and responds to accelerator pedal movement. This switch has two sets of contact points. One set monitors the idle position and the other set monitors the full throttle position. The idle contacts close when the throttle valve is positioned at Idle and open when it is at any other position. The full throttle contacts close only when the throttle is positioned at full throttle. The contacts are open while the throttle valve is at any other position. The idle switch compensates for enrichment during idle and after idle sends a signal to the control unit to modify the fuel supply. The full throttle switch compensates for enrichment at the full throttle position.

Fuel filter

The fuel filter, which is mounted in the engine compartment, insures that only clean fuel reaches the injectorn. A clogged fuel filter will stop the flow of fuel and cause the engine to stall. This is usually preceded by hesitation and sluggish operation.

Fuel damper

The fuel damper which is mounted on the fuel delivery pipe is designed to suppress pulsations in fuel flow from the fuel pump.

Pressure regulator

The pressure regulator, which is attached to the intake manifold in the fuel supply line, maintains a constant fuel pressure at all stages of acceleration and deceleration. Under extreme manifold vacuum conditions, the full pressure delivered by the fuel pump combined with a high vacuum could cause excessive pressure in the fuel line. If such a condition occurs the pressure regulator opens to return excess fuel to the fuel tank.

Water thermo sensor

This device, which is located in the thermostat housing, monitors changes in the engine coolant temperature. As soon as a temperature change is sensed, a signal is sent to a control unit where a modified injector pulse duration will be computed.

Solenoid resistor

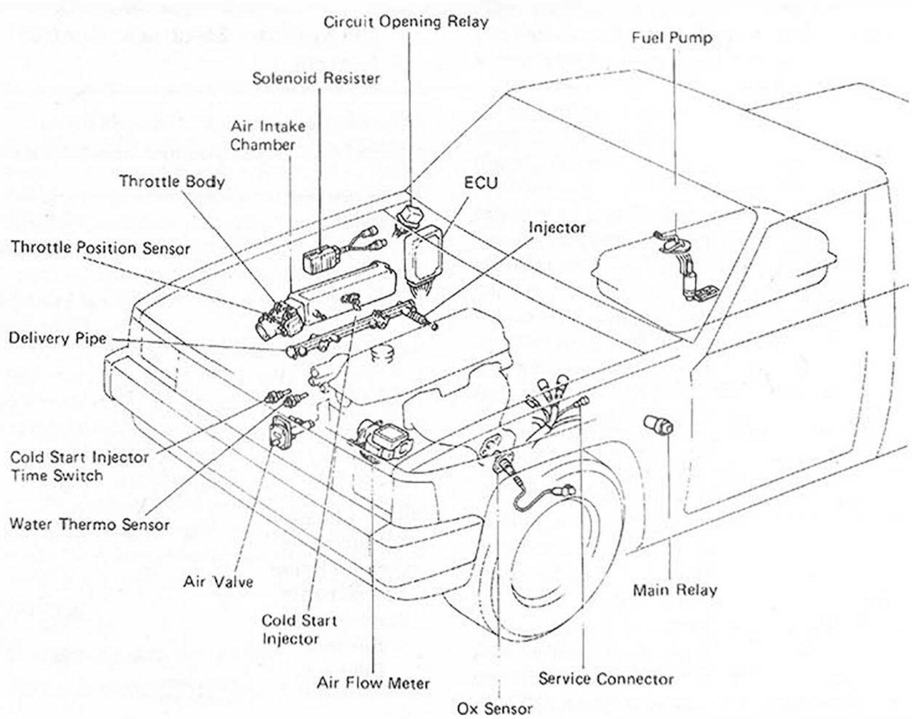
The solenoid resistor protects the injectors from alternator surges and effects of other electrical components by lowering the source voltage.

Cold start injector

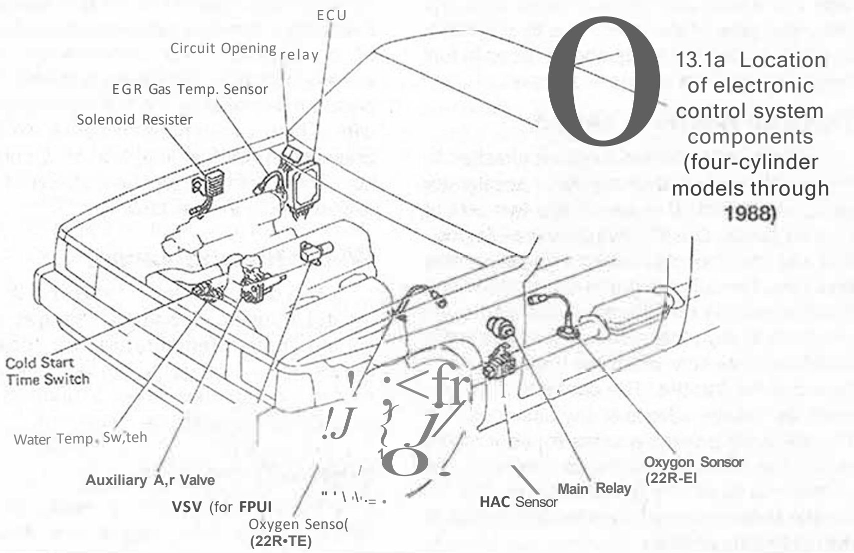
This valve is designed to enrich the fuel/air mixture during cold engine operation by injecting fuel into the intake manifold independently of the cylinder injectors. It receives electrical signals from the cold start injector time switch.

Cold start injector time switch

The switch, mounted in the thermostat housing, uses a bimetal contact to sense the engine coolant temperature for proper operation of the cold start injector.



11.1 The location of the components in a typical EFI system {1985 four-cylinder shown)



13.1a Location of electronic control system components (four-cylinder models through 1988)

Oxygen sensor

The oxygen sensor, which works in conjunction with the EFI system and the catalytic converter, measures the amount of oxygen present in the exhaust gases. This information is fed to the control unit, which adjusts the air/fuel mixture to compensate.

12 Fuel lines - repair and replacement

Warning: *Gasoline is extremely flammable, so extra precautions must be taken when working on any part of the fuel system. Do not smoke or allow open flames or bare light bulbs in the work area. Also, do not work in a garage if a natural gas type appliance with a pilot light is present.*

1 The fuel injection system is designed to operate at a pressure much higher than conventional fuel systems, so even slight leakage at a fuel joint can become a major problem. Ignoring a leaking joint is a serious fire risk and the pressure loss is certain to affect the system operation. From time-to-time check the security of all the fuel joints. Make sure tllat the rigid lines are not kinked or bent in any way. If a rubber hose shows signs of deterioration, replace it. Caution: Do not disconnect any fuel lines without first eliminating the pressure from the system as described in Section 10.

2 Since the EFI system accurately meters the intake air through the airflow meter, even a slight air leak will cause an improper fuel/air mixture, resulting in poor engine performance. For this reason a thorough inspection for leaks should he made at the oil filler cap, dipstick seal, PCV hoses, airflow meter-to-throttle body air duct, etc.

3 If a section of metal fuel line must be replaced, only brazed seamless steel tubing should be used, as copper or aluminum tubing does not have enough durability to withstand vibrations encountered during normal engine operation.

4 If only one section of a metal fuel line is damaged it can be cut out and replaced with a piece of rubber fuel hose. The rubber hose should be cut four inches (100 mm) longer than the section to be replaced, so there is about two inches of overlap between the rubber and metal lines at either end of the section. Hose clamps should be used to secure both ends of the repaired section.

5 If a section of metal line longer than six inches is being removed, use a combination of metal tubing and rnbber hose so that the hose lengths are no longer than 10 inches.

6 Never use rubber hose within four inches of any part of the exhaust system.

13 EFI system - Electronic Control System

Refer to illustrations 13.1a through 13.1d

Note: *A Federally-mandated extended warranty covers the control unit, the information sensors and all components under its control. Damage to the ECU, the sensors and/or the control devices caused by the vehicle owner during diagnosis may void the warranty. Before proceeding, check with the dealer to inquire about the status of this extended warranty and how it pertains to your vehicle.*

ECU

1 This check employs a miniature test lamp to determine whether the open-injector pulse for cranking the engine is actually applied to the injectors (should the engine fail to start). To carry out this check, the engine must be cranked at a speed of more than 80 rpm. The battery must be fully charged. The test lamp should be a 12V-3W miniature type, with leads attached to the terminals **(see illustrations).**

2 Turn the ignition switch to the Off position.

3 Disconnect the wire harness from the cold start injector.

4 Disconnect the number one cylinder injector wire harness.

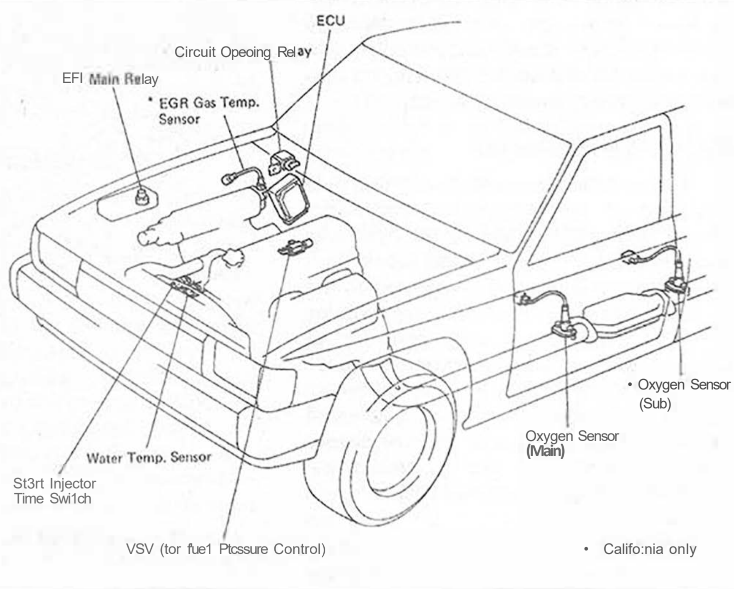
5 Connect the test lamp to the number one cylinder injector wire harness terminals.

6 Turn the ignition switch to the Start position to crank the engine and note whether or not the lamp flashes. If the lamp flashes, the electrical pulse is present. If it does not, the control unit may be defective. Check all wires and connections carefully.

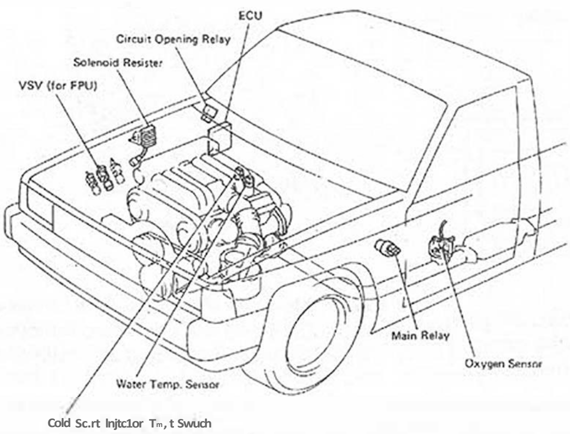
7 It must be emphasized that this check only proves whether or not *a* signal pulse is reaching the injectors. If the control unit is still suspect, there are numerous other circuits inside the unit that could be at fault, so have it checl<ed by a Toyota dealer service department.

8 The control unit is mounted under the right side kick panel in the cab and can be replaced as follows.

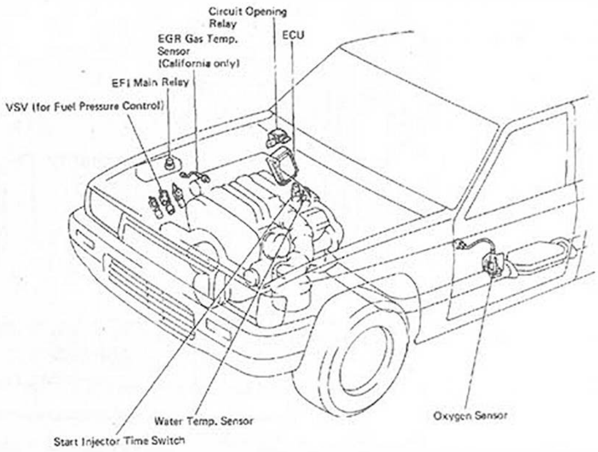
9 Turn the ignition switch to the Off position and then disconnect the battery ground cable.



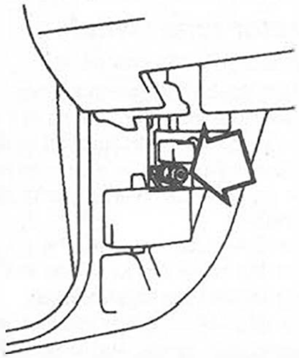
13.1b Location of electronic control system components (four-cylinder models, 1989-on)



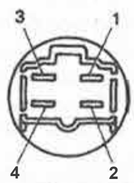
13.1 c Location of electronic control system components (V6 models through 1988)



13.1 d Location of electronic control system components (V6 models 1989-on)

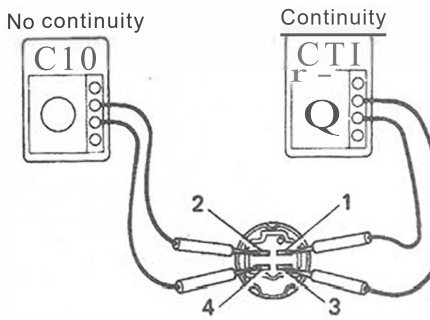


13.14 The EFI main relay (arrow) is located behind the left side kick panel in the cab - to check its operation, tum on the ignition switch and listen for a click from the relay



Between terminals	Resistance (Q)
1 - 2	60 ohms +/- 20 ohms
3 – 4	Infinity

13.15 Measure the resistance between main relay terminals 1 and 2 and 3 and 4 - if your readings are not within the ranges specified in the above table, replace the relay (four-cylinder through 1988)



13.16 Verify that there is continuity between terminals 1 and 3, but not between terminals 2 and 4 and 3 and 4 - if continuity is not as specified, replace the relay (four-cylinder 1989-on and V6)

10 Remove the screws and detach the control unit cover (if equipped).

11 Carefully disconnect the wire harness from the control unit.

12 Remove the bolts that hold the control unit to the mounting bracket and detach the control unit.

13 Installation is the reverse of the removal procedure. **Note:** Be *careful when reinstalling the harness connector not to bend or break any of the terminals.*

Main relay

Refer to illustrations 13.14, 13.15 and 13.16

14 Locate the main relay on pre-1989 models **(see illustration)** by removing the left side kick panel in the cab. On 1989 and later models, the relay is located in the fuse panel on the right side of the engine compartment. Turn on the ignition switch and listen for a clicking noise at the relay.

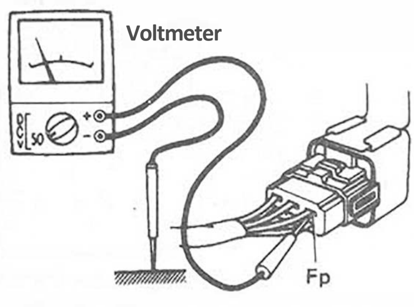
15 If your vehicle is equipped with a four-cylinder engine, remove the relay from the mount and measure the resistance between the terminals **(see illustrations).The** resistance between terminals 1 and 2 should be 40 to 60 ohms for 1984 models (60 to 80 for 1985 through 1988 models). The resistance between terminals 3 and 4 should be infinite. On 1989 and later models, there should be continuity between terminals 1 and 3 but not between terminals 2 and 4 and 3 and 4. If the checks do not produce the indicated results, the relay is defective and should be replaced with a new one.

16 If it's equipped with a V6, remove the relay from its mount and verify that there is continuity between terminals 1 and 3, that there is no continuity between 2 and 4 and that there is no continuity between terminals 3 and 4 **(see illustration).** If continuity is not as specified, replace the relay. Then apply battery voltage across terminals 1 and 3 and verify that there is continuity between terminals 2 and 4. If relay operation is not as specified, replace it.

Circuit opening relay

Refer to illustrations 13.18a, 13.18b and 13.19

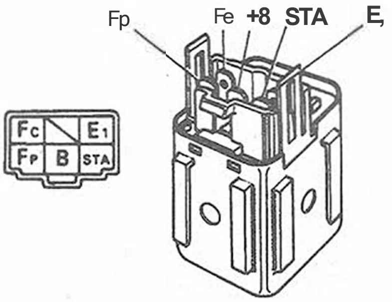
17 Locate the relay by removing the right side kick panel and on some models, the



13.18a Verify that there is voltage at terminal Fp of the circuit opening relay while the engine is cranking and running (four-cylinder)

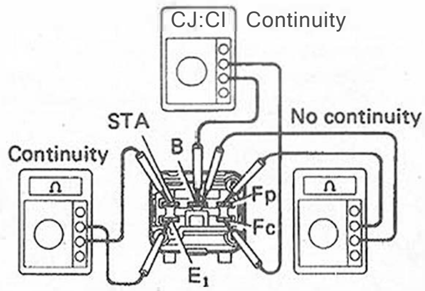
glove box and speaker.

18 If your vehicle is powered by a four cylinder engine, check for voltage at terminal Fp **(see illustration)** when the engine is being cranked and when it is running. Stop the engine and disconnect the relay wire harness. Using an ohmmeter, check the resistance between the relay terminals (see illus-

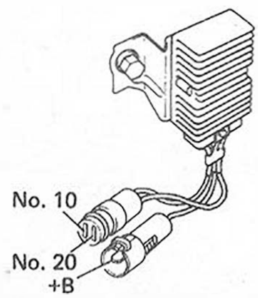


Between terminals	Resistance (0)
STA - E,	17 - 25
+B - Fe	88 - 132
+B - F•	Infinity

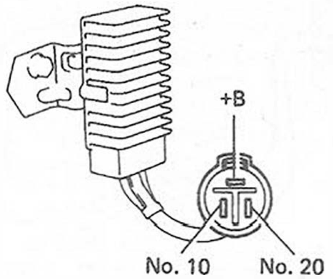
13.18b Measure the resistance between the indicated terminals of the relay and compare your readings to the respective specified resistance range for each pair (four-cylinder)



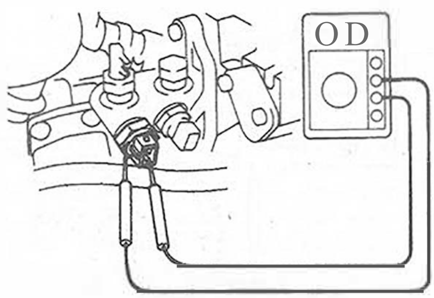
13.19 Verify thatthe continuity between the indicated terminals of the circuit opening relay is as specified (V6)



13.22a Measure the resistance between terminal + B and the other two terminals of the solenoid resistor (four-cylinder)



13.22b Measure the resistance between terminal + B and the other two terminals of the solenoid resistor {V6)



Between tormin&ls	Resistance (!!)	Coolant temp.
STA-STJ	20-40	below 30° C (86° F)
	40-60	•bove 40° C (104° F)
STA- Ground	20 - 80	-

13.28a Measure the resistance between the start injector time switch terminals indicated in this table and compare your readings to the specified ranges (the values indicated in this table apply to 1986 and 1987 normally aspirated fours and 1987 and 1988 turbo fours)

tration). If the indicated resistance is not as specified, replace the relay.

19 If your vehicle is powered by a V6 engine, unplug the relay harness and verify that there is continuity between terminals STA and E1, and between terminals B and Fe, but not between terminals B and Fp **(see illustration).** If continuity is not as specified, replace the relay. Apply battery voltage across terminals SAT and E and verify **that** there is continuity between terminals B and Fp. Apply battery voltage across terminals B and Fp and verify that there is continuity between terminals B and Fp. If the relay does not operate as specified, replace it.

Solenoid resistor

Refer to illustrations·13.22a and 13.22b

20 Disconnect the battery ground cable.

21 Locate the solenoid resistor on the right side of the engine compartment. Disconnect the solenoid resistor wire harness.

22 Using an ohmmeter, check the resistance between terminal + B and the other two terminals (see **illustrations).** The resistance should be 2 to 3 ohms for each check.

23 If the measured resistance is not as specified, the solenoid resistor must be replaced as discussed below.

24 To replace the solenoid resistor, disconnect the battery ground cable. Disconnect the solenoid resistor wire harness. Remove the screws and detach the resistor.

25 Installation is the reverse of the removal procedure.

Start injector time switch

Refer to illustrations 13.28a and 13.28b

26 Disconnect the battery ground cable.

27 Disconnect the wire harness from the cold start injector time switch (located in the thermostat housing on the four and in the water bypass outlet at the rear of the intake manifold on the V61.

28 Using an ohmmeter, measure the resistance between the terminals as shown in the accompanying tables **(see illustrations).**

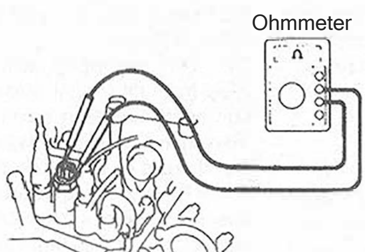
29 If the resistance readings do not fall within the specified range, the cold start injector time switch will have to be replaced.

30 To replace the start injection time switch, drain the coolant, unplug the switch electrical connector and unscrew the switch. Be sure to coat the threads of the new switch with Teflon tape to prevent leaks. Installation is the reverse of removal.

Coolant temperature sensor

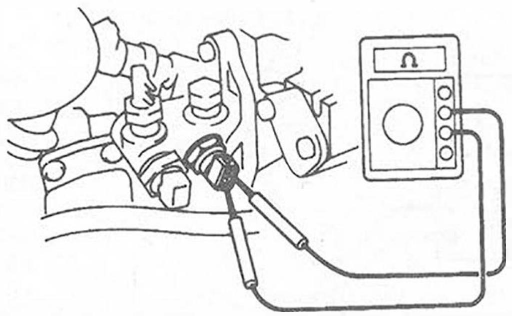
Refer to illustrations 13.34a, 13. 34b and 13.35

Note: *The water thermo* sensor is *designed to*

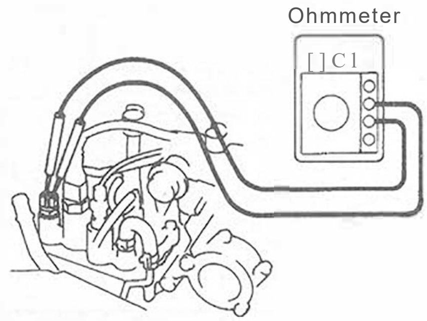


13.28b Measure the resistance between the start injector time switch terminals indicated in this table and compare your readings to the specified ranges (the values indicated in this table apply to the V6 and 1988-on normally aspirated fours)

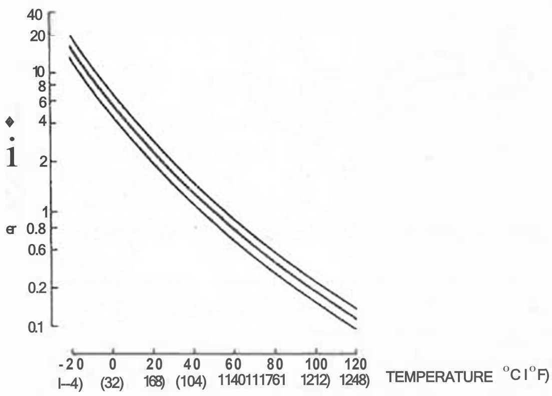
Between terminals	Resistance (U)	Coolant temperature
STA-STJ	30-50	Below 10° C (50° F)
	70-90	Above 20° C (68° FJ
STA - Ground	30 - 90	-



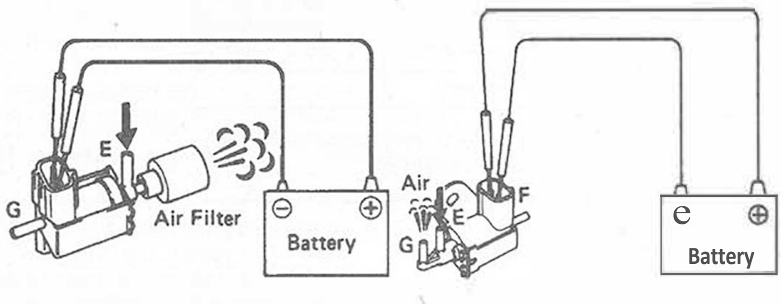
13.34a To check the coolant temperature sensor on a four-cylinder (located on the thermostat housing next to the cold start injector time switch) touch the leads of an ohmmeter to the water temperature sensor terminals and note the resistance readings at different temperatures (four-cylinder)



13.34b To check the coolant temperature sensor on the V6 (located on the water by-pass outlet next to the cold start injector time switch), touch the leads of an ohmmeter to the water temperature sensor terminals and note the resistance readings at different temperatures



13.35 Compare your indicated coolant temperature sensor readings at various temperatures to the correct values indicated on this coolant temperature sensor resistance/temperature table



13.39 Checking the VSV - pre-1989 on left and 1989-on right

have a certain resistance value over a given temperature range. It can be checked after removal from the engine using containers of hot and cold water, but the procedure described here is for one that is in place in the engine.

31 Run the engine until it is at normal operating temperature.

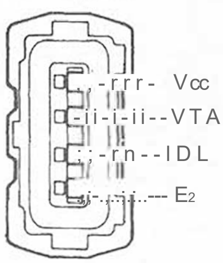
32 Locate the coolant temperature sensor (next to the start injector time switch). Disconnect the sensor wiring harness.

33 By placing a thermometer on the cylinder head, next to the sensor, the temperature can be monitored.

34 Connect the probes of the ohmmeter to the terminals of the sensor **(see illustrations).** Watch the thermometer and note the resistance readings as the engine cools.

35 Compare the resistance readings at the various temperatures to the accompanying chart. **(see illustration)** If they are not as specified, the sensor may be faulty.

36 To replace the sensor, drain the coolant, detach the cable from the negative terminal of the battery, unplug the electrical connector from the sensor and unscrew the sensor. Installation is the reverse of removal.



13.48 To check the operation of the fuel cut rpm system, bridge terminals IDL and E2 with a jumper wire, then gradually raise the engine rpm and verify that there is fluctuation between the fuel cut and fuel return points

High temperature line pressure up system

Refer to illustration 13.39

37 Locate the vacuum switching valve (VSV) (left side of cam cover on four; right side of engine compartment on V6).

38 Unplug the electrical connector from the VSV and attach a pair of jumper wires directly from the battery to the VSV terminals.

39 Blow into pipe E and verify that air comes out of the air filter (or pipe G on 1989-on models) **(see illustration).**

40 Detach the cable for the negative terminal of the battery.

41 Blow into pipe E again and verify that air comes out of pipe G (or pipe F on 1989 on models).

42 If the VSV fails either of the above tests, replace it.

43 To check for a short circuit in the VSV, use an ohmmeter to verify that there is no continuity between the terminal and the VSV body. If there is continuity, replace the VSV.

44 Measure the resistance between the terminals. It should be between 30 and 50 ohms at 68° F. If resistance is not within specification, replace the VSV.

45 To replace the VSV, simply detach the cable from the negative terminal of the battery, unplug the VSV electrical connector and detach the VSV valve from its mounting bracket. Installation is the reverse of removal.

Fuel cut RPM

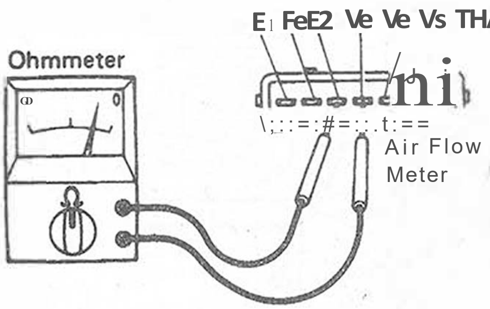
Refer to illustration 13.48

46 Apply the emergency brake, place the vehicle in Neutral and warm up the engine.

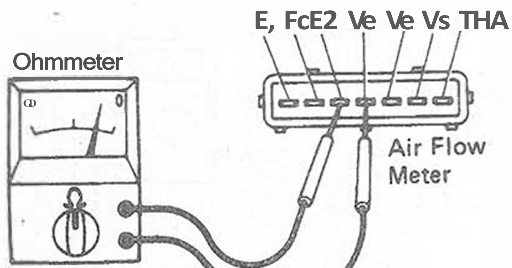
47 Unplug the electrical connector from the throttle position sensor.

48 On the wire harness side of the TPS connector, jump terminals IDL and E2 **(see illustration).**

49 Gradually raise the engine rpm and verify



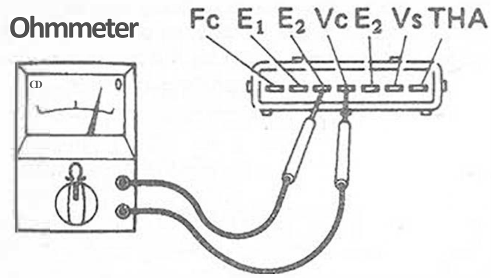
14.3a Airflow meter terminal locations (1984 four-cylinder models only)



14.3b Airflow meter terminal locations (1985-on, four-cylinder models)

Between terminals	Resistance	Temperature
E2 - V,	20 - 400!1	-
E2 - Ve	100 - 300 0	-
E2 - Ve	200 - **4000**	-
E, - THA	10 - 20 KO **4** - 7 KO 2 - 3 KO' 0.9 - 1.3 KO 0.4 - 0.7 KO	-20°C I 4°F) 0°C (32°F) 20°C I 68°F) 40°C (104°F) 60°C (140°F)
E, - Fe	**Infinity**	-

14.3c Airflow meter terminal resistance table (four-cylinder models)



14.3d Airflow meter terminal locations (all V6 models)

that there is fluctuation between the fuel cut and fuel return points (see Specifications).

14 Airflow meter - check and replacement

Refer to illustrations 14.3a, 14.3b, 14.3c, 14.3d, and 14.3e

Note: *The following checks can be carried out without removing the airflow meter from the vehicle. An ohmmeter is needed for this check.*

1 Disconnect the battery ground cable.

2 Disconnect the wire harness electrical connector from the airflow meter.

3 Using an ohmmeter, measure the resistance between the indicated terminals (see **illustrations**). **Note:** *Measure the first three pairs of terminals in the table for fours; measure the first two pairs of terminals in the table for V6s.* The airflow meter should be replaced as an assembly if it is defective.

4 To check the insulation resistance between the airflow meter body and the potentiometer terminals, hold one **of** the ohmmeter probes to the case and touch each of the terminals with the other probe. If continuity exists between any terminal and the body, the airflow meter is faulty and should be replaced as an assembly.

5 Connect the ohmmeter probes to terminals E2 and THA.

6 Using a normal household thermometer, measure the air temperature as near to the sensor as possible.

7 The accompanying tables give the correct resistance ranges at various temperatures. **Note:** *The air temperature sensor is part of the airflow meter and cannot be replaced as a unit. If the resistance readings are outside the ranges listed in the chart, the airflow meter must be replaced as an assembly.*

8 Disconnect the battery ground cable.

9 Remove the air duct and air hoses.

10 Disconnect the airflow meter wire harness connector.

11 Remove all fasteners and carefully detach the airflow meter assembly and gasket. Discard the gasket.

12 Installation is the reverse of the removal procedure. Be sure to use a new gasket when reinstalling the airflow meter.

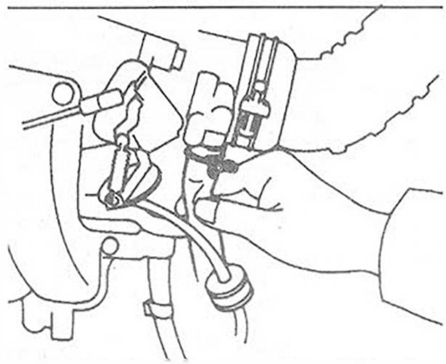
15 Air valve - check and replacement

Refer to illustrations 15.1, 15.2 and 15.10

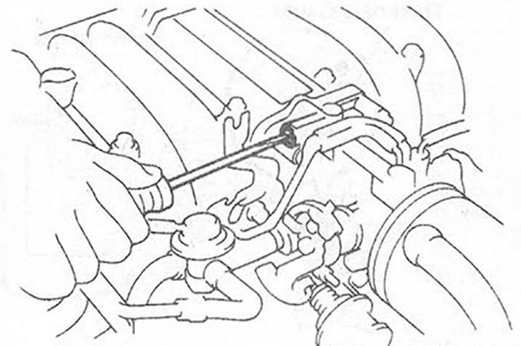
1 If you have a four-cylinder engine, start it and pinch off the throttle body-to-air valve hose to cut off the air flow **(see illustration)**.

Terminals	Resistance	Temperature
Vs - E2	200-600!2	-
Ve - E2	200 -400!2	-
THA - E_2	10 - 20 kU 4 - 7 kn 2 - 3 kn **0.9 - 1.3 k!2** 0.4 - 0.7 kn	-20°C (4°F) 0°C (32°F) 20°C { 68°F} **40°C (104°F)** **60°C (140°FI**
Fe - E_1	**Infinity**	-

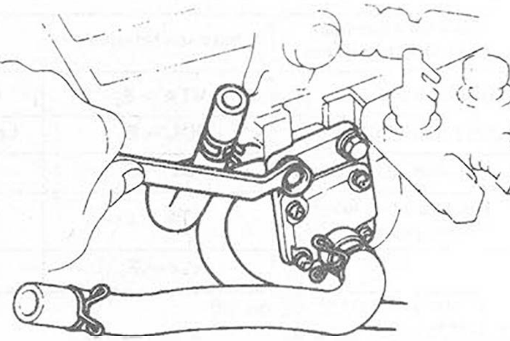
14.3e Airflow meter terminal resistance table (V6)



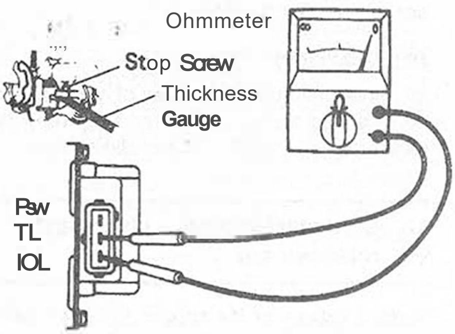
15.1 To check the operation of the air valve on a four, start the engine, then pinch off the air valve-to-throttle body hose - while the engine is still cold, rpm should drop; when the engine is warmed up, rpm should not drop more than 50 rpm



15.2 To check the operation of the air valve on a V6, start the engine, then turn the idle speed adjusting screw all the wa in - while the engine is still cold, rpm should drop; when the engme 1s warmed up, rpm should not drop



15.10 To remove the air valve, detach the electrical connector, the coolant by-pass hose and the two air valve hoses, then remove the two mounting bolts



16.3a Throttle position sensor terminal locations (1984 only)

Cieerancs between lever and afop screw	Continuity of teri-nlnels		
	IDL - TL	Paw - TL	IDL - Psw
0.60mm 10.0197 in.l	Continuity	No continuity	No continuity
0.70mm (0.0276 ln.l	No continuity	No continuity	No continuity
Throttle valve fully open.d position	No continuity	Continuity	No continuity

16.3b Throttle position sensor terminal resistance table (1984 only)

The engine rpm should drop. Allow the engine to reach normal operating temperature. Repeat the check described above. The bypass air passage should be closed so the engine idle speed should not drop by more than 50 rpm.

2 If you have a V6, start it up and let it reach a steady idle. Check the air valve operation by fully screwing in the idle speed adjusting screw (see **illustration).** The engine rpm should drop while the engine is still cold. After the engine has warmed up, the engine should not drop with the idle speed adjusting screw all the way in.

3 If the air valve is still suspect after carrying out these checks, it is possible to visually check whether or not it is working.

4 With the engine stopped and completely cool, disconnect the hose from each end of the air valve.

5 By looking through the air valve it is possible to see if the bypass port is open. If it is, reconnect the hoses and run the engine until normal operating temperature is reached.

6 Now disconnect the hoses again. This time the bypass port should be completely closed.

7 To replace the air valve, disconnect the battery ground cable.

8 Drain three to four quarts of engine coolant.

9 Disconnect the coolant hoses and the inlet and outlet air hoses. Unplug the wire harness connector.

1o Remove the two bolts **(see illustration)** from the air valve and detach it from the air intake chamber.

11 Installation is the reverse of the removal procedure. Be sure to use a new gasket.

16 Throttle position sensor - check and replacement

Refer to illustrations 16.3a, 16.3b, 16.3c, 16.3d and 16.11

1 Disconnect the battery ground cable.

2 Unplug the throttle position sensor connector.

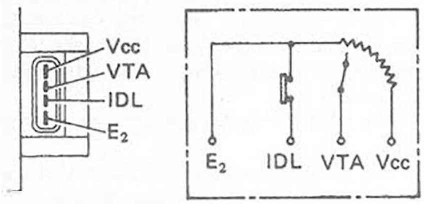
3 In two of the following tests you must insert a thickness gauge between the throttle stop screw and stop lever. The two gauge sizes used must correspond to the clearance between the lever and stop screw specified in the accompanying table. Using an ohmmeter, check the sensor at each of the indicated throttle settings **(see illustrations).** If the results are not as specified, the throttle position sensor may require adjustment or replacement.

4 Disconnect the battery ground cable.

5 Disconnect the wire harness at the sensor.

6 Remove the two screws that hold the throttle position sensor to the throttle body and detach the sensor.

7 Installation is the reverse of the removal



16.3c Throttle position sensor terminal locations (1985-on four-cylinder and V6)

procedure. After installation, the throttle position sensor must be adjusted as follows:

1984

8 With the mounting screws loose, insert a thickness gauge (0.028-inch or 0.7 mm) between the throttle stop screw and lever and connect the ohmmeter to terminals IDL and TL.

9 Gradually turn the sensor counterclockwise until the ohmmeter deflects, then tighten the two screws.

1O Recheck the continuity between the terminals of the sensor (see Step 3).

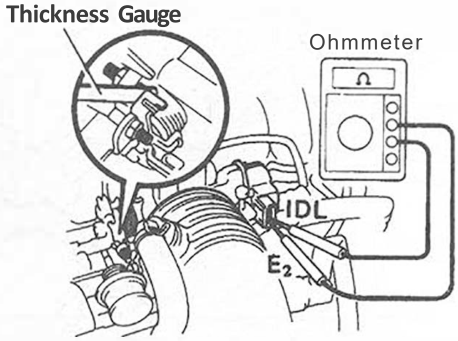
1985 on

11 The procedure is identical to the one for 1984, but a 0.0185 inch (0.47 mm) feeler gauge (four cylinder) or a 0.0244 inch (0.62 mm) gauge (V6) must be used and the ohm-

Clearance between lever and stop screw	Between terminals	Resistance
* 0 mm (0 in.)	VTA - E_2	0.2 - 0.8 kil
** 0.57 mm (0.0224 in.)	IDL - E_2	Less than 2.3 k n
0.85 mm (0.0335 in.)	IDL - E_2	Infinity
Throttle valve fully opened position	VTA - E_2	3.3 - 10 kfl
-	Vee - E_2	4 - 9 k Ohms

• 0.50mm (0.0197 in) on V6
•• 0.77mm (0.0303 in) on V6

16.3d Throttle position sensor terminal resistance table (1985 through 1988 four-cylinder, V6)



16.11 To adjust the throttle position sensor on an 1985 or later vehicle, insert a thickness gauge of the specified thickness between the throttle lever and throttle stop screw and attach the probes of an ohmmeter to terminals IDL and E2 (V6 shown, fours similar)

meter must be connected to terminals IDL and E2 **(see illustration).**

17 Throttle body - check, removal, adjustment and installation

Refer to illustrations 17.2, 17.13and 17.14

On-vehicle check

1 Verify that the throttle linkage operates smoothly by grasping it with the thumb and forefinger and opening and closing it a few times. If it doesn't, replace the throttle body.

2 Start the engine, detach the vacuum hose from each of the three ports on top of the throttle body and check the vacuum at each port with your finger. Compare your findings with the accompanying table **(see illustration).**

3 Check the throttle position sensor (see Section 16).

4 If your vehicle is powered by a V6, check the operation of the air valve (see Section 15).

Removal

5 Drain the engine coolant from the throttle body.

6 Remove the air intake duct.

7 Unplug the electrical connector to the throttle position sensor.

8 Label, then detach, all vacuum lines, the coolant hoses and the air valve hose.

9 If your vehicle is equipped with an automatic transmission, detach the throttle valve cable (see Chapter 7).

10 Detach the accelerator cable and bracket.

11 Remove the throttle body mounting fasteners and remove the throttle body and gasket. Discard the gasket.

Inspection

12 Thoroughly wash and clean the throttle body casting with a soft brush in carburetor cleaner. Do not, however, clean the throttle position sensor with anything-just wipe it off with a clean, soft rag. Using compressed air, blow out all passageways in the throttle body.

13 To check the throttle valve, verify that there is no clearance between the throttle stop screw and the throttle lever when the throttle valve is fully closed. When the throttle valve is fully closed, verify that the advancer port is visible on the air cleaner side of the throttle body intake bore **(see illustration).** If it's not, adjust the throttle valve closing angle by adjusting the throttle stop screw.

14 To adjust the throttle stop screw, loosen the throttle stop screw locknut and loosen the screw until it's just barely touching the throttle lever, then screw it in another 1/4-turn and lock it in place with the locknut. The vacuum advance port **(see illustration)** should be barely visible at the edge of the throttle valve. **Caution:** *Do NOT adjust the throttle valve closing angle unless absolutely necessary.*

15 If necessary, adjust the throttle position sensor (see Section 16).

Installation

16 Installation is the reverse of removal. Be sure to use a new gasket and tighten the mounting fasteners to the specified torque.

18 Cold start injector - check and replacement

Note: *Because of the special tools required to test the cold start injector off the vehicle, it is recommended that it be done by a Toyota dealer service department. The procedure described below is an on-vehicle check of the cold start injector. If the test results are inconclusive, have the system checked by a dealer service department.*

Check

1 This check must be done with the engine cold.

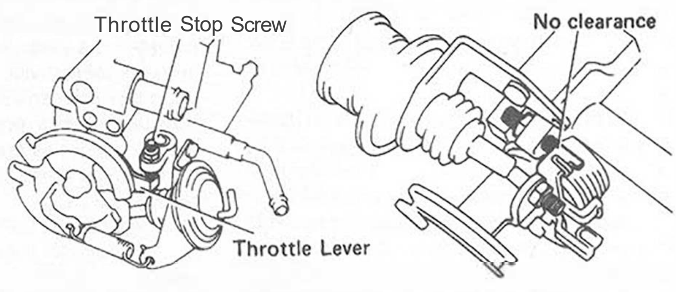
2 Start the engine and, using the procedure described in Section 20, listen to the cold start injector (located on the air intake chamber). You should hear a clicking noise, meaning the injector is functioning.

3 If a clicking sound is heard, let the engine reach operating temperature and repeat the check. No clicking should be heard.

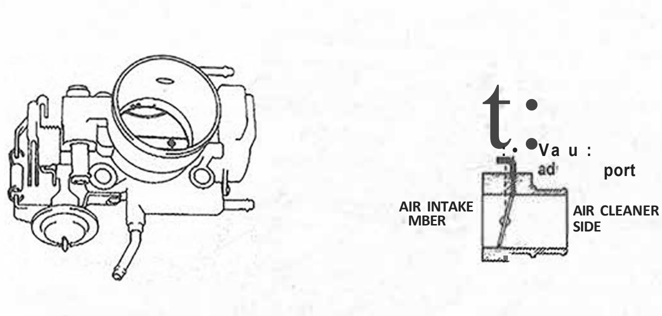
Port No.	At idling	At 3,000 rpm*
A	Vacuum	Vacuum
E	No vacuum	Vacuum
R	No vacuum	No vacuum
p	No vacuum	Vacuum

* at 3500 rpm on V6 models

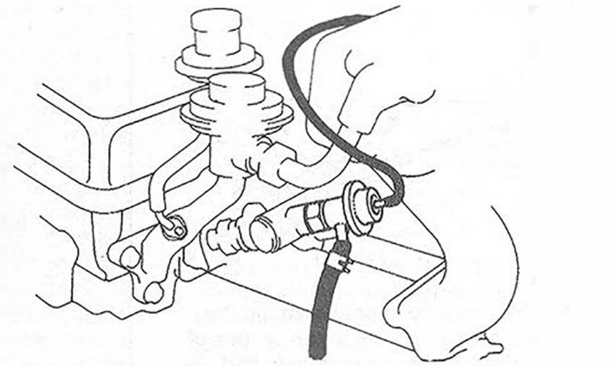
17.2 To check the vacuum at each port, start the engine, pull off each vacuum hose (on top of the throttle body) and check for vacuum at the specified rpm with your finger



17.13 There should be no clearance between the throttle stop screw and the throttle lever when the throttle valve is fully closed (four-cylinder left, V6 right)



17.14 When the throttle valve is fully closed. verify that the vacuum advance port (arrow) is visible at the edge of the valve



19.1a Typical pressure regulator, located on fuel rail, on a four

4 If no clicking is heard in Step 2, a resistance check of the cold start injector should be performed. To do this, turn the ignition switch to the Off position.
5 Disconnect the battery ground cable.
6 Disconnect the wire harness from the cold start injector.
7 Using an ohmmeter, measure the resistance between the injector terminals. It should be 2 to 4 ohms. If the resistance is not as specified, the injector is most likely defective. Further testing is beyond the scope of the home mechanic. Remove the injector and have it bench-tested by a dealer.

Replacement

8 Release the fuel pressure in the system (see Section 10).
9 Disconnect the cold start injector wire harness.
10 Remove the cold start injector fuel line banjo fitting bolt and crush washers. Discard the washers.
11 Remove the two mounting bolts and detach the injector.
12 Installation is the reverse of the removal procedure. Be sure to use new crush washers for the banjo fitting. Tighten the injector mounting bolts securely. Tighten the cold start injector tube banjo bolt to the specified torque.

19 Pressure regulator - check and replacement

Refer to illustrations 19.1a and 19.1b

Check

1 To check the operation of the pressure regulator (located on the delivery pipe) **(see illustrations),** start the engine and listen to the regulator with an automotive stethoscope, if available, or with a short section of tubing. It should be making a clear audible pulsing sound as it opens and closes. If it's silent, replace it.
2 Checking the sound of the regulator verifies that it's working, but it doesn't tell you whether it's regulating fuel pressure properly. The only way to find out is to check the fuel pressure.

Replacement

3 Eliminate the pressure in the fuel system (see Section 10).
4 Remove the EGR pipe (four cylinder only).
5 Disconnect the vacuum sensing hose and the fuel return hose. Place a suitable container or shop rag under the fuel hose fitting to catch the leaking fuel.
6 Carefully loosen the locknut and remove the pressure regulator.
7 Installation is the reverse of the removal procedure. Be sure to position the regulator with the return hose outlet pointing in the right direction. Tighten the locknut to the specified torque.

20 Air intake chamber - removal and installation

Warning: *Gasoline is extremely flammable,* so *extra precautions must be taken when working on any part of the fuel* system. *Do not smoke or allow open flames or bare light bulbs in or near the work area. Also, don't work in* a *garage if* a *natural* gas *appliance such* as a *water heater or clothes dryer is present.*

1 Detach the cable from the negative terminal of the battery.
2 Drain the engine coolant from the throttle body.
3 Remove the air intake duct.
4 Detach the accelerator cable and bracket.
5 If your vehicle is equipped with an automatic transmission, detach the throttle valve cable (see Chapter 7).
6 Label, then detach, the following hoses:

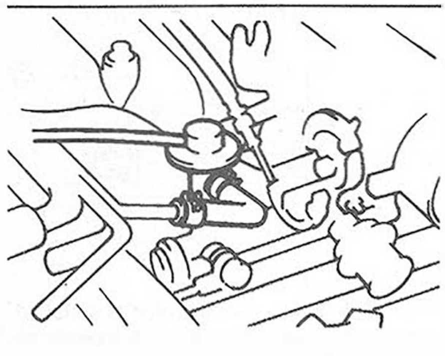
a) *Both PCV* hoses *(non-turbo models); single PCV hose (turbo models)*
b) *Brake booster hose*
c) *Air control valve* hoses *(if equipped with power steering)*
d) *VSV hoses (if equipped with air conditioning)*
e) *EVAP hose*
f) *EGR vacuum modulator* hose
g) *Fuel pressure up VSV and* hose *and reed valve* hose *(non-turbo models); pressure regulator hose (turbo models)*
h) *VCV (turbo models)*
i) *Both air valve* hoses *from throttle body*
j) *Both coolant by-pass* hoses *from throttle body*

7 Remove the EGR vacuum modulator (see Chapter 6).
8 Unplug the electrical connectors from the throttle position sensor and the cold start injector (and, on California models, the EGR gas temperature sensor wire).
9 Label, then detach, all vacuum lines and hoses from the throttle body and air intake chamber.
10 Detach the cold start injector from the air intake chamber (see Section 18).
11 Remove the EGR pipe bolts (see Chapter 6) from the air intake chamber.
12 Remove the bolts holding the manifold stay to the air intake chamber.
13 Remove the four bolts, two nuts, bond strap and fuel hose clamp.
14 Remove the air intake chamber with the throttle body, resonator and gasket. Discard the old gasket.
15 Installation is the reverse of removal.

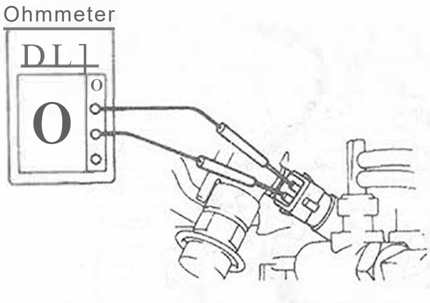
21 Injector - check and replacement

Refer to illustrations 21.5, 21.12a, 21.12b, 21.13a, 21.13b and 21.13c

Warning: *Gasoline* is *extremely flammable,* so *extra precautions must be taken when working on any part of the fuel* system. *Do not smoke or allow open flames or bare light*

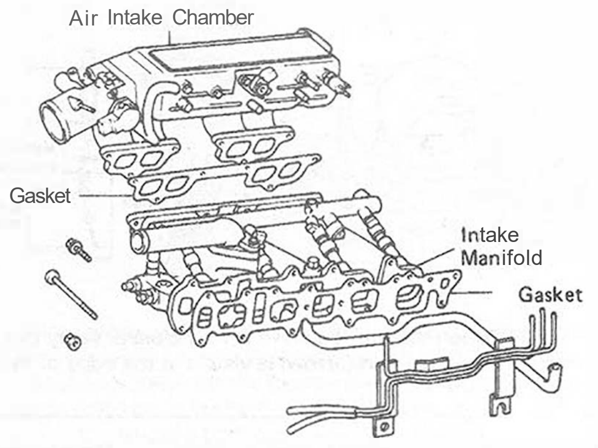


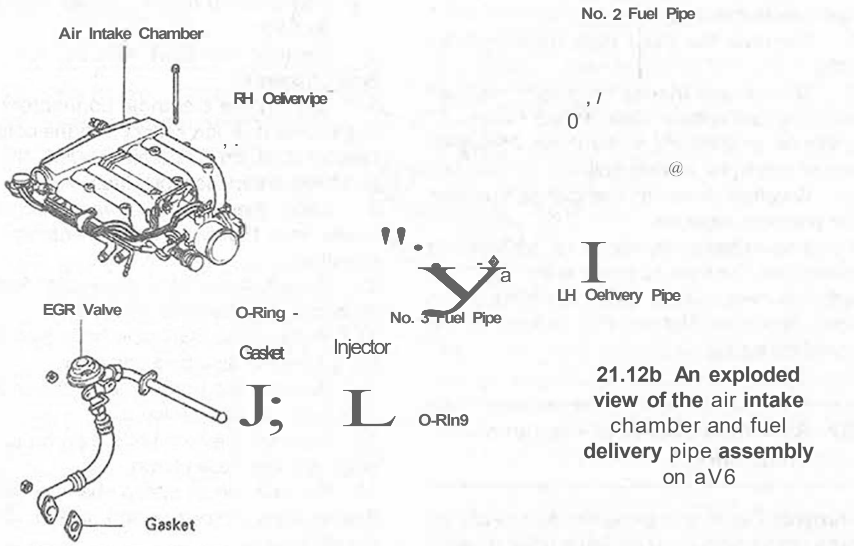
19.1b Typical pressure regulator, located on fuel rail, on a V6



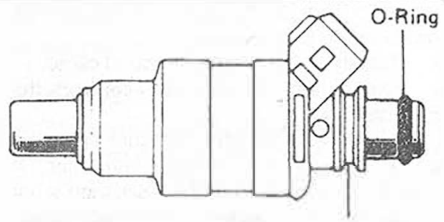
21.5 To check an injector, unplug the electrical connector, touch the probes of an ohmmeter to the terminals and compare your reading to the specified resistance - if the indicated resistance doesn't match the specified resistance, replace the injector

21.12a An exploded view of the air intake chamber and fuel delivery pipe assembly on a four-cylinder engine





21.12b An exploded view of the air intake chamber and fuel delivery pipe assembly on a V6



21.13a Always replace the O-ring every time an injector is removed and make sure that the grommet and O-ring are installed correctly

bulbs in or near the work area. Also, do not work in a garage if a natural gas type appliance with a pilot light is present.

Check

1 If more than one injector is suspect, the control unit should be checked as previously described (see Section 13).

2 To trace a single faulty injector with the engine running, use a screwdriver as a stethoscope. Position the blade of the screwdriver on the injector and hold the handle against your ear. You should hear a click every time the injector operates. Compare the noise of the suspect injector with the remaining injectors. If the volume of the click is noticeably less than at the other injectors, that particular injector is faulty and should be replaced with a new one.

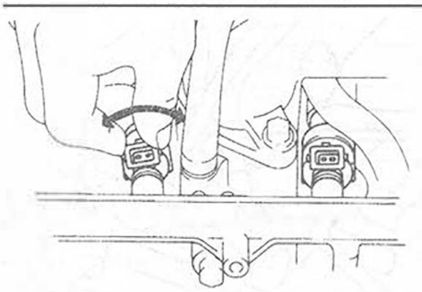
3 Once you have isolated a possibly faulty injector it can be verified by carrying out a resistance check. To do this, first disconnect the battery ground cable.

4 Disconnect the wiring harness from the suspect injector.

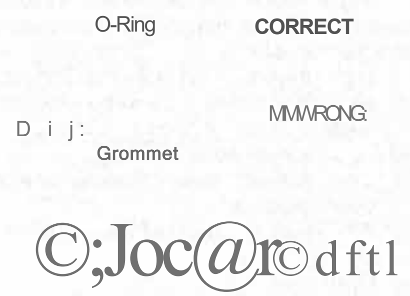
5 Attach the leads from an ohmmeter to the terminals on the injector (see illustration) and note the ohmmeter reading. Compare your reading to the specified resistance. If the resistance is not correct, replace the injector with a new one.

Replacement

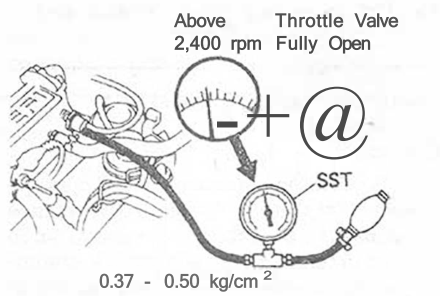
6 Release the fuel pressure as described earlier in this Chapter.



21.13b After the delivery pipe is installed, check the installation of each injector by rotating it like this - if it doesn't rotate smoothly . . .



21.13c . . . chances are that it has been installed incorrectly and must be reinstalled (be sure to use another new O ring)



22.4 To check turbocharger pressure, install a pressure gauge to the gas filter and, while driving with the engine running at 2400 rpm or more with the throttle valve fully open in the **L** range, check the turbocharging pressure and compare your reading to the specified pressure

7 Disconnect the battery ground cable.
8 Remove the air intake chamber (see Section 20).
9 Disconnect the fuel return hose.
10 Disconnect the following wires:

a) *Auxiliary air valve wire*
b) *Knock sensor wire*
c) *Oil pressure sender gauge or switch wire*
d) *Starter wire (terminal 50)*
e) *Transmission wires*
f) *Compressor wires (if equipped with AIC)*
g) *Injector wires*
h) *Water temperature sender gauge wire*
i) *Overdrive temperature switch wire (if equipped with automatic transmission)*
j) *Oxygen sensor wire*
k) *Igniter wire*
l) *VSV wire (If equipped with AIC)*
m) *Cold start injector time switch wire*
n) *Water temperature sensor wire*

11 Disconnect the fuel hose banjo bolt and remove the bolt, pulsation damper and crush washers from the delivery pipe.
12 Remove the mounting bolts, then remove the delivery pipe and the injectors as an assembly. **Note:** *When moving the delivery pipe be careful not to drop any of the injectors, spacers or insulators* **(see illustrations).**
13 Installation is the reverse of the removal procedure with the following notes:

a) *Install a new grommet and O-ring* **(see illustration)** *on each injector.*
b) *Apply gasoline to the O-rings and install the injectors in the delivery pipe.*
c) *On a four cylinder engine, install the four insulators in the injector holes of the intake manifold. On a V6, install the six insulators and spacers into the injector holes of the intake manifold.*
d) *Attach the injectors with the delivery pipe to the manifold. On the V6, don't forget the spacers for the intake manifold mounting bolts.*
e) *Make sure the injectors rotate smoothly* **(see illustrations)** *and install the bolts in the delivery pipe. Tighten the bolts/nuts to the specified torque.* **Note:** *If the injectors do not rotate smoothly, the probable cause may be incorrect installation of the O-rings. Replace the O-ring after removing the injector.*
f) *Use new crush washers on the pulsation damper banjo bolts and tighten it to the specified torque.*

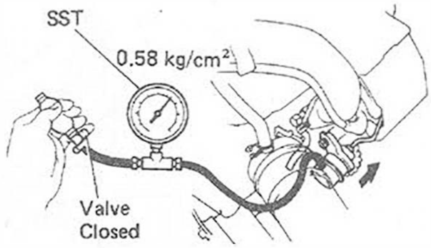
14 After installation is complete, check for fuel leaks.

22 Turbocharger - inspection, removal and installation

Refer to illustrations 22.3, 22.4, 22.9, 22. 19 and 22.20

Inspection

1 Check the intake air system for leakage or clogging between the air cleaner and the turbocharger inlet and between the turbocharger outlet and cylinder head. If the air cleaner is clogged, clean or replace it (see Chapter 1). If the hoses are collapsed or deformed, repair or replace them (see Chapter 1). If there is leakage from the connections, tighten or repair the connections. If there are cracks in the components, replace them.
2 Inspect the exhaust system for leakage or clogging between the cylinder head and the turbocharger inlet and between the turbocharger outlet and the exhaust pipe. If any of the components are deformed, repair or replace them. If there is any foreign material in the passages, remove it. If there is leakage from any components, repair or replace them. If there are cracks in any components, replace them.
3 To check the operation of the actuator and the wastegate valve, detach the actuator hose and, using a pressure gauge (Ford SST 09992-00241 or equivalent), apply about 8.2 psi of pressure to the actuator and verify that the rod moves **(see illustration).** If it doesn't, replace the turbocharger. **Caution:** *Never apply more than 10.0 psi of pressure to tile actuator.*
4 To check turbocharging pressure, install a pressure gauge (Ford SST 09992-00241 or equivalent) and, while driving the vehicle with the engine running at 2400 rpm or more with the throttle valve fully open in the L range, note the reading on the gauge **(see illustration)** and compare it to the specified turbocharging pressure. If the pressure is less than specified, check the intake air and exhaust systems for leakage. If there is no leakage, replace the turbocharger assembly. If the pressure is above specification, make sure that the actuator hose is not disconnected or cracked. If it isn't, replace the turbocharger assembly.

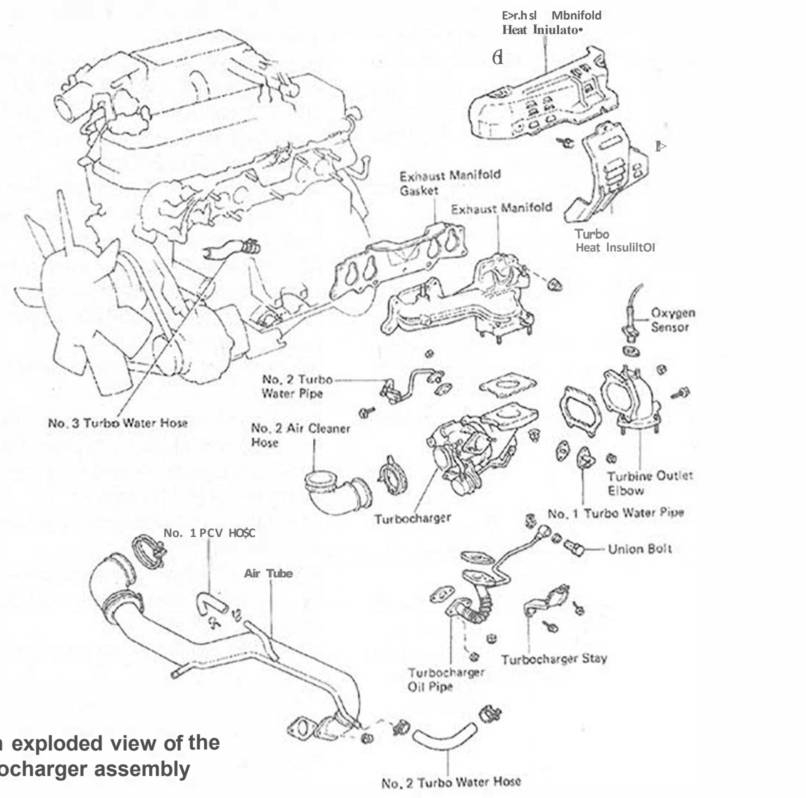


22.3 To check the operation of the actuator and the wastegate valve, detach the actuator hose and, using a pressure gauge, apply about 8.2 psi of pressure to the actuator and verify that the rod moves

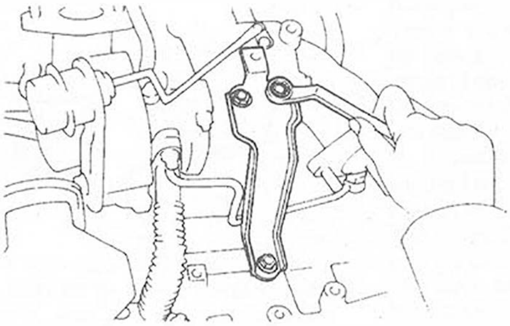
5 Detach the air cleaner hose. Grasp the edge of the impeller wheel and turn it. Verify that it turns smoothly. If it does not turn or if it turns with a drag, replace the turbocharger assembly.

Removal

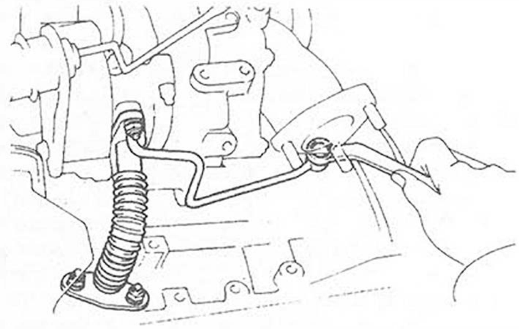
6 Detach the cable from the negative terminal of the battery.
7 Drain the engine coolant.
8 Disconnect the oxygen sensor wire clamp and connector.
9 Disconnect the PCV hoses **(see illustration).**



22.9 An exploded view of the turbocharger assembly



22.19 Removing the turbocharger stay



22.20 Removing the turbo oil pipe

10 Disconnect the No. 1 and No. 2 turbo water hoses.
11 Loosen the clamp on the throttle body.
12 Remove the two nuts, air tube assembly and gasket.
13 Remove the No. 1 air cleaner hose assembly.
14 Remove the No. 2 air cleaner hose.
15 Remove the exhaust manifold and turbo heat insulators.
16 Disconnect the No. 3 turbo water hose.
17 Raise the vehicle and place it securely on jackstands.
18 Remove the three nuts from the flange, loosen the pipe clamp bolt and nut, disconnect the clamp and disconnect the exhaust pipe from the turbine outlet elbow. Discard the gasket.
19 Remove the turbocharger stay **(see illustration).**
20 Remove the banjo bolt and crush washers, remove the two nuts from the flange of the oil pie and disconnect the turbo oil pipe **(see illustration).**
21 Remove the exhaust manifold mounting nuts and remove the turbocharger and the exhaust manifold as an assembly.
22 Remove the No. 2 turbo water pipe bolt and nuts, the water pipe and the gasket.
23 Remove the turbo oil pipe nuts, the oil pipe and the gasket.
24 Remove the No. 1 turbo water pipe nuts, water pipe and gasket.
25 Remove the turbine outlet elbow nuts, the turbine outlet elbow (with the oxygen sensor) and the gasket.
26 Remove the exhaust manifold nuts, the manifold and the gasket.

Installation

27 Pour approximately 20 cc of new oil into the oil inlet and turn the impeller wheel by hand to splash oil on the bearing.
28 Place a new gasket on the manifold with the groove of the gasket facing upward (turbocharger side), install the exhaust manifold onto the turbo and tighten the exhaust manifold-to-turbo nuts to the specified torque.
29 Install a new gasket and the turbine outlet elbow and tighten the four nuts to the specified torque.
30 Install a new gasket and the No. 1 water pipe and tighten the two nuts securely.
31 Install a new gasket and the oil pipe and tighten the two nuts to the specified torque.
32 Install a new gasket and the No. 2 water pipe and tighten the two nuts and the bolt securely.
33 Place a new exhaust manifold gasket and a new turbocharger oil pipe flange gasket in position, install the turbocharger and exhaust manifold as an assembly on the exhaust manifold and oil pipe stud bolts, temporarily install the nine exhaust manifold nuts, the oil pipe flange nuts and the oil pipe banjo bolt. Then tighten the exhaust manifold mounting nuts, the oil pipe flange nuts and the oil pipe banjo bolt to the specified torque.
34 Install the turbocharger stay and tighten the nuts securely.
35 Place a new gasket on the exhaust pipe, connect the exhaust pipe to the turbine outlet elbow and tighten the flange nuts to the specified torque. Connect the clamp and tighten the bolt securely.
36 Connect the No. 3 turbo water hose.
37 Install the turbo and exhaust manifold heat insulators.
38 Install the No. 2 air cleaner hose with the arrow facing the turbocharger side and fasten the clip by turning it 180 degrees clockwise or counterclockwise.
39 Install the No. 1 air cleaner hose assembly.
40 Install the air tube assembly with two nuts and the clamp, connect the No. 1 and No. 2 turbo water hoses and connect the No. 2 and No. 3 PCV hoses.
41 Connect the oxygen sensor connector and clamp.
42 Fill the engine with coolant.
43 Connect the cable to the negative terminal of the battery.
44 Start the engine and check for leaks.

23 Exhaust system - servicing

Caution: *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.*
1 The exhaust system consists of the exhaust manifold, the catalytic converter, the muffler, the tailpipe and connecting pipes, brackets, hangers and clamps. The entire exhaust system is attached to the body with mounting brackets and rubber hangers. If any one of the parts are improperly installed, excessive noise and vibration will be transmitted to the body.
2 Regular inspection of the exhaust system should be made to keep it safe and quiet. Look for any damaged or bent parts, open seams, holes, loose connections, excessive corrosion or other defects which could allow exhaust fumes to seep into the vehicle. Deteriorated exhaust system components should not be repaired; they should be replaced with new parts. Refer to Chapter 6 for catalytic converter removal and installation procedures.
3 If the components are extremely corroded or rusted together, it may be a good idea to have the work performed by a reputable muffler shop, since welding equipment will probably be required to remove the components.
4 Always work from the back to the front when removing exhaust system components. Penetrating oil applied to mounting bolts and nuts will make them much easier to remove. Always use new gaskets, hangers and clamps and apply anti-seize compound to mounting bolt threads when putting everything back together. Also, when replacing any exhaust system parts, be sure to allow enough clearance from all points on the underbody to avoid overheating the floor pan and possibly damaging the truck bed.

Chapter 5
Engine electrical systems

Contents

	Section
Alternator - inspection and brush replacement	15
Alternator - on-vehicle check	13
Alternator - removal and installation	14
Battery cables - check and replacement	4
Battery check and maintenance	See Chapter 1
Battery emergency jump starting	3
Battery - removal and installation	2
Charging system - description	12
Distributor cap and rotor check and replacement	See Chapter 1
Distributor - on-vehicle inspection	9
Distributor - removal and installation	11
Drivebelt check, adjustment and replacement	See Chapter 1
General information and precautions	1
Igniter - removal and installation	8
Ignition coil - check and replacement	7
Ignition system - check	6
Ignition system - description	5
Ignition timing check and adjustment	See Chapter 1
Regulator - check and replacement	16
Signal generator (pickup coil) - removal and installation	10
Spark plug replacement	See Chapter 1
Spark plug wire check and replacement	See Chapter 1
Starter motor - removal and installation	19
Starter motor - testing in vehicle	18
Starting system - description	17

Specifications

Ignition system

General

Cylinder numbers (front-to-rear)	
Four-cylinder	1-3-4-2
V6	
Right (passenger side)	1-3-5
Left (driver's side)	2-4-6
Firing order	
Four-cylinder	1-3-4-2
V6	1-2-3-4-5-6
Timing mark location {all engines)	Crankshaft pulley
Ignition timing	Refer to VECI label in engine compartment

Distributor

Direction of rotation	Clockwise
Air gap (all models)	0.008 to 0.016 in
Signal generator (pickup coil) resistance {four cylinder models)	
1979 thru 1981 and 1983	130 to 190 ohms
1982 and 1984 thru 1990	140 to 180 ohms
1991 -on	185 to 265 ohms

Ignition coil

Primary resistance	
1979 and 1980	
Federal	1.3to1.7ohms
California and Canada	0.8 to 1.0 ohms
1981 and 1982	0.4 to 0.5 ohms
1983 and 1984	
Type 111	0.4 to 0.5 ohms
Type IV	0.8 to 1.1 ohms
1985 thru 1989	
Carbureted	0.4 to 0.5 ohms
Fuel injected	0.5 to 0.7 ohms
1990 and 1991	
Four-cylinder engine	0.5 to 0.7 ohms
V6 engine	0.4 to 0.5 ohms
1992	
Four-cylinder engine	0.46 to 0.69 ohms
V6 engine	0.3 to 0.6 ohms
1993 on (4-cylinder and V6)	0.36 to 0.55

Ignition coil (continued)

Secondary resistance	
1979 and 1980	
Federal	12.0 to 16.0 K ohms
California and Canada	11.5 to 15.5 K ohms
1981 and 1982	8.5 to 11.5 K ohms
1983 and 1984	
Type III	8.5 to 11.5 K ohms
Type IV	10.7 to 14.5 K ohms
1985 thru 1989	
Carbureted	8.5 to 11.5 K ohms
Fuel injected (non-turbo and V6)	11.4 to 15.6 K ohms
1990 and 1991	
Four-cylinder engine	11.4 to 15.6 K ohms
V6 engine	10.2 to 13.8 K ohms
1992	
Four-cylinder engine	10.1 to 16.7 K ohms
V6 engine	9 to 15 K ohms
1993 on (4-cylinder and V6)	9.0 to 15.4 K ohms
Insulation resistance	Infinity (at least more than 10 M ohms)

Alternator

Types	
1979 and 1980	40A or 55A (both types externally mounted)
1981 thru 1984	Tirrill type or IC type (both types externally mounted)
1985 thru 1988	IC type (mounted inside alternator)
Rated output	
1979 and 1980	40 amps or 55 amps
1981 thru 1984	
Tirrill regulator type	40 amps
IC regulator type	40 amps, 55 amps or 60 amps
1985-on (including V6)	60 amps
Drivebelt tension	See Chapter 1
Standard amperage	
No load (1979-on)	Less than 10 amps
With load	
1979 and 1980 and 1985-on (including V6)	More than 30 amps
1981 thru 1984	More than 20 amps
Regulated voltage	
1979 thru 1984	
40A and Tirrill regulator type	13.8 to 14.8 volts
55A and IC regulator type	14.0 to 14.7 volts
1985 thru 1988	13.5 to 15.1 volts
Brush length	
1979 thru 1984	
Minimum	0.217 in
Standard	0.492 in
1985-on	
Minimum	
4-cylinder	0.177 in
V6	0.059 in
Standard	0.413 in

1 General information and precautions

The engine electrical systems include the ignition, charging and starting components. They are considered separately from the rest of the electrical system because of their proximity and importance to the engine. Exercise caution when working around any of these components for several reasons: they are easily damaged, if tested, connected or stressed incorrectly.

The alternator is driven by an engine drivebelt which could cause serious bodily harm if your fingers become entangled in it while the engine is running. The starter and alternator are both sources of direct battery voltage which could arc or even cause a fire if overloaded or shorted.

Never leave the ignition on for longer than ten minutes with the engine not running. Do not disconnect the battery cable while the engine is running. Do not cross connect the battery cables from another source (such as another vehicle) when jump starting. Don't ground either of the ignition coil terminals, even momentarily. Make sure that the igniter is properly grounded to the body.

A tachometer is required for many of the procedural steps in this Chapter. As some tachometers are not compatible with this ignition system, it is recommended that you refer to the manufacturer's instructions regarding its use. When a tachometer is connected to the system, connect the tachometer test probe to the ignition coil's negative terminal.

Many of the procedural steps in this Chapter require the use of a multimeter, familiarity with its operation and a working knowledge of the basics of electricity. If you do not have these skills, it would be wise to have an authorized dealership or shop specializing in electrical systems diagnose your problem. You can often save money by removing and installing the various components of the engine electrical system even if you are having someone else do the actual diagnosis and/or repairs.

2 Battery - removal and installation

1 Disconnect both cables from the battery terminals, the negative first and then the positive.
2 Remove the bolt and nut from the battery hold-down clamp and remove the clamp.
3 Lift out the battery.
4 Installation is the reverse of removal.

3 Battery - emergency jump starting

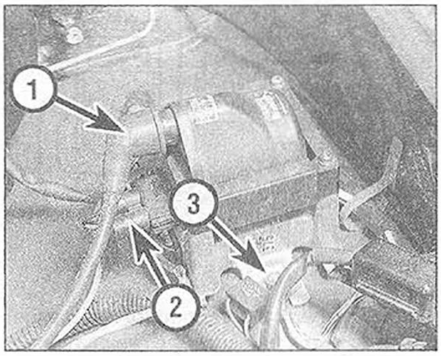
Refer to the booster battery (jump) starting procedure at the front of this manual.

4 Battery cables - check and replacement

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.
3 If only the positive cable is to be replaced, be sure to disconnect the negative cable from the battery first.
4 Disconnect the positive cable from the starter (refer to Section 19) and/or the negative cable from the ground connection. Remove the cable. Make sure that the replacement cable is the same length and diameter.
5 Clean the threads of the starter or ground connection with a wire brush to remove rust and corrosion. Apply a light coat of petroleum jelly to the threads to ease installation and prevent future corrosion.
6 Attach the cable to the starter or ground connection and tighten the mounting m1t securely.
7 Before connecting the new cable to the battery, make sure that it reaches the terminal without having to be stretched.
8 Connect the positive cable first, followed by the negative cable.

5 Ignition system - description

The ignition system is designed to ignite the fuel/air charge entering the cylinder at just the right moment. It does so by producing a high voltage electrical spark between the electrodes of the spark plug. The timing of the spark (when it occurs in the engine cycle) is automatically varied to meet the requirements of engine load and speed.



7.2 To remove the coil, detach the cable from the negative terminal of the battery, detach the coil high tension lead **(1),** unplug the primary leads (2) and remove the mounting bracket bolts (3 - other bolt not shown) (1979 through 1992 shown)

All the Toyota pick-up truck models covered in this volume are eql1ipped with electronic ignition systems which provide relatively trouble and maintenance free operation.

The typical system consists of an ignition switch, ignition coil, distributor, electronic control unit (igniter), spark plugs and wires, and the battery. Although some components may differ slightly in detail, the ignition systems on later models are essentially the same as earlier systems.

6 Ignition system - check

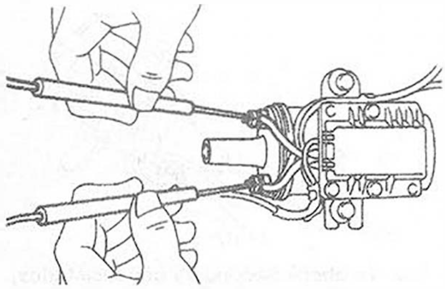
Warning: *Because of the high voltage generated by the ignition system, extreme care should be taken whenever an operation is performed involving ignition components. This not only includes the exciter, coil, distributor and spark plug wires, but related components such as spark plug connectors, tachometer and other test equipment.*

Ignition tester method

1 If the engine turns over but will not start, disconnect the spark plug wire from any spark plug and attach it to a spark tester (available at most auto parts stores).
2 Connect the clip on the tester to a ground such as a metal bracket, crank the engine and observe the tip of the tester to see if a spark occurs.
3 If a spark occurs, sufficient voltage is reaching the plugs to fire the engine. If no spark occurs, one of **the** ignition components coil, distributor cap, rotor, pick-up coil, igniter, ECU or spark plug wires - is defective. Check them all thoroughly.

Alternative method

Note: *If you are unable to obtain a spark tester, the following method will enable you to determine whether the ignition system has spark but it will not tell you if there is enough voltage present to actually initiate combustion.*
4 Disconnect the spark plug boot from a



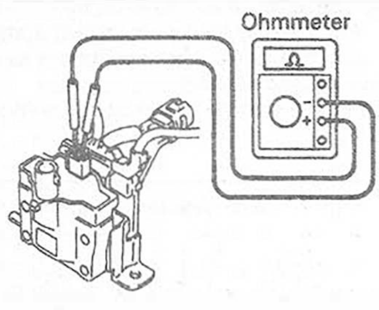
7.4a To check primary coil resistance, measure the resistance between the positive and negative terminals and compare your reading to the specified coil primary resistance (1979 through 1992)

spark plug. Using an insulated tooi, hold the wire about 1/4-inch from a good ground and have an assistant crank the engine.
5 If there is no spark, check another wire in the same manner. A few sparks followed by no spark is the same condition as no spark at all.
6 If there is good spark, check the spark plugs (refer to Chapter 1) and the fuel system (refer to Chapter 4).

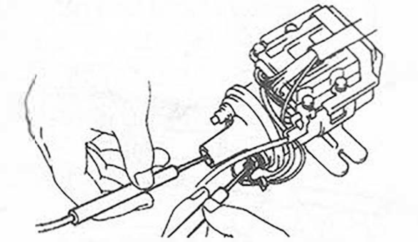
7 Ignition coil - check and replacement

Refer to illustrations 7.2, 7.4a, 7.4b, 7.5a and 7.5b

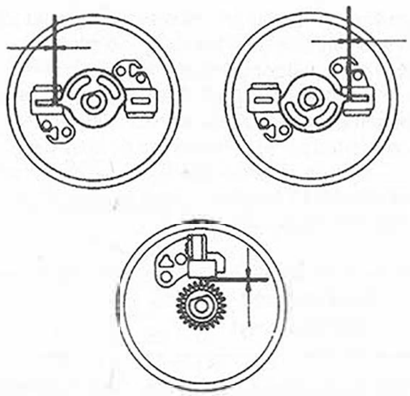
Caution: *If the coil terminals touch a ground source, the coil and/or igniter could be damaged.*
1 Mark the wires and terminals with pieces of numbered tape, then remove the primary wires and the high-tension lead from the coil.
2 Remove the coil/igniter assembly (see **illustration)** from its mount, clean the outer case and check it for cracks and other damage.
3 Inspect the primary coil terminals and the coil tower terminal for corrosion. Clean them with a wire brush if any corrosion is found.
4 Check the primary coil resistance by attaching the leads *of* an ohmmeter to the positive and negative primary terminals (see illustrations). Compare the measured resis-



7.4b To check the primary resistance of the coil, measure the resistance between the positive and negative terminals (1993 and later models)



7.5a To check secondary coil resistance, measure the resistance between the positive primary terminal and the high tension terminal and compare your reading to the specified coil secondary resistance



9.3b To check the air gap on a distributor for a V6, insert a feeler gauge between the **signal rotor and the pickup coil projection at the indicated points**

tance to the Specifications.

5 Check the secondary coil resistance by hooking one of the ohmmeter leads to one of the primary terminals and the other ohmmeter lead to the high-tension coil tower terminal **(see illustrations).** Compare the measured resistance to the Specifications.

6 Measure the insulation resistance by attaching the leads of an ohmmeter to the positive terminal and ground (the igniter body). Compare the measured resistance to the Specifications.

7 If the measured resistances are not as specified, the coil is probably defective and should be replaced with a new one.

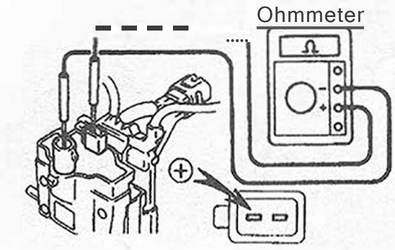
8 It is essential for proper ignition system operation that all coil terminals and wire leads to be kept clean and dry.

9 Install the coil in its mount and hook up the wires.

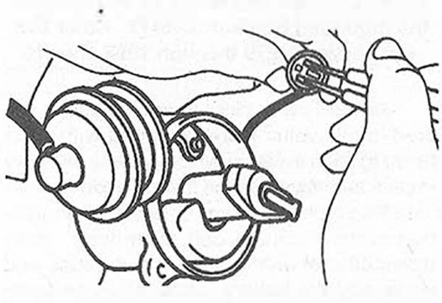
8 Igniter - removal and installation

1 If, after the ignition coil, distributor cap, rotor, spark plug wires and fuel system have been checked out, the vehicle still won't start, is hard to start, idles roughly or stalls, the igniter (located on top of the coil) should be suspect. It can be replaced as follows.

2 Remove the coil/igniter assembly as a



7.5b To check the secondary resistance of the coil, measure the resistance between the positive and high tension terminals (1993 and later models)



9.7a Use an ohmmeter to measure the resistance between the two terminals of the pickup coil lead electrical connector for the distributor on a four-cylinder engine

unit (see Section 7), then unbolt and separate the igniter from the coil.

3 Visually inspect all components for obvious damage, burning, etc.

4 Installation is the *reverse* of removal. **Caution:** *Remember that if the coil terminals touch ground, the coil and/or igniter could be damaged.*

9 Distributor - on-vehicle inspection

Refer to illustrations 9.3a, 9.3b, 9.7a, 9.7b and 9.9

1 Detach the cable from the negative terminal of the battery.

2 Remove the distributor cap (see Chapter 1).

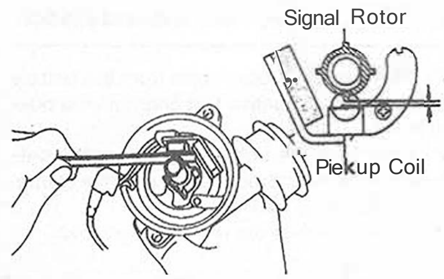
Air gap check

3 Using a feeler gauge, measure the gap between the signal rotor tooth and the pickup coil projection **(see illustrations).**

4 Check that the gap is within specifications.

5 On 1979 thru 1986 models, if the gap is not within specifications, loosen the two screws that hold the signal generator and adjust the signal generator plate until the gap is within specifications. Tighten the screws and recheck the gap.

6 On 1987 and later four-cylinder models



9.3a To check the air gap on a distributor for a four cylinder engine, insert a feeler gauge between the signal rotor and the signal generator (pickup coil) projection

9.7b On a V6, use an ohmmeter to measure the resistance between terminal G- and each of the other three terminals

and on V6 models, if the gap is not within specifications, replace the distributor.

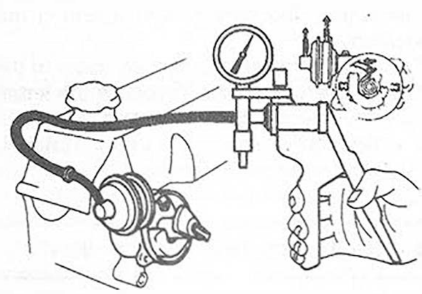
Signal generator (pick-up coil) check

7 Using an ohmmeter **(see illustrations),** check that the resistance of the signal generator is within specifications.

8 If the resistance is not correct, replace the signal generator (see Section 10).

Vacuum advance check (carbureted vehicles only)

9 If you do not have a vacuum pump, go to Step 11. If you do have one, disconnect the vacuum hose from the vacuum advance unit and connect the pump to the vacuum pipe on the diaphragm (see **illustration).**



9.9 If the distributor on your vehicle has a vacuum advance device, detach the vacuum hose from the diaphragm, attach a vacuum pump and apply some vacuum to the advance unit - if it's working properly, it should move the rotor assembly slightly

10 Apply vacuum and verify that the vacuum advance moves. If it doesn't, replace the vacuum advance unit.
11 Hook up a timing light in accordance with the manufacturer's instructions, as if you were adjusting the ignition timing.
12 Start the engine and set it at approximately 2500 rpm.
13 Observe the timing marks at the front of the engine and remove the vacuum hose(s) from the vacuum advance control unit on the distributor. When the hose(s) are removed, the timing mark on the crankshaft pulley should appear to move closer to the stationary mark on the timing tab. When the hose(s) are reconnected, the mark should move away again.
14 If reconnecting the vacuum hose(s) produces an abrupt increase in advance, or none at all, the vacuum advance control unit is probably defective. Replace it.

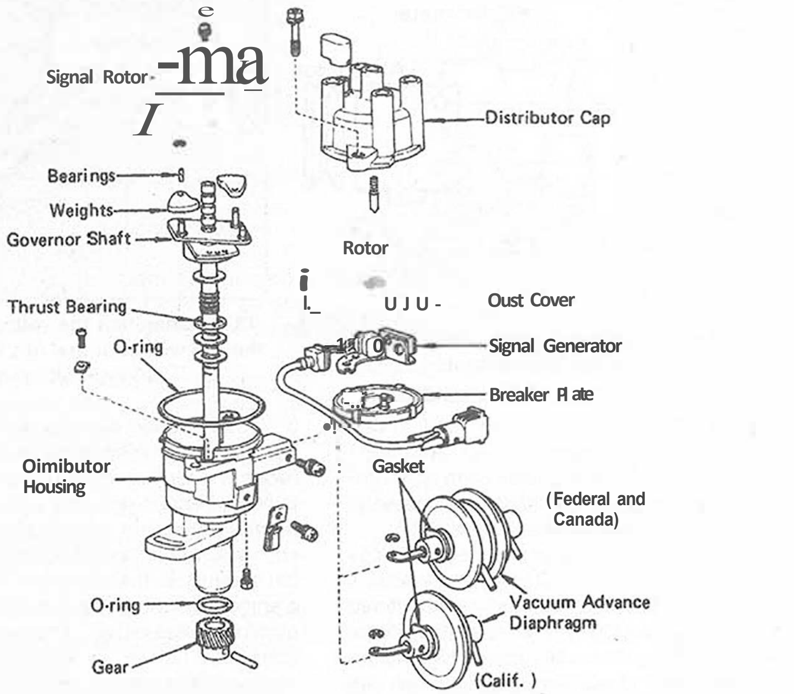
Centrifugal advance check (carbureted vehicles only)

15 To statically check the centrifugal advance mechanism, simply turn the rotor shaft clockwise, release it and note whether it returns slightly (turns counterclockwise).
16 Grasp the rotor shaft with your thumb and index finger and try to twist it from side to side to verity that it's not excessively loose.
17 To dynamically check the centrifugal advance mechanism, hook up a timing light in accordance with the manufacturer's instructions, as if you were adjusting the ignition timing.
18 With the engine running at idle speed and the timing light properly connected, remove the vacuum hose(s) from the vacuum advance control unit on the distributor.
19 Observe the timing marks on the front of the engine and slowly accelerate the engine. The timing mark on the crankshaft pulley should appear to move smoothly in a direction away from the stationary mark on the timing tab. Then when the engine is slowed down, the mark should return to its original position.
20 If the above conditions are not met, the advance mechanism inside the distributor should be checked for broken governor springs, corrosion or other problems.
21 Reconnect the vacuum hose(s).

10 Signal generator (pickup coil) - removal and installation

Refer to illustration 10.1

1 Remove two screws and pull off the distributor cap and O-ring (see illustration).
2 Remove the distributor rotor by pulling it off.
3 Remove the dust cover from the signal generator by prying it up with a screwdriver.
4 Remove the signal generator by removing the two retaining screws.
5 Installation procedures are the reverse of those tor removal.
6 Check the air gap (see Section 9).

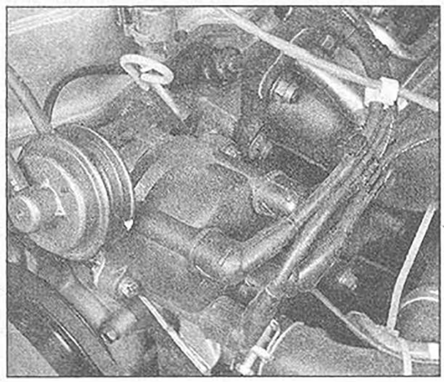


10.1 An exploded view of a typical distributor (fuel injected models don't have centrifugal or vacuum advance devices)

11 Distributor - removal and installation

Refer to illustration 11.1

1 After carefully marking them, remove the coil wire and plug wires from the distributor cap **(see illustration).**
2 Remove the number one spark plug.
3 Manually rotate **the** engine to top dead center on the compression stroke for number one piston (see Chapter 2).
4 Carefully mark **the** vacuum hoses if more than one is present on your model.
5 Disconnect the vacuum hose(s).
6 Disconnect the electrical wires to the distributor.
7 Use a small brush and paint or a scribe to mark the rotor position in relation to the body of the distributor. Scribe a similar mark between the distributor body and the mating surface on the engine cylinder head.
8 Remove the hold down bolt and clamp.
9 Remove the distributor. **Note:** *Do not rotate the engine with the distributor out.*
10 Before starting installation of the distributor, make certain the number one piston is at top dead center on the compression stroke.
11 Align the drilled mark on the driven gear with the center of the number one spark plug terminal on the distributor cap. Insert the distributor into the engine with the adjusting clamp centered over the hold-down hole. Make sure that the gear does not turn as the distributor is inserted.
12 Install the hold-down bolt. The marks previously made on the distributor housing and on the rotor and cylinder head should



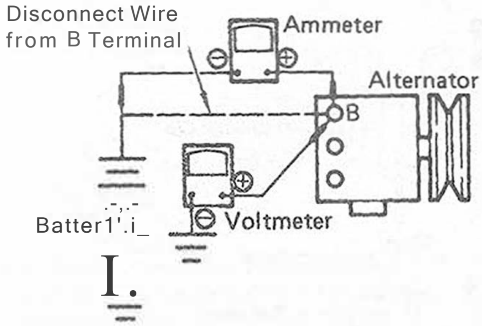
11.1 A typical distributor on a (carbureted) four-cylinder engine

line up before the bolt is tightened.
13 Install the distributor cap.
14 Connect the wiring for the distributor.
15 Install the spark plug wires.
16 Install the vacuum hoses as previously marked.
17 Time the engine as described in Chapter 1, *Ignition timing - adjustment.*

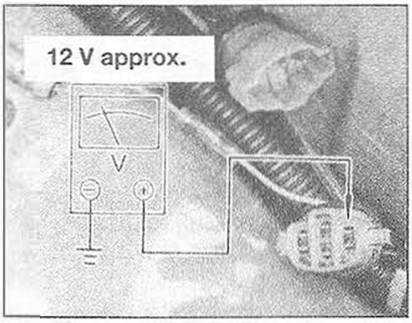
12 Charging system - description

Two basic types of charging systems are used on the vehicles covered in this manual. The most obvious difference between the two is the type of regulator employed.

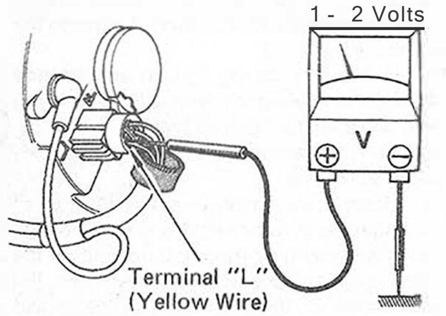
One type, which utilizes a conventional, external voltage regulator, is simply referred to as a 40A or SSA type in carbureted vehi-



13.8 The correct hook-up for testing alternator output



13.15 Checking the voltage reading at the red wire terminal of a typical SSA or IC type alternator



13.18 Checking the voltage reading at the L terminal of a SSA or IC type alternator

cles manufactured in 1979 and 1980. In carbureted vehicles manufactured from 1981 thru 1984, this system is referred to as a Tirrill regulator type. All Tirrill systems are rated at 40A. They were discontinued after 1984.

The second charging system employs an integrated circuit (IC) regulator which is externally mounted on vehicles manufactured from 1981 thru 1984 and rated at 40A, 55A or 60A. The alternators used on vehicles manufactured from 1985 thru 1988, which are rated at 60A (including the V6), also use an IC type regulator, except that it's mounted inside the alternator.

Both charging systems mount the alternator on the left front of the engine and utilize a V-belt and pulley drive system. Drivebelt tension and battery service are the two primary maintenance requirements for these systems. See Chapter 1 for the procedures regarding engine drivebelt checking and battery servicing.

13 Alternator - on-vehicle check

Refer to illustrations 13.8, 13.15, 13.18, 13.20 and 13.27

1 As indicated at the beginning of this Chapter, basic electrical knowledge and skills, plus a working knowledge of a multimeter, are necessary for the successful performance of the following procedures. If you attempt the procedures in this Section and the ones that follow, relating to the alternator, be aware that other parts of the engine electrical system may also affect the alternator's performance. Check and test the system carefully before beginning any repairs.

General check

2 Check the battery, battery terminals and drivebelt tension according to the instructions found in Chapter 1. Check the battery cables (see Section 4). Check the fusible link for continuity.

3 Check the engine, gauge and turn signal fuses located in the combination fuse relay box and the interior fuse box (see Chapter 12).

4 Check the connections on the rear of the alternator and at the regulator. Make sure they are tight and corrosion free.

5 Use caution during the following step because the engine must be running. Keep hands and tools away from the drivebelts and pulleys. Perform this test with the engine at normal operating temperature. Allow the engine to run at normal idling speed and listen carefully to the alternator. It should make a smooth whirring sound if it makes any discernible noise at all. There should be no abnormal noises or grinding sounds. If unusual noises exist, remove the alternator and check it internally for bad bearings and brushes or take it to an alternator rebuilding shop or dealership. Do not disassemble the unit if you do not have the knowledge and tools required for this process.

6 While the engine is running, see that the charge light is off. Turn the engine off and turn the ignition switch back to On but don't start the engine. The charge light should be on. If it isn't, check the charge light circuit and bulb.

Output test

7 Perform the following steps with the engine off. Make certain all connections are tight and making good contact. Damage to the charging system components and test equipment or injury to the operator may result if the connections are improperly made.

8 Disconnect the **wire** from terminal B of the alternator and connect it to the negative terminal of an ammeter. Connect the positive lead of the ammeter **to** terminal 8. Connect the positive lead of the voltmeter to terminal 8. Connect the negative lead of the voltmeter to ground (see illustration).

9 Start the engine. advance the engine speed from idle to 2000 rpm. Check the ammeter and voltmeter readings throughout the range.

10 If the alternator is a 40A or Tirrill type and the readings do not match the Specifications listed at the front of the chapter, it must be checked further (see Section 16).

11 If the alternator is a 55A or IC type and the voltage reading is greater than Specified, replace the regulator (see Section 16). If the voltage reading is lower than specified for the 55A and IC types, check the alternator and regulator as outlined in Steps 13 through 25.

12 If the alternator is a 1985 or later model (or on a V6), and the voltage reading is less than specified, proceed to Step 26 below.

55A or IC type (1981 through 1984)

13 Turn off the engine.

14 Unplug the connector from the regulator and turn the ignition switch to On.

15 Check the voltage reading at the red wire terminal **(see illustration).**

16 If the check reveals no voltage, check the engine fuse and/or the ignition switch.

17 Reattach the connector to the IC regulator.

18 Check the voltage reading at the alternator L terminal **(see illustration).**

19 If the voltage reading is 1 to 2 volts, the alternator must be checked by an electrical technician.

20 If the voltage is the same as the battery voltage, turn the ignition switch off and unplug the connector from the alternator. Check to see if there is continuity between the alternator terminals L and F **(see illustration).**

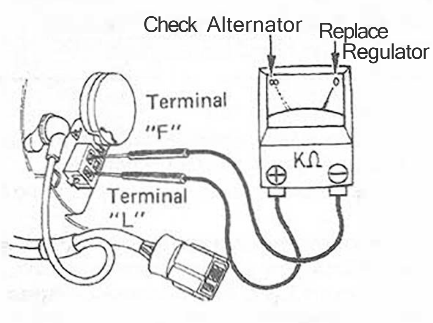
21 If there is no continuity, the alternator must be checked by a qualified electrical technician.

22 If there is continuity, replace the regulator (see Section 16).

23 Check the charging system with the engine running at approximately 2000 rpm.

24 Turn the headlights on and place the heater fan control switch in the Hi position.

25 The ammeter should read above the standard amperage listed in the Specifications. If the reading is slightly lower and the battery is fully charged, the charging system is probably all right. If the reading is signifi-



13.20 Checking for continuity between the L and F terminals on a typical 55A or IC type alternator cantly below specifications, the alternator must be checked by a qualified electrical technician.

1985 and later alternators (including V6)

26 If the alternator is on a 1985 thru 1988 vehicle (including the V6) check the IC regulator and alternator as follows:
27 With terminal F grounded **(see illustration),** start the engine and check the voltage reading of terminal B.
28 If the voltage is greater than the specified voltage, replace the IC regulator.
29 If the voltage is less than the specified voltage, have the alternator checked by a qualified electrical technician.
30 With the engine running at 2000 rpm, turn on the high beam headlights, place the heater fan control switch on the Hi position and check the reading on the ammeter.
31 If the ammeter reading is significantly less than specified, have the alternator checked and repaired by a qualified electrical technician. **Note:** Sometimes *the indicated ammeter reading will be slightly less than the specified amperage with a fully charged battery.*

14 Alternator - removal and installation

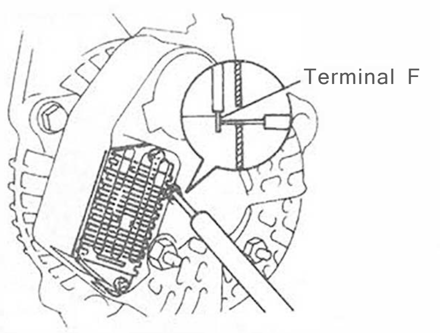
1 Disconnect the negative cable from the battery. **Note:** Make sure that you either have *a wiring diagram or make a diagram to indicate the proper position of each wire in the following steps.*
2 On 1985 and later models (except V6s) equipped with power steering, the coolant must be drained, the engine compartment bottom shroud must be removed and the coolant inlet hose must be detached from the engine before the alternator bolts are *removed.*
3 Label, then disconnect the wires at the rear of the alternator.
4 Remove the lower alternator swivel retaining bolt and nut.
5 Remove the adjustment bolt and nut. **Note:** *The belt guard is retained by the adjusting bolt and nut combination on* some *models.*
6 Release the drivebelt and *remove* the alternator by pulling it to the rear to clear the adjustment bracket.
7 Installation is the reverse of removal. **Note:** *The alternator adjusting tab is threaded. When installing the alternator, make the belt adjustment, tighten the bolt and then install the locknut (see Chapter 1).*

15 Alternator - inspection and brush replacement

1979 through 1984

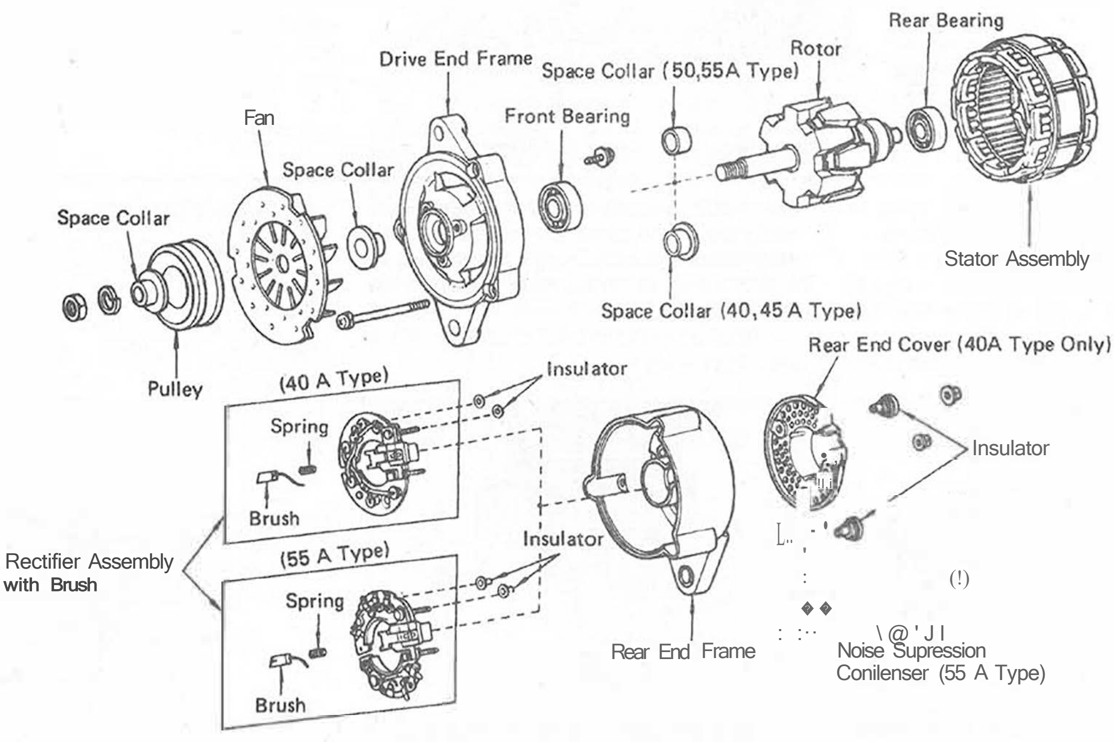
Refer to illustrations 15.2a, 15.2b, 15.7, 15.9 and 15.11

1 Remove the alternator as described in the previous Section.
2 Remove the three alternator through bolts **(see illustrations).**

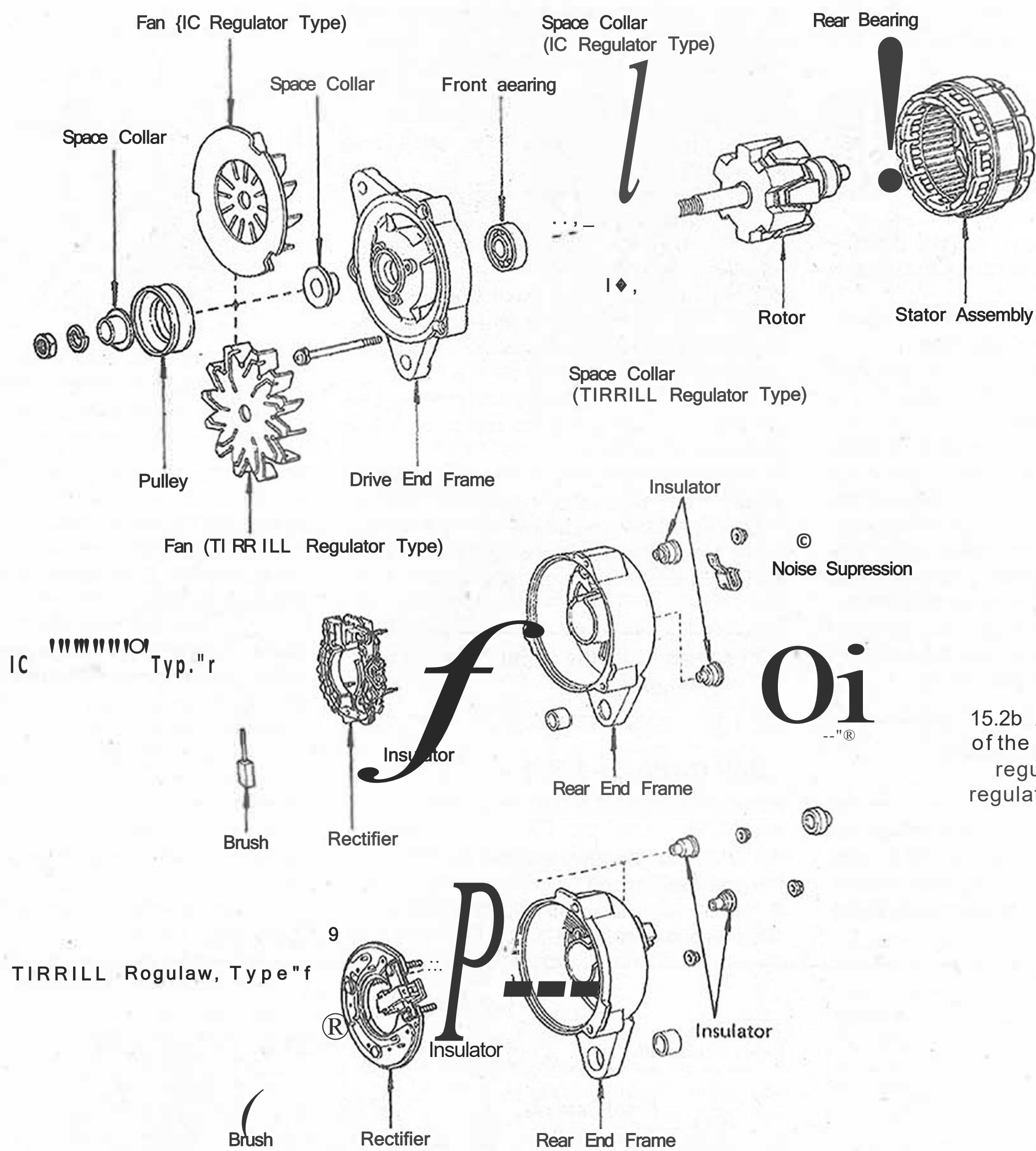


13.27 On a 1985 thru 1988 alternator, be sure to ground terminal F before checking the voltage at terminal B on the alternator

3 Clamp the alternator pulley into a vise equipped with soft jaws. **Note:** *Be careful not to damage the alternator pulley.*
4 Remove the four nuts, two terminal insulators and the noise suppression condenser (55A and IC types).
5 Remove the rear end frame from the stator by gently prying it loose with two pry bars or screwdrivers. **Note:** *Be very careful not to damage any internal wiring or the external housing.*
6 Remove the stator assembly.
7 Measure the exposed brush length **(see illustration)** and compare it to the Specifications. If the brushes are worn beyond the specified limits, replace them with new ones as follows:
8 Unsolder the brushes at their connecting points.



15.2a An exploded view of the 1979 and 1980 40A/55A type alternator



15.2b An exploded view of the 1981 thru 1984 IC regulator and Tirrill regulator type alternator

9 Pull the brushes out of their respective slots in the brush holder (see illustration).

10 Position the new brushes in the holder.

11 Solder the new brushes to the connecting points (see illustration). Make sure that the exposed length of the brush is correct.

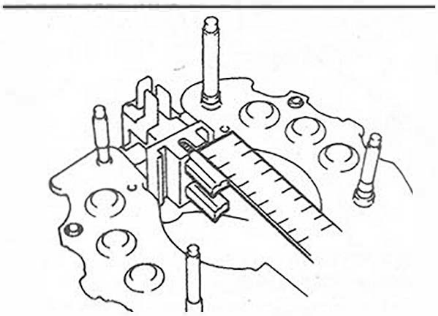
12 Reassembly is the reverse of disassembly. **Note:** *Take care that the housing is realigned in the same manner that it was when disassembled.* Using a small piece of wire, fashion a brush holder to fit through the slots provided in the retainer. This will hold the brushes in the retracted position while installing the stator.

1985 and later models

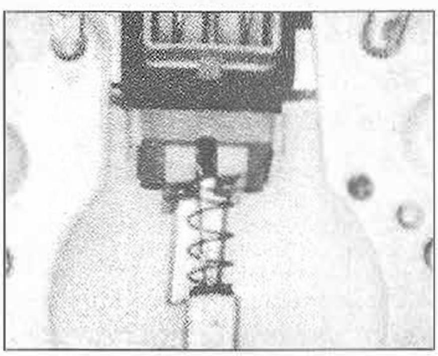
Refer to illustrations 15.14a, 15.14b, 15.15, 15.16 and 15.19

13 Remove the alternator (see Section 14).

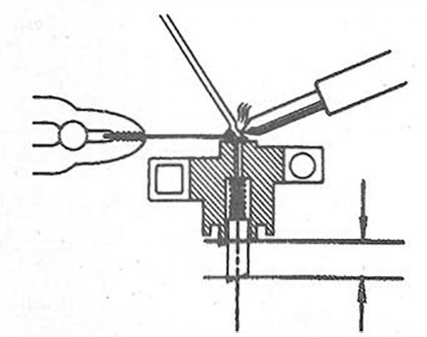
14 Remove the nut and terminal insulator, then remove the three end cover nuts (see



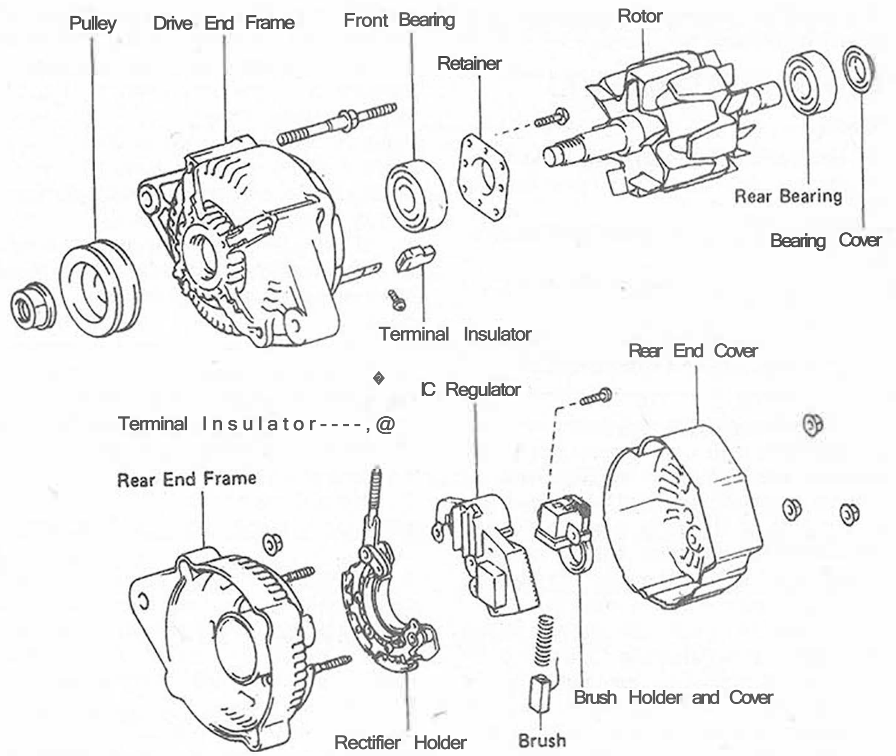
15.7 Measuring the exposed brush length **on a typical alternator rectifier/brush holder assembly**



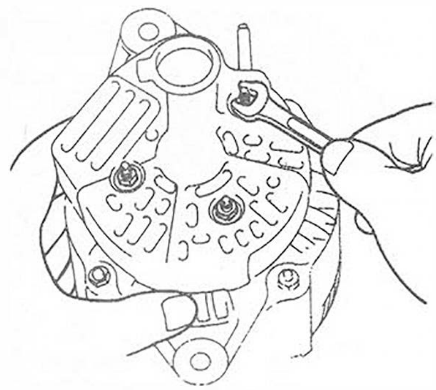
15.9 Removing the alternator brushes from the brush holder



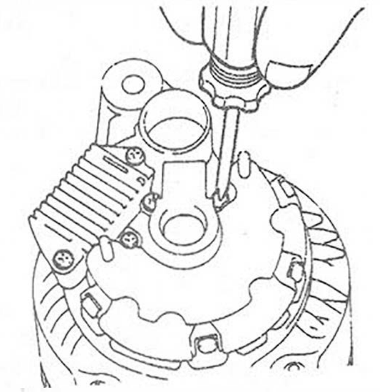
15.11 Soldering new alternator brushes in place



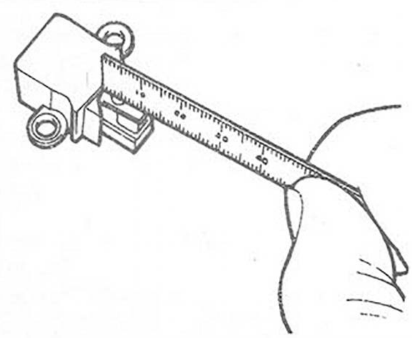
15.14a An exploded view of the alternator with integral IC regulator used on 1985 and later vehicles {four-cylinder type shown, V6 similar)



15.14b Removing the alternator rear end cover nuts



15.15 Removing the brush holder screws



15.16 Measuring the exposed brush length

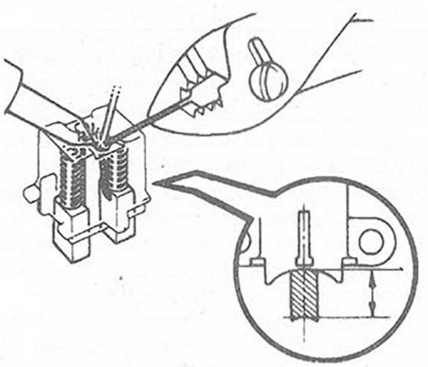
illustrations) and separate the end cover from the rear of the alternator.
15 Remove the two screws and detach the brush holder and cover from the alternator **{see illustration).**
16 Measure the exposed length of the brushes **{see illustration).** If they are shorter than the specified length, replace them with new ones as follows.
17 Unsolder the leads and pull out the brushes and springs.
18 Insert the leads of the new brushes through the springs and install them in the holder.
19 Make sure the brushes protrude the specified standard length, then solder the leads to the holder **{see illustration).** Make sure the brushes move smoothly in the holder, then cut off any excess lead wire.
20 Installation is the reverse of removal. Make sure the brush holder-to-wire connector clearance is at least one millimeter (0.039 inch).

16 Regulator - check and replacement

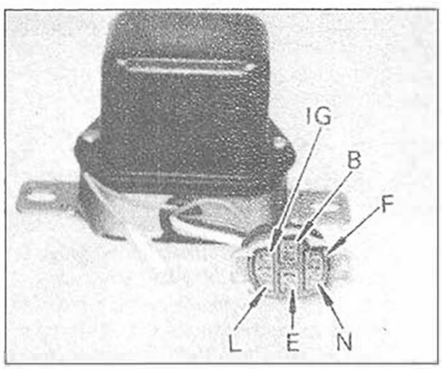
Check (40A/55A and Tirri/I types only)

Refer to illustrations 16.Sa, 16.Sb and 16.18

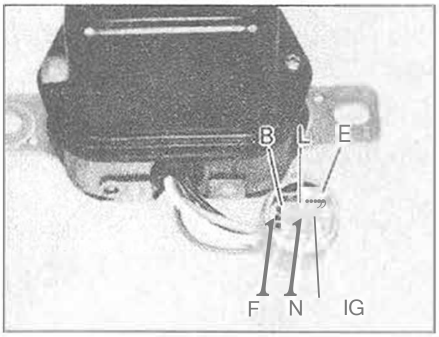
1 Check the regulator connections for a good tight fit and good electrical continuity.
2 Unplug the electrical connector and remove the two regulator mounting bolts. Remove the regulator and the regulator cover.
3 Inspect the point surfaces for burning and/or pitting.
4 If defective, replace the regulator. If the points appear to be in good condition, perform the following checks.
5 The following tests require the use of an ohmmeter. Measure the resistance between terminals IG and F **{see illustrations).** There should be zero resistance with the points open and 11 ohms resistance with the points closed.
6 Measure the resistance between terminals Land E There should be zero resistance with the points open and 100 ohms resis-



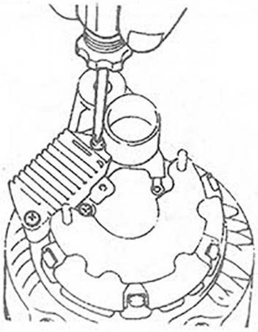
15.19 Make sure that the brush protrudes the specified amount before soldering the leads



16.5a The terminals of a 40A/55A type external voltage regulator



16.5b The terminals of a Tirrill type external voltage regulator



16.18 To remove an integral type IC regulator from the alternator, remove the alternator, remove the brush holder, then unscrew the regulator

tance with the points closed.

7 Measure the resistance between terminals B and E. Resistance should be infinity with the points open and 100 ohms resistance with the points closed.

8 Measure the resistance between terminals B and L. The resistance should be infinity with the points open and zero with the points closed.

9 Measure the resistance between terminals N and E. Resistance should be 23 ohms.

10 If the regulator fails any of the above checks, replace it with a new one.

11 If the regulator checks described above indicate that the regulator is in good condition, but the charging system output is not as specified, the regulator can be adjusted (a job that should be left to an automotive electrician). It is usually easier and maybe cheaper to simply replace the regulator with a new one.

Replacement (External regulators including 40A/55A, Tirril and IC types)

12 Detach the cable from the negative terminal of the battery.

13 Unplug the electrical connector.

14 Remove the two mounting bolts.

15 Installation procedures are the reverse of those for removal.

Replacement (internal IC types)

16 Remove the alternator (see Section 14)

17 Remove the brush holder (see Section 15)

18 Remove the IC regulator **(see illustration).**

19 Installation is the reverse of removal.

17 Starting system - description

Two types of starting systems are used. A conventional starter with direct drive, which is readily identifiable by its top mounted solenoid (magnetic switch) is one type. The second type of starter is a gear reduction type with bottom mounted solenoid switch. It is also identifiable by the side terminals on the bottom mounted solenoid switch.

The gear reduction type starter is further subdivided into two models; 1.0 kW and 1.4 kW. The 1.0 model is identifiable by its removable field frame end cover, while the field frame cover assembly on the 1.4 kW is one piece.

Both starter types are activated through the starter switch, and a Neutral safety switch is provided on automatic transmission equipped vehicles. Direct battery current is provided to the starter motor by the solenoid, which also engages the drive pinion with the engine flywheel.

The Sections **that** follow in this Chapter include starter removal and installation procedures, brush and solenoid (magnetic switch) removai'and installation and performance testing. These procedures may be performed by the home mechanic who has a working knowledge **of** electrical basics and multimeter testing.

It should be noted that rebuilt starter units are often available from wholesale and retail auto parts out'lets on an exchange basis, and that the utilization of these rebuilt units can often save the vehicle owner time and money.

18 Starter motor - testing in vehicle

1 If the starter motor does not turn at all when the switch is operated, make sure that the shift lever is in Neutral or Park (automatic transmission) or that the clutch pedal is depressed (manual transmission).

2 Make sure that the battery is charged and that all cables, both at the battery and starter solenoid terminals, are secure.

3 If the starter motor spins but the engine is not cranking, the overrunning clutch in the starter motor is slipping and the motor must be removed from the engine for replacement.

4 If, when the switch is actuated, the starter motor does not operate at all but the solenoid clicks, then the problem lies with either the battery, the main solenoid contacts or the starter motor itself. **Note:** *Before diagnosing starter problems, make sure that the battery is fully charged.*

5 If the solenoid plunger cannot be heard when the switch is actuated, the solenoid itself is defective or the solenoid circuit is open.

6 To check the solenoid, connect a jumper lead between the battery positive terminal and the terminal on the solenoid. If the starter motor now operates, the solenoid is OK and the problem is in the ignition switch, neutral start switch or in the wiring.

7 If the starter motor still does not operate, replace it and exchange it for a rebuilt unit.

8 If the starter motor cranks the engine at an abnormally slow speed, first make sure that the battery is charged and that all terminal connections are tight. If the engine is partially seized, or has the wrong viscosity oil in it, it will crank slowly.

9 Run the engine until normal operating temperature is reached, then disconnect the coil wire from the distributor cap and ground it on the engine.

10 Connect a voltmeter positive lead to the starter motor terminal of the solenoid and then connect the negative lead to ground.

11 Crank the engine and take the voltmeter readings as soon as a steady figure is indicated. Do not allow the starter motor to turn. for more than 30 seconds at a time. A reading of 9 volts or more, with the starter motor turning at normal cranking speed, is normal. If the reading is 9 volts *or* more but the cranking speed is slow, the motor is faulty. If the reading is less than 9 volts and the cranking speed is slow, the solenoid contacts are probably burned.

19 Starter motor - removal and installation

1 Disconnect the negative battery cable from the battery.

2 Raise the vehicle and place it securely on jackstands.

3 Disconnect the leads from the starter. There is one clip connection and one terminal held by a nut and washer.

4 Remove the bolts retaining the starter to the bellhousing.

5 Remove the starter.

6 Installation procedures are the reverse of those for removal. **Note:** *On some models there is a tab on the clip which connects to the starter that must be properly aligned.*

Chapter 6 Emissions control systems

Contents

	Section
Air Injection {AI) system	9
Air Suction (AS) system	10
Automatic choke system	14
Auxiliary Accelerator Pump {AAP) system	15
Catalytic converter system	11
Cold Mixture Heater (CMH) system)	19
Dash pot (DP) system	7
Deceleration fuel cut system	16
EFI system self-diagnosis capability - general information	20
Exhaust Gas Recirculation (EGA) system	8
Fuel Evaporative Control (EVAP) system canister replacement	See Chapter 1
Fuel Evaporative Emission Control (EVAP) system	3
General information	1
High Altitude Compensation (HAC) system	12
Hot Air Intake (HAI) system	13
Idle advance system	18
Mixture Control (MC) system	5
Positive Crankcase Ventilation (PCV) system	2
PCV valve check and replacement	See Chapter 1
Secondary slow circuit fuel cut system	17
Spark Control (SC) system	6
Thermostatic air cleaner check	See Chapter 1
Throttle Positioner (fP) system	4

Specifications

Fuel Evaporative Emission Control (EVAP) system

Outer vent control valve solenoid resistance	63 to 73 ohms

Throttle Positioner (TP) system

Setting speed	1050 rpm
VSV resistance (cold)	
1979	48 to 60 ohms
1980 and 1981	18 to 23 ohms

Oxidation Catalyst (OS)

Thermo sensor resistance	2 to 200 K ohms

Automatic choke system

Heating coil resistance (cold)	
1981 and 1982	16 to 20 ohms
1983-on	19 to 23 ohms

Dashpot {DP) system

Setting speed	
Carbureted four-cylinder	3000 rpm
EFI-equipped four-cyl and V6	2000rpm

1 General information

Refer to illustration 1.1

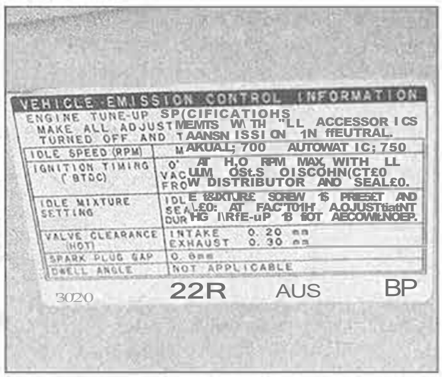
To prevent pollution of the atmosphere from burned and evaporating gases, a number of major and auxiliary emission control systems are incorporated on Toyota trucks. The combination of systems used depends on the year in which the vehicle was manufactured. the locality to which it was originally delivered and the engine type. Check the Vehicle Emissions Control Information (VECI) label **(see illustration)** in your engine compartment to determine which systems are used on your vehicle. The major systems incorporated on the trucks with which this manual in concerned include:

Positive Crankcase Ventilation (PCV) system
Fuel Evaporative Emission Control (EVAP) system
Throttle Positioner (TP) system
Spark Control (SC) system
Exhaust Gas Recirculation (EGR) system
Air Injection (AI) system
Air Suction (AS) system
Catalytic Converter (CCo) system
Mixture Control (MC) system
High Altitude Compensation (HAG) system

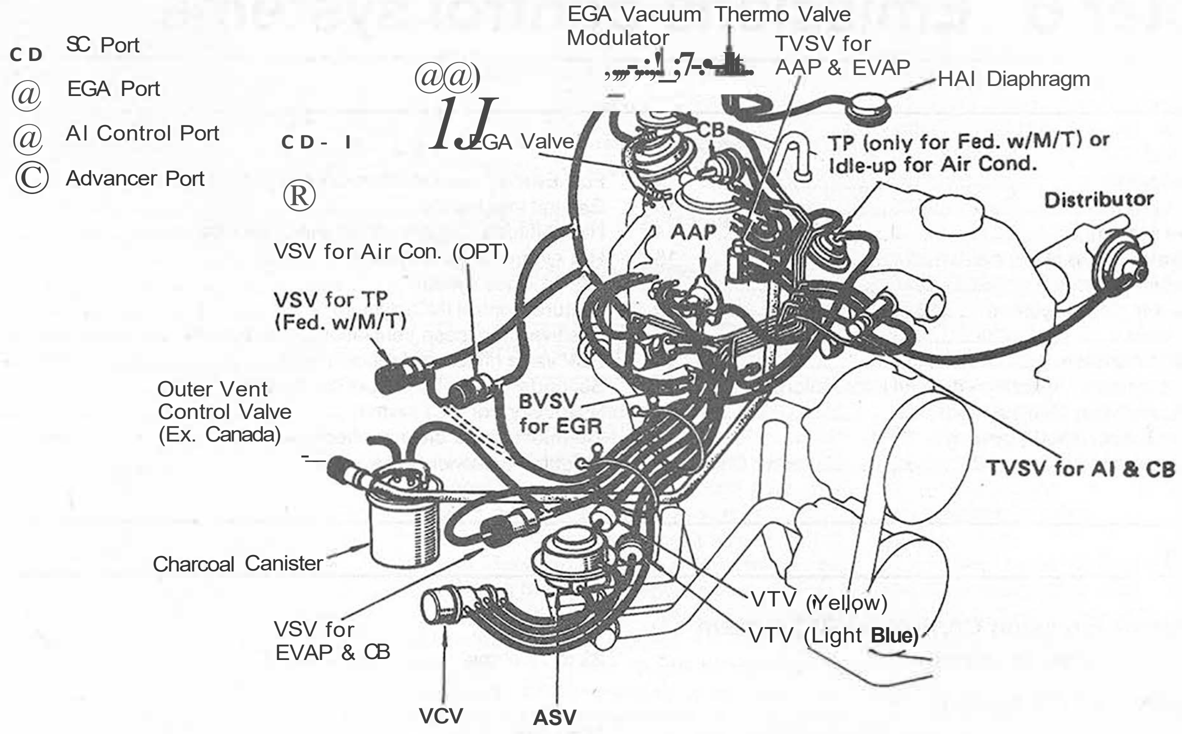
The auxiliary systems incorporated include:

Automatic Hot Air Intake (HAI) system
Auto choke system - including Choke Breaker (CB), Choke Opener (CO) and Fast Idle Cam Breaker (FICB) systems
Auxiliary Accelerator Pump (AAP)
Deceleration fuel cut system
Secondary slow circuit fuel cut system
Air bleed system
Cold Mixture Heater (CMH) system

The Sections in this Chapter include general descriptions. checking procedures (where possible) and component replace-



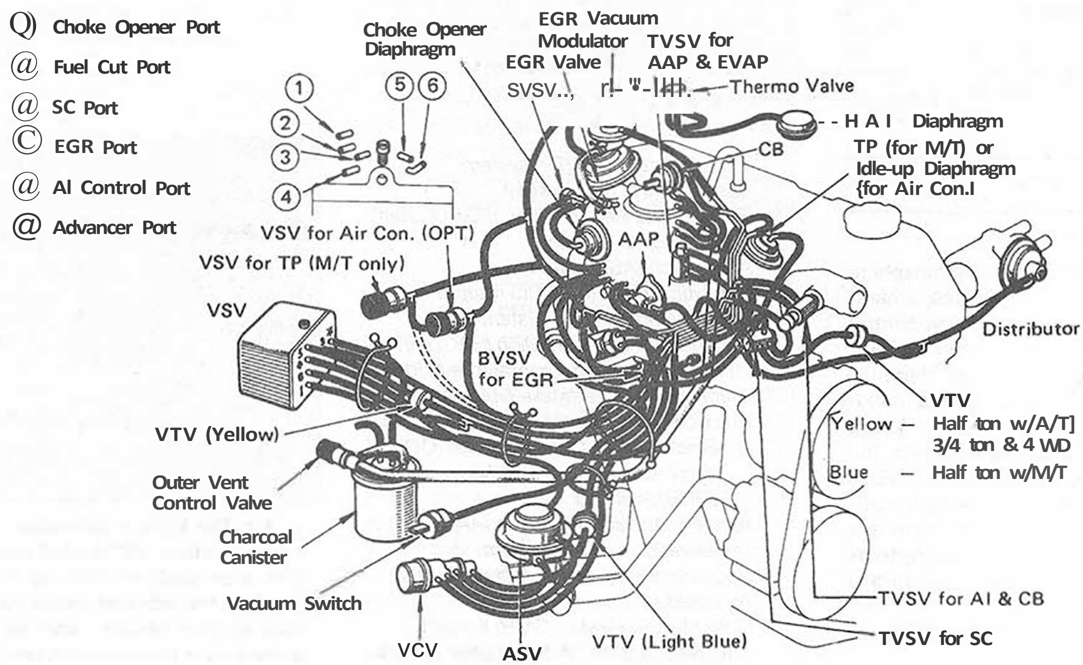
1.1 The Vehicle Emission Control Information (VECI) label is a handy reference guide for tune-up information and for the types of emission devices used on your vehicle - another label (not shown) near this one provides a vacuum schematic showing the location of all emissions hoses and devices



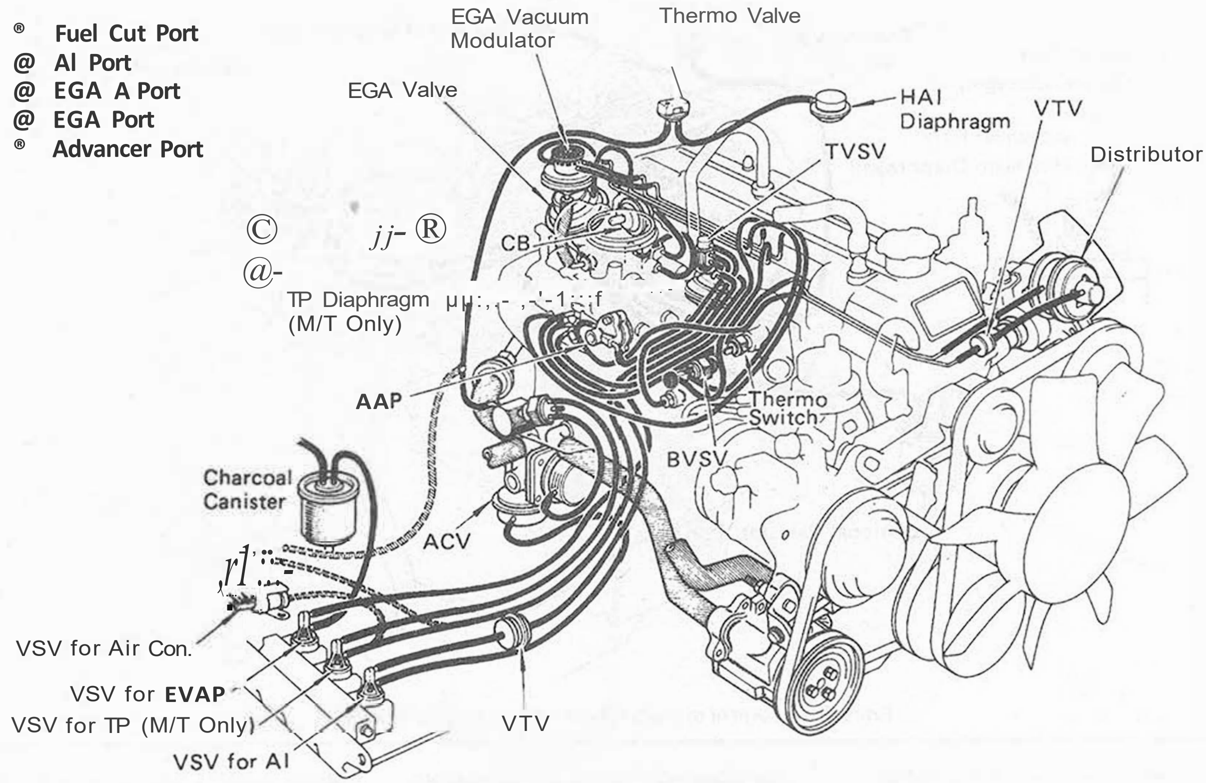
Emissions control system layout - Federal and Canada (1979)

ment procedures (where applicable) for each of the systems listed above.

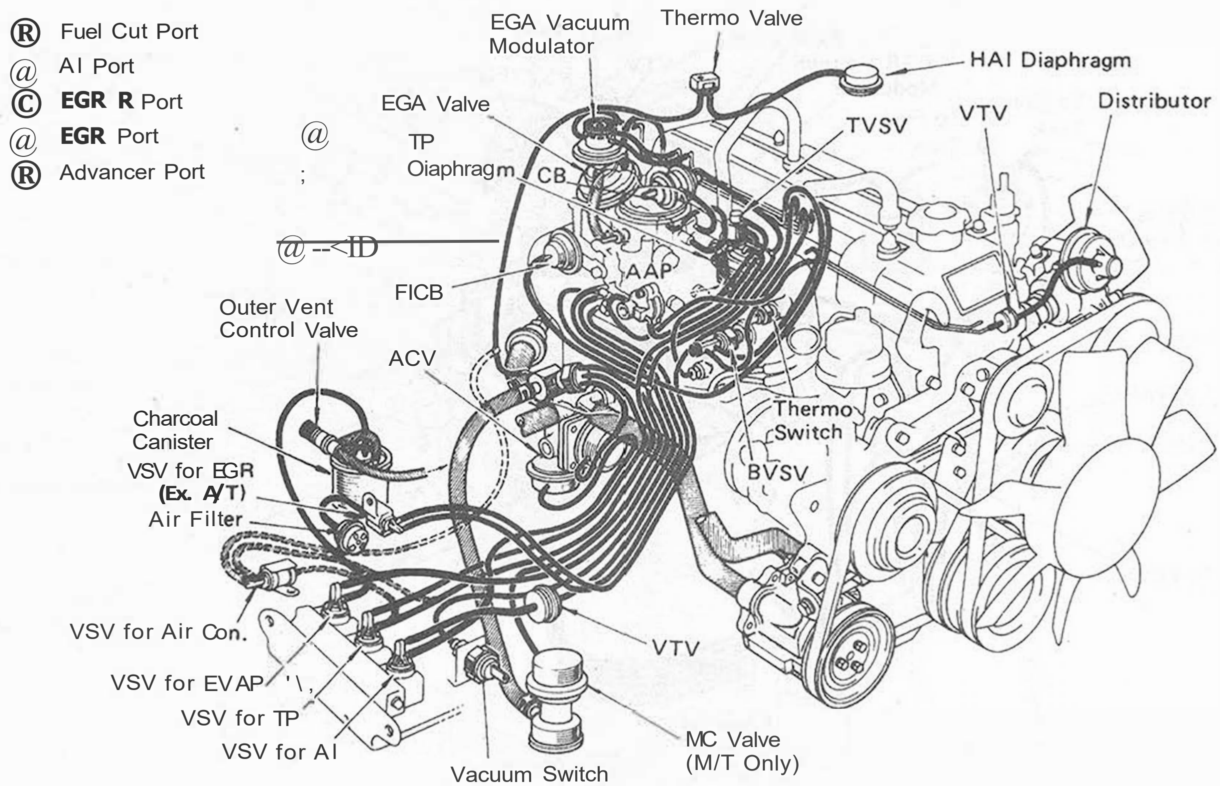
Before assuming that an emission control system is malfunctioning, check the fuel and ignition systems carefully. In some cases, special tools and equipment, as well as specialized training, are required to accurately diagnose the causes of a rough running or difficult to start engine. If checking and servicing become too difficult or if a procedure is beyond the scope of the home mechanic, consult a Toyota dealer service department. This does not necessarily mean however, that the emission control systems are particularly difficult to maintain and repair. You can quickly and easily perform many checks and do most (if not all) of the regular maintenance at home with common tune-up and hand tools. **Note:** *The* most *frequent cause of emission* system *problems* is *simply a loose or broken vacuum* hose *or*



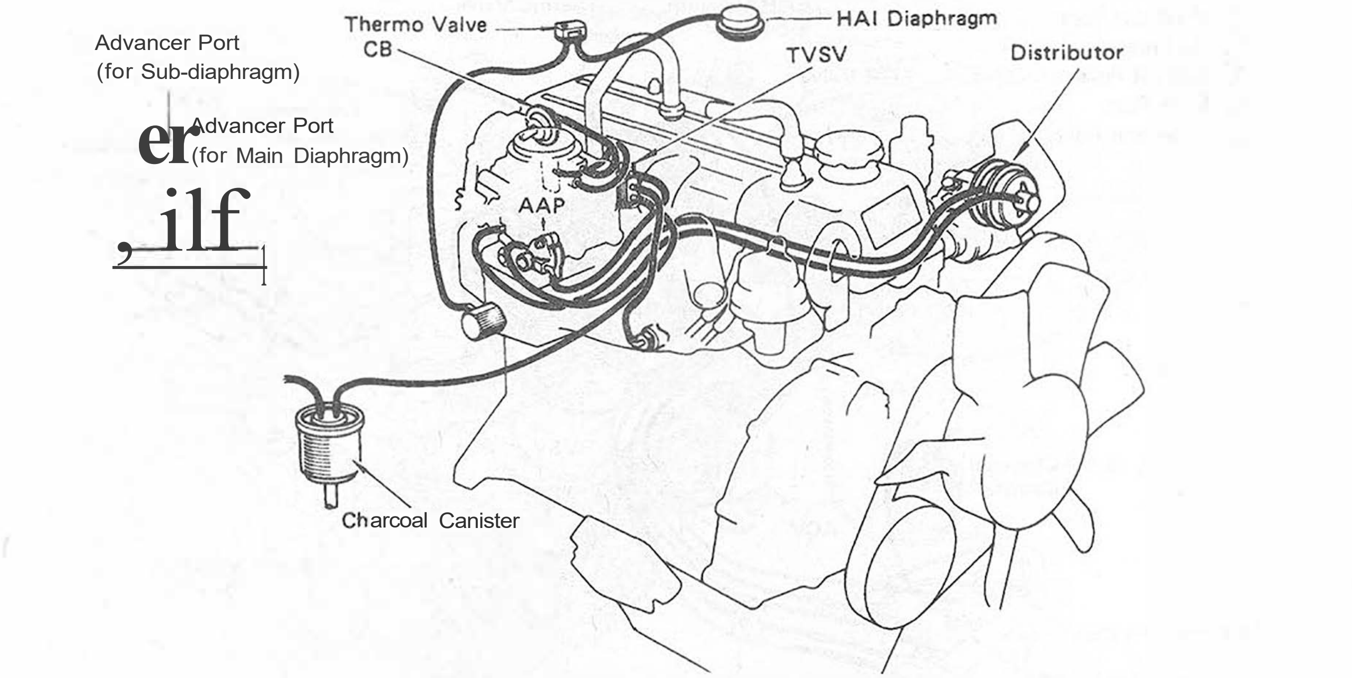
Emissions control system layout - California (1979)



Emissions control system layout - Federal and Canada 2WD (1980)



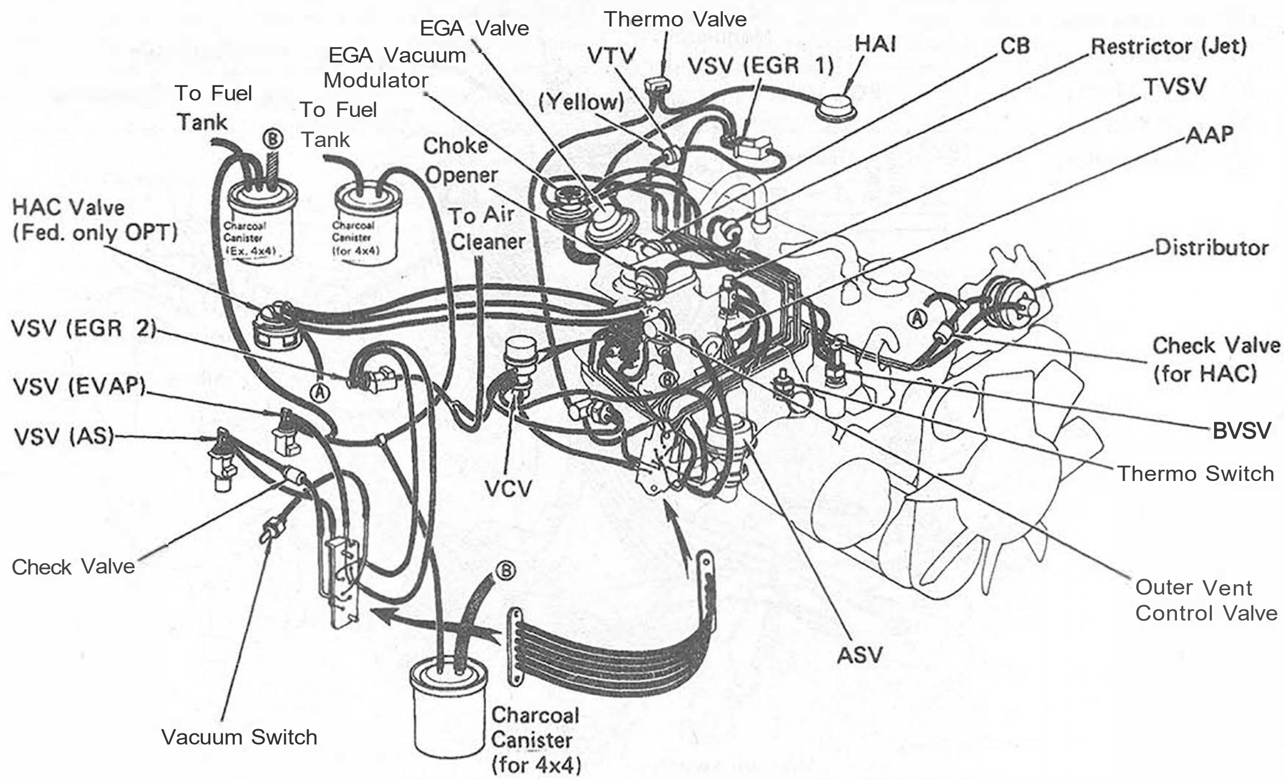
Emissions control system layout - California (1980)



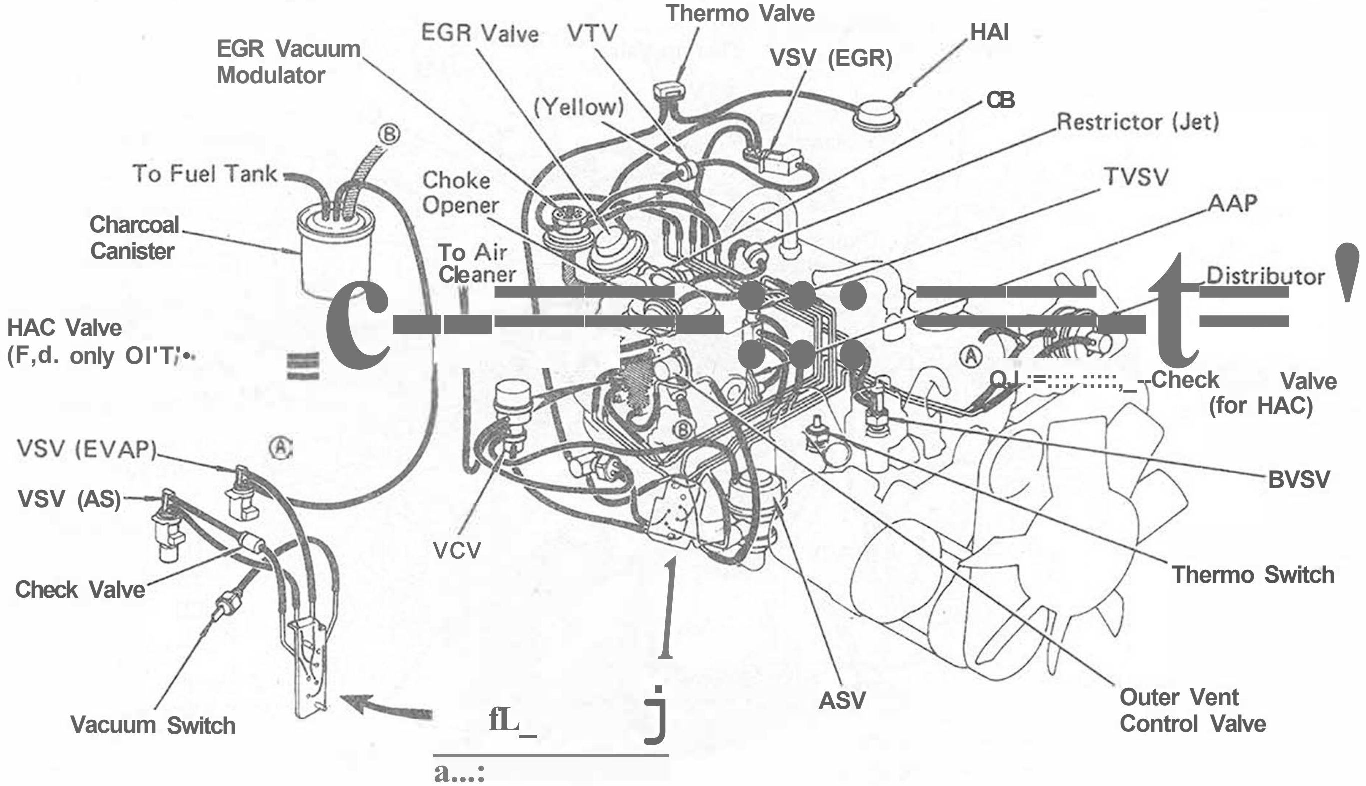
Emissions control system layout - Canada 4WD (1980)

wiring connection. Therefore, always check hose and wiring connections first (refer to the accompanying emissions control system layout illustrations).

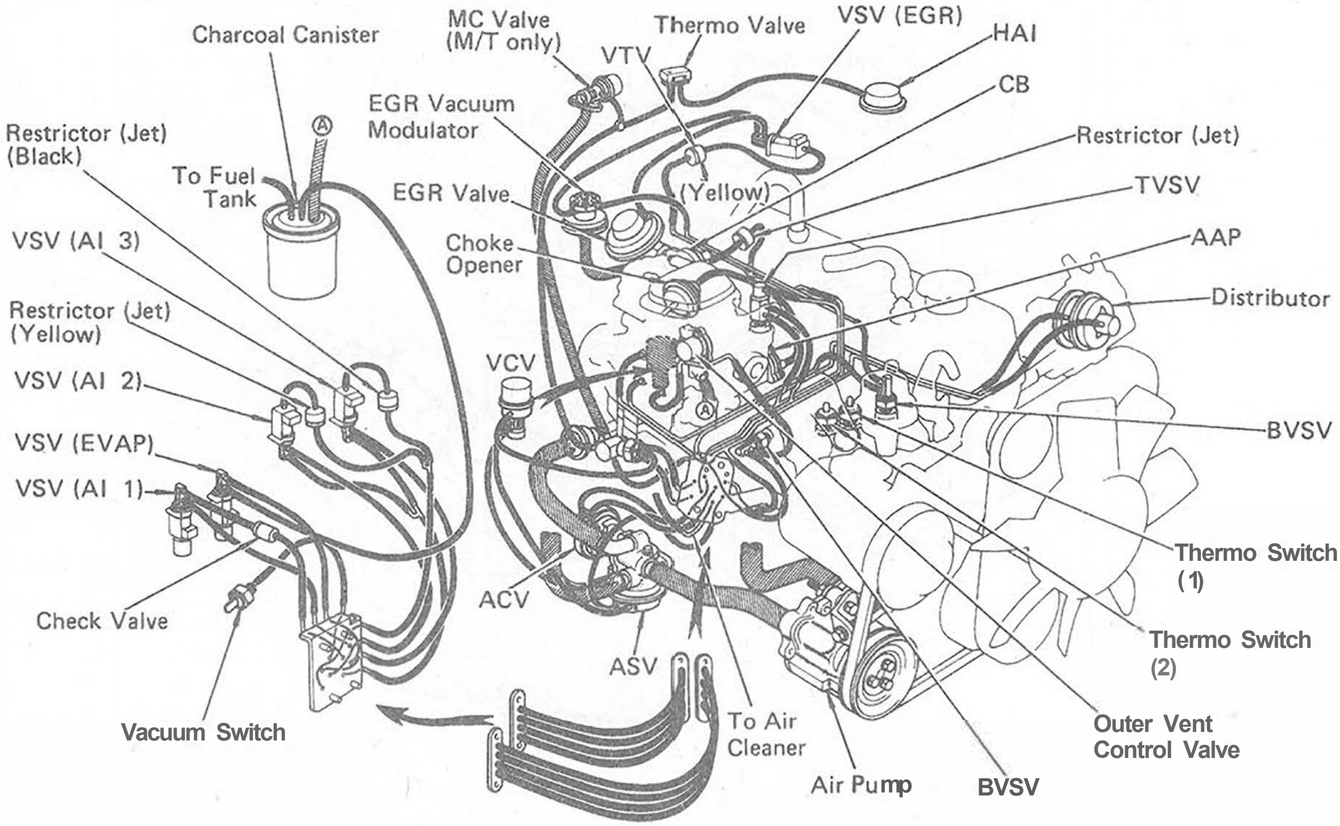
Pay close attention to any special precautions outiined in this Chapter (particularly those concerning the catalytic converter). It should be noted that the illustrations of the various systems may not exactly match the systems installed in your particular vehicle, due to changes made by the manufacturer during production or from year to year.



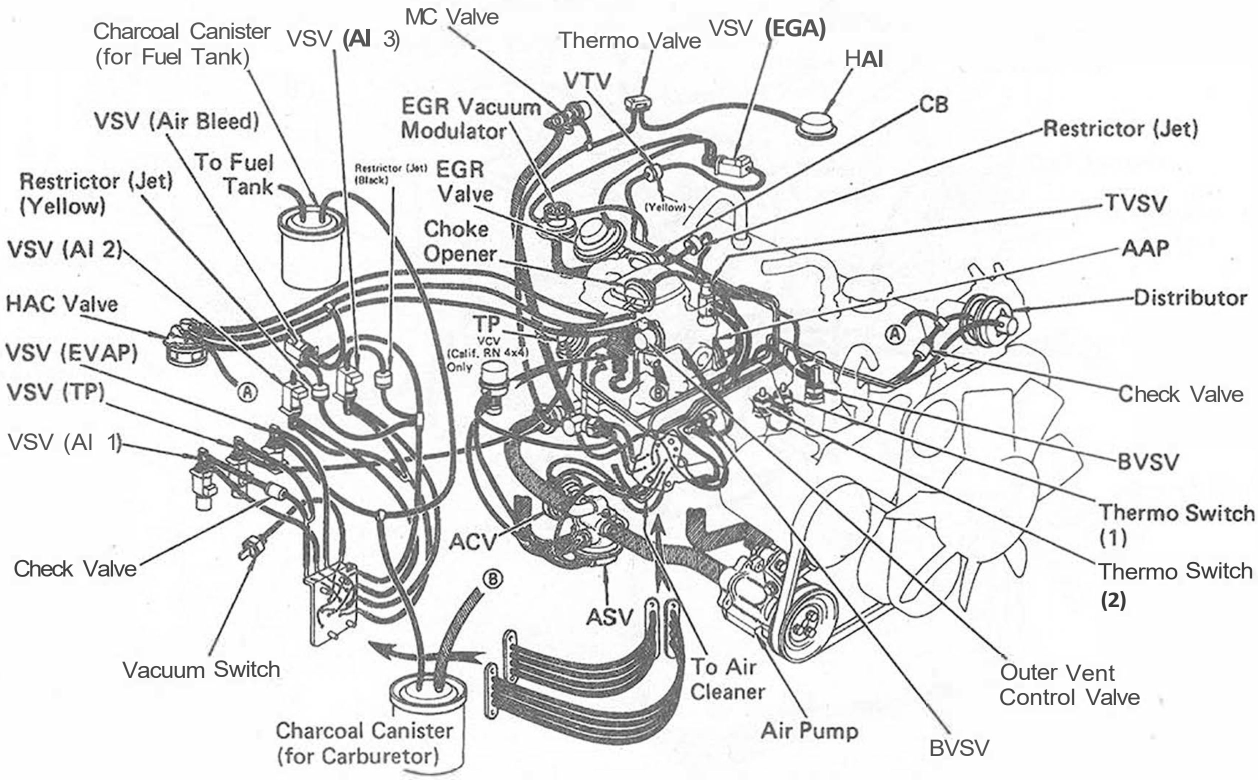
Emissions control system layout - Federal and Canada 2WD with manual transmission (1981)



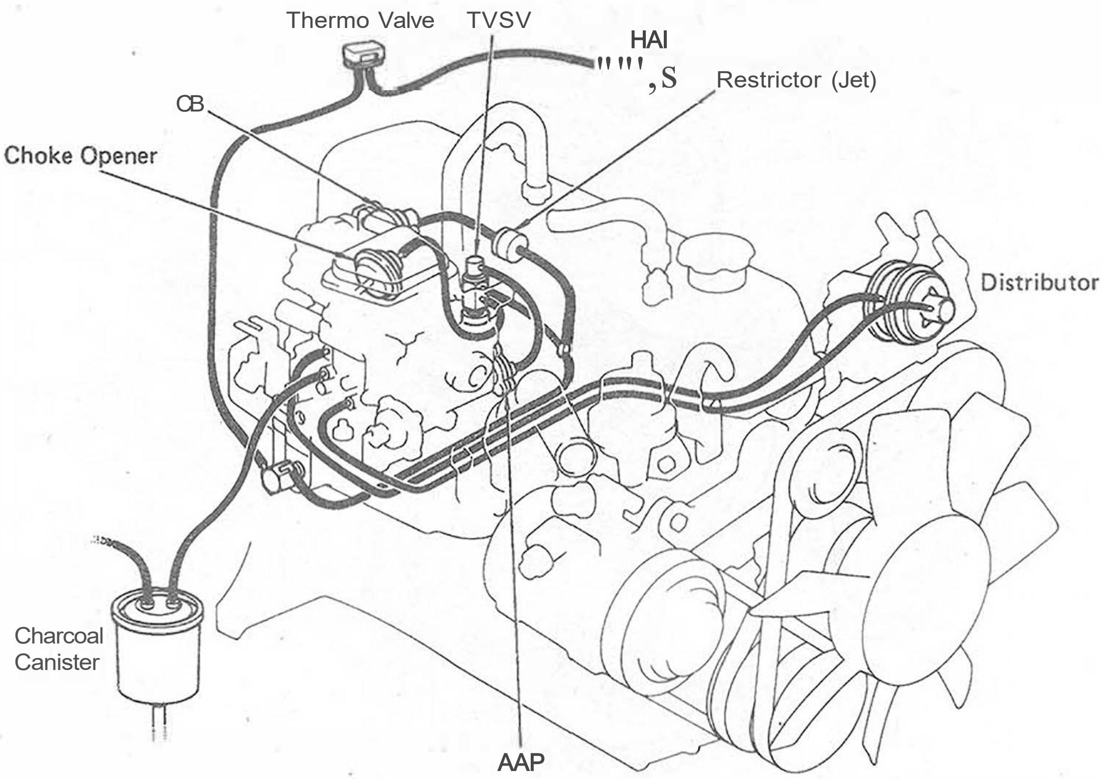
Emissions control system layout- Federal and Canada 2WD with automatic transmission (1981)



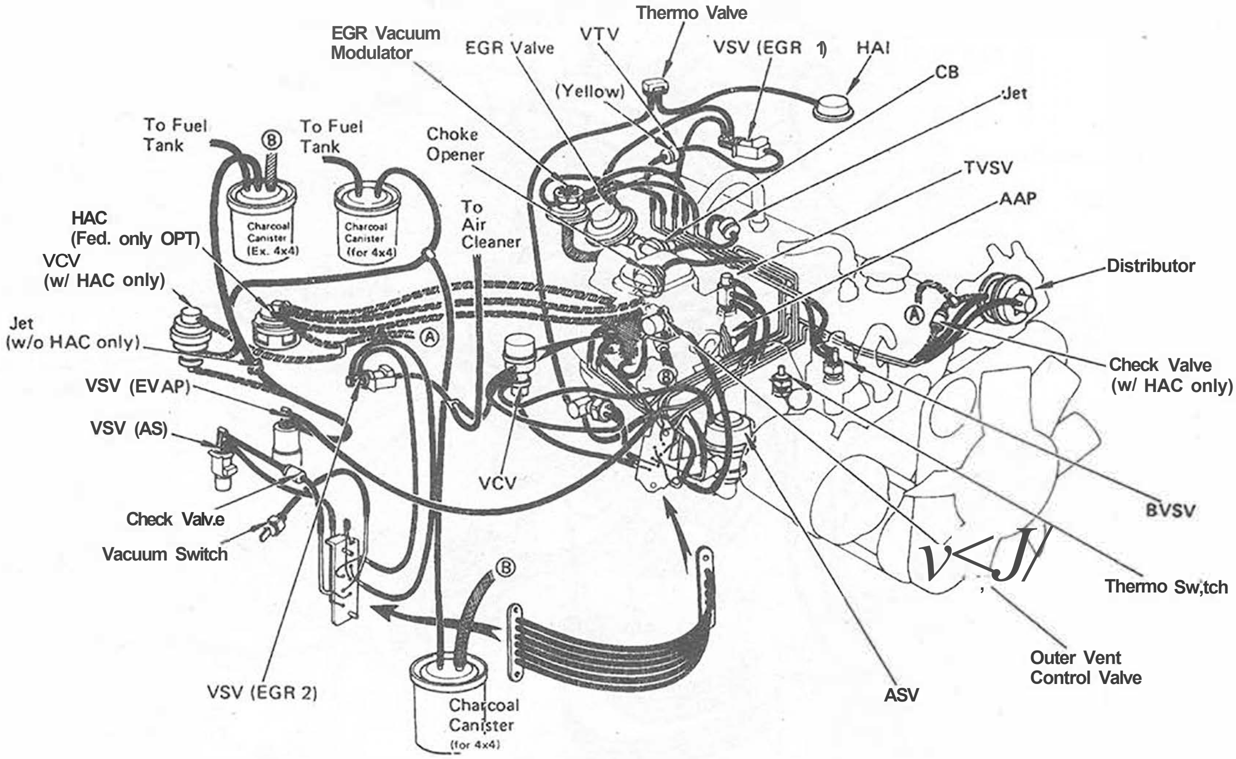
Emissions control system layout- California 2WD (1981)



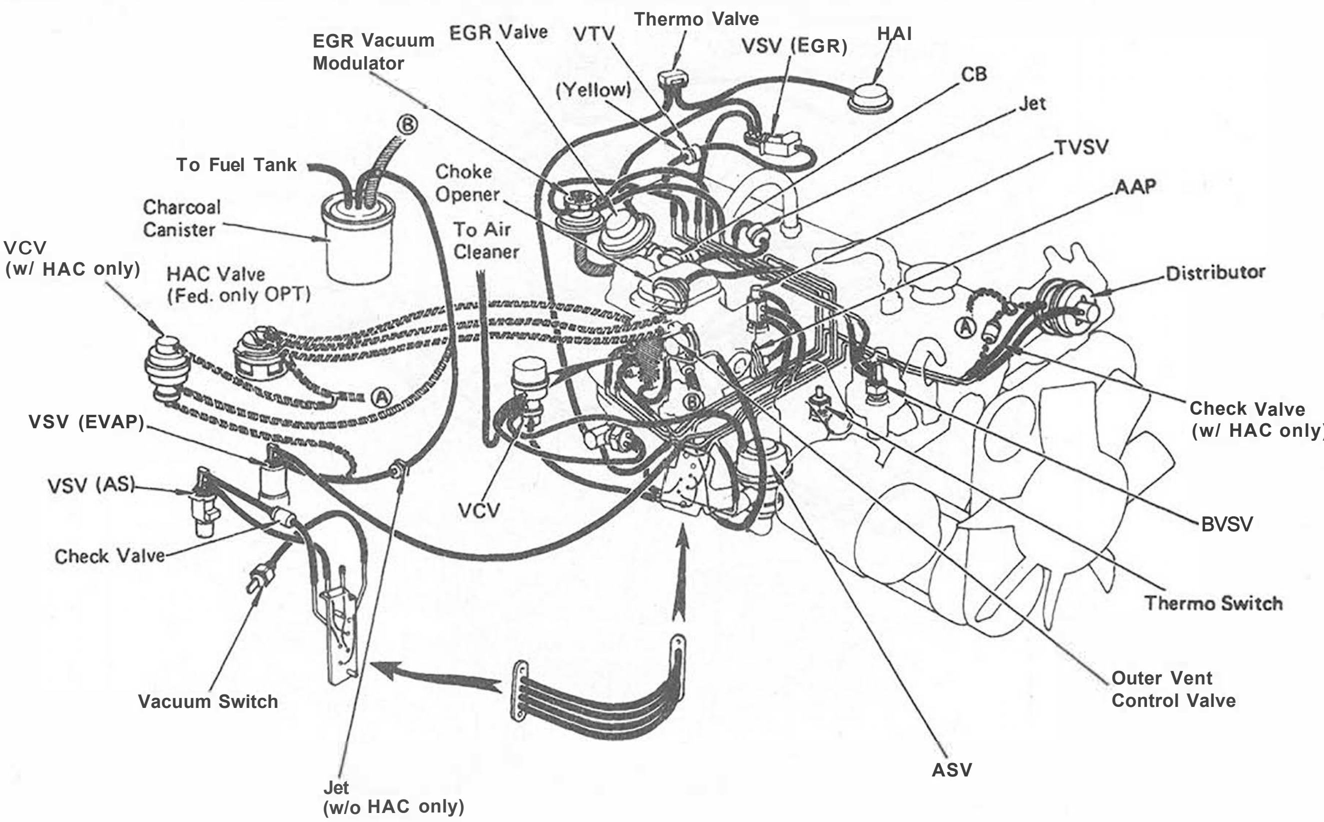
Emissions control system layout - California 4WD (1981)



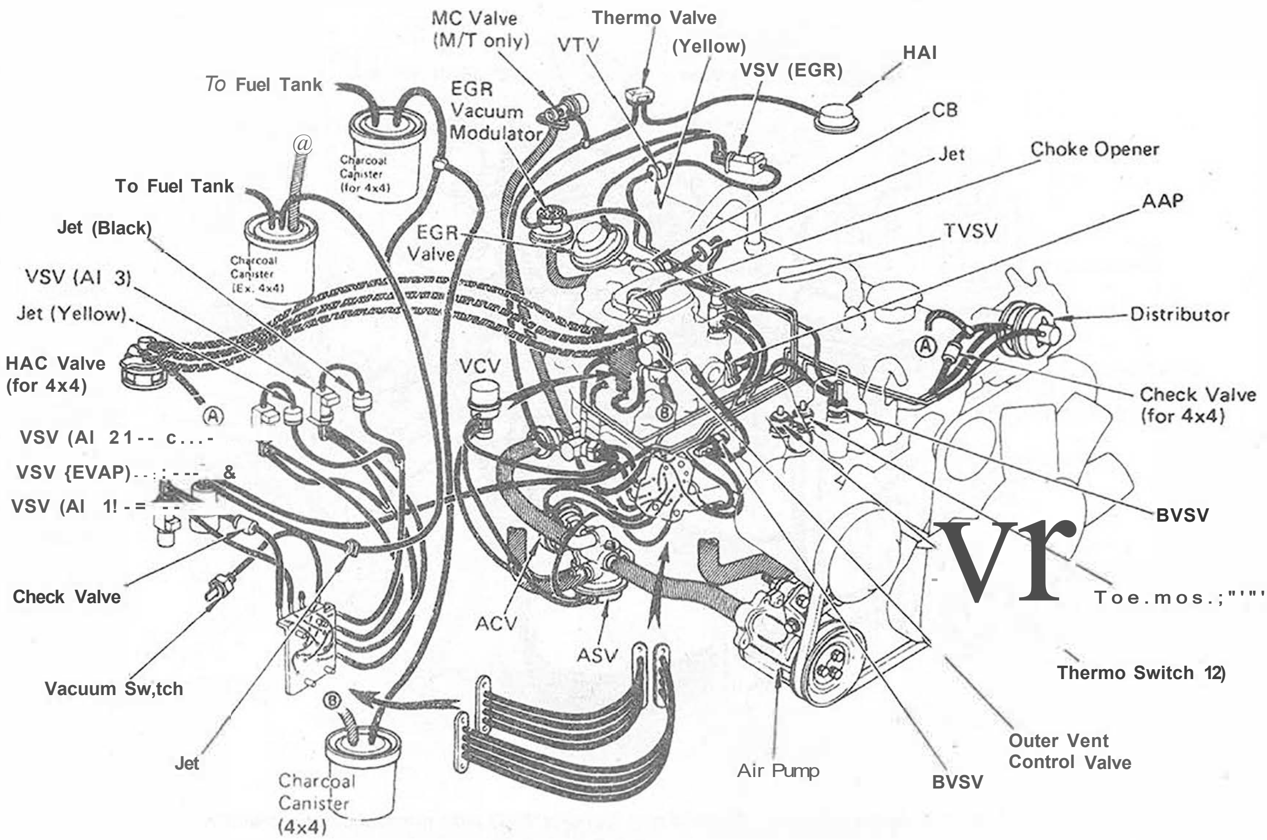
Emissions control system layout - Canada 4WD (1981)



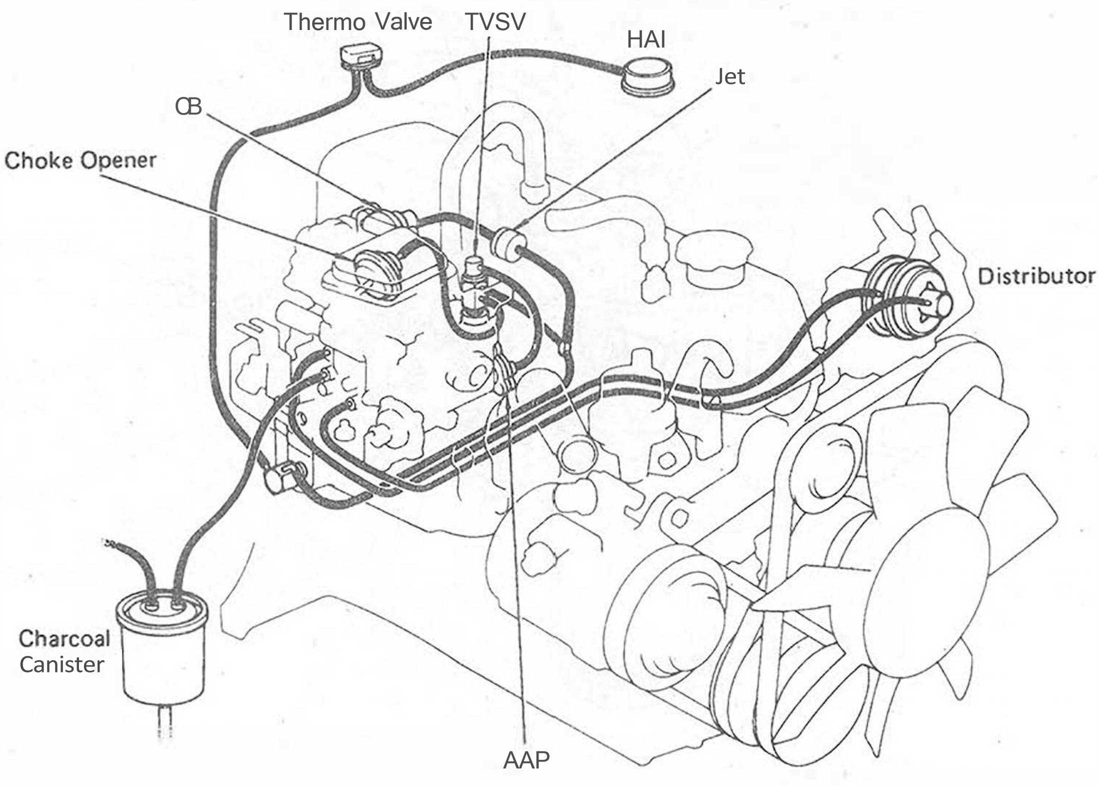
Emissions control system layout - Federal and Canada 2WD with manual transmission (1982)



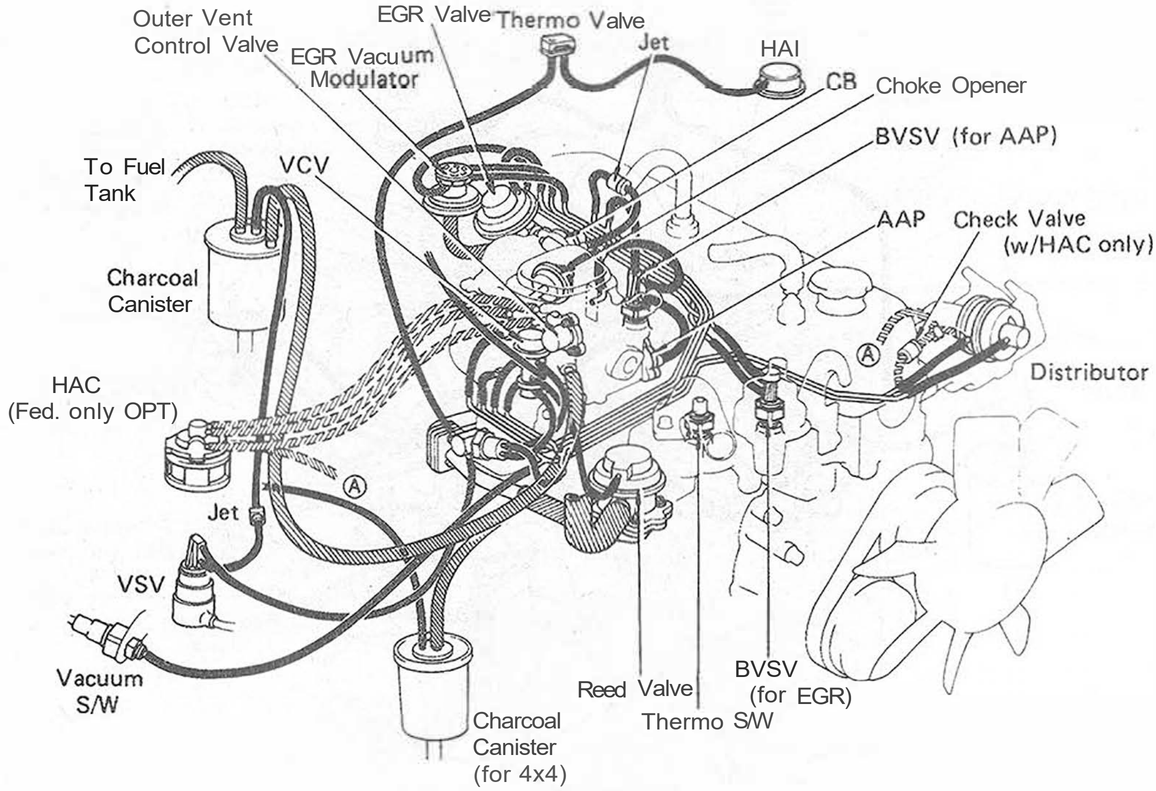
Emissions control system layout - Federal and Canada 2WD with automatic transmission (1982)



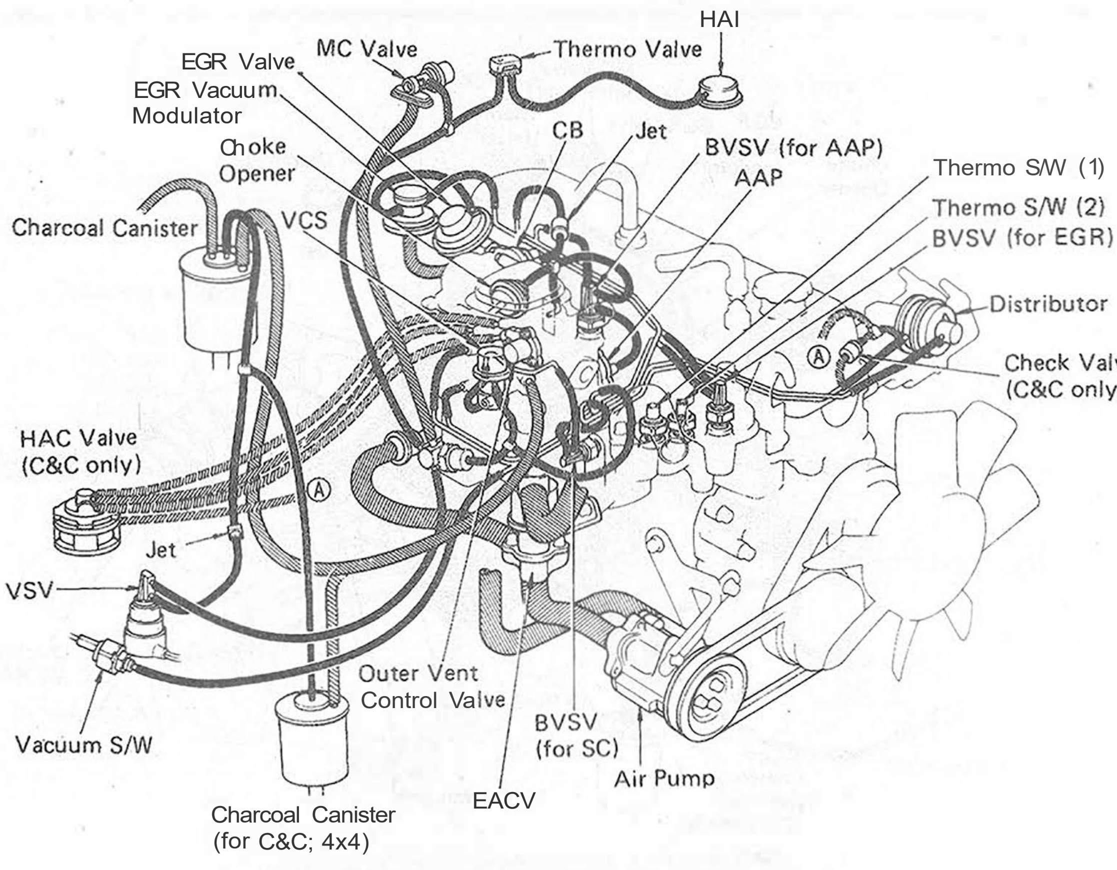
Emissions control system layout - California (1982)



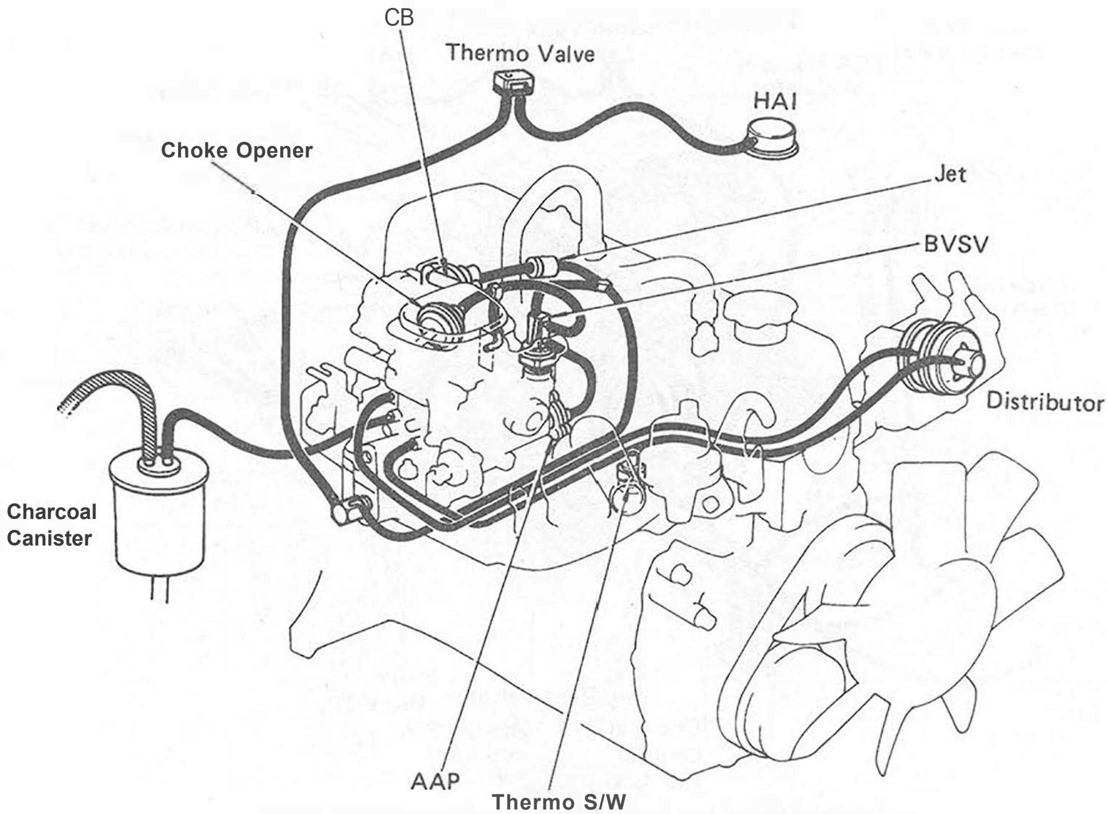
Emissions control system layout - Canada 4WD (1982)



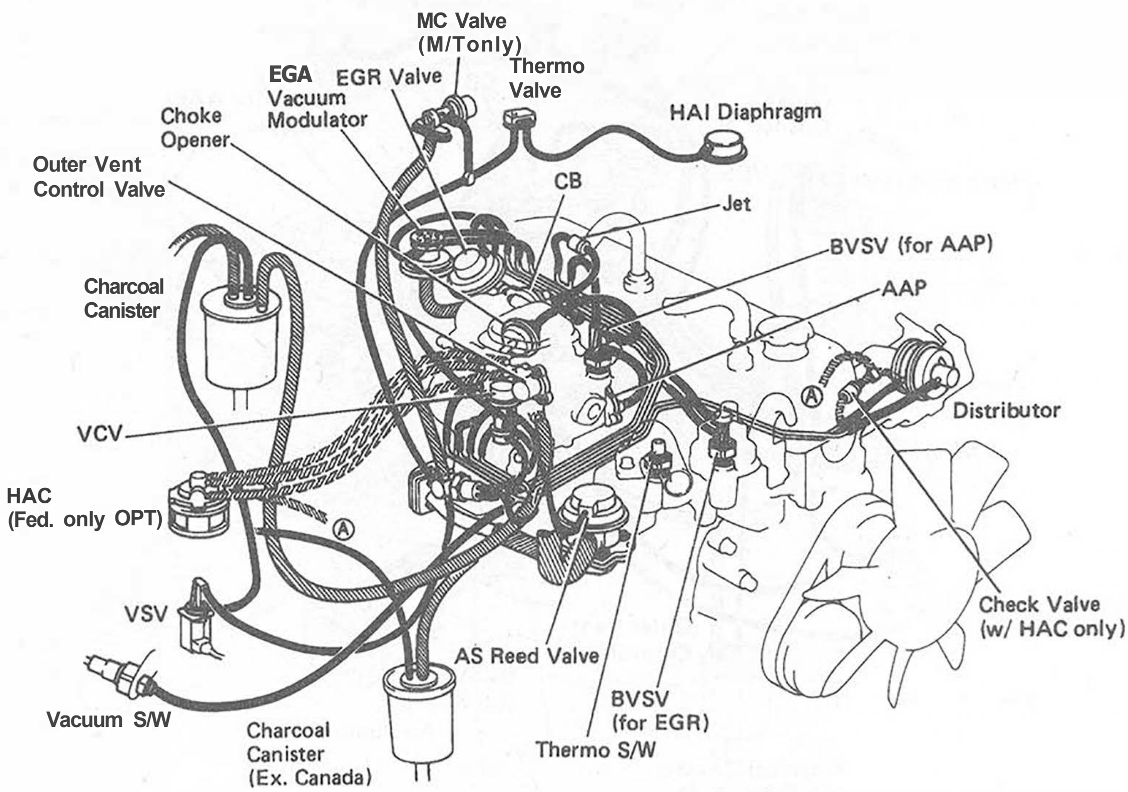
Emissions control system layout - Federal and Canada **2WD (1983)**



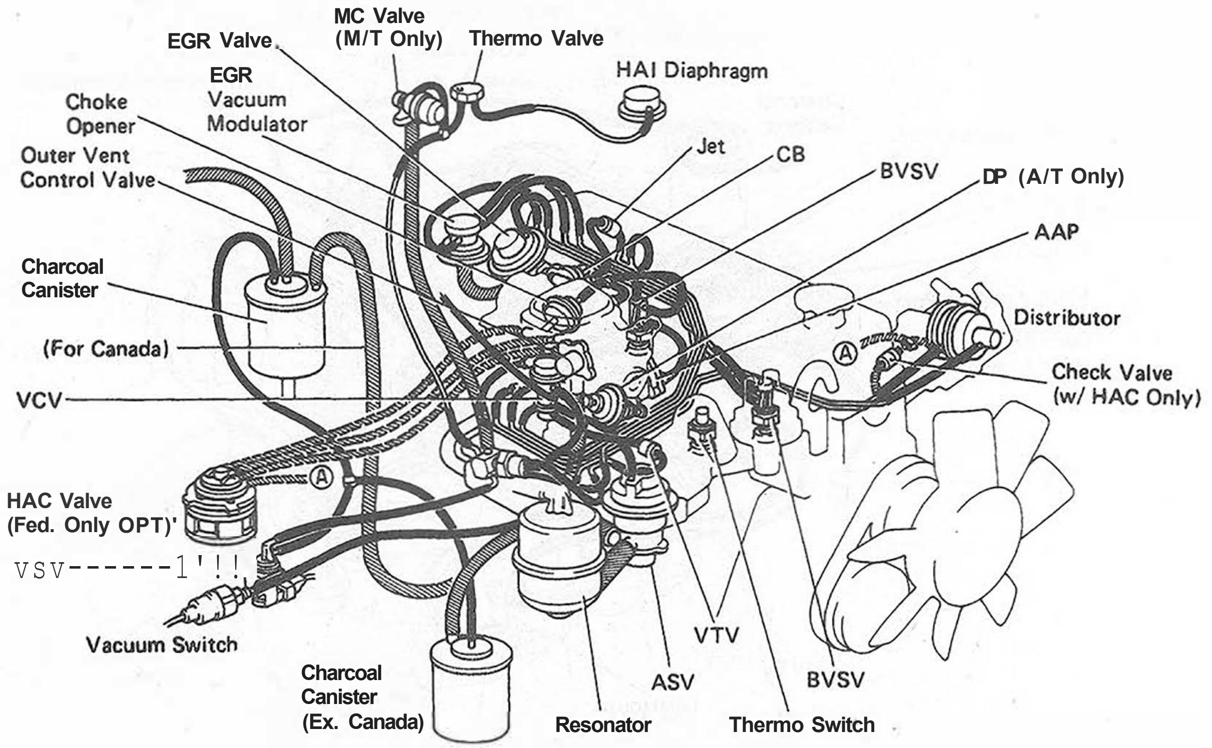
Emissions control system layout - California (1983)



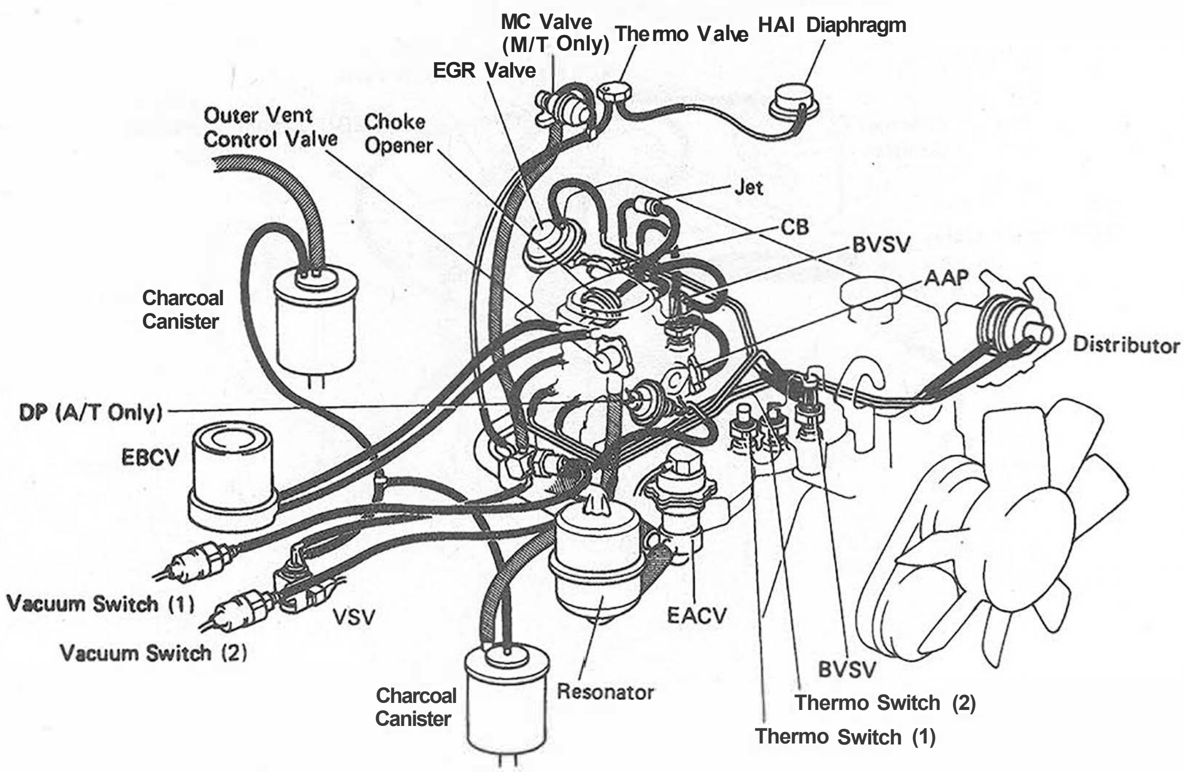
Emissions control system layout - Canada 4WD (1983)



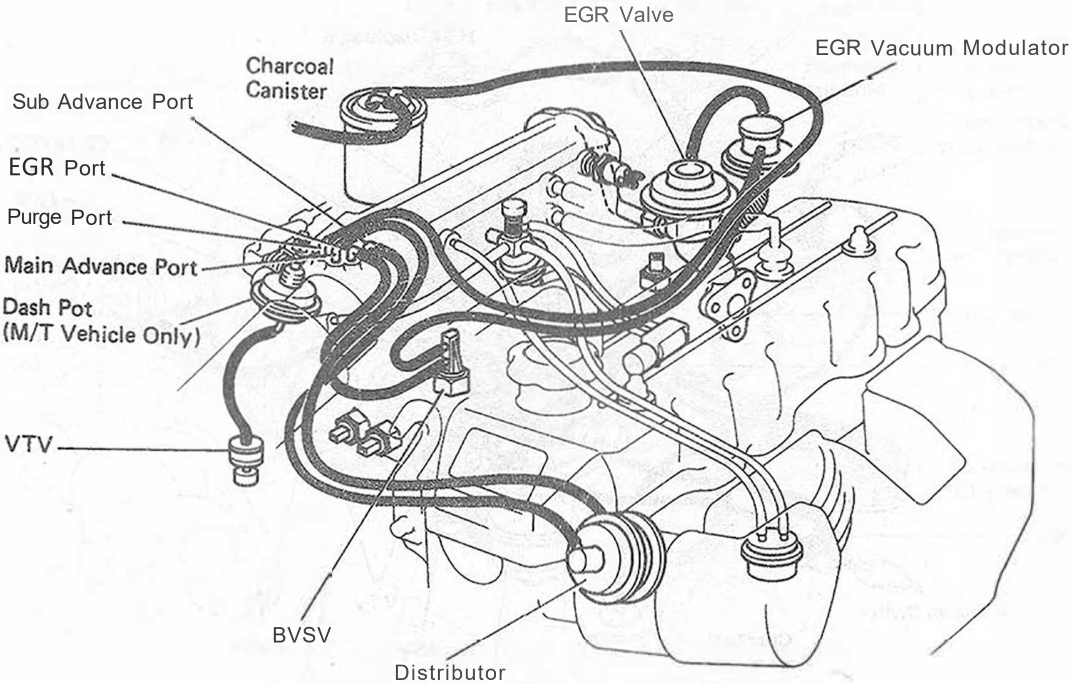
Emissions control system layout - Federal and Canada (1984)



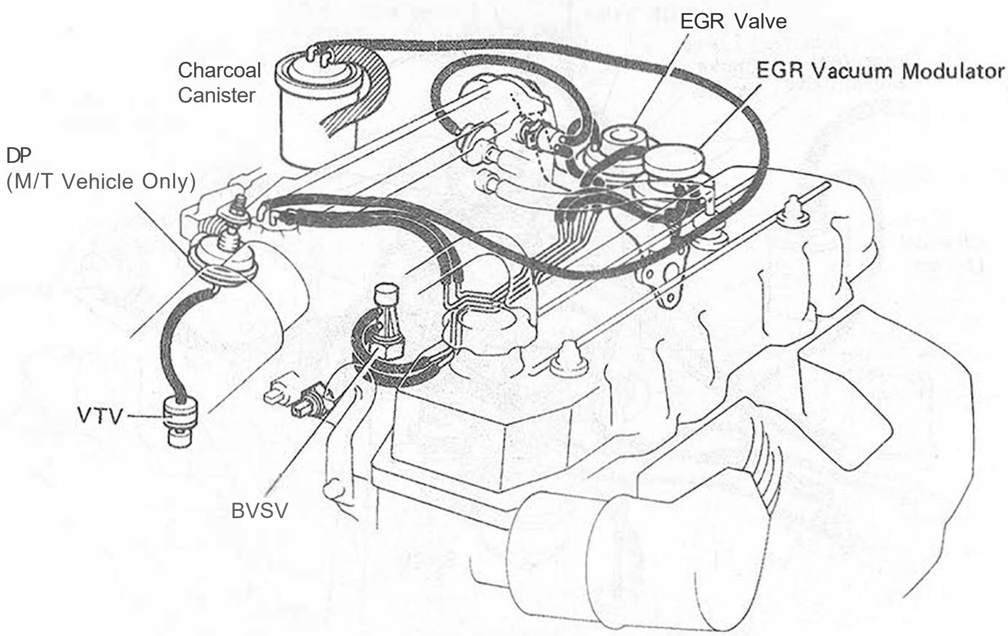
Emissions control system layout - Federal and Canada (1985)



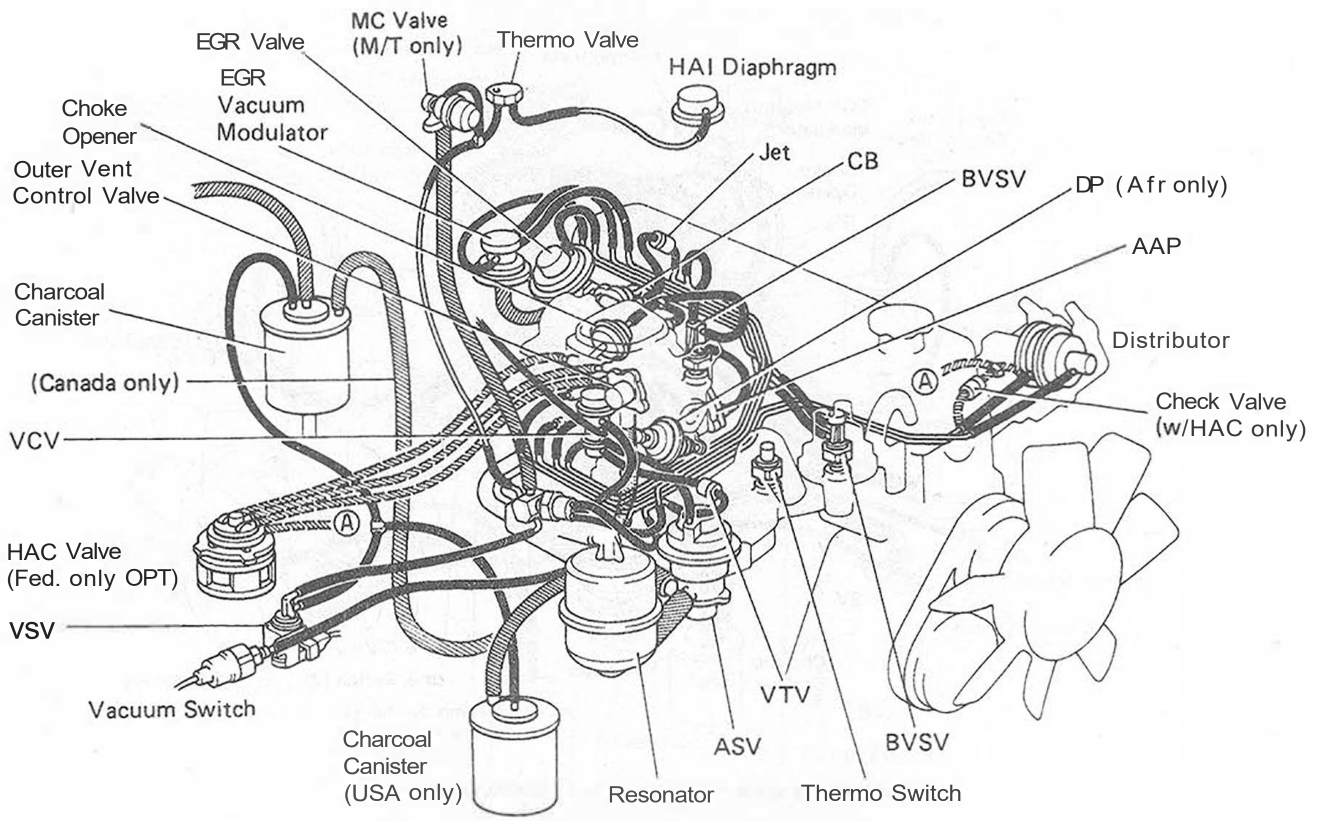
Emissions control system layout- California (1985)



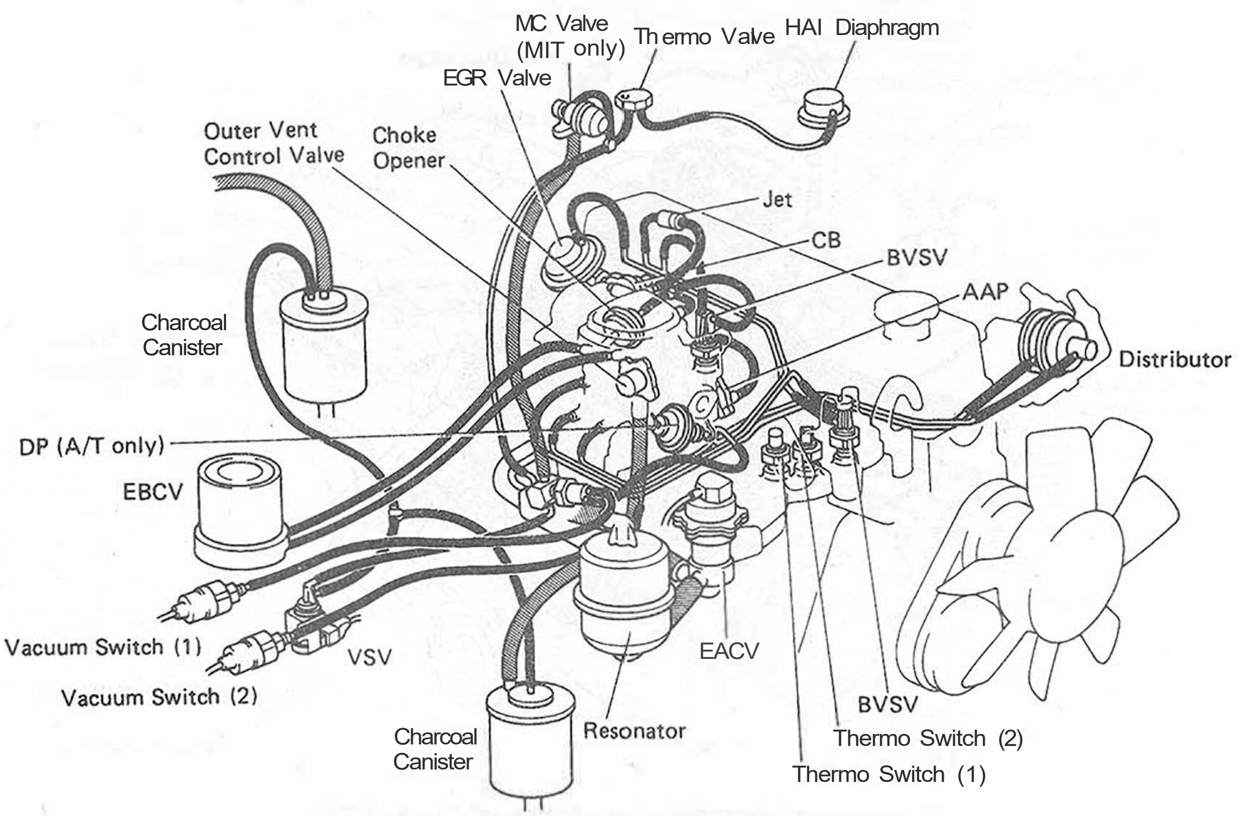
Emissions control system layout - EFI models (1984)



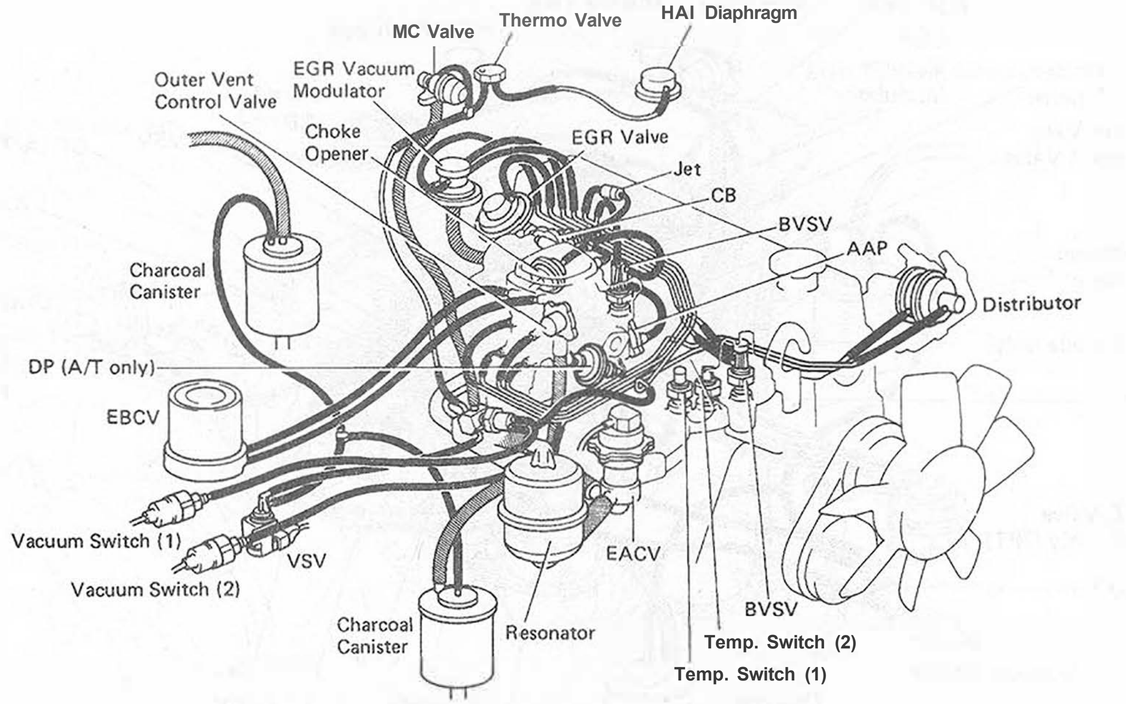
Emissions control system layout - EFI models (1985)



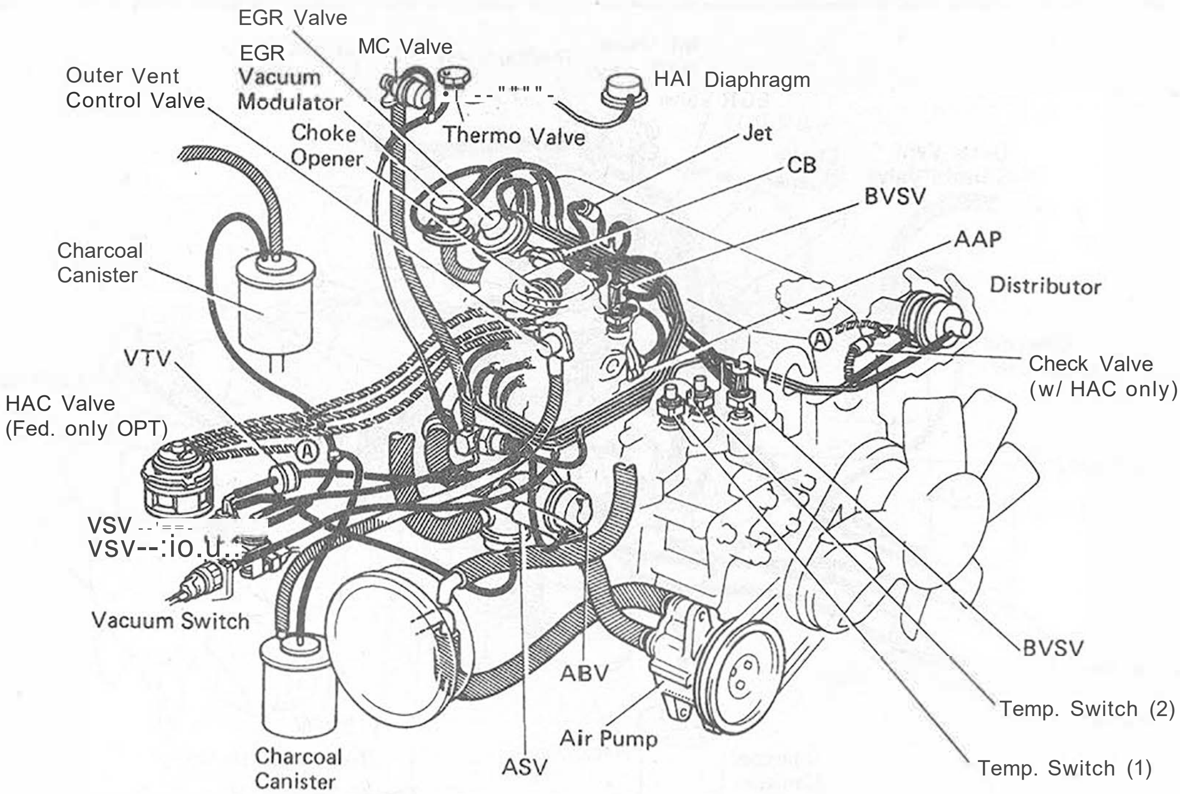
Emissions control system layout - Federal and Canada (1986 and 1987)



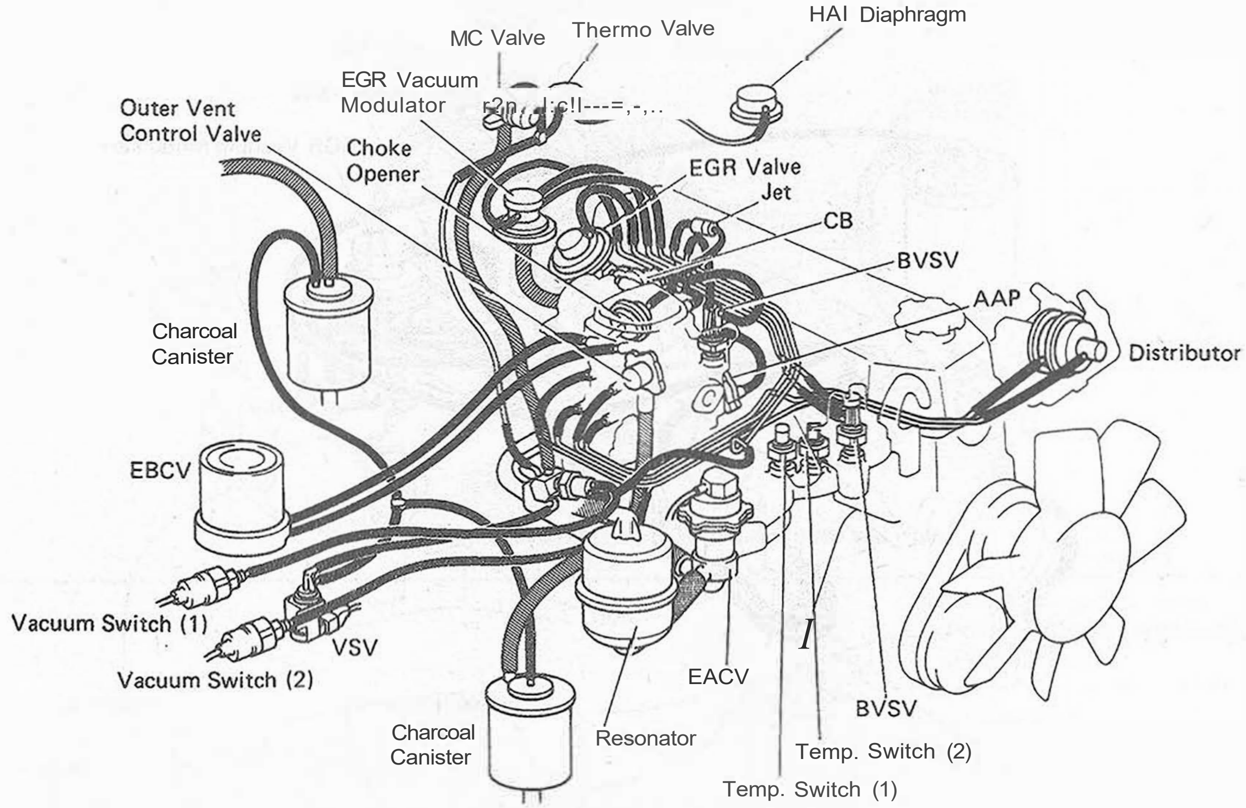
Emissions control system layout - California (1986)



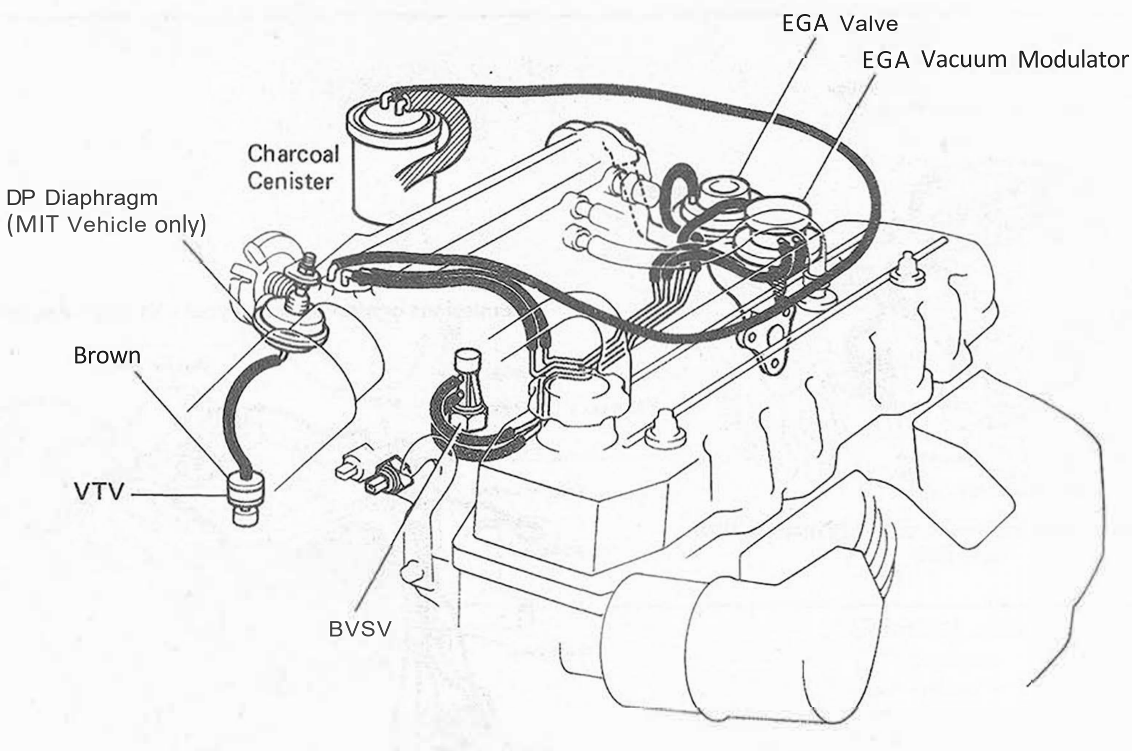
Emissions control system layout - California (1987)



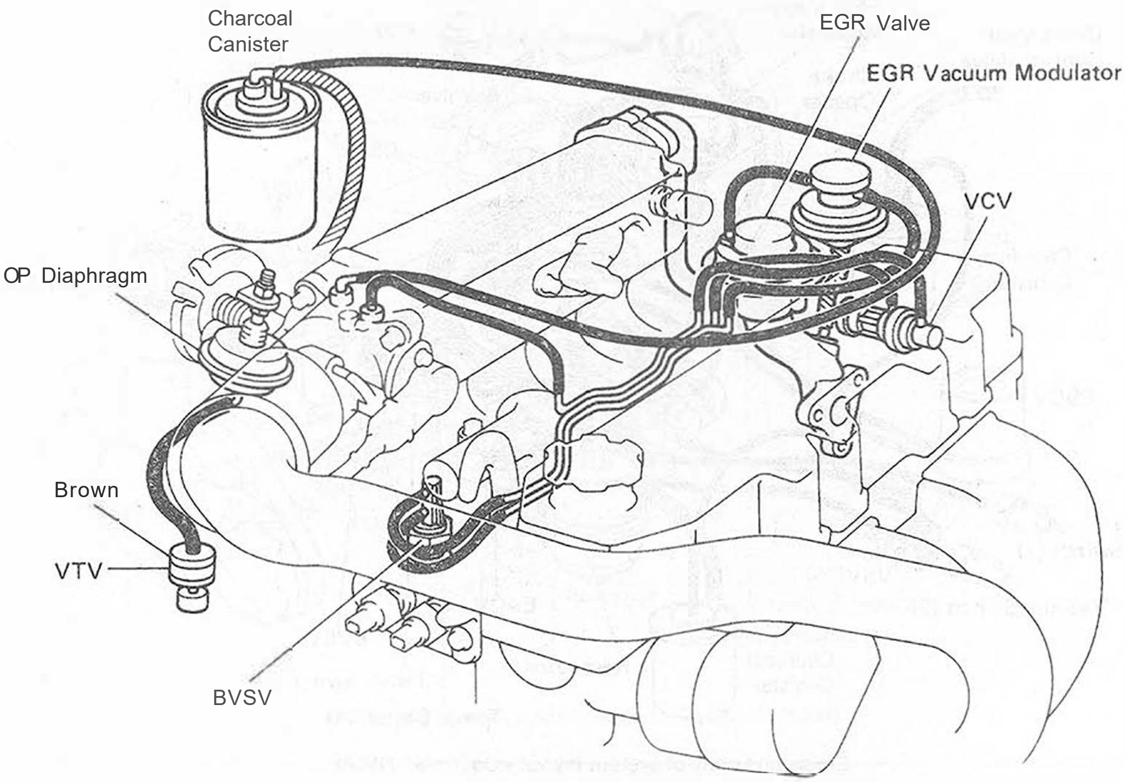
Emissions control system layout - Federal and Canada (1988)



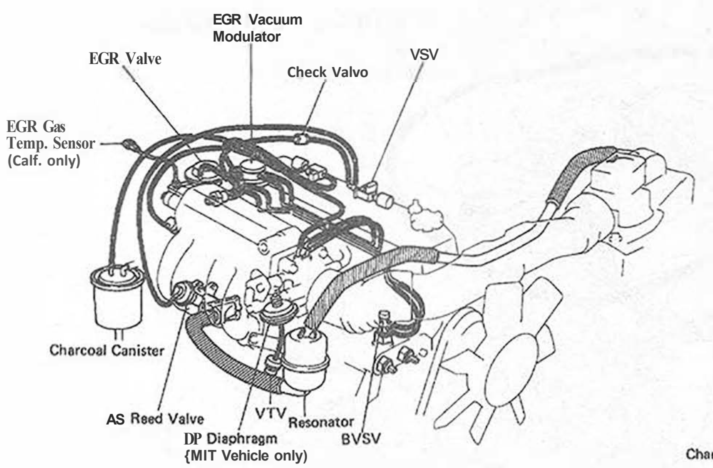
Emissions control system layout - California (1988)



Emissions control system layout - EFI models (1986 and 1987)

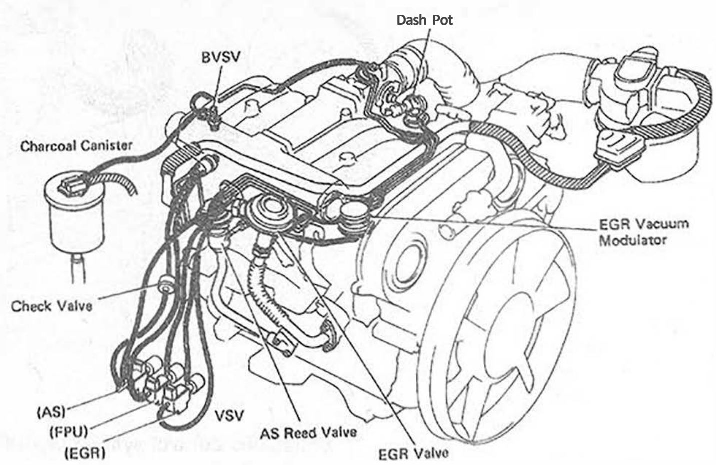


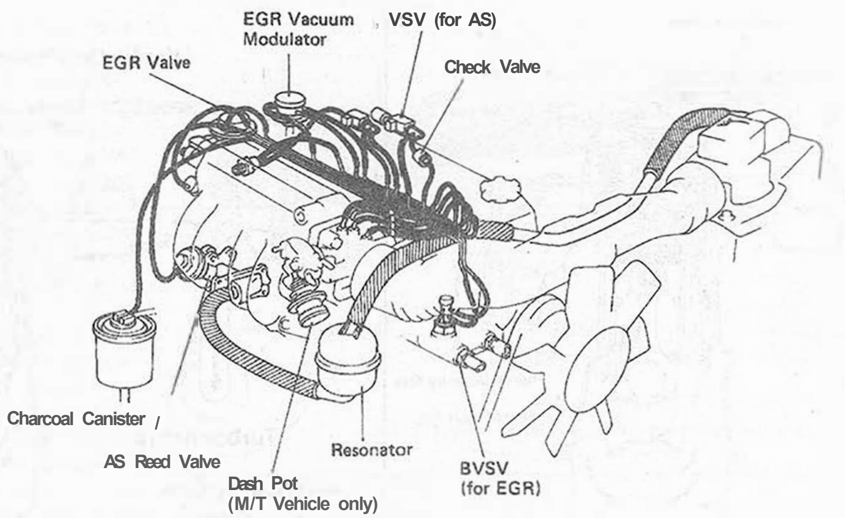
Emissions control system layout - Turbo EFI models (1986 thru 1988)



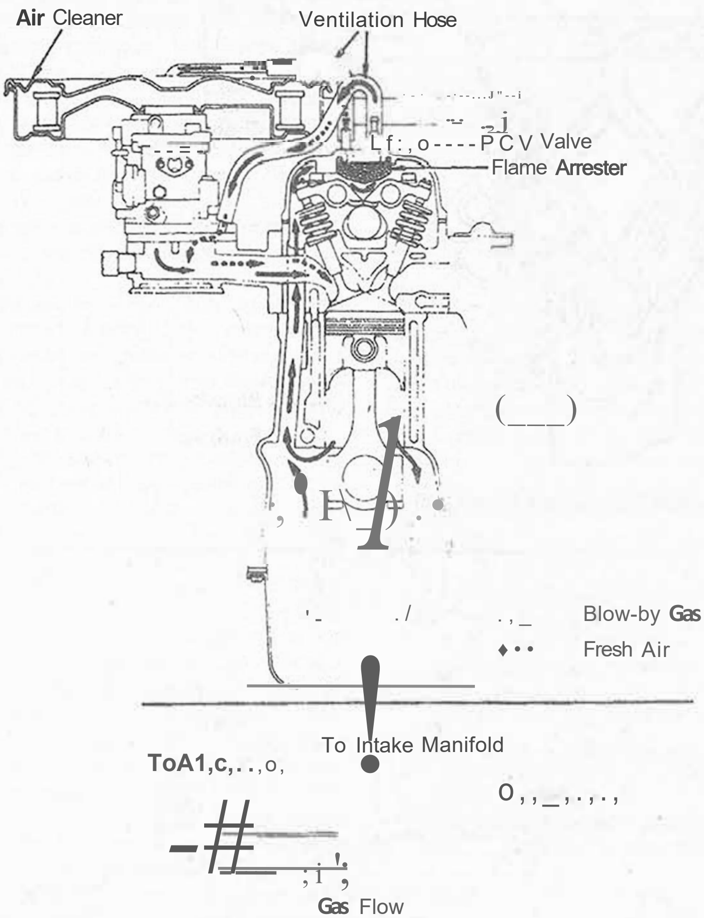
Emissions control system layout- EFI models 1988 and 1989

Emissions control system layout- V6 (1988 and later)





Emissions control system layout - EFI models 1990 and later



2.1a Typical **PCV** system layout (carburetor)

2 Positive Crankcase Ventilation (PCV) system

Refer to illustrations 2.1a, 2.1b, 2.1c and 2.1d

General description

1 This system is designed to reduce hydrocarbon emission (HC) by routing blow-by gases (fuel/air mixture that escapes from the combustion chamber past the piston rings into the crankcase) from the crankcase to the intake manifold and combustion chamber, where they are burned during engine operation. It is included on all year and engine models **(see illustration).**

2 The system is very simple and consists of rubber hoses and a small replaceable metering valve (PCV valve).

Checking and component replacement

3 Checking, cleaning and replacement of the PCV system components is a routine maintenance procedure. Refer to Chapter 1 for details.

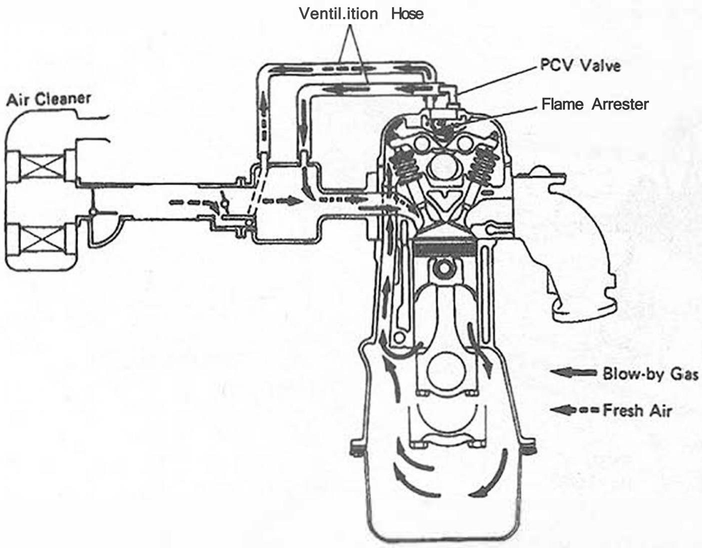
3 Fuel Evaporative Emission Control (EVAP) system

Refer to illustrations 3.3, 3.4, 3.5, 3.17, 3.19 and 3.24

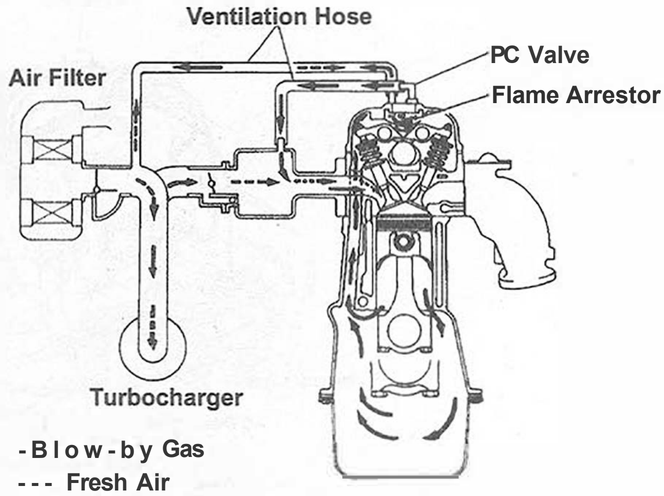
General description

1 This system is designed to trap and store fuel that evaporates from the fuel tank and carburetor float chambers which would normally enter the atmosphere and contribute to hydrocarbon (HC) emissions. EVAP systems are incorporated on all engine and year models.

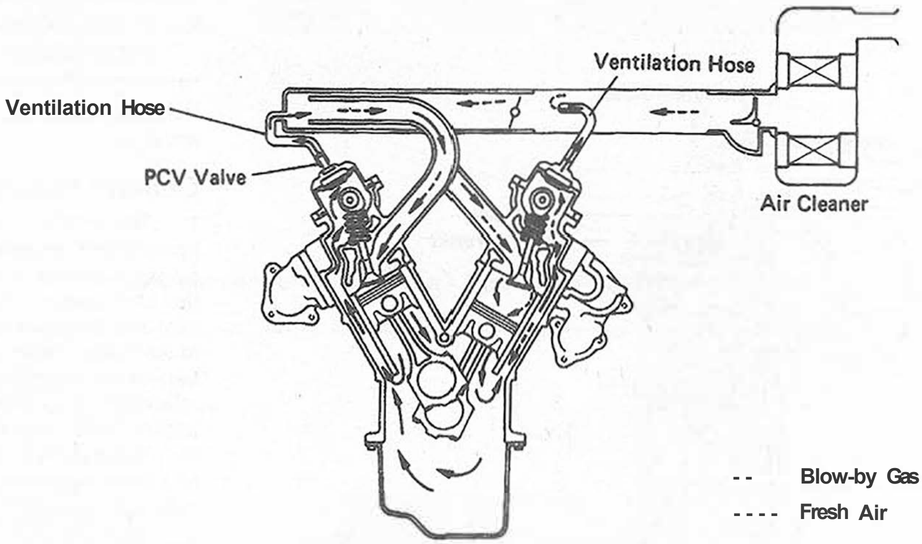
2 The system on a carbureted vehicle



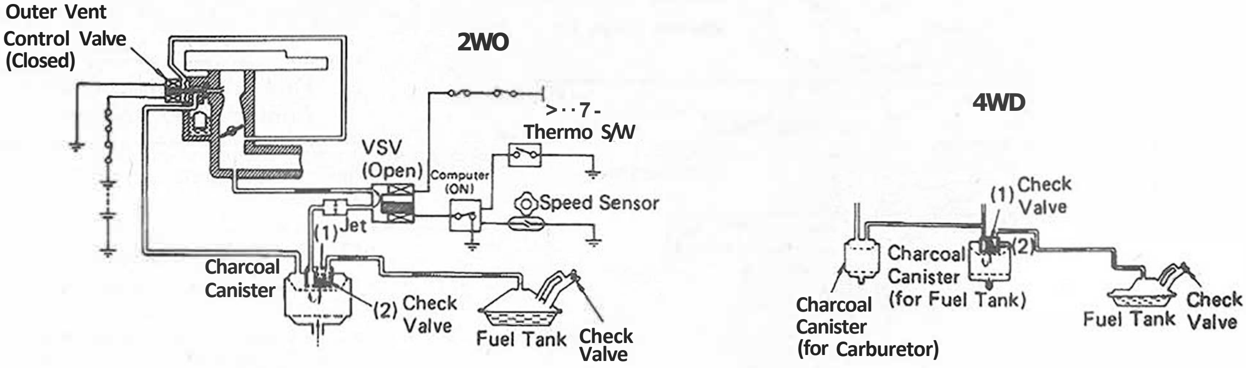
2.1 b Typical PCV system layout (EFI)



2.1c Typical PCV system layout (Turbo EFI)



2.1 d Typical PCV system layout (V6)

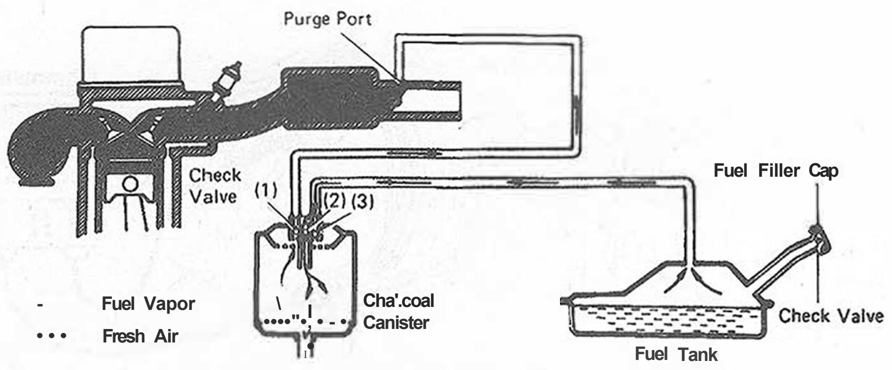


3.3 A typical EVAP system on a carbureted vehicle consists of an outer vent control valve, charcoal-filled canister(s), thermo switch, speed sensor, TVSV, VSV, jet check valves, VCV and connecting lines and hoses, although not all components are incorporated on all systems. On EFI equipped vehicles, the EVAP system is considerably simpler. It has a charcoal canister with an integral check valve and the connecting hoses between the canister, fuel tank and intake manifold. V6 vehicles also have a bimetal vacuum switching valve (BVSV).

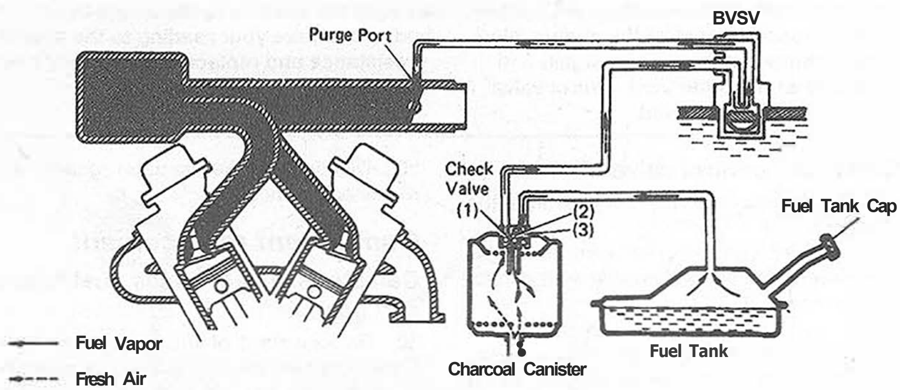
3 When the engine is off and high pressure begins to build in the fuel tank and carburetor float chambers, fuel vapors are absorbed by the charcoal in the canister(s) **(see illustration).** When the engine is started (cold), the charcoal continues to absorb and store fuel vapor. As the engine coolant warms up, the stored fuel vapors are routed to the intake manifold and combustion chamber where they are burned during normal engine operation. The VSV and outer vent control valve direct the fuel vapors to the appropriate place. The VSV is activated by the coolant temperature and/or the speed sensor, via a microcomputer, while the outer vent control valve is activated by intake manifold pressure changes. The check valve mounted in the fuel tank filler cap is calibrated to open when the tank vacuum reaches a certain level, allowing outside air to enter the tank and relieve the high vacuum. The check valve in the charcoal canister operates in a similar manner.

4 On a vehicle with EFI **(see illustration),** the EVAP system is considerably less complex:

a) *At idle and low speed, fuel vapors from the tank are absorbed by the canister. A check valve integrated into the top of the canister closes, preventing these vapors from being drawn out of the canister and into the intake chamber.*
b) *Duri ng medium and high speed driving, this check valve opens, allowing the high manifold vacuum of the intake to draw the fuel vapors from the canister into the intake chamber.*
c) *When there* **is** *high pressure in the tank (the vehicle* **is** *parked, with the engine off, for example), the check valve that regulates the line between the fuel tank and the canister opens, allowing the canister to absorb fuel vapors from the tank. A third check valve prevents these vapors from escaping the canister and flowing back to the tank. A fourth check valve, located in the fuel filler cap, closes to prevent the pressurized vapors from escaping into the atmosphere.*
d) *When there is high vacuum in the tank, these check valves in the canister reverse themselves: The first one closes and the other one opens, preventing fuel vapors from being drawn out of the canister by the vacuum in the tank. And the check valve in the fuel filler cap opens to allow air into the tank to relieve the vacuum.*



3.4 **A** typical **EVAP** system on an EFI-equipped vehicle



3.5 The EVAP system on a vehicle with a V6

5 On V6-equipped models **(see illustration),** the EVAP system is similar to the one described above for EFI-equipped fours. The fuel vapors are still routed either from the tank into the canister or from the canister into the air intake chamber through the same three check valves integrated into the top of the canister, but vapor flow into the intake chamber is also controlled by a bimetal vacuum switching valve (BVSV), which in turn is opened and closed by coolant temperature:

a) *When the BVSV is closed (the coolant temperature is below 95-degrees F), or when it's open (coolant exceeds 129-degrees F) but the upper edge of the throttle valve is positioned downstream from the purge port in the roof of the intake, fuel vapors from the tank are absorbed by the canister.*
b) *When the BVSV is open and the throttle valve* **is** *positioned above the purge port, fuel vapors from the canister are drawn into the intake chamber.*

Check

Canister

6 Label the lines and their respective canister pipes before detaching them. The following test requires that you be able to identify the tank and purge pipes.

7 Remove the charcoal canister(s) (some models have one canister, some have two).

8 Inspect the canister(s) for cracks or damage.

9 To check the canister(s) for a clogged filter, blow into the fuel tank pipe with low pressure compressed air and verify that the air flows out the other pipes without resistance.

10 Blow into the purge pipe and verify that air flows without resistance from the other pipes.

11 If the canister fails either of the above tests, replace it.

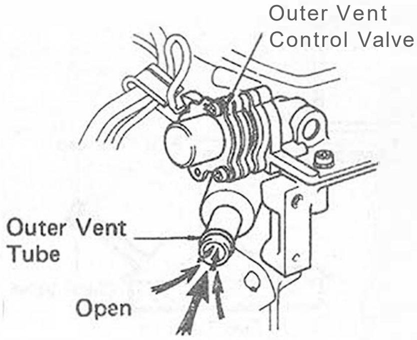
12 To clean the filter, blow low pressure compressed air into each pipe while closing off the other canister pipes. No activated charcoal should come out. If it does, replace the canister. **Caution:** *Do not attempt to wash the canister.*

Fuel filler cap and check valves

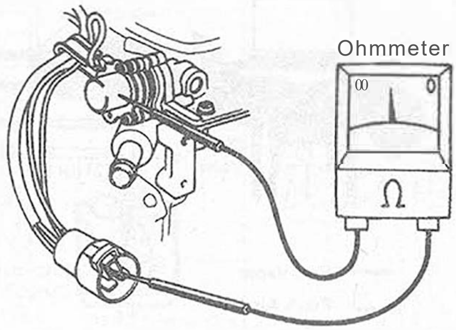
13 Checking the canister and lines is a routine maintenance procedure. Refer to Chapter 1 for details.

14 To check the filler cap and check valve, remove the cap and detach the retainer (it is held in place with screws). The retainer is not removable on newer caps.

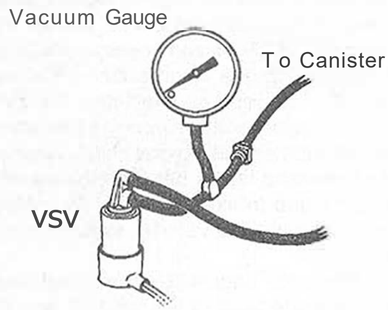
15 Look for a damaged or deformed gasket and make sure that the check valve is not stuck open. If the valve or gasket is not in good condition, replace the cap with a new one.



3.17 Detach the outer vent hose from the carburetor, blow air into the outer vent pipe and verify that the outer vent control valve is open - then start the engine, blow air into the outer vent pipe again and verify that the outer vent control valve is closed



3.19 Unplug the wiring connector to the outer vent control valve and measure the resistance between the positive terminal and the solenoid body - compare your reading to the specified resistance and replace the valve if it's out of specification



3.24 To check the speed sensor-to-VSV circuit, hook up a vacuum gauge to the hose between the VSV and the canister with a T-fitting and, with the engine warmed up and running, verify that the vacuum is zero at low speed (under 7 mph) - then verify that there is manifold vacuum above 16 mph

Outer vent control valve

16 Disconnect the outer vent hose from the carburetor.
17 Blow air into the outer vent pipe **(see illustration)** and see if the outer vent control valve is open.
18 Start the engine and, with the engine idling, blow air into the outer vent pipe again. The outer vent control valve should now be closed.
19 Unplug the wiring connector and, using an ohmmeter, measure the resistance between the positive terminal and the solenoid body (see illustration). Make sure it is within specifications. If a problem is found, replace the outer vent control valve with a new one.

Thermo switch (1)

20 Make sure that the engine is cool (under 109-degrees F [43-degrees C]).
21 Using an ohmmeter, check for continuity between the switch terminal and the switch body.
22 Start the engine and warm it up to operating temperature (over 131-degrees F (55-degrees C)).
23 Make sure there is no continuity. If a problem is found, replace the thermo switch with a new one.

Speed sensor

24 Using a T-fitting, connect a vacuum gauge to the hose between the VSV and canister **(see illustration).**
25 Place the connected vacuum gauge in the driver's compartment.
26 Warm up the engine to operating temperature.
27 Check that the vacuum gauge reads zero at low driving speed (below seven miles per hour).
28 Check that the vacuum gauge indicates intake manifold vacuum at middle and high speed driving (above 16 mph).
29 Disconnect the vacuum gauge and reconnect the hose.

Component replacement

Canister(s}, lines, hoses, fuel filler cap gasket

30 Replacement of the canister(s), lines, hoses and fuel filler cap gasket is straightforward. Be sure to label all hoses and lines to ensure proper reassembly.

Thermo switch

31 Drain sufficient coolant from the radiator (see Chapter 1) to drain the intake manifold, then disconnect the wires from the switch. Unscrew the old switch and replace it with a new one. Be sure to use thread sealant or Teflon tape to seal the threads. Reconnect the wires and refill the radiator.

Speed sensor

32 The speed sensor is an integral part of the speedometer assembly; if the sensor is inoperative, the speedometer must be replaced (see Chapter 12).

VSV, outer vent control valve, jet andVCV

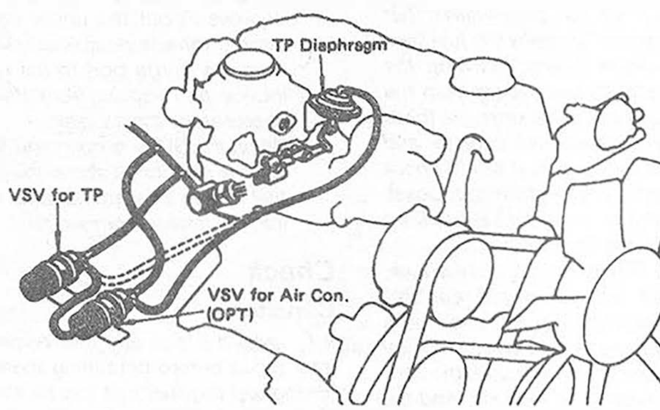
33 Replacement of these components is accomplished by disconnecting the hoses and/or wires from the faulty components and reconnecting them to the new ones. Remove and install one wire or hose at a time to avoid mixing them up.

4 Throttle Positioner (TP) system

Refer to illustrations 4.1a, 4.1b and 4.1c

General description

1 To reduce HC and CO emissions, this system **(see illustrations)** opens the throttle valve slightly more when decelerating than at idle. This causes the air-fuel mixture to burn more completely. This system is used on



4.1 a Throttle Positioner (TP) system layout (1979) some 1979 through 1981 models only.

2 The system consists of a throttle positioner, a VSV and connecting hoses. It operates in conjunction with the vehicle's speed sensor.

3 With the vehicle at speeds above 16 mph (26 km/h), intake manifold vacuum acts on the TP diaphragm and the TP is set. The throttle valve is in the medium or high speed position. Upon deceleration of the vehicle above seven mph (11 km/h), the throttle valve is held in a position that is slightly more open than at idle. Upon deceleration below seven mph (11 km/h), atmospheric pressure acts on the TP diaphragm to release the TP and the throttle valve is returned to the idle position.

Checking

4 If the Throttle Positioner system is suspected of being at fault, have the various components checked by a Toyota service technician or repair facility.

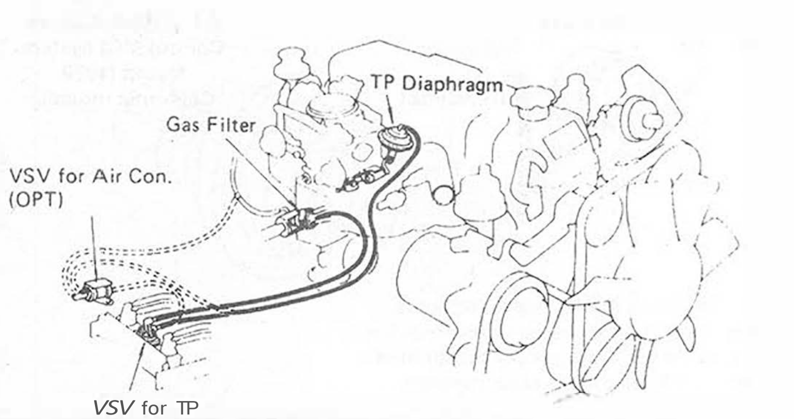
Component replacement

Throttle positioner

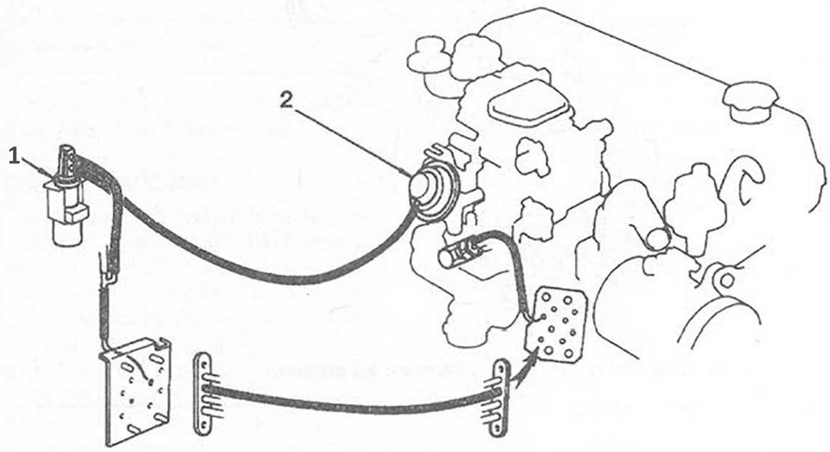
5 Disconnect the hose and remove the mounting screws which hold the faulty TP in place. Install the new TP, tighten the screws and reconnect the hose.

VSV and speed sensor

6 See Section 3.



4.1 b Throttle Positioner (TP) system layout (1980)



4.1c Throttle Positioner (TP) system layout (1981)

5 Mixture Control (MC) system

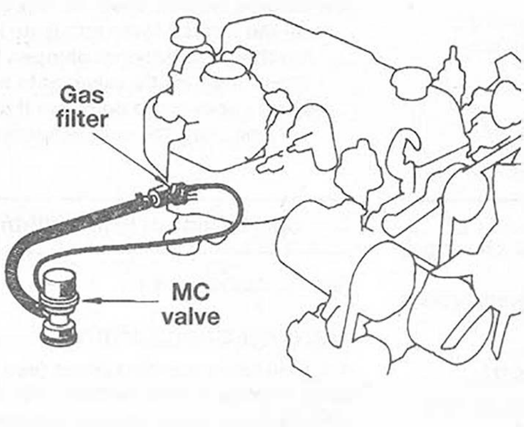
Refer to illustrations 5.2a, 5.2b and 5.6

General description

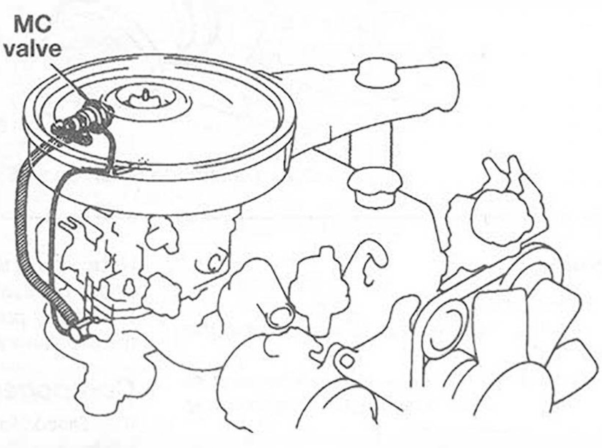
1 To reduce HC and CO emissions, this system allows fresh air to enter the intake manifold on sudden deceleration. MC systems are incorporated on 1980 and later carbureted, manual transmission equipped vehicles.

2 The system consists of a mixture control valve and its connecting hoses **(see illustrations).**

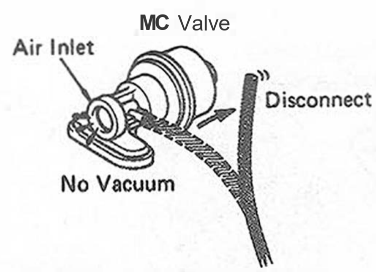
3 At constant rpm, the MC valve is closed and no air flows through it. Upon sudden deceleration, high vacuum acts on chamber 8 of the valve, forcing it open and allowing fresh air to be routed through the valve into the intake manifold. This allows the fuel/air mixture to burn completely. After a few seconds, vacuum in both chambers of the MC valve equalizes through a balancing port and the valve is closed.



5.2a **A** typical Mixture Control **(MC)** system layout (1979 and 1980)

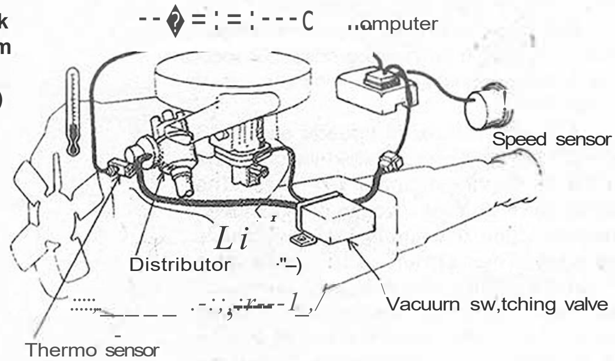


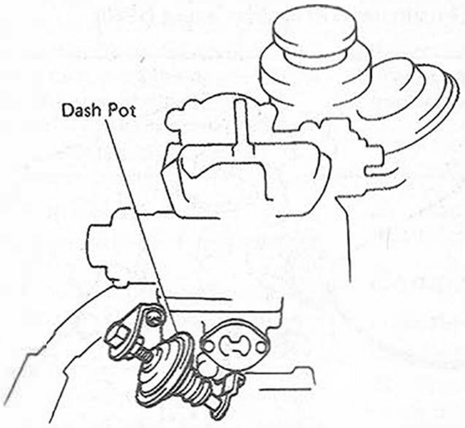
5.2b **A** typical Mixture Control **(MC)** system layout (1981-on)



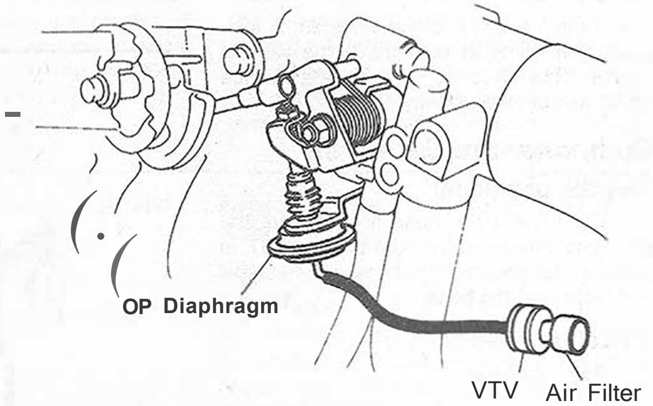
5.6 To check the MC valve, start the **engine, detach the vacuum hose from the valve, place your finger over the air inlet and verify that there is no vacuum**

6.1 A typical Spark Control (SC) system layout (1979 California models)

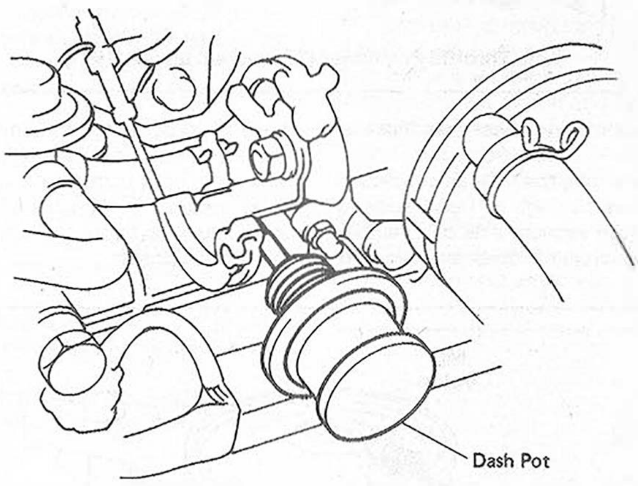




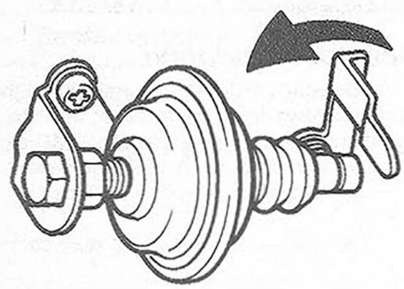
7.1a Dashpot location on a carbureted engine



7.1 b Dashpot location on an EFI-equipped engine



7.1c Dashpot location on a **V6**



7.4a To check the DP setting speed on a carbureted engine, open the throttle valve until the throttle lever arm is no longer touching the dashpot plunger, then release the throttle valve, note the **DP** setting speed and compare it to the specified **DP** setting speed

Checking

4 Start the engine.

5 Disconnect the vacuum hose from the MC valve.

6 Place your fingers over the air inlet of the MC valve and check that no vacuum is felt **(see Illustration).**

7 Reconnect the vacuum hose and check that vacuum is felt momentarily at the outlet.

Note: *At this time, the engine will idle roughly or die, but this is normal.*

8 If any problem is encountered, replace the MC valve with a new one.

Component replacement

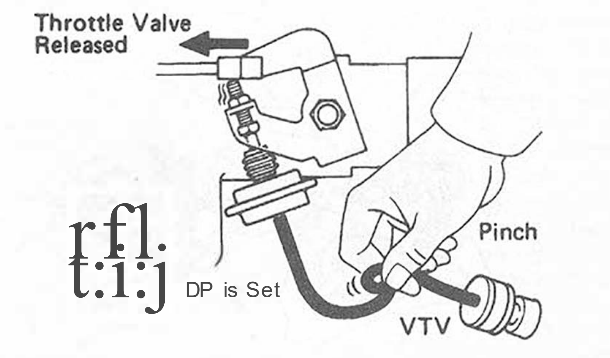
9 Disconnect the attached hoses, replace the faulty MC valve with a new one and reinstall the hoses.

6 Spark Control (SC) system

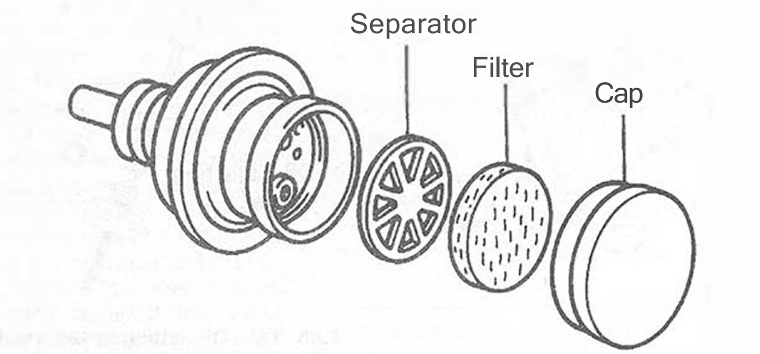
Refer to illustration 6.1

General description

1 The spark control system **(see illustration)** is designed to reduce HC and NOx emissions by advancing the ignition timing only when the engine is cold. SC systems are incorporated on all vehicles in 1979; all vehi-



7.4b To check the **DP** setting speed on a 1985 through 1988 EFI-equipped 4-cyl engine, maintain the engine speed at 2500 rpm, pinch the vacuum hose between the DP and the **VTV,** release the throttle valve, note the DP setting speed and compare it to the specified **DP** setting speed



7.4c To check the DP setting speed on a V6 or a 1989-on EFI-equipped 4-**cyl, remove the cap, filter and separator from the DP** . . .

cles except Canadian 4WD models in 1980; and California vehicles only in 1981 through 1984.

2 The SC system includes a distributor mounted vacuum unit, a BVSV, a TVSV, VTV and various hoses and fittings, although not all components are incorporated on all systems.

3 Depending on the engine coolant temperature, altitude and the position of the throttle, vacuum is applied to either one or both sides of the diaphragms in the distributor vacuum unit and the ignition timing is changed to reduce emissions and improve cold engine driveability.

Check

4 If a fault is suspected in the SC system - usually as the result of poor driveability as the engine warms up - the various components of the SC system should be checked by a Toyota service technician or repair facility.

Component replacement

Vacuum advance unit

5 To replace any distributor parts, see Chapter 5.

BVSV

6 Drain the coolant from the engine block (see Chapter 1), remove the vacuum hoses from the BVSV, then remove the BVSV and replace it with a new one. Installation is the reverse of the removal procedures. **Note:** *Be sure to apply liquid sealer to the threads of the new* BVSV *before installing it.*

TVSV

7 Disconnect the hoses from the faulty unit and remove it with a wrench. Reverse the procedure, installing a new TVSV.

VTV

8 Disconnect the hoses from both ends of the faulty unit and replace it with a new one, then reconnect the hoses. Make sure that you replace the faulty unit with one of the same color coding.

7 Dashpot (DP) system

Refer to illustrations 7. 1a, 7. 1b, 7. 1c, 7.4a, 7.4b, 7.4c, 7.4d, 7.6a, 7.6b and 7.6c

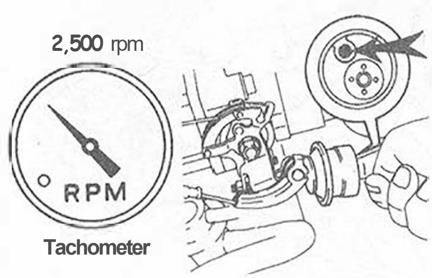
General description

1 The dashpot (DP) system **(see illustrations).** used on 1985 through 1987 vehicles with carbureted engines and an automatic transmission, on 1985 and later EFI-equipped four-cylinder vehicles with a manual transmission and on V6 powered vehicles, reduces HC and CO emissions by opening the throttle valve slightly more during deceleration than at idle. This causes the air-fuel mixture to burn completely.

2 The three DP systems used on various vehicles differ slightly. All three systems utilize a diaphragm and plunger assembly that dampens the closing rate of the throttle valve. The DP system used on EFI equipped vehicles also uses an air filter and vacuum transmitting valve (VTV), which are connected to the dashpot by a vacuum hose. The diaphragm and plunger assembly, VTV and air filter are integrated into a single unit on the V6.

3 All three DP systems share the same operation principles:

a) *When the engine* is *idling and the throttle valve* is *In the idle position, the throttle shaft lever arm pushes against the plunger with sufficient force to overcome the pressure of the diaphragm spring and expel the air from the diaphragm housing, pushing the plunger into the housing.*
b) *During normal driving, the throttle valve* is *open and the throttle shaft lever arm* is *not touching the DP plunger,* so *the plunger* is *extended by the diaphragm spring.*
c) *During deceleration, the throttle shaft lever arm pushes against the plunger, but the expulsion of air behind the diaphragm* is *delayed slightly preventing the plunger from retracting instantly, which slightly delays the throttle valve's return* to its *normal idle position* .



7.4d . . . race the engine at 2500 rpm for a few seconds, cover the VTV hole, release the throttle valve, note the DP setting speed and compare it to the specified DP setting speed

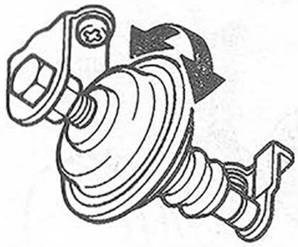
Check

Dashpot

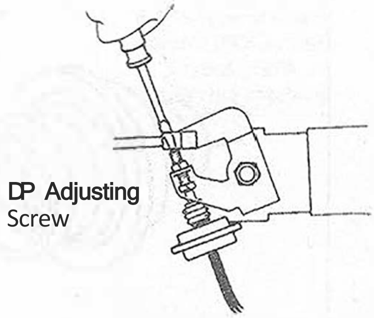
4 Warm up the engine/ check the idle speed and, if necessary, adjust it.

a) *If you are checking the OP on a carbureted vehicle with an automatic transmission, open the throttle valve until the throttle lever arm no longer touches the DP plunger* **(see illustration).**
b) *If you are checking the DP on an EFI-equipped vehicle with a manual transmission, push on the throttle lever arm, open the throttle valve enough to maintain engine speed at a steady 2500 rpm and pinch the vacuum hose between the OP and the VTV* **(see illustration).**
c) *If you are checking the DP on a V6, remove the cap and filter* **(see illustration)** *from the DP, race the engine at 2500 rpm for a few seconds and plug the VTV hole* **(see illustration).**

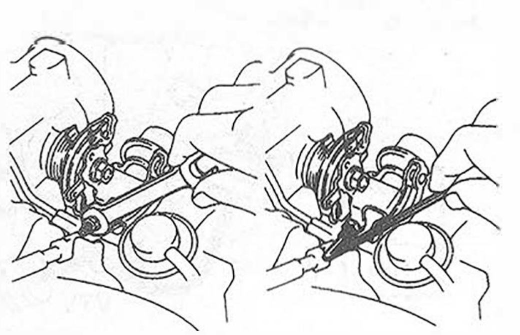
5 Release the throttle valve, note the DP "setting speed" (the rpm at which the throttle



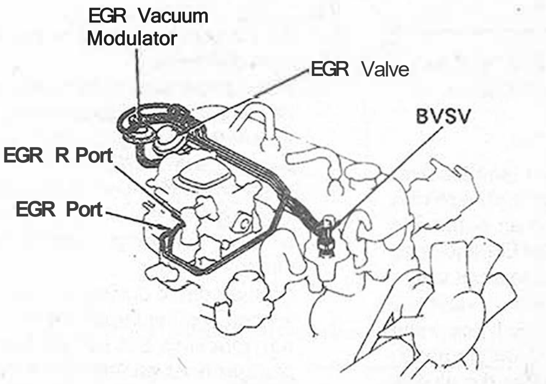
7.6a If the DP setting speed needs to be readjusted on a carbureted vehicle, loosen the locknut and turn the **DP** diaphragm housing until the speed is correct, then tighten the locknut



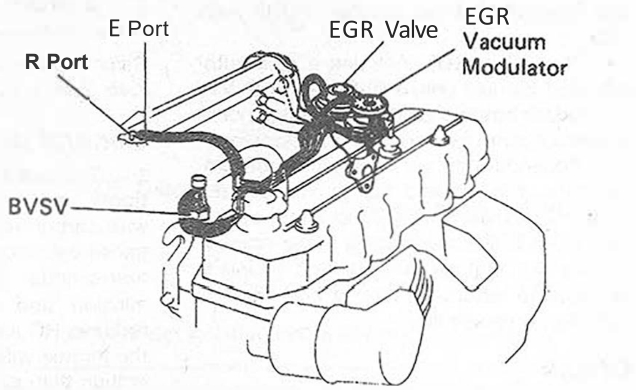
7.6b If the DP setting speed needs to be adjusted on an EFI-equipped vehicle, loosen the locknut and, using a screwdriver (earlier mod,el) or a hex wrench (later model), adjust the DP adjusting screw until the speed is correct, then tighten the locknut



7.6c If the DP setting speed needs to be adjusted on a V6 or a 1989-on EFI-equipped 4-cyl, loosen the locknut (left) and, using a hex wrench, turn the DP adjusting screw until the speed is correct (right), then tighten the locknut



8.1a EGR system layout- typical for 4-cylinder models with carburetor



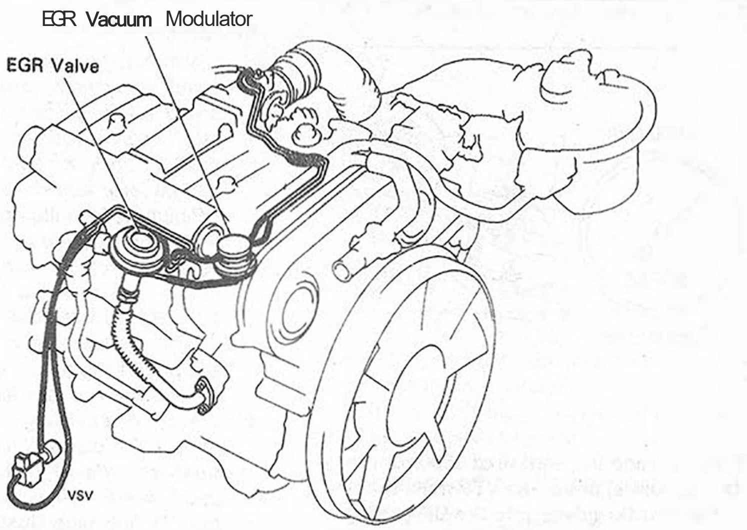
8.1b EGR system layout - typical for 4-cylinder models with EFI

lever arm touches the DP plunger) and compare it to the specified DP setting speed.

6 If the observed rpm is not as specified:

a) *On a carbureted vehicle, unlock the lock nut on the DP diaphragm housing and adjust the setting speed by turning the housing* (see illustration).

b) *On an EFI-equipped vehicle or a V6, unlock the lock nut on the DP diaphragm housing and adjust the setting speed by turning the DP adjusting screw with a hex wrench* **(see illustrations).**



8.1 c EGA system layout - typical for V6 engine models

VTV (EFI-equipped four-cylinder engines and V6 only)

7 Set the DP speed using the procedure outlined above.

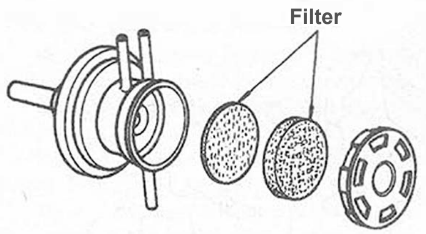
8 Release the pinched hose and verify that the engine returns to idle speed in about one second.

9 If the VTV performs as specified, the DP system is okay. If it doesn't, disassemble and inspect it.

10 Check the filter for contamination or damage. Using compressed air, clean the filter.

11 Check the VTV by blowing air into each side. It should flow without resistance in one direction and with difficulty from the opposite.

12 If the VTV doesn't perform as specified, replace it.



8.6 A typical EGR vacuum modulator and filter assembly

8 Exhaust Gas Recirculation (EGR) system

Refer to illustrations 8.1a, 8.1b, 8.1c and 8.6

General description

Note: *On all 1993 and later models, the designation for the BVSV (Bimetal Vacuum Switching Valve) was changed to TW (Thermal Vacuum Valve). The valve operates the same within the EGR system, only the name has been changed.*

1 To reduce NOx emissions, part of the exhaust gases are recirculated through the EGR valve into the intake manifold to lower the maximum combustion temperature **(see illustrations).**

2 The main component of the system is the EGR valve. It operates in conjunction with a wide variety of devices, such as the EGR vacuum modulator, the BVSV, the VSV(s) and the VTV, although not all components are incorporated on all models.

3 At low engine temperatures, the VSV or BVSV and EGR valves are shut and the exhaust gas is not being recirculated. At higher engine temperatures, the *VSV* or BVSV opens. When the throttle valve is pivoted open enough to expose the EGR port, and the pressure in the EGR valve is low, the pressure increases, closing the modulator and causing the EGR valve to open. The pressure then drops, reopening the modulator and closing the EGR valve, cutting off exhaust gas recirculation. The VSV(s) and VTV, where incorporated, serve the EGA system in various capacities, depending on coolant temperature, exhaust gas pressure, fuel flow pressure and ignition switch position.

Check

4 If the engine runs roughly at idle, hesitates under acceleration, accelerates poorly or gets poor mileage, the EGR system is probably not shutting off.

5 Before checking the EGR valve, always inspect the condition of all vacuum hoses in the system. Make sure they're all properly attached and are in good condition. If any of the hoses are cracked or otherwise damaged, replace them.

6 Also inspect the EGA vacuum modulator filter **(see illustration)** for contamination or damage. If it's dirty, clean it with compressed air.

7 Disconnect the vacuum hose from the EGR valve and connect a vacuum pump to it.

8 Apply vacuum directly to the EGR valve. The engine should run roughly or die. Inspect EGR tube for being carbon clogged. If not, replace EGR value.

Component replacement

EGR valve

9 Disconnect the vacuum hose, remove the retaining bolts and the valve, replace the faulty valve with a new one, install the bolts and reconnect the vacuum hoses.

9 Air injection (AI) system

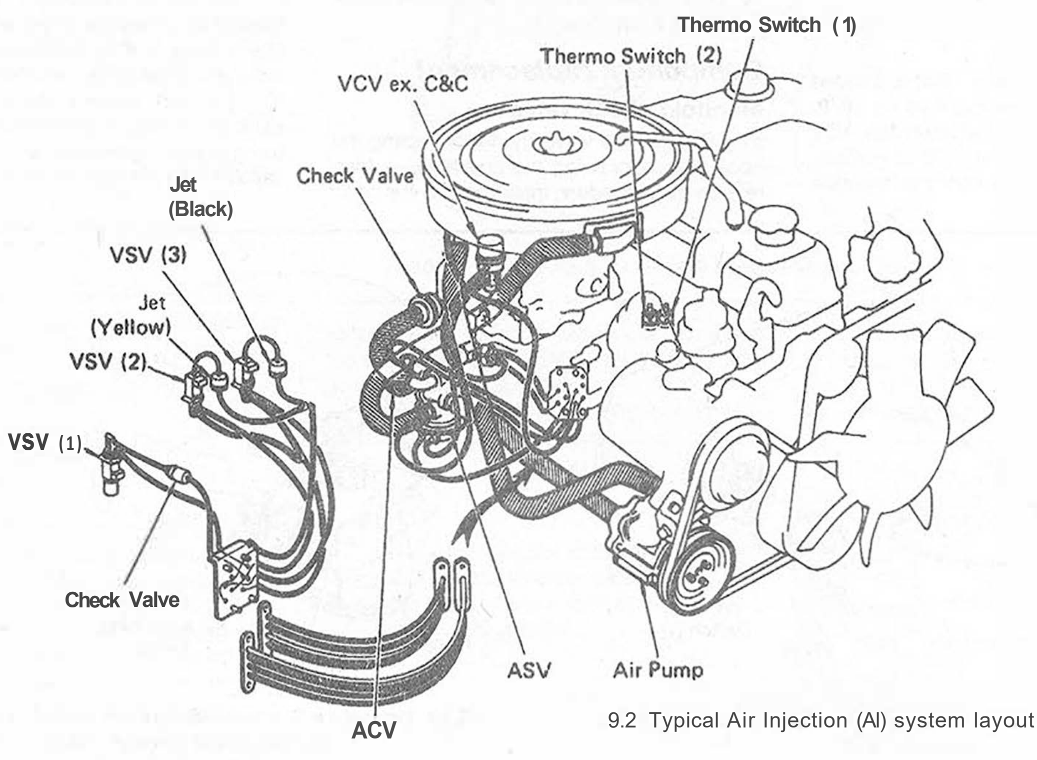
Refer to illustration 9.2

General description

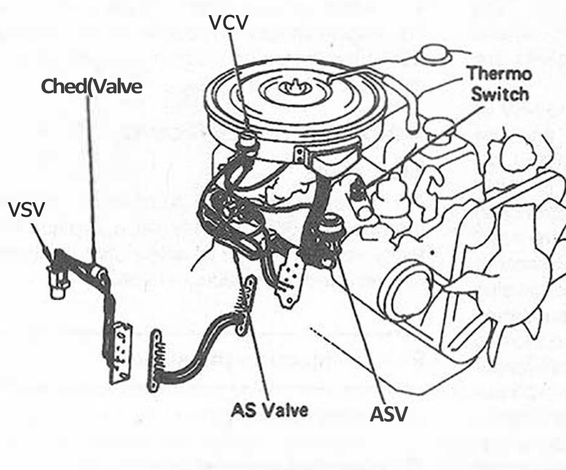
1 This system supplies air under pressure to the exhaust port to promote combustion of unburned hydrocarbons and carbon monoxide before they are allowed to exit the exhaust system.

2 This system **(see illustration)** is composed of various configurations of any of the following devices: an air pump, check valve(s), thermo switch(es), thermo sensor(s), an oxygen sensor, restrictor jets, plus ABV, ACV, ASV, EACV, TVSV, VCS, VCV, VSV AND VTV components. Note that not all components are included on every system. To determine which components are employed on the AI system on your vehicle, refer to the VECI label (see Section 1).

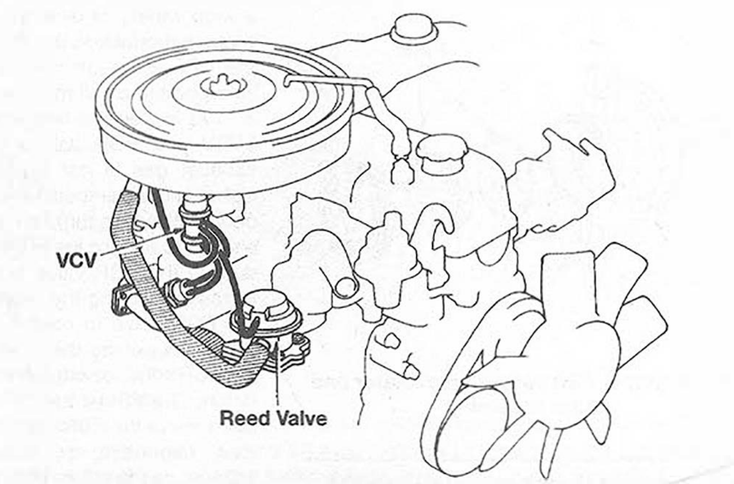
3 The check valve mounted on the manifold prevents the reverse flow of exhaust gases into the system. The other compo-



9.2 Typical Air Injection (AI) system layout



10.1a Typical Air Suction (AS) system layout (1981 and 1982)



10.1 b Typical Air Suction (AS) system layout • Federal **and Canada 4x2** (1983 and **1984)**

nents control the injection of the air into the ports based on catalytic converter temperatures and engine load.

Check

4 Visually check the hoses, tubes and connections for cracks, loose fittings and separated parts.

5 Check the drivebelt condition and tension (refer to Chapter 1 for this procedure).

Air pump, ABV, ACV, ASV and EACV

6 These components require special tools and/or checking procedures for checking and servicing. It is therefore recommended that you have these components inspected by your Toyota dealer.

Check valves

7 Inspect the check valve that is located between the ASV and the manifold on 1979, 1980 and 1990 models, between the ACV and the manifold on 1981 and 1982 models, by disconnecting the hose from the inlet side and remove the ACV, ASV or EACV from the manifold. Next, blow into the check valve from the manifold side and verify that air does not flow through the check valve, then reverse the check valve and verify that air does flow through **the** valve when blowing into the inlet side.

8 If a problem is found, replace the check valve with a new one.

9 Inspect the check valve that is found between the VSV and the manifold by disconnecting the hoses from both ends. Next blow air into the white pipe of the valve and verify that air flows through the valve. Reverse the valve and verify that air does not flow through the valve when blowing air into it from the black side.

10 If a problem is found, replace the check valve with a new one.

Component replacement

Manifold check valve

11 Replace the valve by disconnecting the hose and unscrewing the check valve, then reverse the procedure, installing the new part.

In-line check valve

12 Replace these parts by disconnecting the hoses and/or wires from the faulty part, then reverse the procedure, installing the new part.

10 Air Suction (AS) system

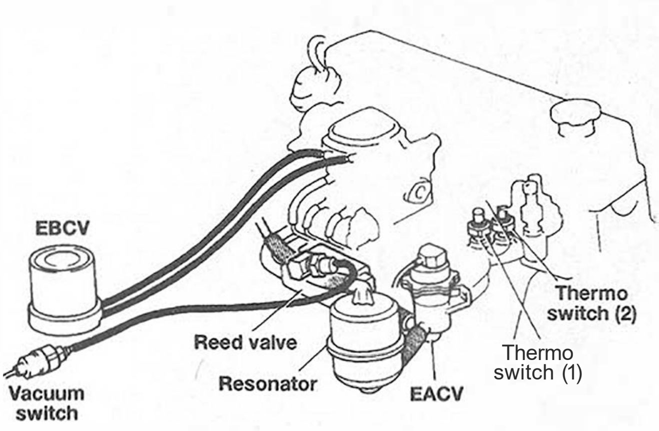
Refer to illustrations 10.1a, 10.1b, 10.1c, 10.1d, 10.1e, 10.1fand10.13

General description

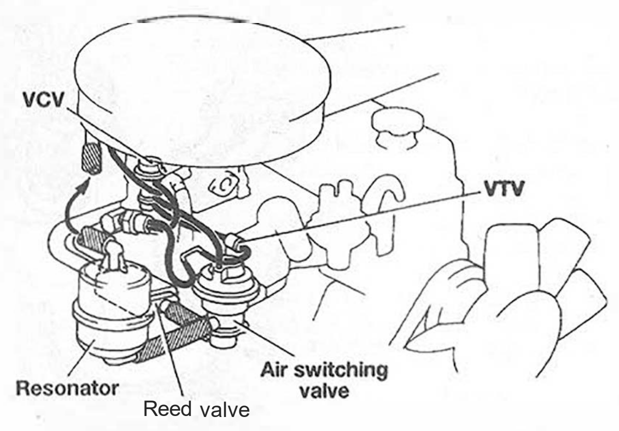
1 This system **(see illustrations) is** used on many Toyota pick-ups to reduce HC and CO emissions.

2 AS systems employ various combinations of an air suction valve, an ASV, a VSV, a check valve, a VCV, a thermo switch, a reed valve and other emissions devices.

3 The AS system draws air into the exhaust manifold to accelerate oxidation, using vacuum generated by the exhaust pulsation in the exhaust manifold.



10.1c Typical Air Suction (AS) system layout- Califomia(1985 through 1988)



10.1 d Typical Air Suction (AS) system layout • **Federal and** Canada (1985 through 1987)

Check

1981 and 1982 vehicles

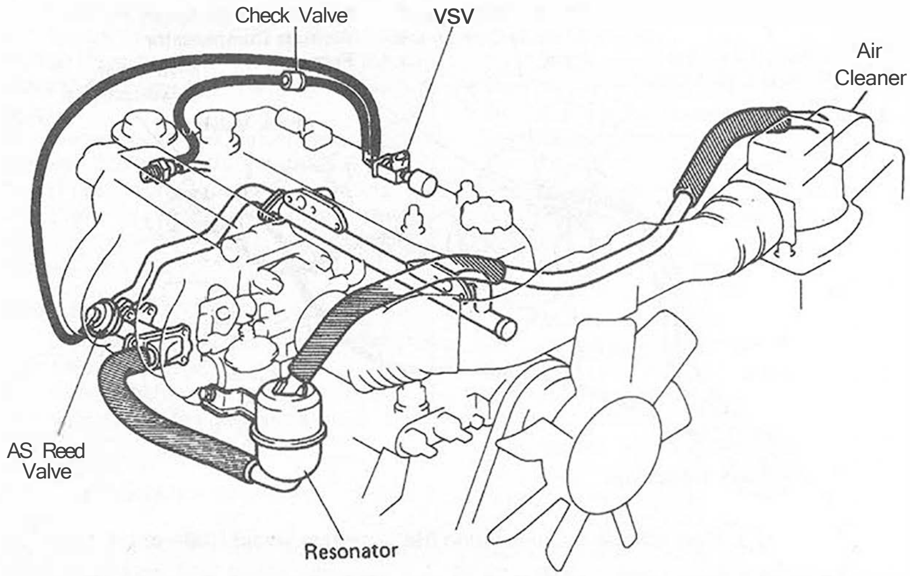
4 Visually check the hoses and tubes for cracks, kinks, damage or loose connections.
5 Disconnect the air suction hose from the air cleaner.
6 Verify that the coolant temperature is below 43-degrees F (6-degrees C).
7 Start the engine and check that a bubbling noise is not heard from the air suction hose at idle.
8 Let the engine warm up to normal operating temperature and check that a bubbling noise is heard from the air suction hose at idle.
9 Disconnect the vacuum hose between the check valve and vacuum pipe bracket at the check valve side and plug the hose end.
10 Check that a bubbling noise is heard from the air suction hose at idle with the engine at normal operating temperature.
11 Reconnect the vacuum hose.
12 With the engine at normal operating temperature, race the engine and quickly close the throttle valve, checking that the bubbling noise at the air suction hose stops momentarily.
13 With the engine idling, connect a wire to both terminals of the Oxidation Catalyst (OC) thermo sensor **(see illustration).**
14 Check that the bubbling noise at the air suction hose stops.
15 Disconnect the wire from the terminals.
16 If no problem has been found thus far, the AS system is okay. If any problem is encountered, take the vehicle to a dealer.

1983 and 1984 vehicles

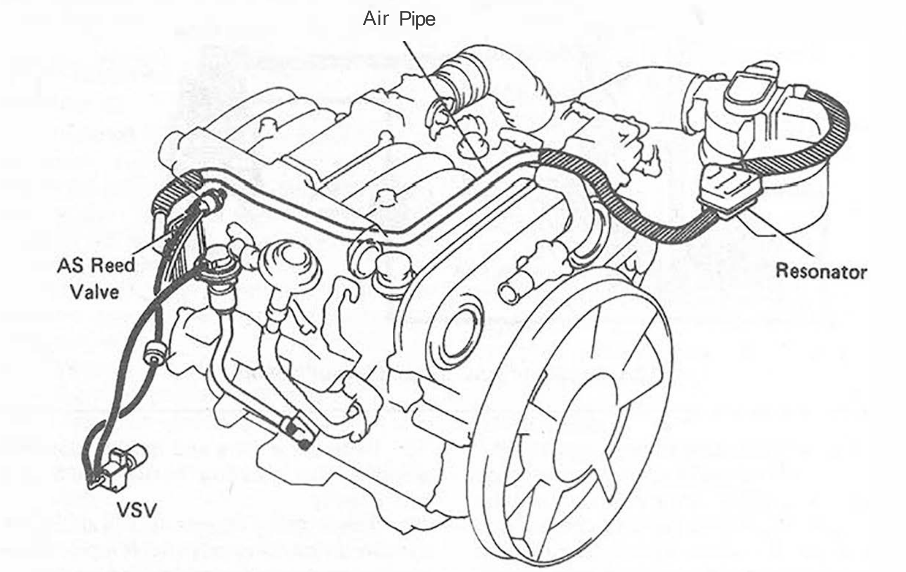
17 Refer to and perform the checks in Paragraphs 4 and 5.
18 With the engine running at idle, check that a bubbling noise is heard from the air suction hose.
19 Disconnect the vacuum hose from the reed valve.
20 Check that a bubbling noise is not heard from the air suction hose at idle.
21 Reconnect the vacuum hose.
22 Refer to and perform the check in Paragraph 12.
23 If no problem has been found thus far, the AS system is okay. If any problem was encountered, take the vehicle to a dealer.

1985 through 1989 California models

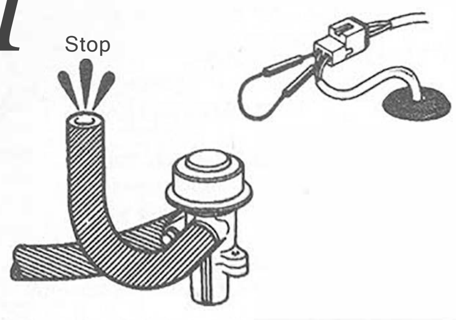
24 Visually check the system hoses and wires for cracks, kinks, damage and loose connections.
25 Disconnect the hose from the EACV and start the engine. With the coolant temperature below 43-degrees F (6-degrees C), no noise should be emitted by the EACV. Warm the engine up until the coolant temperature is between 64-degrees and 111-degrees F (18-degrees to 44-degrees C). then run the engine above 1390 rpm. A bubbling noise should be emitted by the EACV.
26 Allow the engine to idle and detach the vacuum hose from the vacuum switch (plug the hose end). The EACV should not emit any noise. Reconnect the vacuum hose.
27 Continue warming the engine until the coolant temperature is above 131-degrees F (55-degrees C) and make sure the noise is heard intermittently above 1390 rpm.
28 **With** the engine running below 1000



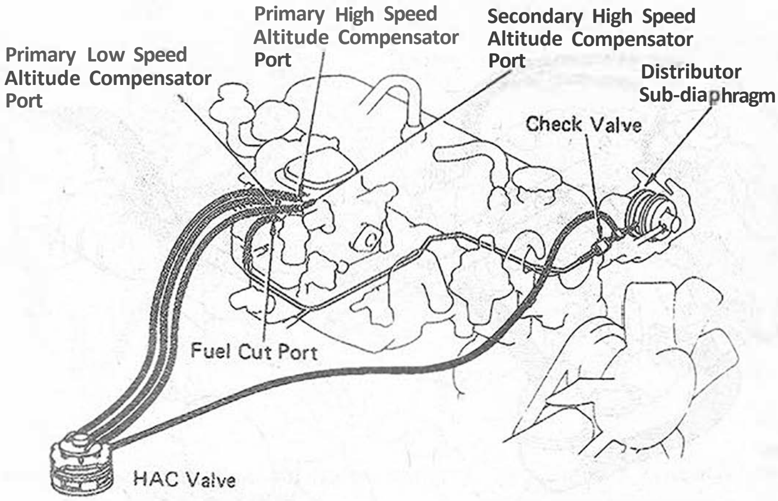
10.1e Typical Air Suction **(AS)** system layout - EFI vehicles (1988 and later)



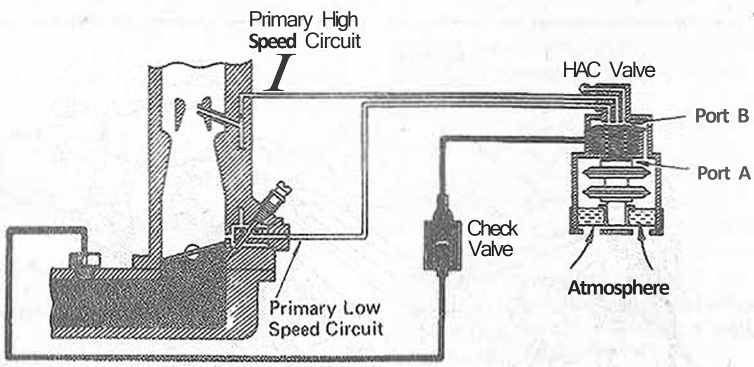
10.1f Typical Air Suction (AS) system layout - V6 vehicles (1988 and later)



10.13 Checking the oxidation catalyst (OC) thermo sensor during the general check of the AS system



12.2 High altitude compensation (HAC) system layout (1981-on)



12.4 Details of HAC system layout (1980)

rpm, the bubbling noise should be constant.

29 To check the fuel feedback system, run the engine at 3000 rpm and disconnect the EACV and EBCV wire harness connectors. Wait a few seconds, then reconnect the EBCV wires and see if the engine speed drops about 300 rpm immediately.

30 Disconnect the hose from the vacuum switch and plug the hose end. The engine speed should return to 2000 rpm within a few seconds. Fleconnect the vacuum hose and wire harness.

31 If everything checks out to this point, the system is working properly. if a problem is encountered take the vehicle to a dealer.

1985 through 1987 models

32 Visually check the system hoses and wires for cracks, kinks, damage and loose connections.

33 Disconnect the suction hose from the air switching valve and see if a bubbling noise is heard coming from the air switching valve with the engine idling.

34 Disconnect the vacuum hose from the valve and see if the noise disappears. Reconnect the vacuum hose.

35 Race the engine and quickly close the throttle. The bubbling noise should stop momentarily.

36 If everything checks to this point, the system is operating properly. If a problem is encountered, take the vehicle to a dealer.

1988 and later EFI equipped models

37 Visually inspect the hoses and tubes for cracks, kinks, damage or loose connections.

38 With the engine running but the coolant still cold (below 86-c!egrees F), disconnect the AS system hose from the air cleaner housing and verify that there is a bubbling noise coming from the hose.

39 Warm up the engine to above 104-degrees F. With the engine idling, verify that a bubbling noise is not coming from the same hose.

40 Race the engine, then quickly snap the throttle shut. Verify that the bubbling noise stops momentarily.

41 If the AS system performs as described, it's okay. If it doesn't, take the vel1icle to a dealer.

1988 and later V6 vehicles

42 Visually inspect all hoses and tubes for cracks, kinks, damage or loose connections.

43 With the engine running but the coolant still cold (below 95-degrees **F),** disconnect the AS system hose from the air pipe and verify that there is a bubbling noise coming from the hose.

44 Warm up the engine to above 95-degrees F. With the engine idling, verify that a bubbling noise is not coming from the same hose.

45 Race the engine above 2000 rpm and verify that a bubbling noise is heard from the pipe within 2 to 6 seconds.

46 If the AS system performs as described, it's okay. If it doesn't, take the vehicle to a dealer. •

11 Catalytic converter system

General description

1 Two types of catalysts are used to convert outgoing exhaust from the engine into other chemicals. The oxidation catalyst converts hvdrocarbons and carbon monoxide to water and carbon dioxide. The 3-way catalyst reduces hydrocarbons, carbon monoxide and oxides of nitrogen emissions to dinitrogen, carbon dioxide and water.

Check

2 Visual inspection of either type of catalyst is the main form of checking it. Any type of dents. damage, loose connections, or cracks can affect the operation of the catalyst. In addition, the l1eat insulator which is situated between the vehicle body and the catalyst must be in place and not touching the catalytic converter. Serious damage to the vehicle or the occupants can result if the heat insulator is loose or missing.

3 The 3-way catalyst can be checked by lightly slapping the housing and listening for any loose, rattling noises inside (this method can only be used if the catalyst is cold). If it's hot, place a block of wood against the bottom and tap the block lightly. This is a sign that the beads of catalyst material have come loose and replacement of tile converter is necessary.

Component replacement

4 Do not attempt to remove the catalytic converter until the complete exhaust system is cool. Raise the vehicle and support it securely on jackstands. Apply some penetrating oil to the clamp **bolts** and allow it to soak in. Disconnect the thermo sensor wiring connector (if so equipped) from under the driver's seat. Push the grommet through the floor pan to free the wire.

5 Remove the bolts and the rubber hangers, then separate the converter from the exhaust pipes. Remove the old gaskets if they are stuck to the pipes.

6 If the thermo sensor is being replaced,

position the converter with the sensor up and remove the bolts. Withdraw the sensor and remove the gaskE:t. Position a new gasket on the converter and slide the new thermo sensor into place. Tighten the bolts securely.
7 Installation of the converter is the reverse of removal. Use new exhaust pipe gaskets and tighten the clamp bolts securely. Replace the rubber hangers with new ones if the originals are deteriorated. Reconnect the thermo sensor wires (if so equipped), start the engine and check carefully for exhaust leaks.

12 High Altitude Compensation (HAC) system

Refer to illustrations 12.2, 12.4 and 12.12

General description

1 Starting with some 1980 Toyota truck models, HAC systems were incorporated to ensure that the proper air/fuel mixture is supplied by the carburetor at altitudes of 3930 feet (1198 meters) and above.
2 The main components of this system include the carburetor altitude compensator ports (primary high and low speed ports in 1980; primary high and low speed ports, a secondary high speed port and a fuel cut port in 1981 through 1988), a HAC valve and a check valve, plus connecting hoses **(see illustration}.**
3 The high altitude compensation is accomplished by two methods: Additional air is supplied to the primary high and low and secondary high speed circuits of the carburetor and the ignition timing is advanced for improved driveability above 3930 feet (1198 meters). At lower altitudes, the additional air is cut off and the initial advance occurs only at idle.

Check (1980 vehicles)

HAC valve

4 Above 3930 feet (1198 meters), check that air flows into either of the two ports on top of the HAC valve **(see illustration}** with the engine idling.
5 Below 2570 feet (783 meters), check that air does not flow into either of the two ports on top of the HAC valve with the engine idling.
6 Depending on the atmospheric pressure between 2570 feet (783 meters) and 3930 feet (1198 meters), the HAC valve may be either opened or closed. Therefore, attempt to check the valve at either altitude listed in Paragraphs 4 and 5.

Carburetor

7 Disconnect the hoses from the pipes on top of the HAC valve.
8 Blow air into each hose and make sure that air flows into the carburetor.

Check valve

9 Disconnect the hoses from the check valve.
10 Blow air into the white pipe and make sure that air flows through the valve.
11 Blow air into the black pipe and make sure that air does not flow through the valve. If a problem is encountered replace the valve with a new one.

Check (1981 and later vehicles)

12 Determine the position of the HAC valve by blowing into any one of the three ports on top of the valve (see illustration). If the passage is open, the valve is in the high altitude position. If it is closed, the valve is in the low altitude position.
13 If the HAC valve is in the high altitude position, warm up the engine to normal operating temperature.
14 Disconnect the hose from the distributor sub-diaphragm and plug the hose end.
15 Check the ignition timing at idle (see Chapter 1).
16 Reconnect the hose to the sub-diaphragm.
17 With the engine still idling at 950 rpm, verify that the ignition advances slightly (approximately ?-degrees).
18 Disconnect the vacuum hose between the check valve and the vacuum pipe at the vacuum pipe side and plug the pipe end.
19 Check that the ignition timing remains stationary for more than one minute.
20 Stop the engine and reconnect the hose to the vacuum pipe, then go to Ste[) 25.
21 If the HAC valve is in the low altitude position, check the ignition timing and advance as described above in Steps 15 through 17.
22 Disconnect the vacuum hose from the lower port of the HAC valve, plug the hose end and perform the checks below.
23 Disconnect the vacuum hose between the check valve and the vacuum pipe at the vacuum pipe side and plug the pipe end.
24 Check that the ignition timing remains stationary for more than one minute.
25 Stop the engine and reconnect the hoses to their proper locations.
26 Disconnect the three hoses from the pipes on top of the HAC valve.
27 Blow air into each hose and make sure that air flows into the carburetor.
28 Reconnect the hoses to their proper locations.
29 If no problems have been encountered in these tests, the HAC system is okay.

HAC valve

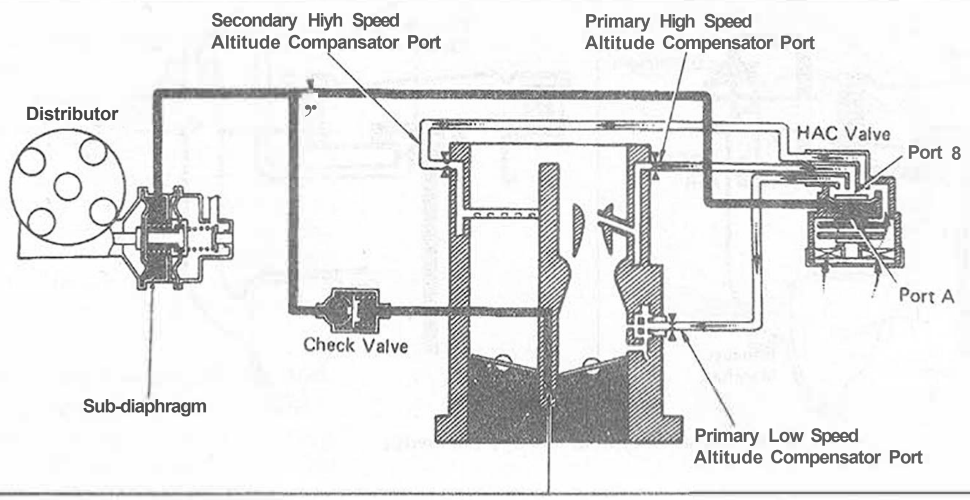
30 Remove the cover from the bottom of the HAC valve and clean and visually check the filter.

Check valve

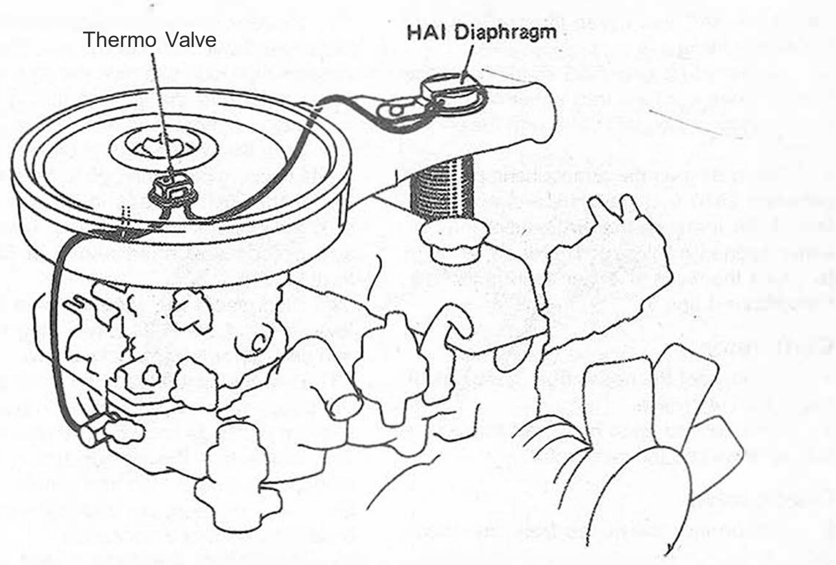
31 Disconnect the hoses from the check valve.
32 Check the air flows through the valve from the inlet side.
33 Check that air does not flow through the valve from the outlet side.

Distributor

34 Remove the distributor cap and rotor (see Chapter 5, if necessary).
35 Apply vacuum to the diaphragm and make sure that the vacuum advancer moves in accordance with the vacuum.
36 Reinstall the rotor and distributor cap.



12.12 Details of the HAC system layout (1981-on)



13.1 a Typical hot air intake **(HAI)** system layout (all years)

Component replacement

37 The HAC valve and check valve can be replaced by removing the hoses from the faulty component and replacing it with a new one.
38 If problems are encountered with the distributor, see Chapter 5.

13 Hot Air Intake (HAI) system

Refer to illustrations 13.1a and 13.1b

General description

1 This system **(see illustratic;ms)** is designed to improve driveability and prevent carburetor icing in extremely cold weather by directing hot air from around the exl:laust manifold to the air cleaner intake.
2 The system is composed of a diaphragm-activated air control valve located in the air cleaner intake, a thermo valve, an exhaust manifold shroud and interconnecting hoses and ducts.
3 When the underhood temperature is below 101 degrees on 1979 and 1980 vehicles, or below 86 degrees on later models, the thermo valve a!lows manifold vacuum to act on the air cleaner diaphragm, which closes the control valve, or baffle, and allows hot air to enter the air cleaner. As temperature rises above 106 degrees on 1979 and 1980 models, or 113 degrees on later models, the thermo valve cuts off the vacuum to the diaphragm and spring pressure opens the air control valve. Intak air is then drawn from under the hood, rather than from around the exhaust manifold.

Check

Air control valve

4 Remove the air cleaner cover.
5 Make sure the underhood temperature is below the low temperature listed in Paragraph 3.
6 Verify that the air control valve closes the cool air passage with the engine running at idle.
7 Reinstall the air cleaner cover and warm up the engine until the underhood temperature is above the high temperature listed in Paragraph 3.
8 Verify that the air control valve opens the cool air passage at idle.

Hoses and connections

9 Visually check the hoses and connections for cracks, leaks *or* damage.

Component replacement

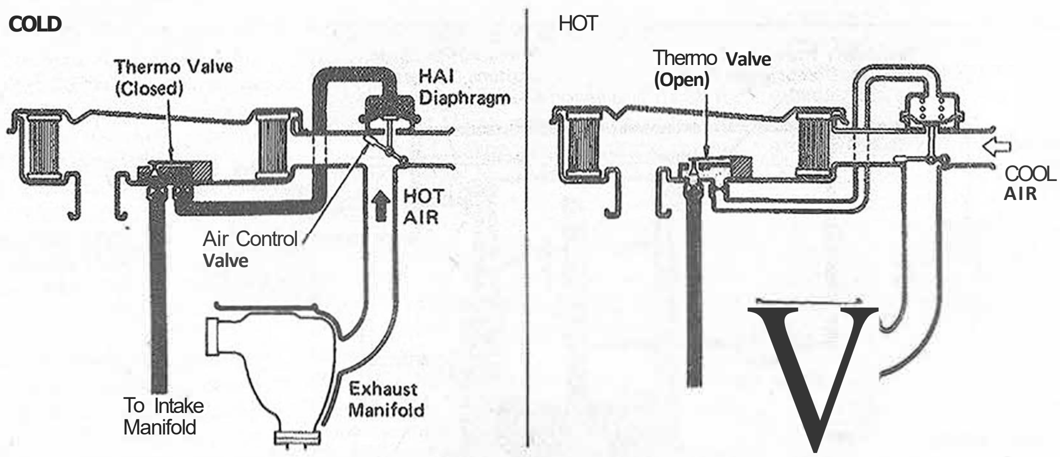
10 Replacement of all of the component(s) in this system is a simple matter of removing the faulty component and replacing it with a new one. Make sure the hoses are correctly installed and tighten all hose clamps and mounting bolts securely. If a new air control valve is installed, mal<e sure it moves freely before checking the system operation.

14 Automatic choke system

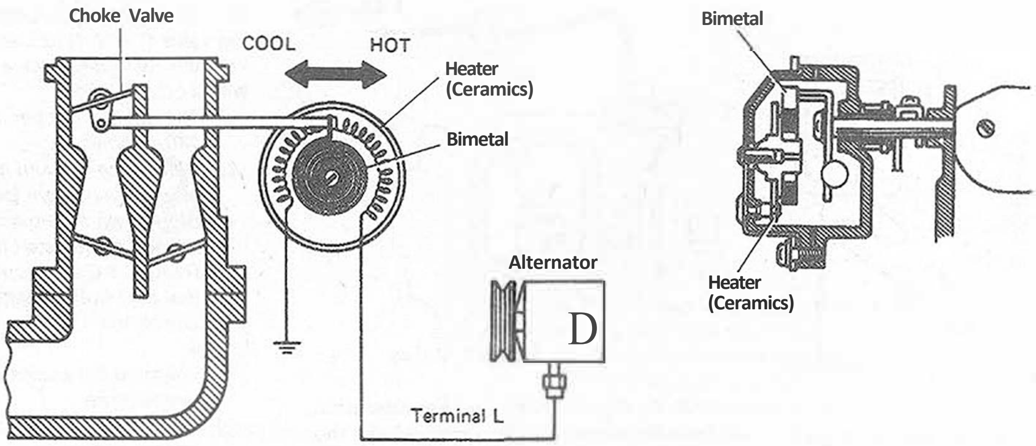
Refer to illustrations 14. 1, 14.2, 14.3, 14.6, 14.9 and 14.10.

General description

1 The automatic choke system {see **illustration)** temporarily supplies a rich fuel/air mixture to the engine by closing the choke valve during cold engine starting. Typical automatic choke systems m<ly include various combinations of any of t1e following components: a water or electrically heated coil, a choke breaker diaphragm, a choke opener diaphragm, a fast idle cam breaker, a VSV, a TVSV, a BVSV and connecting hoses and linkage, although not all components are employed on every model. The components employed in a specific system are dependent upon year, model and Federal and local motor



13.1 b Details of typical HAI system layout

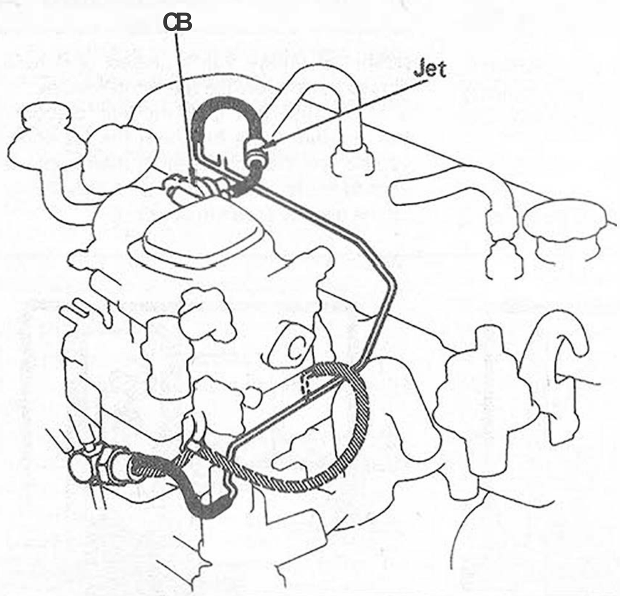


14.1 Typical automatic choke system (1985 thru 1988)

vehicle regulations. Your local Toyota dealer can supply you with information on your particular vehicle should you be in doubt as to which components make up your system.

2 The choke breaker {see **illustration)** opens the choke valve slightly when the engine starts, preventing an overly rich mixture and the resulting increase in emissions discharge to the atmosphere.

3 After the engine reaches a pre-determined temperature, the choke opener holds the choke valve open and releases the fast idle cam to the 4th step which lowers the engine speed and prevents an overly rich mixture condition. On 1980 models, a fast idle cam breaker diaphragm is employed to perform this latter function {see illustration).



14.2 The choke **breaker {CB)** system {1983 and later models shown)

Check

Automatic choke system

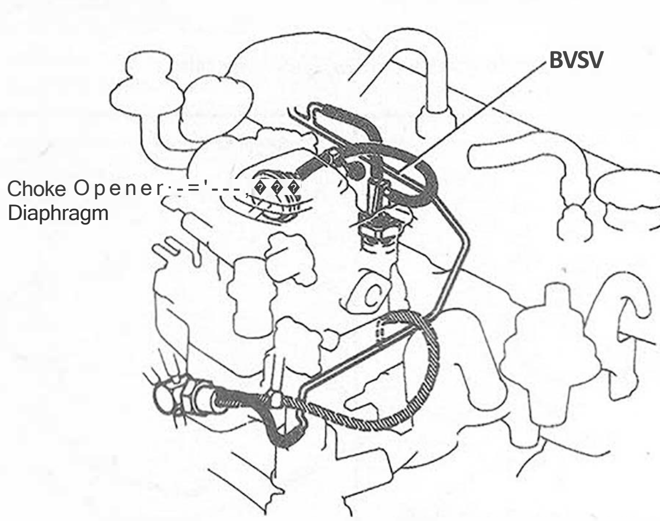
4 Refer to Chapter 1, for the general carburetor choke check procedures. If the choke is determined to be malfunctioning, check the hoses for cracks, kinks and broken sections and make sure all wiring connections are tight before checking the other system components.

Heater housing (water heated) (1980 models)

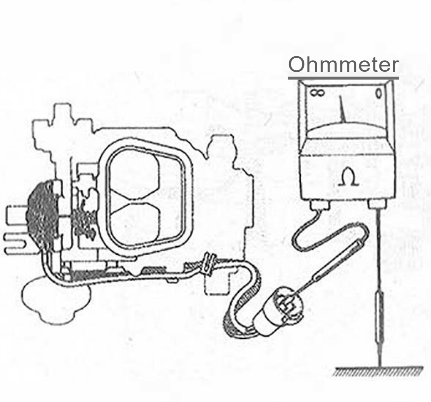
5 Look for water leaks. Check the hoses for cracks and damage. Make sure that the middle mark on the thermostatic case is aligned with the mark on the coil housing. If not, correct it by loosening the three screws around the circumference of the housing, aligning the marks and re-tightening the screws. **Caution:** *Do not loosen the bolt at the center of the* case, as *this will allow coolant to leak out.*

Heater housing (electrically heated) (1981-on models)

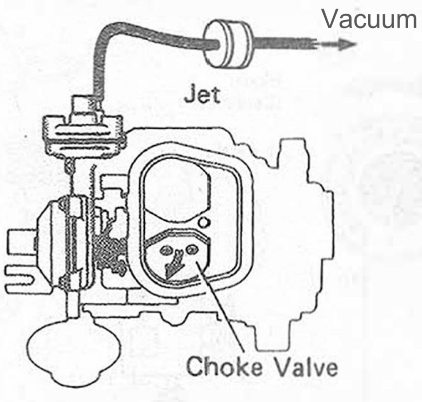
6 Unplug the wiring connector and, using an ohmmeter, measure the resistance of the



14.3 The choke opener system



14.6 Measuring the resistance of an electrically heated choke housing



14.9 To check choke breaker operation, hold the throttle open slightly, push the choke valve closed, hold it closed and release the throttle valve, then disconnect the vacuum hose from the jet, apply vacuum to the jet port and note whether the choke valve opens slightly

connector terminal, (see illustration) and compare your reading to the specified resistance.

7 Start the engine. Shortly after starting it, note whether the choke is starting to open, then touch the choke housing and verily that it is heating up.

Choke breaker

8 While holding the throttle slightly open, push the choke valve closed and hold it closed as you release the throttle valve.

9 On 1981 and later models, disconnect the vacuum hose between the jet and the vacuum pipe at the jet side. then apply vacuum to the jet and verify that the choke valve opens slightly {see **illustration).**

Choke opener

10 Check the thermostatic vacuum switching valve (TVSV) (1981 and 1982) or bimetal vacuum switching valve (BVSV) (1983-on) with a cold engine:

a) *The coolant temperature must be below 140-degrees F.*
b) *Detach the vacuum hose from the choke opener diaphragm* **(see illustration}.**
c) *Step down on the accelerator pedal and release it, then start the engine.*
d) *Reattach the vacuum hose and verify that the choke linkage does not move.*

11 Check the TVSV or BVSV with a warm engine:

a) *Warm up the engine to normal operating temperature.*
b) *Detach the vacuum hose from the choke opener diaphragm.*
c) Set *the fast idle cam by holding the throttle slightly open, pushing the choke valve closed and holding it closed* as *you release the throttle valve.*
d) *Start the engine but do not touch the accelerator pedal.*
e) *Reattach the vacuum hose and verify that the choke linkage* moves *and that the fast idle cam* is *released to the 4th step.*

12 If the choke opener does not perform as described, proceed to the steps below.

13 Apply vacuum to the diaphragm and verify that the linkage moves. If it doesn't, replace the diaphragm.

BVSV

14 Be sure that the coolant temperature is below 140-degrees (1981 thru 1983) or 131 degrees (1984-on).

15 Remove the hoses from the BVSV pipes.

16 Blow air into pipe J and verify that air comes out of pipe L.

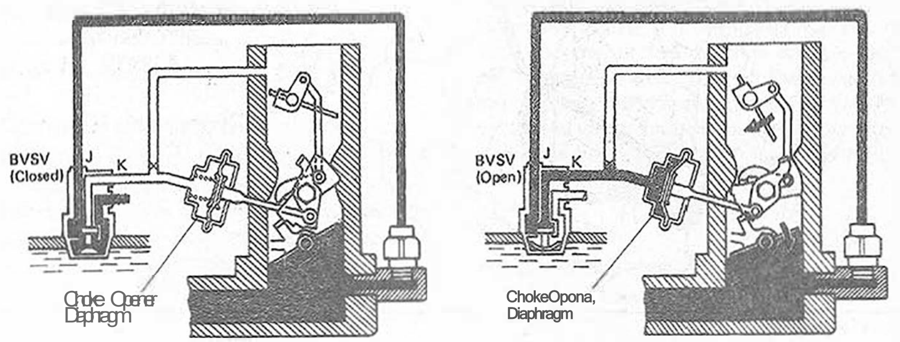
17 Warm up the engine to above 167-degrees (1981 thru 1983) or 165-degrees (1984-on).

18 Blow air into pipe J and verify that air comes out of pipe K.

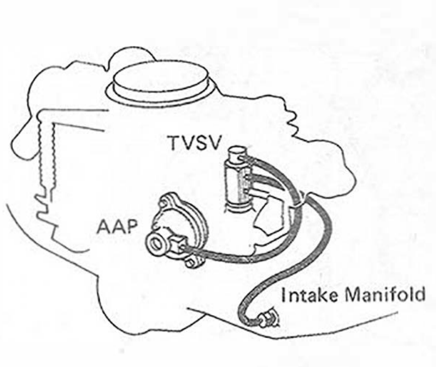
19 If any problem is encountered replace the BVSV with a new one.

Component replacement

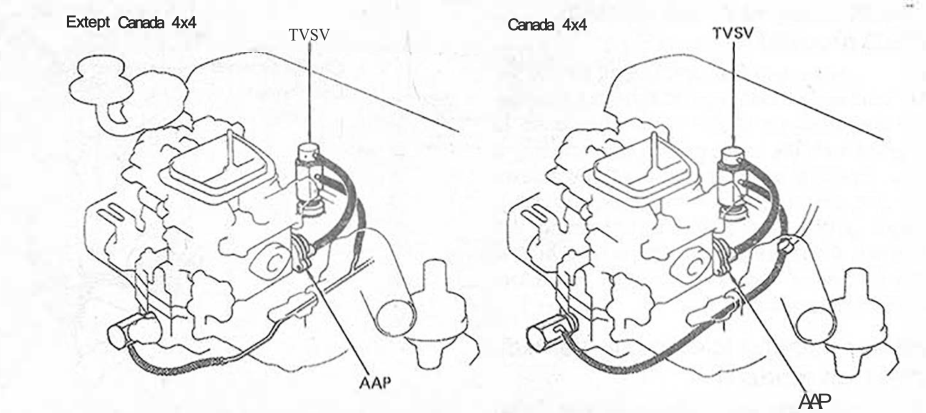
20 Because replacement of the heater



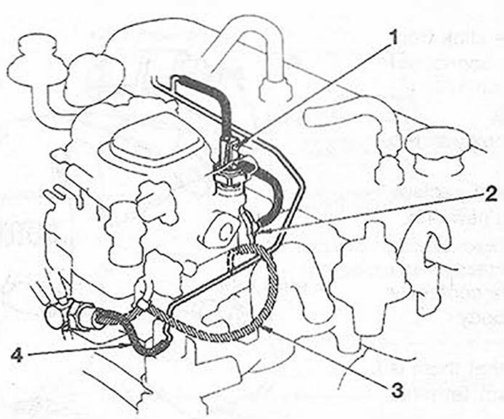
14.10 Choke opener system details



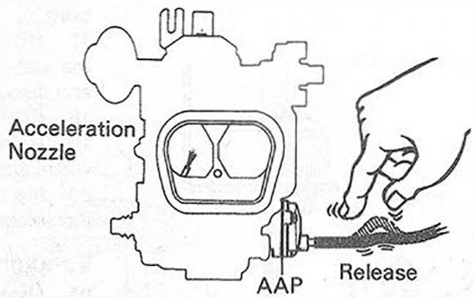
15.1a Auxiliary Accelerator Pump (AAP) system (1979 and 1980)



15.1b Auxiliary Accelerator Pump (AAP) system (1981 and 1982)



15.1c Auxiliary Accelerator Pump **(AAP)** system {1983-on)



15.7 To check the **AAP** system, remove the air cleaner, start the engine and, with the coolant temperature below the prescribed level, pinch the **AAP** hose and stop the engine, then release the hose and verify that gasoline spurts from the accelerator nozzle - then warm the engine up to operating temperature, pinch the hose, stop the engine and verify that gasoline does not spurt from the accelerator nozzle

housing, choke breaker, choke opener and/or fast idle cam breaker requires partial disassembly of the carburetor, refer to the instructions included with the carburetor rebuild kit for your carburetor. Be sure to make any adjustments required after the components are replaced.

21 To replace the VSV or TVSV, see Section 3.

22 To replace the BVSV, remove the hoses from the pipes, then use a wrench to remove the BVSV from the intake manifold. Installation is the reverse of the removal procedure.

15 Auxiliary Accelerator Pump (AAP) system

Refer to illustrations 15. 1a, 15. 1b, 15. 1c and 15.7

General description

1 The AAP system (see illustrations) is designed to improve cold engine acceleration performance.

2 The system is composed of an auxiliary accelerator pump, a TVSV on all models through 1982, replaced with a BVSV in 1983, and various vacuum hoses.

3 A typical air/fuel mixture is very lean. When accelerating with a cold engine, the main accelerator pump capacity is insufficient to provide good acceleration. At constant RPM the diaphragm in the AAP is pulled by vacuum and fuel is drawn into the AAP chamber. Upon acceleration, the diaphragm is returned by spring pressure and the stored fuel in the AAP chamber is forced into the acceleration nozzle, enriching the air/fuel mixture. Once the engine is sufficiently warmed up, The AAP system becomes inoperative.

Check

General

4 Be sure that the coolant temperature is below 122-degrees (1979 and 1980), 140-degrees (1981 thru 1983) or 131-degrees (1984-on).

5 Remove the air cleaner cover.

6 Start the engine.

7 Pinch the AAP hose **(see illustration)** and stop the engine.

8 Release the hose and verify that gasoline spurts 'from the accelerator nozzle.

9 Warm up the engine to normal operating temperature.

10 Pinch the hose and stop the engine.

11 Verify that gasoline does not spurt from the accelerator nozzle.

12 If no problem is encountered in the above check, the AAP system is okay, otherwise inspect the components as follows.

AAP diaphragm

13 Start the engine.

14 Disconnect the vacuum hose from the AAP.

15 Apply and release vacuum to the diaphragm with the engine idling, observing that the engine rpm changes when the vacuum is released.

16 Reconnect the AAP hose.

17 If a problem is encountered, replace the diaphragm with a new one.

Component replacement

18 To replace the AAP diaphragm, remove the hoses from the pipes, unscrew the AAP housing and replace the diaphragm with a new one. Reassembly is the reverse of the disassembly procedure.

19 To replace the TVSV or BVSV, see Section 3 or Section 14, as applicable.

16 Deceleration fuel cut system

Refer to illustrations 16. 1, 16. 7 and 16. 16

General description

1 This system **(see illustration)** serves to prevent overheating and after-burning in the exhaust system.

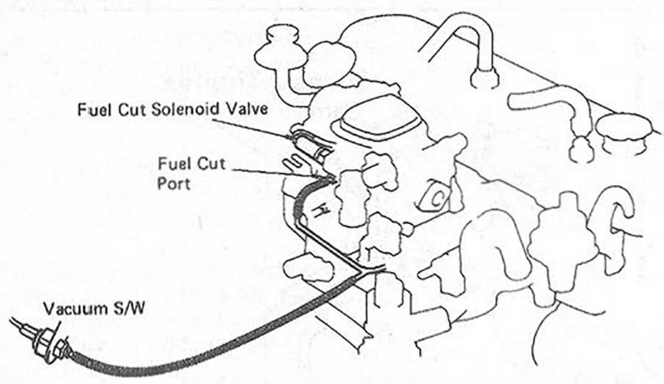
2 The system is made up of a fuel cut solenoid valve, a vacuum switch and attaching vacuum hose.

3 The system cuts off part of the fuel in the slow circuit of the carburetor at low rpm under high and low vacuum conditions and at high rpm under low vacuum conditions. At high rpm under high vacuum conditions, the system is off and the slow circuit in the carburetor is closed .

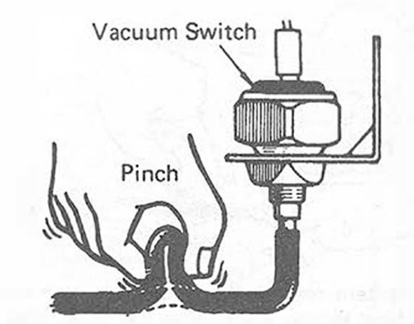
Check

General

4 For vehicles with HAC systems, disconnect the vacuum hoses from the lower port of the HAC valve and plug the hose end (refer to



16.1 A typical deceleration fuel cut system layout (all years)



16.7 Checking the decel fuel cut system

Section 12).

5 Connect a tachometer to the engine according to the instructions supplied by the tachometer manufacturer.

6 Start the engine and observe that it runs normally.

7 Pinch off the hose to the vacuum switch **(see illustration).**

8 Gradually increase the engine speed and observe that the engine misfires slightly between 1800 and 3000 rpm. **Caution:** *Perform this check quickly to avoid overheating the catalytic converter.*

9 Release the pinched hose.

10 Gradually increase the rpm to 3000 again and observe that the engine operation returns to normal.

11 With the engine idling, unplug the wiring connector to the solenoid valve and observe that the engine idles roughly or dies. **Note:** *Perform this check quickly to avoid overheating the catalytic converter.*

12 Stop the engine and reconnect the wiring.

13 Remove the tachometer.

14 If no problem was encountered in the checks above, the system is okay, otherwise inspect the components as follows.

Fuel cut solenoid valve

15 Disconnect the connector and remove the fuel cut solenoid valve.

16 Connect the two terminals inside the connector to a 12 volt battery **(see illustration).**

17 Observe that you can feel a click from the solenoid when the battery is connected and disconnected.

18 Check the O-ring for damage.

19 Reinstall the valve and hook up the wiring connector.

20 If a problems was encountered, replace the solenoid valve or O-ring with a new one.

Vacuum switch

21 Using an ohmmeter, check for continuity between the switch terminal and body.

22 Start the engine.

23 Using an ohmmeter, check that there is no continuity between the switch terminal and the body.

24 If a problem is encountered, replace the vacuum switch with a new one.

Component replacement

25 The fuel cut solenoid valve and vacuum switch can be replaced by disconnecting the connector and hoses, removing the faulty component and installing a new one, reversing the removal procedures.

17 Secondary slow circuitfuel cut system

Refer to illustration 17.6

General description

1 This system cuts off part of the fuel in the secondary slow circuit of the carburetor to prevent dieseling.

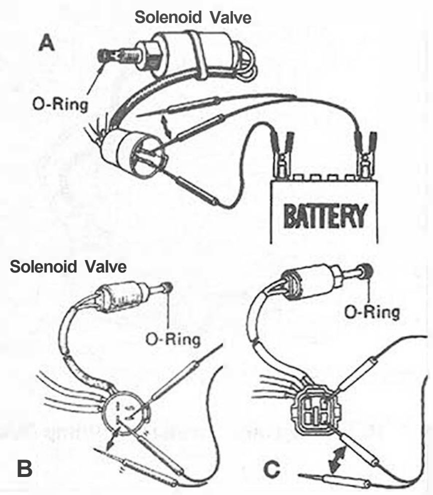
2 This system is used on 1979 and 1980 California vehicles and is composed of a secondary slow circuit fuel cut valve located on the carburetor throttle body (flange).

3 With the primary throttle valve opening angle below 59-degrees from the horizontal, the secondary slow cut valve and secondary slow circuit are closed. With the throttle valve angle above 59-degrees, the slow cut valve opens, allowing fuel into the slow circuit.

Check

4 Fully open and close the throttle valve.

5 Measure the stroke of the fuel cut valve.



16.16 Terminal guide for checking the fuel cut solenoid valve:

A *1981 to 1984 (1979 and 1980 similar)*
B *1985 thru 1987*
C *1988*

It should be 0.059 to 0.079 inch (1.5 to 3.0 mm).

6 If necessary, adjust the valve stroke by bending lever **A (see illustration). Note:** *The stroke should be set before the kick-up (opening of the secondary throttle valve) occurs.*

Component replacement

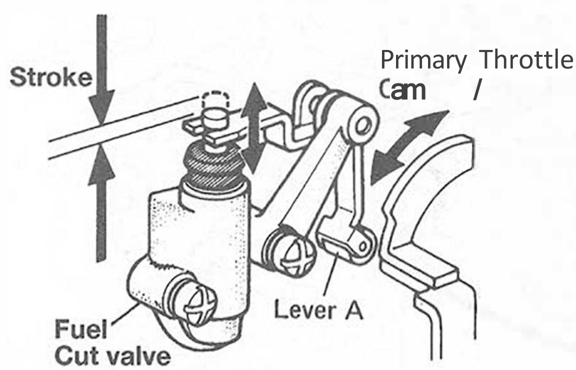
7 Remove the screw retaining the secondary slow circuit fuel cut valve to the throttle body and replace the valve with a new one. Be sure to adjust the valve stroke, if necessary, as indicated in Paragraphs 5 and 6 when installing a new valve.

18 Idle advance system

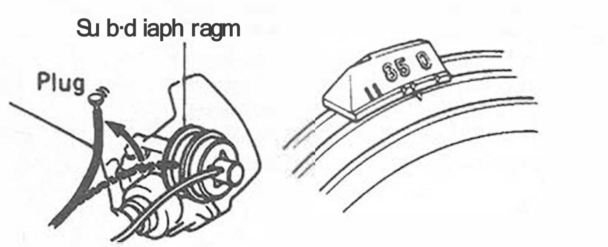
Refer to illustration 18.5

General description

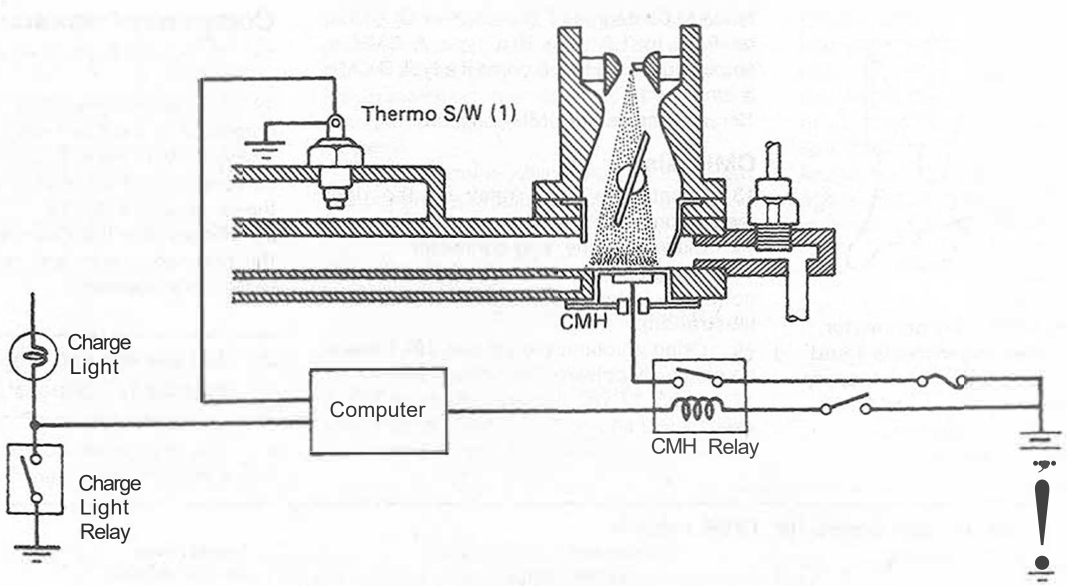
1 The purpose of the idle advance system



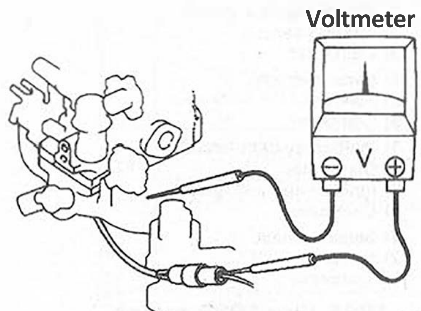
17.6 Secondary slow circuit fuel cut system components



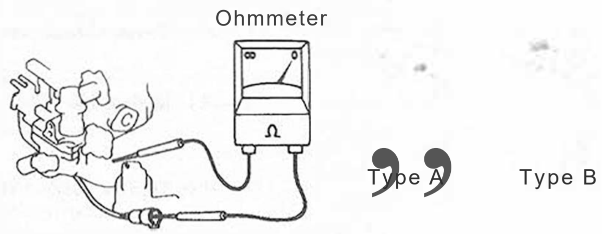
18.5 Checking the idle advance system



19.2 Details of a typical Cold Mixture Heater (CMH) system (all years)



19.6 Checking the **CMH** system



19.11 To check the **CMH** itself, measure the resistance between the positive terminal and the intake manifold and compare your reading to the specified resistance

is to improve fuel economy at idle. The system advances the ignition timing only while the engine is idling.

Check

2 Warm up the engine to its normal operating temperature.

3 Hook-up a timing light in accordance with the manufacturer's instructions .

4 Check the ignition timing at idle (see Chapter 1).

5 Detach the vacuum hose from the distributor subdiaphragm **(see illustration)** and plug the hose end.

6 Check the ignition timing at idle again and verify that the timing has changed slightly.

7 Reattach the vacuum hose and disconnect the timing light.

8 If the system does not perform as specified, inspect and repair or, if necessary, replace the vacuum advancer (see Chapter 5).

19 Cold Mixture Heater (CMH) system

Refer to illustrations 19.2, 19.6, 19.11 and 19.15

General description

1 To reduce cold engine emissions and improve driveability, the intake manifold riser is heated by this system during cold engine operation to accelerate vaporization of the fuel.

2 The system **(see illustration)** is composed of a thermo switch, A CMH and a CMH relay, and is found on 1983 through 1988 vehicles only .

3 With the engine running and the coolant below 109-degrees F (43-degrees C), the CMH relay is on and the CMH is heated. At approximately 131-de·grees F (55-degrees C), the CMH system is completely off.

Check

General

4 Start the engine.

5 Verify that the coolant temperature is below 109-degrees F.

6 Using a voltmeter, check that there is voltage between the positive terminal of the CMH connector and the intake manifold **(see illustration). Note:** *The voltmeter probe should be inserted from the rear side of the connector.*

7 Warm up the engine to above 131-degrees F (55-degrees C).

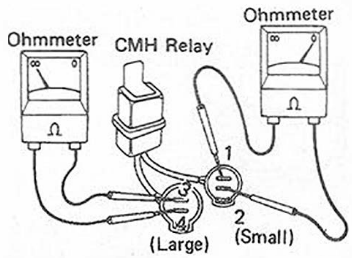
8 Repeat the voltmeter check, verifying that there is no voltage.

9 If the system voltage is okay, inspect the components as follows.

CMH

10 Unplug the CMH electrical connector.

11 Using an ohmmeter, measure the resistance between the positive terminal and the intake manifold (see illustration). The resis-



19.15 Unplug the **CMH** relay connector, **verify continuity between terminals 1 and 2 but not between terminals 3 and 4: apply battery voltage to terminals 1 and 2 and verify continuity between terminals 3 and 4**

tance at 68-degrees F (20-degrees C) should be 0.35 to 1.0 ohm if a type A CMH is employed, or 0.5 to 2.0 ohms if a type B CMH is employed.

12 Reconnect the CMH connector.

CMH relay

13 Locate the CMH relay on the right fender apron in the engine compartment.

14 Disconnect the relay connector.

15 Using an ohmmeter, check that there is continuity between terminals 1 and 2 **(see illustration).**

16 Using an ohmmeter, check that there is no continuity between terminals 3 and 4.

17 Apply 12 volt battery voltage to terminals 1 and 2 and verify that there is continuity between terminals 3 and 4 with an ohmmeter.

Component replacement

18 To replace the thermo switch, see Section 3.

19 To replace the CMH, disconnect the connector at the CMH relay and remove the faulty unit from the intake manifold, under the carburetor, and install a new one, reversing the removal procedures.

20 To replace the CMH relay, disconnect the two connectors and replace the faulty relay with a new one.

20 EFI system self diagnosis capability - general information

The EFI system control unit (computed has a built-in self diagnosis system which

Malfunction codes for 1984 models

Number of blinks	System	Trouble area
1 blink	System normal	No malfunction
2 blinks	Airflow meter signal (Ve)	1) Airflow meter circuit (Ve, Vs) 2) Airflow meter 3) Computer
3 blinks	Airflow meter signal (Vs)	1) Airflow meter circuit (VB, Ve, Vs) 2) Airflow meter 3) Computer
4 blinks	Water thermo sensor signal	1) Thermo sensor circuit 2) Thermo sensor 3) Computer
5 blinks	Oxygen sensor signal	1) Sensor circuit 2) Sensor 3) Computer
6 blinks	Ignition signal	1) Ignition system circuit 2) Distributor 3) Ignition coil and igniter 4) Computer
7 blinks	Throttle position sensor signal	1) Sensor circuit 2) Sensor 3) Computer

Malfunction codes for 1985, 1986, 1987 normally aspirated fours; 1986 thru 1988 turbos

1 blink	Same as 1984	Same as 1984
2 blinks	Airflow meter signal	1) Airflow meter circuit 2) Airflow meter 3) Computer
3 blinks	Ignition signal	1) Igniter circuit (+B, IGT, IGF) 2) Igniter 3) Computer
4 blinks	Same as 1984	Same as 1984
5 blinks	Same as 1984	Same as 1984
6 blinks	RPM signal	1) Igniter circuit 2) Igniter 3) Distributor 4) Computer
7 blinks	Same as 1984	Same as 1984
8 blinks	Intake air thermo sensor signal	1) Sensor circuit 2) Sensor 3) Computer
10 blinks	Starter signal	1) Speed sensor circuit 2) Main relay circuit 3) Ignition switch circuit 4) Ignition switch 5) Computer
11 blinks	Switch signal	1) AC switch 2) Throttle position sensor circuit 3) Throttle position sensor 4) Computer
12 blinks	Knock control sensor	1) Knock control sensor circuit 2) Knock control sensor 3) Computer
13 blinks	Knock control CPU	Computer
14 blinks	Turbocharger pressure•	1) Turbocharger 2) Air flow meter 3) ECU

•22R-TE engine only

detects malfunctions in the system sensors and alerts the driver by illuminating a CHECK ENGINE warning light in the instrument panel. The computer stores the failure code until the diagnostic system is cleared by removing the EFI fuse with the ignition switch off. The warning light goes out automatically when the malfunction is repaired.

The CHECK ENGINE warning light should come on when the ignition switch is placed in the On position. 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.

To determine which sensor or system component is malfunctioning, connect a jumper wire across terminals T and E of the CHECK ENGINE harness connector. On 1986 and earlier models, the connector is located near the ignition coil. On 1987 and later models, the terminals are identified as T and E1. or TE1 and E1 and the connector is located near the fuse box (see Chapter 1, Section 39, **illustration 39.6).** Make sure the battery voltage is greater than 11 volts, the transmission is in Neutral, the accessories are off, the

1988 and later models

Code No.	Number of blinks "CHECK ENGINE"	System	Diagnosis	Trouble area
-	ON __J]J1J1JU'IfiJ OFF	Normal	This appears when none of the other codes are identified.	-
11	_fLJ1_	ECU I+B)	Momentary interruption in power supply to ECU.	• IG switch circuit • IG switch • Main relay circuit •Main relay <>ECU
12	_J1J1JL_	RPM Signal	NO "Ne and G" signal to ECU within 2 seconds after the engine is cranked.	"Distributor circuit o Distributor • Starter signal circuit •ECU
13	_JLJlJffi_	RPM Signal	NO "Ne" signal to ECU when engine speed is above 1,000 rpm.	• Distributor circuit • Distributor •ECU
14	_JlJlJ1J1Jl_	Ignition Signal	NO "IGf" signal to ECU 6 - 8 times in succession.	• Igniter and ignition coil circuit • Igniter and ignition coil
21 or 27 (Cal only)	-1UUL	Oxygen Sensor Signal	• Detection of oxygen sensor detrioration.	eOxygen sensor circuit •Oxygen sensor •ECU
		Oxygen Sensor Heater Signal	o Open or short circuit in oxygen sensor heater signal (HT).	• Oxygen sensor heater circuit • Oxygen sensor heater •ECU
22	_J1J1JUL_	Water Temp. Sensor Signal	• Open or short circuit in water temp. sensor signal (THW).	• Water temp. sensor circuit • Water temp. sensor •ECU
24		Intake Air Temp. Sensor Signal	• Open or short circuit in intake air temp. sensor signal {THA).	• Intake air temp. sensor circuit • Intake air temp. sensor oECU
25	--1UlJlJUlM_	Air-fuel Ratio Lean Malfunction	• When the air-fuel ratio feedback correction value or adaptive control valve feedback frequency is abnormally high during feed-back condition. • Open circuit in oxygen sensor signal (Ox).	• Injector circuit o Injector o Fuel line pressure • Ignition system • Oxygen sensor circuit • Oxygen sensor • Air flow meter • Water temp. sensor •ECU
26	___M.1UlMfUL	**Air-fuel Ratio Rich Malfunction**		• Injector circuit • Injector • Fuel line pressure • Cold start injector o Air-flow meter oECU

Continued next page

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.

The diagnostic code is the number of flashes indicated on the CHECK ENGINE light. Normal system operation (code 1 - no malfunction) will produce one blink every three seconds (one blink every **4-1** /2 seconds for 1985 and later models). If any malfunction bas been detected, the light will blink from two to seven times every three seconds (two to thirteen times every 4-1 /2 seconds for later models). The accompanying tables explain the code that will be flashed for each of the malfunctions. The accompanying charts indicate the diagnostic code - in flashes - along with the system, diagnosis and specific areas. Note that the codes for 1988 non-turbo and V6 vehicles are displayed somewhat differently than the other models. With codes above 10, the flashes appear with a pause between the two numbers, i.e. code 21 will have two quick flashes, then a short pause followed by one flash. The code will be repeated as long as the jumper wire is attached.

After the diagnosis check, remove the jumper wire and install the rubber cap in the check engine wire harness connector. Check the indicated system or component or take the vehicle to a dealer service department to have the malfunction repaired.

After repairs have been made, the diagnostic code must be canceled by removing the EFI fuse for 30 seconds or more with the ignition switch off. The lower the air temperature, the longer the fuse must be left out.

After cancellation, perform a road test and make sure the warning light does not come on. If desired, the check can be repeated to confirm that code 1 (system normal) is flashed. If the original trouble code is repeated, additional repairs are required.

1988 and later models (continued)

Code No.	Number of blinks "CHECK ENGINE"	System	Diagnosis	Trouble area
31	__fifUlj1__	Airflow meter signal or vacuum switch signal	Open circuit in Ve signal or short circuit between Vc and E2 when idle contacts are closed. Open or short in vacuum switches.	Air flow meter circuit Air flow meter, ECU Vacuum switch signal Vacuum switches. EGR
32	_J1J1J1J1J1_	Air flow Meter Signal	• Open circuit in E_2 or short circuit between Ve and Vs.	•Airflow meter circuit •Airflow meter •ECU
41	___J1JlJlJlJl_	Throttle Position Sensor Signal	• Open or short circuit in throttle position sensor signal (VTA).	• Throttle position sensor circuit • Throttle position sensor •ECU
42	-11JUl.flJ1Jl	Vehicle Speed Sensor Signal	• No "IDL" signal or No "NSW" signal or "A/C" signal to ECU, with the check terminals E_1 and T shorted. • No !"SPD" signal to ECU for 8 seconds when engine speed is between 1,500 rpm and 4,000 rpm and coolant temp. is above 80° C except when racing the engine.	• Vehicle speed sensor circuit • Vehicle speed sensor •ECU
43	_f1f1f1f1Jffif1	Starter Signal	• NO "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving.	• IG switch circuit • IG switch •ECU
52	-1U1flJ1JLJlfL	Knock Sensor Signal	• Open circuit in knock sensor signal (KNK).	• Knock sensor circuit • Knock sensor •ECU
53	_flilfU1fU1flJL	Knock Control Signal in ECU	• Knock control program faulty.	•ECU
71	California only JlflfUlJUUlJl	EGR System Malfunction	• EGR gas temp. below pre• determined level during EGR operation. • Open circu1it EGR gas temp. sensor signal (THG).	• EGR valve • EGR hose • EGR gas temp. sensor circuit • EGR gas temp. sensor • VSV for EGR circuit •ECU
51	_MUlIUlfL	Switch Signal	• Air conditioner switch ON, neutral start switch OFF, idle switch OFF during diagnosis check.	•A/C switch circuit •A/C switch •A/C Amplifire • Throttle position sensor circuit • Throttle position sensor •ECU

Chapter 7 Part A
Manual transmission

Contents

	Section
General information	1
Lubricant level check	See Chapter 1
Lubricant replacement	See Chapter 1
Manual transmission overhaul - general information	5
Manual transmission - removal and installation	4
Oil seal replacement	2
Shift lever - removal and installation	3

Specifications

Torque specifications	**Ft-lbs**
Clutch bellhousing-to-engine bolt	
L43 37 to 50	
L45, 48, 52	37 to 50
W42, 46, 50	37 to 50
W46, 55, 56	27
G52 37 to 50,	
G40, 57, 58	53
R150, 151	53
Stiffener plate bolt (R150, 151)	27
Speedometer driven gear	7 to 11

1 General information

Refer to illustrations 1.1a and 1.1b

All vehicles covered in this manual are equipped with either a 4 *or* 5-speed manual transmission or an automatic transmission **(see illustrations).** All information on the manual transmission is included in this Part of Chapter 7. Information on the automatic transmission can be found in Part B. Information on the transfer case used on 4WD models can be found in Part C.

Due to the complexity, unavailability of replacement parts and the special'tools necessary, internal repair procedures-r-or the manual transmission is not recommended for the home mechanic. The information contained within this manual will be limited to general information, seal replacement and removal and installation procedures.

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

2 Oil seal replacement

1 Oil leaks frequently occur due to wear of the extension housing oil seal and bushing, and/or the speedometer drive gear oil seal and O-ring. Replacement of these seals is relatively easy, since the repairs can usually be performed without remol(ing the transmission from the vehicle .

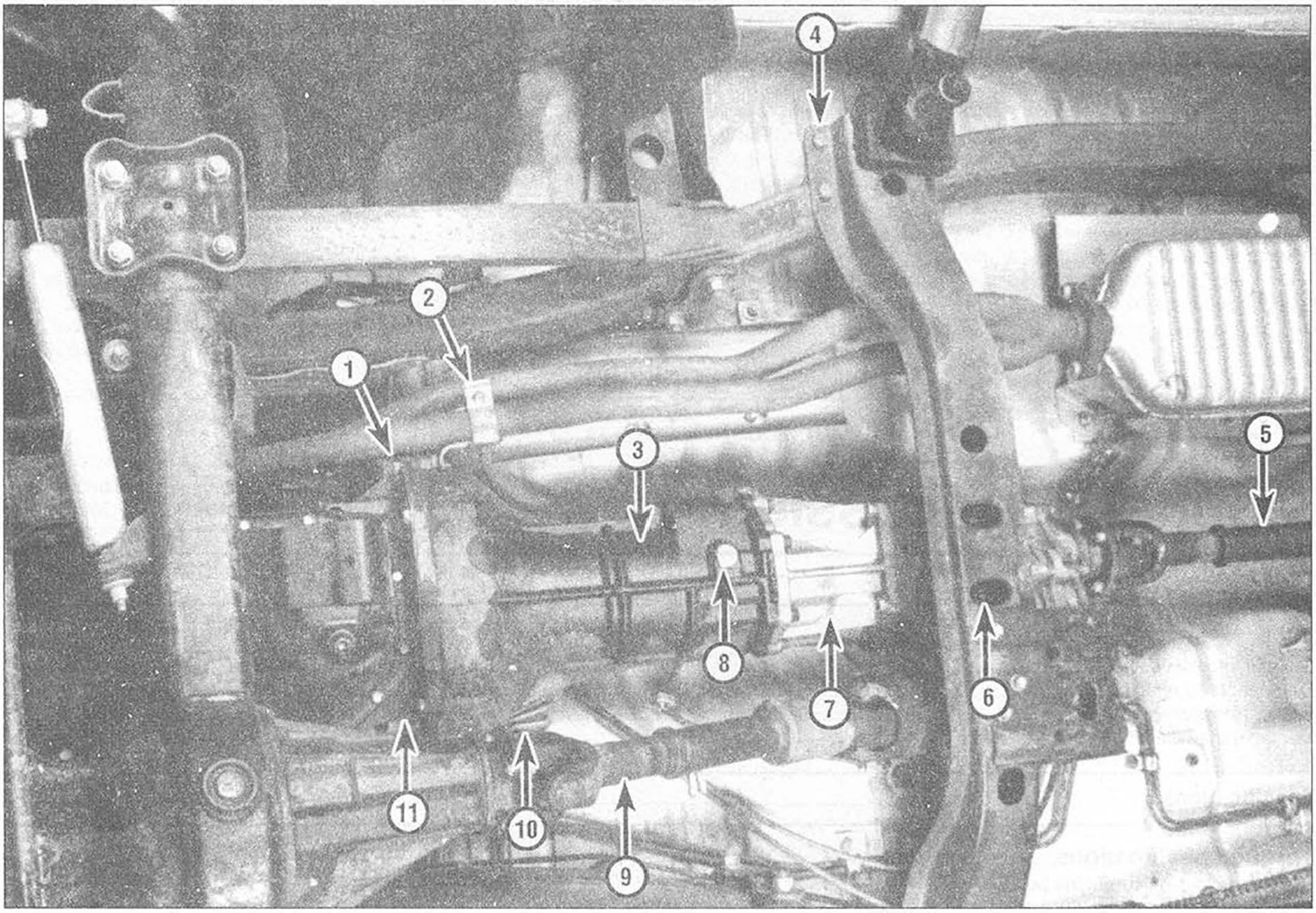
Extension housing

2 The extension housing oil seal is located at the extreme rear of the transmission, where the driveshaft is attached. If leakage at the seal is suspected, raise the rear of the vehicle and support it securely on jackstands. Be sure to block the front wheels to keep the vehicle from rolling. If the seal is leaking, transmission lubricant will be built up on the front of the driveshaft and may be dripping from the dust shield at the rear of the transmission.

3 Refer to Chapter 8 and remove the driveshaft.

4 Using a soft-faced hammer, carefully tap the dust shield to the rear and remove it from the transmission. Be careful not to distort it.

5 Using a screwdriver or pry bar, carefully pry the oil seal and bushing out of the rear of the transmission. Do not damage the splines on the transmission output shaft.



1.1a Typical 4WD transmission and related components

1 Transmission housing bolts
2 Exhaust pipe clamp
3 Transmission
4 Rear support member bolts
5 Rear driveshaft
6 Rear mounting bolts
7 Transfer case
8 Transmission drain plug
9 Front driveshaft
10 Clutch release cylinder
11 Starter

6 If the oil seal and bushing cannot be removed with a screwdriver or pry bar, it may be necessary to obtain a special seal removal tool, available at your dealer or an auto parts store.

7 Using a large section of pipe or a very large deep socket as a drift, install the new oil seal. Drive it into the bore squarely and make sure that it is completely seated. Install a new bushing using the same method .

8 Reinstall the dust shield by carefully tapping it into place.

Lubricate the splines of the transmission output shaft and the outside of the driveshaft sleeve yoke with lightweight grease, then install the driveshaft. Be careful not to damage the lip of the new seal.

Speedometer driven gear

9 The speedometer cable and driven gear housing is located on the side of the extension housing. Look for transmission oil around the cable housing to determine if the seal and 0-ring are leaking.

10 Disconnect the cable housing with pliers.

11 Using a wrench, remove the speedometer driven gear housing.

12 Remove the driven gear from the housing.

13 Using a hook, remove the seal.

14 Using a small socket of the appropriate diameter or other similar tool as a drift, install the new seal.

15 Install a new 0-ring to the driven gear housing and reinstall the driven gear housing and cable assembly to the extension housing.

3 Shift lever - removal and installation

Refer to illustration 3.3

1 Remove the console (if equipped) and shift boot screws.

2 Place the shift lever in Neutral.

3 Remove the shift lever retainer-to-transmission bolts/screws **(see illustration)** .

4 To disconnect the shift lever from the transmission, on some older models, a special tool, available from Toyota dealers, is needed to detach the shift lever.

5 Lift the shift lever assembly from the transmission.

6 Installation is the reverse of removal.

4 Manual transmission - removal and installation

Removal

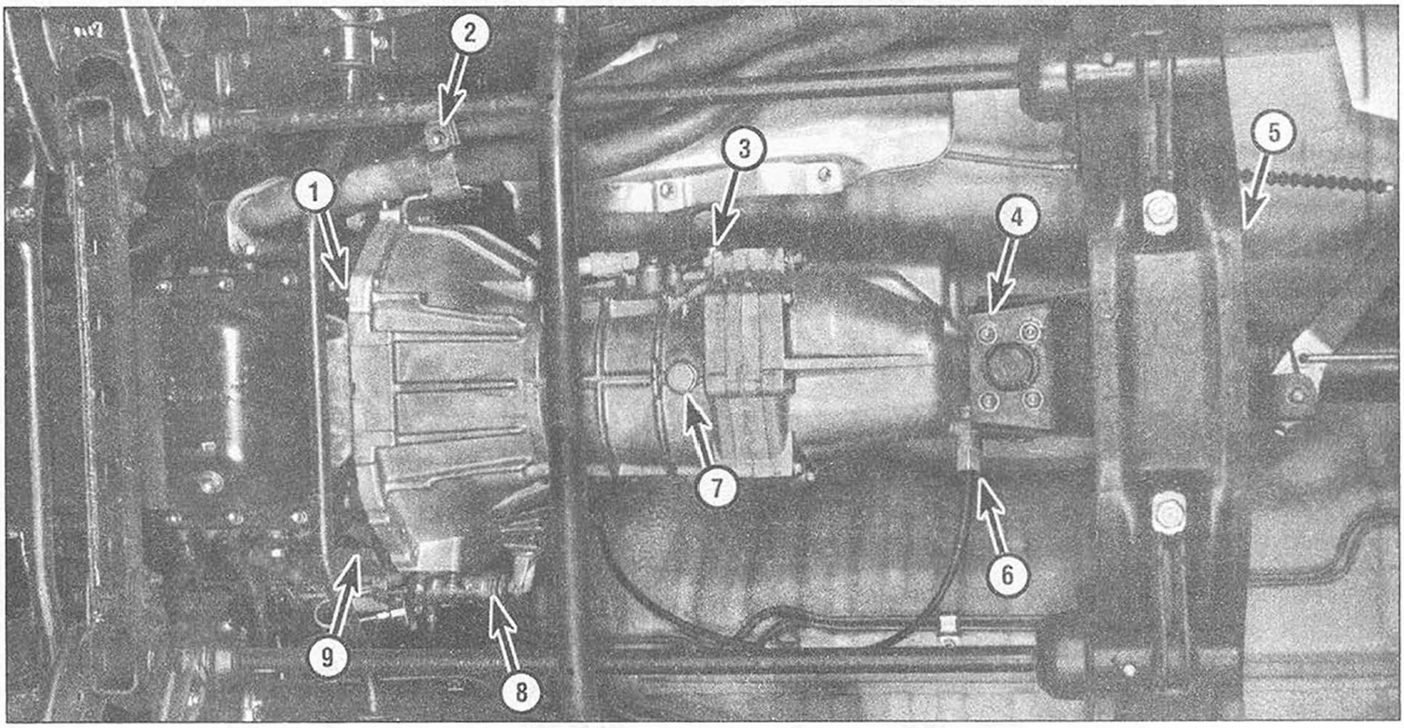
1 Disconnect the negative cable at the battery.

2 On 1989 and later models, remove the fan shroud.

3 From inside the vehicle, remove the shift lever (see Section 3). On 4WD models, use pliers to disengage the snap-ring and remove the transfer case shift lever.

4 Raise the vehicle and support it securely on jackstands.

5 Disconnect the speedometer cable and electrical connections from the transmission and, if equipped, the transfer case **(see illustrations 1.1a and 1.1b).**



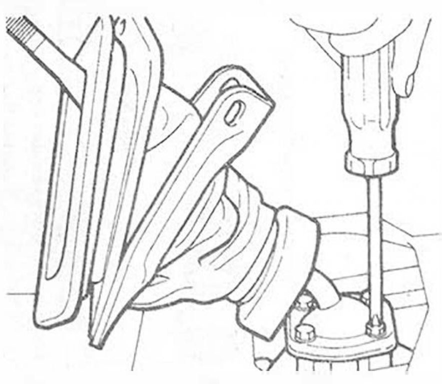
1.1 b Typical 2WD transmission and related components

1 Transmission housing bolts
2 Exhaust pipe clamp
3 Back-up light switch connector
4 Rear mounting bolts
5 Rear bracket bolts
6 Speedometer cable
7 Transmission drain plug
8 Clutch release cylinder
9 Starter

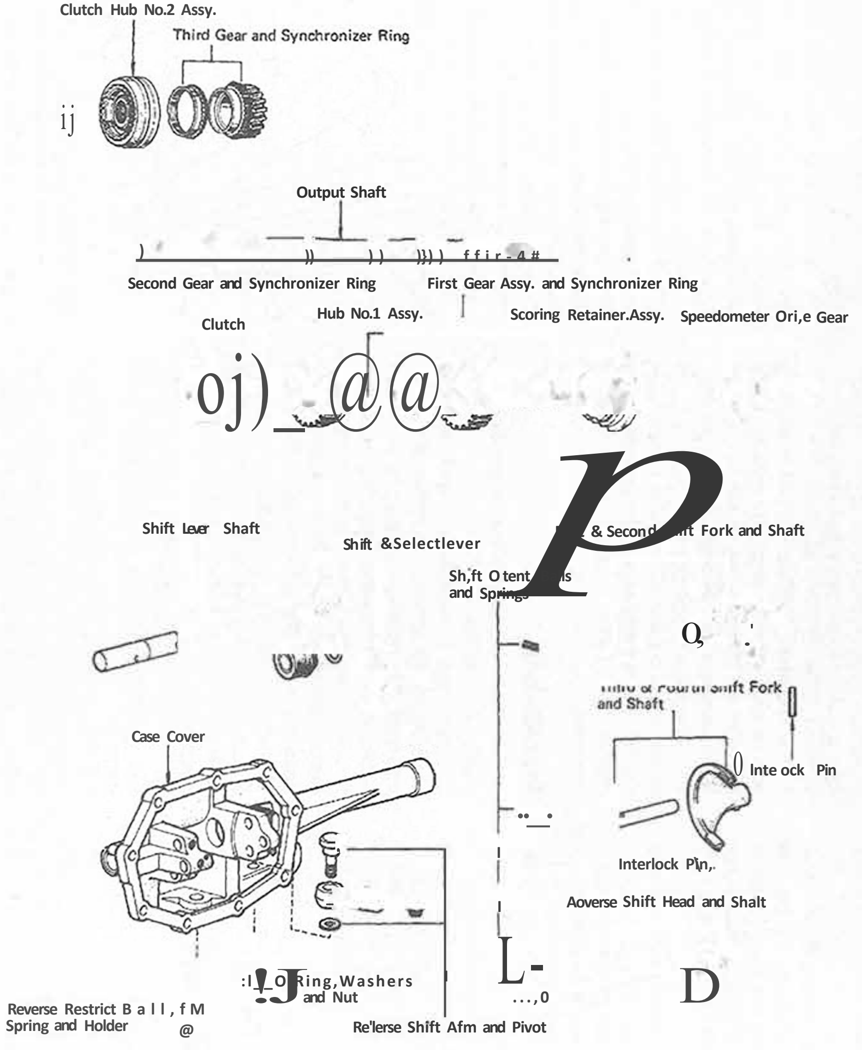
6 Remove the driveshaft (Chapter 8).
7 Drain the transmission and, if equipped, the transfer case.
8 Remove the starter motor, if possible. On some newer models you may not be able to remove the starter until the clutch release cylinder and various mounting brackets are out of the way and the transmission is partially lowered.
9 Unbolt the clutch release cylinder and fasten it out of the way.
10 Remove the exhaust system components as necessary for clearance (Chapter 4).
11 Support the engine. This can be done from above by using an engine hoist, or by placing a jack (with a block of wood as an insulator) under the engine oil pan. The engine should remain supported at all times while the transmission is out of the vehicle.
12 Support the transmission with a jack - preferably a special jack made for this purpose. Safety chains will help steady the transmission on the jack.
13 Remove the rear transmission support-to-crossmember nuts and bolts .
14 Remove the nuts from the crossmember bolts. Raise the transmission slightly and remove the crossmember.
15 Remove the bolts securing the transmission clutch housing to the engine .
16 Make a final check that all wires and hoses have been disconnected from the transmission and transfer case (4WD models) and then move the transmission and jack toward the rear of the vehicle until the clutch housing is clear of the engine dowel pins. Keep the transmission level as this is done. Be careful not to damage the extension housing dust deflector (4WD models).
17 Lower the transmission clutch housing and *remove* it from under the vehicle. **Caution:** *Do not depress the clutch pedal while the transmission is removed from the vehicle.*
18 The clutch components now can be inspected (Chapter 8). In most cases, new clutch components slhould be installed as a matter of course if the transmission is removed.

Installation

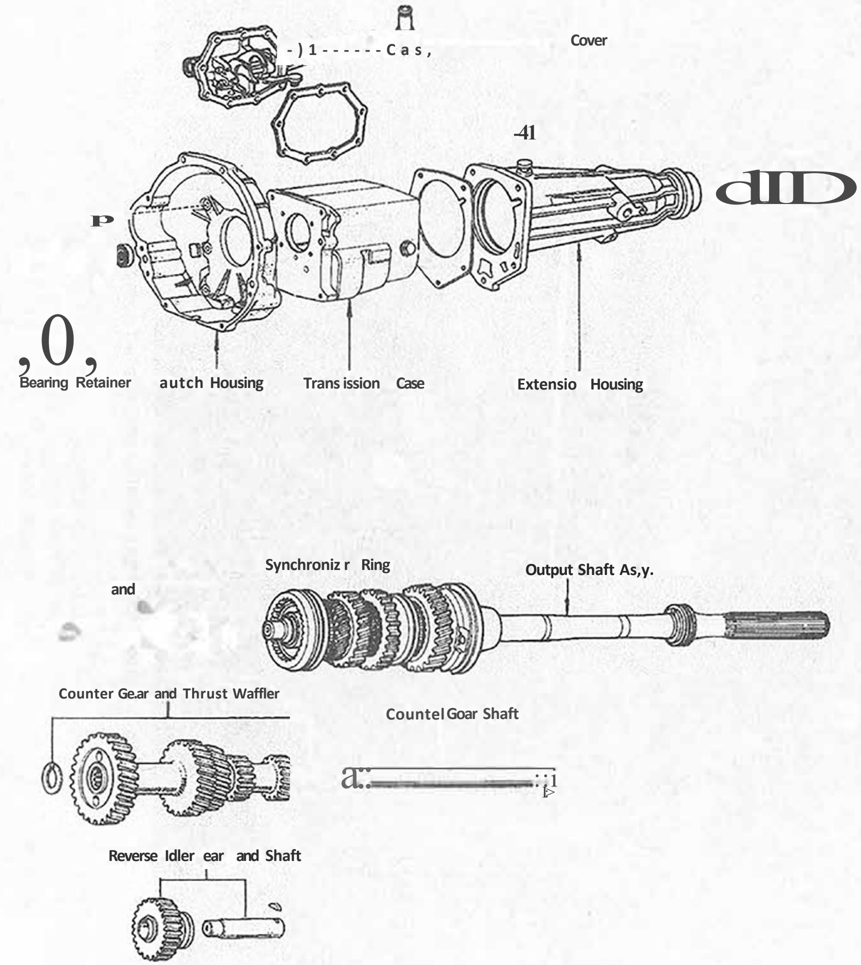
19 If removed, install the clutch components (Chapter 8).
20 With the transmission clutch housing secured to the jack as on removal, raise it into position behind the engine and then carefully slide it forward, engaging the clutch housing over the dowel pins. Do not use excessive force to install the transmission-if it does not slide into place, readjust the angle of the transmission so it is level.
21 Install the transmission/clutch housing-to-engine bolts. Tighten the bolts to the specified torque.
22 Install the crossmember and transmission support. Tighten all nuts and bolts securely.
23 Remove the jacks supporting the transmission and the engine.
24 Install the various items removed previously, referring to Chapter 8 for the installation of the driveshaft and Chapter 4 for information regarding the exhaust system components.
25 Make a final check that all wires, hoses and the speedometer cable have been connected and that the transmission and if equipped, transfer case have been filled with lubricant to the proper level (Chapter 1). Lower the vehicle.
26 From inside the vehicle connect the shift lever (see Section 2).
27 On 4WD models, install the transfer case shift lever.
28 Connect the negative battery cable. Road test the vehicle for proper operation and check for leakage.



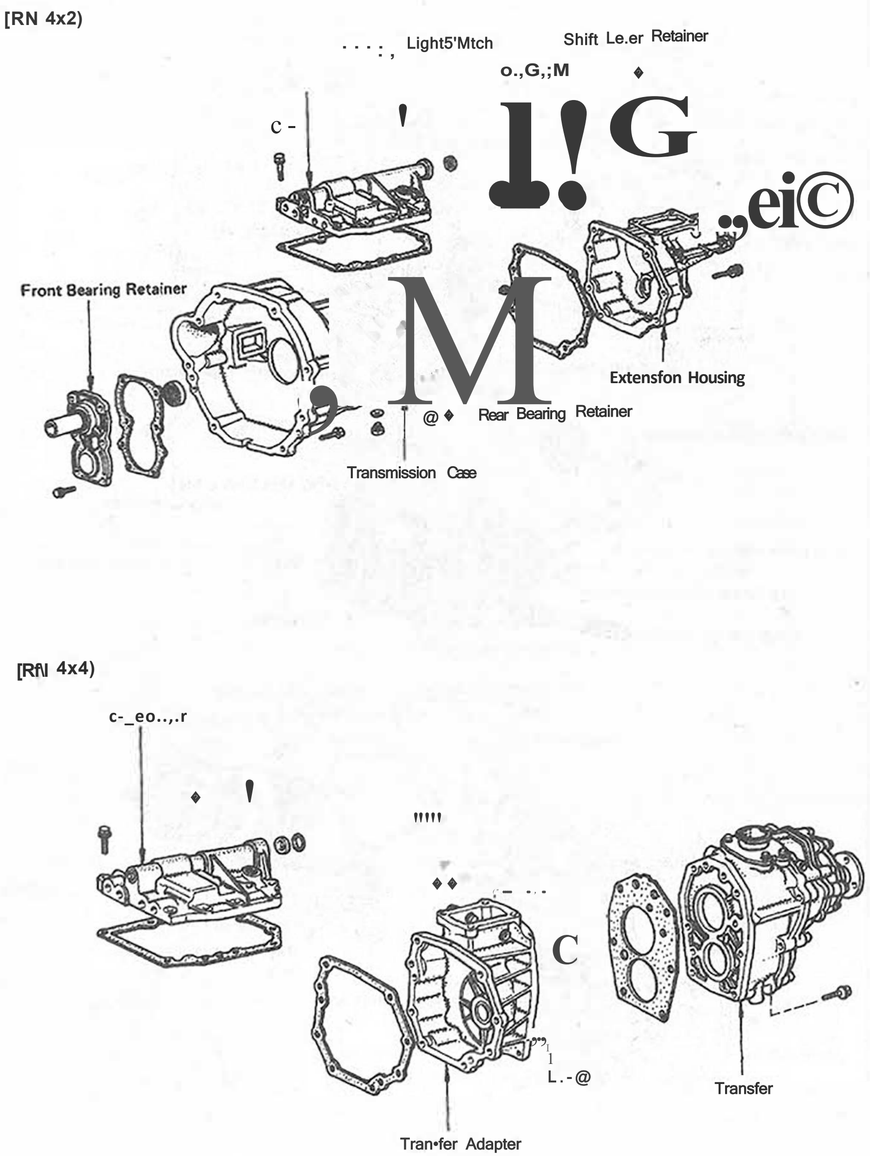
3.3 On some models a screwdriver can be used to remove the shift lever bolts/screws



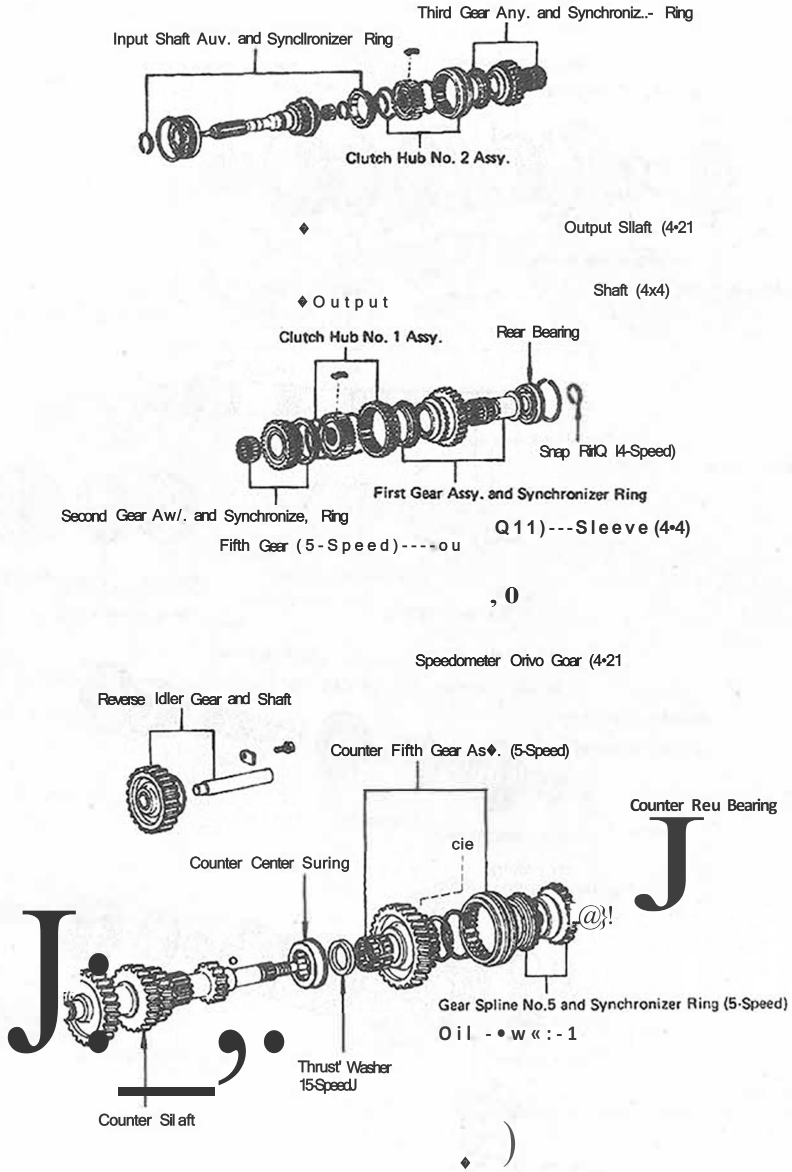
5.4a L43 transmission output shaft and shift assembly details



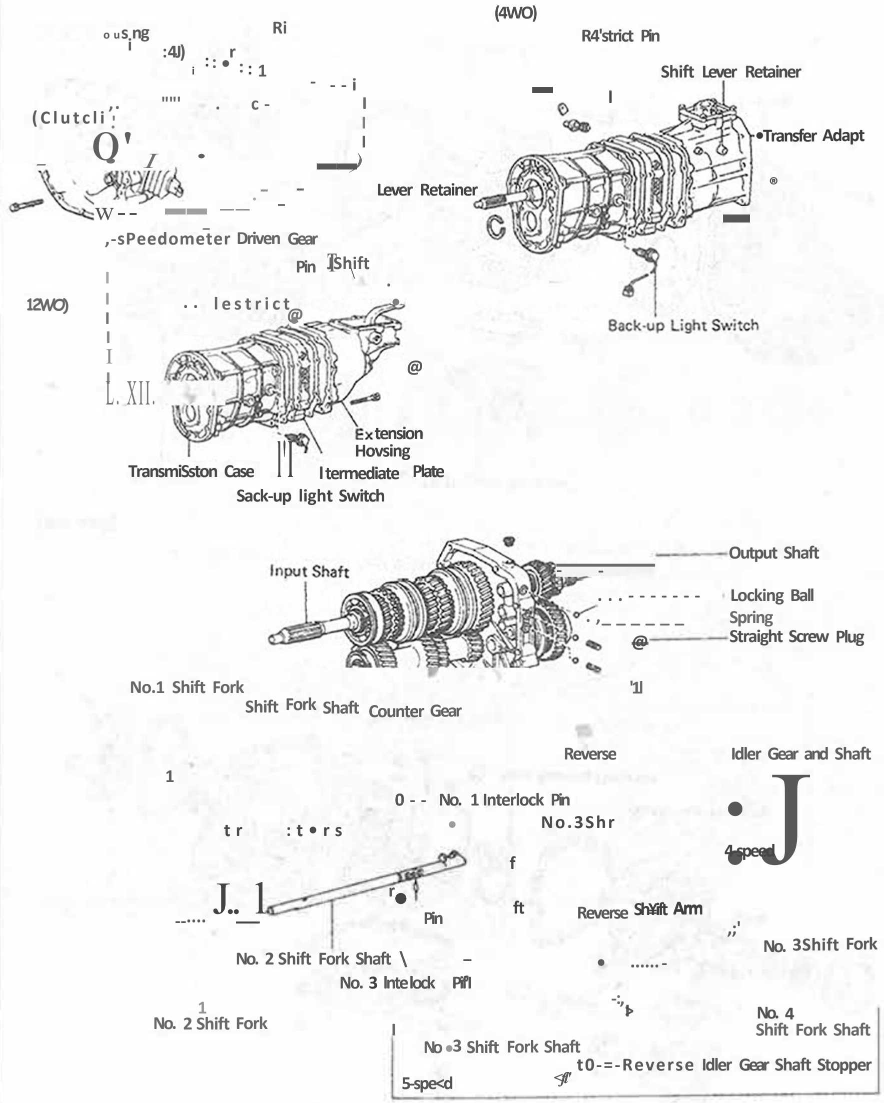
5.4b L43 transmission case and input shaft and gear details



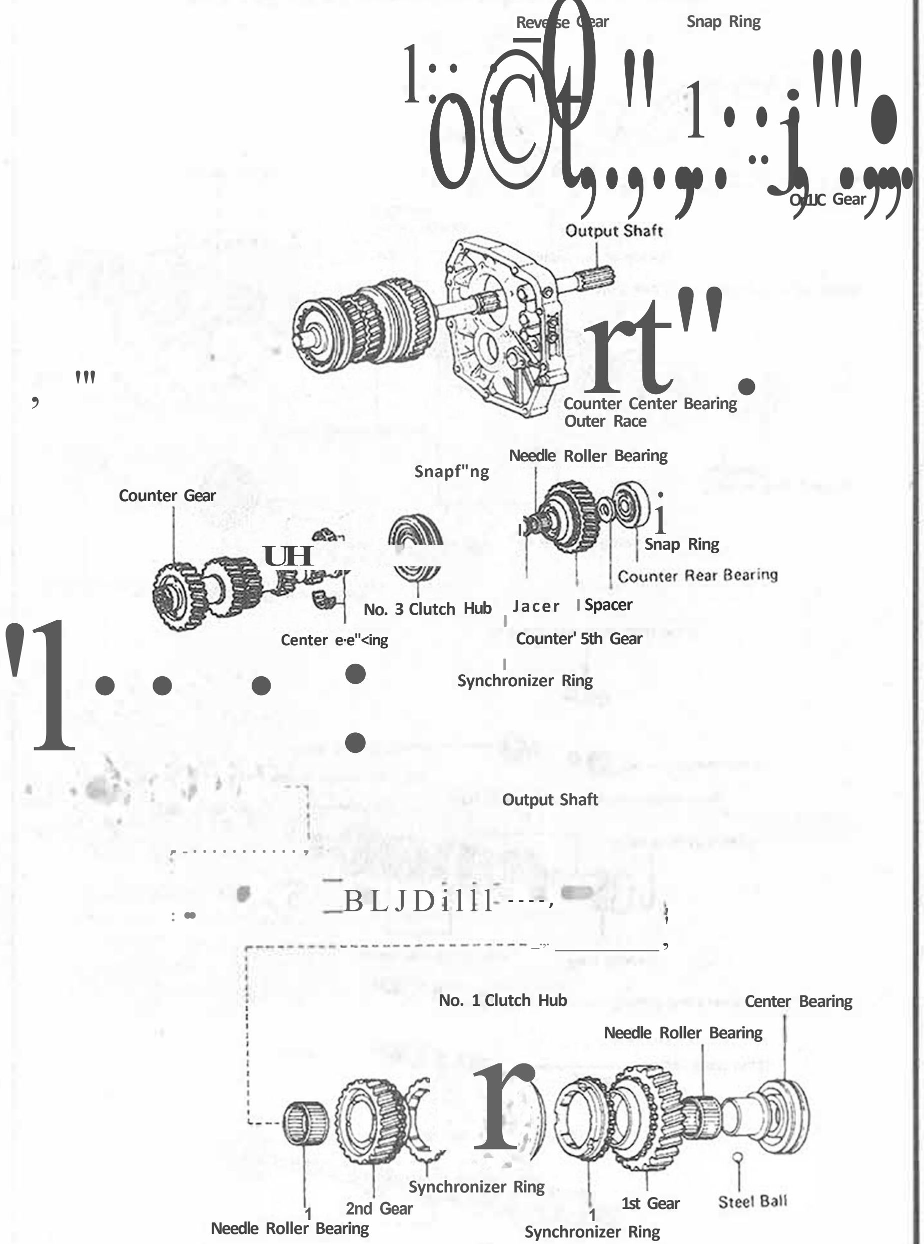
5.4c L45, 48, 52 transmission case details



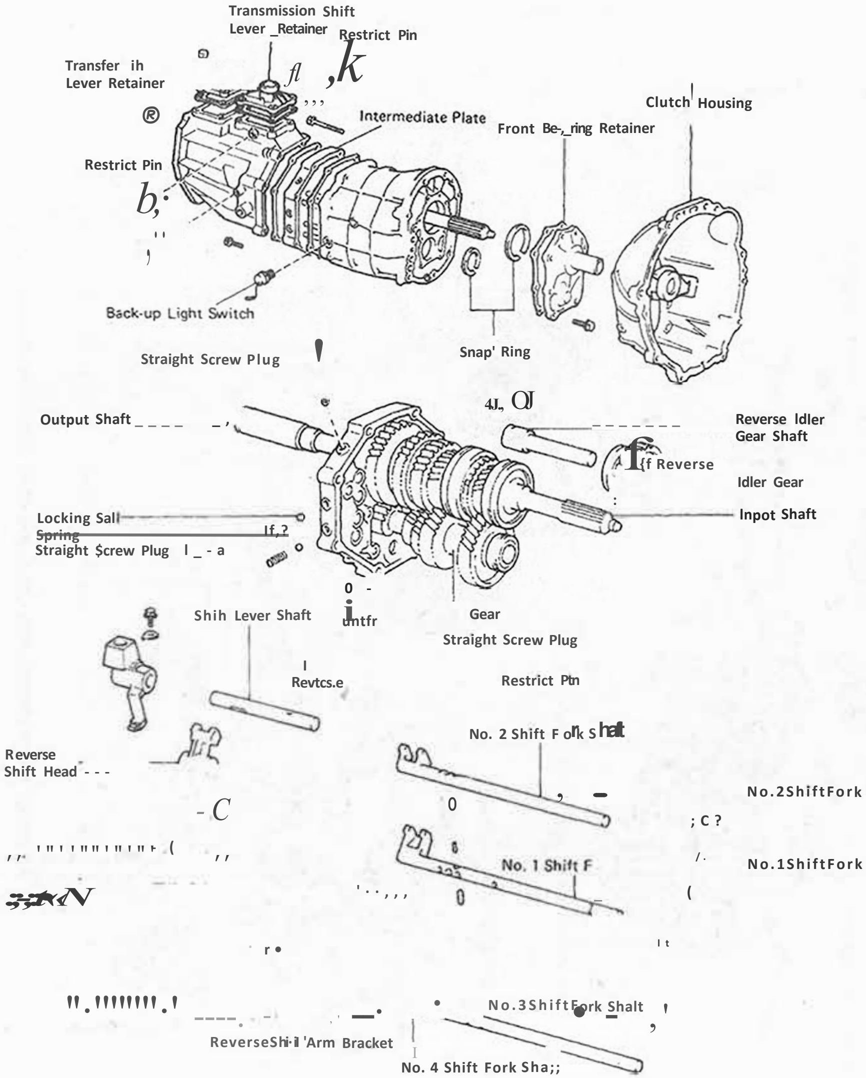
5.4d L45, 48, 52 transmission shaft and gear details



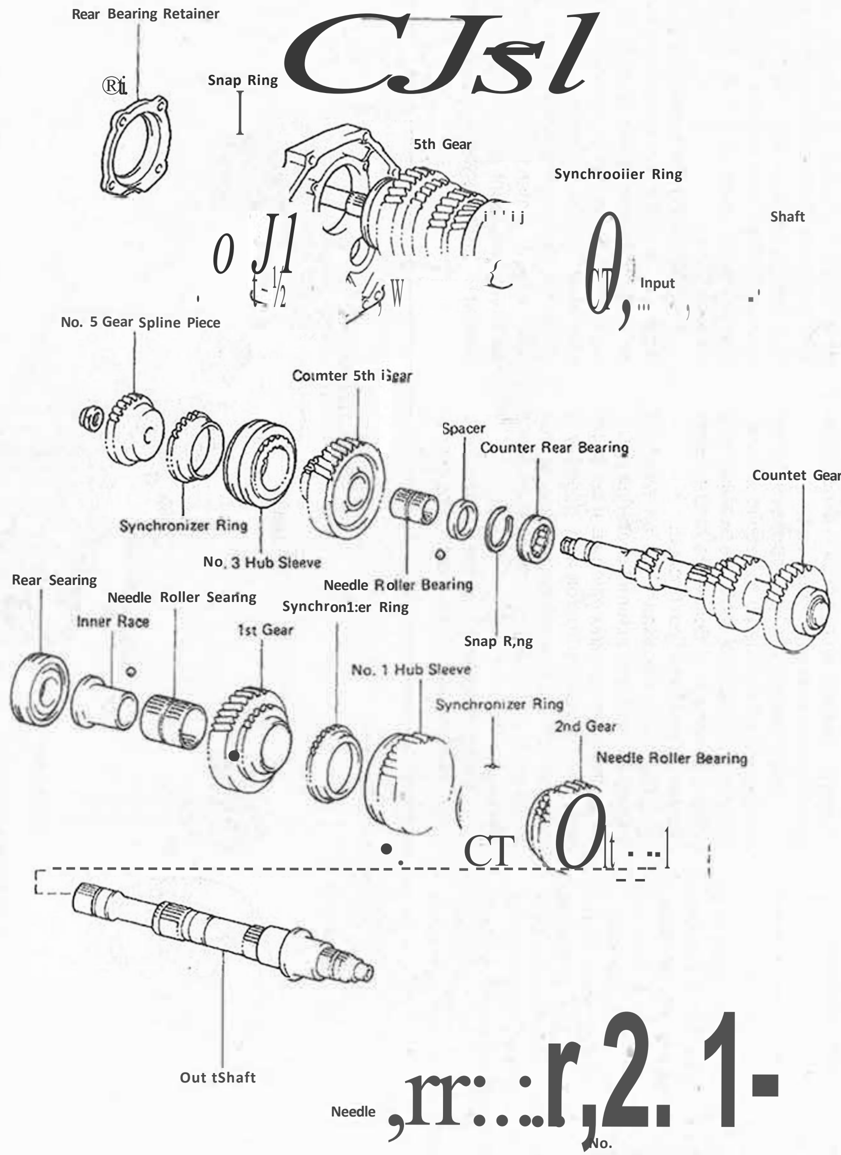
5.4e W42, 46, 50, 52, 55. 56 transmission case and shifter details



5.4f W42, 46, 50, 52, 55, 56 transmission shaft and gear details



5.4g G52 transmission case and shift assembly details



5.4h G52 transmission shaft and gear details

5 Manual transmission overhaul - general information

Refer to illustrations 5.4a through 5.4m

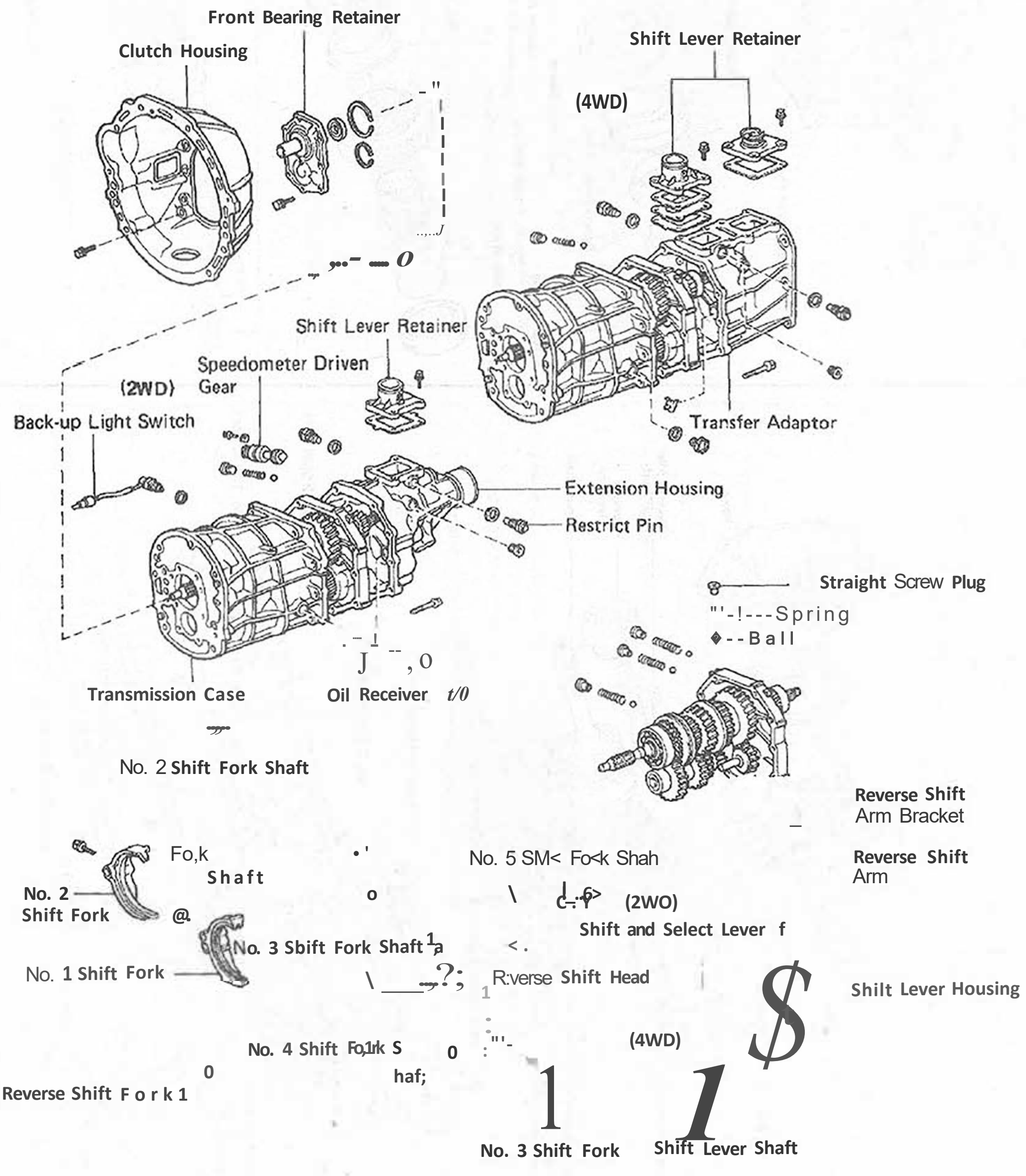
Overhauling a manual transmission is a difficult job for a do-it-yourselfer. It involves the disassembly and reassembly of many small parts. Numerous clearances must be precisely measured and, if necessary, changed with select fit spacers and snap-rings. As a result, if transmission problems arise, it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

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

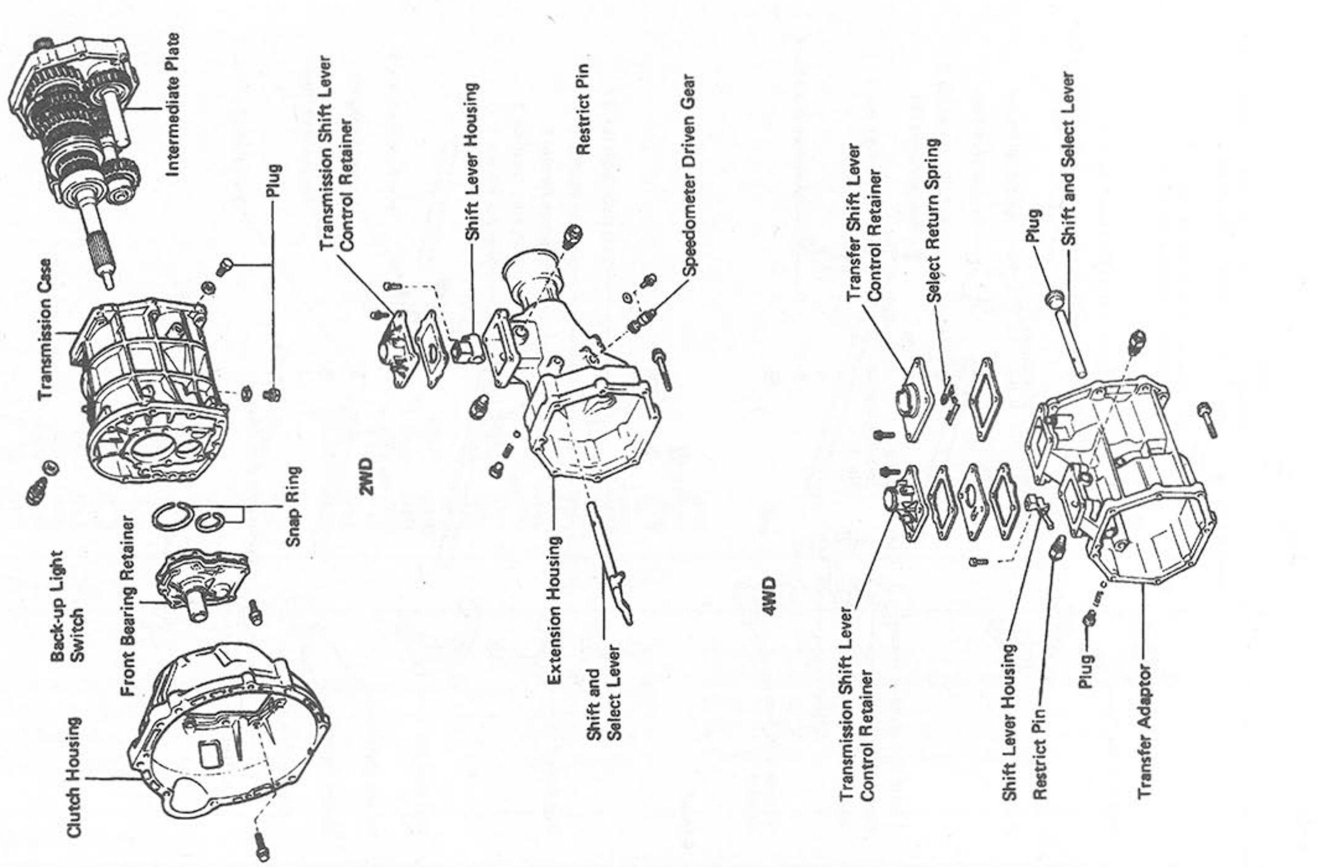
The tools necessary for an overhaul include internal and external snap-ring pliers, a bearing puller, a slide hammer, a set of pin punches, a dial indicator and possibly a hydraulic press. In addition, a large, sturdy workbench and a vise or transmission stand will be required.

During disassembly of the transmission, make careful notes of how each piece comes off, where it fits in relation to other pieces and what holds it in place. Exploded views are included **(see illustrations)** to show where the parts go-but actually noting how they are installed when you remove the parts will make it much easier to get the transmission back together.

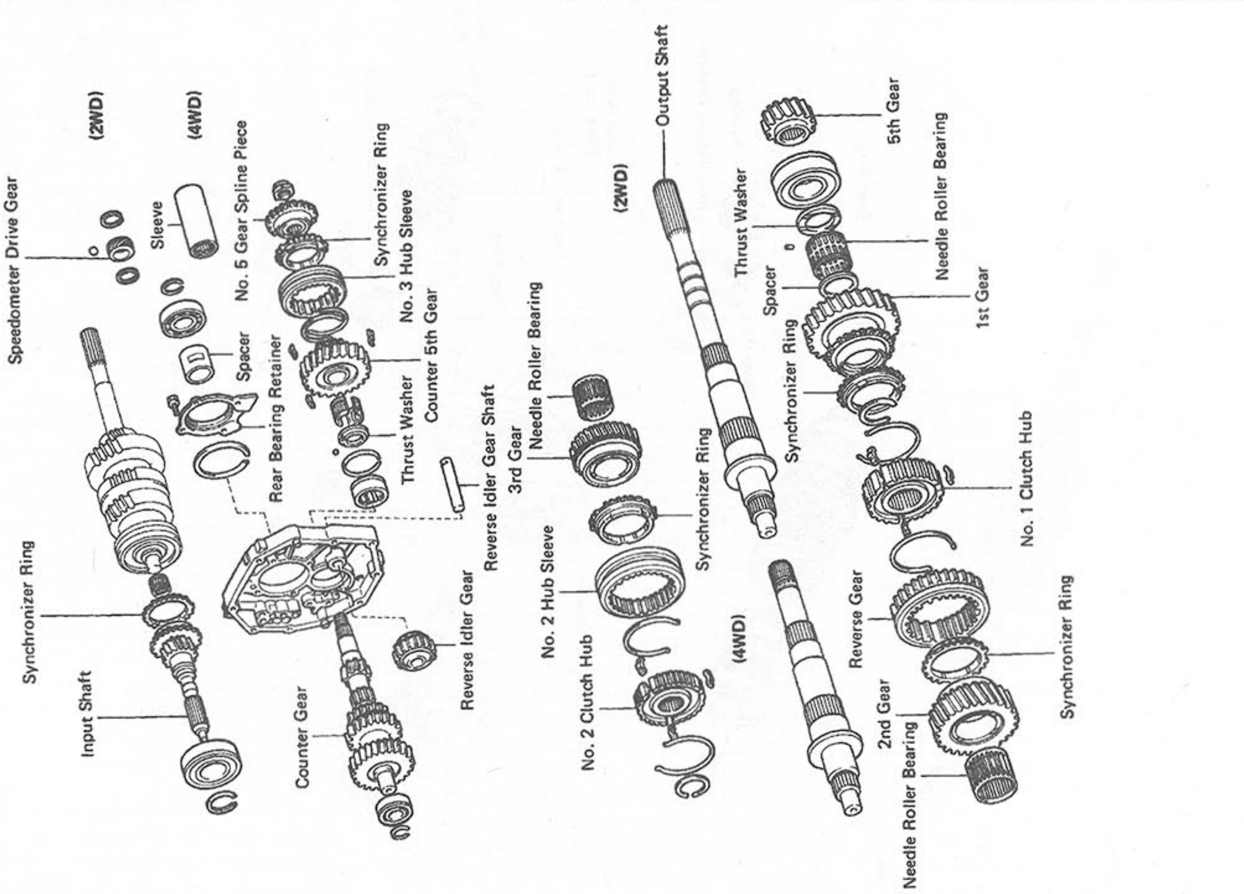
Before taking the transmission apart for repair, it will help if you have some idea what area of the transmission is malfunctioning. Certain problems can be closely tied to specific areas in the transmission, which can make component examination and replacement easier. Refer to the Troubleshooting section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



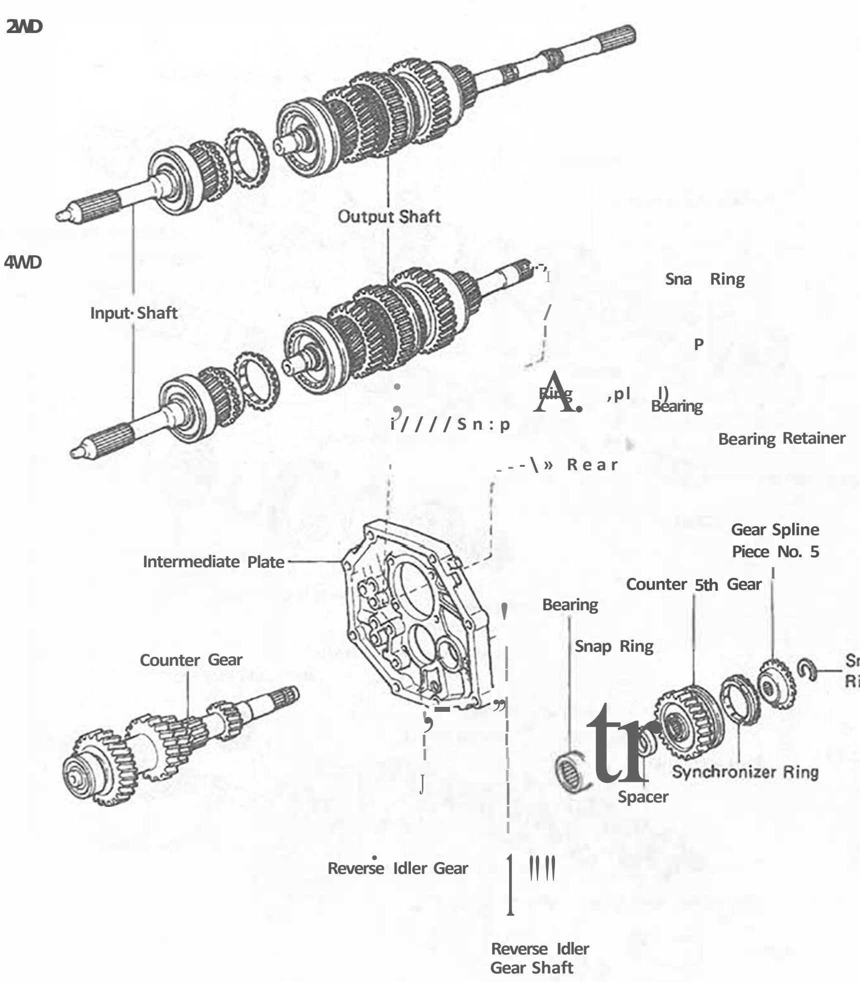
5.4i **R150, 151** transmission case and shift assembly details



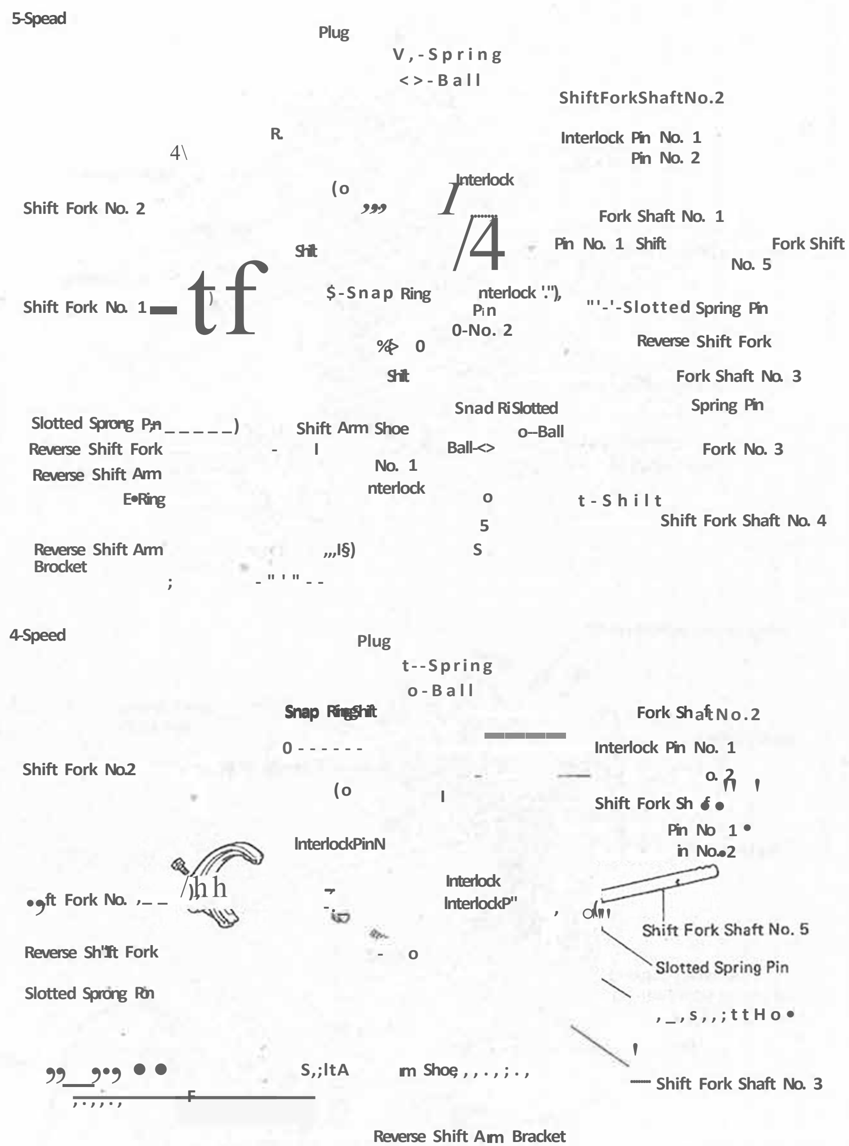
5.4k G40, 57, 58 transmission case details



5.4j R150, 151 transmission shaft and gear assembly details



5.41 G40, 57, 58 transmission shaft and gear details



5.4m G40, 57, 58 transmission shift assembly details

Chapter 7 Part B
Automatic transmission

Contents

	Section
Automatic transmission - removal and installation	6
Diagnosis - general	2
Fluid level check	See Chapter 1
Fluid and filter change	See Chapter 1
General information	1
Neutral start switch - adjustment and replacement	5
Oil seal replacement	See Chapter 7A
Shift linkage - adjustment	4
Throttle Valve (TV) linkage - adjustment	3

Specifications

Torque specifications	**Ft-lbs**
Transmission-to-engine bolt	
1979 thru 1983	37 to 57
1984 on	47
Torque converter-to-driveplate bolt	
1979 thru 1983	11 to 15
1984 on	20
Rear engine mount-to-crossmember	
1979 thru 1983	26 to 36
1984 on	9
Rear engine mount-to-extension housing	14 to 22

1 General information

All vehicles covered in this manual are equipped with either a 4- or 5-speed manual transmission or an automatic transmission. All information on the automatic transmission is included in this Part of Chapter 7. Information for the manual transmission can be found in Part A. Information on the transfer case used on 4WD models can be found in Part C.

Specialized techniques and equipment are required when working on the automatic transmissions, due to their complexity. Consequently, this Chapter addresses only those procedures concerning routine maintenance, general diagnosis and removal and installation.

If the transmission requires major repair work, it should be left to a dealer service department or an automotive transmission repair shop. You can, however, remove and install the transmission yourself and save the expense, even if the repair work is done by a transmission specialist.

2 Diagnosis - general

Note: *Automatic transmission malfunctions may be caused by five general conditions: poor engine performance, improper adjustments, hydraulic malfunctions, mechanical ma/functions 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 (Chapter 1), shift linkage adjustment and throttle linkage 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.*

Preliminary checks

1 Drive the vehicle to warm the transmission to normal operating temperature.

2 Check the fluid level as described in Chapter 1:

a) *If the fluid level is unusually low, add enotigh 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 8).*

c) *If the fluid is foaming, drain it and refill the transmission, then check for coolant in tf1e 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 valve cable for freedom of movement. Adjust it if necessary (Section 3). **Note:** *The throttle cable may function properly when the engine is shut off and cold, but it may malfunction once the engine is hot. Check it cold and at normal engine operating temperature.*
5 Inspect the shift control linkage (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.
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 it.
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 (a leaking torque converter, for instance) 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 pan periodically. Make sure the bolts are tight; no bolts are missing, the gasket is in good condition and the pan is flat (dents in the pan may indicate damage to the valve body inside).
15 If the pan gasket is leaking, the fluid level or the fluid pressure may be too high, the vent may be plugged, the pan bolts may be too tight, the pan sealing flange may be warped, the sealing surface of the transmission housing may be damaged, the gasket may be damaged or the transmission casting may be cracked or porous. If sealant instead of gasket material has been used to form a seal between the pan and the transmission housing, it may be the wrong sealant.

Seal leaks

16 If a transmission 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 0-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.

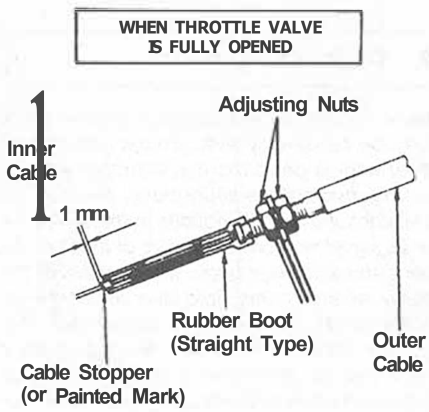
Fluid comes out vent pipe or fill tube

20 If this condition occurs, the transmission 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 Throttle valve (TV) linkage - adjustment

Refer to illustration 3.3

1 Make sure the throttle cable bracket is not bent or loose before attempting to make this adjustment. Also, the rubber boot must be seated properly on the adjuster.
2 Press the accelerator pedal all the way to the floor (an assistant would be helpful here). **Note:** *The throttle valve in the carburetor must be fully open; check and adjust if necessary.*



3.3 Throttle Valve (TV) linkage adjustment details

3 Check the distance between the end of the rubber boot and the stopper (or painted mark) on the cable **(see illustration).** It must be 0.040-inch (1 mm).
4 If the boot-to-stopper clearance is not as specified, loosen and back off the outer adjusting nut. Turn the inner adjusting nut to remove the cable housing as required to produce the specified clearance. Be sure to tighten the outer nut to lock the housing in position.

4 Shift linkage - adjustment

Refer to illustrations 4.4 and 4.8

1 This adjustment should not be considered routine and is not required unless wear in the linkage or misalignment of the shift position indicator occurs.
2 Position the shift lever in Drive, Second, Low and Reverse and make sure the transmission responds accordingly. Place the lever in Neutral, then verify that the transmission lever shifts to Neutral. Check to see if the shift position indicator registers correctly with the lever in each detent position.
3 If adjustment is required, the vehicle must be raised and supported securely on jackstands.

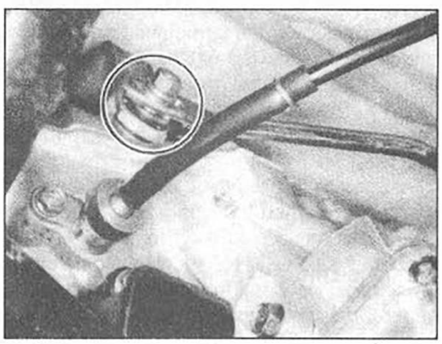
1979 thru 1983 models

Refer to illustrations 4.4 and 4.8

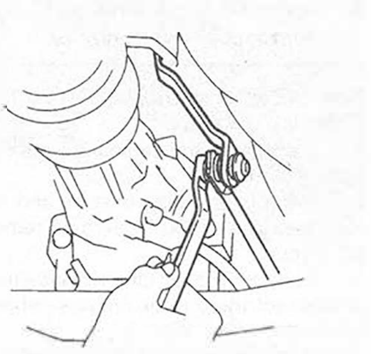
4 Working from under the vehicle, loosen the nut on the swivel connection **(see illustration).**
5 Have an assistant position the shift lever in the Neutral position detent and hold it so it cannot move. Push the transmission control rod all the way forward; the n pull it back exactly three notches. Tighten the nut on the swivel connection, then check the shift lever operation and position indicator alignment.

1984 thru 1988 models

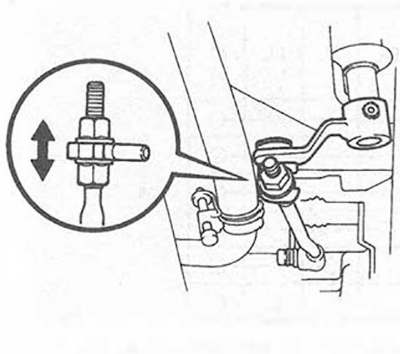
6 Push the lever on the transmission all the way to the rear, then return it two notches to the Neutral position.
7 In the passenger compartment, place the shift lever in the Neutral position.



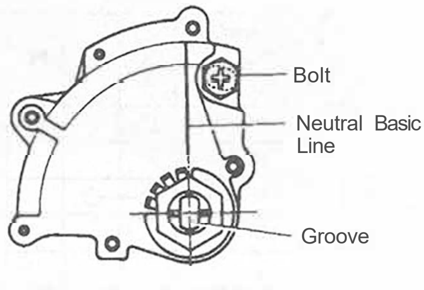
4.4 On 1979 thru 1983 models, adjust the transmission shift linkage at the point circled



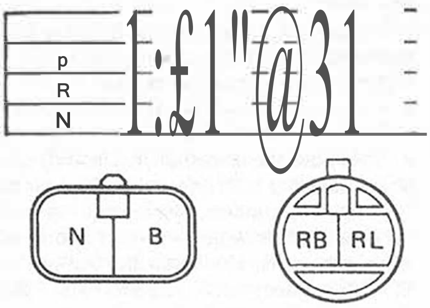
4.8 1984 thru 1988 model shift linkage adjustment point



4.9 Shift linkage on 1989 and later models

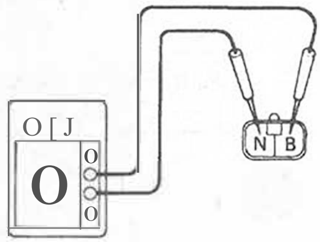


5.5 Neutral start switch adjustment details (1984 and later models)



5.8a Continuity should exist between the indicated safety switch terminals when the switch is correctly aligned (early models)

Terminal / Shift Position	B	N	RB	RL
P range	O	O		
R range			O	O
N range	O	O		



5.8b The switch connector and the continuity table look like this on later models (through 1988)

8 With the assistant holding the shift lever tightly against the stop (toward Reverse gear), tighten the linkage nut securely **(see illustration).**

1989 and later models

Refer to illustration 4.9

9 When shifting the shift lever from the Neutral position to the other positions, verify that the lever can be shifted smoothly and accurately to each position and that the position indicator correctly indicates the position. If the indicator isn't aligned with the correct position, carry out the following adjustment procedure:

- *a) Remove the nut on the cross shaft rod* **(see illustration).**
- *b) Push the cross shaft rod fully downward.*
- *c) Return the cross shaft rod three notches to the Neutral position.*
- *d) Set the shift lever to the Neutral position.*
- *e) While holding the shift lever lightly toward the Reverse position side, adjust the cross shaft rod nut.*
- *f) Tighten the cross shaft rod nut.*
- *g) Start the engine and make sure that the vehicle moves forward when shifting the lever from the Neutral to the Drive position and reverse when shifting it to the Reverse position.*

5 Neutral start switch - adjustment and replacement

Refer to illustration 5.5, 5.8a, 5.8b, 5.8c, 5.8d and 5.11

1 The neutral start switch is located on the right side of the transmission housing. Its purpose is to allow the starter to operate only when the selector lever is in Neutral or Park. It also operates the back-up lights when the lever is in Reverse.

2 If the engine can be started with the shift lever in any position other than Park or Neutral, the neutral start switch should be checked and adjusted and, if necessary, replaced.

3 Place the shift lever in Neutral.

4 Raise the vehicle and place it securely on jackstands.

5 Loosen the neutral start switch bolt **(see illustration).**

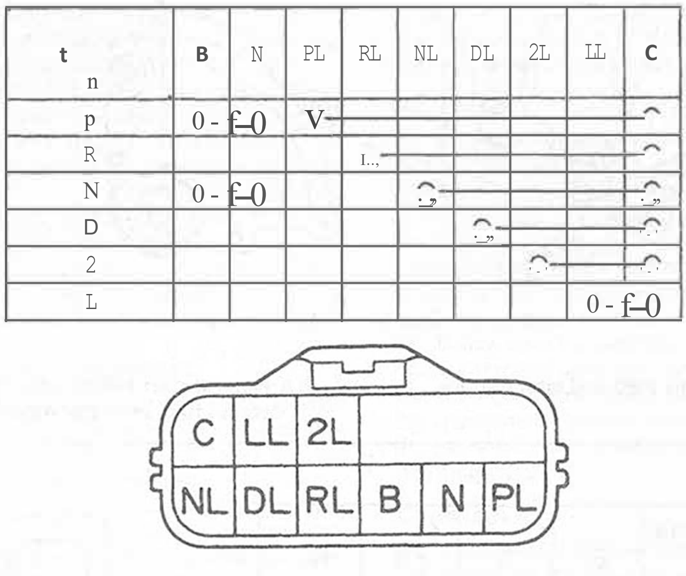
6 Align the groove in the end of the control shaft with the vertical index line on the switch by pivoting the switch.

7 Tighten the switch bolt.

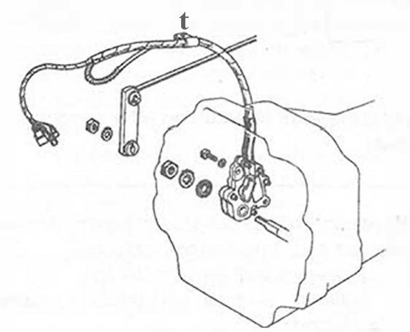
8 To verify that you've adjusted the switch properly, check for continuity between the indicated terminals of the switch electrical connector **(see illustrations).**

t n	B	N	PB	RB	NB	DB	2B	LB	C
P	O	O	O						O
R				O					O
N	O	O			O				O
D						O			O
2							O		O
L								O	O

5.8c The switch connector and the continuity table look like this on 1989 through 1992 models



5.8d The switch connector and the continuity table look like this on 1993 and later models



5.11 Typical neutral safety switch installation details

9 If the switch fails the continuity check, replace it.

10 Detach the cable from the negative battery terminal.

11 Remove the control shaft nut and washer **(see illustration).**

12 Detach the lever.

13 Bend the lock washer tangs open and unscrew the switch retaining nut. Remove the washer and grommet behind the nut.

14 Remove the switch mounting bolt.

15 Unplug the switch electrical connector, if you haven't already done so.

16 Remove the neutral start switch.

17 Installation is the reverse of removal. Make sure the grooved side of the grommet faces toward the transmission. Don't forget to bend down the tangs on the lock washer.

18 Adjust the switch as previously described.

6 Automatic transmission - removal and installation

Refer to illustrations 6.10a, 6.10b, 6.18a, 6.18b, 6.20 and 6.21

1 Disconnect the cable from the negative battery terminal.

2 Drain the cooling system and disconnect the radiator top hose, then remove the fan shroud.

3 Remove the air cleaner assembly and disconnect the throttle linkage cable at the carburetor or fuel injection.

4 Remove the upper mounting nut on the starter.

5 Raise the vehicle and support it securely on jackstands.

6 Drain the fluid from the transmission (Chapter 1).

7 Disconnect the wiring connectors to the solenoid. Neutral safety and back-up light switches located near the starter.

8 Remove the starter motor (see Chapter 5).

9 Remove the driveshaft(s). On 4WD models, remove the front driveaxles (Chapter 8).

10 On 4WD models, disconnect the transfer case shift linkage and then unbolt and remove the cross shaft **(see illustrations).**

11 Disconnect the speedometer drive cable.

12 Disconnect the manual shift linkage at the rear connection. Disconnect the fluid cooler lines from the transmission and plug them.

13 Disconnect the exhaust pipe clamp.

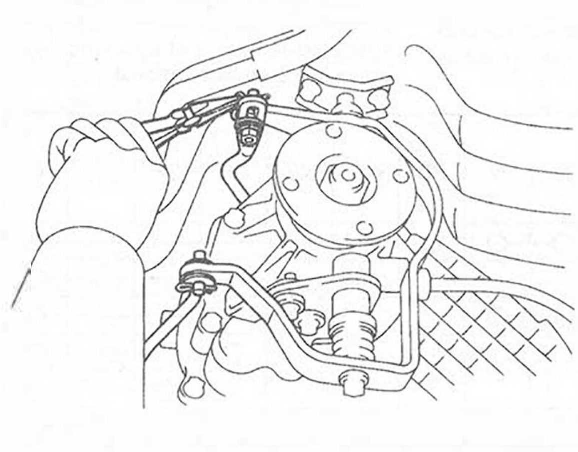
14 On 4WD models, disconnect and plug the two oil cooler lines.

15 Remove the bolt and pull the fluid filler tube from the transmission, taking care not to lose the O-rings.

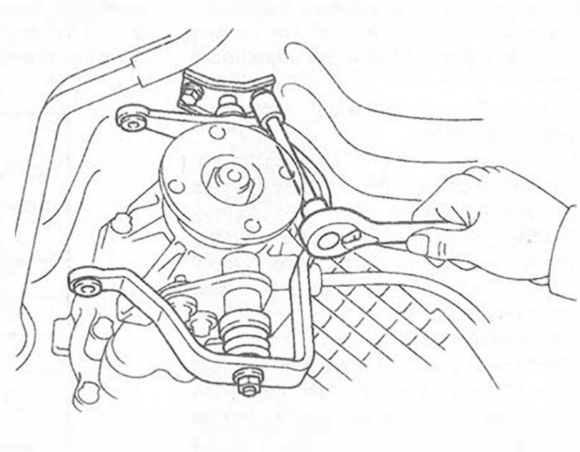
16 Remove the driveplate cover.

17 Remove the splash shield from below the radiator (if equipped).

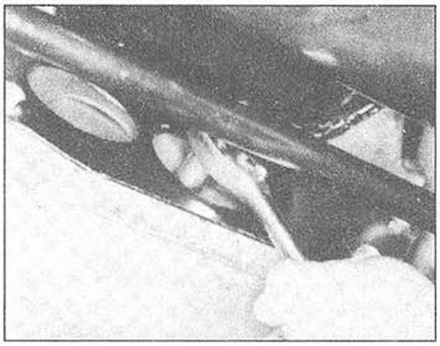
18 Support the automatic transmission with



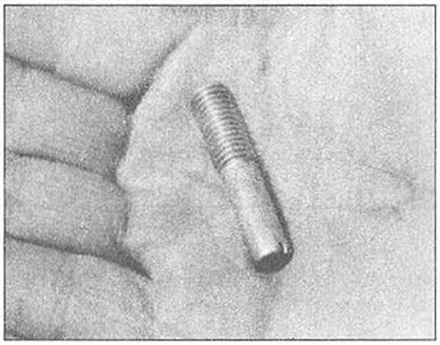
6.10a Use needle nose pliers to disconnect the transfer case linkage by pulling out the retaining pins



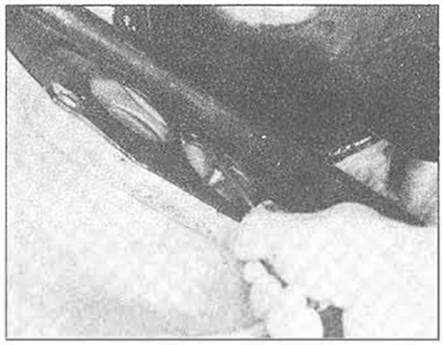
6.10b Remove the two transfer case shift cross shaft bolts with a socket and extension



6.18a Use a socket and ratchet to remove each of the six torque converter bolts in turn by rotating the crankshaft pulley bolt with a wrench



6.18b Guide pins {llke this one made by cutting the head off a bolt) are necessary for removal of the transmission



6.20 Use a large screwdriver to pry between the engine rear plate and the guide pins to move the transmission away from the engine

a jack, then remove the rear support cross-member and mount. Through the open lower half of the torque converter housing, remove the six bolts which join the driveplate and converter together. Remove them one at a time by rotating the driveplate **(see illustration).** To do this, turn the crankshaft with a wrench attached to the front pulley securing bolt. Now screw two guide pins (easily made from two old bolts) into opposite bolt holes in the front of the driveplate. then rotate the engine until they are horizontal **(see illustration).** These pins will act as pivot points during removal of the transmission.

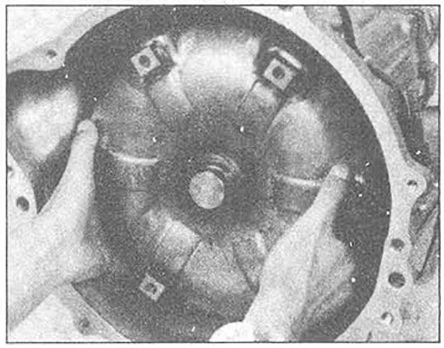
19 Place a jack under the _engine oil pan (use a block of wood to protect it), and remove the bolts which attach the torque converter housing to the engine.

20 Lower both jacks progressively until the transmission will clear the lower edge of the firewall. Insert two levers, or large screwdrivers, between the engine rear plate and the temporary pivot pins and pry the transmission away from the engine **(see illustration).** Catch the fluid which will run from the torque converter during this operation. Never position the levers between the driveplate and the torque converter as damage or distortion will result.

21 The torque converter can now be pulled forward to remove it from
the housing (see illustration). The driveplate can be unbolted from the crankshaft flange if it has to be replaced because of a worn starter ring gear (see Chapter 2).

22 The installation procedure is basically the reverse of removal. Refer to Chapter 2, Section 29, for the procedure to follow when initially attaching the transmission to the engine.

Tighten all bolts and nuts securely. using a torque wrench where necessary. Be sure to refill the cooling system and the transmission with the required fluids (see Chapter 1).



6.21 Grasp the torque converter securely and pull it from the transmission; be careful, it is quite heavy

Adjust the shift and throttle valve linkages as described in this Chapter before road testing the vehicle.

Notes

Chapter 7 Part C
Transfer case

Contents

	Section
General information	1
Oil change	See Chapter 1
Oil level check	See Chapter 1
Transfer case oil seals - replacement	2
Transfer case - removal and installation	3

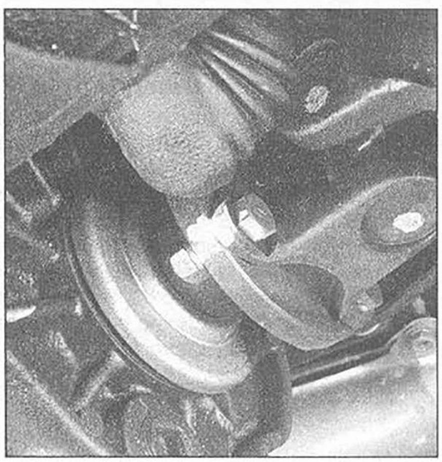
Specifications

Torque specifications	Ft-lbs
Transfer case-to-transmission bolt	
Manual transmission	29
Automatic transmission	25
Companion flange nut	
1979 to 1983	80 to 101
1984 to 1990	90
1991 to 1995	87

1 General information

Four-wheel drive models are equipped with a transfer case mounted on the rear of the transmission. Drive is passed from the engine through the transmission and the transfer case to the front and rear wheels by the driveshafts.

Because of the special tools and techniques required, disassembly and overhaul of the transfer case should be left to a dealer or properly equipped shop. You can, however, remove and install the transfer case yourself and save the expense, even if the repair work is done by a specialist.



2.2 Mark the relationship of the driveshaft to the transfer case companion flange before removing the bolts (this will ensure correct alignment of the shaft during installation)

2 Transfer case oil seals - replacement

Refer to illustrations 2.2 and 2.5

Note: *This procedure does not apply to models with the A340H automatic transmission. On models with the A340H automatic transmission, the transfer case is removed and disassembled along with the transmission.*

1 Raise the truck and support it on jackstands. Remove the transfer case rock guard and drain the oil.

2 Mark the position of the appropriate driveshaft flange in relation to the transfer case flange **(see illustration).** Remove the bolts and disconnect the driveshaft.

3 Remove the loclknut from the transfer case companion flange. To keep the flange from turning, reinstall two of the driveshaft mounting bolts and engage a pry bar between them.

4 Using a puller, remove the companion flange.

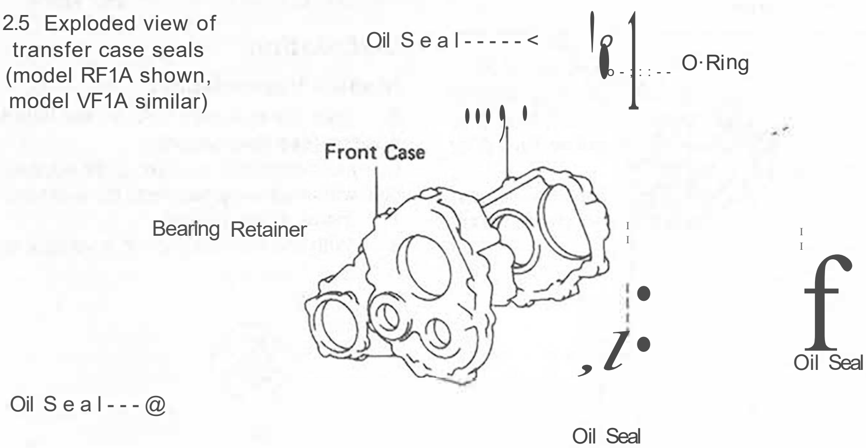
5 Carefully pry the oil seal out with a screwdriver, being sure not to scratch or damage the seal bore in the case **(see illustration).** A block of wood placed between the screwdriver and case can provide additional leverage.

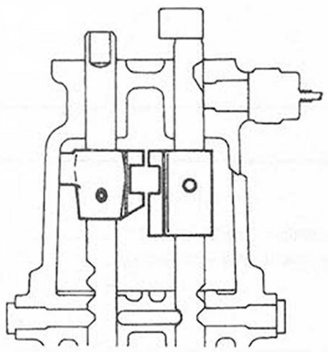
6 Lubricate the lip of the seal with gear oil and tap it into position with a socket or block of wood.

7 Place the companion flange into position. Install the locknut and tighten it to the specified torque.

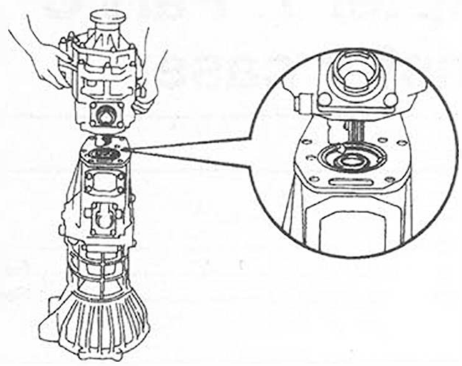
8 Reinstall the driveshaft, being sure the flange marks made during removal are aligned.

2.5 Exploded view of transfer case seals (model RF1A shown, model VF1A similar)

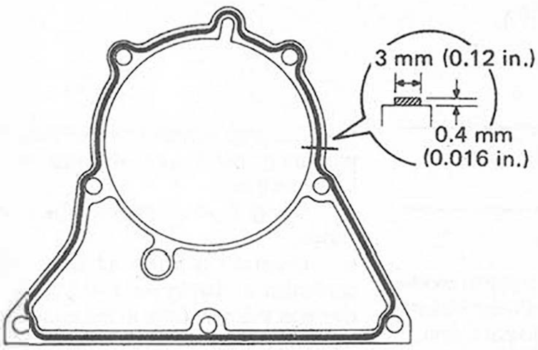




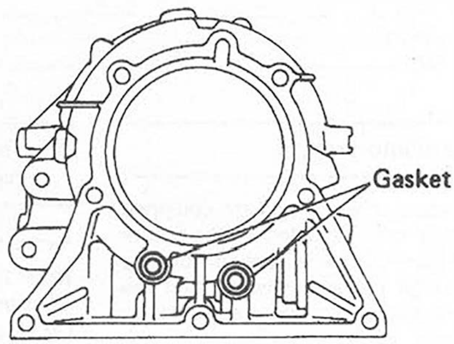
3.5 Move the shift fork shafts to the high/four position before installing the transfer case to the transmission



3.8 Lower the transfer case input shaft carefully into the transmission, taking care not to damage the oil seal (circled portion)



3.9a On the transmission, apply a bead of the specified sealant around the transmission/transfer case contact surface . . .



3.9b . . . and then install the two gaskets

9 Refill the transfer case with oil, referring to Chapter 1 if necessary.
10 Reinstall the rock guard and lower the truck to the ground.

3 Transfer case - removal and installation

Refer to illustrations 3.5, 3.8, 3.9a and 3.9b

1 Remove the transmission and transfer case from the vehicle as a unit, referring to the removal procedures in either Part A or Part B of this Chapter.
2 Carefully clean off the assembly, removing ail mounts, dampers and dust covers from the transfer case.
3 Stand the transfer case/transmission in a vertical position, with the transfer case pointed up and remove the transfer case-to-transmission bolts.
4 Pull the transfer case straight up and remove it from the transmission, taking care not to damage the adapter rear oil seal with the transfer case input shaft gear spline.

Installation

Manual transmission

5 Shift the two shift forks to the high/four position **(see illustration).**
6 Lubricate the transfer case adapter oil seal with multi-purpose moly base grease.
7 Install a new gasket.
8 With the transmission in a vertical position, carefully insert the input gear straight into the adapter rear oil seal, install the transfer case to the transmission **(see illustration).** Install the bolts. Tighten the bolts to the specified torque.

Automatic transmission

9 Carefully clean the contact surfaces of the transmission and transfer case, making sure that all traces of sealer are removed. Apply a 0.12-inch (3 mm) wide bead of sealer such as Loctite 518 or equivalent to the transmission contact surface and install the two gaskets **(see illustrations).** Carefully lower the transfer case onto the transmission and install the seven retaining bolts. Tighten the bolts to the specified torque.

Chapter 8 Clutch and driveline

Contents

	Section
Center bearing - replacement	13
Clutch components - removal, inspection and installation	3
Clutch - description and check	2
Clutch hydraulic system - bleeding	8
Clutch master cylinder - removal, overhaul and installation	6
Clutch pedal assembly - removal and installation	9
Clutch pedal free play check and adjustment	See Chapter 1
Clutch release bearing - replacement	4
Clutch release cylinder - removal, overhaul and installation	7
Driveaxle boot replacement and CV joint overhaul	25
Driveline inspection	11
Driveshafts, differentials and rear axles - general information	10
Driveshafts - removal and installation	12
Flywheel - removal and installation	See Chapter 2
Freewheel hub (4WD) - disassembly, inspection and reassembly	22
Freewheel hub (4WD) - removal and installation	21
Front axle assembly (4WD) - removal and installation	20
Front axleshaft (1985 and earlier 4WD models) - removal, overhaul and installation	23
Front differential (4WD) - removal and installation	19
Front differential side gear shaft oil seals (1986 and later 4WD models) - replacement	26
Front driveaxle (1986 and later 4WD models) - removal and installation	24
Front wheel bearing check, repack and adjustment	See Chapter 1
General information	1
Pilot bearing - inspection, removal and installation	5
Pinion oil seal - replacement	15
Rear axle assembly - removal and installation	18
Rear axleshafts, bearings and oil seals - removal and installation	16
Rear differential - removal and installation	17
Universal joints - inspection and replacement	14

Specifications

Clutch

Fluid type	DOT 3 brake fluid
Disc rivet head depth limit	1/16 in (0.3 mm)
Diaphragm spring tip out-of-alignment limit	0.020 in (0.5 mm)

Driveshaft

Runout limit	0.031 in (0.8 mm)
U-joint snap-ring thickness	
1/2-ton and 4WD	
Color code	
None	0.0581 to 0.0600 in (1.475 to 1.525 mm)
Brown	0.0600 to 0.0620 in (1.525 to 1.575 mm)
Blue	0.0620 to 0.0640 in (1.575 to 1.625 mm)
3/4-ton	
Color code	
None	0.0935 to 0.0955 in (2.375 to 2.425 mm)
Brown	0.0955 to 0.0974 in (2.425 to 2.475 mm)
Blue	0.0974 to 0.0994 in (2.475 to 2.525 mm)
U-joint spider bearing axial play	Less than 0.0020 in (0.05 mm)
Driveaxle standard length	15.705 in (389.9 mm)

Rear axle shaft

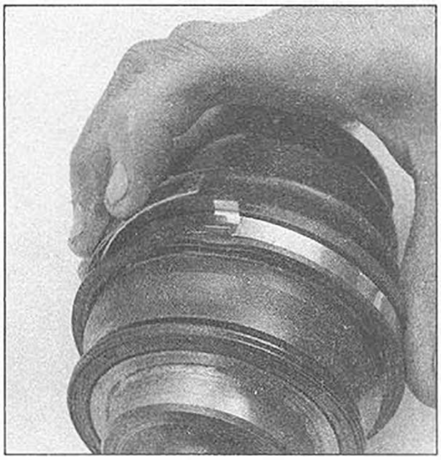
Maximum shaft runout	0.079 in (2.0 mm)
Maximum flange runout	0.008 in (0.2 mm)

Differential

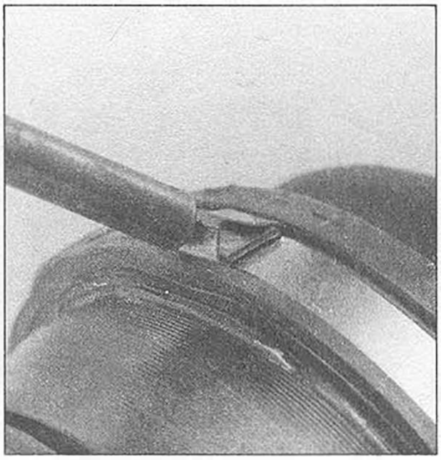
Drive pinion preload (within backlash)	
7.5 inch ring gear	5.2 to 8.7 in-lb
8.0 inch ring gear	
2 pinion type	7.8 to 11.3 in-lb
4 pinion type	4.3 to 6.9 in-lb

Torque specifications

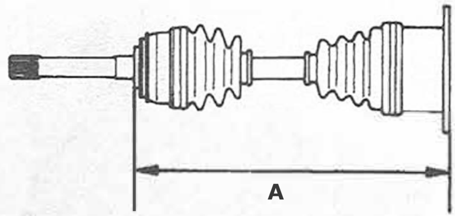
	Ft-lbs
Clutch pressure plate-to-flywheel	11 to 15
Bellhousing-to-engine	37 to 57
Clutch master cylinder reservoir mounting bolt	15 to 21



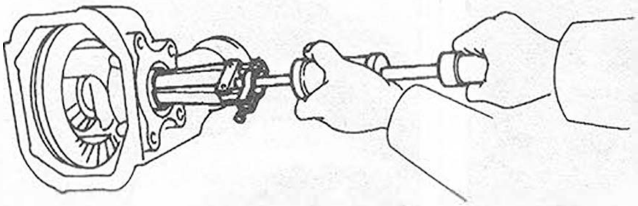
25.12a To install the new clamps. bend the tang downward and . . .



25.12b . . . tap the tabs down to hold it in place



25.14 The driveaxle standard length (A) should be as specified and the boots shouldn't be compressed or stretched out



26.3 Pop the seal from the differential carrier with a seal puller and slide hammer. Note: Sometimes the seals can be pried out with a large screwdriver or pry bar

(see illustrations).

13 Slide the inboard boot onto the driveaxle. Align the match marks you made before removing the joint and, using a brass bar and hammer, tap the tripod onto the driveaxle. Install the snap ring. Fill the inboard joint tulip with grease and install it over the tripod joint. Slide the boot into place and install the boot clamps.

14 Measure the driveaxle standard length and make sure that the boot is not stretched, contracted or distorted in any way **(see illustration).**

15 Install the driveaxle (Section 24).

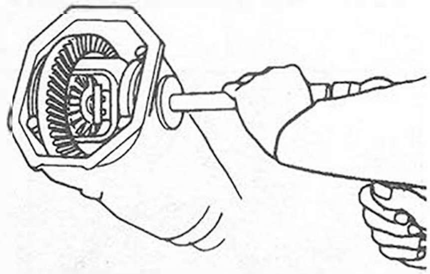
26 Front differential side gear shaft oil seals {1986 and later 4WD models) - replacement

Refer to illustrations 26.3 and 26.4

1 Remove the front axle assembly following the procedure described in Section 20.

2 Remove the side gear shaft and differential tube from the differential carrier (see Section 19).

3 Using a seal puller attached to a slide hammer, remove the seal from the differential carrier **(see illustration).**

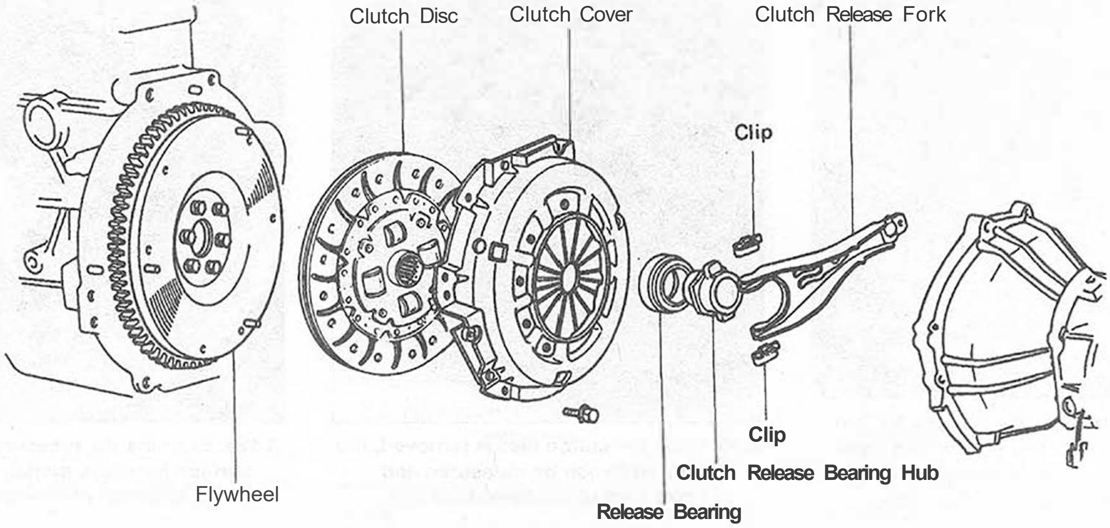


26.4 A seal driver is the preferred tool for installing the new seals into the differential carrier, but a socket or section of pipe with an outside diameter slightly less than that of the seal can be used

4 Using an appropriately sized seal driver or large socket, drive the new seal into the differential carrier until it is flush with the carrier surface **(see illustration).**

5 Install the differential tube to the differential carrier and install the side gear shaft (Section 19).

6 Install the front axle assembly (Section 20).



2.1 Exploded view of the clutch components

c) *To check for complete clutch release, run the engine (with the brake on to prevent movement) and hold the clutch pedal approximately 112-inch from the floor mat. Shift the transmission between 1st gear and Reverse several times. If the shift is not smooth, component failure is indicated. Measure the slave cylinder pushrod travel. With the clutch pedal completely depressed the slave cylinder pushrod should extend substantially. If the pushrod will not extend very far or not at all, check the fluid level in the clutch master cylinder.*

d) *Visually inspect the clutch pedal bushing at the top of the clutch pedal to make sure there is no sticking or excessive wear.*

e) *Under the vehicle, check that the clutch fork is solidly mounted on the ball stud.*

Note: *Because access to the clutch components is an involved process, any time either the engine or transmission Is removed, the clutch disc, pressure plate assembly and release bearing should be carefully inspected and, if necessary, replaced with new parts. Since the clutch disc is normally the item of highest wear, it should be replaced as a matter of course if there is any question about its condition.*

3 Clutch components - removal, inspection and installation

Refer to illustrations 3.4, 3.5, 3.8, 3.10, 3.12a, 3.12b and 3.14

Warning: *Dust produced by clutch wear and deposited on clutch components contains 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 m a covered container.*

Removal

1 Access to the clutch components is normally accomplished by removing the transmission, leaving the engine in the vehicle. If, of course, the engine is being removed for major overhaul, then the opportunity should always be taken to check the clutch for wear and replace worn components as necessary. The following procedures assume that the engine will stay in place.

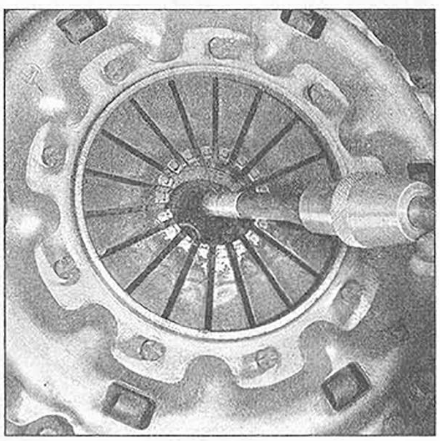
2 Remove the slave cylinder (see Section 7).

3 Referring to Chapter 7 Part A, remove the transmission from the vehicle. Support the engine while the transmission is out. Preferably, an engine 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 used between the jack and oil pan to spread the load. **Caution:** *The pickup 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.*

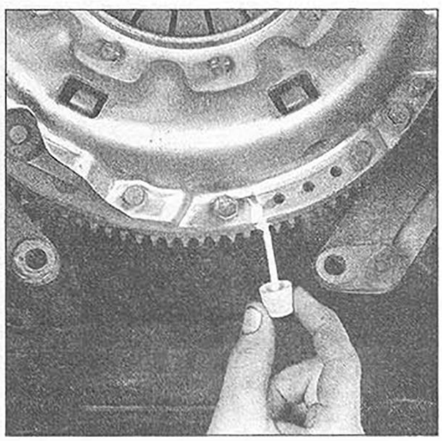
4 To support the clutch disc during removal, install a clutch alignment tool through the clutch disc hub **(see illustration).**

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, apply marks yourself so the pressure plate and the flywheel will be in the same alignment during installation **(see illustration).**

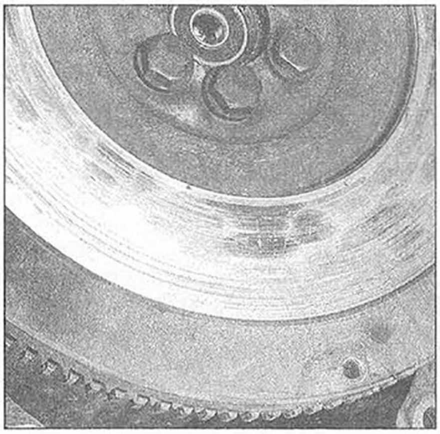
6 Turning each bolt only 1/2-turn at a time, slowly loosen the pressure plate-to-flywheel bolts. Work in a diagonal pattern and loosen each bolt a little at a time until all spring pressure is relieved. Then hold the pressure plate securely and completely remove the bolts, followed by the pressure plate and clutch disc.



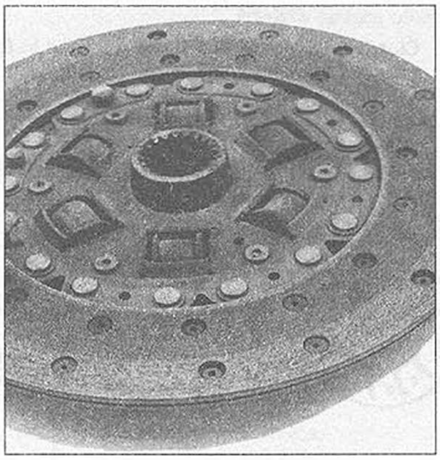
3.4 A clutch alignment tool can be used to prevent the disc from dropping out as the pressure plate is removed



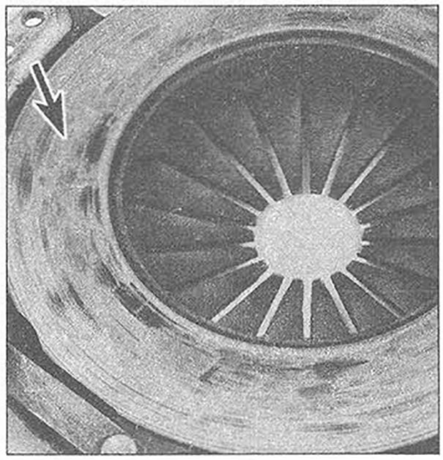
3.5 Be sure to mark the pressure plate and flywheel in order to ensure proper alignment during installation



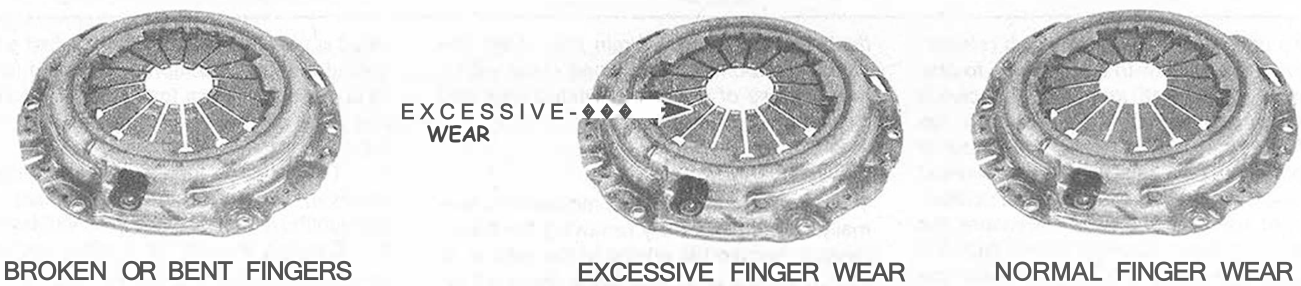
3.8 Check the flywheel for cracks, hot spots (as seen in this photo) and other obvious defects. Slight imperfections can be removed by a machine shop



3.10 Once the clutch disc is removed, the rivet depth can be measured and compared to the Specifications



3.12a Examine the pressure plate friction surface for score marks, cracks and evidence of overheating

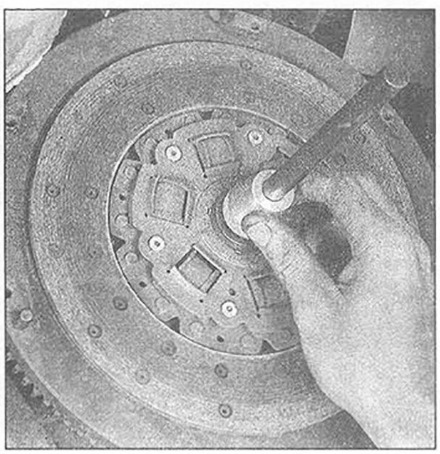


3.12b Replace the pressure plate if excessive wear is noted

Inspection

7 Ordinarily, when a problem occurs in the clutch, it can be attributed to wear of the clutch driven disc assembly. However, all components should be inspected at this time.

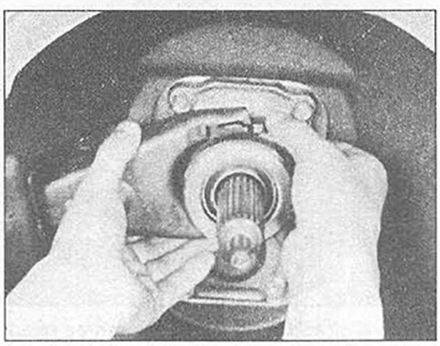
8 Inspect the flywheel for cracks, heat checking, grooves or other signs of obvious defects **(see illustration).** If the imperfections are slight, a machine shop can machine the surface flat and smooth, which is highly recommended regardless of the surface appearance. Refer to Chapter 2 for the flywheel removal and installation procedure.



3.14 Insert a clutch alignment tool or metal bar through the middle of the clutch and move the disc until it is centered

9 Inspect the pilot bearing (Section 5).

10 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, warpage, cracks, distorted springs or damper bushings and other obvious damage **(see illustration).** As mentioned above, ordinarily the clutch disc is replaced as a matter of course, so if in doubt about the condition, replace it with a new one.



4.5 Removing the retaining clips from the clutch release bearing

11 Ordinarily, the release bearing is also replaced along with the clutch disc (see Section 4).

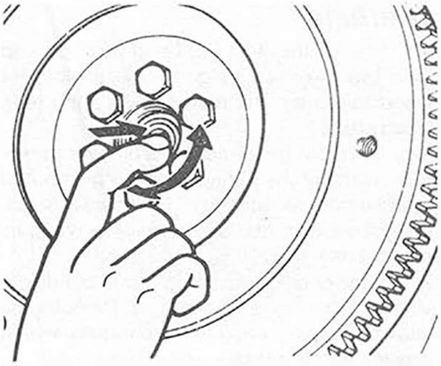
12 Check the machined surfaces and the diaphragm spring fingers of the pressure plate **(see illustrations).** If the surface is grooved or otherwise damaged, replace the pressure plate. Also check for obvious damage, distortion, cracking, etc. Light glazing can be removed with medium grit emery cloth. If a new pressure plate is indicated, new or factory-rebuilt units are available.

Installation

13 Before installation, carefully wipe the flywheel and pressure plate machined surfaces clean with a rubbing-alcohol dampened rag. It's important that no oil or grease is on these surfaces or the lining of the clutch disc. Handle these parts only with clean hands.

14 Position the clutch disc and pressure plate with the clutch held in place with an alignment tool **(see illustration).** Make sure it's installed properly (most replacement clutch discs will be marked "flywheel side" or something similar - if not marked, install the clutch with the damper springs or bushings toward the transmission).

15 Tighten the pressure plate-to-flywheel



5.5 Turn the pilot bearing by hand while pressing in on it - if it is rough or noisy, a **new one should be installed**

bolts only finger tight, working around the pressure plate.

16 Center the clutch disc by ensuring the alignment tool is through the splined hub and into the pilot bearing in the crankshaft. Wiggle the tool up, down or side-to-side as needed to bottom the tool in the pilot bushing. 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 specified torque. Remove the alignment tool.

17 Using high temperature grease, lubricate the inner groove of the release bearing (refer to Section 4). Also place grease on the fork fingers.

18 Install the clutch release bearing as described in Section 4.

19 Install the transmission, slave cylinder and all components removed previously, tightening all fasteners to the proper torque specifications.

4 Clutch release bearing - replacement

Refer to illustration 4.5

1 The sealed release bearing, although designed for long life, is worth replacing at the same time that the other clutch components are being replaced or serviced.

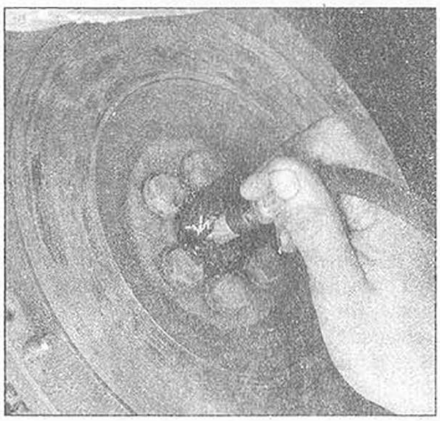
2 Deterioration of the release bearing should be suspected when there are signs of grease leakage or if the unit is noisy when spun with the fingers.

3 Remove the rubber dust boot which surrounds the release lever at the bellhousing opening.

4 Using a screwdriver, unhook and detach the retaining spring from the pivot stud in the bellhousing.

5 Remove the retaining clips **(see illustration).**

6 The clutch release bearing and hub assembly can now be removed. **Note:** *Make sure that the release fork* has *not been cracked or bent. Slowly turn the front face of the* release *bearing, making sure it turns freely and without any noise. The release bearing* is *pre-lubricated and should not be washed in solvent.*



5.9 Fill **the opening behind the bearing with grease** . . .

7 If necessary, remove the release bearing from its hub using a two- or three-jaw puller.

8 Press on the new bearing, but apply pressure only to the center race. If necessary, take the bearing and hub to a local repair shop, as considerable force may be needed to press the bearing on.

9 Reassembly is the reverse of disassembly but apply multi-purpose grease to the internal recess of the release bearing hub.

10 Also apply similar grease to the pivot points of the clutch release lever, the sliding surface of the bearing sleeve and the splines on the transmission input shaft. **Note:** *Apply only a thin coat of grease to these points,* as *too much grease will run onto the friction lining when hot, causing damage to the clutch* disc surfaces.

5 Pilot bearing - inspection, removal and installation

Refer to illustrations 5.5, 5.9, 5. *10 and* 5. *11*

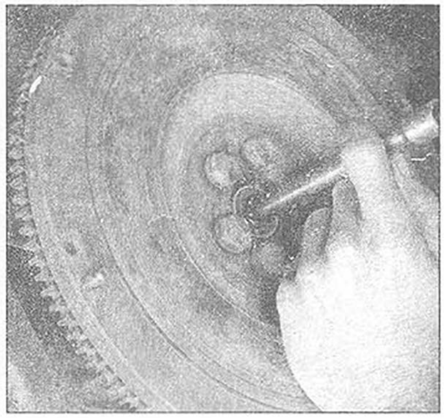
1 The clutch pilot bearing is a needle roller type bearing which is pressed into the rear of the crankshaft. Its primary purpose is to support the front of the transmission input shaft. The pilot bearing should be inspected whenever the clutch components are removed from the engine. Due to its inaccessibility, if you are in doubt as to its condition, replace it with a new one. **Note:** *If the engine* has *been removed from the vehicle, disregard the following* steps *which do not apply.*

2 Remove the transmission (refer to Chapter 7 Part A)

3 Remove the clutch components (Section 3).

4 Using a clean rag, wipe the bearing clean and inspect for any excessive wear, scoring or obvious damage. A flashlight will be helpful to direct light into the recess.

5 Check to make sure the pilot bearing turns smoothly and quietly **(see illustration).** If the transmission input shaft contact surface is worn or damaged, replace the bearing with a new one.



5.1 O . . . then force the bearing out hydraulically with a steel rod slightly smaller than the bore in the bearing - when the hammer strikes the rod, the grease will transmit force to the backside of the bearing and push it out

6 Removal can be accomplished with a special puller but an alternative method also works very well.

7 Find a solid steel bar which is slightly smaller in diameter than the bearing. Alternatives to a solid bar would be a wood dowel or a socket with a bolt fixed in place to make it solid.

8 Check the bar for fit - it should just slip into the bearing with very little clearance.

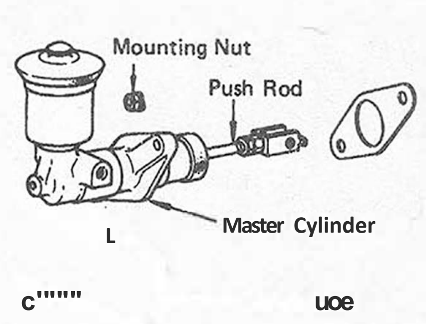
9 Pack the bearing and the area behind it (in the crankshaft recess) with heavy grease (see **illustration).** Pack it tightly to eliminate as much air as possible.

10 Insert the bar into the bearing bore and lightly hammer on the bar, which will force the grease to the backside of the bearing and push it out **(see illustration).** Remove the bearing and clean all grease from the crankshaft recess.

11 To install the new bearing, lubricate the outside surface with oil, then drive it into the recess with a hammer and a socket with an outside diameter that matches the bearing outer race **(see illustration).**

12 Install the clutch components, transmis-

5.11 Using a hammer and socket, carefully drive the new bearing into place



6.2 Clutch master cylinder mounting details

sion and all other components removed to gain access to the pilot bearing.

6 Clutch master cylinder - removal, overhaul and installation

Refer to illustrations 6.2, 6.4 and 6.5

Caution: *Do not allow brake fluid to contact any painted surfaces of the vehicle, as damage to the finish may result.*

Removal

1 Disconnect the master cylinder pushrod from the clutch pedal.
2 Disconnect the hydraulic line from the master cylinder and drain the fluid into a suitable container **(see illustration).**
3 Remove the master cylinder flange mounting nuts and withdraw the unit from the engine compartment.

Overhaul

4 Remove the hold-down bolt and pull off the reservoir tank **(see illustration).** Newer models use a slotted spring pin to attach the reservoir. To remove, drive out the pin with a small punch.
5 Pull back the boot and remove the snap-ring **(see illustration}.**
6 Pull out the pushrod, washer and piston.
7 Examine the inner surface of the cylinder bore. If it is scored or exhibits bright wear areas, the entire master cylinder should be replaced.
8 If the cylinder bore is in good condition, obtain a clutch master cylinder rebuild kit, which will contain all of the necessary replacement parts.
9 Prior to installing any parts, first dip them in brake fluid to lubricate them.
10 Installation of the parts in the cylinder is the reverse of removal.

Installat,on

11 Installation is the reverse of removal, but check the pedal height and freeplay as described in Chapter 1 and bleed the hydraulic system (Section 8).

7 Clutch release cylinder - removal, overhaul and installation

Refer to illustrations 7.2 and 7.4

Removal

1 The clutch release cylinder is located at the right side of the transmission bellhousing.
2 Using a flare-nut wrench, disconnect the clutch line union (see illustration).
3 Remove the two bolts and pull off the release cylinder.

Overhaul

4 Pull off the dust boot and pushrod and then tap the cylinder gently on a block of wood to extract the piston and spring **(see illustration).**
5 Unscrew and remove the bleeder screw.
6 Examine the surfaces of the piston and cylinder bore for scoring or bright wear areas. If any are found, discard the cylinder and purchase a new one.
7 If the components are in good condition, wash them in clean brake fluid. Remove the seal and discard it, noting carefully which way the seal lips face.
8 Obtain a repair kit which will contain al) the necessary new items.
9 Install the new seal using your fingers only to manipulate it into position. Be sure the lips face in the proper direction.
10 Dip the piston assembly in clean brake fluid before installing it and the spring into the cylinder.
11 Reinstall the bleeder.
12 Complete the reassembly by installing the pushrod and the dust cover. Be sure the dust cover is secure on the cylinder housing.

Installation

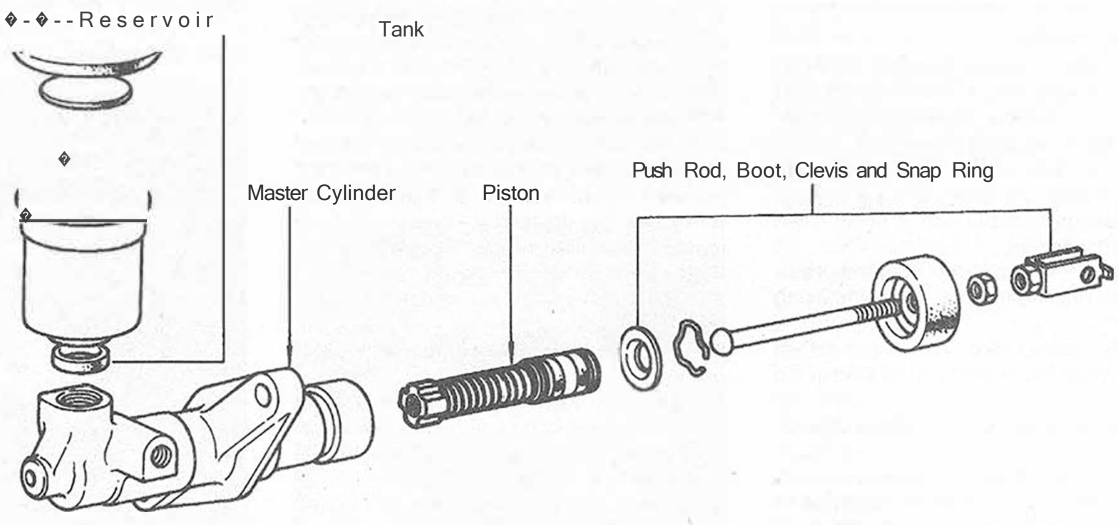
13 Installation is the reverse of the removal procedure. After the cylinder has been installed, bleed the clutch hydraulic system as described in Section 8.

8 Clutch hydraulic system - bleeding

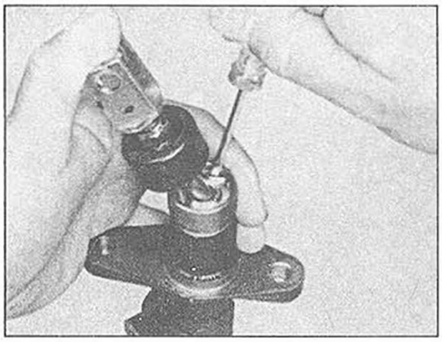
Refer to illustration 8.3

Caution: *Do not allow the brake fluid to contact any painted surface of the vehicle, as damage to the finish will result.*

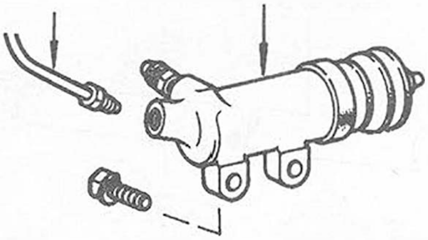
1 Bleeding will be required whenever the



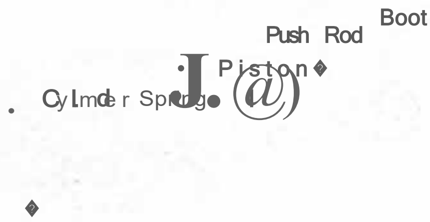
6.4 Exploded view of a typical older clutch master cylinder with a hold-down bolt attaching the reservoir



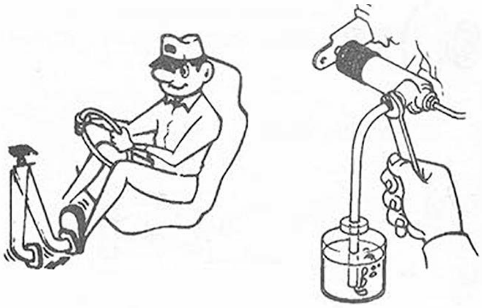
6.5 Pry the snap-ring from the clutch master cylinder using a small screwdriver



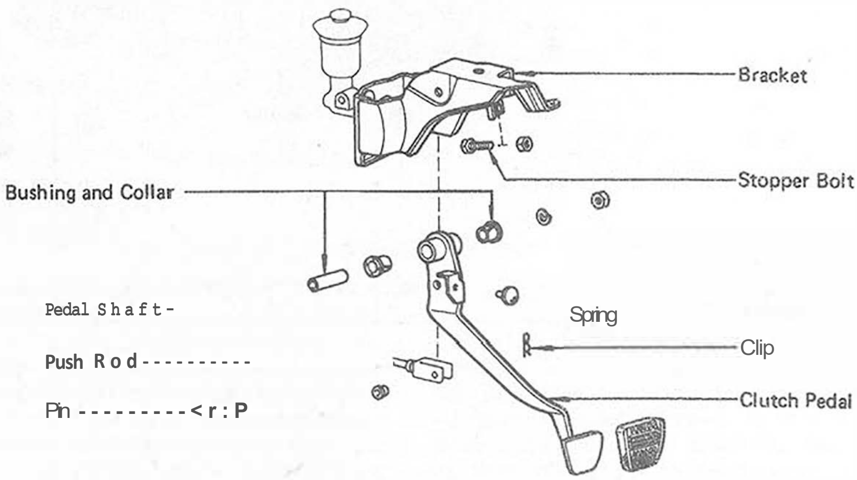
7.2 Clutch release cylinder mounting details



7.4 Exploded view of the clutch release cylinder



8.3 When bleeding the clutch hydraulic **system, a hose is connected to the bleeder** valve at the release cylinder and then submerged in brake fluid. **Air will** be seen as **bubbles** in **the container and the tube**



9.1 Clutch pedal mounting details

hydraulic system has been dismantled and reassembled and air has entered the system.

2 First fill the fluid reservoir with clean brake fluid which has been stored in an air-tight container. Never use fluid which has drained from the system or has bled out previously, as it may contain grit.

3 Attach a rubber or plastic bleed tube to the bleeder screw on the release cylinder and immerse the open end of the tube in a glass jar containing an inch or two of fluid **(see illustration).**

4 Open the bleeder screw about half a turn and have an assistant quickly depress the clutch pedal completely. Tighten the screw and then have clutch pedal slowly released with the foot completely removed. Repeat this sequence of operations until air bubbles are no longer ejected from the open end of the tube beneath the fluid in the jar.

5 After two or three strokes of the pedal, make sure the fluid level in the reservoir has not fallen too low. Keep it full of fresh fluid, otherwise air will be drawn into the system.

6 Tighten the bleeder screw on a pedal down stroke (do not overtighten it), remove the bleed tube and jar, top-up the reservoir and install the cap.

7 If an assistant is not available, alternative 'one-man' bleeding operations can be carried out using a bleed tube equipped with a one-way valve or a pressure bleed kit, both of which should be used in accordance with the manufacturer's instructions.

9 Clutch pedal assembly - removal and installation

Refer to illustration 9.1

1 Remove the pedal return spring **(see illustration).**

2 Disconnect the master cylinder pushrod from the pedal by removing the spring clip and pulling out the pushrod pin.

3 Remove the pedal shaft.

4 Remove the clutch pedal with its bushings and collar.

5 Clean the parts in solvent and replace any that are damaged or excessively worn.

6 Installation is the reverse of the removal procedure. During installation, apply multi-purpose grease to the pedal boss, return spring, pedal shaft and pushrod pin.

10 Driveshafts, differentials and rear axles - general information

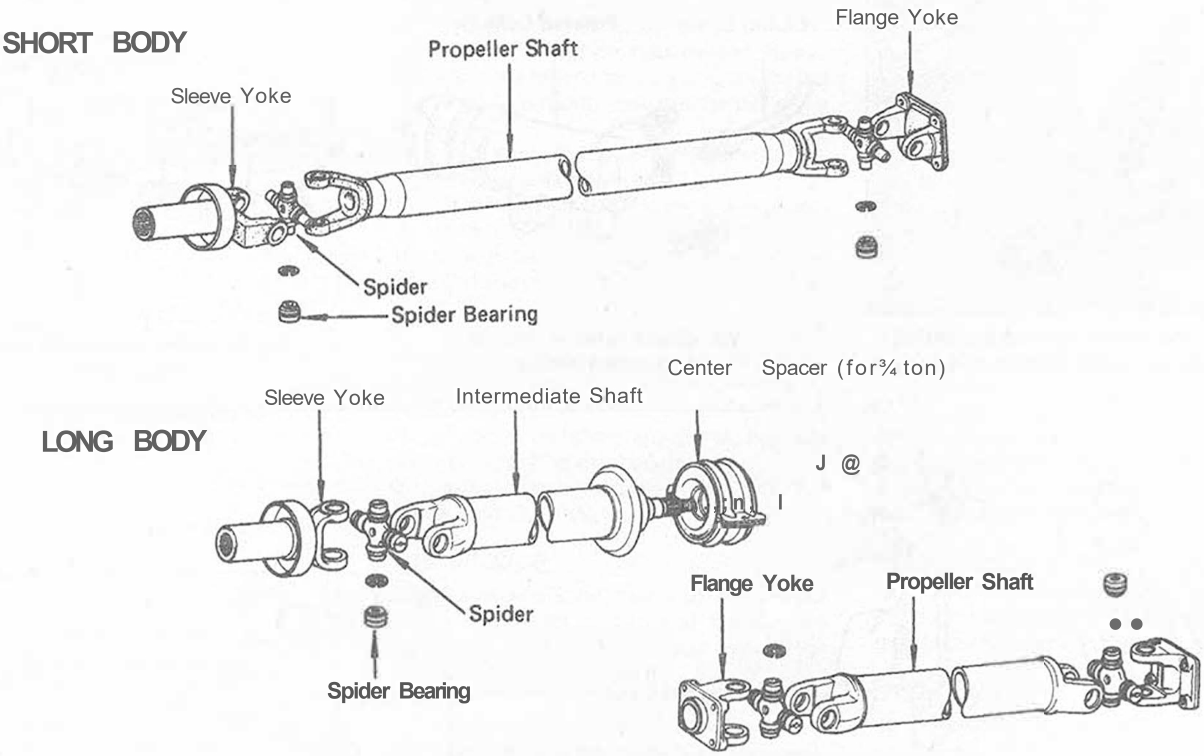
Refer to illustrations 10.1a, 10.1b and 70.1c

Three different driveshaft assemblies are used on the vehicles covered in this manual **(see illustrations).** Regular bed 2WD vehicles use a one-piece d;iveshaft which incorporates two universal joints, one at either end of the shaft.

Long bed 2WD vehicles use a two-piece driveshaft which incorporates a center bearing at the rear of the front shaft. This driveshaft uses three universal joints; one at the transmission end, one behind the center bearing and one at the differential flange.

The 4WD vehicles use two driveshafts· the primary shaft runs between the transfe; case and the front differential and the rear driveshaft runs between the transfer case and the rear differential.

All universal joints are of the solid type and can be replaced separate from the drive-shaft.



10.1 a 2WD driveshaft assemblies - exploded view

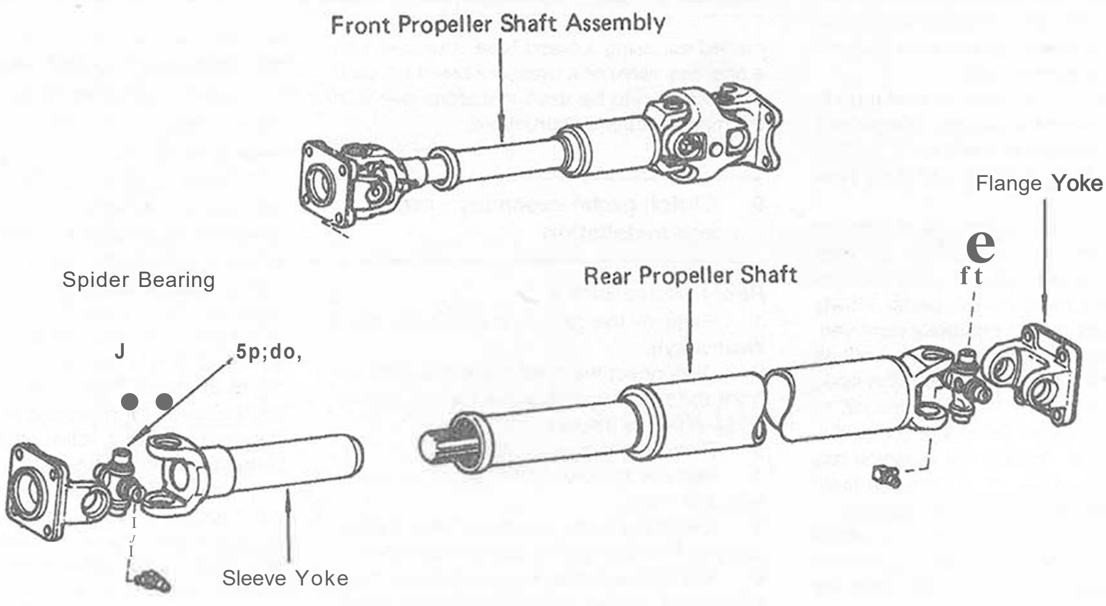
The driveshafts are finely balanced during production and whenever they are removed or disassembled, they must be reassembled and reinstalled in the exact manner and positions they were originally in, to avoid excessive vibration.

The rear axle is of the semi-floating type, having a 'banjo' design axle housing, which is held in proper alignment with the body by the rear suspension.

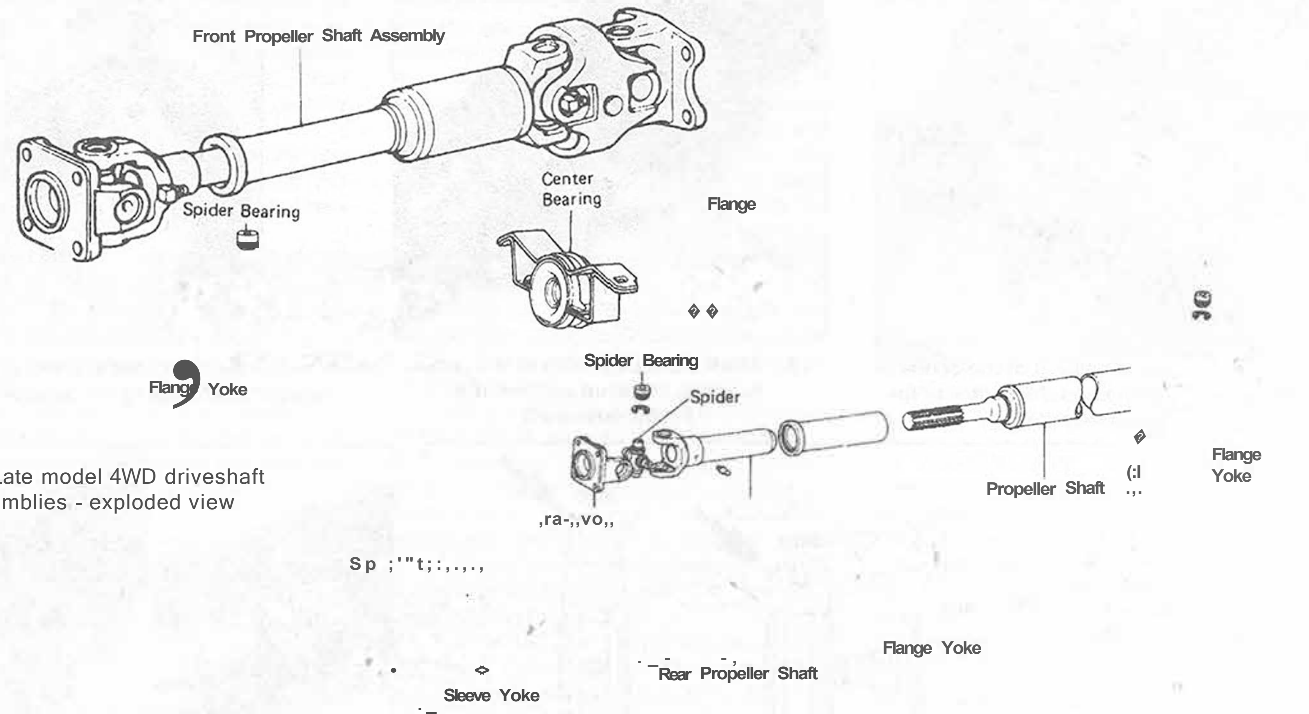
Mounted in the center of the rear axle is the differential, which transfers the turning force of the driveshaft to the rear axleshafts, on which the rear wheels are mounted.

The axleshafts are splined at their inner ends to fit into the splines in the differential gears; outer support for the shaft is provided by the rear wheel bearing.

Because of the complexity and critical nature of the differential adjustments, as well as the special equipment needed to perform



10.1b 4WD driveshaft assemblies - exploded view



10.1c Late model 4WD driveshaft assemblies - exploded view

the operations, we recommend any disassembly of the differential be done by a Toyota dealer service department or other qualified repair facility.

11 Driveline inspection

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

2 Slide under the vehicle and visually inspect the condition of the driveshaft. Look for any dents or cracks in the tubing. If any are found, the driveshaft must be replaced.

3 Check for any oil leakage at the front and rear of the driveshaft. Leakage where the driveshaft enters the transmission indicates a defective rear transmission seal. Leakage where the driveshaft enters the differential indicates a defective pinion seal. For these repair operations refer to Chapters 7 and 8 respectively.

4 While still under the vehicle, have an assistant turn the rear wheel so the driveshaft will rotate. As it does, make sure that the universal joints are operating properly without binding, noise or looseness. On long bed models, listen for any noise from the center bearing, indicating it is worn or damaged. Also check the rubber portion of the center bearing for cracking or separation, which will necessitate replacement.

5 The universal joint can also be checked with the driveshaft motionless, by gripping your hands on either side of the joint and attempting to twist the joint. Any movement at all in the joint is a sign of considerable wear. Lifting up on the shaft will also indicate movement in the universal joints.

6 Finally, check the driveshaft mounting bolts at the ends to make sure they are tight.

7 On 4WD models, the above driveshaft checks should be repeated on all driveshafts. In addition, check for grease leakage around the sleeve yoke, indicating failure of the yoke seal.

8 Check for leakage at each connection of the driveshafts to the transfer case and front differential. Leakage indicates worn oil seals.

9 At the same time, check for looseness in the joints of the front driveaxles. Also check for grease or oil leakage from around the driveaxles by inspecting the rubber boots and both ends of each axle. Oil leakage at the differential junction indicates a defective side oil seal. Leakage at the wheel side indicates a defective front hub seal, while leakage at the boots means a damaged rubber boot. For servicing of these components, see the appropriate Sections.

12.2 Mark the relationship of the driveshaft flanges to the transfer case and differential companion flanges to facilitate realignment

12 Driveshafts - removal and installation

Refer to illustrations 12.2 and 12.15

Front driveshaft (4WD)

Caution: *Do not disassemble the front driveshaft of 4WD vehicles.*

1 Raise the front of the vehicle and place it on jackstands.

2 Mark the edges of both front and both rear flanges so they can be realigned upon installation **(see illustration).**

3 Remove the four bolts at both front and rear flanges.

4 Push the shaft slightly to the rear to disconnect the front flange and lower the driveshaft.

Rear driveshaft

5 Raise the rear of the truck and support it on jackstands.

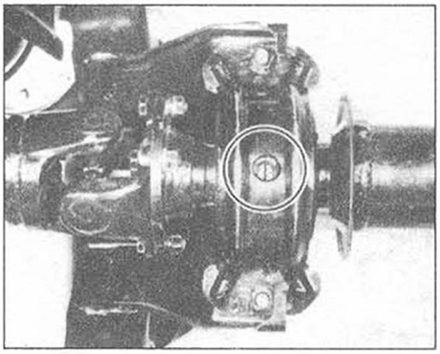
6 Remove the two bolts holding the center support bearing to the frame (3-joint type).

7 Mark the edges of the driveshaft rear flange and the differential pinion flange so they can be realigned upon installation **(see illustration 12.2).**

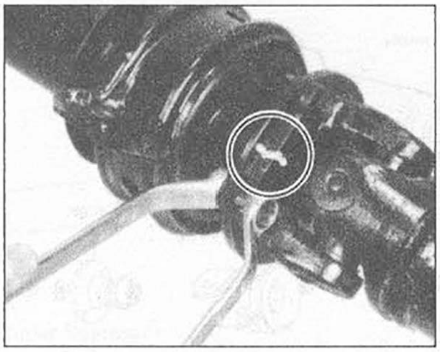
8 Remove the four nuts and bolts.

9 Push the shaft forward slightly to disconnect the rear flange (2WD).

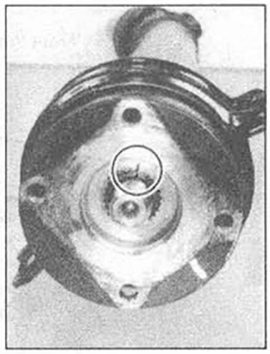
1o Pull the yoke from the transmission while supporting the driveshaft with your hand (2WD).



12.15 Correct alignment of the center bearing center line and the center of the bracket hole

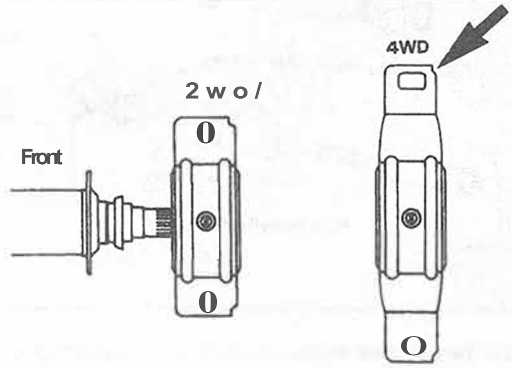


13.1 **Mark** the relationship of the center flange to the front section of a 3-joint driveshaft



13.3 **Mark** the relationship of the companion flange to the threaded shaft

13.11 Install the center bearing with the notches in the flange facing the rear of the vehicle



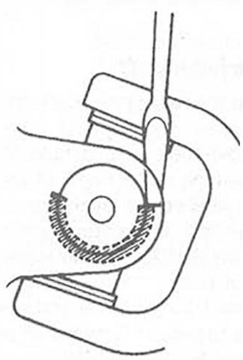
11 Mark the driveshaft flange and the flange on the transfer case so they can be realigned upon installation (4WD).

12 Remove the four nuts and bolts (4WD).

13 Push the shaft slightly to the rear to disconnect the front flange and gently lower the driveshaft (4WD).

14 While the driveshafts are removed, insert a plug in the transmission to prevent lubricant leakage.

15 Installation is the reverse of the removal procedures. During installation, make sure all flange marks line up. When connecting the center bearing support to the frame, first finger-tighten the two mounting bolts, then make sure that the bearing bracket is at right angles to the driveshaft and that the bearing center line is in the center of the bracket hole **(see illustration).** Tighten all nuts and bolts to the specified torque.



14.7 Push the snap-rings from the U-joint bearings with a small screwdriver

13 Center bearing - replacement

Refer to illustrations 13.1, 13.3 and 13.11

Note: *This procedure requires the use of a hydraulic press. If access to a press is not available, take the disassembled driveshaft to a dealer service department or repair shop to have the center bearing removed.*

1 Remove the driveshaft (Section 12). Mark the relationship of the center flange to the front section of the driveshaft **(see illustration).**

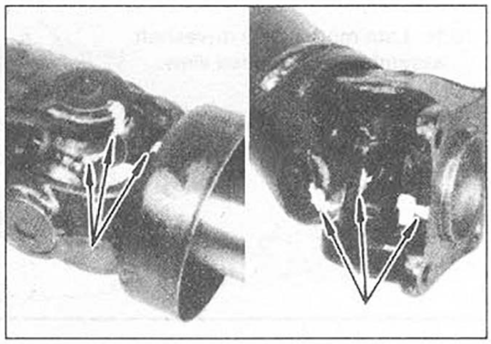
2 Remove the four bolts that attach the center flange to the companion flange **(see illustration 13.1).**

3 Mark the companion flange in relation to the slot in the threaded shaft **(see illustration).**

4 The center joint nut is staked to prevent it from working loose. To remove it, first use a punch to knock the staking back out, then unscrew it from the shaft. To keep the flange from turning, either obtain a special tool designed for this purpose, or one can be made using a flat steel bar and old bolts inserted through the flange holes. The bar should be drilled to match at least two of the flange holes.

5 Using an appropriate puller, remove the companion flange.

6 The center bearing can be removed from the front section of the driveshaft by using a hydraulic press and appropriate support plate.



14.5 Mark the relationship of the driveshaft, universal joint spider and yoke or flange before disassembling the joint

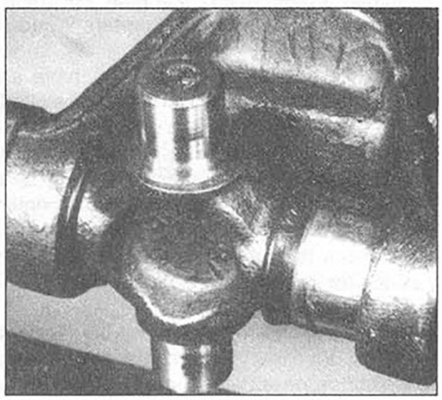
7 Using a dial indicator, inspect all driveshafts for damage and runout. If the shaft runout is greater than the specified maximum, replace the shaft with a new one.

8 Inspect the yokes and flanges for damage and wear. If damage or wear is found, replace the appropriate parts with new ones.

9 Inspect the center support bearing for wear or damage and make sure that the bearing turns freely. If any faults are found, replace the center bearing with a new one.

10 For inspection procedures for the universal joints, see Section 14.

11 Begin reassembly of the driveshaft by coating the splines of the intermediate shaft



14.9a Use a vise, a large socket (left) and a small socket (right) to press the bearing out of the universal joint

with multi-purpose grease and placing the bearing on the shaft **(see illustration).**

12 Place the flange on the shaft and align the marks. **Note:** *On 3/4-ton models, attach the spacer to the rear side of the bearing before installing the flange.*

13 Using the special tool or the one you have fabricated (see Step 4) to hold the flange, tighten a new center joint nut to press the bearing into position.

14 Tighten the nut to 123 to 144 ft-lb (17.00 to 10.0 kg-m).

15 Loosen the nut, then tighten it to the Specified torque.

16 Using a hammer and punch, stake the center joint nut.

17 Attach the rear shaft to the center support bearing flange by aligning the marks on the flanges and connecting the four bolts and nuts.

14 Universal joints - inspection and replacement

Refer to illustrations 14.5, 14.7, 14.9a, 14.9b, 14.17a and 14.17b

1 Wear in the needle roller bearings is characterized by vibration in the transmission, noise during acceleration, and in extreme cases of lack of lubrication, metallic squeaking and ultimately grating and shrieking sounds as the bearings disintegrate.

2 • It is easy to check if the needle bearings are worn with the driveshaft (3-joint) in position by trying to turn the shaft with one hand, the other hand holding the rear axle flange when the rear universal joint is being checked or the front half coupling when the front universal joint is being checked. Any movement between the driveshaft and the front half couplings, and around the rear half couplings, is indicative of considerable wear.

3 On one-piece driveshafts, try turning the shaft with one hand, with the other hand holding the rear axle flange when the rear universal joint is being checked and the front half coupling when the front universal joint is being checked. Any movement between the shaft and the couplings is indicative of wear and the universal joints should be replaced with new ones.

4 With the driveshafts removed, the universal joints may be checked by holding the shaft in one hand and turning the yoke or flange with the other. If the axial movement is more than specified, replace the bearings with new ones.

5 To replace the universal joints, with the driveshaft removed, place alignment marks on each shaft, universal joint spider and yoke or flange **(see illustration).**

6 Using a ratchet extension or similar tool and hammer, tap lightly on the bearing outer races of the universal joint to relieve pressure on the snap-rings.

7 Using a screwdriver, remove the snap-rings from their grooves **(see illustration).**

8 To remove the bearings from the yokes, you will need two sockets. One should be large enough to fit into the yoke where the snap-rings were installed and the other should have an inside diameter just large enough for the bearings to fit into when they are forced out of the yoke.

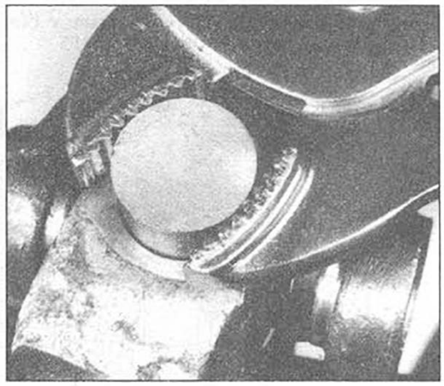
9 Mount the universal joint in a vise with the large socket on one side of the yoke and the small socket on the other side, pushing against the bearing. Carefully tighten the vise until the bearing is pushed out of the yoke and into the large socket **(see illustration).** If it cannot be pushed all the way out, remove the universal joint from the vise and use pliers to finish removing the bearing (see illustration).

10 Reverse the sockets and push out the bearing on the other side of the yoke. This time, the small socket will be pushing against the cross-shaped universal joint spider end.

11 Before pressing out the two remaining bearings, make sure **the** spider is marked so it can be installed in the same relative position during reassembly.

12 The remaining universal joints can be disassembled following the same procedure. Be sure to mark all components for each universal joint so they can be kept together and reassembled in the proper position.

13 Check the spider journals for scoring, needle roller impressions, rust and pitting. Replace it if any of the above conditions exist.



14.9b Pliers may be needed to finish removing the bearing

14 Check the sleeve yoke splines for wear and damage.

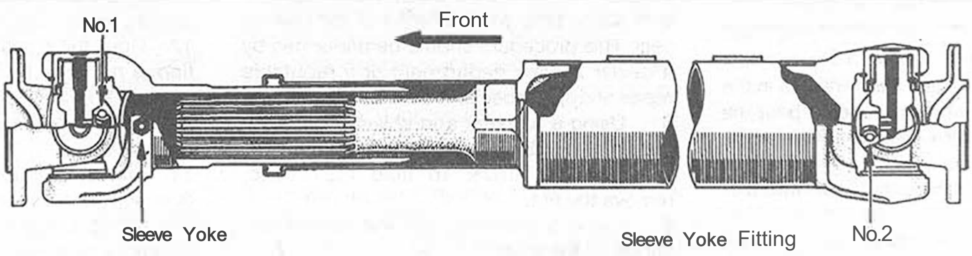
15 When reassembling the universal joints, replace all needle bearings, dust seals and snap-rings with new ones.

16 Before reassembly, pack each grease cavity in the spiders with a small amount of grease. Also, apply a thin coat of grease to the new needle bearing rollers and the roller contact areas on the spiders.

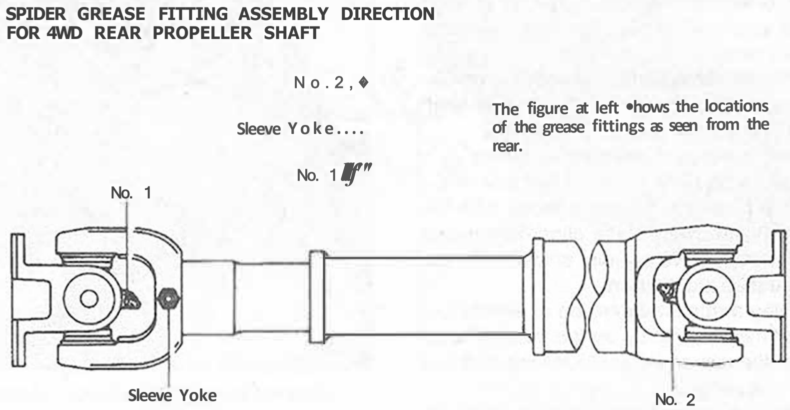
17 Apply a thin coat of grease to the dust seal lips and install the bearings and spider into the yoke using the vise and sockets that were used to remove the old bearings. Work slowly and be very careful not to damage the bearings as they are being pressed into the yokes. **Note:** *When replacing the rear universal joint on 4WD vehicles, be sure that the grease fitting assembly hole is facing in the proper direction* (see illustrations).

18 Press the bearings in until the width of the snap-ring grooves is approximately 0.100 in (2.5 mm). Install snap-rings of the same thickness on each side (three sizes are available for 1/2-ton and 4WD models, and three sizes for 3/4-ton models) and make sure there is no clearance between the bearing cups and the snap-rings. Tap the yoke with a hammer to move the cups slightly.

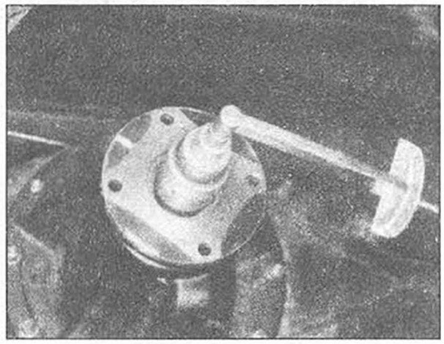
19 Make sure that the spider moves freely in the bearings, then check the axial play. If it is excessive, thicker snap-rings must be useCl



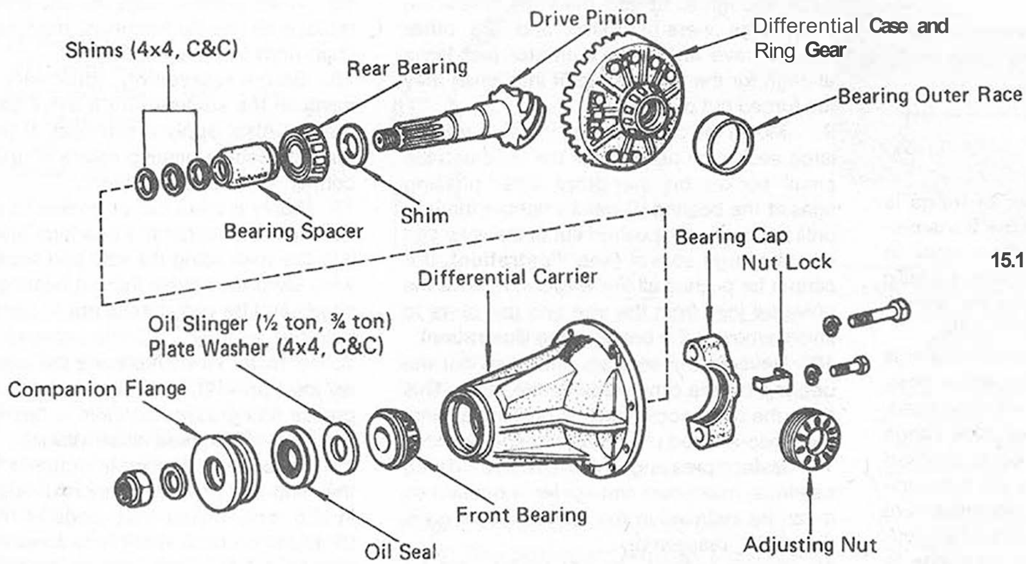
14.17a Make sure that the grease fittings are located as shown when replacing the rear driveshaft universal joints on 1983 and earlier 4WDmodels



14.17b Grease fitting locations for 1984 and later model 4WD rear driveshaft



15.5 **A** torque wrench is used to measure drive pinion preload



15.1 Differential components - exploded view

to reduce the play.

20 Assemble the remaining universal joint(s) and, in the case of 3-joint shafts, rejoin the two driveshafts.

15 Pinion oil seal - replacement

Refer to illustrations 15.1 and 15.5

1 A pinion shaft oil seal failure results in the leakage of differential gear lubricant past the seal and onto the driveshaft yoke or flange. The seal is replaceable without removing or disassembling the differential **(see illustration).**

2 Raise the vehicle and place it on jackstands.

3 Remove the drain and fill plugs from the differential housing and allow the differential lubricant to drain into a suitable container. When the draining is complete, loosely install the drain plug.

4 Disconnect the driveshaft from the companion flange (Section 12).

5 Using *a* torque wrench, slowly turn the pinion shaft nut and measure the preload **(see illustration)** within the backlash of the drive pinion gear and the ring gear (if the axles and wheels turn, the backlash has been exceeded and the torque figure is incorrect). The preload should be within the Specifications. If it is not, the preload must be adjusted with shims prior to installation of the new oil seal. This procedure should be performed by a dealer service department or a reputable repair shop, as special tools are required.

6 Using a hammer and chisel, loosen the staked part of the companion flange nut.

7 Using a holder to hold the flange, *remove* the nut.

8 Using a hammer, tap the companion flange off the shaft.

9 After noting what the visible side of the oil seal looks like, carefully pry ii out of the differential with a screwdriver or pry bar. Be careful not to damage the splines on the pinion shaft.

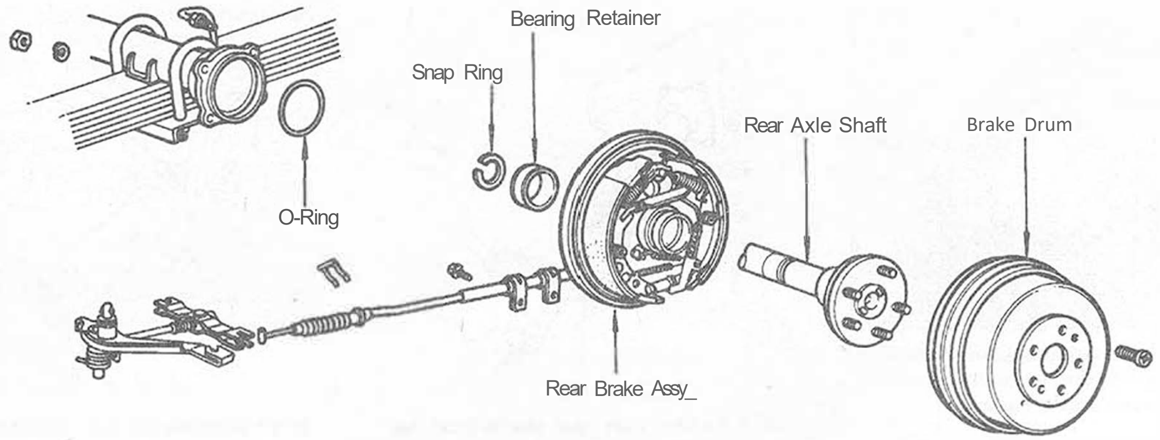
10 Lubricate the new seal lip with molybdenum disulphide grease and carefully install it in position in the differential. Using a short section of pipe of t11e proper circumference and a hammer, carefully drive the seal into a depth of 0.039 in (1.0 mm) to 0.059 in (1.5 mm).

11 Clean the sealing lip contact surface of the differential companion flange. Apply a thin coat of molybdenum disulfide grease to the seal contact surface and the shaft spines and, using a plastic hammer, tap the companion flange onto the shaft.

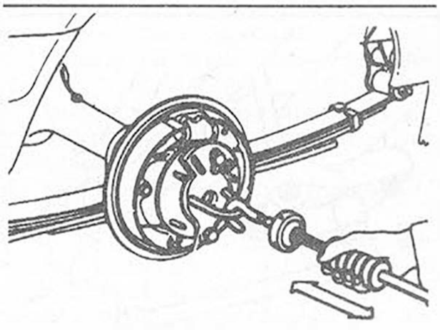
12 Coat the threads of a new companion flange nut with multi-purpose grease and, using the holder to hold the flange, tighten the nut to the torque specified before the preload test.

13 Turn the companion flange several times to snug down the bearing.

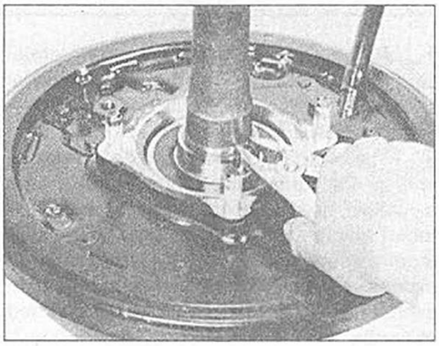
14 Using a torque wrench, see how much torque is required to turn the pinion shaft within the range of gear backlash (if the axles and wheel turn, the backlash has been exceeded and the torque figure is incorrect). This torque is the drive pinion bearing preload. If the preload is greater than that specified, the bearing spacer will have to be replaced by an authorized dealer service department or reputable repair shop. If the preload is less than



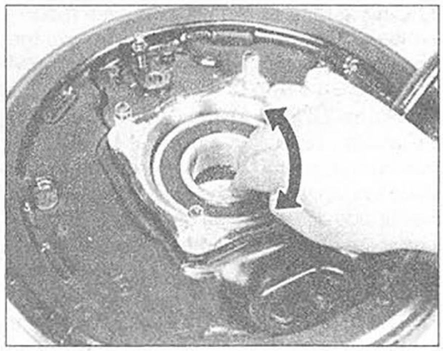
16.1 Rear axleshaft assembly - exploded view



16.7 A rear axle adapter plate and slide hammer may be needed to remove the rear axle assembly



16.9 Remove the snap-ring from the axleshaft



16.14 Rotate the inner race of the bearing to feel for roughness or sticking. If it doesn't turn smoothly, replace it

that specified, retighten the nut 5 to 10 degrees at a time until the specified preload is reached. If the maximum torque specified is reached before the preload figure is obtained, the bearing spacer must be replaced by a qualified repair facility. **Note:** *Do not back off the pinion nut to reduce the preload. Once the proper preload is reached, stake the nut with* a *punch and hammer.*

15 Coat the threads of a new companion flange nut with the multipurpose grease, and, using the holder, tighten the nut to the specified torque.

16 Using a torque wrench, measure the preload within the backlash between the drive pinion and ring gear (by the same method described in Step 5). It should fall within the Specifications. When the preload is ascertained, stake the nut with a punch and hammer.

17 Connect the driveshaft to the companion flange (Section 12).

18 Tighten the drain plug in the rear axle housing and fill the housing to the proper level with the recommended gear lubricant (see the Recommended lubricants and fluids Section at the front of Chapter 1).
Install the filler plug and tighten it fully.

19 Lower the vehicle to the ground, test drive it and check around the differential end yoke for evidence of leakage.

16 Rear axleshaft:s, bearings and oil seals - removal and installation

Refer to illustrations 16.1, 16.7, 16.9, 16.14 and 16.20

1 The axleshafts can be removed without disturbing the differential assembly. They must be *removed* in order to replace the bearings and oil seals and when removing the differential carrier from the rear axle housing **(see illustration). Note:** *Read the entire* Sec*tion before starting work.*

2 Raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling.

3 Remove the rear wheels and release the parking brake, then remove the brake drums (see Chapter 9 for details).

4 Remove the drain plug and drain the differential oil into a suitable container. When the draining is complete, finger-tighten the drain plug in place.

5 Disconnect the brake line (see Chapter 9 for details).

6 Remove the brake backing plate mounting nuts.

7 The axleshaft. complete with the brake assembly, can now be pulled out from the rear axle. If the axleshaft will not pull out by hand, a slide hammer can be attached to the wheel studs using an adapter plate **(see illustration).**

8 Since the wheel bearing is press fitted onto the axleshaft, its removal and installation will require the use of special tools and either a special puller or a hydraulic press. If the necessary equipment is not available, this operation should be left to a dealer or other suitably equipped shop. If the equipment is available, proceed as follows.

9 Using snap-ring pliers, *remove* the snap-ring from the axleshaft **(see illustration).**

10 Using either a special puller designed for this purpose or a hydraulic press equipped with the necessary supports, press the axleshaft from the backing plate.

11 Inspect the axleshaft for wear or damage.

12 Inspect the outer seal for wear or damage.

13 To replace the outer seal, *remove* it with a puller, then use a seal driver or section of appropriately sized pipe and a hammer to drive in the new seal.

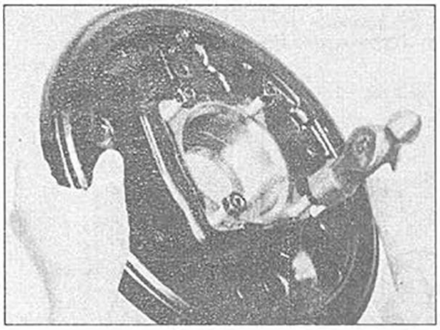
14 Check the rear axle bearing for wear or damage **(see illustration).**

15 To replace the bearing, first remove the bearing oil seal.

16 Using a driver and collar and with the brake assembly properly supported, press the bearing out.

17 Using the collar and driver, press in the new bearing and install a new oil seal (see Step 13).

18 Inspect the bearing case for damage or cracks.

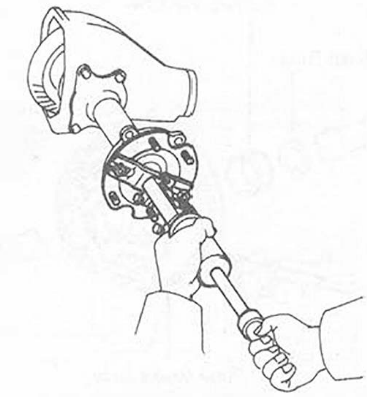


16.20 Knock the backing plate mounting lugs from the backing plate, then remove the bearing case

19 To replace the bearing case, first remove the oil seal and bearing (Steps 13 and 16).
20 Install nuts on the backing plate mounting lugs, then tap on the nuts to remove the lugs. Remove the bearing case **(see illustration).**
21 To install the new bearing case, position the backing plate on the new case and, using two sockets placed one on either side of the mounting lug, press in the lugs. **Note:** *Position the flat side of the bearing case and two longer lugs at the upper side of the bearing case.*
22 Install a new bearing and oil seal (Steps 13 and 17).
23 Inspect the inner oil seal for wear or damage.
24 To replace the inner oil seal, first use a puller to remove the old seal.
25 Use a driver or section of appropriately sized pipe and a hammer to drive in the new seal.
26 To install the axleshaft, first apply multi-purpose grease to the inner lip of the oil seal.
27 Place the backing plate and bearing retainer on the axleshaft.
28 Using a collar and press, press the axleshaft into the backing plate assembly.
29 Using snap-ring pliers, install the snap-ring on the axle.
30 Attach the axle and backing plate assembly to the axle housing and tighten the four nuts at the back of the backing plate to the specified torque.
31 Following installation, tighten the drain plug and fill the differential with the proper grade and amount of lubricant as specified in Chapter 1.

17 Rear differential - removal and installation

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 drain plug and drain the differential oil into a suitable container, then reinstall the drain plug finger-tight.
3 Remove the rear axleshafts (see Section 16).
4 Disconnect the driveshaft flange from the companion flange (see Section 12).

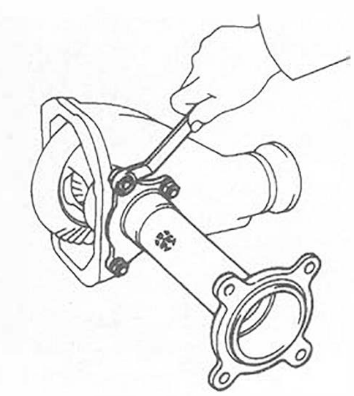


19.9 Pull the side gear shafts from the differential with a slide hammer and adapter plate

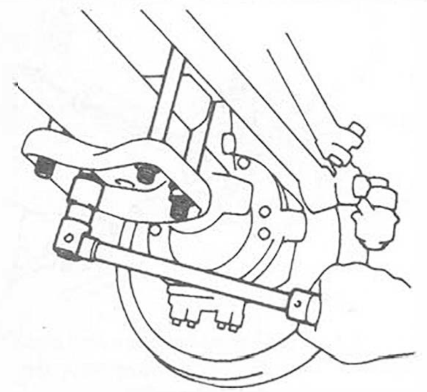
5 Remove the nuts from the differential carrier assembly and pull out the differential assembly. The mounting nuts should be loosened in steps, following a criss-cross pattern.
6 The overhaul of the rear axle differential unit is not within the scope of the home mechanic, due to the specialized gauges and tools which are required. Where the unit requires servicing or repair, due to wear or excessive noise, it is most economical to exchange it for a factory reconditioned assembly.
7 Before reinstalling the rear differential, scrape all traces of old gasket from the mating surfaces of the axle housing. Position a new gasket on the housing (use a silicone-type gasket sealant).
8 Installation is the reverse of the removal procedure.
9 Following installation, fill the differential with the proper grade and quantity of lubricant (see Chapter 1).

18 Rear axle assembly - removal and installation

1 Loosen the rear wheel lug nuts, raise the vehicle and support it securely on jackstands placed underneath the frame. Remove the wheels.
2 Support the **rear** axle assembly with a floor jack placed underneath the differential.
3 Remove the shock absorber lower mounting nuts and compress the shocks to get them out of the way (Chapter 10).
4 Disconnect the driveshaft from the differential companion flange and hang it with a piece of wire from the underbody (Section 12).
5 Unbolt the stabilizer bar from the stabilizer bar link, if so equipped (Chapter 10).
6 Disconnect the parking brake cables from the equalizer (2WD models). On 4WD models, unbolt the equalizer from the rear axle housing and disconnect the rear cable ends from the adjusting levers on the brake backing plates (Chapter 9). Unbolt the load sensing proportioning valve control rod from



19.10 Remove the four differential tube-to-differential carrier mounting nuts and separate the tube from the carrier



20.7 Remove the U-bolt nuts only after the axle assembly has been supported with a floor jack

the axle housing.
7 Disconnect the flexible brake hose from the junction block on the rear axle housing. Plug the end of the hose or wrap a plastic bag tightly around it to prevent excessive fluid loss and contamination.
8 Remove the U-bolt nuts from under the leaf spring seats (Chapter 10).
9 Raise the rear axle assembly off of the leaf spring and carefully maneuver it out from between the leaf spring and the frame (2WD models). It would be a good idea to have an assistant on hand, as the assembly is very heavy. On 4WD models, lower the assembly from the vehicle.
10 Installation is the reverse of the removal procedure. Be sure to tighten the U-bolt nuts and the driveshaft companion flange bolts to the specified torque.

19 Front differential (4WD) - removal and installation

1979 through 1985 models

1 Raise the front end of the vehicle and place it securely on jackstands.
2 Remove the differential drain plug and

drain the lubricant into a suitable container, then reinstall the drain plug finger-tight.
3 Remove the front axleshafts (see Section 23).
4 Disconnect the front driveshaft flange from the companion flange (see Section 12).
5 Remove the nuts from the differential housing and pull out the differential carrier assembly.
6 Installation is the reverse of the removal procedures. Be sure to tighten all bolts and nuts to the specified torque. Use the correct amount and type of lubricant when refilling the differential (see Chapter 1).

1986 and later models

Refer to illustrations 19.9 and 19.10

7 Unscrew the plug at the bottom of the differential and allow the lubricant to drain. Remove the front axle assembly following the procedure outlined in Section 20.
8 Remove the differential cover from the carrier.
9 Using a slide hammer and axle flange adapter, remove the differential side gear shafts **(see illustration).**
10 Unbolt the differential tube from the carrier **(see illustration).**
11 Installation is the reverse of the removal procedure. When installing the cover to the carrier, apply a bead of silicone gasket sealer to the mating surface on the cover, position the cover on the carrier and install the bolts. Tighten the bolts to the specified torque while the sealer is still wet. Be sure to tighten the remainder of the fasteners to the specified torque and use the correct type and amount of lubricant when refilling the differential.

20 Front axle assembly (4WD) - removal and installation

1 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands placed under the frame rails. Remove the wheels.

1979 through 1985 models

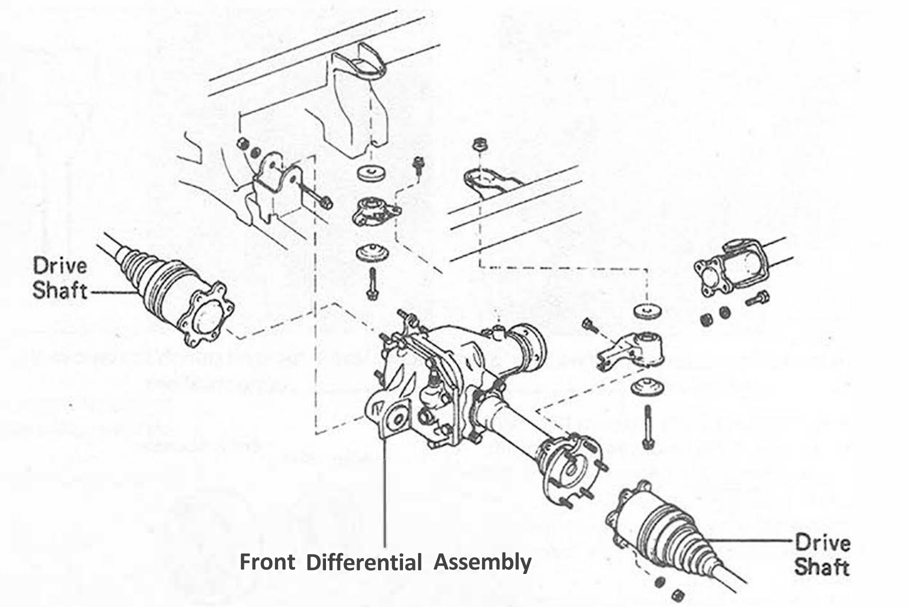
Refer to illustration 20.7

2 Disconnect the drag link from the left side steering knuckle arm (Chapter 10).
3 Disconnect the brake hoses from the calipers (Chapter 9). Plug the ends of the hoses to prevent excessive fluid loss and contamination.
4 Remove the shock absorber lower mounting bolts and compress the shocks to get them out of the way.
5 Remove the stabilizer bar-to-axle housing nuts and bolts, if so equipped (Chapter 10). Take note as to how the washers, bushings and spacers are arranged.
6 Unbolt the torque rod from its mounting bracket on the axle housing (Chapter 10).
7 Support the axle housing with two floor jacks, one placed under each axle tube. Remove the U-bolt nuts from under the leaf spring seats **(see illustration).**
8 Carefully lower the assembly from the vehicle.
9 Installation is the reverse of the removal procedure. Be sure to tighten the U-bolt nuts to the specified torque.

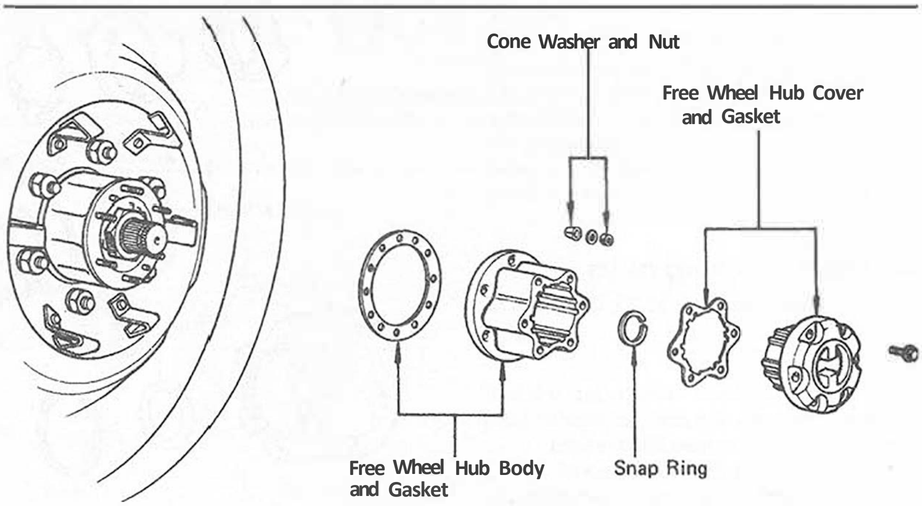
1986 and later models

Refer to illustration 20.11

10 Unbolt the drive axles from the differential side gear shafts (see Section 24). Support the inner ends of the driveaxles with pieces of wire - don't let them hang unsupported, as damage to the outboard constant velocity (CV) joint may occur.
11 Support the differential with a floor jack. Remove the differential front mounting bolt and nut **(see illustration).**
12 Remove the bolt that fastens the axle tube bracket to the frame **(see illustration 20.11).**
13 Remove the differential rear mounting bolt **(see illustration 20.11).**
14 Carefully lower the assembly from the vehicle.
15 Installation is the reverse of the removal procedure. Be sure to tighten all of the fasteners to the specified torque.



20.11 Front axle assembly mounting details **(1986** and later **4WD** models)



21.2 Manual locking freewheel hub assembly mounting details

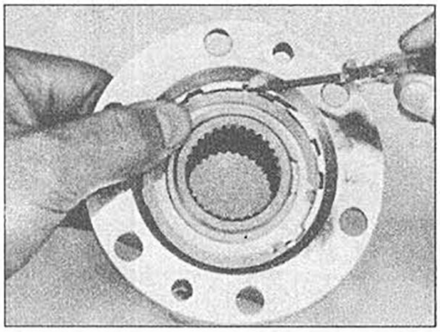
21 Freewheel hub (4WD) - removal and installation

Manual locking hubs

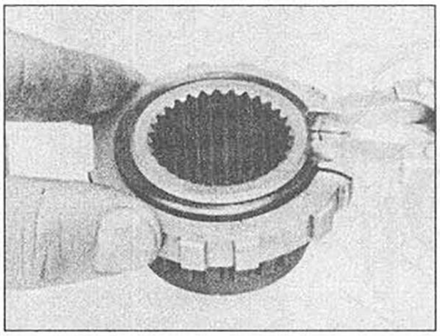
Refer to illustrations 21.2, 21.3, 21.5 and 21.7

Removal

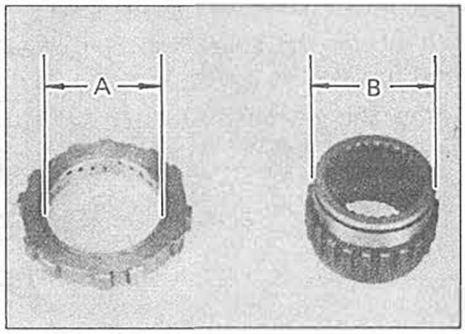
1 Set the hub cover to the Free position.
2 Remove the hub cover mounting bolts and pull off the cover with the clutch **(see illustration).**



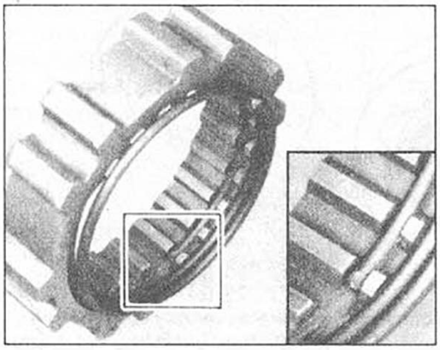
22.4 Removing the snap-ring retaining the inner hub and ring to the hub body (1991 and earlier models)



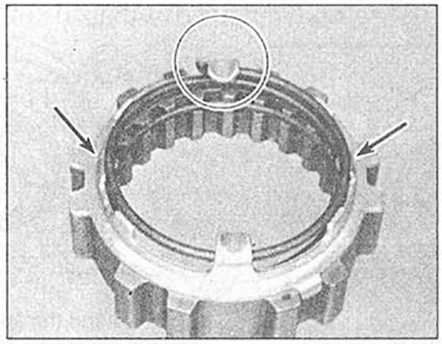
22.5 Remove the snap-ring retaining the hub ring to the inner hub (1991 and earlier models)



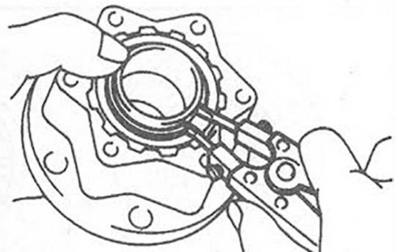
22.9 Oil clearance between the hub ring (A) and the inner hub (B) should be 0.012 in (0.3 mm) (1991 and earlier models)



22.13 Proper alignment of the tension spring in the clutch



22.14 Spring end abuts one of the large tabs, and the top ring rests on the small tabs of the follower pawl



22.23a Remove the snap-ring and detach the inner hub

freewheel hub body **(see illustration),** then remove the inner hub and ring from the body.

5 On 1991 and earlier models, using snap-ring pliers, remove the snap-ring that retains the freewheel hub ring to the inner hub **(see illustration),** then remove the ring and spacer from the inner hub.

6 Inspect the cover, handle and seal for wear or damage. If wear or damage is found, replace the appropriate parts with new ones.

7 . Temporarily attach the handle to the cover and see if the handle moves smoothly and freely.

8 Inspect the hub body, clutch spring, clutch body and follower pawl for wear and make sure that the clutch moves smoothly in the hub body. Replace any worn parts with new ones.

9 On 1991 and earlier models, inspect the inner hub and free wheel ring for wear or damage, and check the oil clearance between the hub and ring **(see illustration).** It should be as specified. Replace any worn parts with new ones.

10 To begin assembly of the freewheel hub, apply multi-purpose grease to the contact surfaces of all parts.

11 Attach a new seal and the spring and ball to the control handle.

12 Insert the handle into the cover and install the snap-ring.

13 Install the tension spring in the clutch, with the spring end aligned with the initial groove **(see illustration).**

14 Place the follower pawl over the tension spring, with one of the large tabs positioned against the bent spring end. The top coil of the spring should rest on the small tabs of the pawl **(see illustration).**

15 Place the spring between the hub cover and clutch, with the large end of the spring toward the cover.

16 Compress the spring and install the clutch with the pawl tab fitted into the handle cam.

17 On 1991 and earlier models, install the spacer and freewheel hub ring in the inner hub, then install the snap-ring with snap-ring pliers.

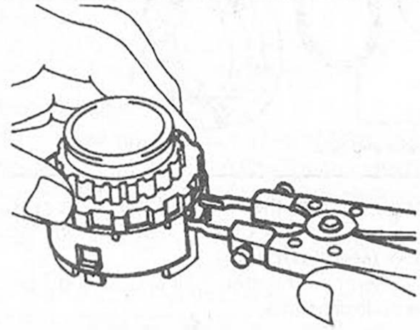
18 On 1991 and earlier models, insert the inner hub and freewheel hub ring into the hub body. Using a screwdriver, install the snap-ring.

19 Set the control handle and clutch to the Free position.

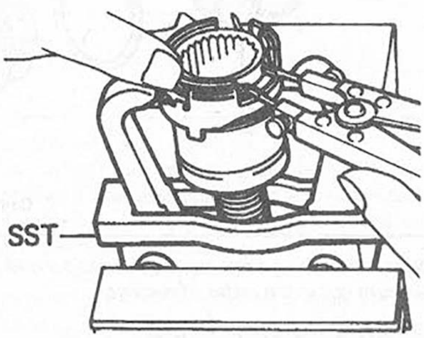
20 Insert the cover in the hub body and verify that the inner hub turns freely.

21 Before attaching the freewheel hub to the vehicle, remove the cover from the body.

22 Install the freewheel hub (Section 21).



22.23b Extend the joint spring and release it from the cam follower tabs



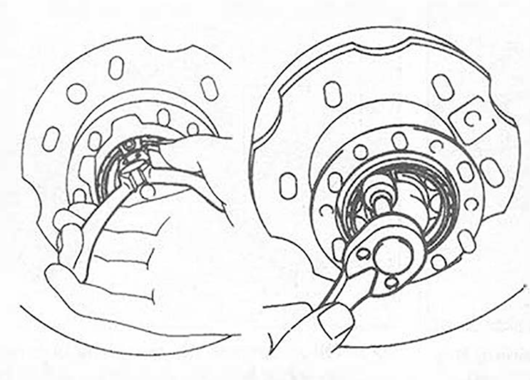
22.25 Remove the snap-ring after compressing the return spring with a gear puller

Automatic locking hubs

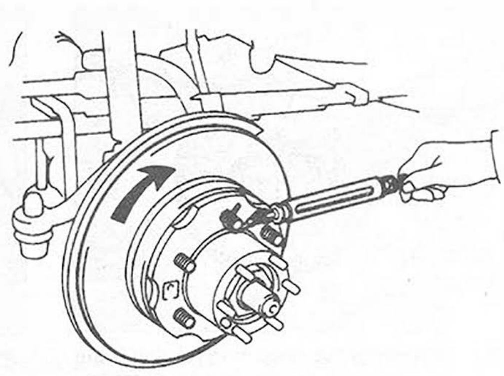
Refer to illustrations 22.23a, 22.23b, 22.25, 22.26a, 22.26b and 22.28

23 Using snap-ring pliers, remove the snap-ring and detach the inner hub from the hub. Extend the joint spring and release it from the cam follower tabs **(see illustrations).** Do not stretch the spring excessively.

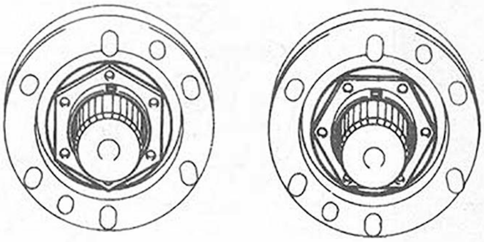
24 Remove the clutch, joint spring, preset



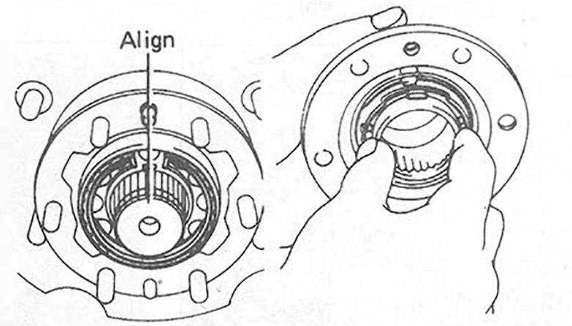
21.10 Compress the brake spring and align the gap with one of the screws, then remove the screw (repeat the procedure for the remaining screws)



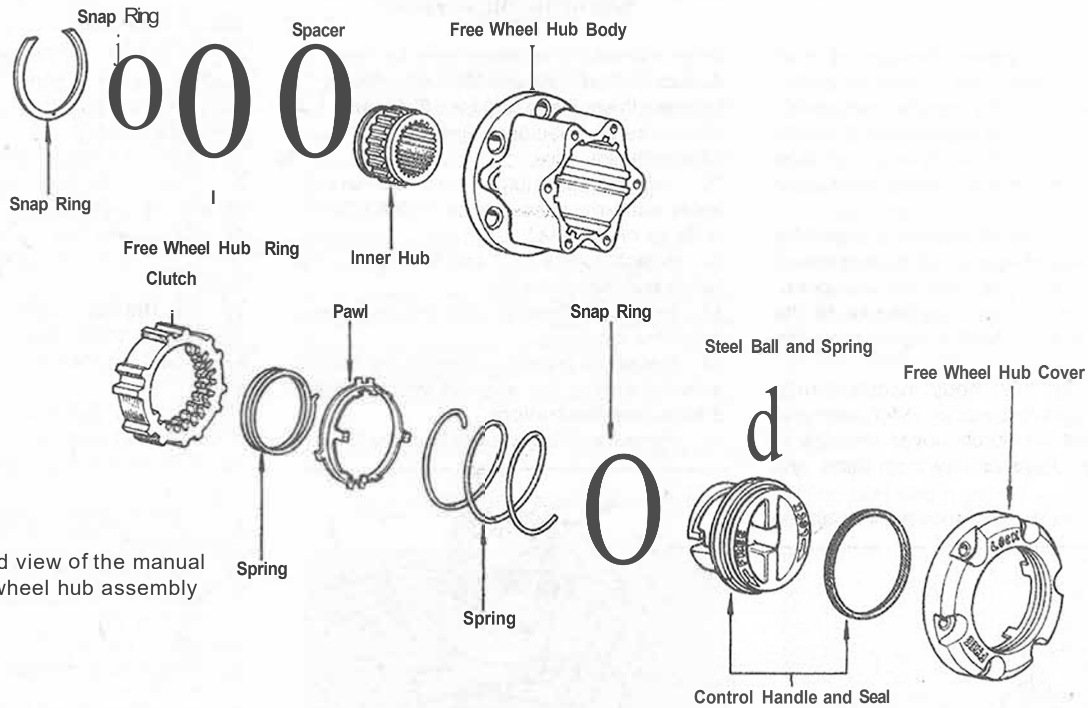
21.14 Checking the oil seal frictional drag with a spring scale



21.15 Make sure the hub nut is aligned in one of the two ways shown



21.16 Align the spring claw of the brake assembly with the pin and the inner cam protrusion with the pin hole when the hub body is installed



22.2 Exploded view of the manual locking freewheel hub assembly

22 Freewheel hub (4WD) - disassembly, inspection and reassembly

Note: *When disassembling the freewheel hub, pay very close attention to the way the parts fit together. If confusion is a possibility, make a sketch as they are disassembled and lay them out in the order of removal.*

Manual locking hubs

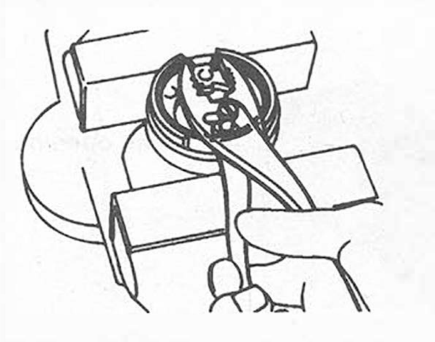
Refer to illustrations 22.2, 22.4, 22.5, 22.9, 22.13 and 22.14

1 Remove the freewheel hub (Section 21).

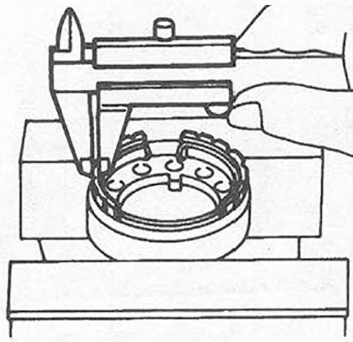
2 Using snap-ring pliers, remove the snap-ring from the inside of the hub cover, then remove the control handle from the cover **(see illustration).**

3 Remove the steel ball and spring from the control handle.

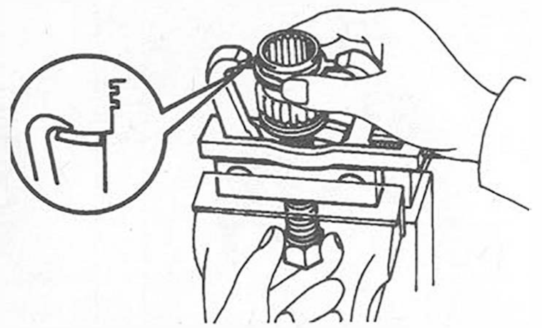
4 On 1991 and earlier models, using a screwdriver, remove the snap-ring that retains the inner hub and freewheel hub ring to the



22.26a Compress the brake spring with pliers and pull the shoe part way out



22.26b Measuring the brake shoe thickness



22.28 Align the cam follower with the step on the hub and adjust the gear puller jaws before beginning reassembly

spring and spring retainer.

25 Compress the return spring with a gear puller (hook the puller jaws over the cam follower tabs), then remove the snap-ring **(see Illustration).** Remove the outer cam, inner cam, cam follower and return spring.

26 Compress the brake spring with pliers and draw the shoe part way out of the drum {don't remove it) **(see illustration).** Measure the shoe thickness with a dial or Vernier caliper **(see illustration).** If it is less than 0.039-inch (1 mm), replace the brake assembly with a new one. Compress the spring and push the shoe back into the drum. Make sure the hub body and clutch engage and disengage smoothly. If they don't, replace the hub assembly. Look for evidence of excessive wear and galling on each part. If wear or damage is noted, replace the hub assembly.

27 Apply Benton Plus Guard SG grease (available from your Toyota dealer) to the sliding surfaces of the components (do not use any other grease). **Note:** *The hubs are maintenance-free and do not require regreasing unless foreign matter has entered them or they have been washed out with solvent.*

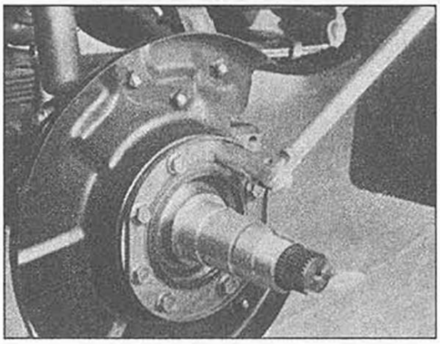
28 Assemble the inner hub and cam follower in the jaws of the gear puller. The cam follower must mesh with the splines of the hub. Adjust the gear puller until the cam follower is aligned with the step on the hub (s **illustration).** The jaws of the puller must bear against the cam follower tabs.

29 Remove the cam follower, then assemble the outer and inner cams. Align the inner cam notch with the outer cam tab, then align the inner cam tab in the opening of the outer cam.

30 Install the return spring on the hub, then attach the cam follower to the cam assembly and slip them onto the hub. Compress the return spring and fit the cam follower tabs under the gear puller jaws. Install the snap-ring.

31 Assemble the joint spring, preset spring and spring retainer on the clutch, then attach them to the inner hub. Expand the joint spring and attach it to the cam follower.

32 The remaining steps are the reverse of removal.



23.4 Remove the eight knuckle spindle mounting bolts then remove the dust seal and cover

23 Front axleshaft (1985 and earlier 4WD models) - removal, overhaul and installation

Removal

Refer to illustrations 23.4, 23.6, 23. 7, 23. 1Q 23.11, 23.12, 23.13, 23.17, 23.18, and 23.20

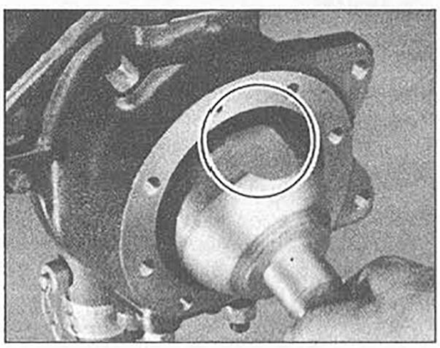
1 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the wheel.

2 Remove the freewheel hub (Section 21).

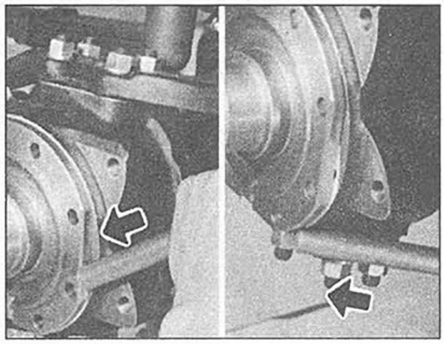
3 Remove the front axle hub (see Chapter 1).

4 Remove the knuckle spindle mounting bolts **(see illustration).**

5 Remove the dust seal and dust cover



23.7 Turn the axleshaft so the flat faces up, then pull the axle from the housing



23.6 Tap the knuckle spindle off the steering knuckle with a brass drift and hammer

from the knuckle spindle.

6 Using a brass bar, tap the knuckle spindle off the knuckle **(see illustration).**

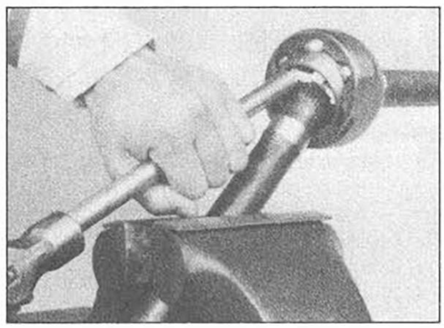
7 Position one flat of the axleshaft outer end facing up and carefully pull the axleshaft oat of the housing **(see illustration).**

8 Inspect the Birfield (constant velocity) joint for excessive wear and looseness. If the joint feels sloppy and worn out, disassemble and inspect it, replacing any parts that may be questionable.

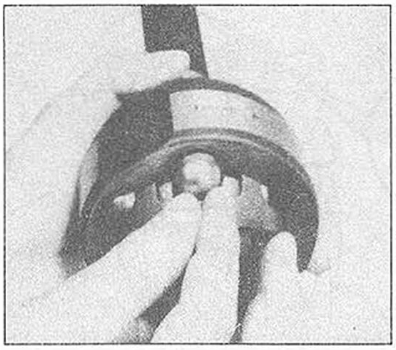
Overhaul

9 Place the inner axleshaft in a vise with soft jaws or blocks of wood, so as not to mar the shaft.

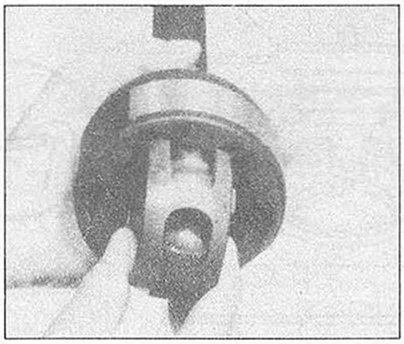
10 Place a brass drift against the inner race of the joint and drive off the joint and outer shaft with a hammer **(see illustration).**



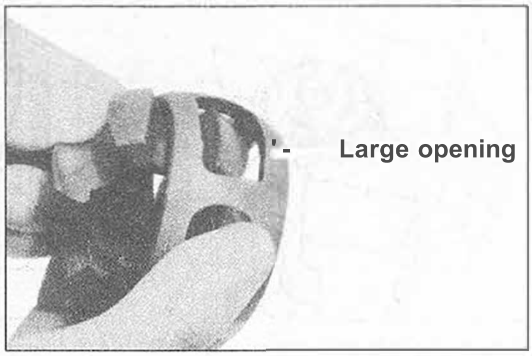
23.10 Dislodge the outer joint and shaft with a brass drift and hammer (be careful not to let the joint fall)



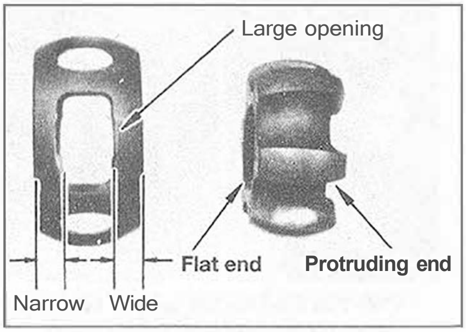
23.11 Tilt the inner race and cage and remove the balls from the joint one at a time



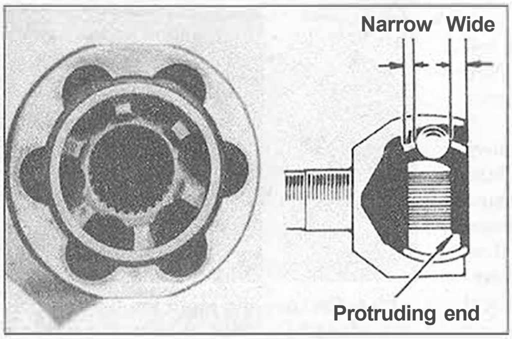
23.12 Tilt the inner race and cage **90** degrees, then align the windows of the cage with the lands of the housing and rotate the inner race up and out of the outer race



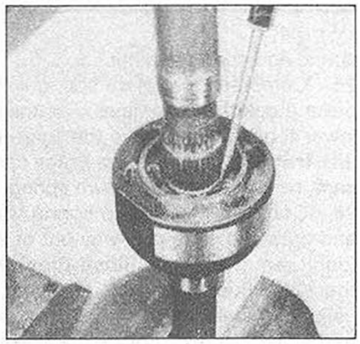
23.13 Align the inner race lands with the cage windows and rotate the inner race out of the cage



23.17 The protruding end of the inner race and the wide side of the cage must be on the same side when assembled



23.18 The wide side of the cage and the protruding end of the inner race must face the open end of the joint when installed



23.20 Compress the inner snap-ring with a screwdriver and slide the inner shaft into the inner race of the joint and outer shaft assembly

11 Tilt the inner race and cage and remove the ball bearings one at a time **(see illustration).**

12 Tilt the two large openings in the cage around the lands of the outer shaft and pull out the cage and inner race (see illustration).

13 Remove the inner race from the cage by positioning it so that two of its lands line up with the large openings in the cage, turning the race 90 degrees and pulling it out (see **illustration).**

14 Clean and inspect the inner parts of the joint for wear or damage. If necessary, replace any worn or damaged parts with new ones.

15 To reassemble the joint, coat the inner parts of the joint and the inside of the outer shaft with molybdenum disulfide grease.

16 Insert the inner race into the cage by reversing Step 13.

17 Position the protruding end of the inner race toward the wide side of the cage **(see illustration).**

18 Assemble the cage and inner race to the outer shaft by reversing Step 12. **Note:** Make *sure to position the wide side of the cage and the protruding end of the inner race facing out* **(see illustration).**

19 Install new snap-rings on the inner axle-shaft.

20 Place the outer shaft in the vise (still lined with soft jaws or wood) and install the inner shaft to the outer shaft while compressing the inner snap-ring with a screwdriver **(see illustration).**

21 Verify that the inner axleshaft can't be pulled out of the joint.

Installation

22 To install the axleshaft in the axle housing, reverse the removal procedure.

24 Front driveaxle (1986 and later 4WD models) - removal and installation

Refer to illustration 24.5

Removal

1 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the wheel.

2 Remove the six driveaxle-to-differential side gear flange nuts. Have an assistant step on the brake to prevent the axle from turning.

3 Remove the freewheeling hub (see Section 21).

4 Using a pair of snap-ring pliers, remove the snap-ring from the outer end of the driveaxle. Slide the spacer off the axle.

5 Separate the inboard joint from the differential side gear flange then carefully pull the driveaxle outer end from the steering knuckle/hub (see illustration).

Installation

6 Apply a coat of molybdenum disulfide grease to the outboard CV joint shaft.

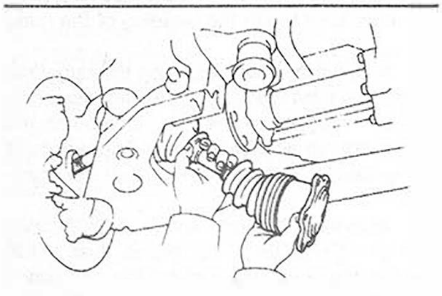
7 Insert the outer end of the shaft into the steering knuckle/hub. Position the inboard CV joint housing onto the differential side gear flange, making sure all six studs protrude through the CV joint flange holes. Install the nuts, but don't tighten them at this time.

8 Install the spacer and the snap-ring to the outer end of the axle.

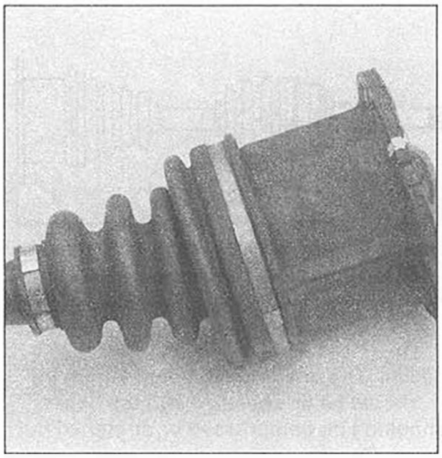
9 Install the freewheeling hub (Section 21).

10 Tighten the six driveaxle-to-side gear shaft nuts to the specified torque, again having an assistant depress the brake pedal to prevent the axle from turning.

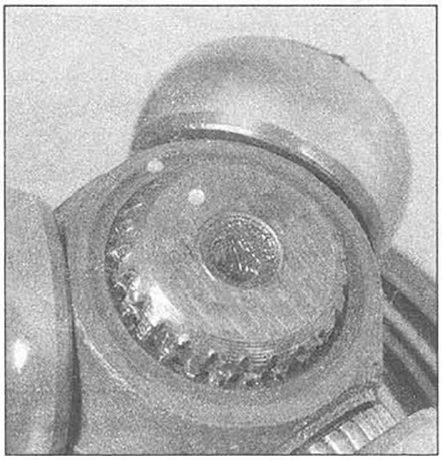
11 Install the wheel and lug nuts. Lower the



24.5 Carefully guide the driveaxle out from the steering knuckle, between the side gear shaft and the lower control arm



25.2 Paint (do not punch) match marks on the inboard joint tulip and the driveaxle



25.6 Use a center-punch to place match marks (arrows) on the tripod and the driveaxle to insure that they are reassembled properly

vehicle and tighten the lug nuts to the specified torque.

25 Driveaxle boot replacement and CV joint overhaul

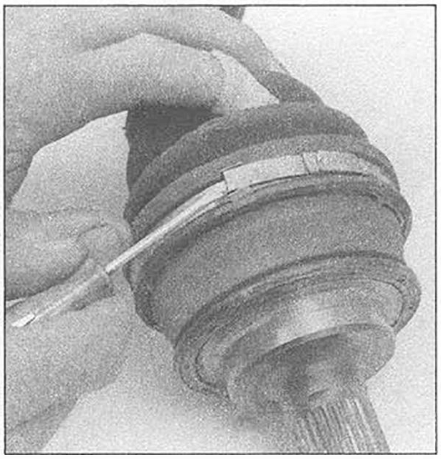
Refer to illustrations 25.2, 25.3, 25.5, 25.6, 25.7, 25.11, 25.12a, 25.12b and 25.14

Note: If *the CV joints exhibit signs of wear indicating 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. Whichever route you choose to take, check on the cost and availability of parts before disassembling your vehicle.*

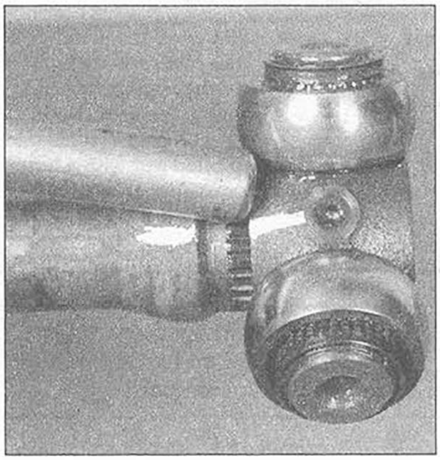
1 Remove the driveaxle (refer to Section 24).

2 Paint a pair of match marks on the joint tulip and the driveaxle **(see illustration).**

3 Pry the outer (larger) clamps loose with a small screwdriver **(see illustration)** and



25.3 The large boot clamps can be pried open with a small screwdriver



25.7 Drive the tripod from the driveaxle with a brass drift and hammer - be careful not to damage the bearing surfaces or the splines on the shaft

slide them off the ends of the driveaxle. Cut the inner (smaller) clamps and the drive shaft damper clamp with a pair of diagonal cutters and discard them.

4 Separate the inboard joint tulip from the tripod joint.

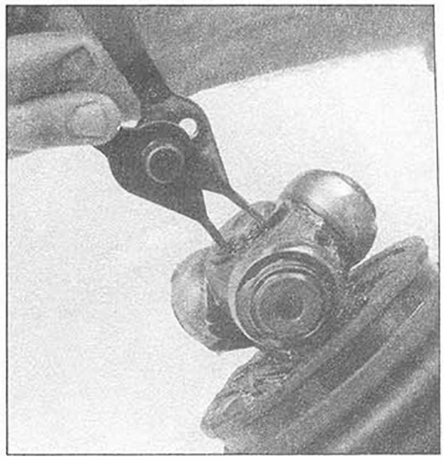
5 Remove the tripod joint snap-ring with a pair of snap-ring pliers **(see illustration).**

6 Punch match marks on the tripod and the driveaxle **(see illustration).**

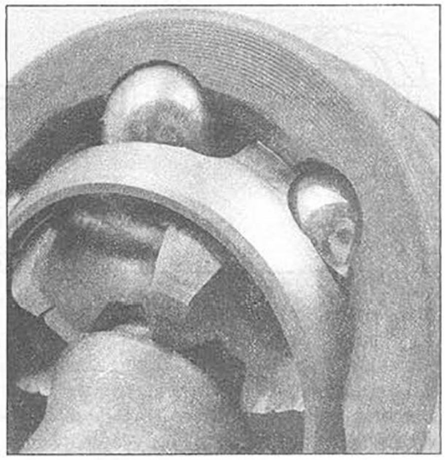
7 Using a hammer and brass punch, drive the tripod joint from the driveaxle **(see illustration).**

8 Slide the inboard joint boot and the outboard joint boot off the driveaxle.

9 Thoroughly wash the inboard and outboard CV joints in clean solvent and blow dry with compressed air, if available. **Note:** *Because the outboard joint cannot be disassembled, it is difficult to wash away all the old grease and to rid the bearing of solvent once it's clean. But it is imperative that the job be done thoroughly,* so *take your time and do it right.*



25.5 Remove the snap-ring that retains the inboard joint tripod with a pair of snap-ring pliers



25.11 After the old grease has been **rinsed away and the cleaning solvent has been blown out with compressed air, rotate the outboard joint** housing **through its full range of motion and inspect the bearing surfaces for wear** or **damage - if any of the balls, the race** or the cage **look damaged, replace the driveaxle/outboard joint assembly**

10 Inspect the inboard tripod joint for signs of wear or damage. If the tripod is obviously worn or damaged, replace it, along with the tulip, as an assembly.

11 Bend the outboard CV joint housing at an angle to the driveaxle to expose the bearings, inner race and cage **(see illustration).** Inspect the bearing surfaces for signs of wear. If the bearings are damaged or worn, replace the driveaxle.

12 Slide the new outboard boot onto the driveaxle. It's a good idea to wrap vinyl tape around the spline of the shaft to prevent damage to the boot. When the boot is in position, add the specified amount of grease (included in the boot replacement kit) to the outboard 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 and install the new clamps

Chapter 9 Brakes

Contents

	Section
Brake check	See Chapter 1
Brake disc - inspection, removal and installation	4
Brake fluid level check	See Chapter 1
Brake lines and hoses - inspection and replacement	8
Brake pedal height, free play and reserve - check and adjustment	See Chapter 1
Brake pedal - removal and installation	14
Brake system - bleeding	10
Disc brake caliper- removal, overhaul and installation	3
Front brake pads - replacement	2
General information	1
Load Sensing Proportioning Valve (LSPV) - general information	9
Master cylinder- removal, overhaul and installation	7
Parking brake cables - replacement	13
Parking brake - check and adjustment	12
Power brake booster - check, removal and installation	11
Rear brake shoes - replacement	5
Rear wheel anti-lock brake system	15
Wheel cylinder - removal, overhaul and installation	6

Specifications

General

Brake fluid type	See Chapter 1
Power brake booster pushrod-to-master cylinder piston clearance	0.024 to 0.026 in (0.60 to 0.65 mm)

Disc brakes

Minimum brake pad thickness	See Chapter 1
Disc runout	0.0059 in (0.15 mm)

Drum brakes

Drum inside diameter (standard)	
2WD all years, 1985 and earlier 4WD	10.000 in (254 mm)
1986 and later 4WD	11.614 in (295 mm)
Drum inside diameter (maximum)'	
2WD all years, 1985 and earlier 4WD	10.079 in (256 mm)
1986 and later 4WD	11.693 in (297 mm)

•Minimum disc thickness and maximum drum inside diameter specifications are stamped into the actual part and should supersede all information given above

Torque specifications	Ft-lbs
Brake booster mounting nuts	8 to 11
Master cylinder-to-brake booster	8 to 11
Brake caliper-to-steering knuckle	
1983 and earlier 2WD, 1984 and earlier 4WD	68 to 86
1984 through 1985 4WD models	55 to 75
1986 and later 4WD models	90
Brake caliper-to-torque plate	
1984 and later 2WD (FS17 type)	62 to 68
1985 and later 2WD (PD60 and PD66 types through 1988)	29
1989 and later 2WD	47
1989 and later 4WD	90
Torque plate-to-steering knuckle	73 to 86
Brake disc-to-front axle hub	
2WD	40 to 54
4WD	29 to 39
Drum brake backing plate-to-rear axle housing	51
Wheel cylinder-to-backing plate	
Leading/trailing type drum brake	84 in-lbs
Duo-servo type drum brake	10
Wheel lug nuts	65 to 87

1 General information

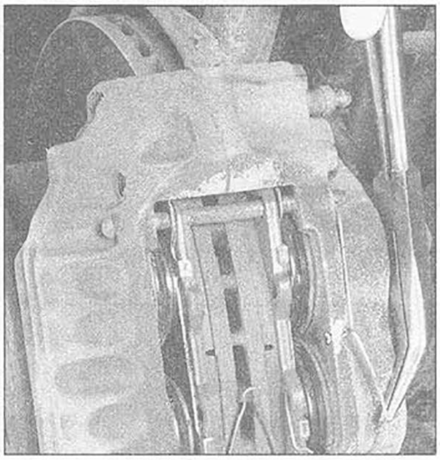
The braking system in the vehicles covered by this manual is a split system design. It incorporates two separate circuits, one for the front brakes and one for the rear brakes. With this system if one circuit fails, the other circuit will still function.

The master cylinder is designed for the split system and incorporates a primary piston for one circuit and a secondary piston for the other.

A vacuum booster unit is used which draws vacuum from the intake manifold to add power assistance to the normal brake pressure.

The Load Sensing Proportioning and Bypass Valve (LSPBV) is designed to prevent the rear wheels from locking under severe braking conditions. The valve operates by changing rear brake fluid pressure distribution in response to vehicle loading.

The front wheels are equipped with disc brakes. These consist of a flat, disc-like rotor which is attached to the axle and wheel. Around one section of the rotor is mounted a stationary caliper assembly which houses two hydraulically-operated disc brake pads. On some models the inner pad is mounted to a piston facing the inner surface of the rotor, while the outer pad is mounted to a yoke and faces the outer surface of the rotor. Other models feature either a dual or four piston caliper arrangement. When the brake pedal is applied, brake fluid pressure forces both pads against the rotor. The pressure and resultant friction on the rotor is what slows the wheel.



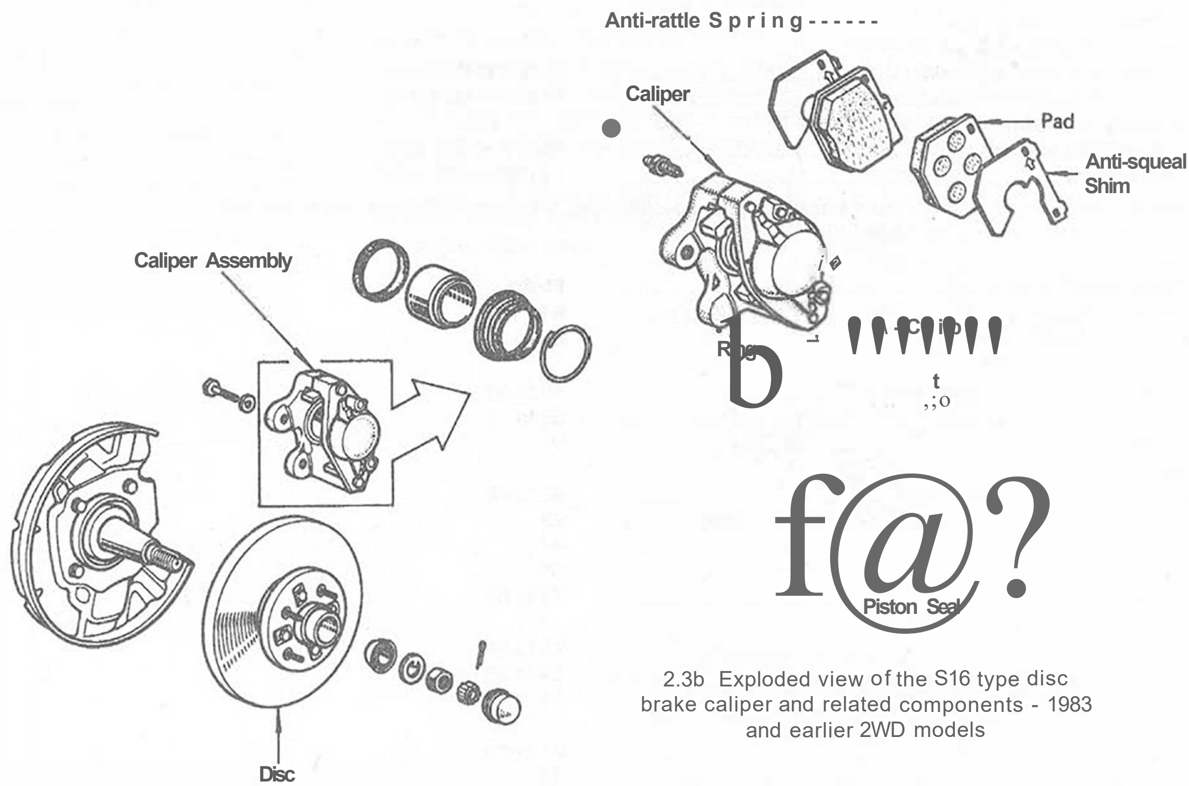
2.3a Removing the retaining clip (left) and pins and anti rattle spring (right)

The rear brakes on some models use the conventional drum brakes of the dual-servo type. Other models employ a single action, leading/ trailing shoe type with a pivot point at the bottom of each shoe. With either of these designs, fluid pressure from the master cylinder forces the rear wheel cylinder pistons outward, which in turn forces the brake shoes against the spinning brake drum attached to the rear wheel. The force of the brake shoes against the drum is what slows the wheel. The wheel cylinders contain two operating pistons which contact both brake shoes. Adjustment is automatic, occurring when the parking brake is applied.

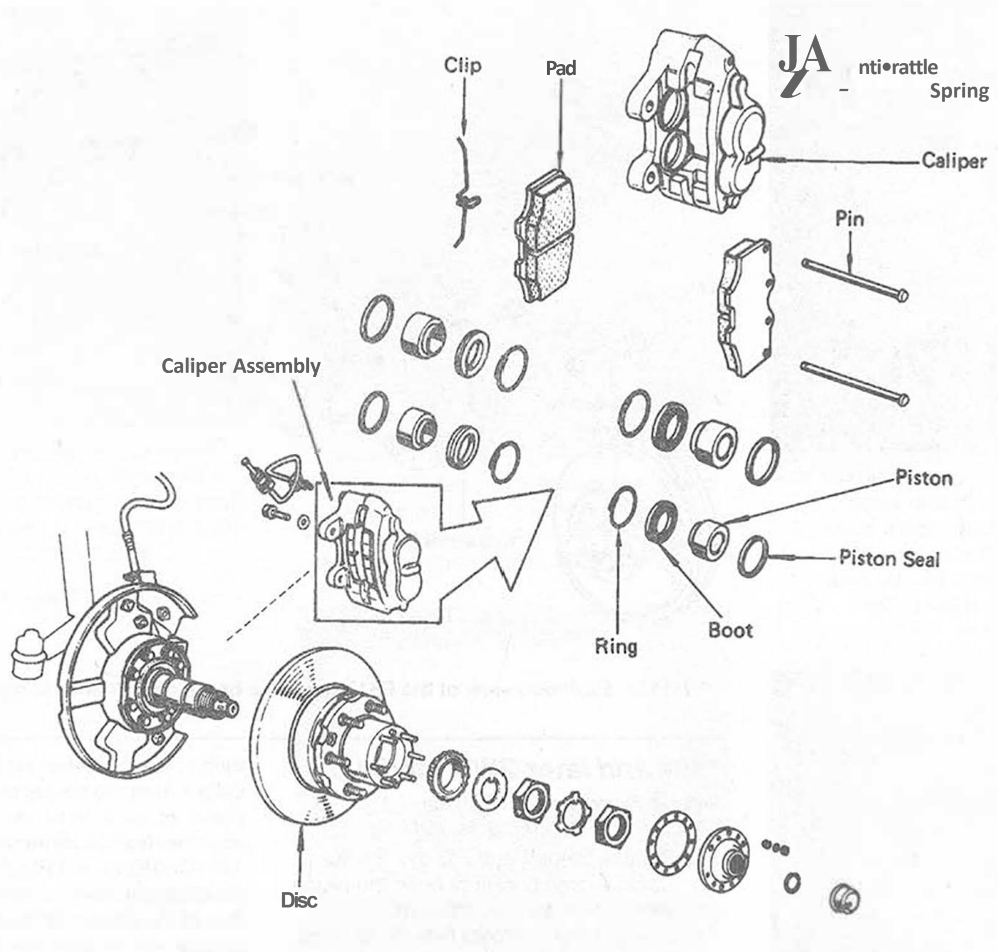
Precautions

There are some general notes and cautions involving the brake system on this vehicle:

a) *Use only DOT 3 brake fluid in this system.*
b) *The brake pads and linings contain asbestos fibers which are hazardous to your health if inhaled. Whenever you work on brake system components, carefully clean all parts with brake cleaner. Do not allow the fine asbestos dust to become airborne.*
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. If a problem is suspected in the brake system, do not drive the vehicle until the fault is corrected.*
d) *Tires, load and front end alignment are factors which also affect braking performance.*



2.3b Exploded view of the S16 type disc brake caliper and related components - 1983 and earlier 2WD models



2.3c Exploded view of the S12x8 type disc brake caliper and related components - 4WD models

2 Front 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 contains* 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 cleaner or denatured alcohol only!*

Note: *It is a good idea to work on only one side at* a *time* so *that the other brake can be used as a guide if difficulties are encountered during reassembly. Also, use only high quality, nationally recognized brand name brake parts.*

All 4WDs and 2WD drive models to 1983

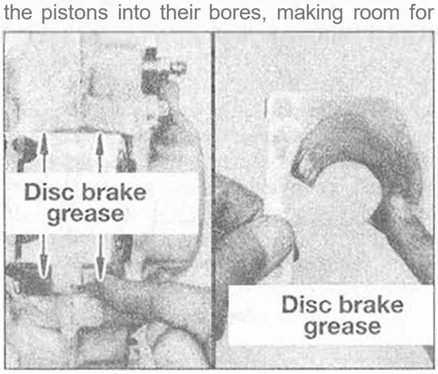
Refer to illustrations 2.3a, 2.3b, 2.3c and 2 7

1 Remove the cover from the brake fluid reservoir, siphon off about two-thirds of the brake fluid into a container and discard it.

2 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the front wheels.

3 Remove the pin retaining clip, then pull the pins out with a pair of pliers **(see illustrations).** While pulling out the pins, cover the anti-rattle spring with your hand so it doesn't fly out and get lost.

4 Using a pair of large pliers, squeeze each pad against the caliper housing to push the pistons into their bores, making room for the new brake pads. Do this slowly, alternating between each end of the pad, to ensure the pistons are compressed evenly and don't become cocked in the bores.



2.7 When applying disc brake grease to the caliper and the anti-squeal shims, apply a thin coat only - an excessive amount may contaminate the pad linings

5 Slide the two pads and anti-squeal shims (2WD only) out of the caliper.

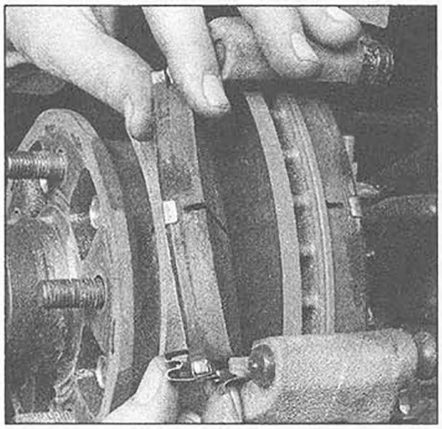
6 Inspect the brake disc as described in Section 4.

7 Apply a thin coat of disc brake grease to the upper and lower openings of the caliper and to the anti-squeal shims, if so equipped **(see illustration).**

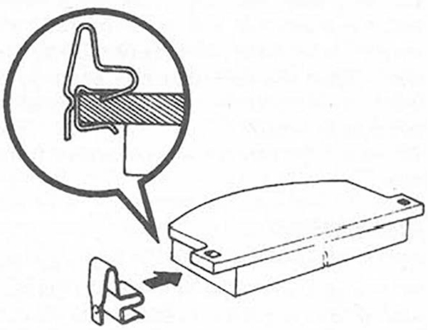
8 Insert the brake pads and anti-squeal shims into the caliper, making sure the arrows on the shims point in the direction of forward wheel rotation.

9 Install the anti-rattle spring and the pad retaining pins and clip. Mount the front wheel and tighten the lug nuts to the specified torque.

10 Perform the same steps to the other side. **Warning:** *Pump the brake pedal several times before driving the vehicle to bring the pads in contact with the brake disc. Check the brake fluid level, topping it off if necessary. Make sure the brakes are working smoothly and make several low speed* stops *before taking the vehicle into* a *traffic situation.*



2.15 Tilt the pads and remove them from the torque plate. As this is done, notice **the position of the pad components. such as the wear indicator, anti-squeal shim(s) and pad support plates**



2.19 Push new wear indicators onto the lower edge of the pad

by the brake hose.

15 Remove the two pads from the torque plate **(see illustration).**

16 Refer to Section 4 and inspect the brake disc.

17 Apply disc brake grease to the anti-squeal shim and install it to the outer pad (and to the caliper piston on PD60 models) **(see illustration).**

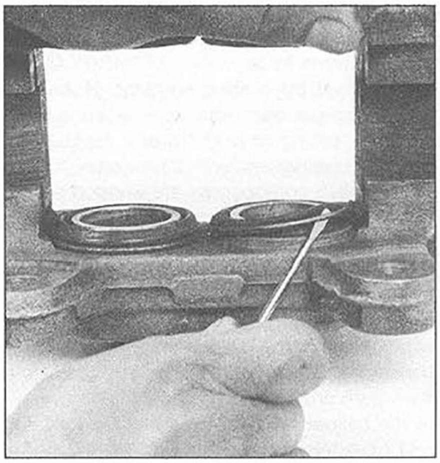
18 Install new pad support plates in the torque plate **(see illustration).**

19 Install new wear indicators to the lower side of each pad **(see illustration).**

20 Place the pads (and anti-rattle springs, if equipped) in the torque plate and install the caliper, tightening the slide pin or mounting bolts to the specified torque. Install the front wheel and tighten the lug nuts to the specified torque.

21 Repeat the procedure on the other front brake. **Warning:** *Pump the brake pedal several times before driving the vehicle to bring the pads into contact with the brake disc. Check the brake fluid level, topping it off if necessary. Make sure the brakes are working smoothly and make several low speed stops before taking the vehicle into a traffic situation.*

2.17 Apply disc brake grease to the pad backing plate and assemble the anti squeal shim(s) to the backing plate (some calipers use two shims, others only one)



3.4a Using a small screwdriver, remove the boot retaining ring

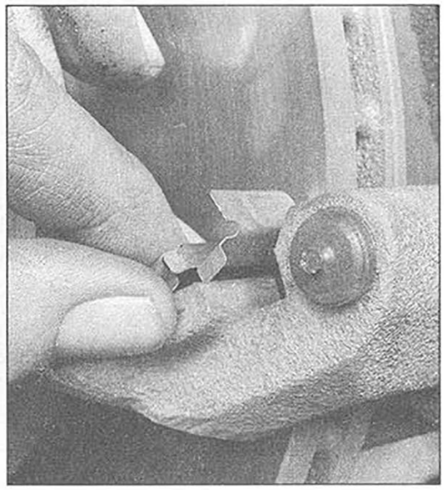
3 Disc brake caliper - removal. overhaul and installation

Refer to illustrations 3.4a, 3.4b, 3.5, 3.7, 3.8a and 3.8b

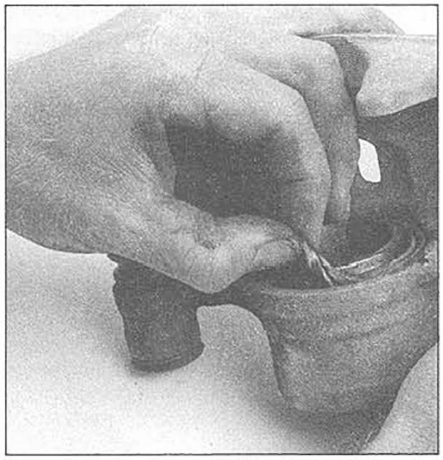
Note: *The following procedure applies to all caliper designs used on the vehicles covered by this manual. On multiple piston caliper designs, simply repeat the necessary Steps to complete the rebuild procedure. If an overhaul is indicated (usually because of fluid leakage) explore all options before beginning the job. New and factory rebuilt calipers are available on an exchange basis, which makes this job quite easy. If it is decided to rebuild the calipers, make sure that a rebuild kit is available before proceeding.*

Removal

1 Disconnect the brake line from the caliper and plug it to keep contaminants out of the brake system and to prevent losing any more brake fluid than is necessary. Unbolt



2.18 Install the pad support plates into the torque plate



3.4b Remove the boot from the cylinder

the brake line bracket from the caliper (on models so equipped).

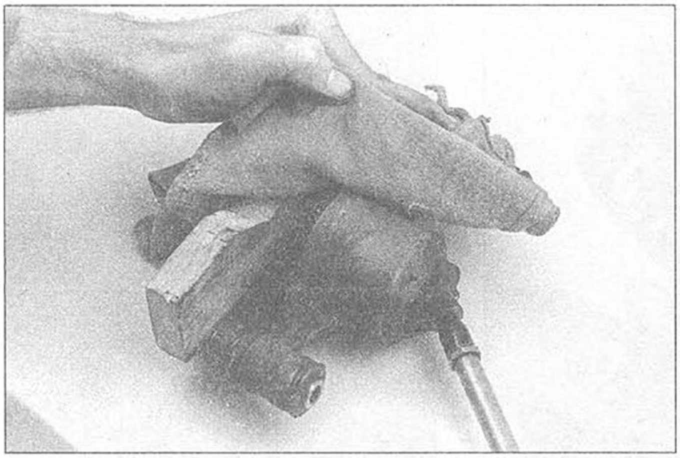
2 Remove the two caliper mounting bolts (or slide pins on the FS17 style caliper) and lift the caliper off the brake disc (see the previous Section).

3 On 4WD and 1983 and earlier 2WD models, remove the brake pads from the caliper (see Section 2).

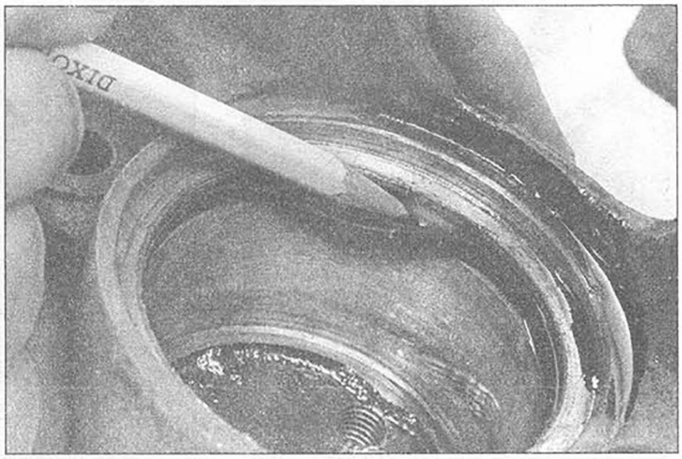
Overhaul

Warning: *Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use only clean brake fluid or denatured alcohol. Allow all parts to dry, preferably using compressed air to blow out all passages. Make sure the compressed air is filtered, as a harmful lubricant residue will be present in unfiltered* systems.

4 To overhaul the caliper, remove the rubber boot retaining ring and the rubber boot **(see illustrations).** Before you remove the piston, place a wood block in the center of the caliper to prevent damage to the piston upon removal.



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



3.7 Use a non-metallic tool to remove the piston seal from the groove in the cylinder - a pencil works well (metal tools can scratch the bore surface)

5 To remove the piston from the caliper, apply compressed air to the brake fluid hose connection on the caliper body **(see illustration).** Use only enough air pressure to ease the piston out of the bore. **Warning:** *Be careful not to place your fingers between the piston and the caliper as the piston may come out with some force.*

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

7 If these components *are* in good condition, remove the rubber seal from the caliper bore using a wooden or plastic tool (metal tools may cause bore damage). Be careful not to damage the cylinder bore **(see illustration).**

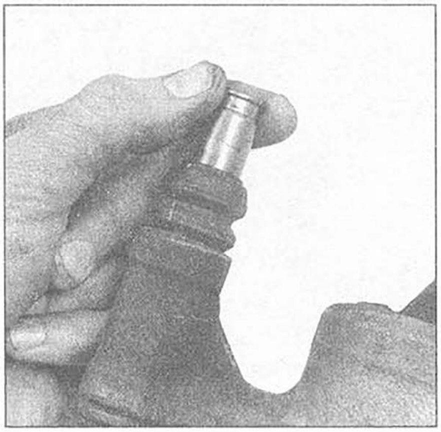
8 On PD60 style calipers, push the sliding bushing out of the caliper housing **(see illustration)** and remove the two rubber boots from both ends. Slide the bushing sleeve out of the caliper housing **(see illustration).** On FS17 models the slide bushings and boots are located in the torque plate.

9 Wash all the components in clean brake fluid or alcohol.

10 To reassemble the caliper, you should already have the correct rebuild kit for your vehicle. **Note:** *During reassembly apply silicone based grease (supplied with the rebuild kit) between the sliding bushing and the bushing sleeve.*

11 Submerge the new piston seal and the piston in brake fluid and install them into the caliper bore. Do not force the piston into the bore, but make sure that it is squarely in place, then apply firm (but not excessive) pressure to install it.

12 Install the new rubber boot and retaining ring.



3.8a On each side of the caliper, push the sliding bushing up through the boot and pull it free, then remove the dust boots (PD60 caliper only)

Installation

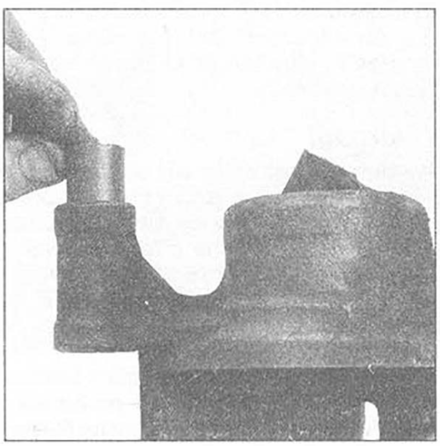
13 To install the caliper, reverse the removal procedure. Be sure to bleed the system by following the procedure described in Section 10.

4 Brake disc - inspection, removal and installation

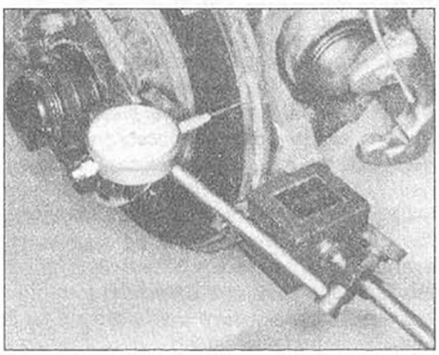
Inspection

Refer to illustrations 4.4a, 4.4b and 4.5

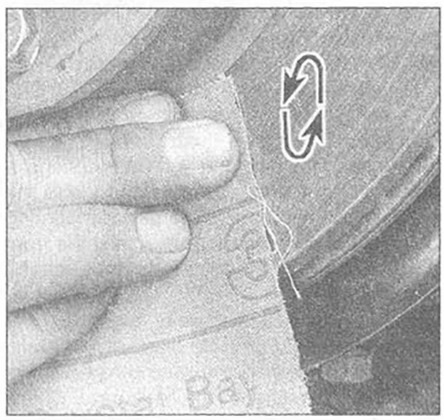
1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands.



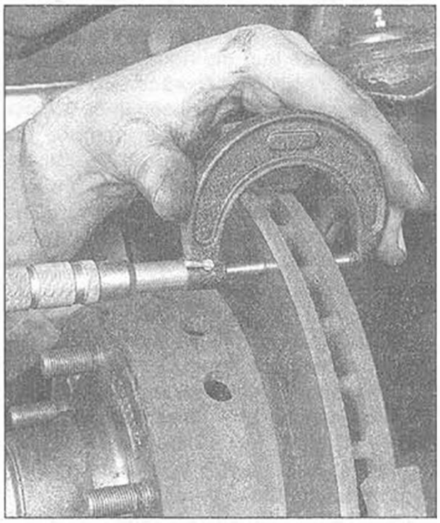
3.8b Push the bushing sleeve out of the caliper (PD60 caliper only)



4.4a Check disc runout with a dial indicator - if the reading exceeds the maximum allowable runout, the disc will have to be resurfaced or replaced



4.4b Using a swirling motion, remove the glaze from the disc with emery cloth or sandpaper



4.5 Measure the disc thickness at several points with a micrometer

Remove the wheel.

2 Remove the brake caliper as outlined in Section 3. It's not necessary to disconnect the brake hose. After removing the caliper bolts, suspend the caliper out of the way with a piece of wire. Don't let the caliper hang by the hose and don't stretch or twist the hose. On single piston caliper models, also remove the two torque plate-to-steering knuckle bolts and the torque plate **(see illustrations 2.13a and 2.14).**

3 Visually check the disc surface for score marks and other damage. Light scratches and shallow grooves are normal after use and may not always be detrimental to brake operation, but deep score marks-over 0.015-inch (0.38 mm) - require disc removal and refinishing by an automotive machine shop. Be sure to check both sides of the disc. If pulsating has been noticed during application of the brakes, suspect disc runout.

4 To check disc runout, place a dial indicator at a point about 1/2-inch from the outer edge of the disc **(see illustration).** Set the indicator to zero and turn the disc. The indicator reading should not exceed the specified allowable runout limit. If it does, the disc should be refinished by an automotive machine shop. **Note:** *Professionals recommend resurfacing of brake discs regardless of the dial indicator reading (to produce a smooth, flat surface that will eliminate brake pedal pulsations and other undesirable symptoms related to questionable discs).* At the very least, if you elect not to have the discs resurfaced, deglaze the brake pad surface with medium grit emery cloth (use a swirling motion to ensure a non-directional finish) **(see illustration).**

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

Removal and installation

Refer to illustrations 4.8, 4.11 and 4.14

6 If it has been determined while performing the inspection procedures in this Section that the brake disc must be removed and/or replaced, perform the following procedure. **Note:** *If the disc is to be taken to a machine shop to be refinished, do not remove the disc from the axle hub. Take the entire disc/hub assembly.*

7 Remove the axle hub (see Chapter 1).

2WD vehicles

8 Remove the disc from the axle hub by removing the five retaining bolts **(see illustration).**

9 Install a new disc and tighten the five bolts, following a criss-cross pattern, to the specified torque.

10 Install the axle hub and adjust the front bearing preload (see Chapter 1).

4WD vehicles

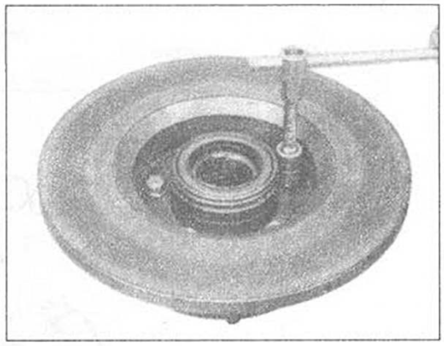
11 Using a large punch and hammer, drive the hub bolts out of the axle hub **(see illustration).**

12 Remove the two disc retaining bolts and separate the disc and hub.

13 Install a new disc to the axle hub and tighten the two retaining bolts to the specified torque.

14 Using a collar positioned under the hub and a large punch, drive the hub bolts into the hub **(see illustration).**

15 Install the axle hub and adjust the front bearing preload (see Chapter 1).



4.8 The disc on 2WD vehicles is retained to the hub by five bolts

5 Rear brake shoes - replacement

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 contains asbestos, which is harmful to your health. Never blow it out with compressed air and do not inhale any of it. An approved filtering mask should be worn whenever servicing the brake system. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake cleaner or denatured alcohol only.*

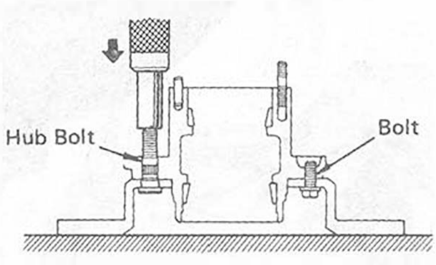
Caution: *Whenever the brake shoes are replaced, the retractor and hold down springs should also be replaced. Due to the continuous heating/cooling cycle that the springs are subjected to, they lose their tension over a period of time and may allow the shoes to drag on the drum and wear at a much faster rate than normal. When replacing the rear brake shoes, use only high quality nationally recognized brand name parts.*

1 Remove the rear wheels and drums according to the brake check instructions in Chapter 1. Perform all drum brake checks as described in Chapter 1. It is a good idea to disassemble only one brake at a time so that the other brake can be used as a guide if difficulties are encountered during reassembly.

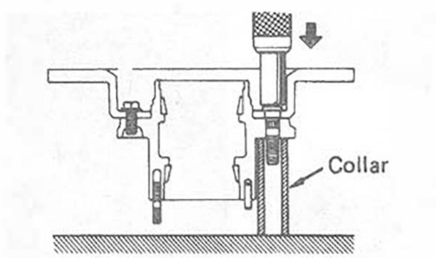
Most 2WD drive models

Refer to illustrations 5.2a, 5.2b, 5.6, 5.7, 5.10, 5.20 and 5.23

2 Using a brake spring tool, remove the adjuster return spring and adjuster **(see illus-**

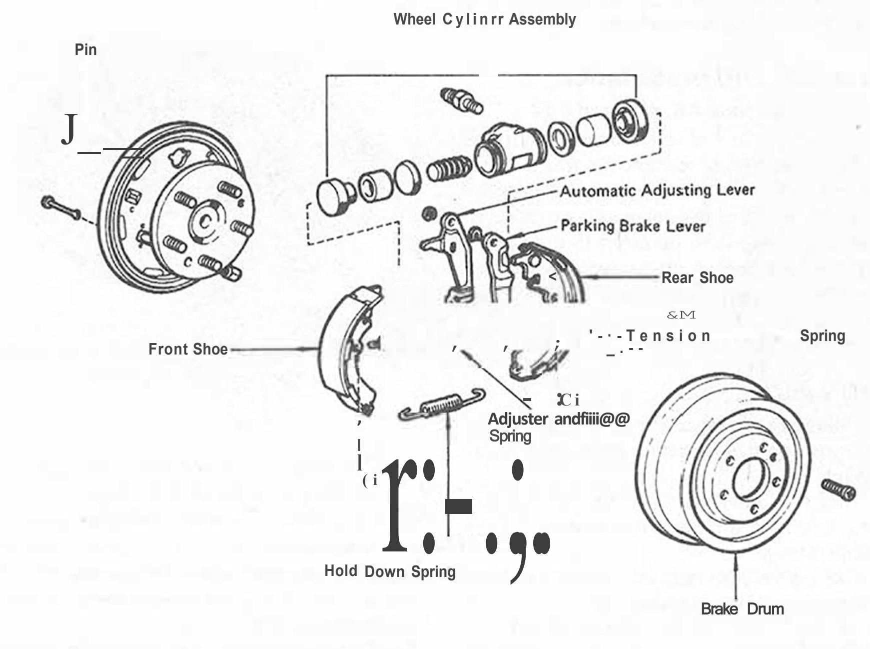


4.11 Knock the hub bolts out of the hub using a large punch and hammer

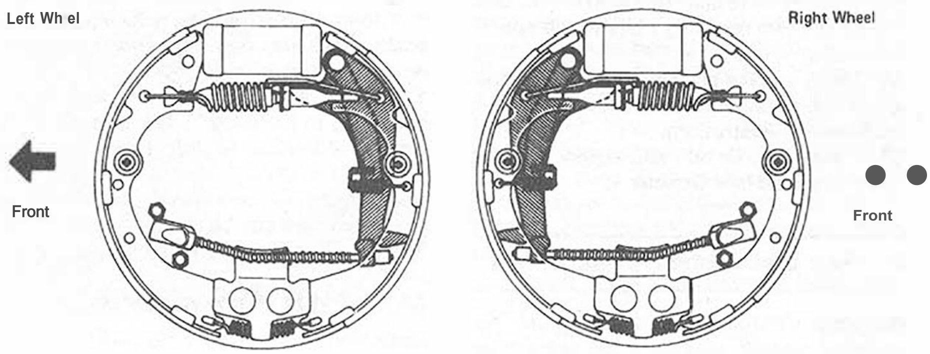


4.14 Place a collar (or an appropriately sized piece of tubing) under the hub to support it while the hub bolt is being driven in

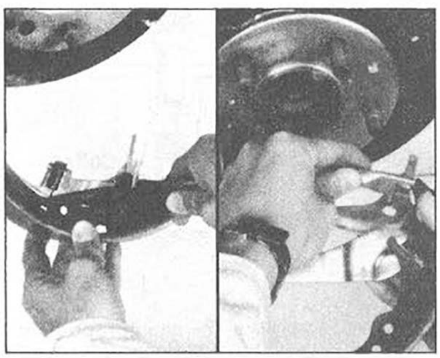
trations). Note the locations of the adjuster assembly components to facilitate installation. Also note that the right-hand adjuster screw has right-hand threads and that the left-hand adjuster has left-hand threads.
3 Using a hold-down tool, remove the front shoe hold-down spring and pin.
4 Remove the front brake shoe and tension spring that goes between the front and rear shoes.
5 Remove the rear shoe hold-down spring and pin, then remove the rear shoe.
6 Remove the automatic adjusting strut and tension spring from the automatic adjusting lever **(see illustration).**
7 Disconnect the parking brake cable from the parking brake lever **(see illustration).**
8 Using a screwdriver, remove the C-clips, parking brake lever and automatic adjusting lever from the rear shoe.
9 Be sure to check the wheel cylinders. Even if no leakage is found coming from the cylinders, it is advisable to rebuild or replace them when new linings are installed, as the new linings will put added strain on the cylinder components (see Section 6).
10 Installation is basically the reverse of removal. Lubricate the brake shoe contact points with a brake lube designed specifically for this purpose **(see illustration).** Use grease sparingly and take care not to get it on the brake shoe lining material. Make sure the brake lining material is clean. Use a special cleaner for this purpose if any oil or grease has contacted the friction surface.
11 Using pliers, attach the parking brake lever and automatic adjusting lever to the new rear shoe with new C-clips.
12 Connect the parking brake cable to the parking brake lever.
13 Connect the strut and shorter tension spring to the automatic adjusting lever.
14 Set the rear brake shoe in place with the end of the shoe inserted in the wheel cylinder.
15 Using a hold-down spring tool, install the rear shoe hold-down spring and pin.
16 Install the longer tension spring between the front and rear shoes.
17 Position the adjuster, then set the front brake shoe in place with the end of the shoe



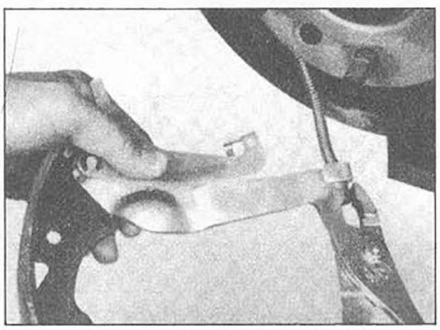
5.2a Exploded view of the leading/trailing design drum brake assembly - most 2WD models, all years



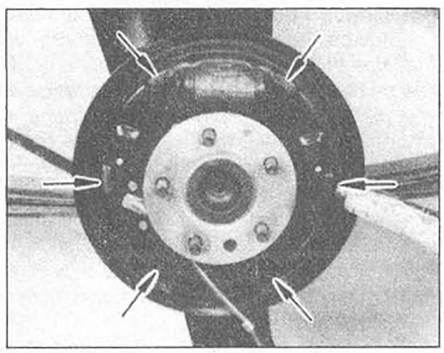
5.2b Assembled **view** of the leading/trailing design drum brake assembly - most 2WD models, all years



5.6 Unhook the tension spring and adjusting strut from the adjusting lever



5.7 Grip the end o.fthe parking brake cable with a pair of pliers, pull on it to compress the spring then unhook it from the lever



5.10 Lubricate the shoe contact points on the backing plate with high temperature brake grease

inserted in the wheel cylinder. Make sure that the adjuster is properly seated in both brake shoes.

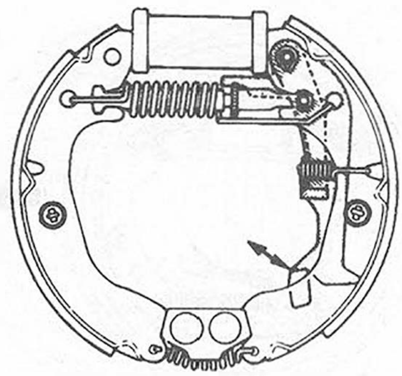
18 Install the front hold-down spring and pin **with a** hold-down spring tool.

19 Using a brake spring tool, install the adjuster return spring.

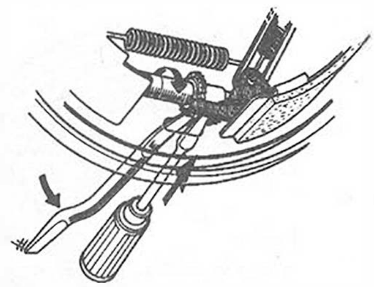
20 Move the bottom of the adjuster lever back and forth, checking to see that the adjusting bolt turns **(see illustration).** If the adjuster bolt does not turn, recheck all components you have just installed for binding or improper fit and make adjustments as necessary.

21 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 automotive machine shop to have it turned. **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), 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 medium-grit emery cloth using a swirling motion.

22 Adjust the brake shoes so the drum just slips over them with very little clearance. Install the wheel and tighten the lug nuts to the specified torque.



5.20 Check to see if the adjuster bolt turns by moving the bottom of the adjuster lever (arrow)



5.23 A screwdriver and brake adjuster tool (or two screwdrivers) are used to adjust the rear brake shoes - to retract the shoes, push the adjuster lever off the star wheel and tum the wheel in the proper direction

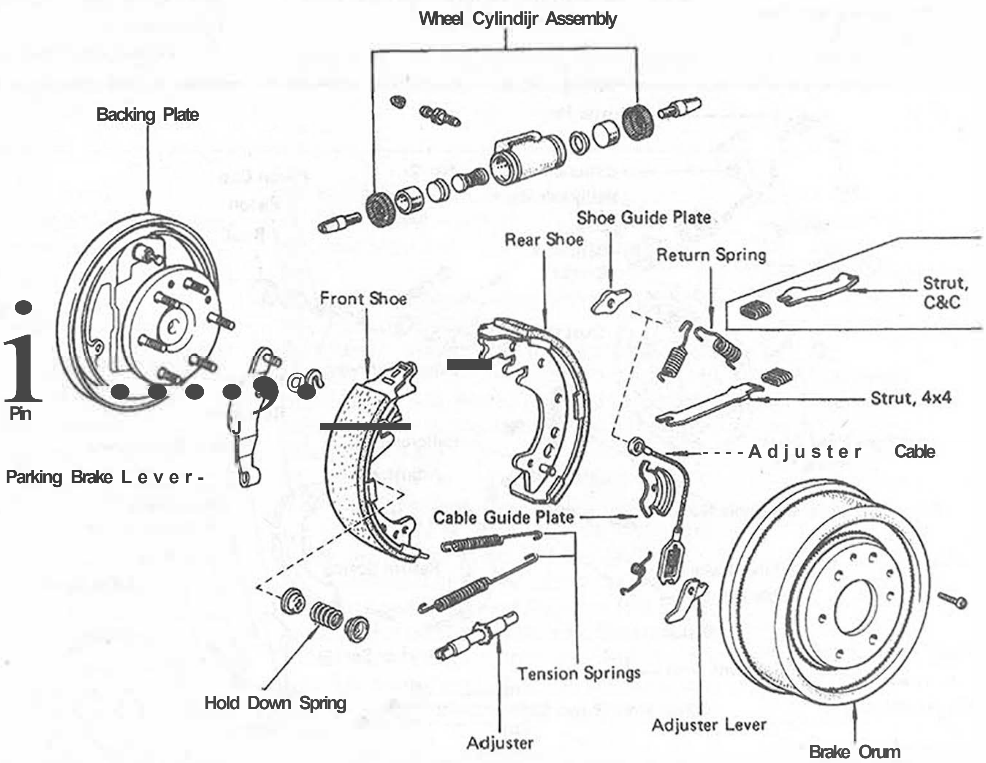
23 Rotate the wheel slowly, listening for the brake shoes dragging on the drum. If they don't, turn the adjuster screw star wheel with a screwdriver inserted through the backing plate until a slight dragging sound is heard. Then, using another small screwdriver, hold the adjuster lever off the star wheel while turning the star wheel in the opposite dirc tion, until no brake shoe drag can be detected when the drum is rotated **(see illustration).**

1985 and earlier 4WD models, some 1985 and later 2WD models

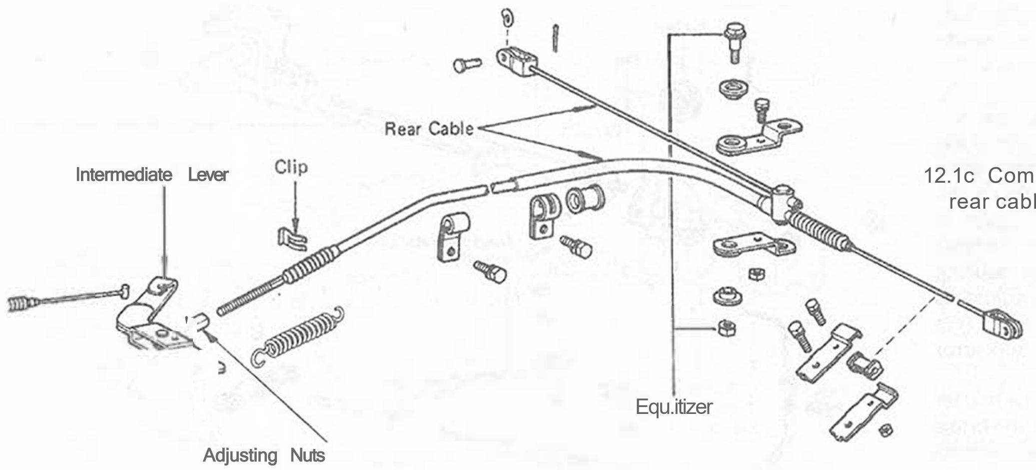
Refer to illustrations 5.24a, 5.24b, 5.25 and 5.27

24 Using a brake spring remover, remove the two shoe return springs from the pin above the wheel cylinder (see illustrations).

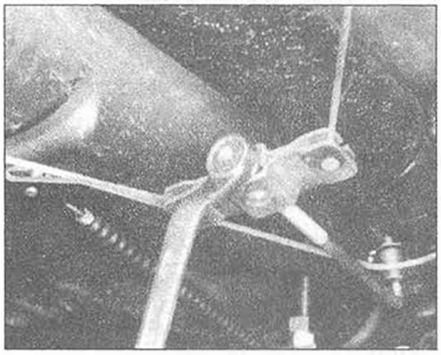
25 Push up on the adjuster lever located between the bottoms of the two brake shoes and remove the adjusting cable, cable guide



5.24a Exploded view of the duo-servo design drum brake assembly - 1985 and earlier 4WD models, some 1985 and later 2WD models

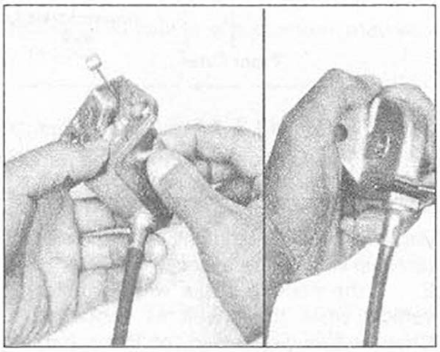


12.1c Components of the parking brake rear cable assembly - 4WD models



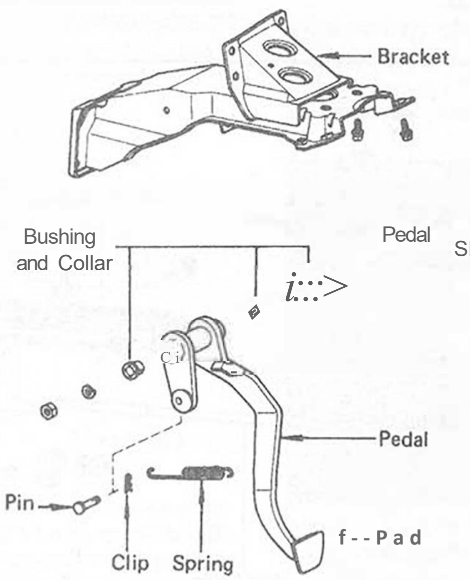
12.3 Turn the adjusting nut at the equalizer to take up slack in the parking **brake** cables **(2WD** models)

7 Tighten one of the adjusting nuts of the intermediate lever while loosening the other until the travel is correct, then tighten both nuts.



13.7 Removing the pulley pin (left) and pulley (right) from the parking brake lever assembly

8 After adjusting the parking brake, confirm that the bellcrank stopper screws come in contact with the backing plates.



14.3 Brake pedal mounting details

13 Parking brake cables - replacement

Refer to illustration 13.7

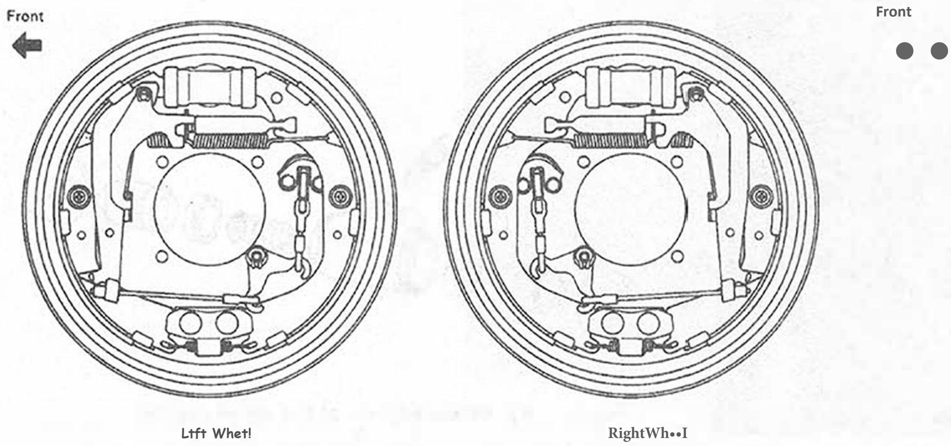
1 It is not necessary to remove the entire parking brake system to replace an individual part such as a parking brake cable. Determine the part in need of replacement through visual inspection before dismantling the entire system. A helper is beneficial in this process to operate the system while you observe its operation from under the vehicle. Jack up the vehicle and support it on jackstands. Remove the adjuster nut from the lever under the center of the vehicle. When unthreading this nut, it will probably be helpful to spray the exposed pullrod threads with a rust penetrant.

Brake lever front cable - all models

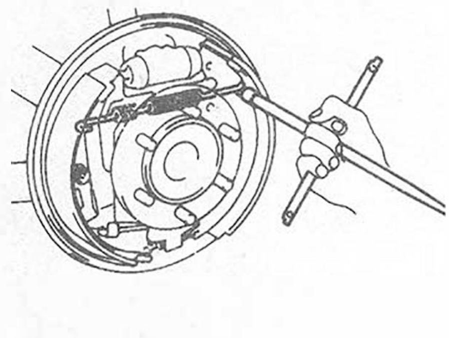
2 To remove the brake lever and front cable, begin by disconnecting the front cable from the intermediate lever.
3 Remove the parking brake indicator light switch.
4 Push the parking brake pawl with your finger to unlock the lever and completely push in the parking brake lever.
5 Remove the pulley bracket by removing the two bolts.
6 Disconnect the front cable from the parking brake lever shaft by pulling the end of the cable from the slot in the side of the shaft.
7 Remove the pulley pin **(see illustration).**
8 Remove the pulley **(see illustration 13.7).**
9 Remove the cable retaining clip with pliers, releasing the front cable from the pulley bracket.

Rear cable - 2WD vehicles

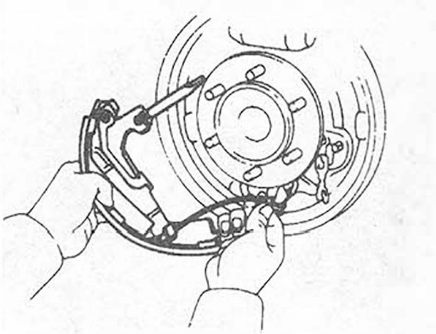
10 To remove the rear cable, first disconnect the rear cable from the equalizer by turning the cables until the ends line up with the slots in the equalizer bracket, then slide the



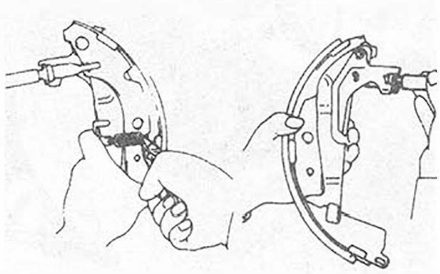
5.46b Assembled view of the 1986 and later model 4WD drum brake assembly



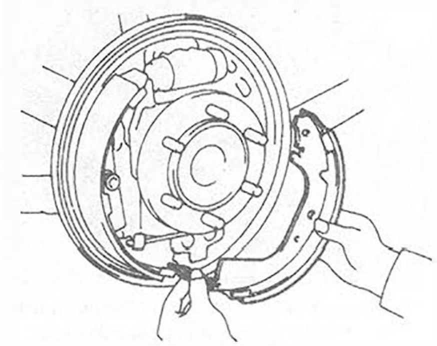
5.46c Use a brake spring tool to unhook the return spring from the brake shoe



5.49 Lift the front shoe off the backing plate and unhook the parking brake cable from the bellcrank



5.50 Unhook the adjusting lever spring and remove the adjuster



5.55 **Install the** anchor spring **between** the two shoes **then mount the** trailing **shoe** on **the backing plate**

to the rear shoe.

42 Hook the adjuster cable to the adjusting lever and install the lever in place.

43 Install the adjusting lever tension spring to retain the lever.

44 Pull the adjusting lever backward with your thumb and release it. If the adjusting bolt does not turn, recheck all components you have just installed for binding or improper fit and make adjustments as necessary.

45 Follow steps 21 through 23 above.

1986 and later 4WD models

Refer to illustrations 5.46a, 5.46b, 5.46c, 5.49, 5.50 and 5.55

46 Using a brake spring tool, remove the return spring from between the front and rear shoes **(see illustrations).**

47 Remove the rear shoe hold down spring and pin, then remove the shoe.

48 Remove the front shoe hold down spring and pin.

49 Remove the front shoe/parking brake lever assembly from the backing plate and unhook the No. 1 parking brake cable from the No. 3 bellcrank **(see illustration).**

50 Remove the adjusting lever spring and adjuster from the front shoe **(see illustration).**

51 Perform Step 8 of this Section.

52 Perform Steps 9 and 10.

53 Apply grease to the adjuster bolt threads and end. Assemble the parking brake lever, adjuster screw and automatic adjuster lever to the front brake shoe **(see illustration 5.50).**

54 Hook the No. 1 parking brake cable to the No. 3 bellcrank, position the front brake shoe assembly on the backing plate and install the hold down **pin** and spring.

55 Connect the anchor spring between the bottom of each shoe and place the rear brake shoe on the backing plate **(see illustration).** Push the rear shoe into the slot in the adjuster screw end. Also, make sure the anchor spring is routed under the anchor plate.

56 Install the rear shoe hold down pin and spring.

57 Stretch the tension spring from the front shoe to the rear shoe, hooking the end of the spring into the proper hole in the rear shoe.

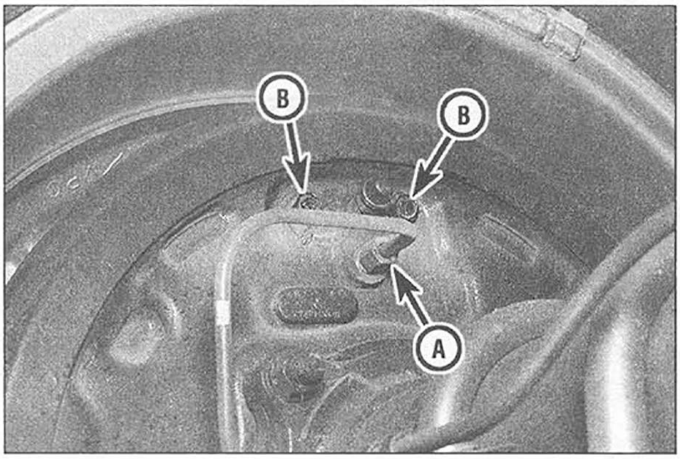
58 Check the operation of the automatic adjuster mechanism by pulling up on the parking brake handle and verifying that the adjuster screw turns.

59 Perform Steps 21 and 22.

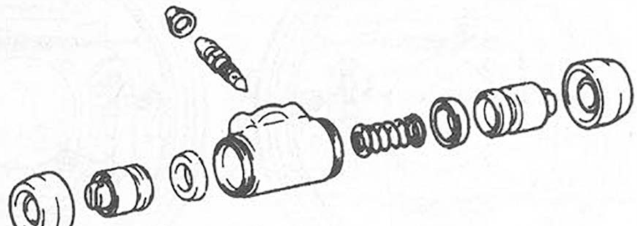
60 Pull the parking brake handle through its full range of motion several times to adjust the brake shoes.

6 Wheel cylinder - removal, overhaul and installation

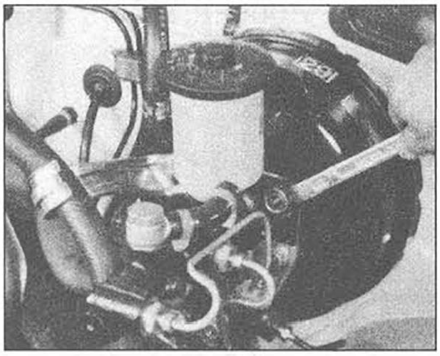
Note: *If an overhaul is indicated (usually because of fluid leakage or sticky operation) explore all options before beginning the job. New wheel cylinders are available, which makes this job quite easy. If it's decided to rebuild the wheel cylinder, make sure that a rebuild kit is available before proceeding. Never overhaul only one wheel cylinder - always rebuild both of them at the same time.*



6.4 Completely loosen the brake line fitting **(A)** then remove the two wheel cylinder mounting bolts **(B)**



6.7 **Exploded view** of the wheel cylinder



7.6 Unscrew the brake line fittings at the master cylinder, then remove the four cylinder mounting bolts

Removal

Refer to illustration 6.4

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 (Section 5).

3 Remove all dirt and foreign material from around the wheel cylinder.

4 Disconnect the brake line **(see illustration).** 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 and place it on a clean workbench. Immediately plug the brake line to prevent fluid loss and contamination.

Overhaul

Refer to illustration 6.7

7 Remove the bleeder valve, seals, pistons, boots and spring assembly from the wheel cylinder body **(see illustration).**

8 Clean the wheel cylinder with brake fluid, denatured alcohol or brake system cleaner. **Warning:** *Do not, under any circumstances, use petroleum based solvents to clean brake parts!*

9 Use compressed air to remove excess fluid from the wheel cylinder and to blow out the passages.

10 Check the cylinder bore for corrosion and score marks. Crocus cloth can be used to remove light corrosion and stains, but the cylinder must be replaced with a new one if the defects cannot be removed easily, or if the bore is scored.

11 Lubricate the new seals with brake fluid.

12 Assemble the brake cylinder components. Make sure the seal lips face in.

Installation

13 Place the wheel cylinder in position and install the bolts.

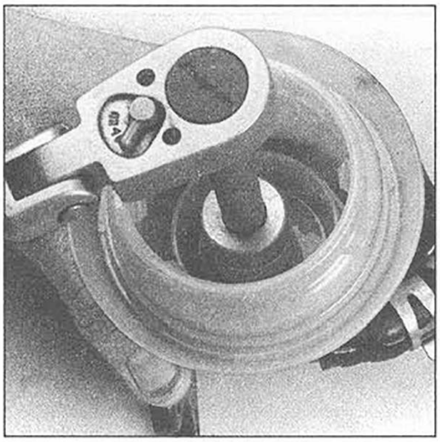
14 Connect the brake line and install the brake shoe assembly.

15 Bleed the brakes following the procedure described in Section 10.

7 Master cylinder - removal, overhaul and installation

Refer to illustrations 7.6, 7.8a, 7.8b, 7.8c, 7.9, 7.10, 7.11a, 7.11b, 7.11c, 7.11d and 7.26

Note: *Before deciding to overhaul the master cylinder, check on the availability and cost of a new or factory rebuilt unit and also the availability of a rebuild kit.*



7.8a Remove the set bolt inside the reservoir (1979 through 1989)

7.8b Use pliers to release the hose clamp, then separate the reservoir hose from the master cylinder and remove the reservoir (1979 through 1989)

Removal

1 The master cylinder is located in the engine compartment, mounted to the power brake booster.

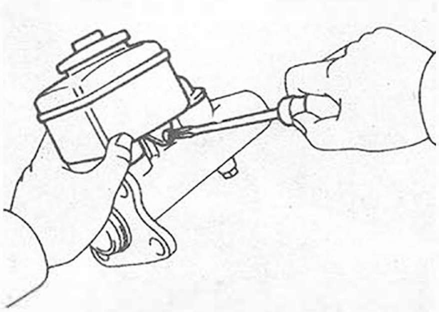
2 Remove as much fluid as you can from the reservoir with a syringe.

3 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.*

4 Loosen the tube nuts at the ends of the brake lines where they enter the master cylinder. To prevent rounding off the flats on these nuts, the use of a flare nut wrench, which wraps around the nut, is preferred.

5 Pull the brake lines slightly away from the master cylinder and plug the ends to prevent contamination.

6 Disconnect the electrical connector at the master cylinder if equipped, then remove the four nuts attaching the master cylinder to



7.8c Remove the set screw and pull off the reservoir (1990 - on)

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.

Overhaul

7 Before attempting the overhaul of the master cylinder, obtain the proper rebuild kit, which will contain the necessary replacement parts and also any instructions which may be specific to your model.

8 Inspect the reservoir grommet for indications of leakage near the base of the reservoir. Remove the reservoir **(see illustrations).**

9 Place the cylinder in a vise and use a punch or Phillips screwdriver to fully depress the pistons until they bottom against the other end of the master cylinder (see illustra**tion).** Hold the pistons in this position and remove the stop bolt on the side of the master cylinder. Remove the two outlet plugs and the copper gaskets.

10 Carefully remove the snap-ring at the end of the master cylinder **(see illustration).**

11 The internal components can now be removed from the cylinder bore **(see illustrations).** Make a note of the proper order of the components so they can be returned to their original locations. **Note:** *The two springs are of different tension, so pay particular attention to their order.*

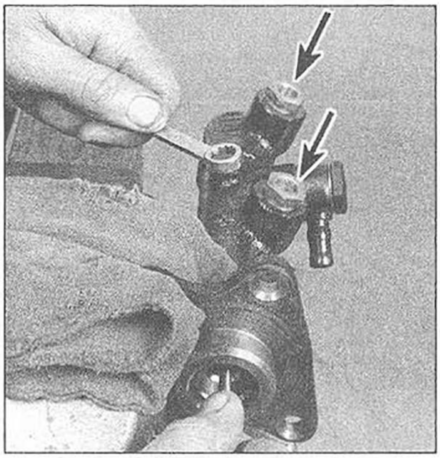
12 Carefully inspect the inside bore of the master cylinder. Any deep scoring or other damage will mean a new master cylinder is required.

13 Replace all parts included in the rebuild kit, following any instructions in the kit. Clean all reused parts with clean brake fluid or denatured alcohol. Do not use any petroleum-based cleaners. During assembly, lubricate all parts liberally with clean brake fluid. Be sure to tighten all fittings and connections to the specified torque.

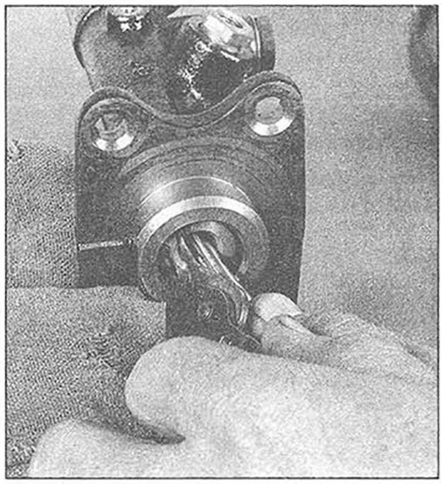
14 Push the assembled components into the bore, bottoming them against the end of the master cylinder, then install the stop bolt.

15 Install the new snap-ring, making sure it is seated properly in the groove.

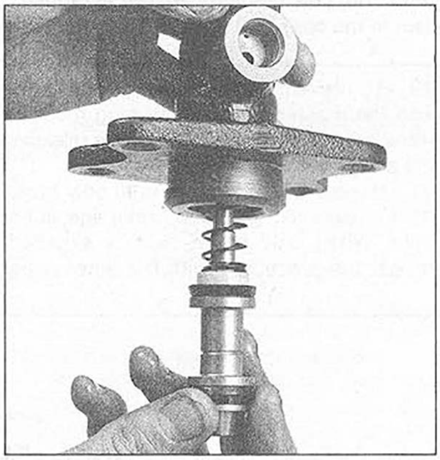
16 Before installing the new master cylinder it should be bench bled. Because it will be necessary to apply pressure to the master cylinder piston and, at the same time, control flow from the brake line outlets, it is recommended that the master cylinder be mounted in a vise, with the jaws of the vise clamping on the mounting flange.



7.9 Push the pistons in all the way and remove the piston stop bolt and the copper gasket (also remove the two outlet plugs [arrows] and gaskets)



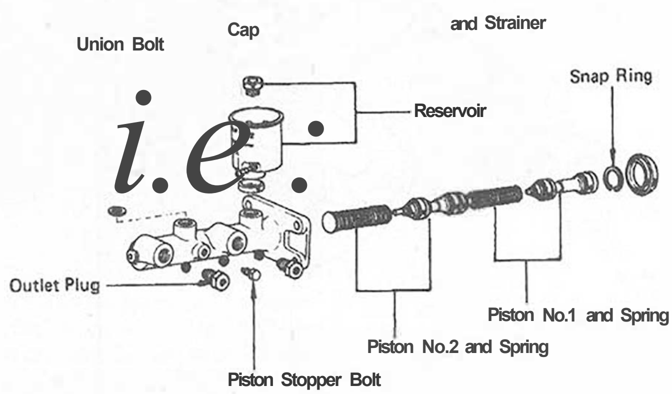
7.10 Push the pistons in and use snap-ring pliers to remove the snap ring



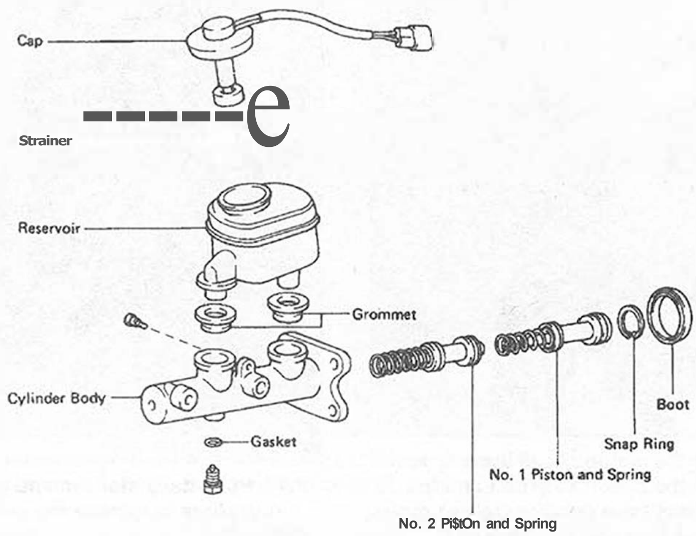
7.11a Tilt the cylinder and remove the No. 1 piston and spring

7.11b To free the No. 2 piston and spring, tap the cylinder firmly against a block of wood

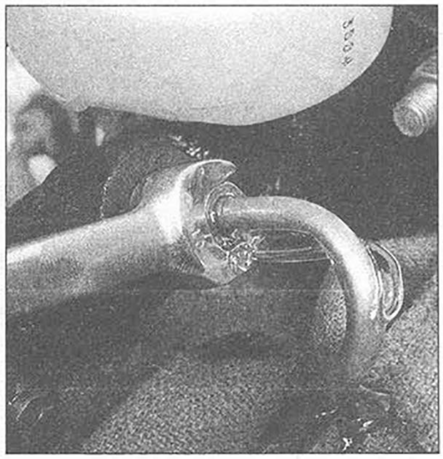
17 Insert threaded plugs into the brake line outlet holes and snug them down so that there will be no air leakage past them, but not



7.11c Exploded view of the master cylinder (1984 through 1988 models use a plastic elbow in place of the union bolt)



7.11d Exploded view of the master cylinder (1990 - on) (1994 models are not equipped with a float mechanism in the cap)



7.26 Have an assistant pump the brake pedal several times, then hold it to the floorboard. Loosen the fitting nut, allowing the air and fluid to escape. Repeat this procedure on both fittings until the fluid is clear of air bubbles

so tight that they cannot be easily loosened.

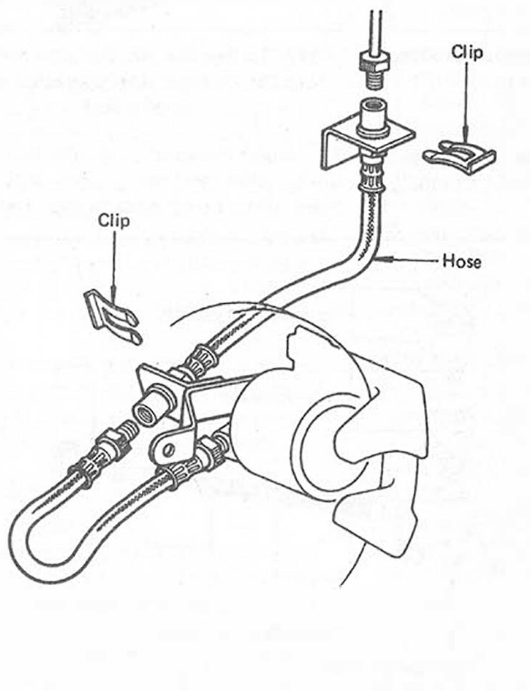
18 Fill the reservoir with brake fluid of the recommended type (see Chapter 1).

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

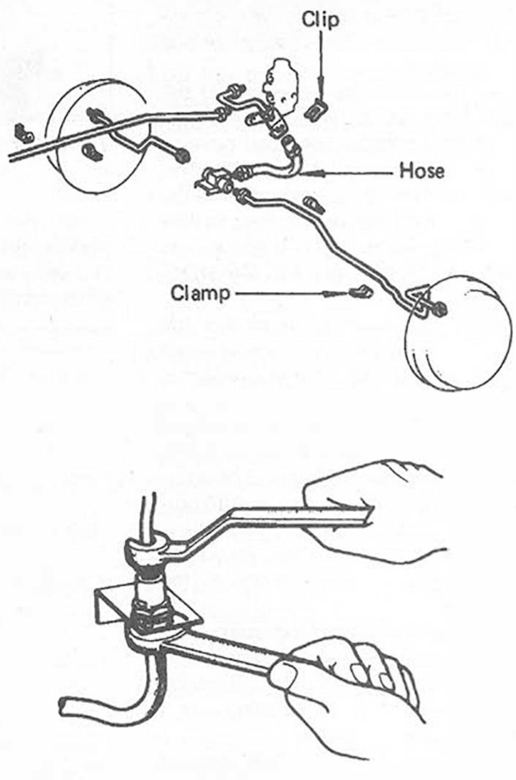
20 To prevent air from being drawn back into the master cylinder the plug must be replaced and snugged down before releasing the pressure on the piston assembly.

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

22 Since high pressure is not involved in the bench bleeding procedure, an alternative to the removal and replacement of the plugs with each stroke of the piston assembly is available. Before pushing in on the piston



8.1 Rubber brake hoses should be inspected about every six months



8.4 A backup wrench must be used to hold the hose from turning, otherwise the steel brake line will twist

assembly, remove the plug as described in Step 19. Before releasing the piston. however, instead of replacing the plug, simply put your finger tightly over the hole to keep air from being drawn back into the master cylinder. Wait several seconds for brake fluid to be drawn from the reservoir into the piston bore, then depress the piston again, removing your finger as brake fluid is expelled. Be sure to put your finger back *over* the hole each time before releasing the piston, and when the bleeding procedure is complete for that outlet, replace the plug and snug it before going on to the other port.

Installation

23 Install the master cylinder over the studs on the power brake booster and tighten the attaching nuts only finger tight at this time.
24 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.
25 Fully tighten the mounting nuts and the brake fittings.
26 Fill the master cylinder reservoir with fluid, then bleed the master cylinder (only if the cylinder has not been bench bled) and the brake system as described in Section 10. To bleed the cylinder on the vehicle, have an assistant pump the brake pedal several times and then hold the pedal to the floor. Loosen the fitting nut to allow air and fluid to escape. Repeat this procedure on both fittings until the fluid is clear of air bubbles **(see illustration).** Test the operation of the brake system carefully before placing the vehicle in normal service.

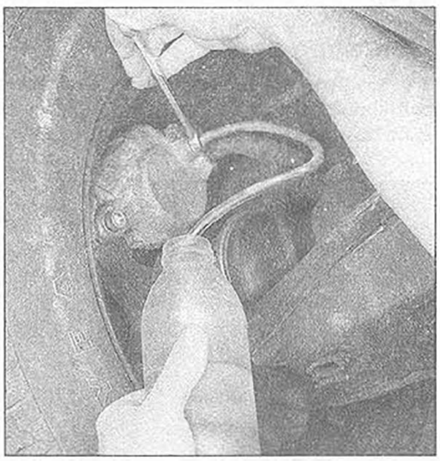
8 Brake lines and hoses - inspection and replacement

Refer to illustrations 8.1 and 8.4

1 About every six months the flexible hoses which connect the steel brake lines with the rear brakes and front calipers **(see illustration)** should be inspected for cracks, chafing of the outer cover, leaks, blisters, and other damage (see Chapter 1).
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 lines or approved flexible brake hoses as replacement items.
3 When installing the brake line, leave at least 0.75 in (19 mm) clearance between the line and any moving or vibrating parts.
4 When disconnecting a hose and line, first remove the spring clip. Then, using a normal wrench to hold the hose and a flare-nut wrench to hold the tube, make the disconnection **(see illustration).** Use the wrenches in the same manner when making a connection, then install a new clip. **Note:** *Make sure the tube* passes *through the center of* its *grommet.*
5 When disconnecting two hoses, use normal wrenches on the hose fittings. When connecting two hoses, make sure they are not bent, twisted or strained.
6 Steel brake lines are usually retained along their span with clips. Always remove these clips completely before removing a fixed 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.

9 Load Sensing Proportioning Valve (LSPV) - general information

1 Due to the fact that disc brakes are non-self-energizing, they require more hydraulic pressure than drum brakes to function properly. Added to the fact that, conversely, drum brakes require less hydraulic pressure to be efficient in an automotive system is the fact that they are usually fitted to the rear of vehicles, requiring even less pressure than the front discs because most of the vehicle's weight is transferred forward during braking.
2 If the hydraulic pressure were the same to the front and rear brakes, the rear drums would be locked up almost every time the brakes were applied with force. The load sensing proportioning valve (LSPV) allows a portion of the rear brake hydraulic pressure to be applied to the front brakes. thus providing for smoother, more controlled stops.
3 Due to the special tools, test equipment and skills required to service the LSPV system, it is not recommended that the home mechanic attempt the procedures. If servicing of the system becomes necessary, take the vehicle to the dealership from which it was purchased, or to another reputable, suitably equipped automotive repair shop.

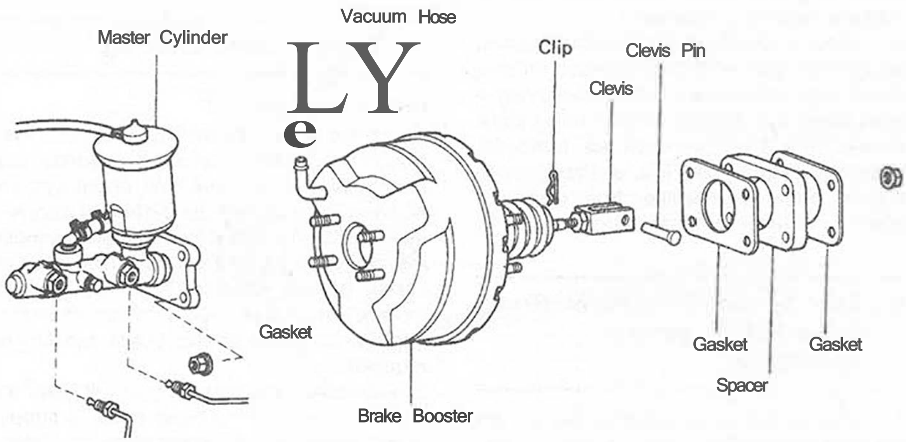


10.7 When bleeding the brakes, a clear piece of tubing is attached to the bleeder screw fitting and submerged in brake fluid - air bubbles can be see in the tube and container when the bleeder valve is opened (when no more bubbles appear, all of the air has been purged)

10 Brake system - bleeding

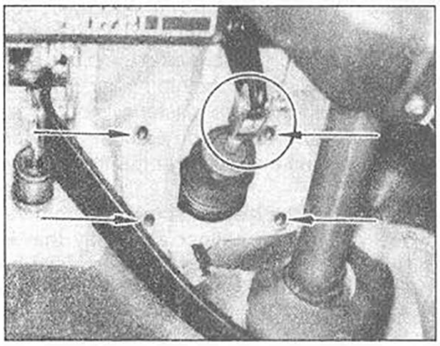
Refer to illustration 10.7

1 If the brake system has air in it, operation of the brake pedal will be spongy and imprecise. Air can enter the brake system whenever any part of the system is dismantled or if the fluid level in the master cylinder reservoif runs low. Air can also leak into the system through a leak too slight to allow fluid to leak out. In this case, it indicates that a general overhaul of the brake system is required.
2 To bleed the brakes, you will need an assistant to pump the brake pedal, a supply of new brake fluid, an empty glass jar, a plastic or vinyl tube which will fit over the bleeder nipple, and a wrench for the bleeder screw.
3 There are five locations at which the brake system is bled; the master cylinder, the front brake caliper assemblies and the rear brake wheel cylinders.
4 Check the fluid level at the master cylinder reservoir. Add fluid, if necessary, to bring the level up to the Full or Max mark. Use only the recommended brake fluid and do not mix different types. Never use fluid from a container that has been standing uncapped. You will have to check the fluid level in the master cylinder reservoir often during the bleed procedure. If the level drops too far, air will enter the system through the master cylinder.
5 Raise the vehicle and set it securely on jackstands, as instructed in the front of the book.
6 Remove the bleeder screw cap from the wheel cylinder or caliper assembly that is being bled. If more than one wheel must be bled, start with the one farthest from the master cylinder.
7 Attach one end of the clear plastic or vinyl tube to the bleeder screw nipple and place the other end in the glass or plastic jar submerged in a small amount of clean brake fluid (see illustration).
8 Loosen the bleeder screw slightly. then tighten it to the point where it is snug yet easily loosened.
9 Have the assistant pump the brake pedal several times and hold it in the fully depressed position.
10 With pressure on the brake pedal, open the bleeder screw approximately one-half turn. As the brake fluid is flowing through the pedal, hold it in the fully depressed position, and loosen the bleeder screw momentarily. Do not allow the brake pedal to be released with the bleeder screw in the open position.
11 Repeat the procedure until no air bubbles are visible in the brake fluid flowing through the tube. Be sure to check the brake fluid level in the master cylinder reservoir while performing the bleeding operation.
12 Fully tighten the bleeder screw, remove the plastic or vinyl tube and install the

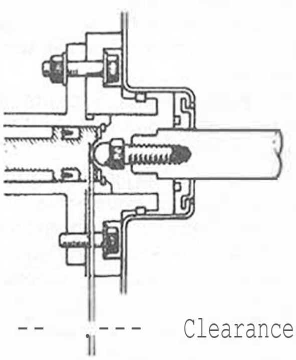


11.7a Power brake booster installation details (gasket and spacer arrangement may vary from model-to-model)

bleeder screw cap.
13 Follow the same procedure to bleed the other wheel cylinder or caliper assemblies.
14 To bleed the master cylinder, have the assistant pump and hold the brake pedal.



11.7b Arrows indicate the nuts holding the brake booster to the firewall - the pushrod clevis is circled



11.14a The booster pushrod-to-master cylinder piston must be as specified - if there is little or no clearance. the brakes may drag; if there is too much clearance, there will be excessive brake pedal travel

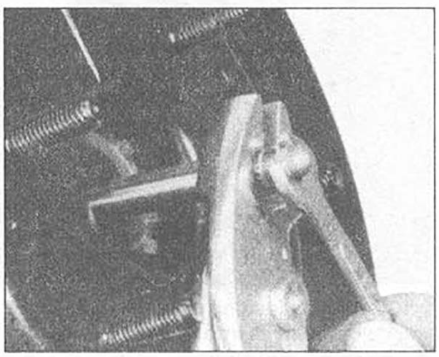
Momentarily loosen the brake line fittings, one at a time, where they attach to the master cylinder. Any air in the master cylinder will escape when the fittings are loosened. Brake fluid will damage painted surfaces, so use paper towels or rags to cover and protect the areas around the master cylinder.
15 Check the brake fluid level in the master cylinder to make sure it is adequate, then test drive the vehicle and check for proper brake operation.

11 Power brake booster - check, removal and installation

Refer to illustrations 11.7a, 11. lb, 11. 14a and 11.14b

Operating check

1 Depress the brake pedal several times with the engine off and make sure that there is no change in the pedal reserve distance.



11.14b To adjust the length of the booster pushrod. hold the serrated portion of the rod with a pair of pliers and turn the adjusting screw in or out, as necessary, to achieve the desired setting

2 Depress the pedal and start the engine. If the pedal goes down slightly, operation is normal.

Air tightness 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 air tight.
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 air tight.

Removal

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 7.
7 Locate the pushrod clevis connecting the booster to the brake pedal **(see illustrations).** This is accessible from the interior in front of the driver's seat.
8 Remove the clevis pin retaining clip with pliers and pull out the pin.
9 Holding the clevis with pliers, disconnect the clevis locknut with a wrench. The clevis is now loose.
10 Disconnect the hose leading from the engine to the booster. Be careful not to damage the hose when removing it from the booster fitting.
11 Remove the four nuts and washers holding the brake booster to the firewall. You may need a light to see these, as they are up under the dash area **(see illustration 11.7).**
12 Slide the booster straight out from the firewall until the studs clear the holes and pull the booster, brackets and gaskets from the engine compartment area.

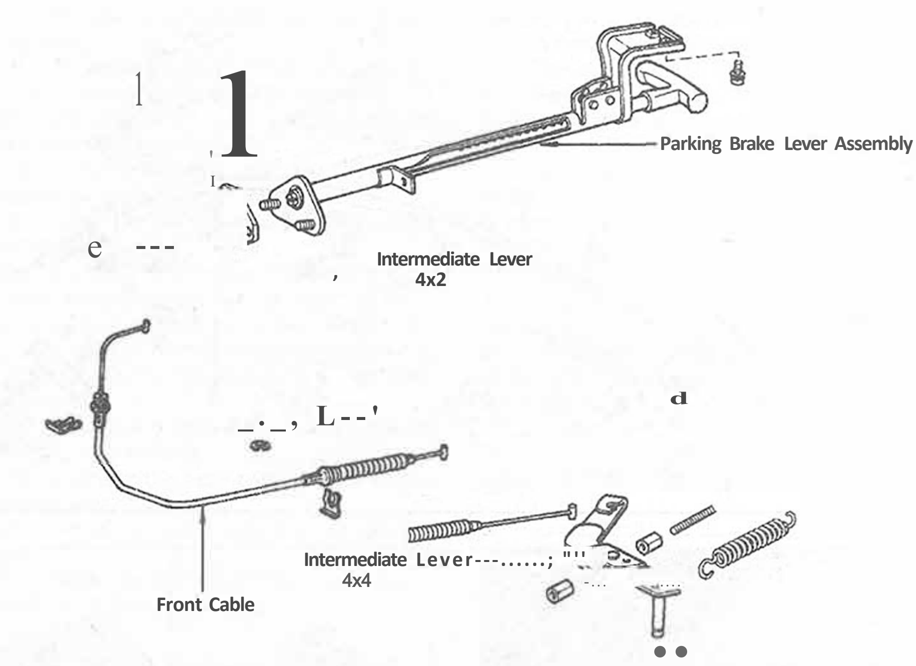
Installation

13 Installation procedures are basically the reverse of those for removal. Tighten the clevis locknut and booster mounting nuts to the specified torque figures.
14 If the power booster unit is being replaced, the clearance between the master cylinder piston and the pushrod in the vacuum booster must be measured. Using a depth micrometer or vernier calipers, measure the distance from the seat (recessed area) in the master cylinder to the master cylinder mounting flange. Next, measure the distance from the end of the vacuum booster pushrod to the mounting face of the booster (including gasket) where the master cylinder mounting flange seats. Subtract the two measurements

to get the clearance **(see illustration).** If the clearance is more or less than specified. turn the adjusting screw on the end of the power booster pushrod until the clearance is within the specified limit **(see illustration).**

15 A second method to measure the pushrod-to-piston clearance is to install the master cylinder to the vacuum booster with a small piece of modeling clay placed on the nd of the pushrod. Make sure the gasket is in place when making this trial fit. Remove he master cylinder and measure the resulting Impression left in the clay. Again adjust as needed to meet the specification. This method may require several trial-and-error fits to reach the proper clearance.

16 After the final installation of the master cylinder and brake hoses and lines, the brake pedal height and free play must be adjusted and the system must be bled. See the appropriate Sections of this Chapter for the procedures.



12.1a Components of the parking brake lever assembly and front cable

12 Parking brake - check and adjustment

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

1 The parking brake system is activated by a handle assembly in the middle of the vehicle's interior. A pulley bracket attached to the end of the handle assembly activates a front cable, which in turn acts on an intermediate lever **(see illustration).** Attached to this lever via an equalizer are cables that run to each rear brake drum and hold the vehicle stationary by expanding the rear shoes in the brake drums **(see illustrations).** Adjustment for cable stretch is accomplished by a threaded nut at the equalizer bar and is accessible from under the vehicle. The parking brake system also is used to activate the automatic brake adjusters on the rear brake shoes. Each time the parking brake is activated, it adjusts the rear adjuster one notch until all of the slack is taken up in the brake system.

2 If the parking brake will not hold the vehicle while the check as described in Chapter 1 is performed, or if the parking brake lever does not respond within the lever click travel limit as designated in the Specifications while pulling the lever all the way up, check to confirm that the rear brake shoe clearance is correct (see Section 5). If the clearance is incorrect, adjust the clearance and recheck the parking brake operation. If the clearance is correct, adjust the parking brake as follows after jacking up the vehicle and placing it on jackstands.

Adjustment - 2WD vehicles

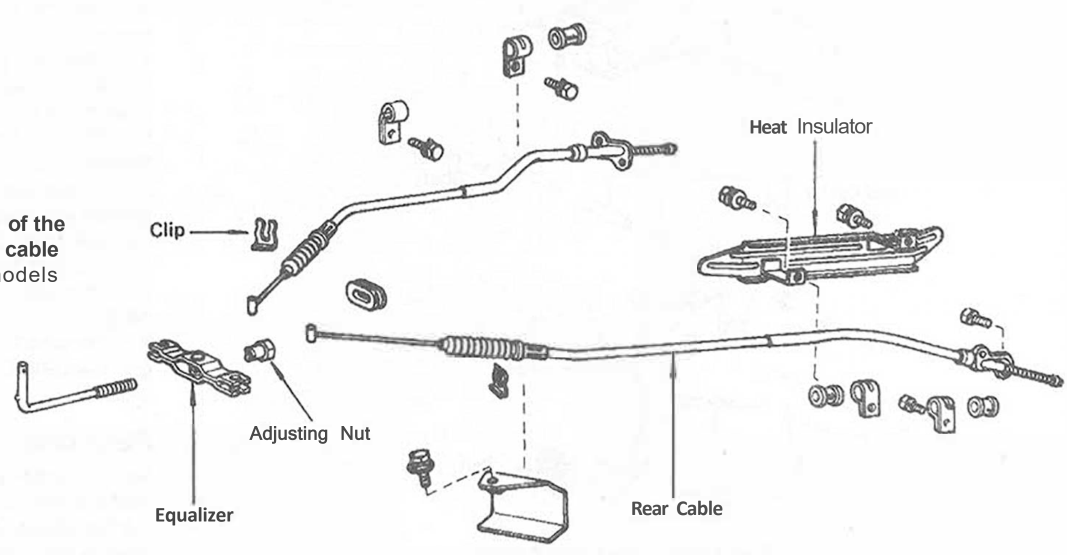
3 Tighten the intermediate lever adjusting nut until the travel is correct **(see illustration).** This may require several trial-and-error adjustments to get the correct lever travel.

4 After adjusting the parking brake, confirm that the rear brakes are not dragging.

Adjustment - 4WD vehicles

5 Locate the bellcrank stopper screws at the back of the rear brake backing plates.

6 Tighten the bellcrank stopper screws until the play of the rear brake links is zero then loosen the screws one turn and tighte the screw locknut.



12.1 b Components of the parking brake rear cable assembly - **2WD** models cables out.

11 Remove the cable retaining clips and clamps.

12 To remove the cables from the brake shoes and backing plates, first remove the drum and brake shoes as described in Section 5 of this Chapter. then unbolt the rear cable from the backing plate.

13 Installation is the reverse of removal. Before installing the brake cables, thoroughly lubricate them with a good quality cable lube or penetrating oil if necessary. Check the cable for signs of stretching or fraying. Put a small amount of light grease on the handle ratchet assembly.

14 Adjust the parking brake as described in Section 12 of this Chapter.

Rear cable - 4WD vehicles

15 Disconnect the rear cable leader from the intermediate lever by unscrewing the two adjusting nuts.

16 Remove the cable retaining clip and clamps.

17 Unbolt the equalizer and cable guide from the rear axle housing, then disconnect the rear cable from the bellcrank.

18 Disassemble the rear brakes as described in Section 5 of this Chapter, then remove the adjusting cable from the adjusting lever on each backing plate.

19 Using pliers, remove the spring from the bellcrank on the rear side of each backing plate.

20 Remove the front and rear bellcranks and the parking brake• cable from each backing plate.

21 To install the rear cables, first coat the front bellcrank with multipurpose grease.

22 Using pliers, install the front bellcrank on each backing plate.

23 Install the cable, rear bellcrank and spring on each backing plate.

24 Assemble the rear brakes as described in Section 5 of this Ch,apter.

25 On each rear brake, tighten the bellcrank stopper screw until the play of the rear brake link becomes zero, then loosen the screw one turn and tighten the screw locknut.

26 Connect the rear cables to the rear bellcranks.

27 Install the equalizer and cable guide on the rear axle housing.

28 Connect the rear cable leader to the intermediate lever.

29 Install the cable retaining clamps and clip.

30 Adjust the parking brake as described in Section 12 of this Chapter.

14 Brake pedal - removal and installation

Refer to illustration 14.3

1 Remove the floor mat.

2 Disconnect the stoplight switch at the plastic connector. Pull it apart at the junction rather than pulling on the wires.

3 Remove the clip from the end of the pushrod pin **(see illustration).**

4 Pull out the pushrod pin.

5 Remove the pedal spring.

6 Remove the nut from the left end of the pedal shaft while holding the right end of the shaft with a wrench.

7 Remove the pedal shaft. The brake pedal will pull down and out of the mounting bracket.

8 Disassemble the bushings and collar from the brake pedal.

9 Inspect all parts for wear or damage and replace them with new parts as needed.

10 Installation procedures are the reverse of those for removal. Coat all the bushings, the collar, the spring and the pedal pin with multi-purpose light grease before installation. Before connecting the stoplight switch, adjust the pedal height (see Chapter 1).

15 Rear wheel anti-lock brake system

The rear wheel anti-lock brake system controls the hydraulic pressure in the rear wheel cylinders during sudden braking on slippery road surfaces preventing the rear wheels from locking. Because special tools, test equipment and skills are required to service the PSPV system, we don't recommend that you work on it. If servicing the system becomes necessary, take the vehicle to a dealership.

Notes

Chapter 10 Part A
Suspension and steering systems (2WD)

Contents

	Section
Balljoints - replacement	8
Front end alignment - general information	23
Front shock absorber - removal and installation	3
Front stabilizer bar - removal and installation	2
Front wheel bearings - check, repack and adjustment	See Chapter 1
General information	1
Lateral rod (4Runner models) - removal and installation	14
Lower suspension arm - removal and installation	7
Power steering fluid level check	See Chapter 1
Power steering pump - removal and installation	21
Power steering system - bleeding	22
Rear coil spring (4Runner models) - removal and installation	15
Rear leaf spring - removal and installation	12
Rear shock absorber - removal and installation	10
Rear stabilizer bar - removal and installation	11
Rear stabilizer bar (4Runner models) - removal and installation	13
Rear suspension arms (4Runner models) - removal and installation	16
Steering free play - adjustment	20
Steering gear - removal and installation	19
Steering knuckle - removal and installation	9
Steering linkage- removal and installation	18
Steering wheel - removal and installation	17
Strut bar - removal and installation	4
Suspension and steering check	See Chapter 1
Torsion bar - removal, installation and adjustment	5
Upper suspension arm - removal and installation	6
Wheels and tires - general information	24

Specifications

General

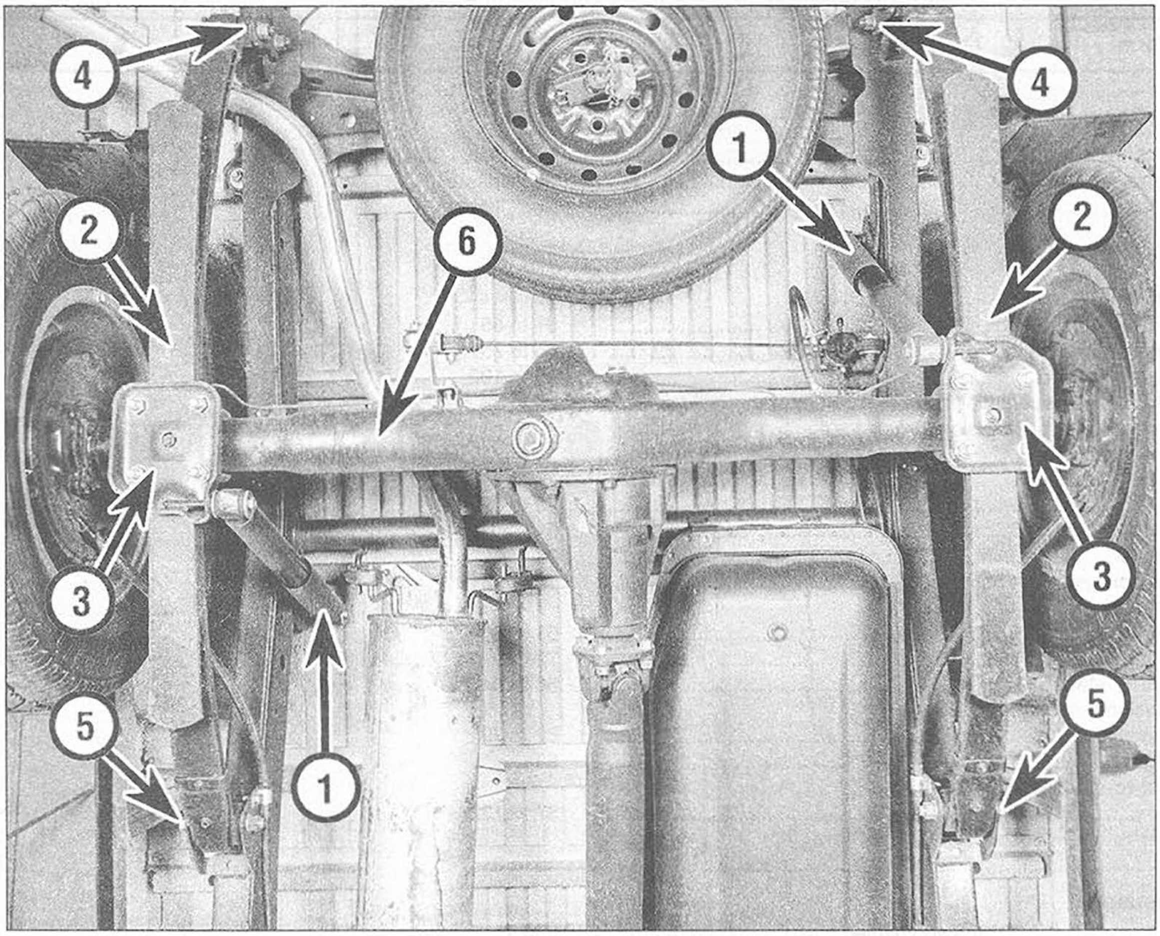
Steering wheel free play	Less than 1.18 in (30 mm)
Steering gearbox oil level	See Chapter 1
Drivebelt tension	See Chapter 1

Torque specifications

	Ft-lbs
Front suspension	
Anchor arm-to-torsion bar lock-nut	51 to 65
Strut bar-to-lower suspension arm bolts	55 to 75
Strut bar-to-bracket nut	69 to 108
Torque arm-to-lower suspension arm	29 to 39
Lower balljoint-to-lower suspension arm	
1983 and earlier	
8 mm bolts	15 to 21
10 mm bolts	29 to 39
1984 through 1988	51
1989 and later	94
Lower suspension arm shaft nut	145 to 216
Upper arm mounting bolts	
1983 and earlier	51 to 65
1984 and later	72
Upper balljoint-to-steering knuckle,	66 to 94
Upper suspension arm shaft bolts	
1983 and earlier	62 to 79
1984 and later	93
Lower balljoint-to-steering knuckle	
2WD	87 to 122
Upper balljoint-to-upper suspension arm	
2WD	15 to 21
Rear suspension	
Leaf spring hanger pin bolts (1983 and earlier)	8 to 11
U-bolt mounting nuts	
2WD	58 to 86
Hanger pin and shackle pin mounting nuts	
1983 and earlier	55 to 79
1984 and later	67

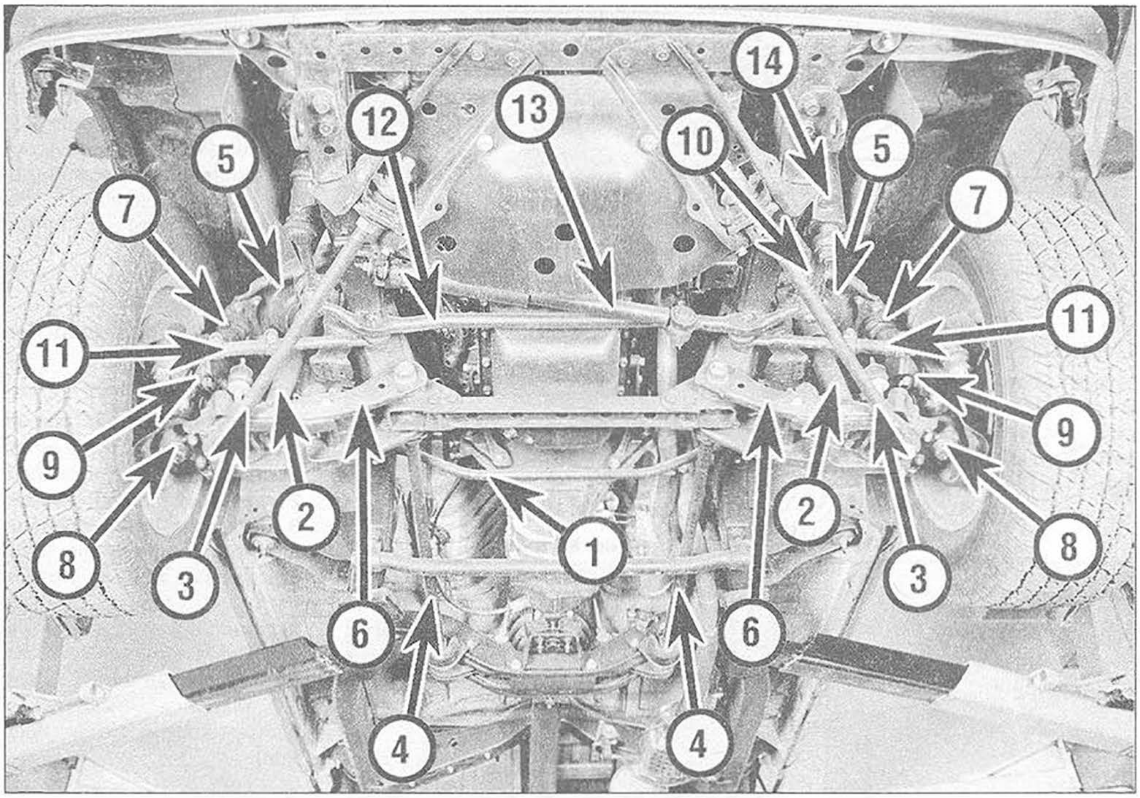
Steering

Steering shaft coupling set bolt	
1983 thru 1985	15 to 21
1986 and later (all)	27
Steering wheel nut	22 to 28
Steering gear housing mounting bolts	
1983 and earlier	37 to 43
1984 and later	48
Pitman arm-to-sector shaft nut	80 to 90
Pitman arm-to-relay rod	55 to 79
Tie-rod tube clamps	15 to 21
Tie-rod mounting bolts	55 to 79
Relay rod mounting nuts (idler arm end)	37 to 50
Relay rod mounting nuts (Pitman arm end)	55 to 79
Knuckle arm-to-steering knuckle	66 to 94
Steering damper-to-relay rod	37 to 50
Steering damper-to-front axle housing	8 to 11
Wheel lug nuts	65 to 87



1.2a Rear suspension components - 2WD (1988 model shown, others similar)

1	*Shock absorber*	4	*Shackle*
2	*Leaf spring*	5	*Hangerpin*
3	*Spring seat*	6	*Rear axle housing*



1.2b Front suspension components - 2WD (1988 model shown, others similar)

1 *Stabilizer bar*
2 *Shock absorber*
3 *Strut bar*
4 *Torsion bar*
5 *Upper suspension arm*
6 *Lower suspension arm*
7 *Upper bal/joint*
8 *Lower balljoint*
9 *Steering knuckle*
10 *Pitman* arm
11 *Tie-rod*
12 *Relay rod*
13 *Steering damper*
14 *Steering gear*

1 General information

Refer to illustrations 1.2a, 1.2b, 1.2c and 1.2d

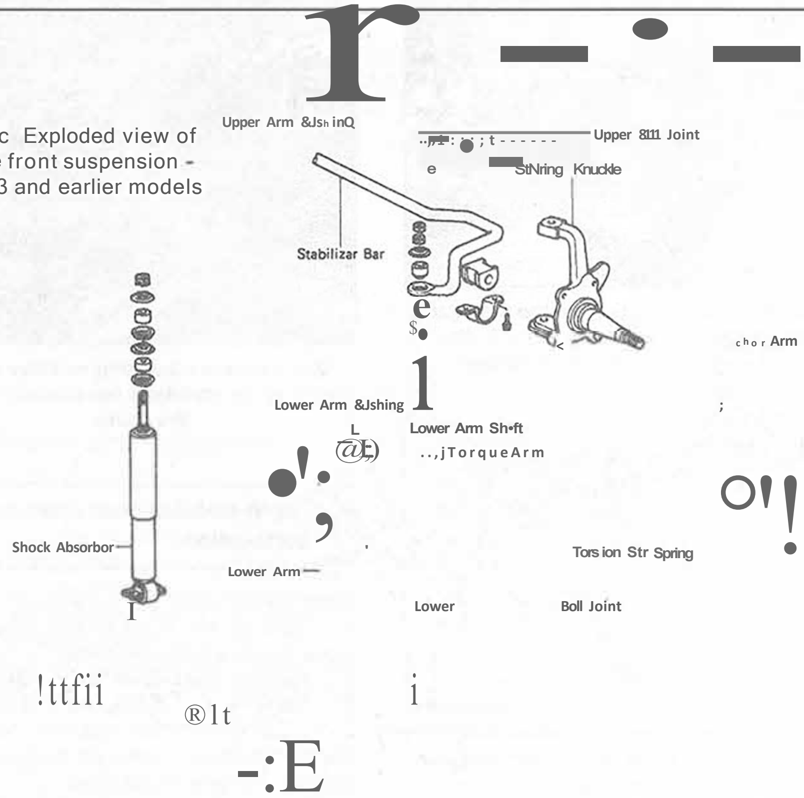
Toyota two wheel drive {2WD) and four wheel drive (4WD) vehicles share many common components in their suspension and steering systems; however, due to the few distinct differences that do exist, this Chapter is divided into two Parts.

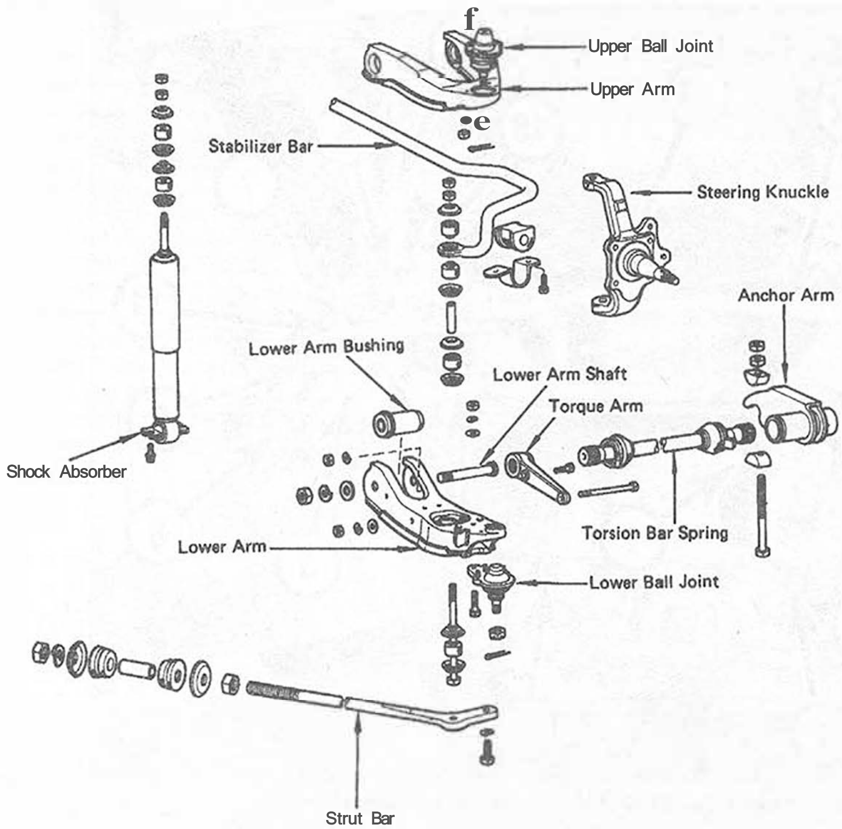
In Chapter 10A, you will find information on the suspension and steering components and procedures that pertain exclusively to 2WD vehicles **{see illustrations),** plus all information on components and procedures that are identical relative to the 4WD's suspension and steering.

Chapter 10B deals only with those components and procedures that are exclusive to 4WD vehicles. Some 4WD components that share functions in the 4WD's driveline system, such as the front axle, are dealt with in Chapter 8. Such components are noted and referenced in this Chapter.

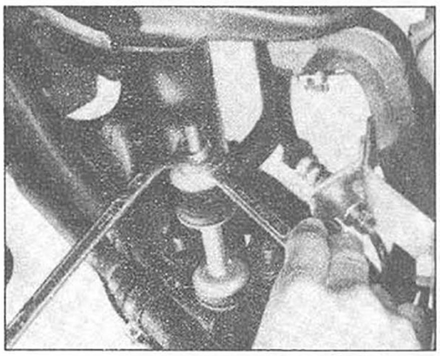
Complete specifications for each vehicle type are listed at the beginning of each sub-Chapter.

1.2c Exploded view of the front suspension - 1983 and earlier models

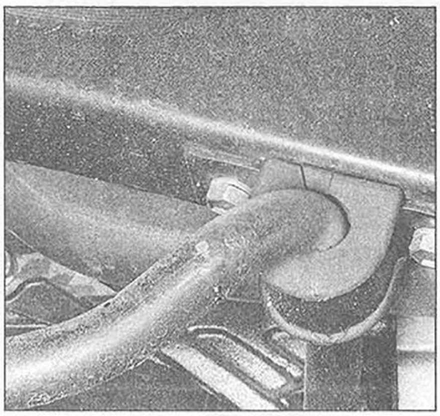




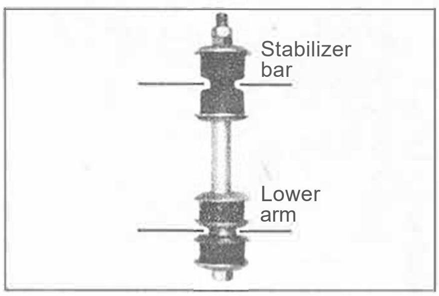
1.2d Exploded view of the front suspension - 1984 and later models



2.3 Remove the nuts from the stabilizer bar link bolts and remove the bolts, washers, spacers and bushings



2.4 A bracket. bushing **and two bolts** connect **the stabilizer bar to each side of the frame**



2.6 When properly assembled, the stabilizer bar links should be arranged like this

2 Front stabilizer bar - removal and installation

Refer to illustrations 2.3, 2.4 and 2.6

1 Jack up the front of the vehicle and place it securely on jackstands.
2 Remove one torsion bar (see Section 5).
3 Remove the nuts, bolts and cushions from both ends of the stabilizer bar at the lower suspension arms and disconnect the stabilizer bar **(see illustration).**
4 Remove the stabilizer bar bushings and brackets from the frame and remove the stabilizer bar **(see illustration).**
5 Inspect all parts for wear or damage. Replace parts as necessary with new ones.
6 Installation is the reverse of the removal procedures. Make sure the bolts, cushions and nuts are assembled in their proper order **(see illustration)** and tighten all bolts and nuts securely.

3 Front shock absorber - removal and installation

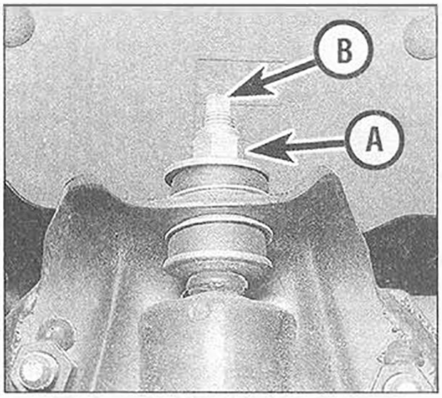
Refer to illustrations 3.3 and 3.5

1 Jack up the front of the vehicle and place it securely on jackstands.
2 Remove the front tires and wheels.
3 Remove the nut(s) holding the shock absorber to the frame **(see illustration).** Clamp a pair of locking pliers to the flats at the top of the shock rod to prevent it from turning.
4 Remove the washers and the cushions from the shaft of the shock absorber.
5 Disconnect the shock from the lower arm by removing the two bolts (see **illustration).**
6 Fully compress the shock absorber.
7 Tilt the shock forward, turn it 90 degrees so the bushing is at right angles to the vehicle and pull it out.
8 Inspect the shock components for wear, damage or oil leaks. Replace parts as necessary with new ones.
9 Installation is the reverse of the removal procedure. Make sure the washers and bushings are assembled in the proper order. Tighten the bolts and nuts securely.

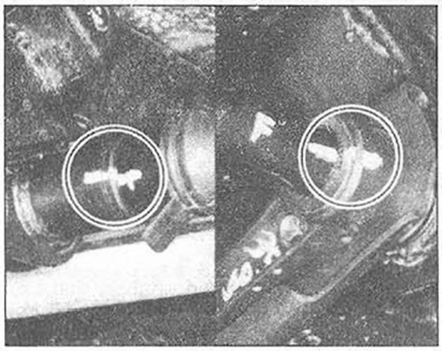
4 Strut bar - removal and installation

Refer to illustration 4.6

1 When replacing the strut bar, do so with the vehicle unloaded and the weight of the vehicle on the tires.
2 Place alignment marks on the threaded portion of the strut bar and the inner nut.
3 Remove the outer nut from the strut bar.
4 Remove the bolts holding the strut bar to the lower arm and remove the strut bar.
5 Inspect the strut bar and components for wear or damage. Replace parts as necessary with new ones.
6 Installation is the reverse of the removal procedure. Make sure to first thread the inside nut onto the strut bar and align marks made before removal. Tighten the bolts according to the torque figures in the Specifications. Tighten the inside and outside nuts a little at a time until distances A and B are equal **(see illustration),** and the specified torque is attained.



3.3 When removing the shock absorber upper mounting nut **(A),** hold the flats on the shock rod (B) to prevent the rod from turning (some models use two nuts in place of a lock nut)



5.2 Apply alignment marks to the torsion bar, anchor arm and torque arm to ensure proper realignment

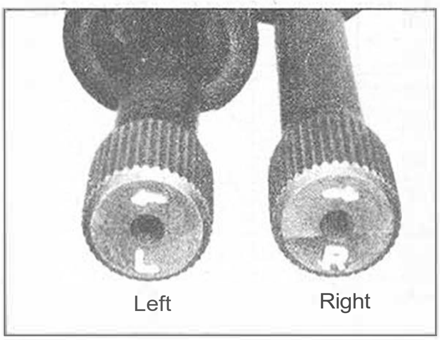
5 Torsion bar - removal, installation and adjustment

Refer to illustrations 5.2, 5.3, 5.4, 5.5, 5.10, 5.12, 5.14 and 5.17a thru 5.17f

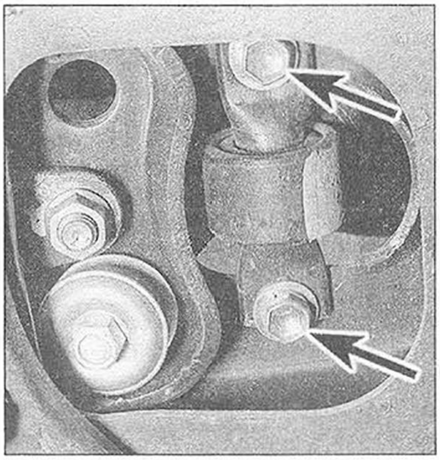
Removal

1 Jack up the front of the vehicle and place it securely on jackstands.

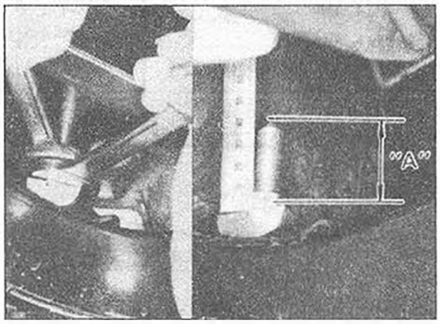
2 Remove the rubber boots and place alignment marks on the torsion bar, anchor arm and torque arm to facilitate proper alignment upon installation (see illustration).



5.5 The torsion bars are marked on the rear ends - don't mix them up



3.5 The shock absorber is fastened to the lower suspension arm by two bolts



5.3 Remove the locknut while holding the adjusting nut with another wrench (left), then measure the anchor arm bolt protrusion (right)

3 Remove the locknut securing the anchor arm and torsion bar and measure the protruding bolt end A **(see illustration).** Record the measurement.

4 Unbolt the torque arm from the lower suspension arm **(see illustration).** Loosen the adjusting nut completely and remove the anchor arm, torque arm and torsion bar.

5 Inspect the parts for wear or damage, including the splines on the torque arm **(see illustration). Note:** *There are left and right identification marks on the rear end of tile torsion bars* **(see illustration).** *Be careful not to interchange them. Replace any damaged or worn parts with new ones.*

Installation and adjustment

Original torsion bars

6 Apply a light coat of multi-purpose grease to the torsion bar splines.

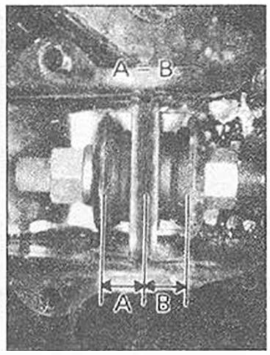
7 Set the alignment marks and attach the torsion bar to the torque arm.

8 Set the alignment marks and attach the anchor arm to the torsion bar.

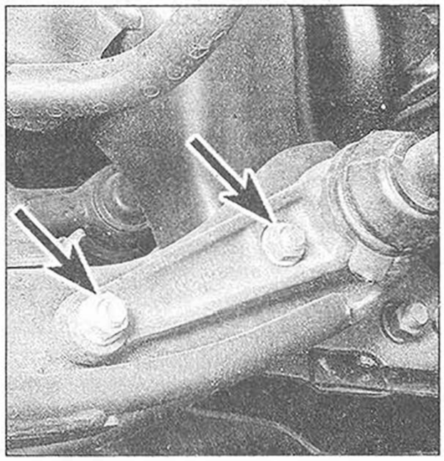
9 Tighten the adjusting nut until the bolt protrusion is equal to that recorded before removal.

New torsion bars

10 Using a jack at the front of the vehicle,

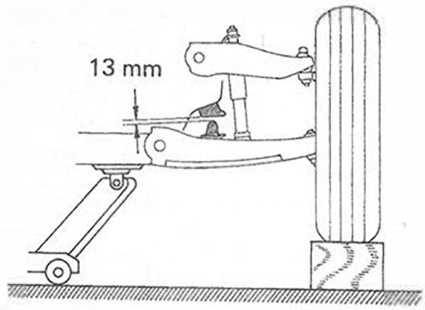


4.6 When tightened to the specified torque, the strut bar bushings should be equally compressed

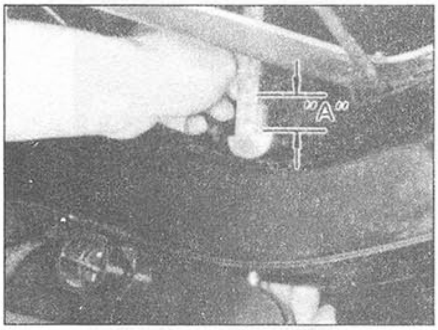


5.4 The torque arm is held to the lower suspension arm by two bolts and nuts. Don't loosen these nuts unless the anchor arm bolt adjusting nut has been completely loosened

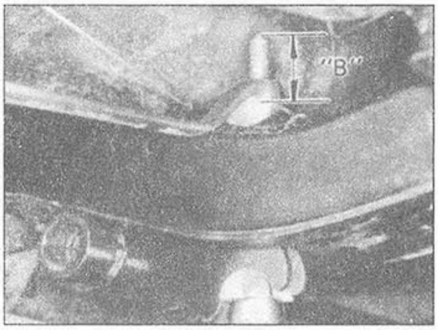
place a wooden block with a height of 7.09 to 7.87 in (180 to 200 mm) under the front tire, then lower the jack until the clearance between the spring bumper on the lower arm and the frame is 0.51 in (13 mm) **(see illus-**



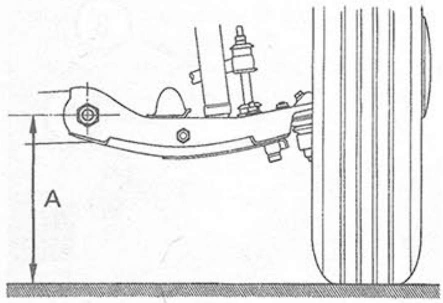
5.10 Place a wood block under the tire and lower the vehicle until the clearance between the spring bumper and the frame is as shown. This will simulate normal ride height



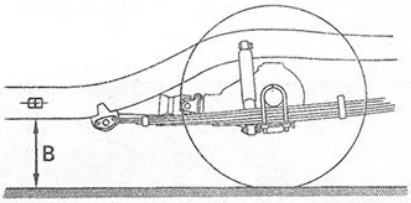
5.12 Measure the anchor arm bolt protrusion (A) with the block under the front tire



5.14 The final bolt protrusion adjustment (B) is made with the vehicle resting on the jackstands



5.17a Measure the front end standard height (A) at the point indicated and compare to the information in the charts which follow



5.17b If it is necessary to check the rear standard height (B), measure it at the point shown and compare it with the appropriate figure in the height table

Model	Tire size	Height A (front)
1/2 ton	7.00–14–6PR	10.291 in (261.4 mm)
1/2 ton	E78–14B	10.016 in (254.4 mm)
SR5	ER78–14B	9.866 in (250.6 mm)
SR5	205/70 SR14	9.512 in (241.6 mm)
3/4 ton	7.50–14–6PR	10.961 in (278.4 mm)

5.17c Vehicle standard height table - 1983 and earlier models

tration). Note: *For safety, make sure the jackstands are in position under the frame.*

11 Apply a light coat of multi-purpose grease to the splines of the torsion bar.

12 Insert the anchor arm onto the torsion bar and install the bolt so that its protrusion **(see illustration)** is 0.31 to 1.10 in (8 to 28 mm) on 1/2-ton vehicles, or 0.43 to 1.22 in (11 to 31 mm) on 3/4-ton vehicles.

13 Remove the wooden block and lower the front of the vehicle until it rests on the jackstands.

14 Tighten the adjusting nut so that bolt protrusion B **(see illustration)** is 2.72 to 3.50 in (69 to 89 mm).

Original and new torsion bars

15 Apply multi-purpose grease to the lips

Vehicle height	Body type and Suspension type	Tire size	Vehicle height mm (in.)	
			Front	Rear
	STD Short	7.00–14–6PR	269 (10.59)	297 (11.69)
		ER78–14	255 (10.04)	283 (11.14)
	STD Long	7.00–14–6PR	273 (10.75)	288 (11.34)
		ER78–14	259 (10.20)	274 (10.79)
	Long Soft ride suspension	↑	↑	275 (10.83)
	Extra cab Soft ride suspension	↑	249 (9.80)	273 (10.75)
	Extra cab STD suspension	↑	↑	272 (10.71)
	3/4 ton	7.50–14–6PR	272 (10.71)	315 (12.40)
	C & C	7.50–14–6PR	275 (10.83)	290 (11.42)
	SR-5 Short	P195/75 R 14	248 (9.76)	243 (9.57)
		205/70 SR 14	254 (10.00)	277 (10.91)
		ER78–14	↑	276 (10.87)
	SR-5 Long	P195/75 R 14	253 (9.96)	273 (10.75)
		205/70 SR 14	259 (10.20)	276 (10.87)
		ER78–14	257 (10.12)	275 (10.83)
	Extra Cab SR-5 Long	P195/75 R 14	249 (9.80)	271 (10.67)
		205/70 SR 14	255 (10.04)	275 (10.83)
		ER78–14	253 (9.96)	273 (10.75)

5.17d Vehicle standard height table - 1984 models

Vehicle height	Body type and Suspension type	Tire size	Vehicle height mm (in.)	
			Front	Rear
	STD Short	7.00–14–6PR	270 (10.63)	299 (11.77)
	STD Long	7.00–14–6PR	275 (10.83)	290 (11.42)
	Long Soft ride suspension	P195/75R14	260 (10.24)	277 (10.91)
	Extra cab Soft ride suspension	↑	250 (9.84)	275 (10.83)
	Extra cab STD suspension	↑	↑	273 (10.75)
	1 ton	185R14-LT8PR	262 (10.31)	295 (11.61)
	C & C	185R14-LT8PR	259 (10.20)	242 (9.53)
	SR-5 Short	P195/75 R 14	249 (9.80)	277 (10.91)
		205/70 SR 14	255 (10.04)	280 (11.02)
	SR-5 Long	P195/75 R 14	253 (9.96)	275 (10.83)
		205/70 SR 14	259 (10.20)	278 (10.94)
	Extra cab SR-5 Long	P195/75 R 14	250 (9.84)	274 (10.79)
		205/70 SR 14	256 (10.08)	278 (10.94)

5.17e Vehicle standard height table - 1985 models

of the boots and install them on the torque arm and anchor arm.

16 Remove the jackstands and bounce the vehicle several times to settle the suspension.

17 Adjust the vehicle height to the standard value **(see illustrations)** with the adjusting nut. **Note:** *If bolt protrusion B* **(see illustration 5.14)** *is not within 2.72 to 3.50 in (69 to 89 mm, change the position of the anchor arm spline and reassemble (1983 and earlier vehicles only).*

18 Using two wrenches, tighten the locknut to the specified torque.

19 When installation is correct, the front wheel alignment should be checked by a reputable front end alignment and repair shop.

6 Upper suspension arm - removal and installation

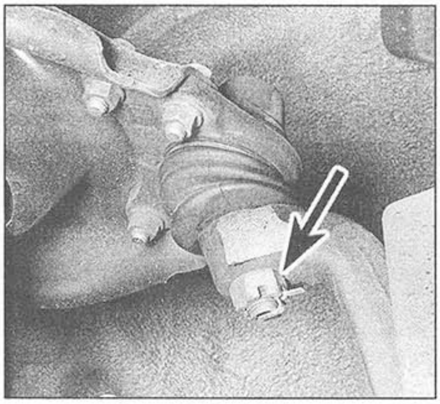
Refer to illustrations 6.4, 6.5, 6.7 and 6.12

Removal

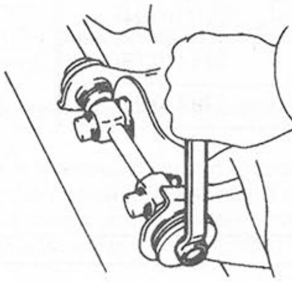
1 Jack up the front of the vehicle and place it securely on jackstands.

Vehicle height	Body type	Tire size	Vehicle height mm (in.)	
			Front	Rear
	1/2 ton Short	7.00–14–6PR	269 (10.59)	287 (11.30)
		P195/75 R 14	251 (9.88)	269 (10.59)
	1/2 ton Long	7.00–14–6PR	273 (10.75)	275 (10.83)
		P195/75 R 14	255 (10.04)	257 (10.83)
		205/70 SR 14	261 (10.28)	263 (10.35)
	1/2 ton Extra Long	P195/75 R 14	255 (10.04)	262 (10.31)
	1.0 ton	185R14–8PRLT	262 (10.31)	286 (11.26)
	C & C Long (SRW)	185R14–8PRLT	262 (10.31)	304 (11.97)
	C & C Long (DRW)	185R14–6PRLT	261 (10.28)	283 (11.14)
	C & C Super Long (DRW)	185R14–6PRLT	263 (10.35)	283 (11.14)

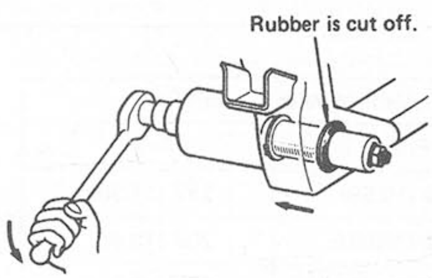
5.17f Vehicle standard height table - 1986 and later models



6.4 Remove the upper balljoint-to-steering knuckle nut



6.12 Tighten the upper arm shaft bolts only when the vehicle is at normal ride height



7.10 As the bolt is tightened, the smaller socket will push the bushing out of the lower arm and into the larger socket

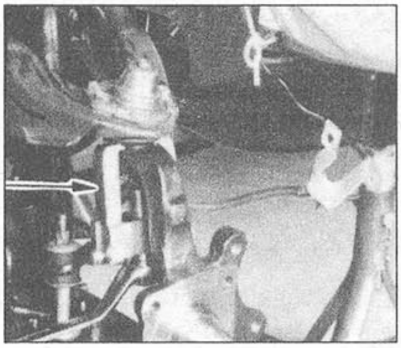
2 Remove the front wheels and tires. Support the lower suspension arm with a floor jack and raise it slightly.

3 Remove the brake caliper and hang it out of the way with a piece of wire (see Chapter 9).

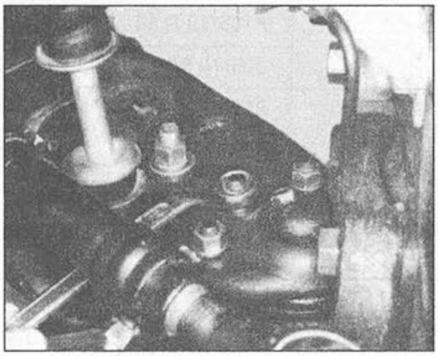
4 Remove the cotter pin and castle nut retaining the upper balljoint to the steering knuckle **(see illustration)**.

5 Using a balljoint puller, remove the upper balljoint from the steering knuckle **(see illustration)**.

6 Remove the bolts and nuts retaining the upper balljoint to the upper suspension arm.



6.5 Use a balljoint separator to pop the balljoint out of the steering knuckle - make sure the lower suspension arm is supported by a floor jack before doing this!



7.5 Remove the lower balljoint-to-lower suspension arm retaining bolts - make sure the lower suspension arm is supported by a floor jack before doing this

7 Remove the upper arm mounting bolts and the adjusting shims **(see illustration)**. **Note:** *Do not lose the shims. Record the position and the thickness of the shims so that they can be reinstalled in their original locations.*

8 Inspect the upper arm for damage. Replace it with a new one if damage is found.

9 Inspect the bushings for wear or damage. If wear or damage is found, replace them. A hydraulic press is needed to perform this job, so it is advisable to take the arm to a repair shop or an auto parts store equipped for this type of work.

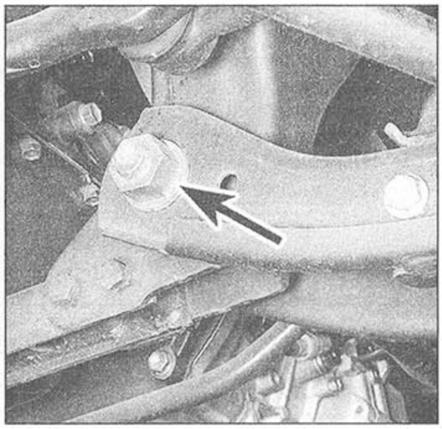
Installation

10 If the bushings have been replaced, don't tighten the upper arm shaft bolts yet (make sure they are loose enough for the shaft to turn).

11 To complete the installation, reverse the remaining removal steps, tightening all bolts, except the upper arm shaft bolts, to the specified torque.

12 Raise the lower suspension arm to simulate normal ride height, then tighten the upper arm shaft bolts to the specified torque **(see illustration)**.

6.7 Record the positions and number of adjusting (alignment) shims as they are removed



7.6 The lower suspension arm is held to the frame by the lower arm shaft, which is splined to the torque arm on the other end

7 Lower suspension arm - removal and installation

Refer to illustrations 7.5, 7.6, 7.10 and 7.11

Removal

1 Remove the torsion bar (see Section 5).

2 Disconnect the stabilizer bar from the lower suspension arm (see Section 2).

3 Disconnect the strut bar from the lower suspension arm (see Section 4).

4 Remove the front shock absorber (see Section 3).

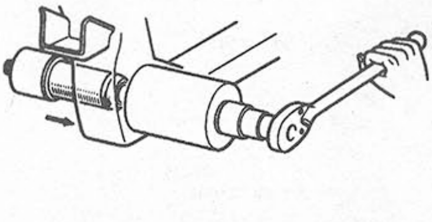
5 Disconnect the lower balljoint from the lower suspension arm by removing the retaining bolts **(see illustration)**.

6 Remove the lower suspension arm shaft nut **(see illustration)**.

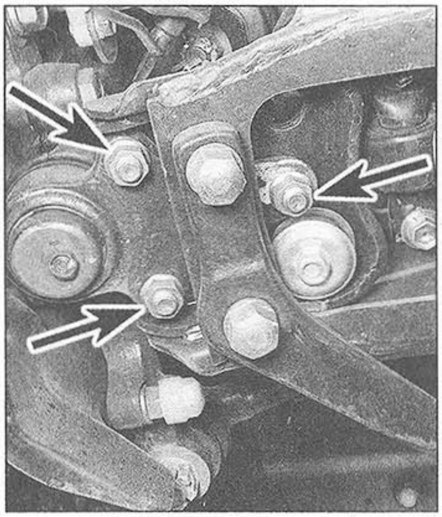
7 Remove the torque arm and lower arm shaft from the lower suspension arm, then pull down on the lower suspension arm to remove it.

8 Inspect the lower suspension arm and its related components for wear or damage. Replace parts as necessary with new ones.

9 Inspect the lower suspension arm bushing for wear or damage. If the bushing is worn or damaged, replace it as follows.



7.11 The new bushing is installed in the lower arm by reversing the positions of the sockets - be sure to lubricate the bushing with soapy water (don't use oil or grease)



8.10 The balljoint is fastened to the lower arm with three bolts and nuts

10 Using a heavy, threaded bolt, nut, two washers, a socket to fit the head of the bolt and two large sockets-one the same diameter as the bushing and threaded to match the bolt threads, the other large enough to fit over the bushing rubber-remove the bushing from the crossmember. **Note:** *As the bushing is removed, the rubber on the rear side will be cut off* **(see illustration)**.

11 Apply soapy water to the front rubber part of the new bushing, reverse the position of the removal apparatus and install the new bushing **(see illustration)**.

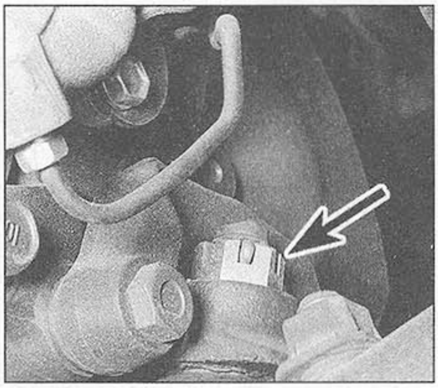
Installation

12 To install the lower suspension arm, place the arm in position and insert the lower shaft into the arm.

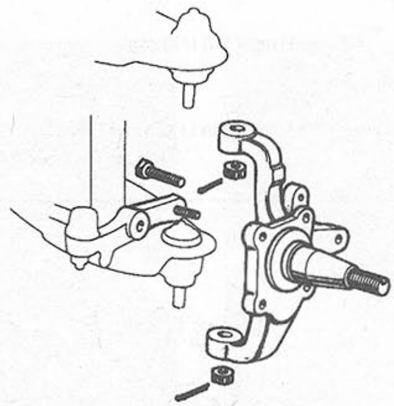
13 Finger tighten, but do not torque the mounting nut at this time.

14 Install the torque arm to the lower suspension arm and tighten the torque arm nuts and bolts to the specified torque.

15 To complete the installation, reverse the remaining removal steps, except for the tightening of the lower suspension arm shaft nut.



8.8 Remove the lower balljoint-to-steering knuckle nut (arrow) - 1988 model shown (1983 and earlier models face downward)



9.5 Steering knuckle installation details

16 Remove the jackstands and lower the vehicle.

17 Bounce the vehicle several times to stabilize the lower suspension arm bushing.

18 Tighten the lower suspension arm shaft to the specified torque.

8 Balljoints - replacement

Note: *This procedure applies to all 2WD vehicles and 1986 and later 4WD models.*

Upper balljoint

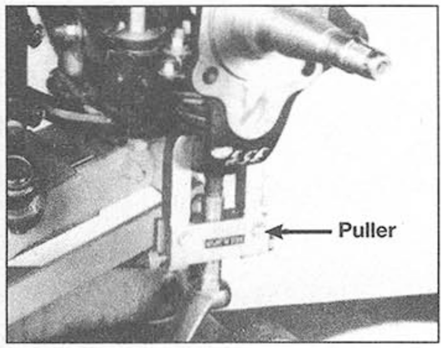
1 For removal of the upper balljoint, refer to Section 6, Steps 1 through 6.

2 To install the upper balljoint, attach it to the upper suspension arm and tighten the mounting nuts and bolts to the specified torque.

3 Connect the upper balljoint to the steering knuckle and install and tighten the castle nut to the specified torque. **Note:** *The balljoint bolts to the top side of the upper suspension arm on 1983 and earlier models, and to the underside of 1984 and later models.*

4 Install a new cotter pin.

5 The remainder of the procedure is the reverse of removal.



8.9 Use a two jaw puller or balljoint separator to separate the balljoint from the steering knuckle

Lower balljoint

Refer to illustrations 8.8, 8.9 and 8.10

6 Raise the vehicle and support it on jackstands placed underneath the frame rails. Remove the wheel.

7 Using a jack, support the lower control arm.

8 Remove the cotter pin and castle nut securing the lower balljoint to the steering knuckle **(see illustration)**.

9 Using a balljoint puller, disconnect the lower balljoint from the steering knuckle **(see illustration)**.

10 Remove the retaining nuts and bolts, then remove the lower balljoint from the lower suspension arm **(see illustration)**.

11 Replace the old balljoint with a new one.

12 Install the new balljoint between the lower arm and steering knuckle.

13 Tighten the lower balljoint mounting nuts and bolts to the specified torque.

14 Connect the balljoint to the steering knuckle, then tighten the castle nut to the specified torque and secure it with a new cotter pin.

9 Steering knuckle - removal and installation

Refer to illustration 9.5

Removal

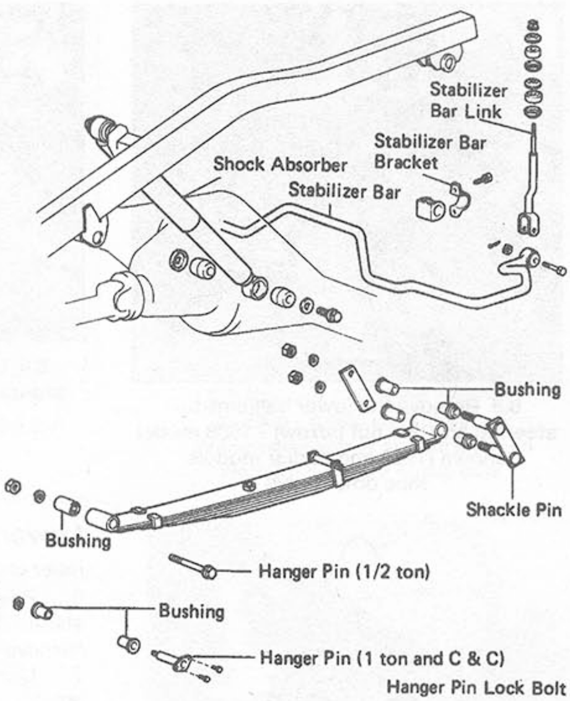
1 Remove the brake caliper and front axle hub (see Chapter 9).

2 Unbolt and remove the dust cover, then remove the knuckle arm (see Section 15).

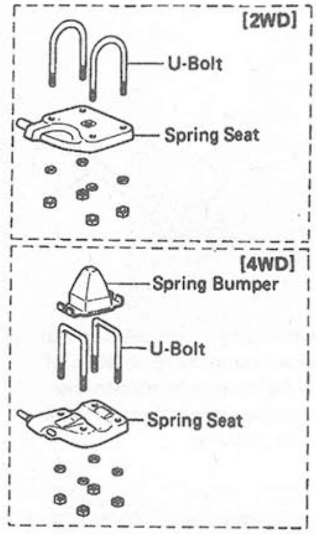
3 Place a jack under the lower arm to support it.

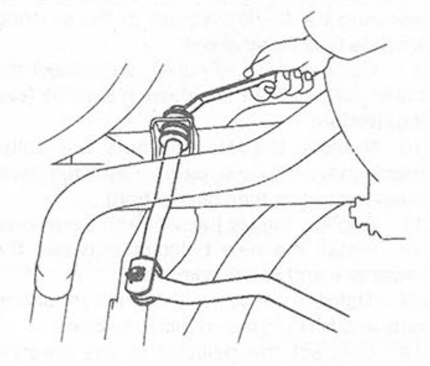
4 Using a balljoint puller, disconnect the lower balljoint from the steering knuckle after removing the cotter pin and castle nut (see Section 8).

5 Using a balljoint puller, disconnect the upper balljoint from the steering knuckle after removing the cotter pin and castle nut (Section 8). Remove the steering knuckle from the balljoints **(see illustration)**.

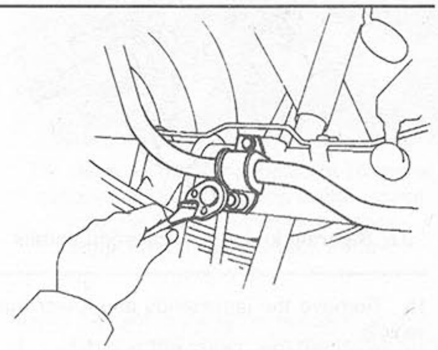


10.3 Exploded view of the rear suspension





11.2 Removing the stabilizer bar link-to-frame nut



11.3 Remove the bolts that retain the stabilizer bar brackets to the rear axle housing

6 Inspect the knuckle for damage or cracks. **Note:** *It is recommended that liquid penetrant or a flaw detector, used according to the instructions that come with it, be employed for this inspection.*

Installation

7 Installation is the reverse of the removal procedures. Be sure to refer to the Specifications for the correct torque when tightening bolts. When installation is complete, the front wheel alignment should be checked by a reputable front end alignment and repair shop.

10 Rear shock absorber - removal and installation

Refer to illustration 10.3

1 If the shock absorber is to be replaced with a new one, it is recommended that both shocks on the rear of the vehicle be replaced at the same time.

2 Raise and support the rear of the vehicle according to the jacking and towing procedures in this manual. Use a jack to raise the differential until the tires clear the ground, then place jackstands under the axle housing. Do not attempt to remove the shock absorbers with the vehicle raised and the axle unsupported.

3 Unscrew and remove the lower shock absorber mounting bolt to disconnect it at the spring seat **(see illustration)**.

4 Unscrew and remove the upper mounting nuts at the frame and remove the shock absorber.

5 If the unit is defective, it must be replaced with a new one. Replace worn rubber bushings with new ones.

6 Install the shocks in the reverse order of removal, but let the vehicle be free-standing before tightening the mounting bolts and nuts.

7 Bounce the rear of the vehicle a couple of times to settle the bushings into place, then tighten the nuts and bolt securely.

11 Rear stabilizer bar - removal and installation

Refer to illustrations 11.2 and 11.3

1 Raise the vehicle and support it securely on jackstands.

2 Remove the stabilizer bar link-to-body nuts **(see illustration)**.

3 Unbolt the stabilizer bar brackets from the axle housing and remove the bar from the vehicle **(see illustration)**.

4 Inspect the rubber bushings for hardness, cracking and general deterioration, replacing them if necessary.

5 If it is necessary to remove a stabilizer bar link, pull out the cotter pin, remove the nut and bolt then separate the link from the bar.

6 To install the stabilizer bar, reverse the removal steps.

12 Rear leaf spring - removal and installation

Refer to illustrations 12.6, 12.8a and 12.8b

1 Jack up the vehicle and support the frame securely on jackstands.

2 Remove the rear wheels and tires.

3 Place a jack under the rear differential housing.

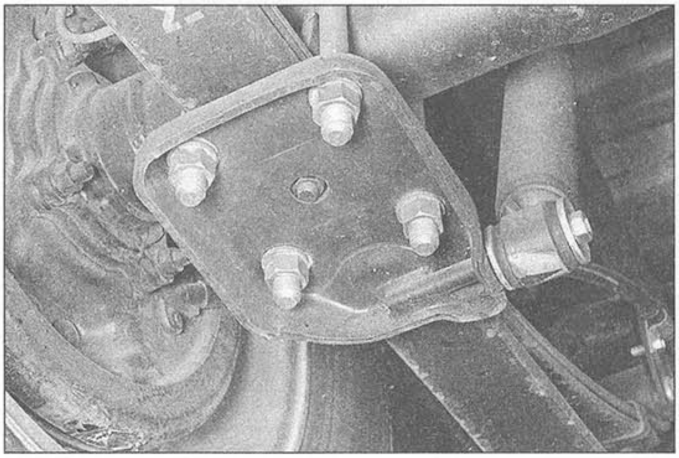
4 Lower the axle housing until the leaf spring tension is relieved, and lock the jack in this position.

5 Disconnect the shock absorber from the spring seat.

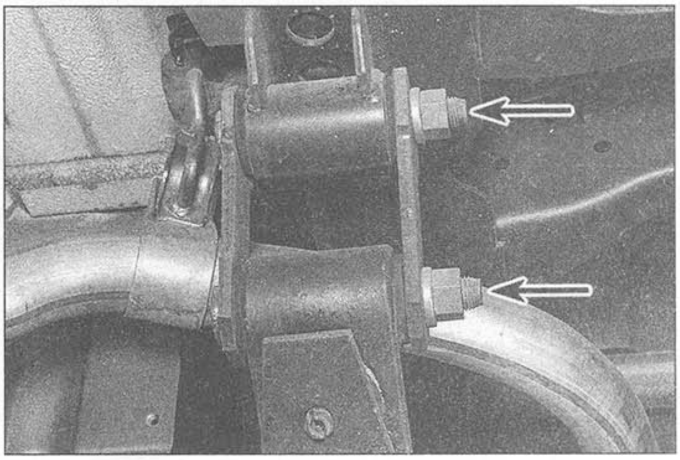
6 Remove the U-bolt mounting nuts **(see illustration)**.

7 Remove the spring seat and U-bolts.

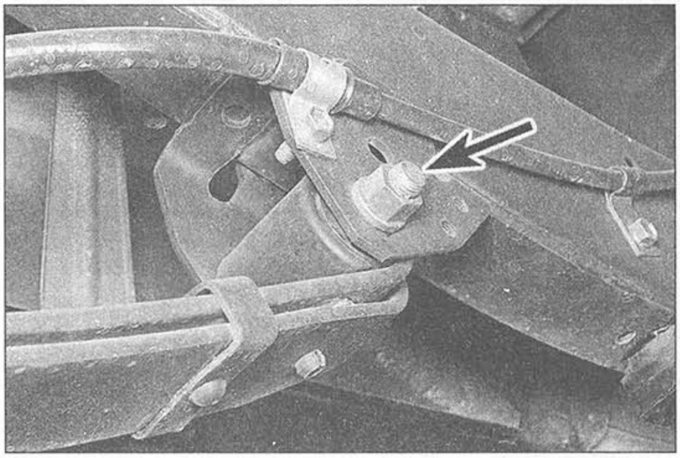
8 Unbolt and remove the shackle pin and hanger pin assemblies **(see illustrations)**.



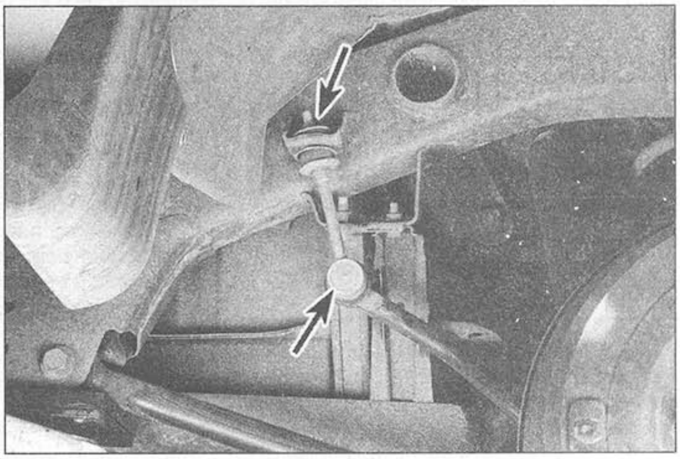
12.6 The spring seat is retained by the four U-bolt nuts



12.8a Remove the shackle pin nuts (arrows), pull the inner shackle plate off the pins and remove the rear end of the leaf spring



12.8b Remove the hanger pin nut, push the pin out of the frame bracket using a punch or drift and pull the leaf spring out of the bracket



13.2 To remove the stabilizer bar link, remove the upper and lower nuts (arrows) (4Runner models)

9 Remove the rubber bushings from the spring ends and frame, then remove the spring.

10 Installation is the reverse of the removal procedure. When installing the hanger pin and shackle pin nuts, finger tighten them until all other components are installed, then raise the jack under the differential until the vehicle is just free of the stands and tighten the hanger pin and shackle pin nuts to the specified torque. The U-bolts should be tightened to the specified torque as well.

13 Rear stabilizer bar (4Runner models) - removal and installation

Refer to illustration 13.2

1 Raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling off the stands.

2 Remove the stabilizer bar link nuts and remove both links **(see illustration)**.

3 Detach the bushing bracket bolts **(see illustration 11.3)**.

4 Remove the stabilizer bar.

5 Inspect the stabilizer bar bushings and link cushions for cracks, tears and other deterioration. Replace as necessary.

6 Installation is the reverse of removal. Be sure to tighten all fasteners to the torque listed in this Chapter's Specifications.

14 Lateral rod (4Runner models) - removal and installation

Refer to illustrations 14.4 and 14.5

1 Raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling off the stands.

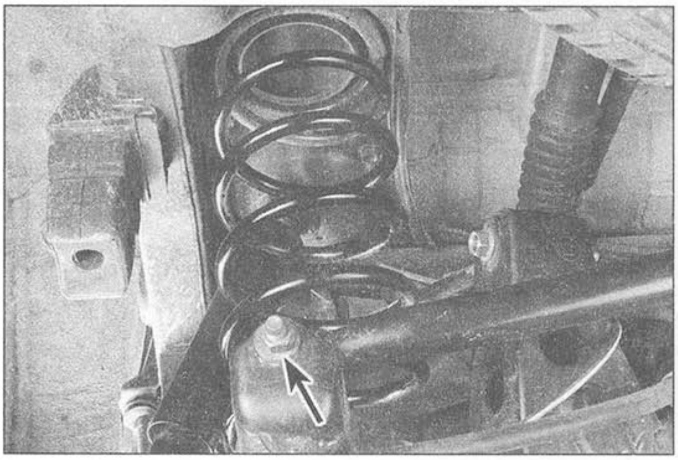
2 Support the rear axle with a floor jack.

3 Disconnect the load sensing proportioning and bypass valve (LSP & BV) from the axle (see Chapter 9).

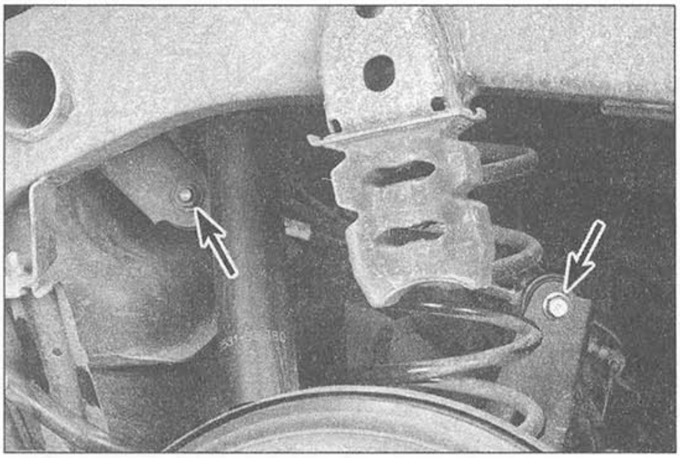
4 Disconnect the upper end of the lateral rod from the frame bracket **(see illustration)**.

5 Disconnect the lower end of the lateral

14.4 To detach the upper end of the lateral rod from the frame bracket, remove this nut and bolt (arrow)



14.5 To detach the lower end of the lateral rod from the axle bracket, remove this nut and bolt (arrow)



16.4 To detach the upper control arm from the frame and the axle, remove these nuts and bolts (arrows)

rod from the axle bracket **(see illustration)**.
6 Remove the lateral rod.
7 Installation is the reverse of removal. Be sure to tighten both nuts to the torque listed in this Chapter's Specifications (the vehicle should be at normal ride height when the bolts are tightened).

15 Rear coil spring (4Runner models) - removal and installation

1 Raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling off the stands.
2 Support the rear axle with a floor jack.
3 Run a chain through the coil spring and bolt its ends together to prevent the spring from flying out accidentally as the rear axle is lowered. Make sure there is enough slack in the chain to allow the spring to extend fully.
4 Disconnect the shock absorbers from the axle (see Section 13).
5 Disconnect the stabilizer bar bushing brackets from the axle (see Section 15).
6 Disconnect the lateral rod from the axle (see Section 16).
7 Slowly lower the rear axle housing just far enough to remove the coil spring. Be careful not to snag the brake line.
8 Installation is the reverse of removal. Make sure that the lower end of the coil spring is seated properly on the spring seat. Tighten all suspension fasteners to the torque listed in this Chapter's Specifications.

16 Rear suspension arms (4Runner models) - removal and installation

Refer to illustrations 16.4

1 Raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling off the stands.
2 Support the rear axle with a floor jack.
3 Detach the ABS harnesses from the upper suspension arms.
4 To remove an upper control arm, remove the nut, washer and bolt attaching the arm to the frame, and the nut, washer and bolt attaching the arm to the axle **(see illustration)**.
5 To remove a lower control arm, remove the nut and bolt attaching the arm to the frame bracket and the and the nut, washer and bolt attaching the arm to the axle bracket.
6 Inspect the control arm bushings. If they're cracked or torn or otherwise deteriorated, have new ones installed at an automotive machine shop.
7 Installation is the reverse of removal. Tighten all fasteners to the torque values listed in this Chapter's Specifications, with the vehicle resting at normal ride height.

17 Steering wheel - removal and installation

Refer to illustration 17.4

Removal

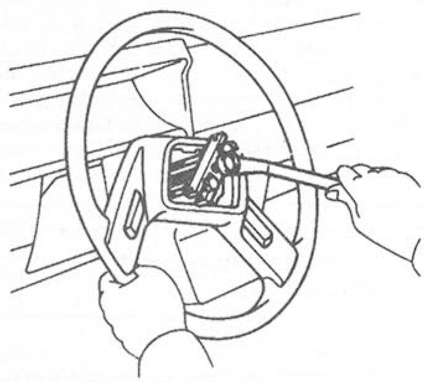
1 Disconnect the cable from the negative battery terminal.
2 Remove the screws from the back of the steering wheel and pull off the horn button or center pad.
3 Mark the steering wheel hub and the column shaft with paint to ensure correct repositioning during reassembly.
4 Unscrew the steering wheel nut and remove the wheel using a suitable puller, if necessary **(see illustration)**. **Note:** *Do not hammer on the wheel or the shaft to separate them.*

Installation

5 Realign the steering wheel and the column shaft using the match marks. Install and tighten the retaining nut to the specified torque, then attach the horn button or center pad.
6 Hook up the negative battery cable to the battery.

18 Steering linkage - removal and installation

1 All steering linkage removal and installation procedures should be performed with the front end of the vehicle raised and placed securely on jackstands.
2 Before removing any steering linkage components, obtain a balljoint separator. It may be a screw-type puller or a wedge-type tool, although the wedge-type tool tends to damage the balljoint seals. It is possible to jar a balljoint taper pin free from its eye by striking opposite sides of the eye simultaneously with two large hammers, but the space available to do so is usually very limited.
3 After installing any of the steering linkage components, the front wheel alignment should be checked by a reputable front end alignment and repair shop.



17.4 Remove the wheel from the shaft with a puller - DO NOT hammer on the shaft

Pitman arm

Refer to illustrations 18.4 and 18.6

4 Remove the nut securing the Pitman arm to the steering gearbox sector shaft **(see illustration)**.

5 Scribe or paint match marks on the arm and shaft.

6 Using a puller, disconnect the Pitman arm from the shaft splines **(see illustration)**.

7 Remove the cotter pin and castle nut securing the Pitman arm to the relay rod.

8 Using a puller, disconnect the Pitman arm from the relay rod.

9 Installation is the reverse of the removal procedure. Be sure to tighten the nuts to the specified torque.

Tie-rod

Refer to illustrations 18.12 and 18.13

10 Remove the cotter pins and castle nuts securing the tie-rod to the relay rod and knuckle arm **(see illustration 18.4)**.

11 Separate the tie-rod from the relay rod and knuckle arm with a puller.

12 Before installing, if both tie-rods have been removed and disassembled, adjust the tie-rod ends in the adjusting clamps until the measurements are equal. The tie-rods should be approximately 12.36 in (314 mm) long **(see illustration)**.

13 Turn the tie-rod ends so they are at approximately 90-degree angles to each other, then tighten the adjusting tube clamps to lock the ends in position **(see illustration)**.

14 The remaining installation steps are the reverse of those for removal. Make sure to tighten the nuts to the specified torque.

Relay rod

15 Remove the cotter pins and castle nuts securing the tie-rod ends to the relay rod **(see illustration 18.4)**.

16 Remove the cotter pin and castle nut securing the steering damper to the relay rod.

17 Remove the cotter pin and castle nut securing the relay rod to the Pitman arm.

18 Remove the cotter pin and castle nut securing the relay rod to the idler arm.

19 Using a puller, separate the relay rod from the tie-rod ends, steering damper, Pitman arm and idler arm.

20 Installation is the reverse of the removal procedures. Be sure to tighten all nuts to the specified torque.

Knuckle arm

Refer to illustration 18.24

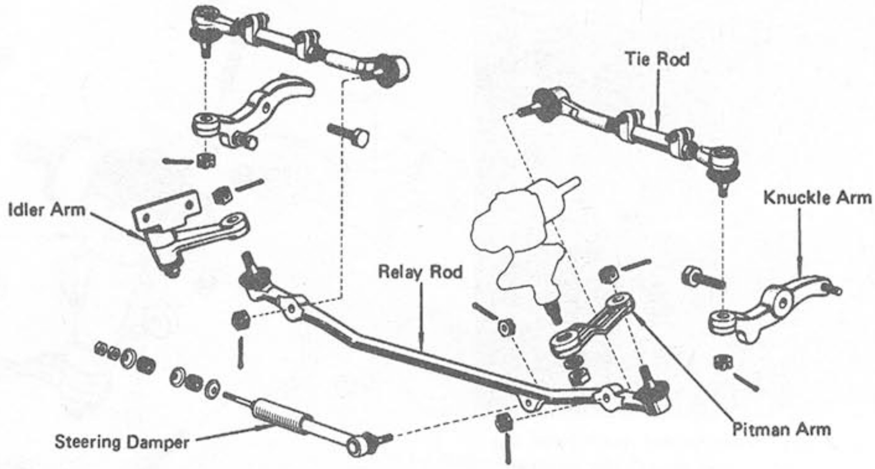
21 Remove the cotter pin and castle nut securing the tie-rod end to the knuckle arm.

22 Using a puller, separate the tie-rod end from the knuckle arm.

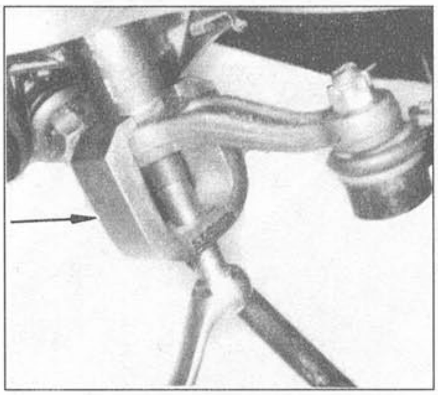
23 Remove the front axle hub (see Chapter 1).

24 Unbolt the knuckle arm from the steering knuckle and remove the knuckle arm **(see illustration)**.

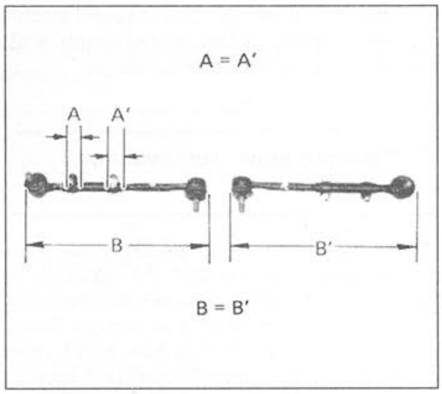
25 Installation is the reverse of the removal procedure. Be sure to tighten all nuts and bolts to the specified torque.



18.4 Exploded view of the steering linkage



18.6 Use a puller to remove the Pitman arm - don't attempt to pry it off the sector shaft



18.12 The exposed thread area (A) and the adjusting clamp position should be equal on both sides of the sleeve. The overall length of the tie-rods (B) should be as specified

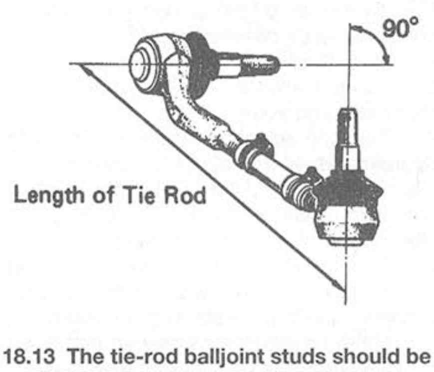
Steering damper

26 Remove the cotter pin and castle nut securing the damper to the relay rod **(see illustration 18.4)**.

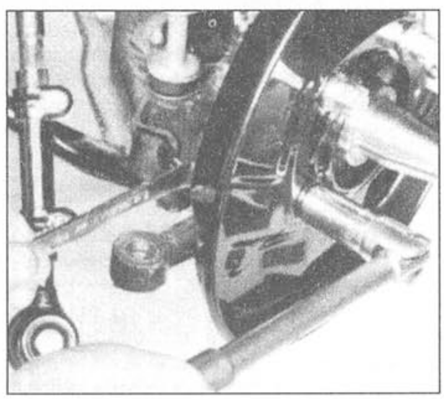
27 Using a puller, separate the damper end from the relay rod.

28 Using two wrenches, remove the locknut and mounting nut securing the damper to the front axle and remove the damper.

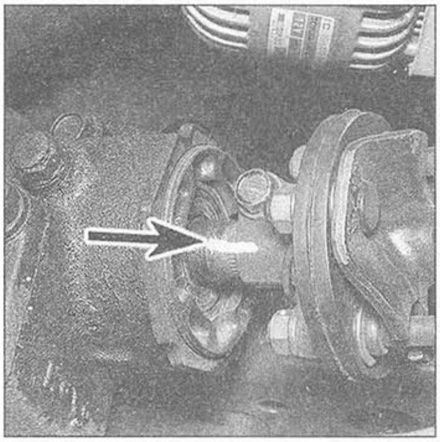
29 When installing, connect the damper to the tie-rod first, then attach the damper to the



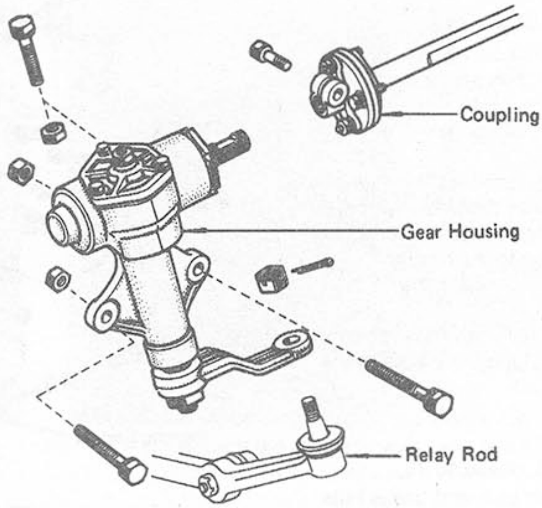
18.13 The tie-rod balljoint studs should be situated at 90-degrees to each other



18.24 Unbolting the knuckle arm from the steering knuckle



19.2 Apply an alignment mark from the steering shaft coupling to the steering gear worm shaft



19.6 Steering gear mounting details

front axle. Make sure the cushions and washers are installed in the proper order and tighten all nuts to the specified torque.

19 Steering gear - removal and installation

Refer to illustrations 19.2 and 19.6

Note: *If you find that the gearbox is defective, it is not recommended that you overhaul it. Because of the special tools needed to do the job, it is best to let your dealer service department overhaul it for you (or replace it with a factory rebuilt unit). However, you can remove and install it yourself by following the procedure outlined here.*

The removal and installation procedures for manual steering and power steering gear housings are identical except that the inlet and outlet lines must be removed from the steering gear housing on power steering equipped models before the housing can be removed.

The steering system should be filled and power steering systems should be bled after the gear housing is reinstalled (see Section 18).

1 Raise the front of the vehicle and place it securely on jackstands.

2 Place an alignment mark on the steering coupling and the gear housing worm shaft to assure correct reassembly **(see illustration)**, then remove the coupling bolt.

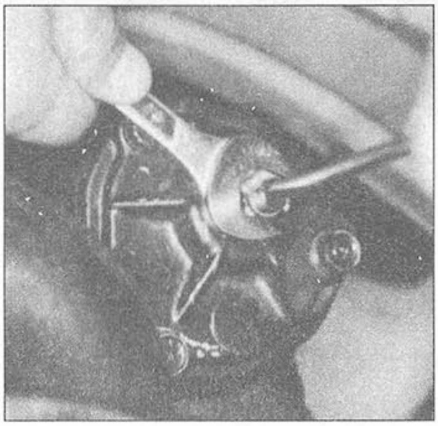
3 Loosen the Pitman arm set nut at the bottom of the steering gear housing.

4 Remove the cotter pin and castle nut securing the relay rod end to the Pitman arm.

5 Using a puller, disconnect the relay rod end from the Pitman arm **(see illustration 18.4)**.

6 Remove the bolts securing the gear housing to the chassis and pull the gear housing from the coupling **(see illustration)**.

7 Installation is the reverse of the removal procedure except that the Pitman arm set nut should be tightened before the Pitman arm is connected to the relay rod end. Be sure to tighten all nuts and bolts to the specified torque.



20.6 The adjusting screw must be held stationary while tightening the locknut

20 Steering free play - adjustment

Refer to illustration 20.6

1 Raise the vehicle with a jack so that the front wheels are off the ground and place the vehicle securely on jackstands.

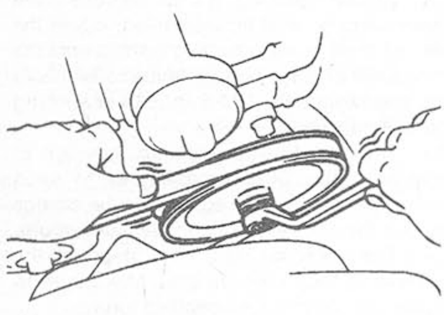
2 Point the wheels straight ahead.

3 Using a wrench, loosen the locknut on the steering gearbox.

4 Turn the adjusting screw clockwise to decrease wheel free play and counterclockwise to increase it. **Note:** *Turn the adjusting screw in small increments, checking the steering wheel free play between them.*

5 Turn the steering wheel halfway around in both directions, checking that the free play is correct and that the steering is smooth.

6 Hold the adjusting screw so that it will not turn and tighten the locknut **(see illustration)**.



21.1 Push down on the drivebelt sufficiently to prevent the pump pulley from turning when the pulley nut is loosened

7 Remove the jackstands and lower the vehicle.

21 Power steering pump - removal and installation

Refer to illustrations 21.1, 21.2 and 21.3

Note: *If you find that the steering pump is defective, it is not recommended that you overhaul it. Because of the special tools needed to do the job, it is best to let your dealer service department overhaul it for you (or replace it with a factory rebuilt unit). However, you can remove it yourself using the procedures which follow.*

Removal

1 Push on the drivebelt to increase its tension sufficiently to prevent the pulley from turning and loosen the drive pulley nut **(see illustration)**.

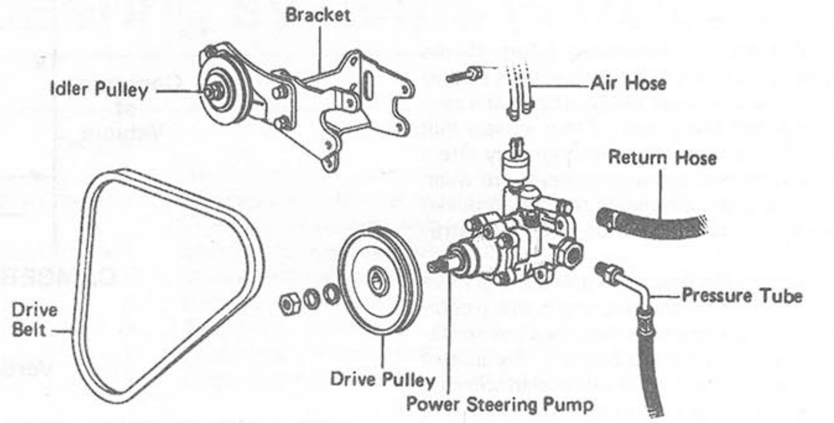
2 Loosen the idler pulley nut **(see illustration)**.
3 Loosen the adjusting bolt and remove the drivebelt **(see illustration)**.
4 Remove the drive pulley nut and the drive pulley.
5 Using a flare nut-wrench (except V6 models), loosen and disconnect the pressure hose. Position a suitable container so as to catch the pump fluid and plug the hose to prevent contamination. On V6 models, remove the union bolt.
6 Loosen the return line hose clamp, pull off the hose and plug it to prevent contamination. On later models, also mark and disconnect the hoses from the air control valve.
7 Remove the pump mounting bolts and lift the pump out of the engine compartment.

Installation

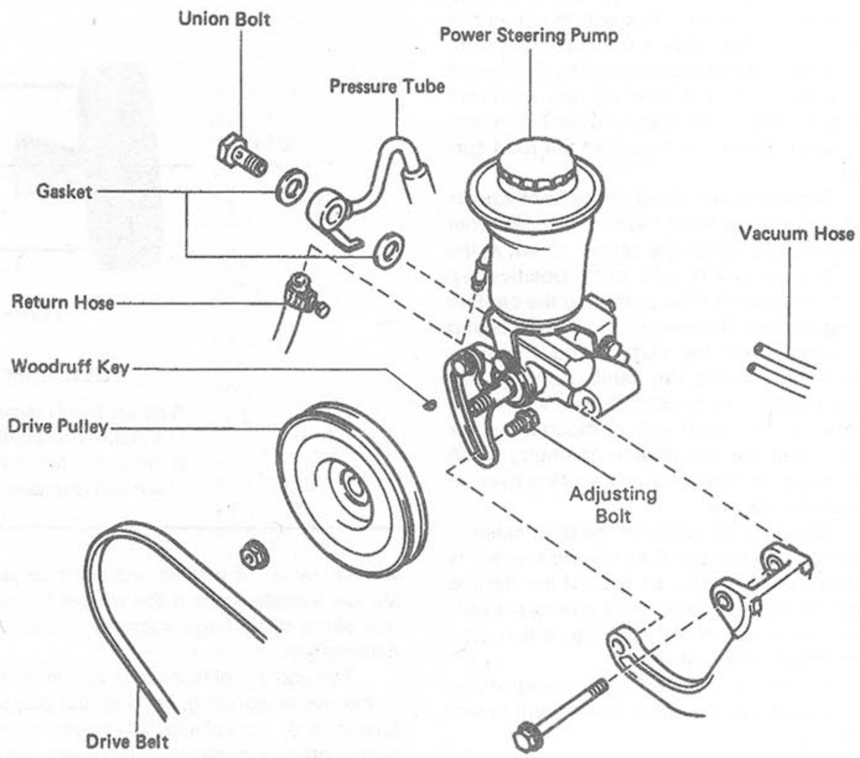
8 Installation is the reverse of the removal procedure. When installing the pressure line, make sure there is sufficient clearance between the line and the exhaust manifold.
9 To adjust the drivebelt tension, see Chapter 1.
10 Fill the power steering fluid reservoir with the specified fluid and bleed the power steering system (see Section 22).
11 Check for fluid leaks.

22 Power steering system - bleeding

1 Check the fluid in the reservoir and add fluid of the specified type if it is low.
2 Jack up the front of the vehicle and place it securely on jackstands.
3 With the engine off, turn the steering wheel fully in both directions two or three times.
4 Recheck the fluid in the reservoir and add more fluid if necessary.
5 Start the engine and turn the steering wheel fully in both directions two or three times. The engine should be running at 1000 rpms or less.
6 Remove the jackstands and lower the vehicle completely.
7 With the engine running at 1000 rpms or less, turn the steering wheel fully in both directions two or three times.
8 Return the steering wheel to the center position.
9 Check that the fluid is not foamy or cloudy.
10 Measure the fluid level with the engine running.
11 Turn the engine and again measure the fluid level. It should rise no more than 0.20 in (5 mm) when the engine is turned off.
12 If a problem is encountered, repeat Steps 7 through 11.
13 If the problem persists, remove the pump (see Section 21), and have the pump repaired by a qualified service facility.



21.2 Power steering pump mounting details - 4-cylinder engine (1988 model shown, others similar)



21.3 Power steering pump mounting details - V6 engine

23 Front end alignment - general information

Refer to illustration 23.1

A front end alignment refers to the adjustments made to the front wheels so they are in proper angular relationship to the suspension and the ground. Front wheels that are out of proper alignment not only affect steering control, but also increase tire wear. The front end adjustments normally required are camber, caster and toe-in **(see illustration)**.

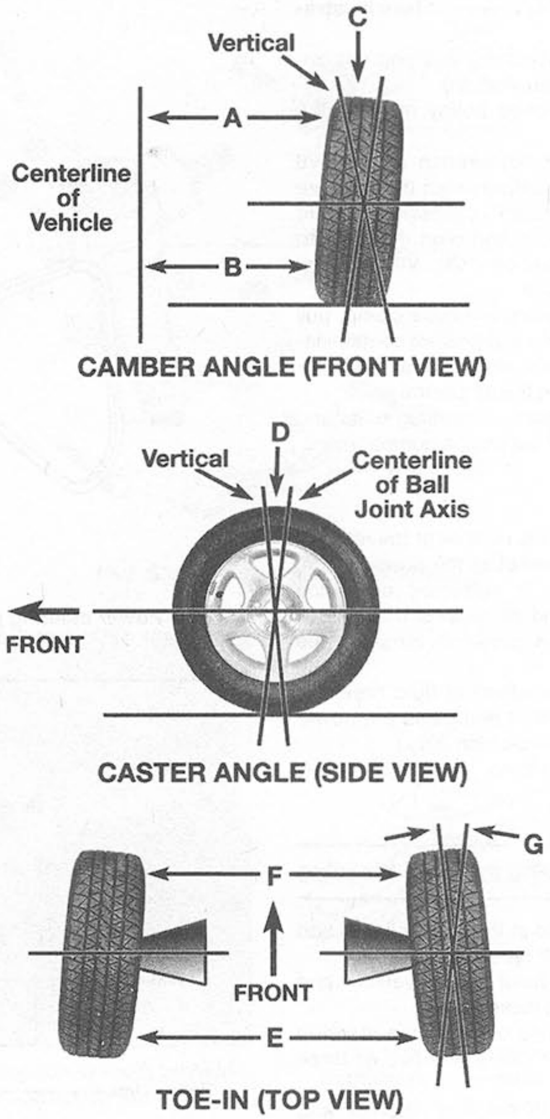
Getting the proper front wheel alignment is a very exacting process, one in which complicated and expensive machines are necessary to perform the job properly. Because of this, you should have a technician with the proper equipment perform these tasks. We will, however, use this space to give you a basic idea of what is involved with front end 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 front wheels. The purpose of a toe specification is to ensure parallel rolling of the front 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. Toe in adjustment is controlled by the tie-rod end position on the inner tie rod. Incorrect toe-in will cause the tires to wear improperly by making them scrub against the road surface.

Camber is the tilting of the front wheels from the vertical when viewed from the front 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 the 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 travelling 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. Caster angle affects the self-centering action of the steering, which governs straight-line stability.

Caster is adjusted by moving shims from one end of the upper control arm mount to the other.



23.1 Front end alignment details

A minus B = C degrees camber)
D = caster (measured in degrees)
E minus F = toe-in (measured in inches or millimeters)
G = toe-in (expressed in degrees)

24 Wheels and tires - general information

Wheels can be damaged by an impact with a curb or other solid object. If the wheels are bent, the result is a hazardous condition which must be corrected. To check the wheels, raise the vehicle and set it on jackstands. Visually inspect the wheels for obvious signs of damage such as cracks and deformation.

Tire and wheel balance is very important to the overall handling, braking and ride performance of the vehicle. Whenever a tire is dismounted for repair or replacement, the tire and wheel assembly should be balanced before being installed on the vehicle.

Wheels should be periodically cleaned, especially on the inside, where mud and road salts accumulate and eventually cause rust and, ultimately, possible wheel failure.

Tires are extremely important from a safety standpoint. The tread should be checked periodically to see that the tires have not worn excessively, a condition which can be dangerous, especially in wet weather.

To equalize wear and add life to a set of tires, it is recommended that they be rotated periodically. When rotating, check for signs of abnormal wear and foreign objects in the tread or sidewalls (refer to Chapter 1, Routine Maintenance).

Proper tire inflation is essential for maximum life of the tread and for proper handling and braking.

Tires that are wearing in an abnormal way are an indication that their inflation is incorrect or that the front end components are not adjusted properly. Take the vehicle to a reputable front end alignment and repair shop to correct the situation.

Chapter 10 Part B
Suspension and steering systems (4WD)

Contents

	Section
Balljoints - replacement	9
Freewheel hub - removal and installation	See Chapter 8
Front axle hub and wheel bearings - removal and installation	See Chapter 1
Front leaf spring - removal and installation	5
Front shock absorber - removal and installation	2
Front stabilizer bar - removal and installation	3
General information	1
Lower suspension arm - removal and installation	8
Rear leaf spring - removal and installation	11
Steering gear - removal and installation	14
Steering intermediate shaft - removal and installation	13
Steering knuckle - removal and installation	10
Steering linkage - removal and installation	12
Swivel hub - removal and installation	15
Torque rod - removal and installation	4
Torsion bar - removal, installation and adjustment	6
Upper suspension arm - removal and installation	7

Specifications

General

Steering wheel free play	Less than 1.18 in (30 mm)
Steering gearbox oil level	See Chapter 1
Drivebelt tension	See Chapter 1
Stub axle alternate spacer available thickness (1986 and later 4WD models)	0.0709 in (1.80 mm) and 0.0886 in (2.25 mm)
Swivel hub preload	6 to 8 lbs

Torque specifications

	Ft-lbs
Front suspension (1985 and earlier models)	
Torque rod mounting bolts	87 to 122
Leaf spring hanger pin bolts	8 to 11
U-bolt mounting bolts	73 to 108
Hanger pin and shackle pin mounting nuts	73 to 108
Steering arm to swivel hub nuts	82
Front suspension (1986 and later models)	
Lower suspension arm-to-frame bolt nuts	203
Upper suspension arm-to-frame bolts	111
Lower suspension arm-to-lower balljoint	43
Upper suspension arm-to-upper balljoint	25
Lower balljoint-to-steering knuckle	105
Upper balljoint-to-steering knuckle	105
Steering knuckle arm-to-steering knuckle	120
Rear suspension	
Leaf spring hanger pin bolts	8 to 11
U-bolt mounting nuts	73 to 108
Hanger pin and shackle pin mounting nuts	55 to 79
Steering	
Intermediate shaft joint yoke bolts	22 to 32
Steering gear mounting bolts	37 to 47
Pitman arm-to-sector shaft	116 to 137
Tie-rod tube clamps	
1983 and earlier	15 to 21
1984 and 1985	27
Tie-rod mounting bolts	55 to 79
Wheel lug nuts	65 to 87

1 General information

Refer to illustrations 1.1 and 1.2

This Chapter deals solely with the suspension and steering components which are unique to vehicles equipped with four-wheel drive (4WD). All procedures and specifications dealing with suspension and steering that are common between the two-wheel drive (2WD) and 4WD vehicles can be found in Chapter 10 Part A.

1985 and earlier 4WD models utilized a conventional solid axle/leaf spring front suspension configuration **(see illustration)**. In 1986, the solid axle design was substituted with a fully independent front suspension **(see illustration)**, which employs upper and lower suspension arms, torsion bar springs and driveaxles with two constant velocity (CV) joints per side.

2 Front shock absorber - removal and installation

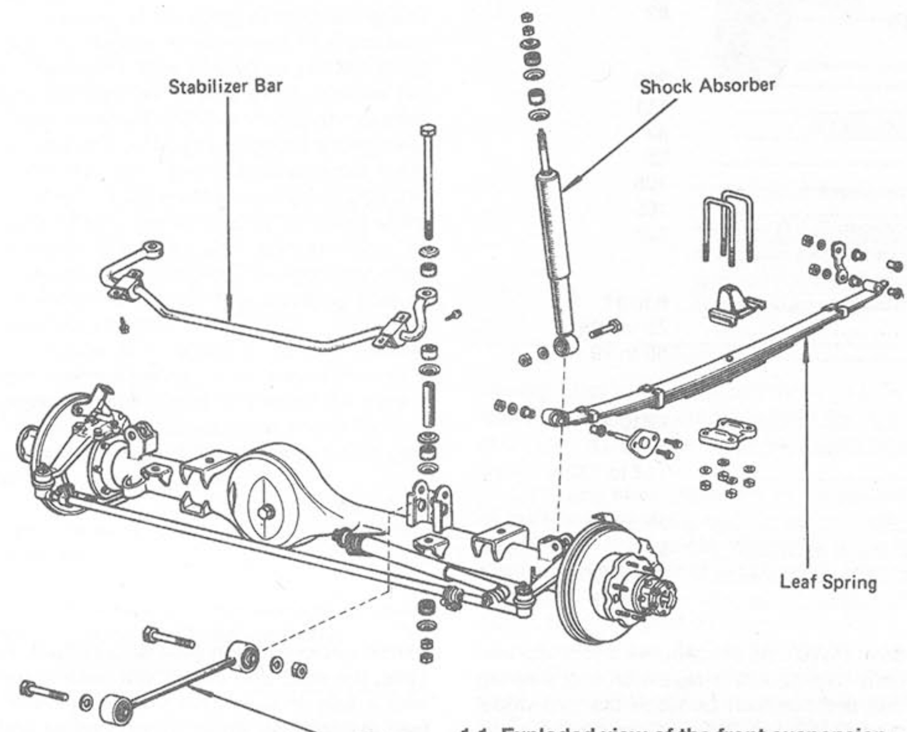
1 Jack up the front of the vehicle and place it securely on jackstands.
2 Remove the front tires and wheels.
3 Remove the two upper nuts holding the shock absorber to the frame bracket **(see illustration 1.1 or 1.2)**.
4 Remove the washers and cushions from the shaft of the shock absorber .
5 Disconnect the shock from the lower arm (or axle housing on 1985 and earlier models) and remove it from the vehicle.
6 Inspect the components for wear, damage or oil leaks. Replace parts as necessary with new ones.
7 Installation is the reverse of the removal procedure. Make sure the washers and bushings are assembled in the proper order.

3 Front stabilizer bar - removal and installation

1 Jack up the front of the vehicle and place it securely on jackstands.
2 Remove the nuts, cushions and bolts from both ends of the stabilizer bar where it attaches to the axle housing **(see illustration 1.1)**.
3 Unbolt and remove the two stabilizer bar brackets from the frame and remove the stabilizer bar from the vehicle.
4 Inspect all parts for wear or damage. Replace parts as necessary with new ones.
5 Installation is the reverse of the removal procedure. Make sure that the cushions are assembled and installed in the proper order and that all nuts and bolts are tightened securely.

4 Torque rod - removal and installation

Note: *This procedure applies to 1985 and earlier 4WD models only.*
1 Jack up the front of the vehicle and place it securely on jackstands.
2 Remove the nut and bolt that attach the torque rod to the bracket on top of the front axle **(see illustration 1.1)**.
3 Remove the bolt retaining the torque rod to the frame and remove the torque rod from the vehicle.
4 Inspect the torque rod for damage. If damage is found, replace the torque rod with a new one.
5 Inspect the bushings for wear or damage.
6 If it is necessary to replace the torque rod bushings, use a press and collar to remove the old bushings.
7 Using a press and collar, install the new bushings. **Note:** *Position the bushing holes at a right angle to the rod and press the bushing in from the beveled end.*
8 Attach the torque rod to the axle and frame and tighten the mounting bolts finger-tight.
9 Lower the vehicle and bounce the front of it several times to stabilize the bushings.
10 Tighten the mounting bolts to the specified torque.



1.1 Exploded view of the front suspension - 1985 and earlier models

5 Front leaf spring - removal and installation

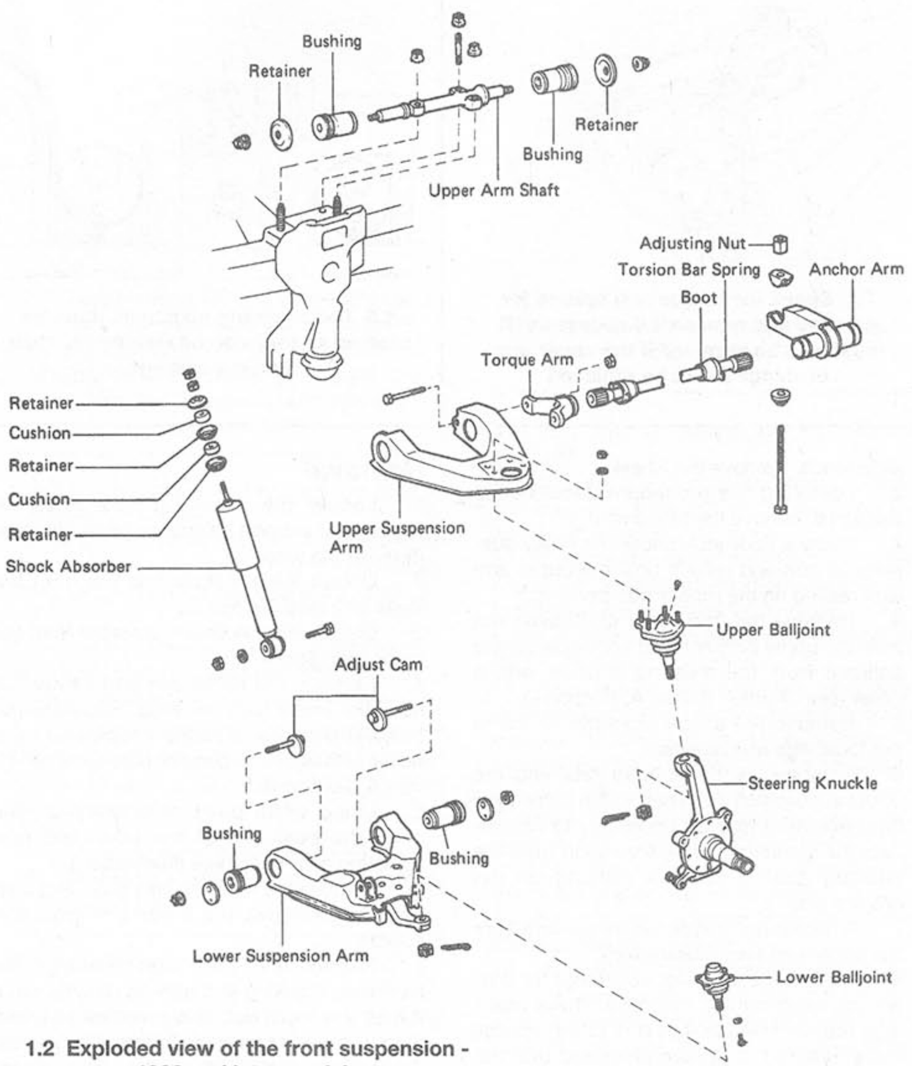
Refer to illustrations 5.8 and 5.10
Note: *This procedure applies to 1985 and earlier models only.*

Removal

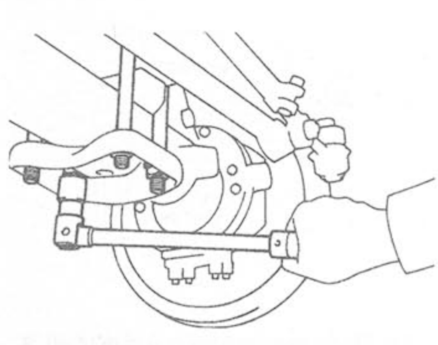
1 Jack up the front of the vehicle, place it on jackstands and remove the wheels and tires.
2 Disconnect the shock absorbers from the axle housing (see Section 2 for details).
3 Disconnect the stabilizer bar from the front axle (see Section 3 for details).
4 Remove the cotter pin from the drag link end (see Section 12).
5 Using a screwdriver, remove the plug from the drag link end.
6 Disconnect the drag link from the knuckle arm.
7 Using a jack, support the axle housing.
8 Unbolt and remove the U-bolts, spring seat and spring bumper from the leaf spring **(see illustration)**.
9 Lower the jack and free the leaf spring.
10 Remove the hanger pin and shackle pin from the front and rear of the front spring, respectively, and remove the spring **(see illustration)**.

Installation

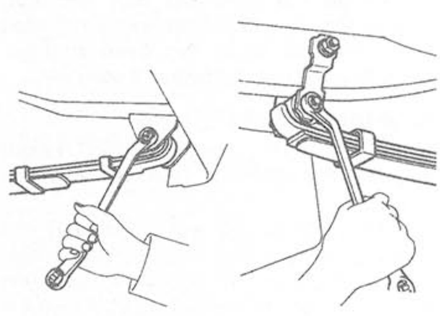
11 To install the spring, first insert the bushings into the frame and both ends of the leaf spring.
12 Place the spring in position on the vehicle.
13 Install the hanger pin to the leaf eye and tighten the two bolts on the bracket to the specified torque.
14 Finger tighten the nut on the end of the hanger pin.
15 Install the shackle pin and finger tighten both nuts.
16 Support the axle housing with a jack.
17 Install the spring bumper, spring seat and U-bolts.
18 Tighten the U-bolt mounting nuts to the specified torque.
19 Raise the front axle housing until the vehicle is just clear of the jackstands .
20 Tighten the front hanger pin nut and both shackle pin nuts to the specified torque, then lower the vehicle back on the jackstands.
21 Connect the stabilizer bar to the axle housing and tighten the nuts securely.
22 Connect the shock absorber to the axle housing and tighten the nut securely.
23 Insert the drag link on the knuckle arm and install the ball stud seat, spring, spring seat and plug in the drag link end.



1.2 Exploded view of the front suspension - 1986 and later models



5.8 Removing the U-bolt nuts - don't do this unless the axle assembly is supported with a jack



5.10 Removing the hanger pin (left) and shackle pin (right) nuts

24 Tighten the plug until it is snug, then loosen it 1-1/3 turns.
25 Secure the plug with a cotter pin.
26 Install the wheels and tires, remove the jackstands and lower the vehicle. Be sure to tighten the lug nuts to the specified torque.

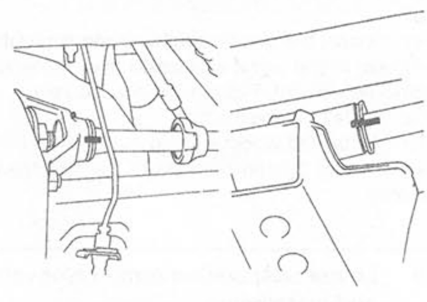
6 Torsion bar - removal, installation and adjustment

Refer to illustrations 6.2 and 6.3

Note: *This procedure applies to 1986 and later 4WD models only.*

Removal

1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.
2 Apply match marks from the torsion bar to the anchor arm and the torque arm **(see illustration)**.
3 Measure the amount of bolt protrusion from the top of the adjusting bolt nut **(see illustration)**
4 Remove the anchor arm adjusting bolt lock nut while holding the adjusting nut with a wrench to prevent it from turning.
5 Remove the adjusting nut and bolt, then remove the anchor arm and torsion bar from the vehicle.

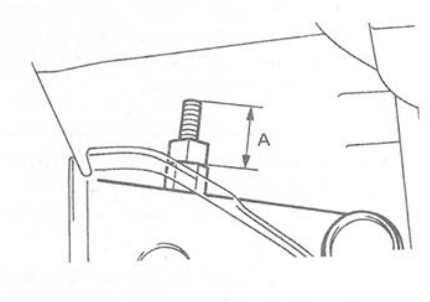


6.2 Applying match marks on the torsion bar, torque arm and anchor arm will ensure correct positioning and easy installation of the torsion bar

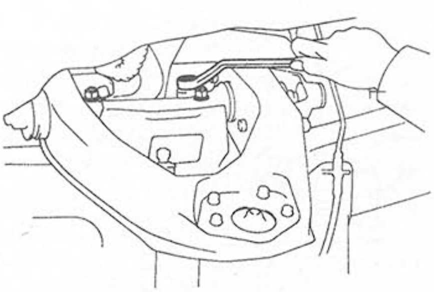
Installation and adjustment

Original torsion bar

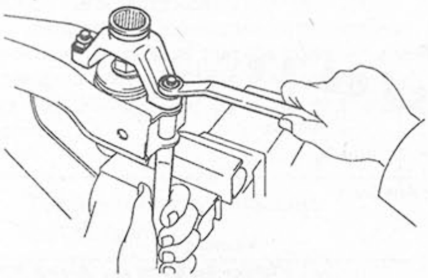
Note: *There are left and right side identification marks on the rear ends of the torsion bars* **(see illustration 5.5 in Chapter 10, Part A)** - if both bars have been removed, be careful not to get them mixed up.
6 Apply a thin coat of "moly" based grease to the splines on each end of the torsion bar.
7 Line up the match marks and insert the torsion bar into the torque arm.
8 Line up the match marks on the bar with the marks on the anchor arm and slide the anchor arm onto the torsion bar.



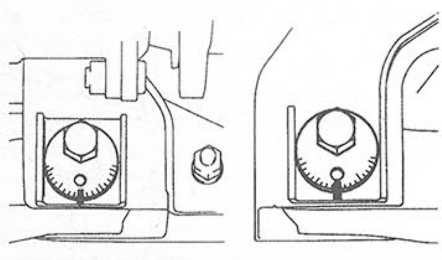
6.3 Measure the bolt protrusion distance (A) and record the reading so the suspension can be returned to the same height upon installation



7.6 The upper suspension arm shaft is held to the frame by three bolts



7.7 Check the torque arm splines for damage and replace it if necessary. It must also be removed if the upper arm bushings are to be replaced



8.5 The adjusting cam bolts must be marked so they can be returned to their original settings

9 Install the adjusting bolt and nut. Tighten the nut until the previously recorded bolt protrusion figure has been attained. Install the lock nut and tighten it securely.

New torsion bars

10 Apply a thin coat of "moly" based grease to the splines on each end of the torsion bar.
11 Install the anchor arm to the small end of the torsion bar and apply a match mark. The bar will fit into the anchor arm only one way - it has one spline that is larger than the others.
12 Remove the anchor arm from the bar.
13 Install the torsion bar spring into the torque arm. This is done by turning the torsion bar slowly until the large spline on the bar finds the large slot in the torque arm.
14 Install the anchor arm, aligning the match marks. Install the adjusting bolt and nut, tightening the nut until the previously recorded bolt protrusion measurement is reached. Install the lock nut, tightening it securely.
15 Install the wheel and tire and lower the vehicle. Tighten the lug nuts to the specified torque.
16 Bounce the front end of the vehicle several times to settle the suspension. Measure the standard vehicle ride height **(see illustration 5.17a in Chapter 10 Part A)**. It should be approximately 11-1/4 inches (285 mm), give or take 1-/4inch (7 mm). A sure-fire method of adjusting the front end standard height is to measure the other side and turn the adjusting nut clockwise or counter-clockwise, to raise or lower the vehicle as necessary to achieve the same height on both sides.

7 Upper suspension arm - removal and installation

Refer to illustrations 7.6 and 7.7

Note: *This procedure applies to 1986 and later 4WD vehicles only.*

Removal

1 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the wheel.
2 Following the procedure described in Section 6, remove the torsion bar.
3 Place a floor jack under the lower suspension arm and raise it until the upper arm isn't resting on the rubber bumper stop.
4 Remove the cotter pin and castle nut from the upper balljoint stud and separate the balljoint from the steering knuckle with a puller (see Chapter 10 Part A, Section 8).
5 Remove the shock absorber-to-frame nut, bushings and retainers.
6 Remove the three bolts retaining the upper suspension arm shaft to the frame **(see illustration)**. It may be necessary to disconnect the steering intermediate shaft from the steering gear if you are working on the driver's side.
7 If necessary, unbolt the torque arm from the upper arm **(see illustration)**.
8 Inspect the upper arm bushings for separation, cracking and hardness. These bushings are replaceable, but due to the special tools required, it is recommended that the upper arm be taken to an automotive machine shop or garage to have the new bushings pressed in.

Installation

9 Position the upper arm on the frame rail and install the three bolts, tightening them to the specified torque.
10 Insert the balljoint stud into the steering knuckle and install the castle nut, tightening it to the specified torque. Install a new cotter pin.
11 Insert the shock absorber rod through its hole in the frame and install the retainers, bushing and nut. Tighten the nut securely.
12 Install the torsion bar.
13 Install the wheel and lug nuts. Lower the vehicle and tighten the nuts to the specified torque.

8 Lower suspension arm - removal and installation

Refer to illustrations 8.5 and 8.7

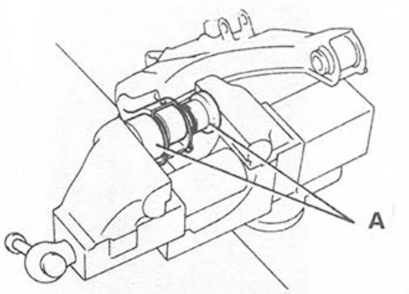
Note: *This procedure applies to 1986 and later 4WD vehicles only.*

Removal

1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.
2 Unbolt the stabilizer bar link from the lower arm (see Section 3).
3 Disconnect the shock absorber from the lower arm (Section 2).
4 Remove the cotter pin and castle nut from the lower balljoint stud. Separate the balljoint from the steering knuckle using a puller or balljoint separator (see Chapter 10 Part A, Section 8).
5 Using white paint or a sharp scribe, mark the positions of the front and rear adjusting cam bolts **(see illustration)**.
6 Remove the nuts from the adjusting cam bolts and remove the lower arm from the vehicle.
7 Inspect the lower arm bushings for hardness, cracking and general deterioration. If they are worn out, it is possible to press them out using two sockets and a large vise. Position one socket against the smaller diameter side of the bushing (the socket should have an outside diameter slightly smaller than the diameter of the bushing) and the other socket over the other side of the bushing. Place the assembly in a vise and tighten the vise until the small socket forces the bushing into the large socket **(see illustration)**.
8 To install the new bushing, reverse the removal procedure and press the bushing into the lower arm until it is completely seated.

Installation

9 Position the lower arm in the frame brackets and install the adjusting cam bolts and nuts, but don't fully tighten the nuts yet.
10 Insert the balljoint stud into the steering knuckle and install the castle nut, tightening it to the specified torque. Install a new cotter pin.
11 Connect the stabilizer bar link to the lower arm.
12 Install the lower end of the shock absorber to the lower arm.
13 Install the wheel and lug nuts. Lower the vehicle and tighten the nuts to the specified torque.
14 Bounce the vehicle several times to settle the suspension. Align the match marks on



8.7 Two sockets (A) and a vise are used to press the bushings out of the lower suspension arm. The smaller socket on the inside of the bushing will push the bushing out of the arm and into the large socket

the adjusting cams and tighten the nuts to the specified torque.

15 It is a good idea to drive the vehicle to an alignment shop to have the front end alignment checked and, if necessary, adjusted.

9 Balljoints - replacement

Refer to Chapter 10 Part A, Section 8 for the 1986 and later 4WD balljoint replacement procedure, as it is the same as the procedure for 2WD models.

10 Steering knuckle - removal and installation

Refer to illustrations 10.4, 10.5, 10.6 and 10.12

Note: *This procedure applies to 1986 and later 4WD models only.*

Removal

1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.

2 Remove the disc brake caliper and hang it out of the way with a piece of wire (see Chapter 9).

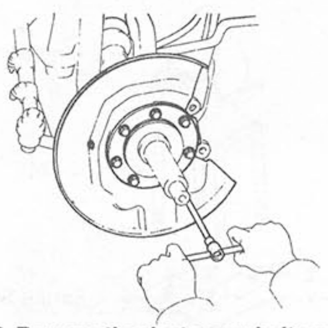
3 Remove the front axle hub (see Chapter 1, Front wheel bearing check, repack and adjustment).

4 Remove the dust cover and oil seal from the steering knuckle **(see illustration).**

5 Disconnect the steering knuckle arm from the steering knuckle **(see illustration)** .

6 At this point, the steering knuckle bushing thrust clearance must be measured. Thread a bolt into the end of the stub axle, grasp the bolt with a pair of pliers and pull outward on it. Using a feeler gauge, measure the clearance between the steering knuckle outside bushing and the spacer on the stub axle **(see illustration)**. If the clearance is greater than 0.039 in (1.0 mm), the steering knuckle bushings (both outside and inside) must be replaced.

7 Unbolt the lower end of the shock absorber from the lower suspension arm.



10.4 Remove the dust cover bolts and the oil seal

8 Remove the stabilizer bar link-to-lower arm bolt.

9 Using a pair of snap-ring pliers, remove the snap-ring from the stub axle. Slide the spacer off the stub axle, too.

10 Remove the castle nuts from the upper and lower balljoint studs then separate the balljoints from the steering knuckle using a puller or balljoint separator (see Chapter 10 Part A, Section 8 if necessary).

11 Push the knuckle and lower arm down to disconnect the knuckle from the upper balljoint. Disconnect the knuckle from the lower balljoint stud, then slide the knuckle off the stub axle. **Note:** *Make sure the driveaxle is supported by the lower arm or hang it by a piece of wire once it has been freed from the knuckle - don't let it hang unsupported, as the inner CV joint may be damaged.*

12 Pry the dust deflector from the steering knuckle **(see illustration).**

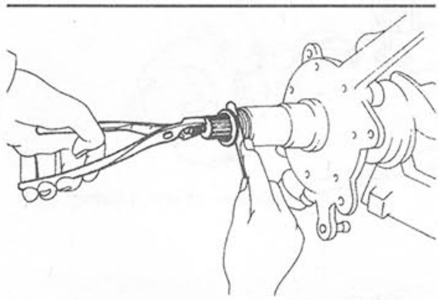
13 If, after the measurement taken in Step 6, it has been determined that the steering knuckle bushings are in need of replacement, take the knuckle to an automotive repair shop or dealer service department to have the new bushings installed.

Installation

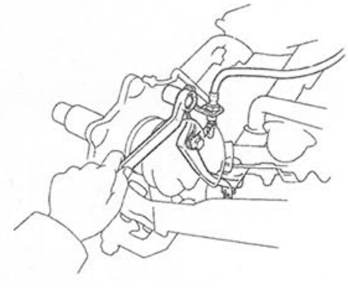
14 Apply a molybdenum disulfide lithium base grease to the steering knuckle inside and outside bushings.

15 Install a new dust deflector by gently tapping around the outer circumference until it is seated.

16 Lubricate the stub axle splines with molybdenum disulfide lithium base grease.



10.6 Pull outward on the axle shaft and measure the gap between the outside steering knuckle bushing and the spacer



10.5 Unbolt the knuckle arm from the steering knuckle

Slide the knuckle over the axle and insert the upper and lower balljoint studs into the knuckle. Install the castle nuts and tighten them to the specified torque. Install new cotter pins.

17 Install the spacer and snap-ring on the stub axle, making sure the snap-ring seats in the groove.

18 If the knuckle inside and outside bushings have been replaced, check the driveaxle thrust clearance using the technique described in Step 6. The clearance should be 0.0030 to 0.0272 in (0.075 to 0.690 mm). If it isn't within this range, change the spacer with one of a different thickness (refer to the Specifications at the front of this Chapter).

19 Connect the stabilizer bar to the lower arm.

20 Attach the shock absorber to the lower arm and tighten the nut securely .

21 Apply a thread sealant to the threads of the steering knuckle arm bolts and install the arm, tightening the bolts to the specified torque.

22 Install the dust cover and new oil seal. Tighten the bolts securely.

23 Install the front axle hub (Chapter 1).

24 Install the brake caliper and bleed the brakes if the brake line was disconnected (Chapter 9).

25 Install the wheel and lug nuts. Lower the vehicle and tighten the lug nuts to the specified torque.

11 Rear leaf spring - removal and installation

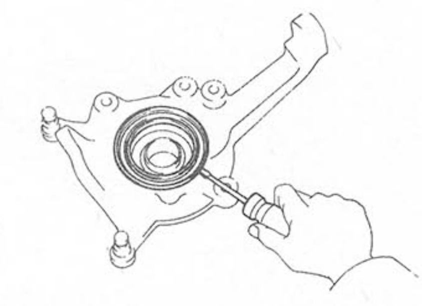
Refer to illustration 11.1

Note: *The components involved and the removal and installation procedures are the same for 4WD vehicles as for 2WD vehicles, except that a spring bumper is added to 4WD vehicles* **(see illustration)**. *The bumper is removed and installed with the spring seat and U-bolts.* See Section 12 in Chapter 10 Part A.

12 Steering linkage - removal and installation

Refer to illustration 12.2

Note: *This Section pertains to 1985 and ear-*



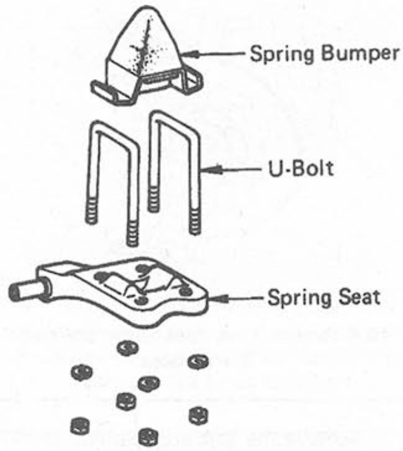
10.12 **The dust deflector can be pried out of the knuckle with a screwdriver**

lier 4WD vehicles only. For information regarding 1986 and later 4WD steering linkage, refer to Chapter 10 Part A, as it is similar to the 2WD steering linkage.

1 All steering linkage removal and installation procedures should be performed with the front end of the vehicle raised and placed securely on jackstands.

2 Before removing any steering linkage components **(see illustration)**, obtain a balljoint separator. It may be a screw-type puller or a wedge-type tool, however the latter usually tears the balljoint seal. It is possible to jar a balljoint taper pin free from its eye by striking opposite sides of the eye simultaneously with two large hammers, but the space available to do so is usually very limited.

3 After installing any of the steering linkage components, the front wheel alignment should be checked by a reputable front end alignment and repair shop.



11.1 The rear spring bumper is retained by the U-bolts

Pitman arm

Refer to illustration 12. 7

4 Remove the cotter pin from the drag link end.

5 Using a screwdriver, remove the drag link plug, spring seat, spring and ball stud seat.

6 Remove the nut securing the Pitman arm to the sector shaft.

7 If none are visible, scribe alignment marks on the arm and shaft **(see illustration)**.

8 Using a puller, remove the Pitman arm from the sector shaft.

9 Installation is the reverse of the removal procedures. Be sure to tighten the nut to the specified torque. When installing the drag link

12.7 Mark the relationship of the Pitman arm to the steering gear sector shaft

end, tighten the end until it is snug, then unscrew it 1-1/3 turns.

Tie-rod

Refer to illustrations 12.14 and 12.17

10 Remove the cotter pin and castle nut securing the steering damper to the tie-rod **(see illustration 12.2)**.

11 Using a puller, remove the steering damper end from the tie-rod.

12 Remove the cotter pins and castle nut securing the tie-rod ends to the knuckle arms.

13 Using a puller, remove the tie-rod ends from the knuckle arms.

14 When installing the tie-rod, turn the tie-rod ends equal amounts into the tie-rod tube. The tie-rod length should be approximately 47.24 in (120 cm), measured from center-to-center of the tie-rod ends **(see illustration)** .

15 Connect the tie-rod ends to the steering arms and tighten the castle nuts to the specified torque, then install the cotter pins.

16 Connect the steering damper and tighten the castle nut to the specified torque, then install the cotter pin.

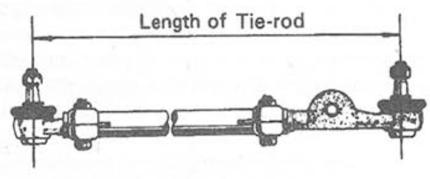
17 Tighten the clamp bolts securing the ends to the tie-rod. **Note:** *The clamp at the steering damper end of the tie-rod must be positioned at the front of the tie-rod and face within 45 degrees from straight down* **(see illustration)**.

Steering damper

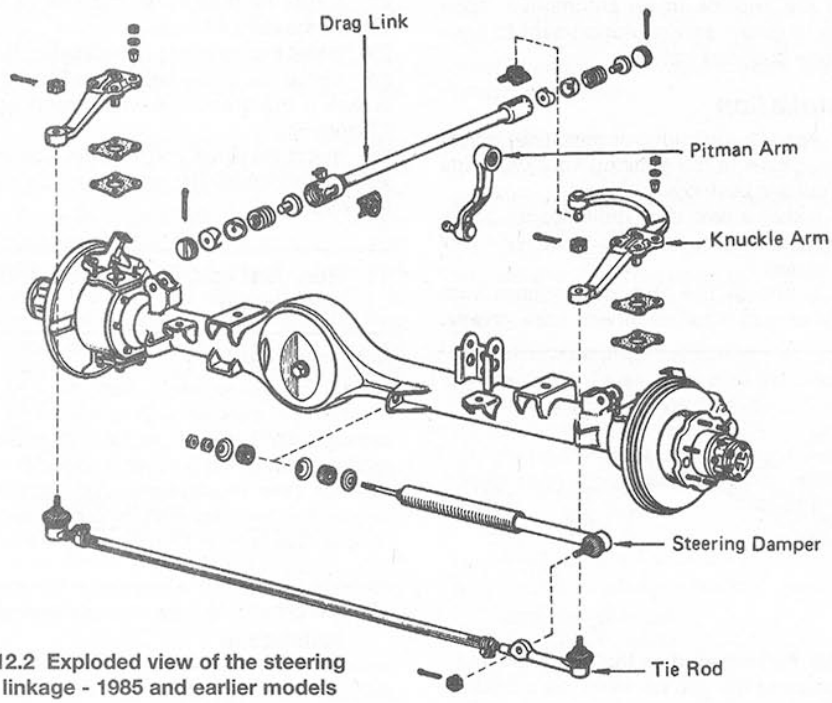
18 Remove the cotter pin and castle nut connecting the steering damper to the tie-rod **(see illustration 12.2)**.

19 Using a puller, disconnect the damper from the tie-rod.

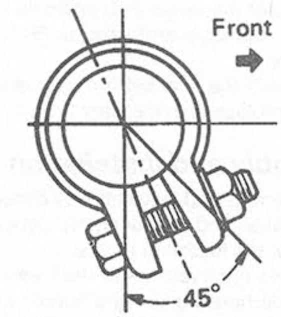
20 Using two wrenches, remove the lock-



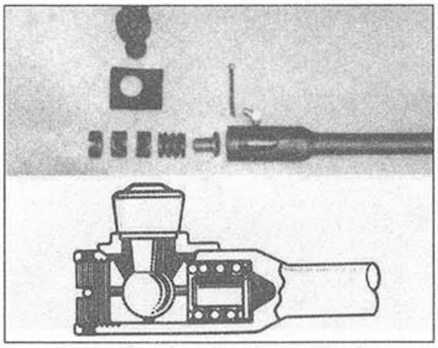
12.14 The tie-rod should be adjusted to the specified length before installing it. An equal number of threads should be showing on each tie-rod end



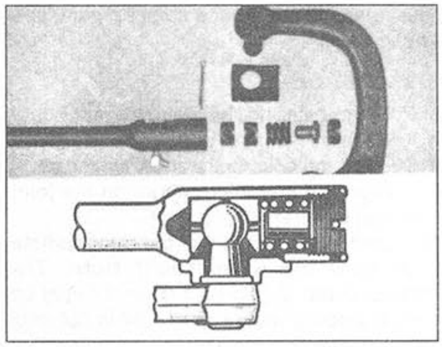
12.2 Exploded view of the steering linkage - 1985 and earlier models



12.17 Proper clamp alignment of the steering damper end of the tie-rod when installed on the vehicle



12.24a Proper assembly of drag link-to-Pitman arm components



12.24b Proper assembly of drag link-to-knuckle arm components

nut and mounting nut securing the damper to the front axle.

21 Installation is the reverse of the removal procedure. Be sure to tighten all nuts to the specified torque.

Drag link

Refer to illustrations 12.24a and 12.24b

22 Disconnect the drag link from the Pitman arm and knuckle arm (see Steps 4 and 5).

23 Remove the drag link.

24 Installation is the reverse of the removal procedure. Drag link-to-Pitman arm assembly order is: spring seat, spring, ball stud seal and plug **(see illustration)**. Drag link-to-knuckle arm assembly order is: ball stud seat, spring, spring seat and plug **(see illustration)**. When installing the drag link ends, tighten the plugs until they are snug, then unscrew them 1-1/3 turns. Apply chassis grease to both grease nipples after installing the drag link.

13 Steering intermediate shaft - removal and installation

Refer to illustrations 13.2 and 13.6

Removal

1 Turn the front wheels to the straight ahead position.

2 Remove the joint protector **(see illustration)**.

3 Using white paint, place alignment marks on the upper universal joint, the steering shaft, the lower universal joint and the steering gear input shaft.

4 Remove the upper and lower universal joint yoke pinch bolts.

5 Pry the intermediate shaft off the steering gear shaft with a large screwdriver, then pull the shaft from the steering column.

Installation

6 Installation is the reverse of the removal procedure. When installing the shaft to the upper joint, adjust the depth of the shaft so that approximately 15 mm of splined area is exposed **(see illustration)**. When connecting the lower end of the shaft, the steering gear worm shaft should penetrate 27 mm (34 mm on power steering models). Be sure to align the marks and tighten the yoke bolts to the specified torque.

14 Steering gear - removal and installation

Refer to illustrations 14.7a and 14.7b

Note: *This procedure applies to 1985 and earlier models only. For information pertaining to the 1986 and later 4WD steering gear, refer to Chapter 10, Part A. If you find that the gearbox is defective, it is not recommended that you overhaul it. Because of the special tools needed to do the job, it is best to let your dealer service department overhaul it for you (or replace it with a factory rebuilt unit). However, you can remove and install it yourself by following the procedure outlined here.*

The removal and installation procedures for manual steering and power steering gear housings are identical except that the inlet and outlet lines must be removed from the steering gear housing on power steering equipped models before the housing can be removed.

The steering system should be filled and bled after the housing is reinstalled, (see Section 18 in Chapter 10, Part A).

Removal

1 Place an alignment mark on the joint yoke and steering gear housing worm shaft to ensure correct reassembly.

2 Loosen the joint yoke bolt and compress the intermediate shaft.

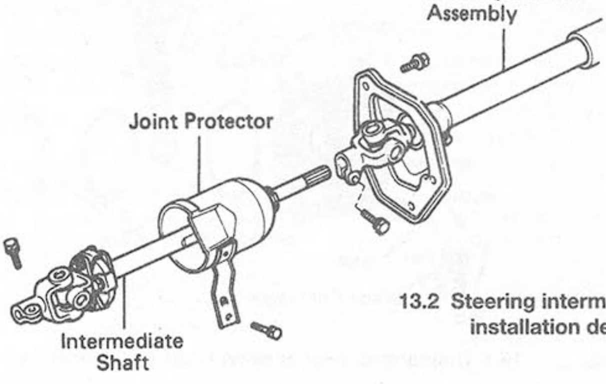
3 Remove the cotter pin and unscrew the plug from the drag link/Pitman arm connection (see Section 12).

4 Disconnect the drag link from the Pitman arm.

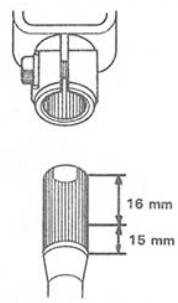
5 Remove the Pitman arm set nut at the end of the sector shaft.

6 Using a puller, disconnect the Pitman arm from the gear housing.

7 Remove the four bolts and take the gear



13.2 Steering intermediate shaft installation details



13.6 After attaching the intermediate shaft to the upper joint yoke, 0.60 in (15 mm) of the spline should appear outside the yoke

housing out of the engine compartment **(see illustrations)**.

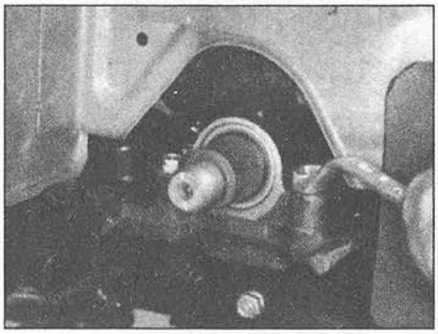
Installation

8 When installing the steering gear housing, first install the gear housing with four bolts and tighten the bolts to the specified torque.
9 Align the matching marks on the joint yoke and worm shaft.
10 Compress and install the intermediate shaft onto the worm shaft. **Note:** *The installed depth should be 1.06 in (27 mm) on manual steering models and 1.34 in (34 mm) on power steering models.*
11 Tighten the joint yoke bolt to the specified torque.
12 Align the matching marks on the Pitman arm sector shaft, install the Pitman arm and tighten the set nut to the specified torque.
13 Insert the Pitman arm into the drag link after inserting the spring retainer, spring and ball stud seat.
14 Insert the plug into the drag link end, tighten it until it is snug, then loosen it 1-1/3 turns.
15 Secure the plug with a cotter pin.

15 Swivel hub - removal and installation

Removal and disassembly

1 Remove the relevant axleshaft (see Chapter 8).
2 Remove the cotter pin and castellated nut retaining the outer tie rod end to the steering arm.
3 Disconnect the tie rod end from the steering arm by placing a suitable dolly or hammer against one side of the steering arm eye and striking the opposite side with a hammer.
4 On the right hand hub, remove the cotter pin from the steering arm end of the drag link. Unscrew the plug, noting the number of turns required as an aid to assembly, remove the spring retainer, spring and outer seat, noting the position of each component as an aid to assembly. Move the drag link



14.7a Removing the steering gear mounting nuts

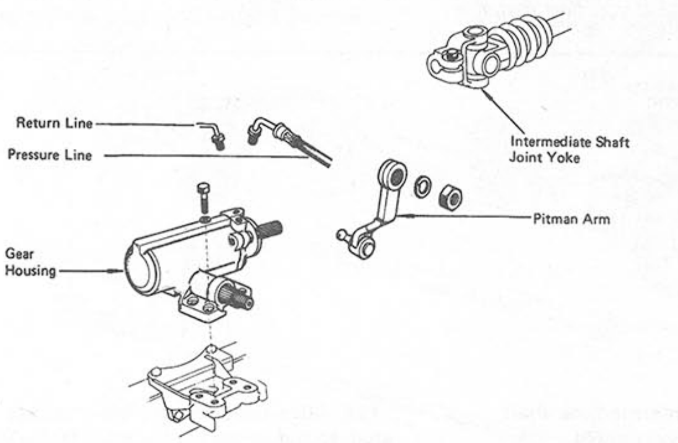
until the ball stud on the steering arm may be withdrawn through the wider section of the slot in the drag link. If necessary, remove the inner seat from the drag link.
5 Remove the steering arm to swivel hub retaining nuts.
6 Remove the lower bearing retainer to swivel hub retaining nuts and washers.
7 Using a suitable pin punch and hammer, remove the cone washers from the steering arm and the lower bearing retainer.
8 Remove the oil seal retainer plate(s) to swivel hub retaining bolts and remove the retaining plate(s).
9 Using a special tool placed inside the swivel hub and between the steering arm and the bearing retainer, press the steering arm and bearing retainer from the swivel hub.
10 Tag the upper and lower bearing cones and adjusting shims to aid in assembly.
11 Maneuver the swivel hub and seal set from the axle housing.
12 If necessary, and using a suitable pin punch and hammer, drive out the upper and lower bearing cups.

Cleaning and inspection

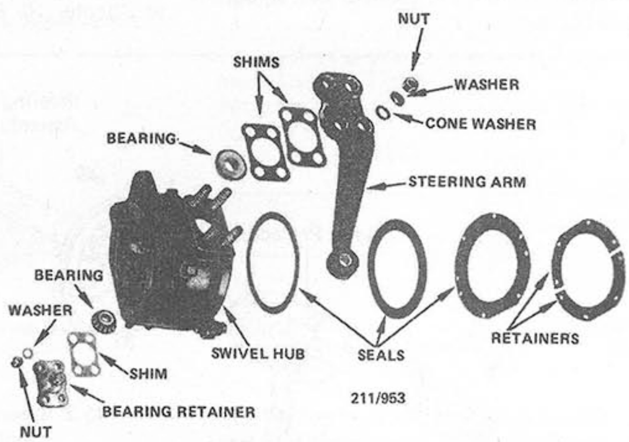
13 Clean all components in a suitable cleaning solvent and blow dry with compressed air.
14 Inspect the bearing rollers and cups for wear, pitting and damage. Replace as necessary.
15 Inspect the swivel hub and axle housing for wear, damage and cracks. Replace as necessary.
16 Inspect the seal set for wear and damage and replace as necessary.

Assembly and installation

17 Assembly and installation is a reversal of the removal and disassembly procedures except for the following points:
18 Where removed, install the bearing cups to the axle housing using a suitable tubular drift.
19 Using the heel of the hand, pack the swivel hub bearing cones with moly-base grease.
20 Install the upper bearing cone to the axle housing.
21 Install the lower bearing cone to the axle housing, hold it in position and maneuver the swivel hub onto the housing.
22 Install the shims, steering arm, bearing retainer, cone washers, spring washers and nuts loosely to the swivel hub.
23 Position a suitable bearing inner race support tool between the upper and lower bearing cones.
24 Gently tap the steering arm and bearing retainer, one at a time, into the swivel hub until both units are fully seated. Remove the support tool.
25 Tighten the steering arm and bearing retainer nuts to Specifications.
26 Using a suitable spring scale mounted on the end of the steering arm, measure the rotating preload of the swivel hub assembly and compare with Specifications. Increase or decrease the size and/or number of shims under the steering arm and bearing retainer to achieve the correct preload. **Note:** *Equal amounts of shims must be added to or removed from both the steering arm and bearing retainer to maintain the central position of the swivel hub.*
27 Once the correct preload has been achieved, install the seal set, drive shaft, stub axle and front hub as previously described.



gear mounting details - 1985 and earlier models



15.1 Dismantled view of swivel hub and associated components

Chapter 11 Body

Contents

	Section		Section
Back door (4-Runner) - disassembly and reassembly	14	Grille - removal and installation	18
Body and frame repair - major damage	7	Hinges and locks - maintenance	5
Body exterior - maintenance	2	Hood - removal, installation and adjustment	17
Body repair - minor damage	6	Load Sensing Proportioning Valve (LSPV)	See Chapter 9
Door glass (with ventilator) - removal and installation	10	Rear cab window - removal, disassembly and installation	16
Door glass (without ventilator) - removal and installation	9	Tailgate lock control - removal and installation	20
Door lock and handle assembly - removal, installation and adjustment	12	Tailgate lock - removal and installation	19
		Upholstery and carpets - maintenance	3
Door - removal, installation and adjustment	13	Vinyl trim - maintenance	4
Door trim panel - removal and installation	8	Window regulator - removal and installation	11
General information	1	Windshield - removal and installation	15

Specifications

Door glass right hand bottom edge-to-channel clearance	
1979 through 1983	4.49 in (114 mm)
1984 on	
Non-ventilator type	10.87 in (276 mm)
Ventilator-type	8.405 In (213.5 mm)

1 General information

All Toyota pick-ups are constructed on a separate channel section frame and all cabs are of welded steel construction.

Short and long wheelbase models are available in a variety of trim levels and in two-wheel drive (2WD) and four-wheel drive (4WD) types.

2 Body exterior - maintenance

1 The condition of your vehicle's body is of considerable importance as it is on this that the resale value will mainly depend. It is much more difficult to repair neglected bodywork than to replace mechanical components. The hidden portions of the body, such as the wheel arches, fender skirts, frame and engine compartment, are equally important, although obviously not requiring as frequent attention as the exterior paint.

2 Once a year or every 12,000 miles it is a good idea to have the underside of the body steam cleaned. All traces of dirt and oil will have to be removed and the underside can then be inspected carefully for rust, damaged hydraulic brake lines, frayed electrical wiring and similar problems. The front suspension should be greased after completion of this job.

3 At the same time, clean the engine and the engine compartment with a water-soluble cleaner.

4 The fender wells should be given particular attention, since undercoating can easily come away and stones and dirt thrown up from the wheels can soon cause the paint to chip and flake and allow 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 once a week or when dirty. Thoroughly wet the vehicle to soften the dirt and then wash it down with a soft sponge and plenty of clean water. If the surplus dirt is not washed off very gently, in time it will wear the paint down.

6 Spots of tar thrown up from the road surfaces are best removed with a cloth soaked in a cleaner made especially for this purpose.

7 Once every six months, or more frequently, depending on the weather conditions, give the body and chrome trim a thorough wax job. If a chrome cleaner is used to remove rust on any of the vehicle's plated parts, remember that the cleaner can also remove part of the chrome, so use it sparingly.

3 Upholstery and carpets - maintenance

1 Remove the carpets or mats and thoroughly vacuum the interior of the vehicle every three months (more frequently if necessary).
2 Beat out the carpets and vacuum them if they are very dirty. If the upholstery is soiled, apply an upholstery cleaner with a damp sponge and wipe it off with a clean, dry cloth.
3 Consult your local dealer or auto parts store for cleaners made especially for newer automotive upholstery fabrics. Always test the cleaner in an inconspicuous place.

4 Vinyl trim - maintenance

Vinyl trim should not be cleaned with detergents, caustic soaps or petroleum based cleaners. Plain soap and water or a mild vinyl cleaner is best for stains. Test a small area for color fastness. Bubbles under the vinyl can be corrected by piercing them with a pin and then working the air out.

5 Hinges and locks - maintenance

Every 3000 miles or three months, the door, hood and tailgate hinges and locks should be lubricated with a few drops of oil. The door striker plates should also be given a thin coat of grease to reduce wear and ensure free movement.

6 Body repair - minor damage

See photo sequence

Repair of minor scratches

1 If the scratch is superficial and does not penetrate to the metal of the body, repair is very simple. Lightly rub the scratched area with a fine rubbing compound to remove loose paint and built up wax. Rinse the area with clean water.
2 Apply touch-up paint to the scratch, using a small brush. Continue to apply thin layers of paint until the surface of the paint in the scratch is level with the surrounding paint. Allow the new paint at least two weeks to harden, then blend it into the surrounding paint by rubbing with a very fine rubbing compound. Finally, apply a coat of wax to the scratch area.
3 If the scratch has penetrated the paint and exposed the metal of the body, causing the metal to rust, a different repair technique is required. Remove all loose rust from the bottom of the scratch with a pocket knife, then apply rust inhibiting paint to prevent the formation of rust in the future. Using a rubber or nylon applicator, coat the scratched area with glaze-type filler. If required, the filler can be mixed with thinner to provide a very thin paste, which is ideal for filling narrow scratches. Before the glaze filler in the scratch hardens, wrap a piece of smooth cotton cloth around the tip of a finger. Dip the cloth in thinner and then quickly wipe it along the surface of the scratch. This will ensure that the surface of the filler is slightly hollow. The scratch can now be painted over as described earlier in this section.

Repair of dents

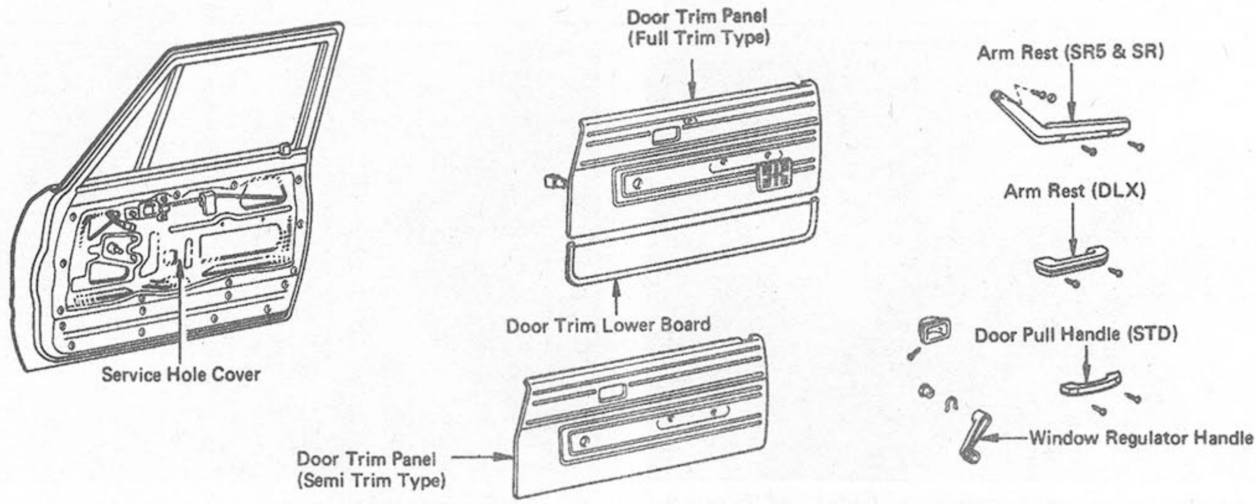
4 When repairing dents, the first job is to pull the dent out until the affected area is as close as possible to its original shape. There is no point in trying to restore the original shape completely as the metal in the damaged area will have stretched on impact and cannot be restored to its original contours. It is better to bring the level of the dent up to a point which is about 1/8-inch below the level of the surrounding metal. In cases where the dent is very shallow, it is not worth trying to pull it out at all.
5 If the back side of the dent is accessible, it can be hammered out gently from behind using a soft-face hammer. While doing this, hold a block of wood firmly against the opposite side of the metal to absorb the hammer blows and prevent the metal from being stretched.
6 If the dent is in a section of the body which has double layers, or some other factor makes it inaccessible from behind, a different technique is required. Drill several small holes through the metal inside the damaged area, particularly in the deeper sections. Screw long, self tapping screws into the holes just enough for them to get a good grip in the metal. Now the dent can be pulled out by pulling on the protruding heads of the screws with locking pliers.
7 The next stage of repair is the removal of paint from the damaged area and from an inch or so of the surrounding metal. This is 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 sub-Section, below, on filling and painting.

Repair of rust holes or gashes

8 Remove all paint from the affected area and from an inch or so of the surrounding metal using a sanding disk or wire brush mounted in a drill motor. If these are not available, a few sheets of sandpaper will do the job just as effectively.
9 With the paint removed, you will be able to determine the severity of the corrosion and decide whether to replace the whole panel, if possible, or repair the affected area. New body panels are not as expensive as most people think and it is often quicker to install a new panel than to repair large areas of rust.
10 Remove all trim pieces from the affected area except those which will act as a guide to the original shape of the damaged body, such as headlight shells, etc. Using metal snips or a hacksaw blade, remove all loose metal and any other metal that is badly affected by rust. Hammer the edges of the hole inward to create a slight depression for the filler material.
11 Wire brush the affected area to remove the powdery rust from the surface of the metal. If the back of the rusted area is accessible, treat it with rust-inhibiting paint.
12 Before filling is done, block the hole in some way. This can be done with sheet metal riveted or screwed into place, or by stuffing the hole with wire mesh.
13 Once the hole is blocked off, the affected area can be filled and painted. See the following sub-Section on filling and painting.

Filling and painting

14 Many types of body fillers are available, but generally speaking, body repair kits which contain filler paste and a tube of resin hardener are best for this type of repair work. A wide, flexible plastic or nylon applicator will be necessary for imparting a smooth and contoured finish to the surface of the filler material. Mix up a small amount of filler on a clean piece of wood or cardboard (use the hardener sparingly). Follow the manufacturer's instructions on the package, otherwise the filler will set incorrectly.
15 Using the applicator, apply the filler paste to the prepared area. Draw the applicator across the surface of the filler to achieve the desired contour and to level the filler surface. As soon as a contour that approximates the original one is achieved, stop working the paste. If you continue, the paste will begin to stick to the applicator. Continue to add thin layers of paste at 20-minute intervals until the level of the filler is just above the surrounding metal.
16 Once the filler has hardened, the excess can be removed with a body file. From then on, progressively finer grades of sandpaper should be used, starting with a 180-grit paper and finishing with 600-grit wet-or-dry paper. Always wrap the sandpaper around a flat rubber or wooden block, otherwise the surface of the filler will not be completely flat. During the sanding of the filler surface, the wet-or-dry paper should be periodically rinsed in water. This will ensure that a very smooth finish is produced in the final stage.
17 At this point, the repair area should be surrounded by a ring of bare metal, which in turn should be encircled by the finely feathered edge of good paint. Rinse the repair area with clean water until all of the dust produced by the sanding operation is gone.
18 Spray the entire area with a light coat of primer. This will reveal any imperfections in the surface of the filler. Repair the imperfec-



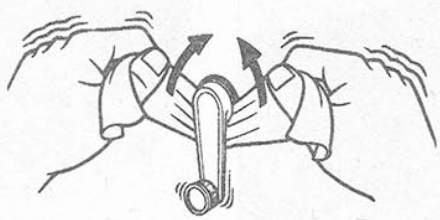
8.1 Typical door trim panel component layout

tions 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.

19 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 which 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 thicknesses of newspaper for the masking operations.

20 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.

21 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.



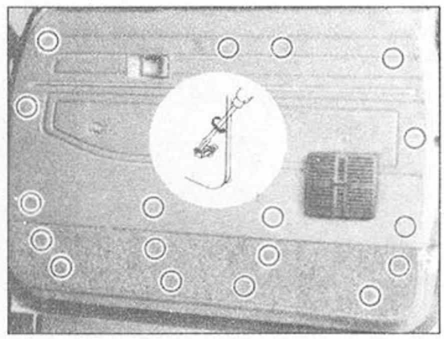
8.2 Use a cloth to push upwards and remove the window crank snap-ring

7 Body and frame repair - major damage

1 Major damage must be repaired by an auto body/frame repair shop with the necessary welding and hydraulic straightening equipment.

2 If the damage has been serious, it's vital that the frame be checked for proper alignment or the vehicle's handling characteristics may be adversely affected. Other problems, such as excessive tire wear and wear in the driveline and steering, may occur.

3 Due to the fact that all of the major body components (hood, fenders, etc.) are separate and replaceable units, any seriously damaged components should be replaced rather than repaired. Sometimes these components can be found in a wrecking yard that specializes in used vehicle components, often at considerable savings over the cost of new parts.



8.3 Location of door panel retainers (circled, early model shown): inset shows the method for disengaging the retainers by prying with a screwdriver

8 Door trim panel - removal and installation

Refer to illustrations 8.1, 8.2, 8.3, 8.5, 8.8a, 8.8b and 8.8c

1 Unscrew and remove the inside door handle bezel and the arm rest **(see illustration)**.

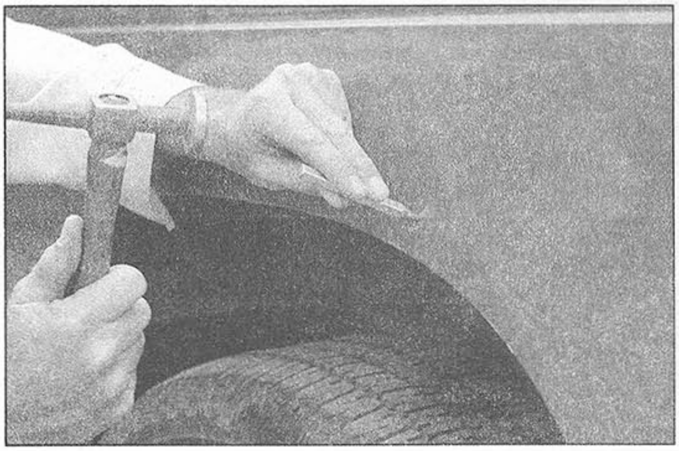
2 Using a piece of cloth placed between the window crank and the window crank trim ring, remove the window crank snap-ring retainer and pull off the crank **(see illustration)**.

3 Using a screwdriver, pry carefully between the door trim panel and the retainers to loosen the panel **(see illustration)**.

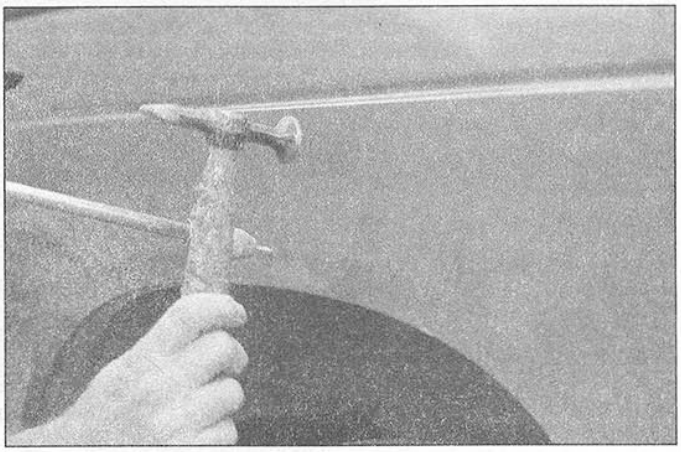
4 If so equipped, reach behind the loosened door panel and disconnect the wires to the radio speakers and/or power window switch.

5 Tilt the loosened door trim up and, with

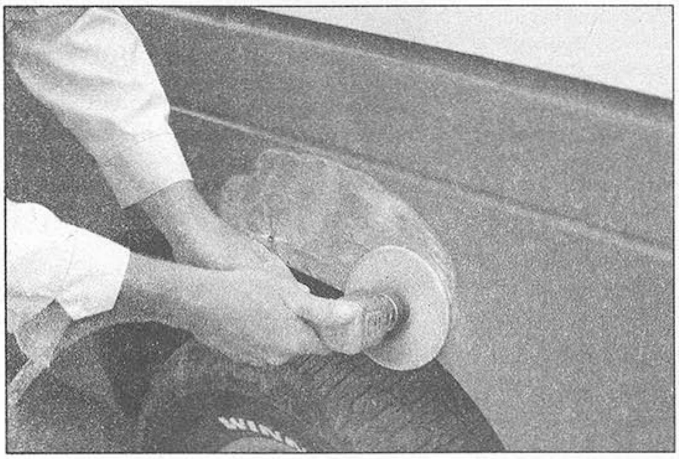
These photos illustrate a method of repairing simple dents. They are intended to supplement *Body repair - minor damage* in this Chapter and should not be used as the sole instructions for body repair on these vehicles.



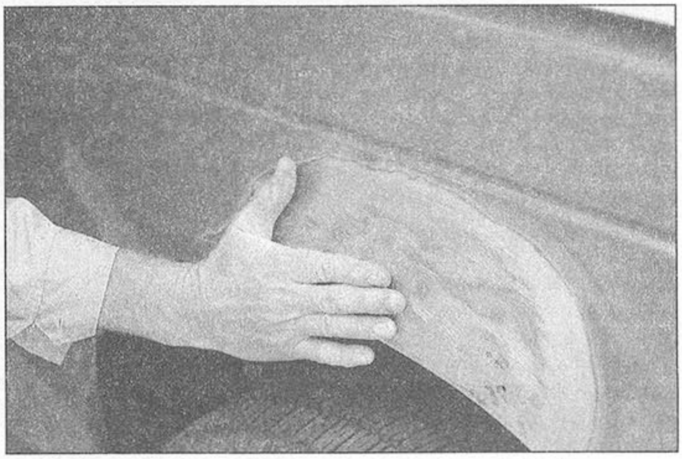
1 If you can't access the backside of the body panel to hammer out the dent, pull it out with a slide-hammer-type dent puller. In the deepest portion of the dent or along the crease line, drill or punch hole(s) at least one inch apart . . .



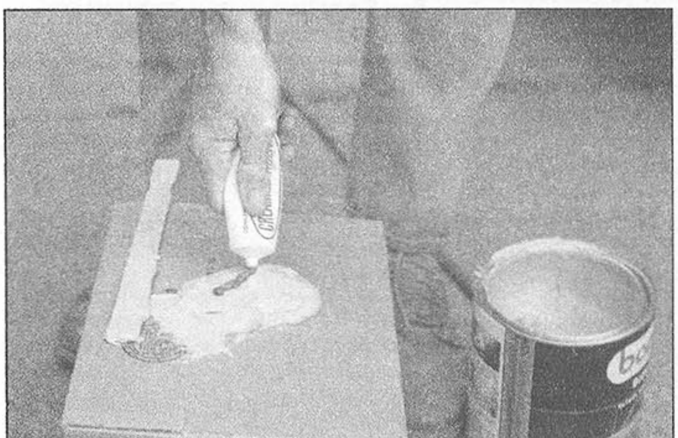
2 . . . then screw the slide-hammer into the hole and operate it. Tap with a hammer near the edge of the dent to help 'pop' the metal back to its original shape. When you're finished, the dent area should be close to its original contour and about 1/8-inch below the surface of the surrounding metal



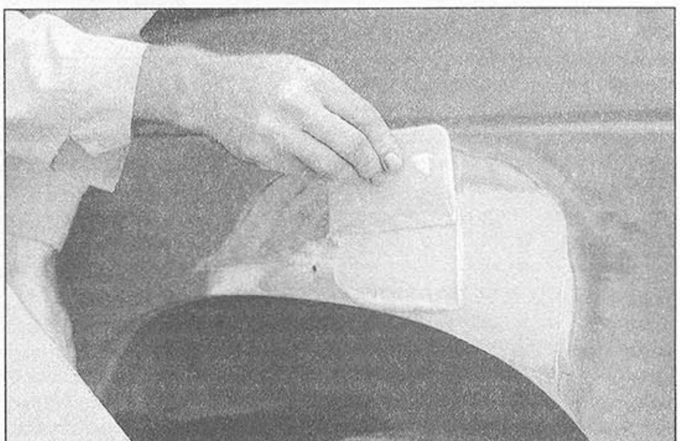
3 Using coarse-grit sandpaper, remove the paint down to the bare metal. Hand sanding works fine, but the disc sander shown here makes the job faster. Use finer (about 320-grit) sandpaper to feather-edge the paint at least one inch around the dent area



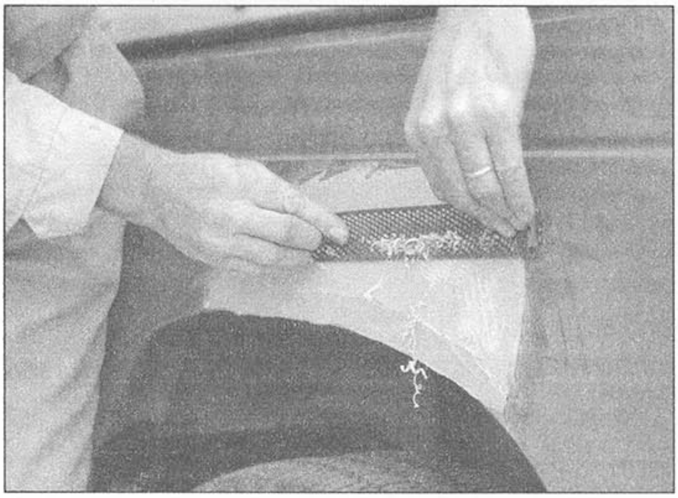
4 When the paint is removed, touch will probably be more helpful than sight for telling if the metal is straight. Hammer down the high spots or raise the low spots as necessary. Clean the repair area with wax/silicone remover



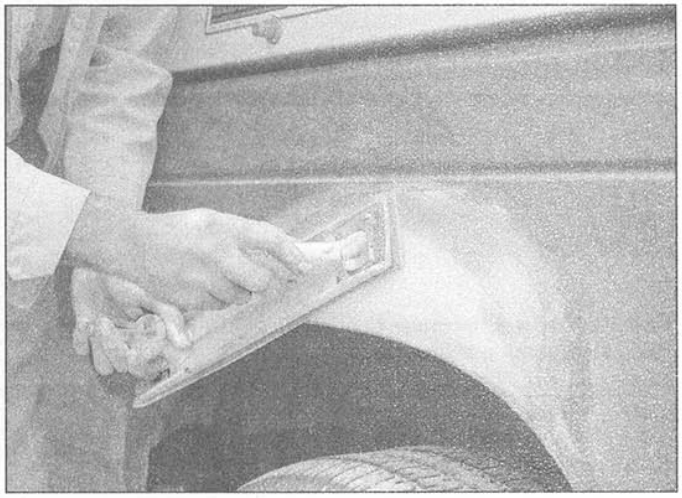
5 Following label instructions, mix up a batch of plastic filler and hardener. The ratio of filler to hardener is critical, and, if you mix it incorrectly, it will either not cure properly or cure too quickly (you won't have time to file and sand it into shape)



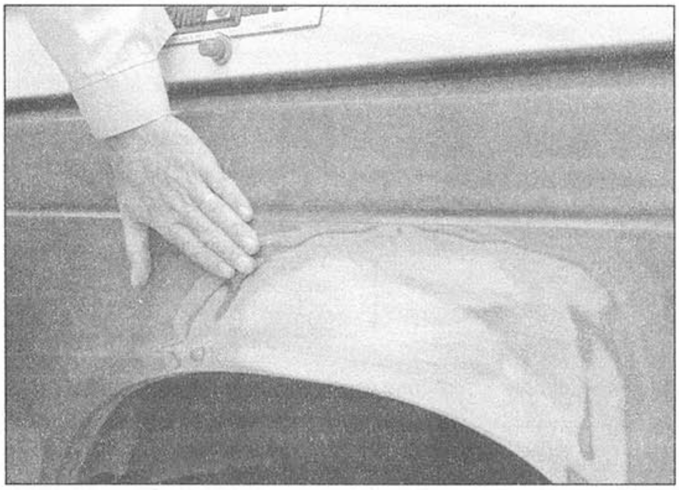
6 Working quickly so the filler doesn't harden, use a plastic applicator to press the body filler firmly into the metal, assuring it bonds completely. Work the filler until it matches the original contour and is slightly above the surrounding metal



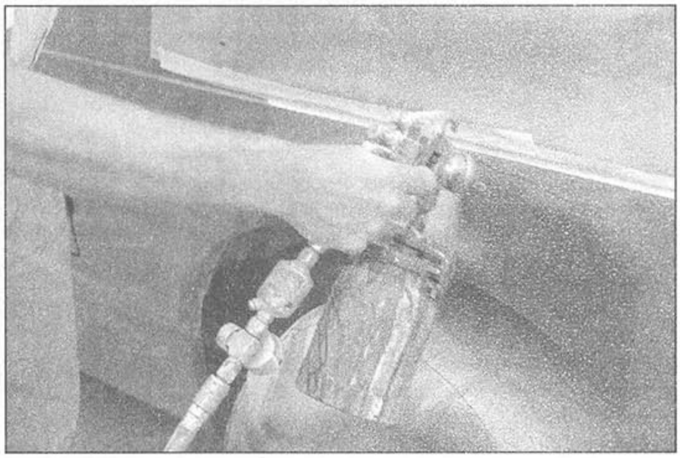
7 Let the filler harden until you can just dent it with your fingernail. Use a body file or Surform tool (shown here) to rough-shape the filler



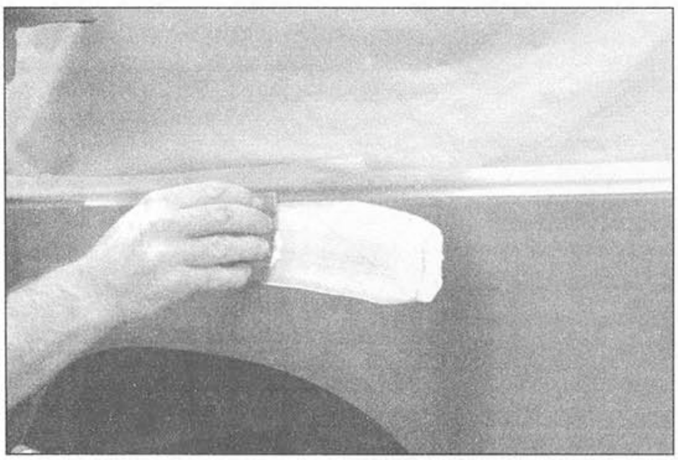
8 Use coarse-grit sandpaper and a sanding board or block to work the filler down until it's smooth and even. Work down to finer grits of sandpaper - always using a board or block - ending up with 360 or 400 grit



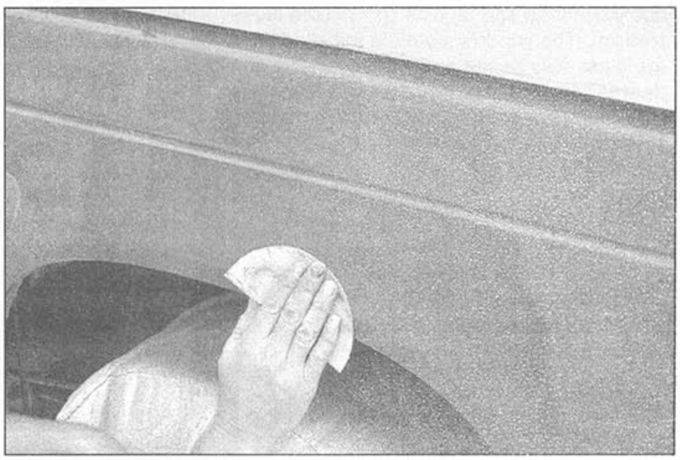
9 You shouldn't be able to feel any ridge at the transition from the filler to the bare metal or from the bare metal to the old paint. As soon as the repair is flat and uniform, remove the dust and mask off the adjacent panels or trim pieces



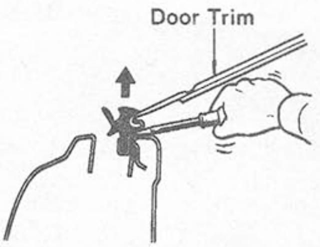
10 Apply several layers of primer to the area. Don't spray the primer on too heavy, so it sags or runs, and make sure each coat is dry before you spray on the next one. A professional-type spray gun is being used here, but aerosol spray primer is available inexpensively from auto parts stores



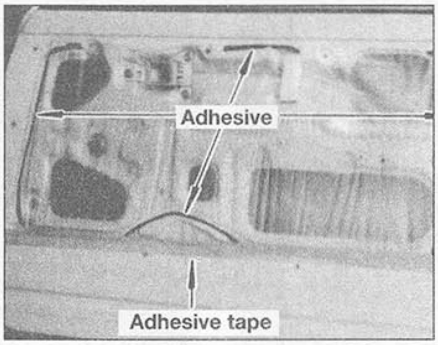
11 The primer will help reveal imperfections or scratches. Fill these with glazing compound. Follow the label instructions and sand it with 360 or 400-grit sandpaper until it's smooth. Repeat the glazing, sanding and respraying until the primer reveals a perfectly smooth surface



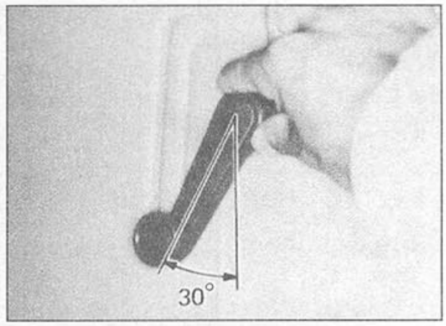
12 Finish sand the primer with very fine sandpaper (400 or 600-grit) to remove the primer overspray. Clean the area with water and allow it to dry. Use a tack rag to remove any dust, then apply the finish coat. Don't attempt to rub out or wax the repair area until the paint has dried completely (at least two weeks)



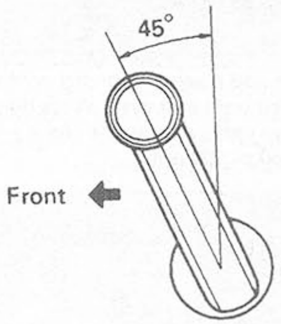
8.5 Use a screwdriver to pry the weatherstripping channel from the door



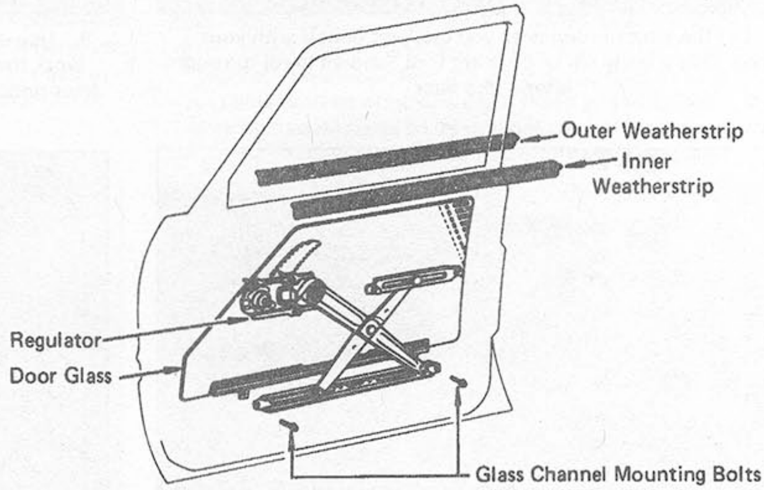
8.8a Service hole cover adhesive installation details



8.8b On 1979 through 1983 models, the window crank should be installed 30 degrees from the straight down position



8.8c Install the window crank 45-degrees from the vertical position on 1984 and later models



9.3 Typical door glass component layout (non ventilator earlier models shown)

a screwdriver, pry the weatherstripping channel from the door, working from front to rear, freeing the trim panel **(see illustration)**. **Note:** *Be careful not to damage the door trim panel as you are removing it.*

6 Peel off the outer ridges of the service hole cover.

7 All of the inside door components are now accessible, but be careful not to tear the service hole cover.

8 Installation is the reverse of the removal procedure. When installing the service cover, apply adhesive and tape as shown **(see illustration)**. The window crank is installed with the glass fully raised and the crank at a 30-degree angle from bottom dead center, toward the front of the panel on 1979 through 1983 models and 45-degrees from vertical position on 1984 and later models **(see illustrations)**.

9 Door glass (without ventilator) - removal and installation

Refer to illustrations 9.3, 9.4 and 9.8

1 Lower the window completely.

2 Remove the door trim panel and peel off the outer ridges of the service hole cover (see Section 8).

3 Remove the outer weatherstripping from the door by prying it out carefully with a screwdriver **(see illustration)**.

4 Remove the two glass channel mounting bolts **(see illustration)**.

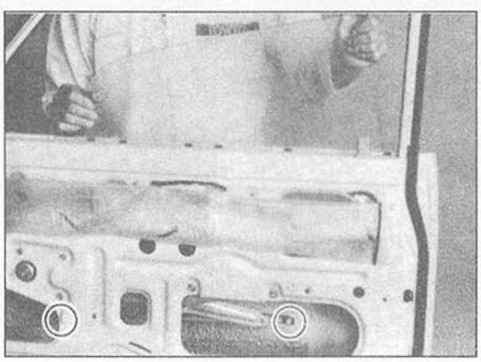
5 Remove the door glass by pulling it up and out.

6 Remove the glass channel from the glass with a putty knife or similar tool, taking care not to damage the glass if it is to be reinstalled.

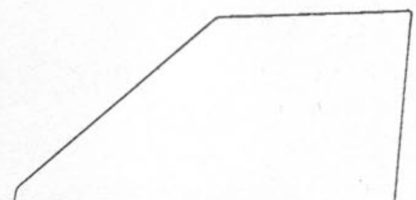
7 To install the glass, apply soapy water to the inside of the weatherstripping in the channel.

8 Tap the glass into the channel with a plastic hammer. **Note:** *The glass should be installed in the channel so that the right-hand bottom edge of the glass is the proper distance from the right edge of the channel* **(see illustration and refer to Specifications)**.

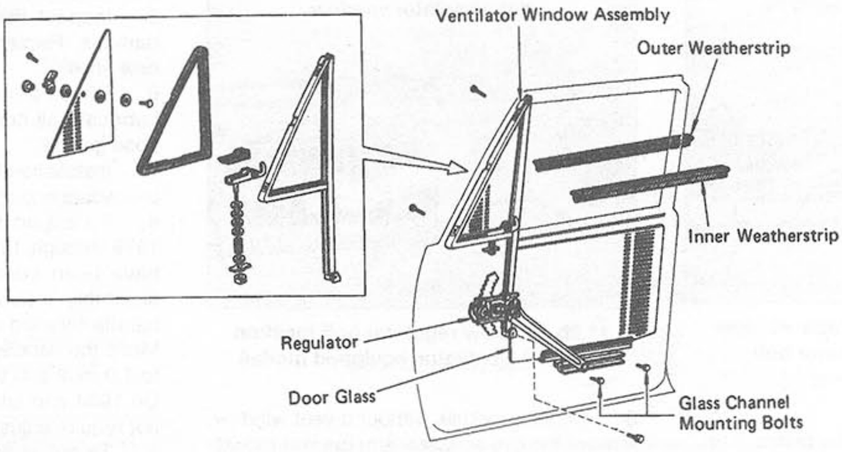
9 The remaining installation procedures are the reverse of those for removal.



9.4 Door glass channel mounting bolt locations (circled)



9.8 The distance between the end of the channel and the end of the glass must be as specified in the Specifications section at the front of this Chapter



10.4a Ventilator-equipped window glass installation details (1979 through 1983 models)

10 Door glass (with ventilator) - removal and installation

Refer to illustrations 10.4a and 10.4b

1 Lower the window completely.

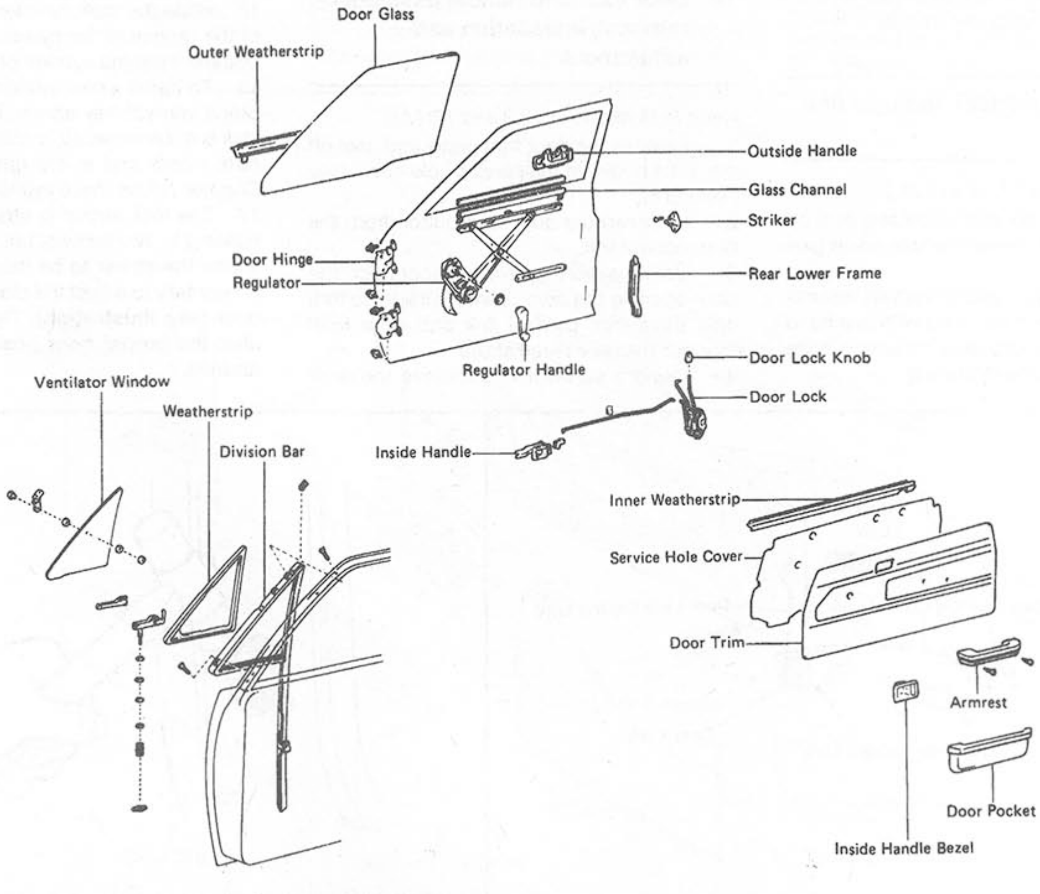
2 Remove the door trim panel and peel up the outer ridges of the service hole cover (see Section 8).

3 On later models, remove the bolt and detach the lower door glass frame. Remove the outer weather stripping from the door by prying it out carefully with a screwdriver.

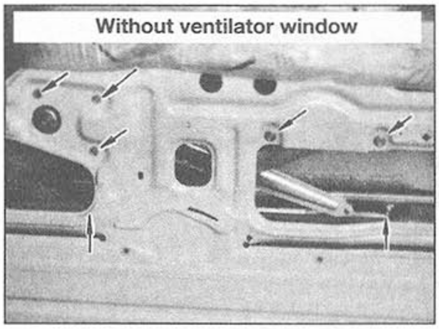
4 Remove the two glass channel mounting bolts and place the glass in the bottom of the door cavity **(see illustrations)**.

5 Remove the three screws retaining the vent window frame and remove the division bar bolts (if equipped).

6 Tilt the vent window assembly in and pull it up and out of the door.



10.4b 1984 and later model door and glass details



11.2a Typical non-ventilator window equipped glass regulator bolt locations (arrows)

7 Remove the door glass by pulling it up.

8 Remove the glass channel from the glass with a putty knife or similar tool, taking care not to damage the glass if it is to be reinstalled.

9 To install the glass, apply soapy water to the inside of the weatherstripping in the channel.

10 Tap the glass into the channel with a plastic hammer. **Note:** *The glass should be installed in the channel so that the right hand bottom edge of the glass is the proper distance from the right edge of the channel* **(see illustration 9.8 and refer to Specifications).**

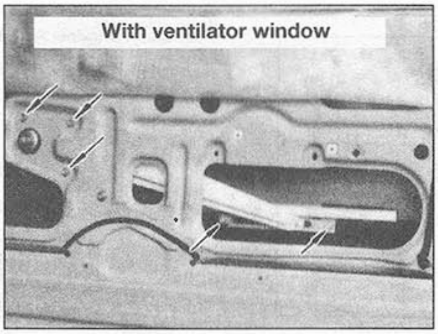
11 The remaining installation procedures are the reverse of those for removal.

11 Window regulator - removal and installation

Refer to illustrations 11.2a and 11.2b

1 Remove the door trim panel and peel off the outer ridges of the service hole cover (see Section 8).

2 Remove the two glass channel mounting bolts and support the glass with one hand while removing the regulator mounting bolts with the other **(see illustrations).**



11.2b Window regulator bolt location (arrows) (ventilator-equipped model)

3 On later models without a vent window, remove the two equalizer arm bracket mounting bolts.

4 Remove the regulator through the service hole.

5 Check the gears for wear and the spring for weakness. Replace parts as necessary with new ones.

6 Before installing the regulator, lubricate the sliding parts with multi-purpose grease.

7 Installation is the reverse of the removal procedure. For proper installation of the door glass, see Section 9 or 10.

12 Door lock and handle assembly - removal, installation and adjustment

Refer to illustrations 12.3 and 12.17

1 Remove the door trim panel and peel off the outer ridges of the service hole cover (see Section 8).

2 Unthread the door lock button from the door control link.

3 Using a screwdriver, disconnect the door opening the control link, outside control link, door lock control link and door lock cylinder link **(see illustration).**

4 Using a screwdriver, remove the door lock assembly.

5 Inspect the linkage arms for wear or damage. Replace parts as necessary with new ones.

6 Check the operation of the door lock. Lubricate all contact points with multi-purpose grease.

7 Installation is the reverse of the removal procedures.

8 To adjust the inside door handle on 1979 through 1983 models, after all linkages have been connected, loosen the handle assembly mounting screws and push the handle forward until light resistance is felt. Move the handle back 0.020 to 0.039 in (0.5 to 1.0 mm) and tighten the mounting screws. On 1984 and later models, the handle does not require adjustment.

9 To adjust the outside door handle, disconnect the outside control link by removing the retaining clip.

10 Loosen the handle mounting bolts.

11 Raise the handle 0.020 to 0.039 in (0.5 to 1.0 mm) from the rest position.

12 Tighten the outside door handle mounting bolts.

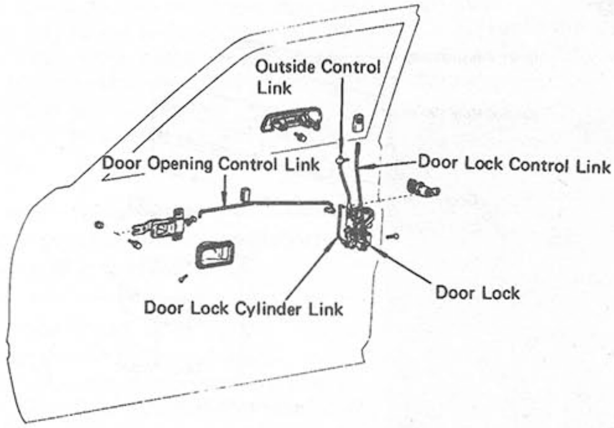
13 Fit the pin to the handle assembly mounting hole by turning the adjuster, then reinstall the retaining clip.

14 To replace the key lock cylinder, disconnect the cylinder link from the cylinder tang by removing the retaining clip.

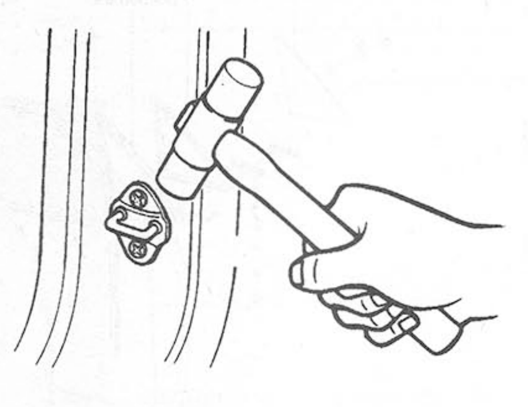
15 Slide the lock cylinder retaining clip out of the groove in the cylinder and remove the cylinder from the outside of the door.

16 To install a new cylinder, reverse the two Steps immediately above. **Note:** *If a cylinder lock is to be replaced, it should be replaced in both doors and in the ignition switch (see Chapter 12), as these cylinders come in sets.*

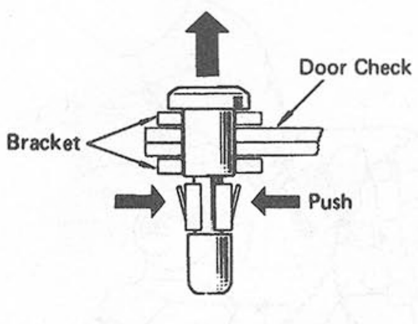
17 The lock striker is attached to the door opening by two screws. Loosening the screws allows the striker to be moved vertically and horizontally to adjust the closed position of the door **(see illustration).** Tighten the screws after the proper door positioning has been attained.



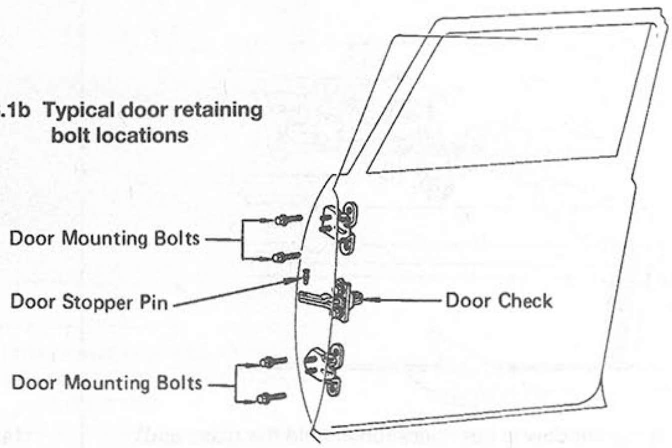
12.3 Typical door lock and handle assembly component layout



12.17 Loosen the lock striker bolts and adjust its position by tapping with a plastic hammer



13.1a Door stopper pin details; after removal, leave the claw raised



13.1b Typical door retaining bolt locations

13 Door - removal, installation and adjustment

Refer to illustrations 13.1a and 13.1b

1 Remove the door by first placing a jack under the center of the door for support. Use a pencil or sharp scribe to draw around the hinges and bolts to help position the door properly upon installation. Remove the door stopper pin **(see illustration)**. Remove the four door hinge bolts, unplug any electrical wiring connectors and carefully lift off the door **(see illustration)**.

2 Installation is the reverse of removal.

3 Adjust the new door for a good fit by referring to the following procedure.

4 Loosen the body hinge bolts and move the door in the direction desired (forward or backward; up or down).

5 Loosen the door hinge bolts and move the door in the direction desired (left or right; up or down).

14 Back door (4-Runner) - disassembly and reassembly

Refer to illustrations 14.2, 14.10a and 14.10b

1 Remove the door trim, the plate and the service hole cover.

2 Disconnect the control link on the regulator side, then remove the two screws and detach the inside handle assembly **(see illustration)**.

3 Remove the inside lock knob and disconnect the link on the regulator side.

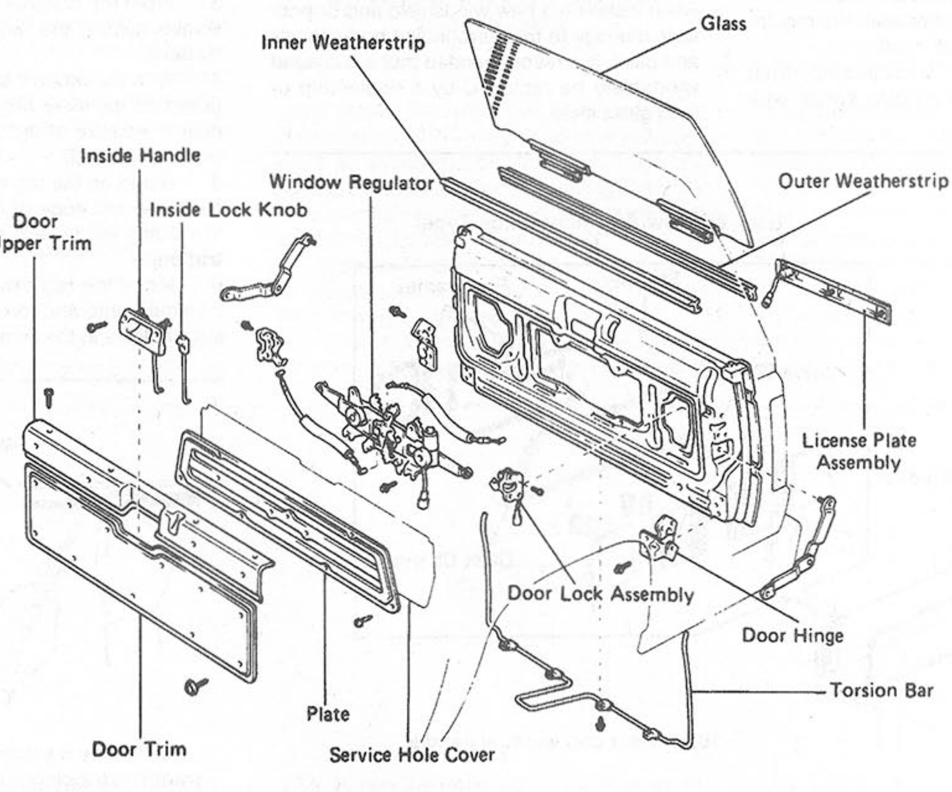
4 Remove the upper trim and the inner weatherstrip.

5 If the electric window is operative, use a screwdriver to move the lock assembly to the lock position, then raise the window glass until the regulator arms are in a straight line.

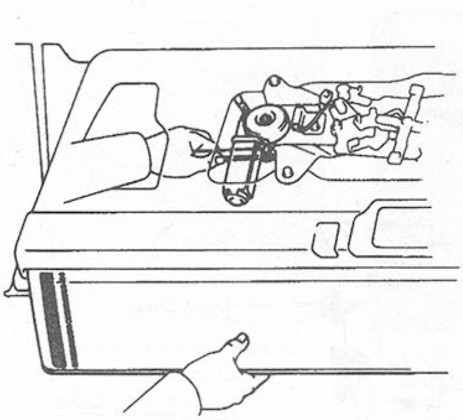
6 Unplug the window regulator wire harness connector.

7 If the window is not operative, disconnect both wires at the regulator, then remove the bolt and detach the ground cable.

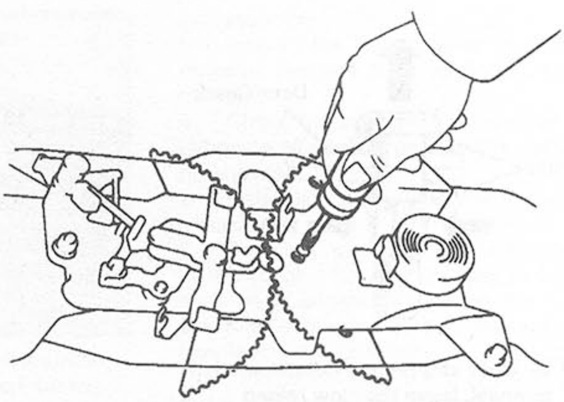
8 Disconnect the door lock cables.



14.2 4-Runner back door - exploded view



14.10a If the window is not operational, hold the glass and remove the regulator



14.10b Position the regulator arms horizontally and insert a stubby screwdriver to secure the arms

9 If the window is operative, disconnect both wires at the regulator, then remove the bolt and detach the ground cable.

10 If the window is not operative, hold the door glass and remove the regulator. **Caution:** *Never attempt to remove the regulator motor without holding the glass (the regulator arm may swing up).* Lower the glass all the way and open the door by pulling on the door lock control cables. Raise the glass to position the regulator arms horizontally, then insert a stubby screwdriver into the hole to secure the arms **(see illustrations)**.

11 Remove the three regulator mount bolts, then slide the regulator from side-to-side to free the arms from the glass channel.

12 Remove the glass, then shift the regulator into the cavity and pull it out.

13 Remove the outer weatherstrip, then unplug the outer power window switch wire harness connector.

14 The door lock assembly can be removed after unplugging the wire harness connector on the left side and removing the three mounting screws.

15 Place a protective pad between the door and bumper, then remove the hinge bolts and detach the door.

16 Reassembly is the reverse of disassembly.

15 Windshield - removal and installation

Due to the possibility of glass breakage when installing a new windshield and/or possible damage to the surrounding body panels and paint, it is recommended that a damaged windshield be replaced by a dealership or auto glass shop.

16 Rear cab window - removal, disassembly and installation

Refer to illustrations 16.1a, 16.1b, 16.3, 16.5, 16.10 and 16.12

1 Using a screwdriver from the inside of the cab, pry carefully around the weatherstrip lip, forcing the weatherstripping out **(see illustrations)**. Have an assistant pull on the window assembly to remove it, with the weatherstripping attached.

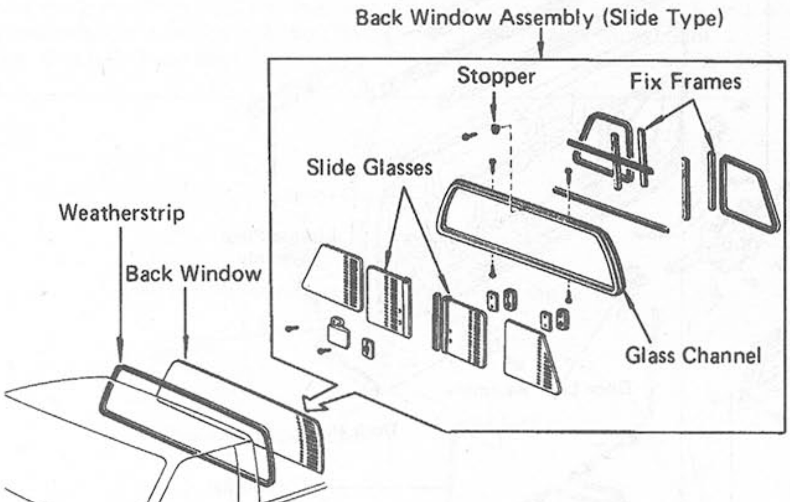
2 On sliding type rear windows, using a screwdriver and pliers, remove the sliding glass stopper from the channel.

3 From the channel track, remove the four screws holding the two fix frames **(see illustration)**.

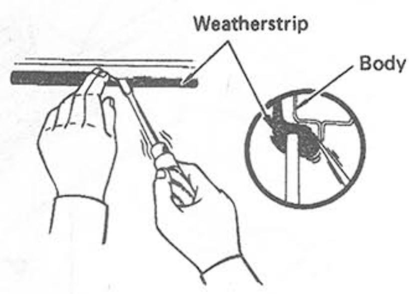
4 With the window assembly standing vertically on its lower edge, place a folded rag near the center of the window frame to protect the channel.

5 Stand on the rag with one foot and gently lift the top edge of the frame and remove the sliding windows and fix frames **(see illustration)**.

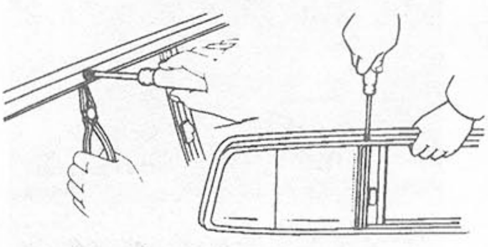
6 Move the rag toward either end of the channel frame and remove the two non-sliding windows in the same manner.



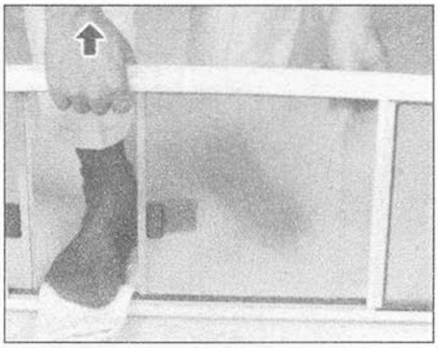
16.1a Rear cab window details



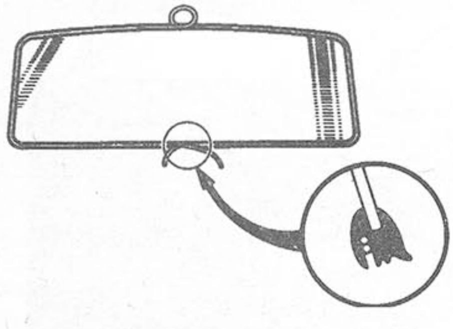
16.1b Use a screwdriver to pry the weatherstripping up and force it out of the groove



16.3 On sliding windows, remove the four screws retaining the two fix frames

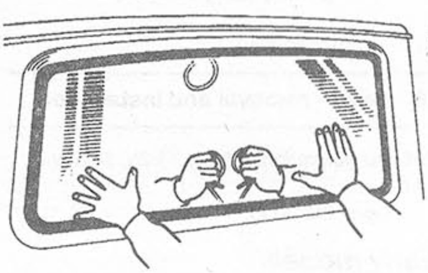


16.5 Hold the center of the frame with your foot while pulling up on the top edge of the frame

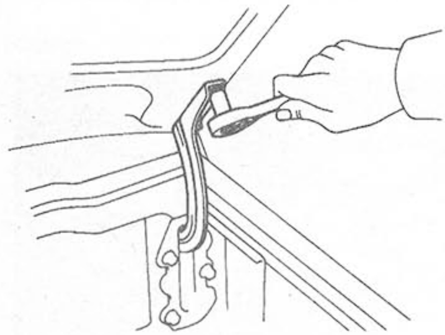


16.10 Place the cord as shown when installing the rear window

7 To install the rear window, first transfer the weatherstripping from the non-sliding window(s) being replaced to the new window(s).
8 Apply soapy water to the contact face of the weatherstripping surrounding the glass channel and to the glass channel flange.
9 The remaining installation procedures are the reverse of those for removal. It is probable that the old weatherstripping has become weather hardened and may develop water leaks. Replace the weatherstripping with new material if any such deterioration is indicated.
10 Once the rear window is assembled, apply a working cord along the weatherstripping groove **(see illustration)**.
11 Begin the installation in the center of the lower part of the glass.
12 Attach the window assembly to the body by pulling on the cord from the inside while an assistant pushes along the weatherstripping from the outside **(see illustration)**.
13 Seat the window assembly by tapping around the circumference of the glass with your open hand.



16.12 With an assistant pushing on the outside of the glass and weatherstripping, pull the cord out of the weatherstripping on the inside, which will correctly position the weatherstripping around the body channels

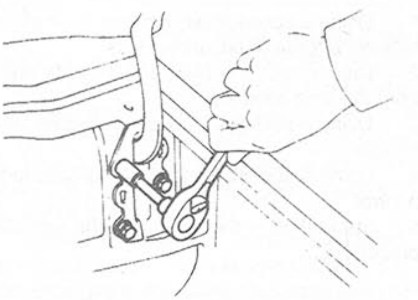


17.1 With an assistant supporting the weight of the hood, remove the four retaining bolts with a socket

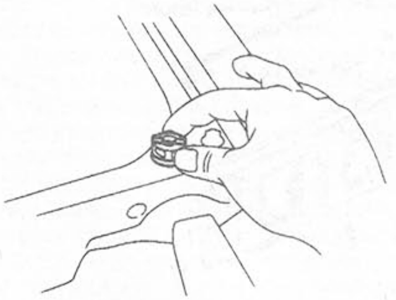
17 Hood - removal, installation and adjustment

Refer to illustrations 17.1, 17.5, 17.6 and 17.7

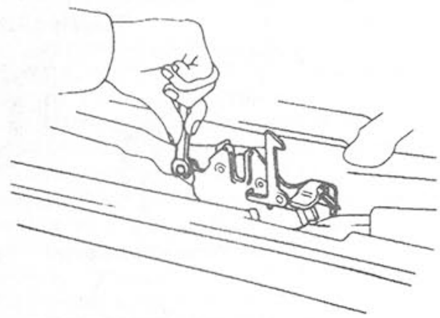
1 To remove the hood, scribe a line (or use paint) around the hinge bolt heads to ensure correct alignment when the hood is installed. Have an assistant hold the hood while the bolts are loosened. Finish removing the bolts while supporting the hood on both sides, then carefully lift it off **(see illustration)**.
2 Installation is the reverse of removal.
3 To adjust the hood for a good fit, refer to the following procedure.
4 Loosen the hood hinge bolts and move the hood in the desired direction (left or right; forward or backward).
5 Loosen the body hinge bolts and move the rear of the hood in the desired direction (up or down) **(see illustration)**.
6 Loosen the adjustment cushions at the front corners of the hood to raise or lower the front of the hood until it is even with the tops of the fenders **(see illustration)**.
7 Loosen the hood lock bolts and move the lock in the desired direction to obtain a snug fit when closed **(see illustration)**.



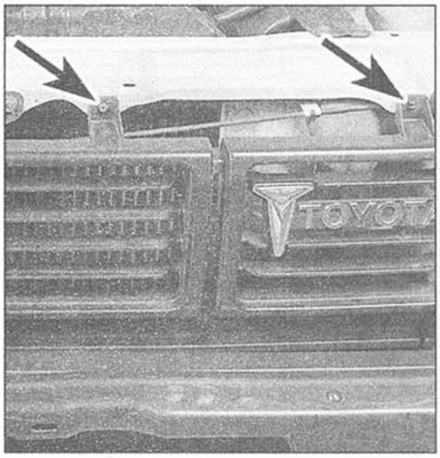
17.5 Loosen the hood body side bolts to adjust the rear edge up and down



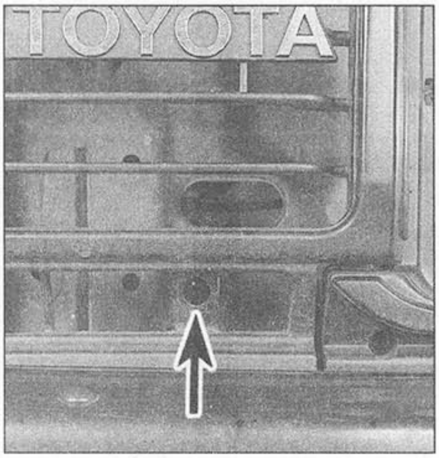
17.6 Screw the hood bumpers in or out to adjust the front edge of the hood



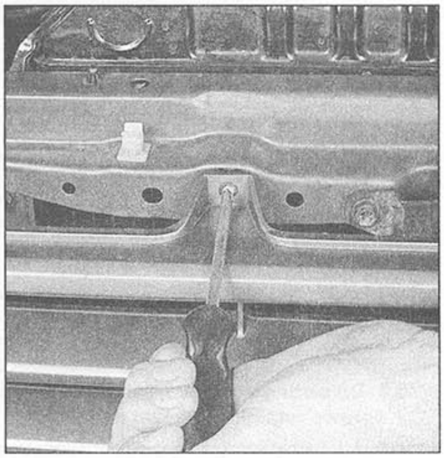
17.7 Loosen the hood lock bolts to adjust how tightly the hood closes



18.2a Location of the screws retaining the top of the grille (arrows) (early models)



18.2b Lower grille retaining screws (arrow) (early models)



18.5 Use a Phillips head screwdriver to remove the grille retaining screws (later models)

18.6 Disengage the grille by prying on the retaining clips while pulling out on the grille

18 Grille - removal and installation

Refer to illustrations 18.2a, 18.2b, 18.5 and 18.6

1 Open the hood.

Early models

2 Remove the four screws along the top edge of the grille and the three screws along the bottom **(see illustrations)**.
3 Pull the grille out.
4 Installation is the reverse of the removal procedure

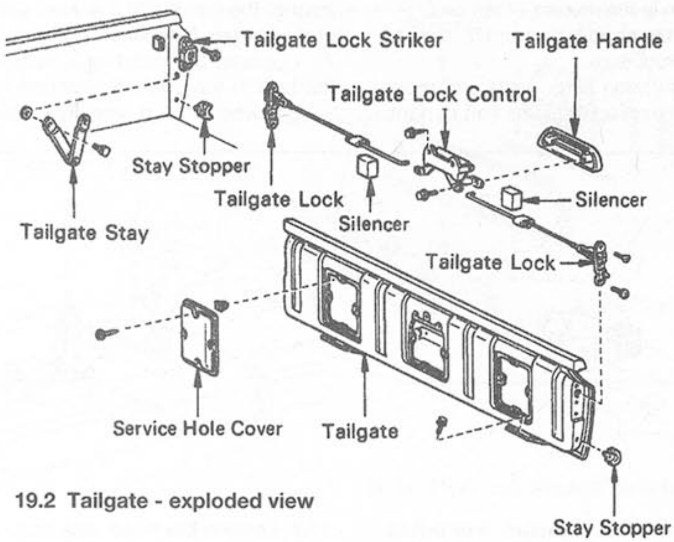
Later models

5 Remove the two grille retaining screws **(see illustration)**.
6 Use a screwdriver to pry on the retaining clips while pulling out on the grille until it is disengaged and then lift it from the vehicle **(see illustration)**.
7 To install, place the grille into position and push it in until the clips are engaged. Install the retaining screws.

19 Tailgate lock - removal and installation

Refer to illustration 19.2

1 Using a wrench, remove the tailgate stay from the tailgate lock and body.
2 Using a screwdriver, remove the service hole cover **(see illustration)**.
3 Disconnect the tailgate lock link from the tailgate lock control.
4 Remove the three set screws from the tailgate lock.
5 Pull the tailgate lock from the tailgate.
6 To install the lock, place it in the tailgate and install the three set screws.
7 Bolt the tailgate stay to the body and to the tailgate lock.
8 Connect the tailgate lock link to the tailgate lock control.
9 Install the service hole cover.



19.2 Tailgate - exploded view

20 Tailgate lock control - removal and installation

1 Using a screwdriver, remove the service hole cover **(see illustration 19.2)**.
2 Disconnect the two tailgate lock links from the lock control.
3 Using a socket, remove the tailgate lock handle.
4 Using a socket, remove the tailgate lock control.
5 Installation is the reverse of the removal procedure.

Chapter 12
Chassis electrical system

Contents

	Section
Bulb replacement	11
Combination meter - removal and installation	8
Electrical troubleshooting - general information	2
Fuses and fusible links - general information	3
General information	1
Hazard warning and turn signal lights - check and replacement	6
Headlights - adjustment	10
Headlights - removal and installation	9
Ignition switch - removal and installation	4
Light control combination switch - removal and installation	5
Windshield wipers - removal and installation	7

Specifications

Light bulb application

	Bulb number	Wattage
Parking light	194	3.8
Front turn signal light	1073	23
Rear side marker light	194	3.8
Rear turn signal light	1073	23
Stop/tail light	1034	23/8
Backup light	1073	23
License plate light	194	3.8
Interior light	12V-3CP	5

1 General information

This Chapter covers the repair and service procedures for the various lighting and electrical components not associated with the engine, as well as general information on troubleshooting the vehicle's various electrical circuits. Information on the battery, alternator, distributor and starter motor can be found in Chapter 5.

The electrical system is a 12 volt, negative ground type with power supplied by a lead/acid battery which is charged by the alternator.

It should be noted that whenever portions of the electrical system are worked on, the negative battery cable should be disconnected to prevent electrical shorts and/or fires.

2 Electrical troubleshooting - general information

A typical electrical circuit consists of an electrical component, any switches, relays, motors, etc. related to that component and the wiring and connectors that connect the component to both the battery and the chassis. To aid in locating a problem in any electrical circuit, wiring diagrams are included at the end of this Chapter.

Before tackling any troublesome electrical circuit, first study the appropriate 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 that circuit are operating properly or not. If several components or circuits fail at one time, chances are the problem lies in the fuse or ground connection, as several circuits often are routed through the same fuse and ground connections.

Electrical problems often stem from simple causes, such as loose or corroded connections, a blown fuse or melted fusible link. Prior to any electrical troubleshooting, always visually check the condition of the fuse, wires and connections of the problem circuit.

If testing 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 voltmeter (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.

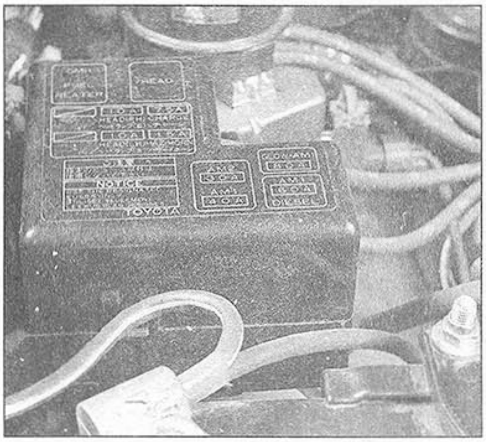
Voltage checks should be performed if a circuit is not functioning properly. Connect one lead of a circuit tester to either the negative battery terminal or a known good ground. Connect the other lead to a connector in the circuit being tested, preferably nearest to the battery or fuse. If the bulb of the tester lights, voltage is reaching that point (which means the part of the circuit between that connector and the battery is problem free). Continue checking along the entire circuit in the same fashion. When you reach a point where no voltage is present, the problem lies between there and the last good test point. Most of the time the problem is due to a loose connection. Keep in mind that some circuits receive voltage only when the ignition key is in the Accessory or Run position.

A method of finding shorts in a circuit is to remove the fuse and connect a test light or voltmeter in its place to the fuse terminals. There should be no load in the circuit. Move the wiring harness from side-to-side while watching the test light. If the bulb lights, there is a short to ground somewhere in that area, probably where insulation has rubbed off a wire. The same test can be performed on other components of the circuit, including the switch.

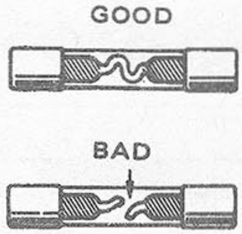
A ground check should be done to see if a component is grounded properly. Disconnect the battery and connect one lead of a self-powered test light, such as a continuity tester, to a known good ground. Connect the other lead to the wire or ground connection being tested. If the bulb lights, the ground is good. If the bulb does not light, the ground is not good.

A continuity check is performed to see if a circuit, section of circuit or individual component is passing electricity through it properly. Disconnect the battery, and connect one lead of a self-powered test light, such as a continuity tester, to one end of the circuit being tested and the other lead to the other end of the circuit. If the bulb lights, there is continuity, which means the circuit is passing electricity through it properly. Switches can be checked in the same way.

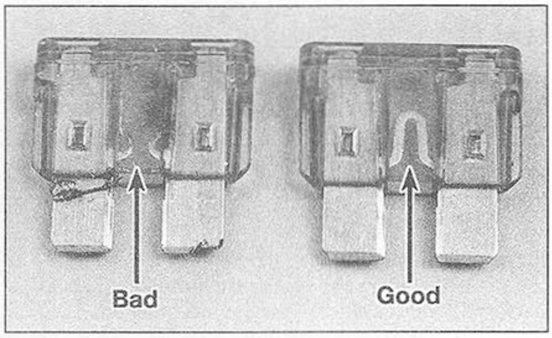
Remember that all electrical circuits are composed basically of electricity running from the battery, through the wires, switches, relays, etc. to the electrical component (light



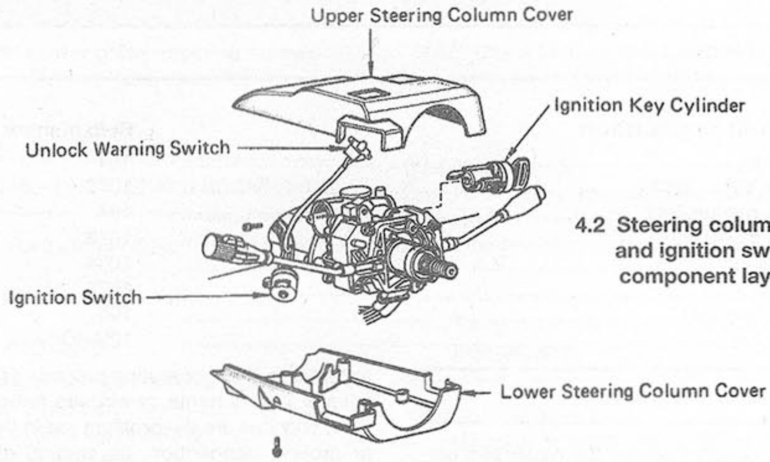
3.1a On later models, a fuse box is located in the engine compartment, behind the battery



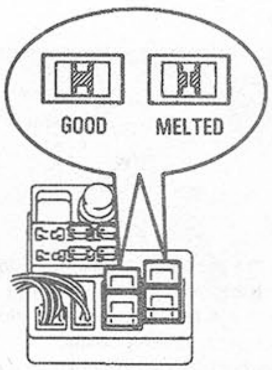
3.1b Early model fuses are tubular in shape with a glass tube covering the filament



3.1c Later model fuses are plastic with a curved filament



4.2 Steering column cover and ignition switch component layout



3.1d The fusible links on later models are located in the engine compartment fuse box and can be checked visually

bulb, motor, etc.). From there it is run to the body (ground) where it is passed back to the battery. Any electrical problem is basically an interruption in the flow of electricity to and from the battery.

3 Fuses and fusible links - general information

Refer to illustrations 3.1a, 3.1b, 3.1c and 3.1d

The electrical circuits of the vehicle are protected by a combination of fuses and fusible links.

The fusebox is located under the dash on the left side of the vehicle. Access is gained by simply snapping off the plastic cover. Later models also have a small fuse box located behind the glove box and a larger one in the engine compartment **(see illustration)**.

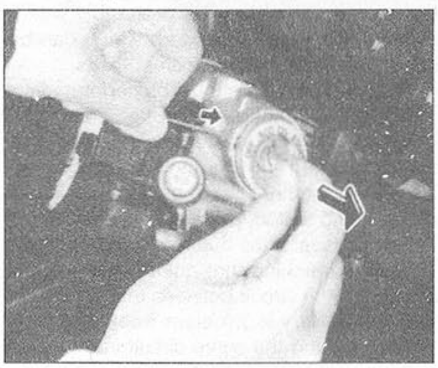
Each of the fuses is designed to protect a specific circuit, as identified on the fuse cover. Spare fuses and a special removal tool are included in the fuse box cover.

If an electrical component has failed, your first check should be the fuse. A fuse which has 'blown' can be readily identified by inspecting the metal element inside the housing **(see illustrations)**. If this element is broken, the fuse is inoperable and should be replaced with a new one.

Fuses are replaced by simply pulling out the old one and pushing in the new one.

It is important that the correct fuse be installed. The different electrical circuits need varying amounts of protection, indicated by the amperage rating on the fuse. A fuse with too low a rating will blow prematurely, while a fuse with too high a rating may not blow soon enough to avoid serious damage to other components or the wiring.

At no time should the fuse be bypassed with metal or foil. Serious damage to the electrical system could result.

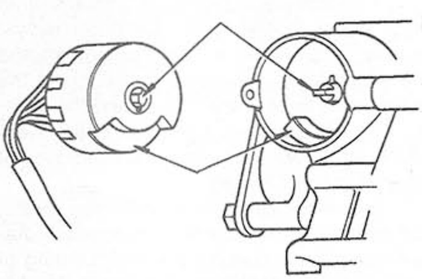


4.5 Push in on the retaining pin while pulling the ignition switch and key out

If the replacement fuse immediately fails, do not replace it with another until the cause of the problem is isolated and corrected. In most cases the cause will he a short circuit in the wiring caused by a broken or deteriorated wire. In addition to fuses, the wiring system incorporates fusible links for overload protection. These links are used in circuits which are not ordinarily fused.

The fusible links are located near the positive battery terminal and are easily removed by unplugging the connectors at either end. On later models the fusible links are located in the engine compartment fuse box and the check and replacement procedures are similar to fuses **(see illustration)**.

If an electrical failure occurs in one of the circuits covered by a fusible link, these



4.8 Prior to installation, align the bracket with the ignition switch should be the first check. If the link is melted, the entire fusible link should be replaced, but only after checking and correcting the electrical fault that caused it.

4 Ignition switch - removal and installation

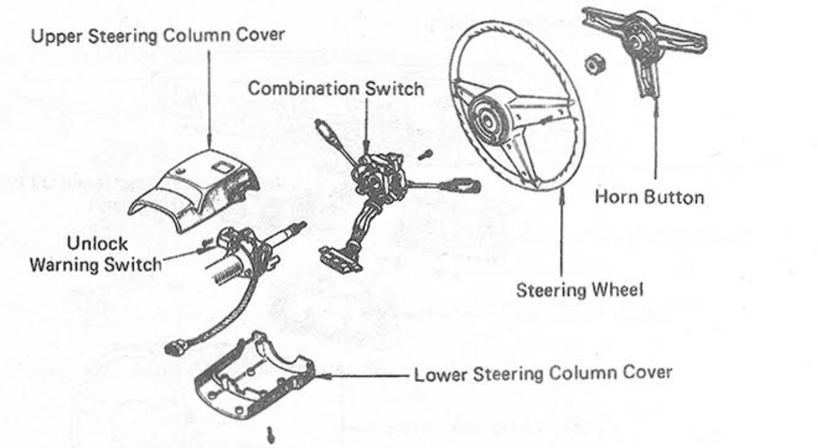
Refer to illustrations 4.2, 4.5 and 4.8

1 Remove the negative cable from the battery.
2 Remove the upper and lower steering column trim **(see illustration).**
3 Disconnect the ignition switch wiring connector.
4 Turn the ignition key to the Accessory position.
5 Push in the retaining pin with a paper clip and pull out the ignition key and cylinder **(see illustration).**
6 Remove the unlock warning switch by removing the two screws.
7 Remove the ignition switch by removing the retaining screw and pulling the switch out of the housing.
8 Installation is the reverse of the steps for removal. Make sure that the switch recess and bracket tab are aligned when installing the switch in the housing **(see illustration).**

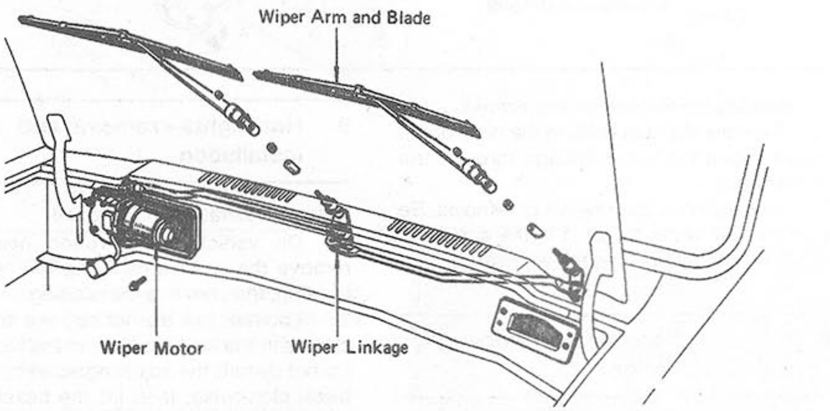
5 Light control combination switch - removal and installation

Refer to illustration 5.3

1 Disconnect the battery. From the back of the steering wheel, remove the screws securing the horn button assembly. Remove the assembly and disconnect it from the wiring harness.
2 Remove the steering wheel as described in Chapter 10.
3 Remove the steering column trim and the upper and lower parts of the switch cover **(see illustration).**
4 Disconnect the combination switch leads at the connector by pressing down on the connector locks and separating the plug and socket parts.
5 Unscrew and remove the switch assembly mounting screws. Note the position of the switch assembly in relation to the canceling pawl and then remove the switch assembly.



5.3 Combination switch and steering column details

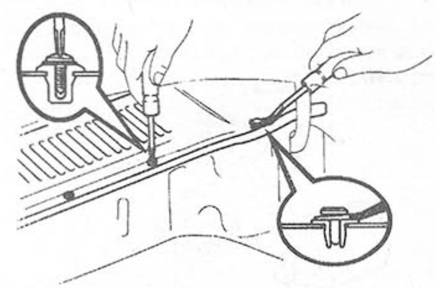


7.1 Windshield wiper component layout

6 When installing the switch assembly (by reversing the removal operation), make sure that the switch and the automatic canceling pawl are in their correct relative positions before installing the steering wheel. After reconnecting the wiring harness plug, make sure that the switch functions correctly before installing the column trim.

6 Hazard warning and turn signal lights - check and replacement

1 If the flashers fail to work properly, first check the bulbs, then make sure that the nuts which hold the light units to the vehicle are tight and free from corrosion. These complete the circuit and any resistance here could affect the operation of the flasher unit.
2 Check the security of all wiring connectors after referring to the proper wiring diagram.
3 If everything is secure after making the above checks, then the hazard warning/turn signal flasher unit itself must be faulty. Since it cannot be repaired, it must be replaced with a new unit. It is located under the dash, approximately between the heater and radio control panels. To replace it, slide it from its bracket mount, disconnect the electrical connector and install a new unit.

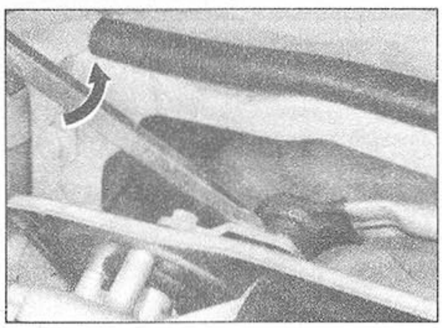


7.2 Remove the screws, pry the clips out and remove the cowl louver

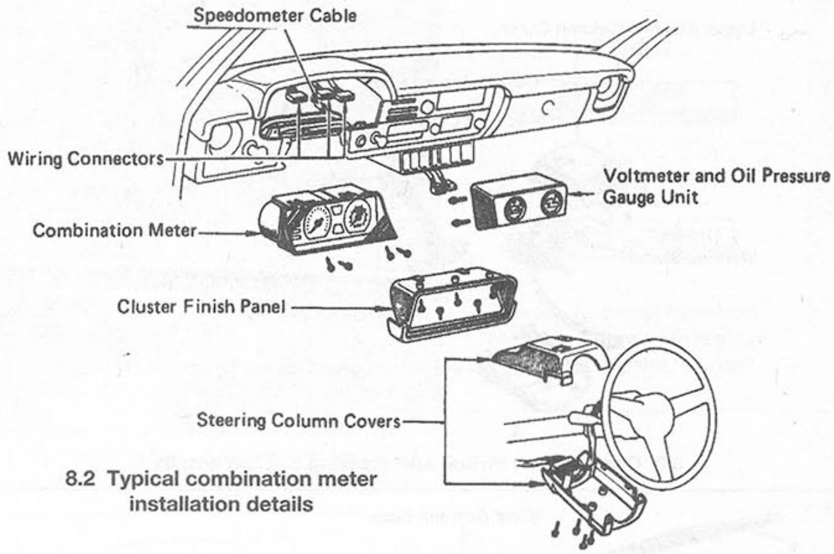
7 Windshield wipers - removal and installation

Refer to illustrations 7.1, 7.2 and 7.3

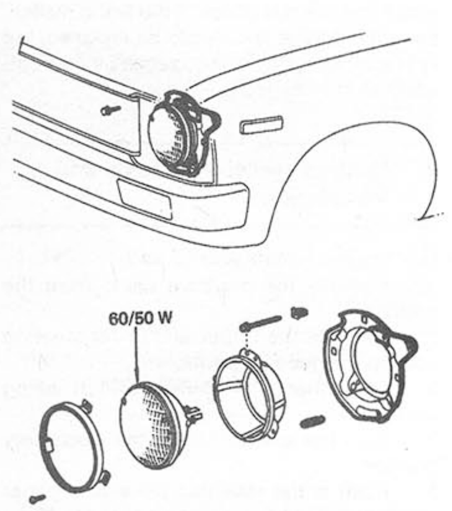
1 Lift up the covers on the wiper arms and use a wrench to remove the nuts, then remove the arms **(see illustration).**
2 Remove the screws and clips and remove the cowl louver **(see illustration).**
3 Insert a screwdriver between the link and the arm and pry the link from the arm **(see illustration).**
4 Disconnect the electrical connector from the wiper motor, then remove the wiper motor



7.3 Pry the wiper arm link off with a screwdriver using a twisting motion as shown



8.2 Typical combination meter installation details



9.2 Round headlight installation details

by removing the three mounting screws.

5 Remove the nuts holding the pivot arms, then remove the wiper linkage through the access hole.

6 Installation is the reverse of removal. Be sure that the wiper motor is in the auto-stop position before attaching the wiper arms.

8 Combination meter - removal and installation

Refer to illustration 8.2

1 Disconnect the negative cable from the battery.

2 Remove the steering column covers **(see illustration)**.

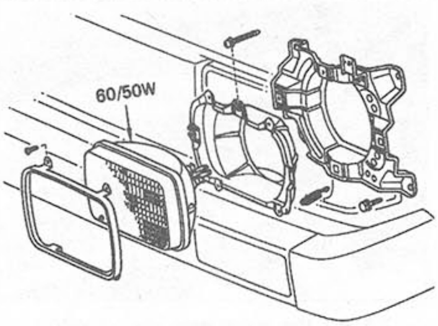
3 Remove the five screws holding the cluster finish panel in place, then remove the finish panel.

4 While pushing the lock lever, pull out the speedometer cable.

5 Remove the retaining screws, then pull out the combination meter and disconnect the wiring connectors.

6 To replace any faulty components within the combination meter, simply unbolt or unscrew them and replace them with new units.

7 Installation is the reverse of removal.



9.4 Rectangular headlight details

9 Headlights - removal and installation

Refer to illustrations 9.2 and 9.4

1 On vehicles with round headlights, remove the screws securing the headlight housing, then remove the housing.

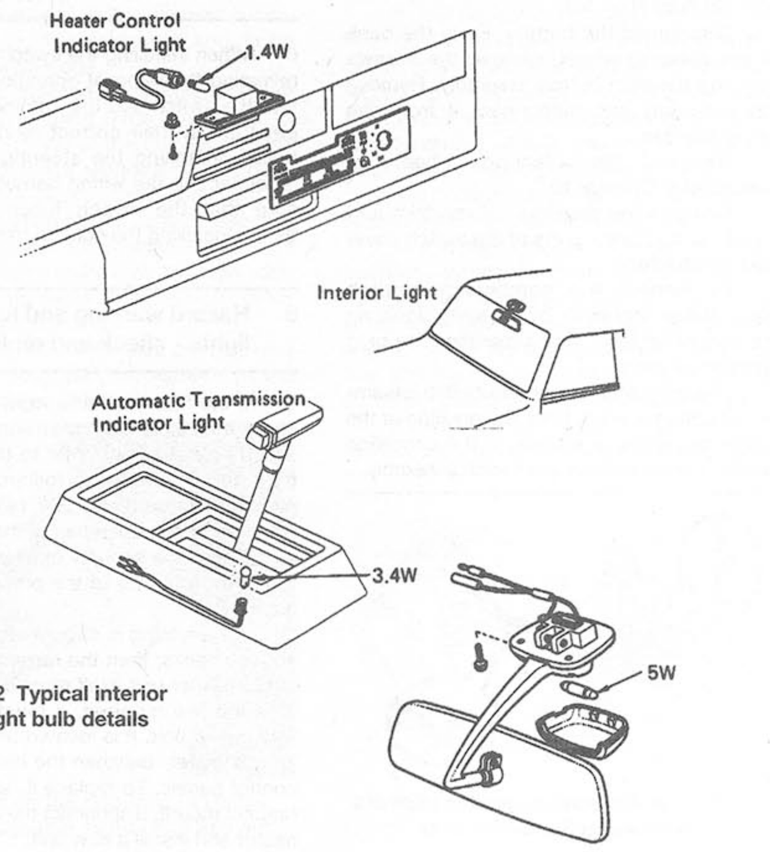
2 Loosen, but do not remove the three screws in the keyhole slots in the light bezel. Do not disturb the adjusting screws. Turn the bezel clockwise, then lift the bezel off the screw heads **(see illustration)**.

3 Hold the headlamp and disconnect the plug from the contacts at the rear.

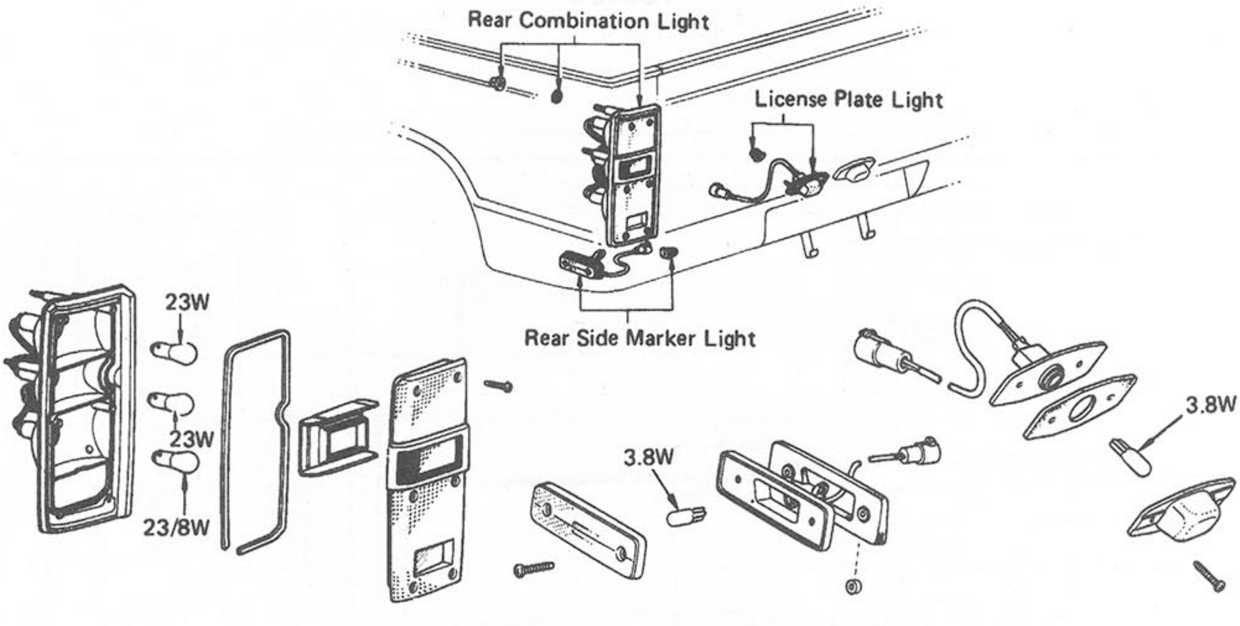
4 On vehicles with rectangular headlights, remove the screws holding the headlight trim ring, then lift off the trim ring **(see illustration)**. On later models, it will be necessary to remove the grille to provide access to the headlight retaining screws (see Chapter 11).

5 Pull out the headlight and disconnect the plug from the contacts at the rear.

6 Installation is the reverse of removal.



11.2 Typical interior light bulb details



11.5 Rear light bulb details

10 Headlights - adjustment

1 Headlight adjustment is achieved using the two adjusting screws on each light unit.
2 Due to the regulations which are in effect in different areas, it is not possible to give specific adjustment instructions.
3 Any adjustments which are made should be regarded only as interim measures and the alignment should be checked as soon as possible by a Toyota dealer or other service station with optical alignment equipment.

11 Bulb replacement

Refer to illustrations 11.2, 11.5 and 11.8

1 Make sure that replacement bulbs are the correct wattage, according to the Specifications, before installing them. Also, be sure to reinstall all pertinent gaskets when reinstalling the lenses.

Interior

Heater control indicator light

2 Remove the two screws above the heater control panel that hold the heater control indicator light housing in place to gain access to the bulb. Pull straight out on the bulb to remove it **(see illustration)**.

Dome light

3 Insert a flat-bladed screwdriver into the recess at the right side of the dome light lens and pry down gently to remove the lens, exposing the bulb.

Automatic transmission indicator light (if so equipped)

4 Remove the control lever trim plate to gain access to the indicator bulb. It is of the bayonet type.

Exterior

Rear combination light

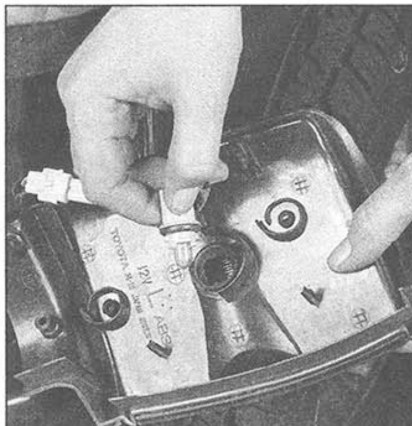
5 Remove the screws securing the lens over the light assembly to remove the lens. The individual bulbs may be released from their bayonet mounts by pushing in on the bulbs and twisting them counterclockwise **(see illustration)**.

Rear side marker light

6 Remove the screws securing the lens and remove the lens. Pull straight out on the bulb to remove it.

License plate light

7 The license plate light bulb is replaced in the same manner as the rear side marker light.

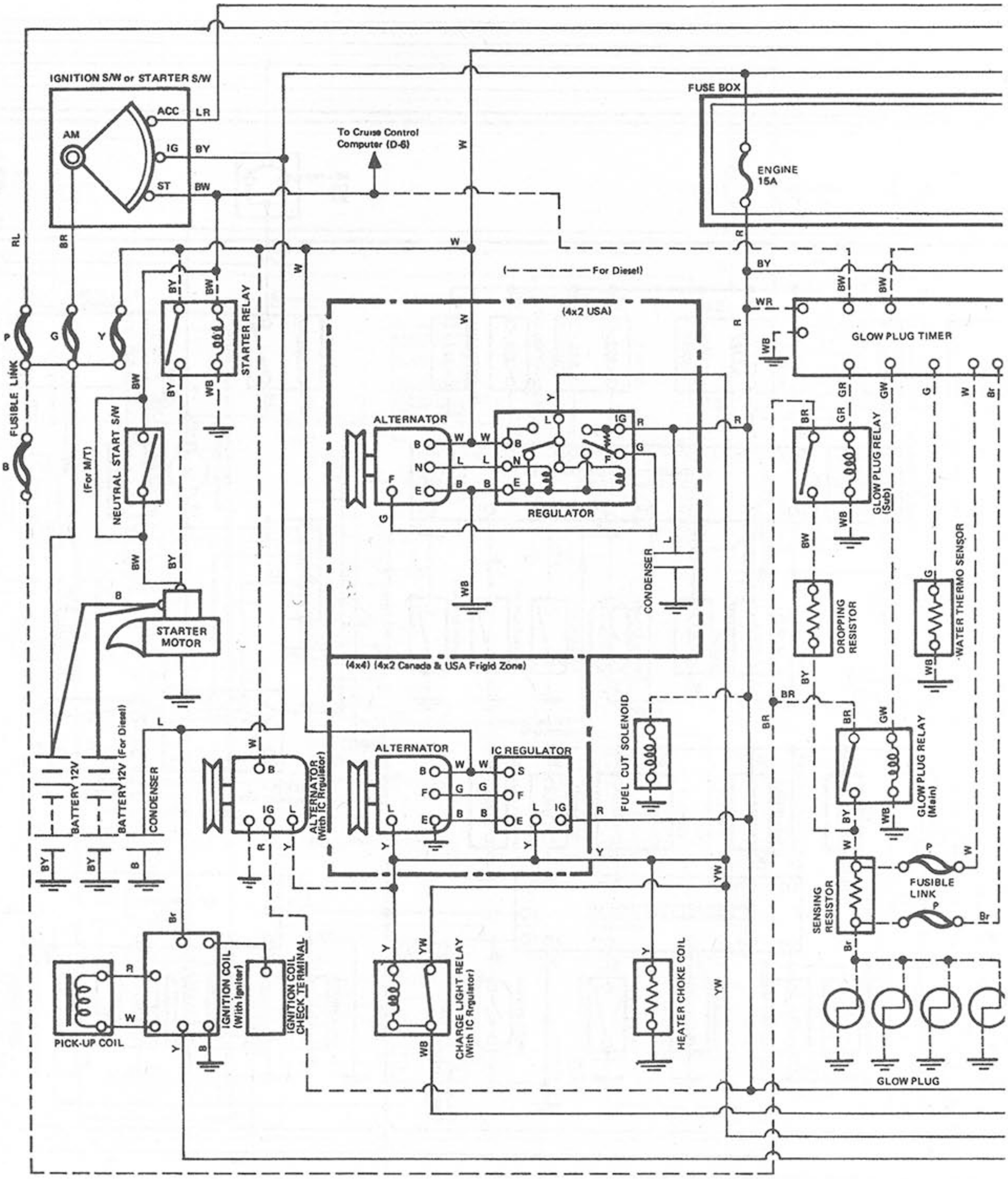


11.8 On later models, remove the three screws and rotate the front parking light housing out for access to the bulb

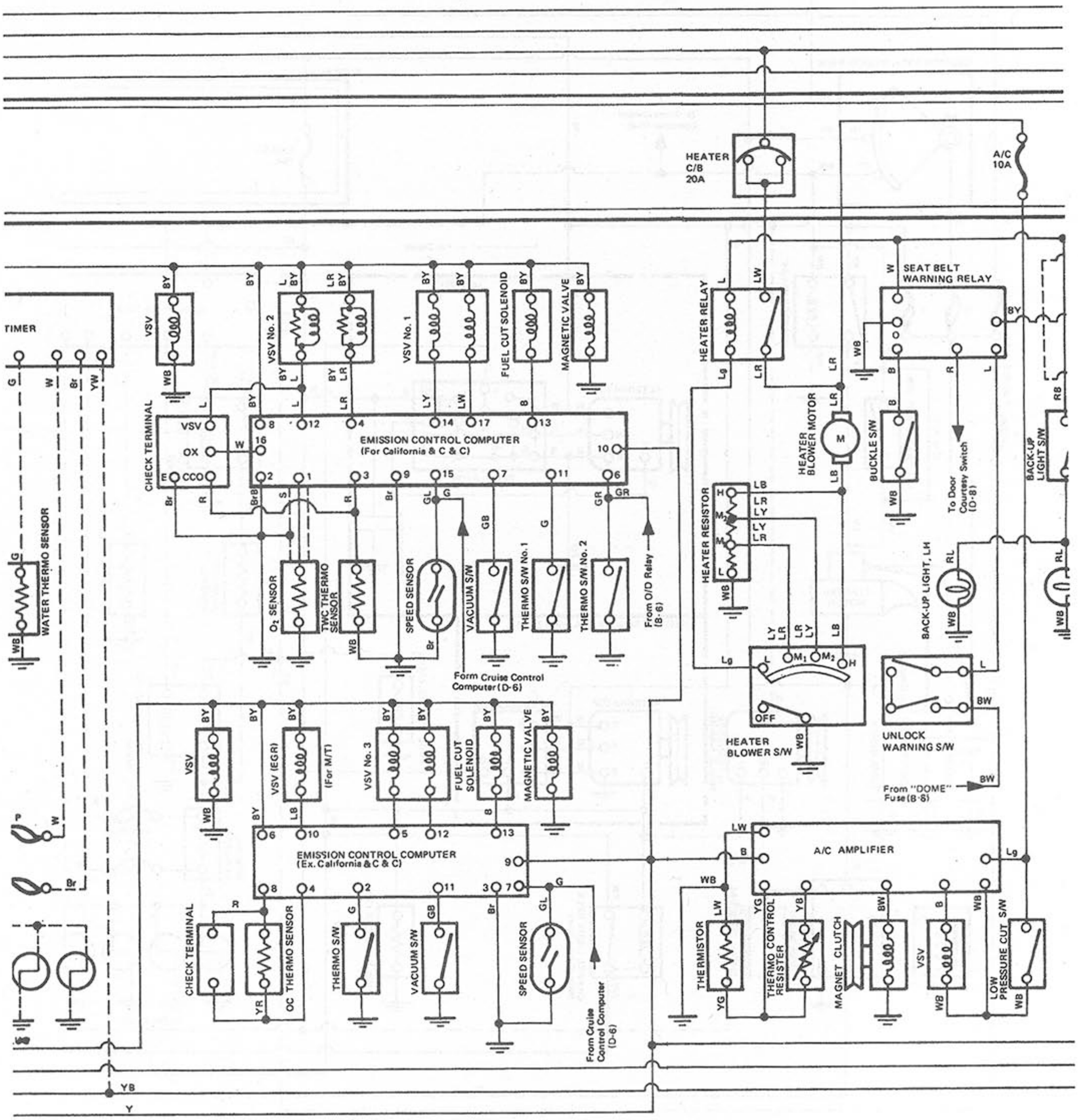
Front turn signal, parking and side marker lights

8 The lights are similar in that the lens in each of them is held in place by two screws. Remove the screws and pull off the lens to gain access to the bulbs. The turn signal and parking bulbs are bayonet mount and the side marker bulb is a push-pull type **(see illustration)**.

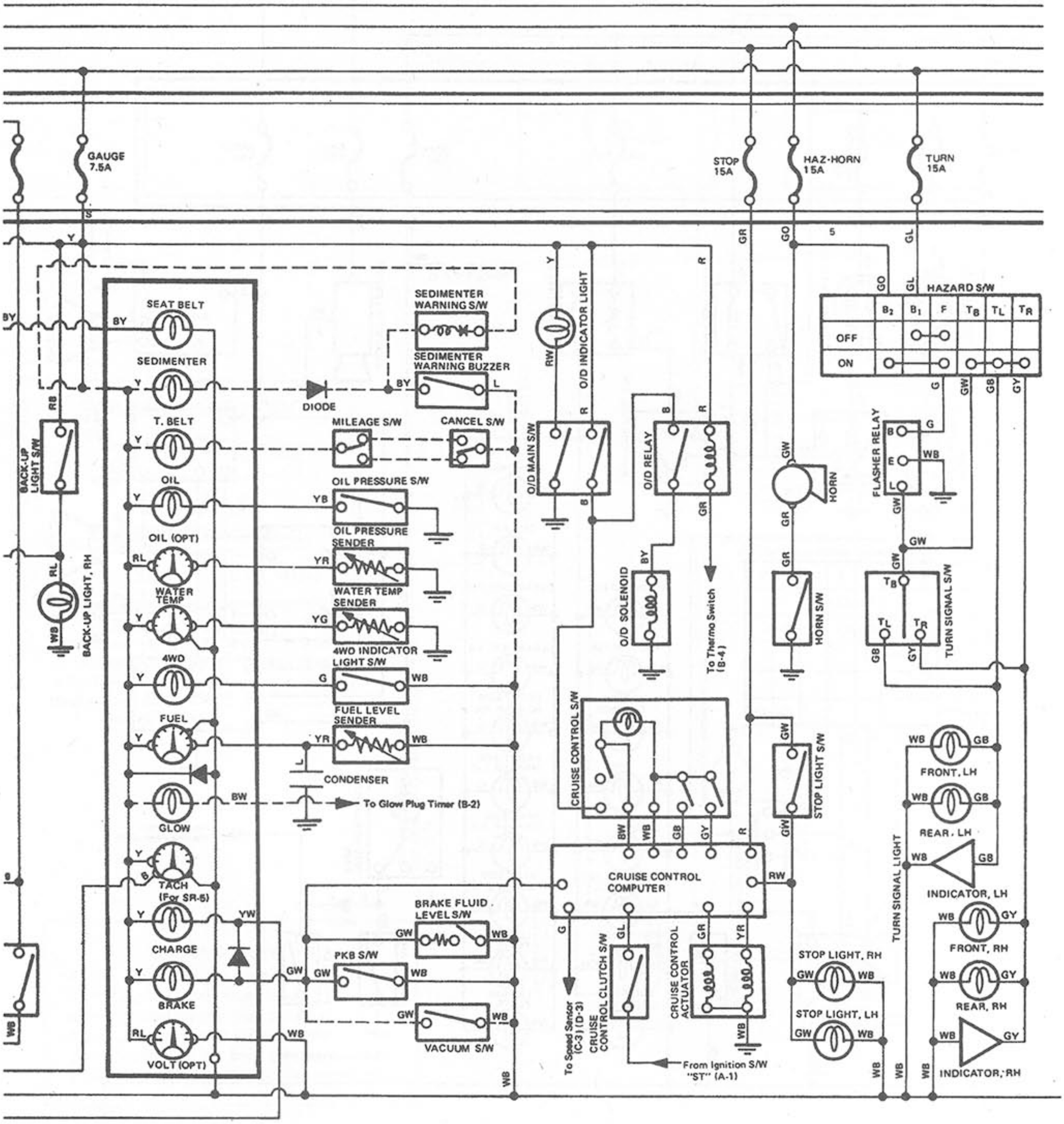
Notes



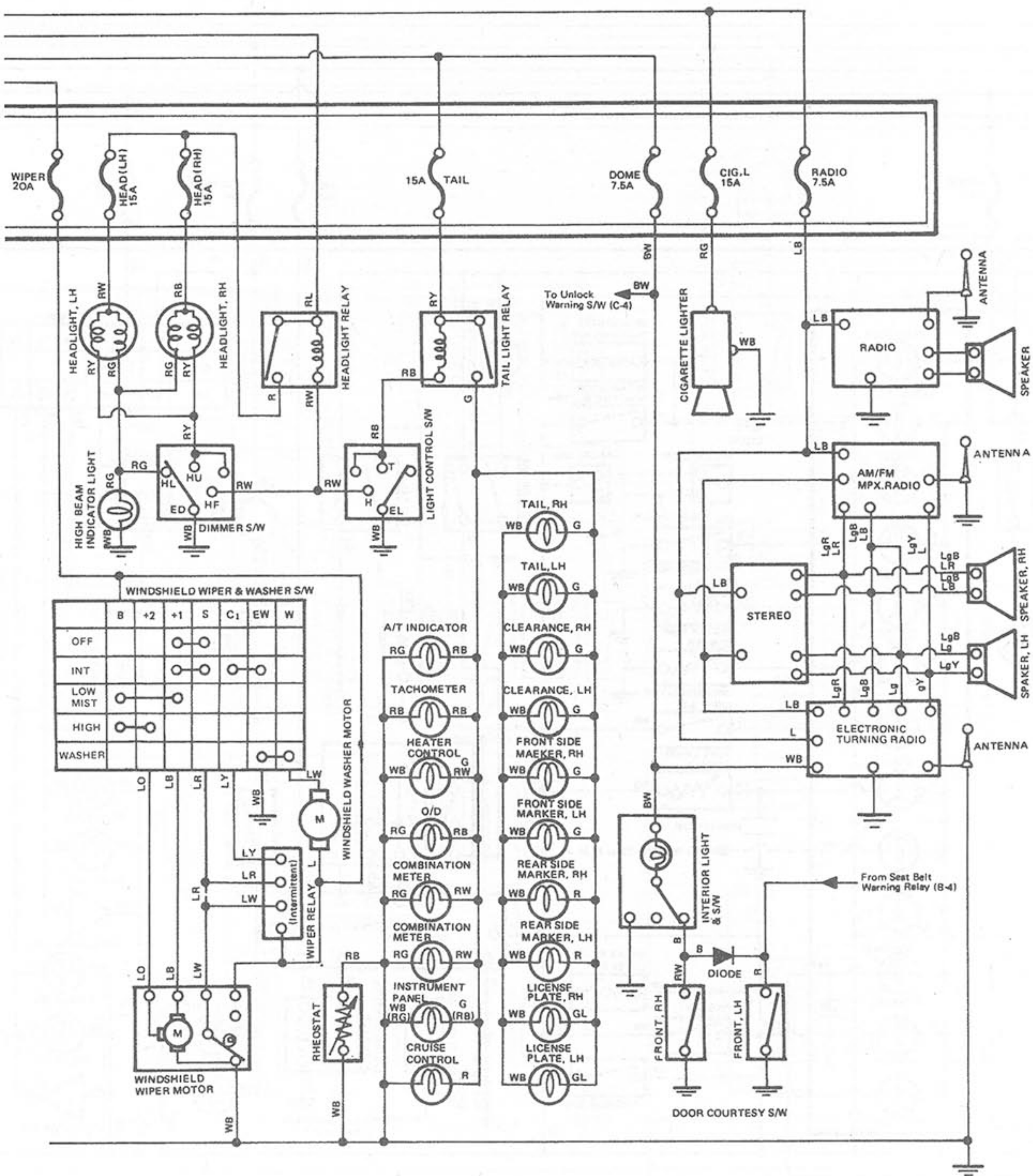
Early model wiring diagram (1 of 4)



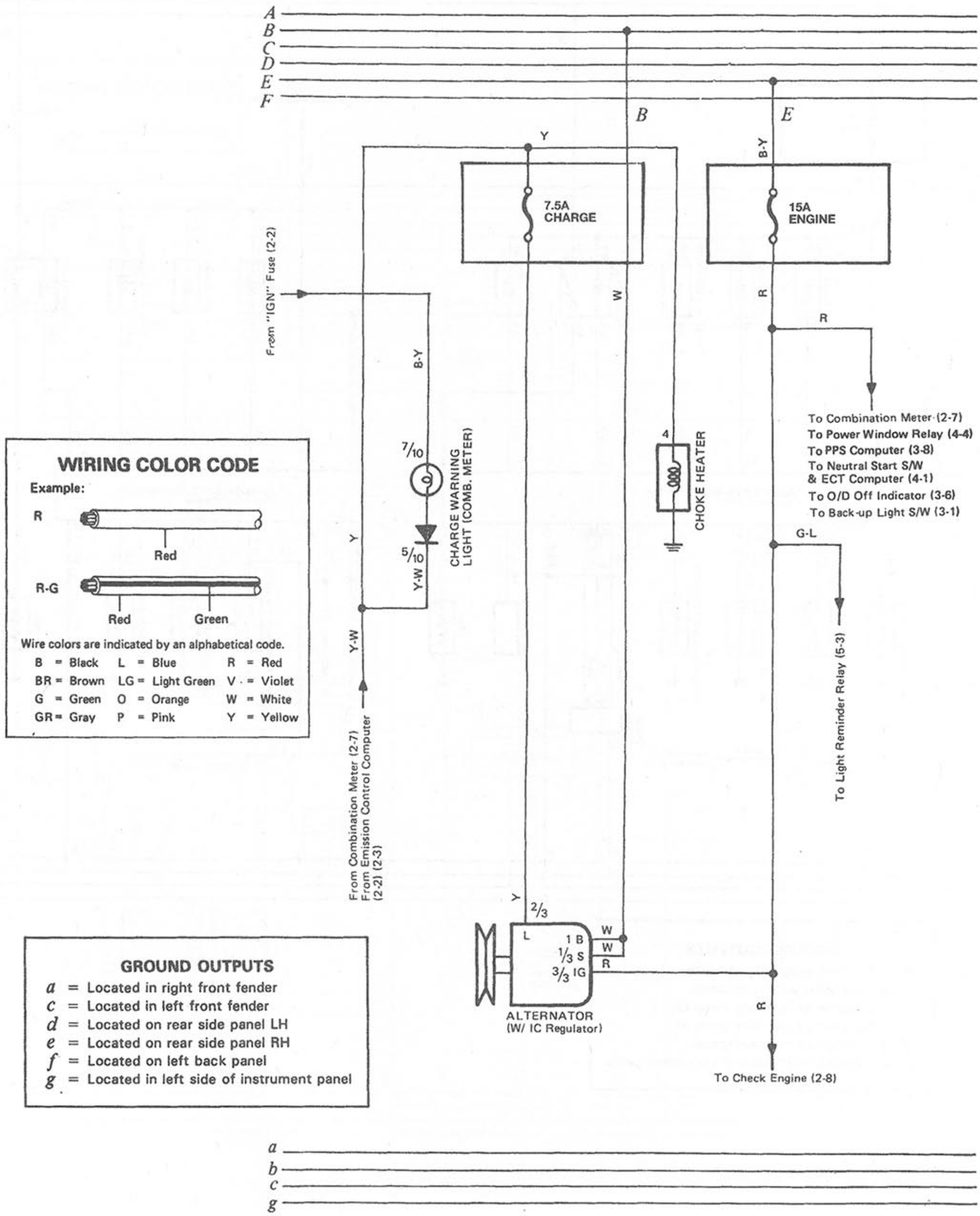
Early model wiring diagram (2 of 4)



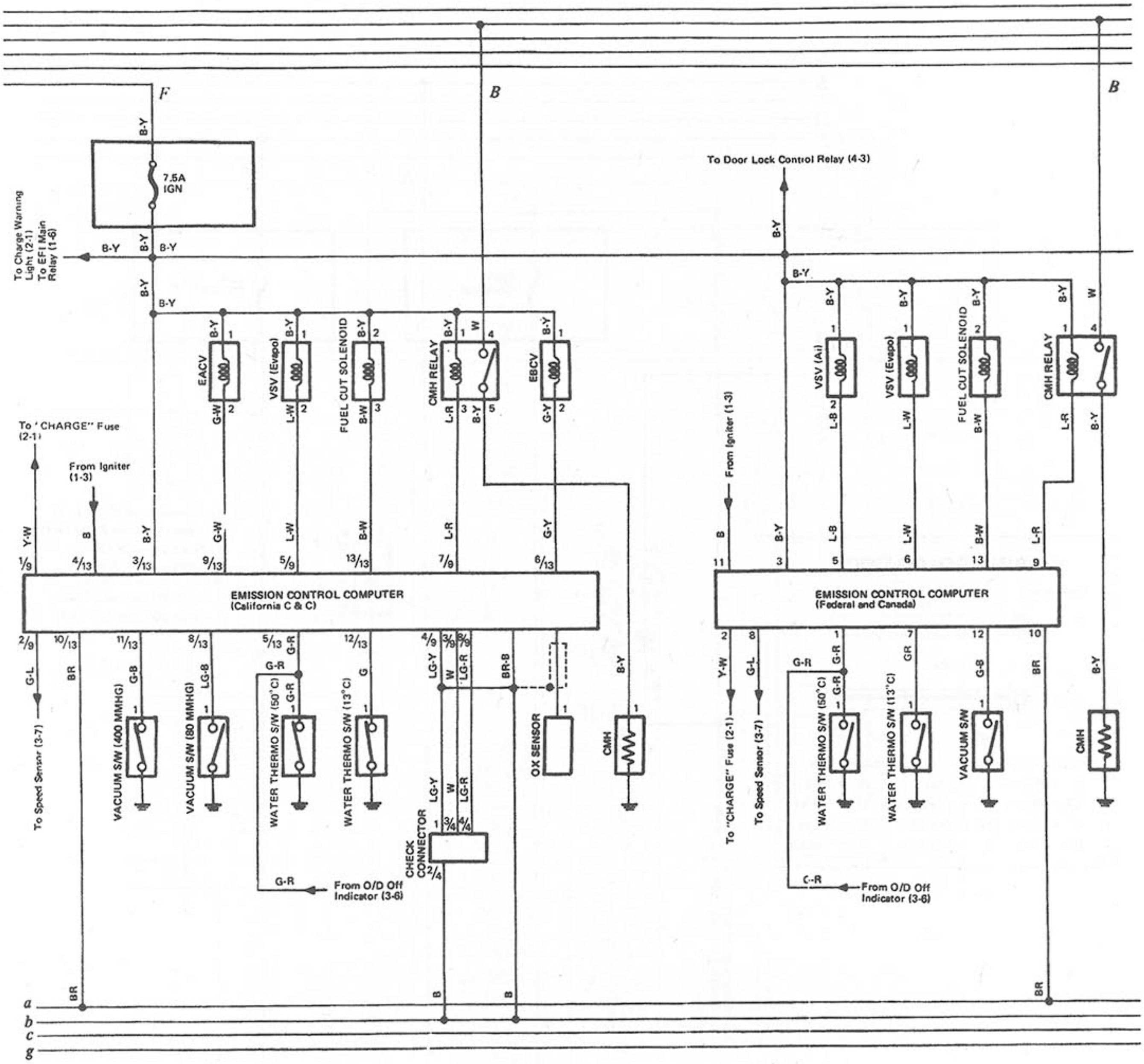
Early model wiring diagram (3 of 4)



Early model wiring diagram (4 of 4)



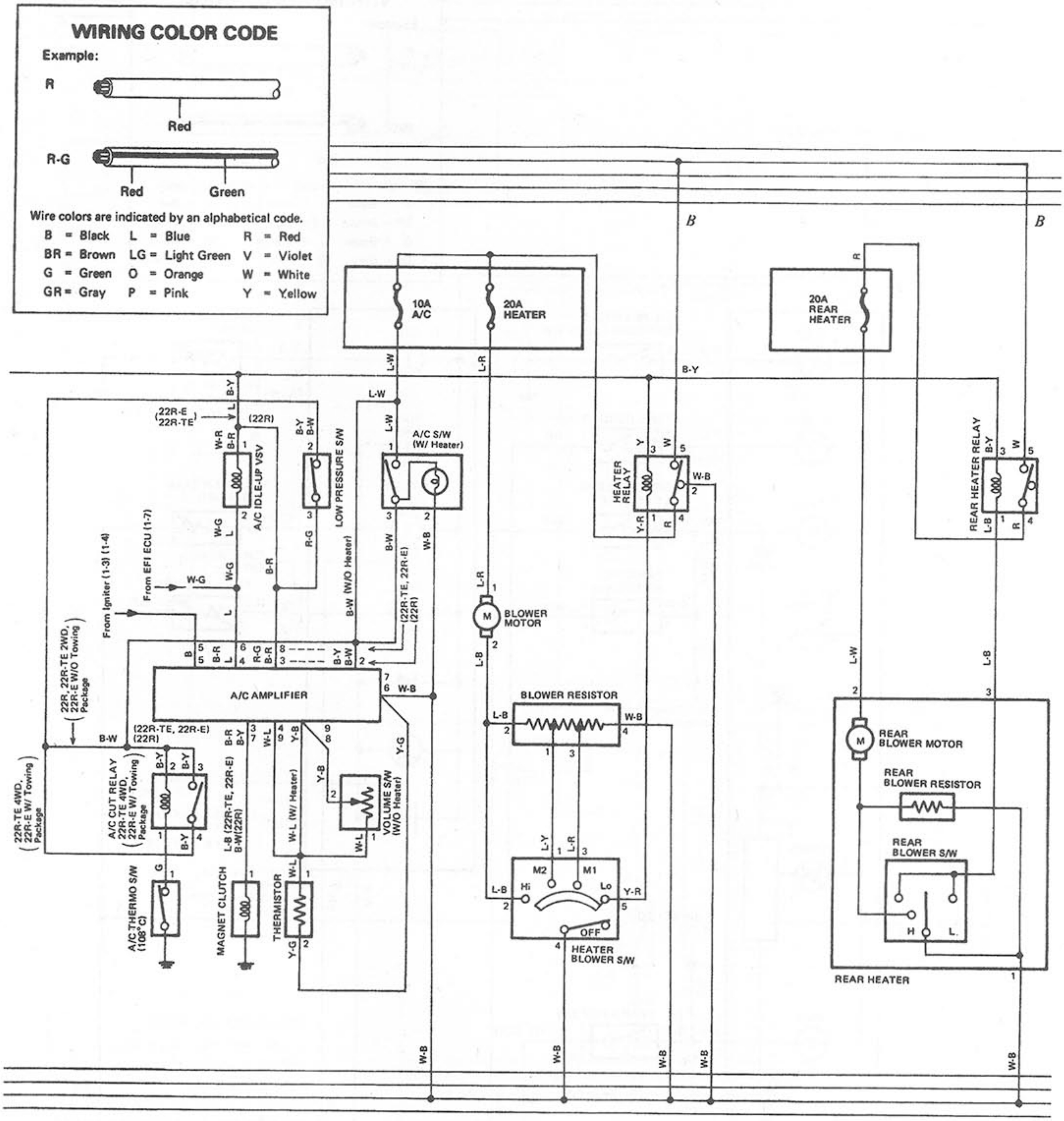
Typical late model - charging system



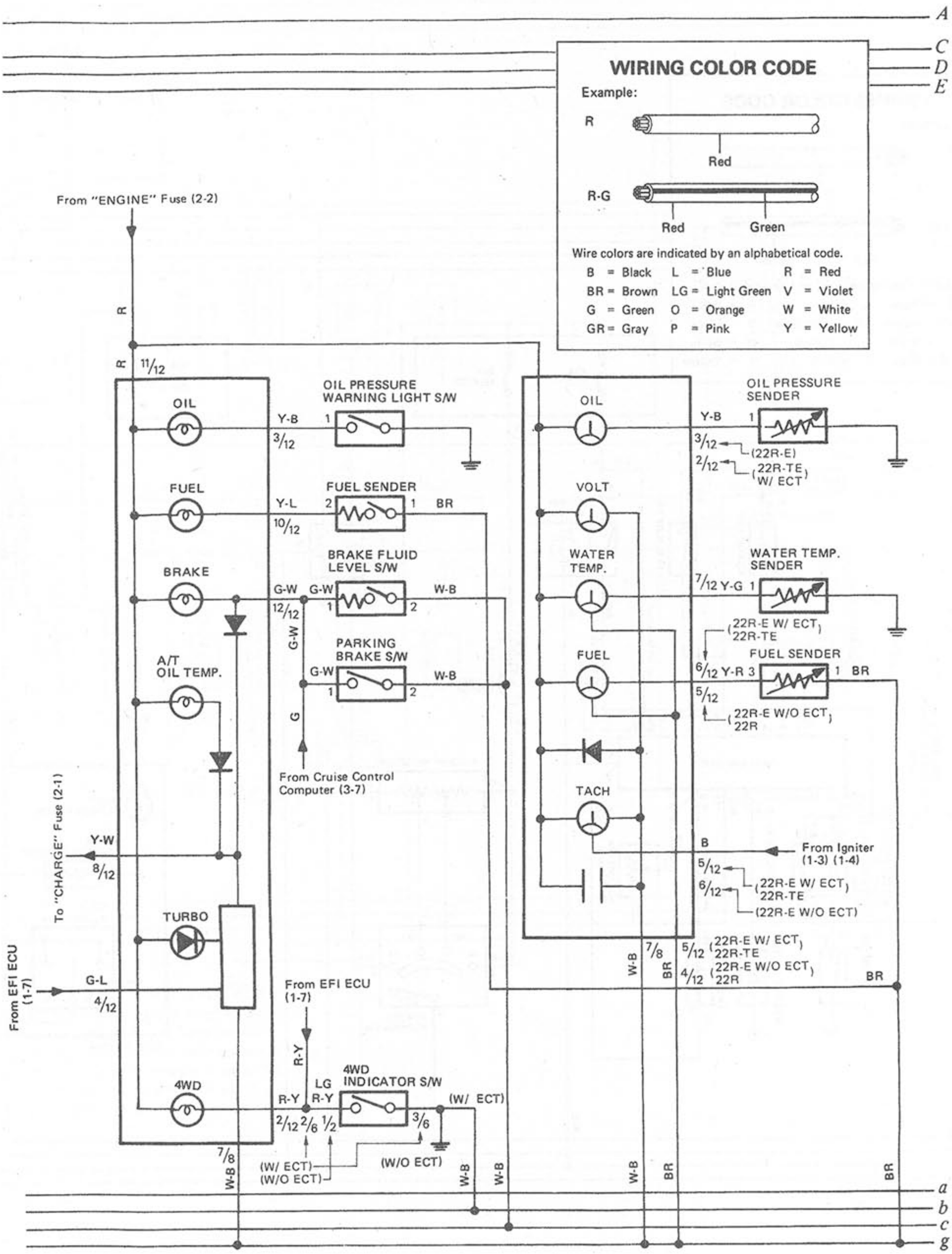
GROUND OUTPUTS

a = Located in right front fender
c = Located in left front fender
d = Located on rear side panel LH
e = Located on rear side panel RH
f = Located on left back panel
g = Located in left side of instrument panel

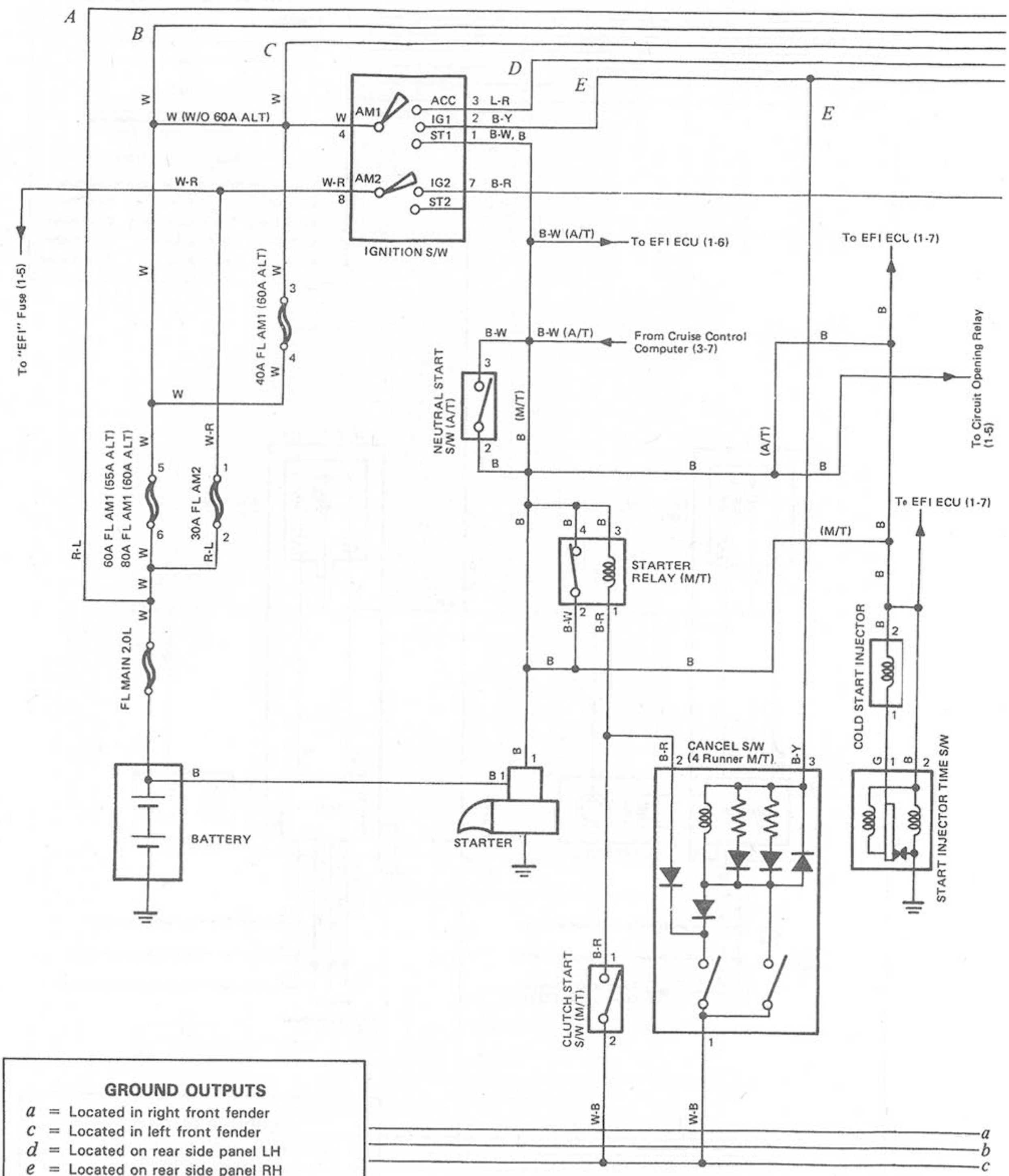
Typical late model - emission control system



Typical late model - heater and air conditioner systems



Typical late model - combination meter



GROUND OUTPUTS

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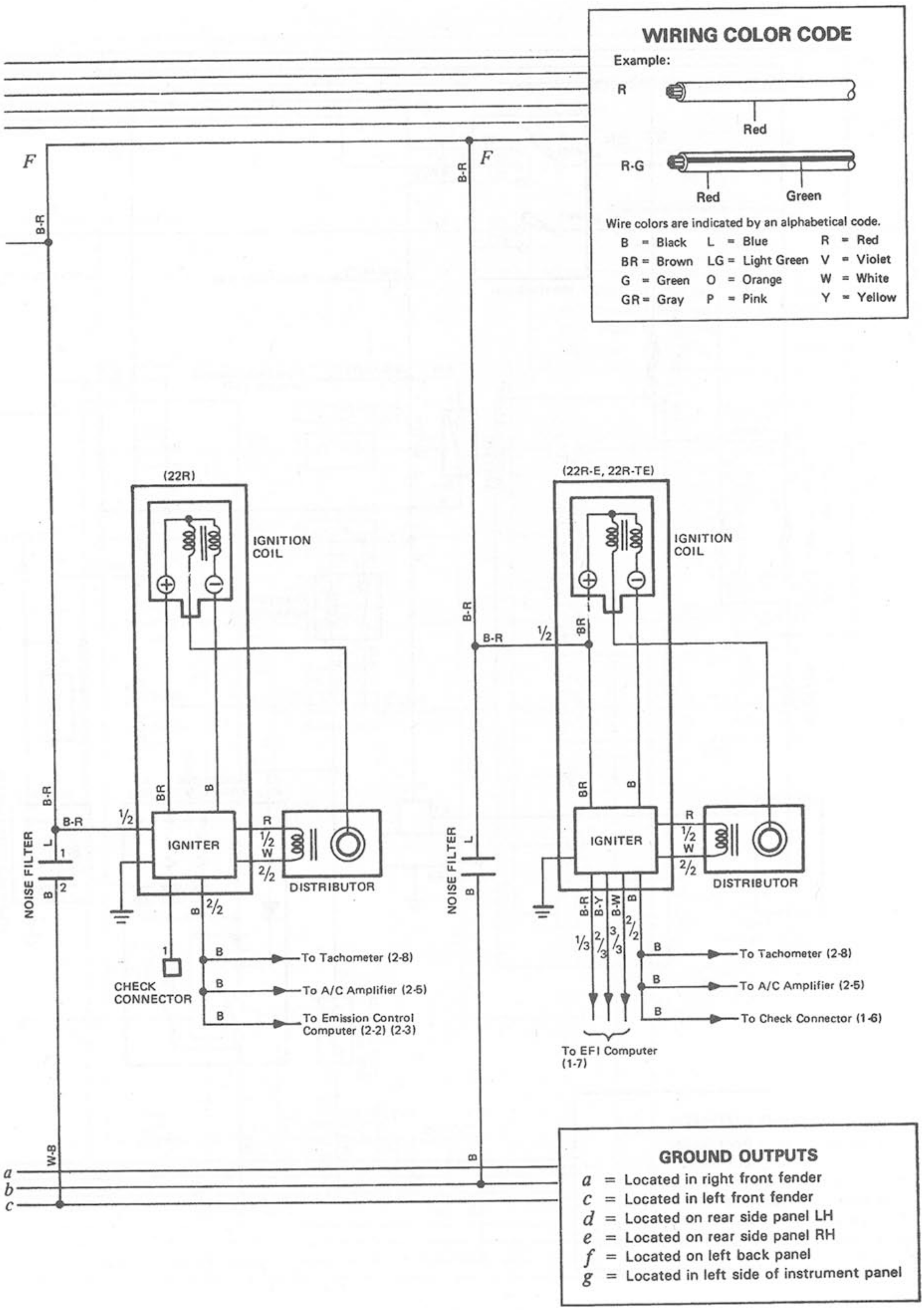
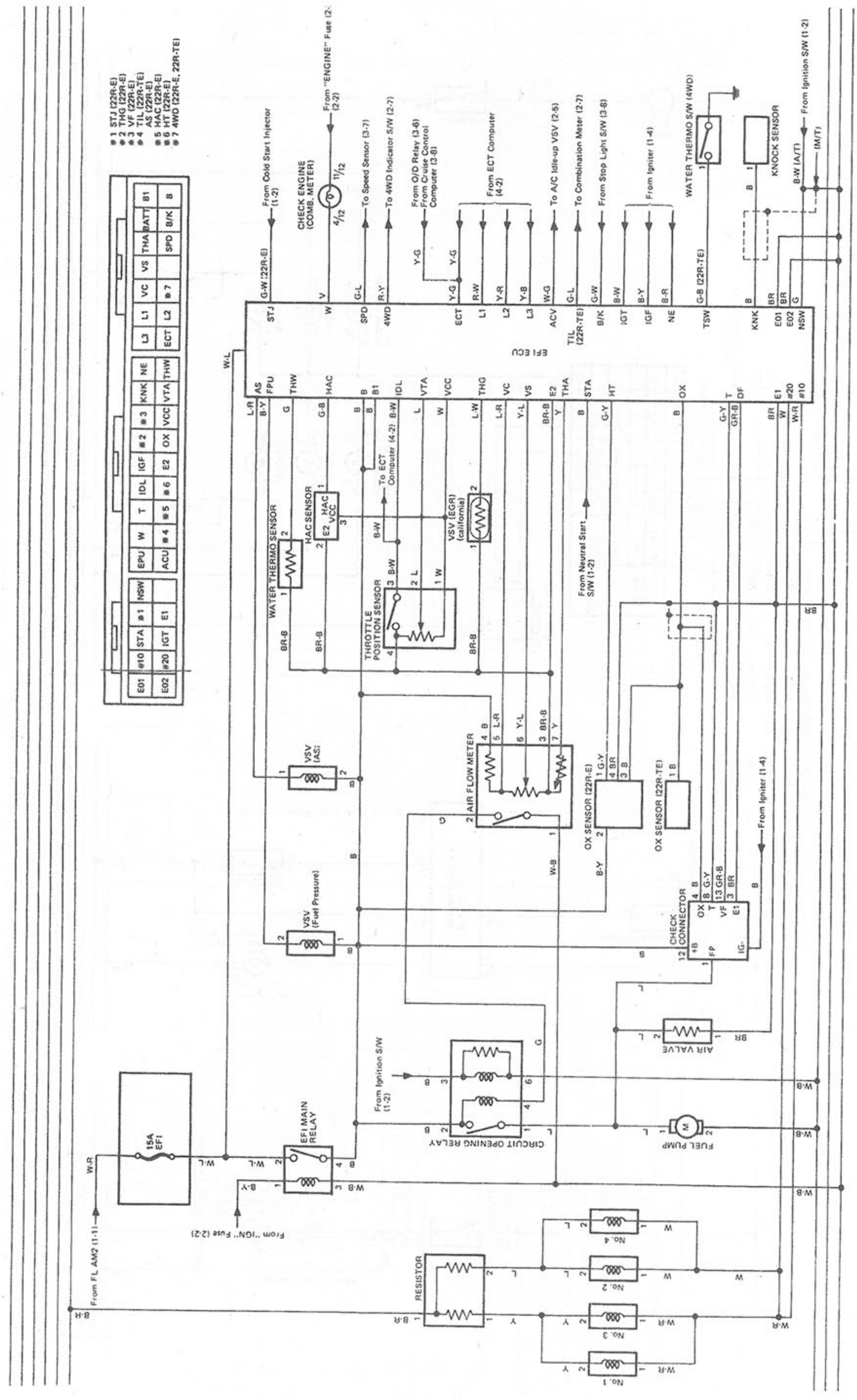
- *d* = Located on rear side panel LH
- *e* = Located on rear side panel RH
- *f* = Located on left back panel
- *g* = Located in left side of instrument panel

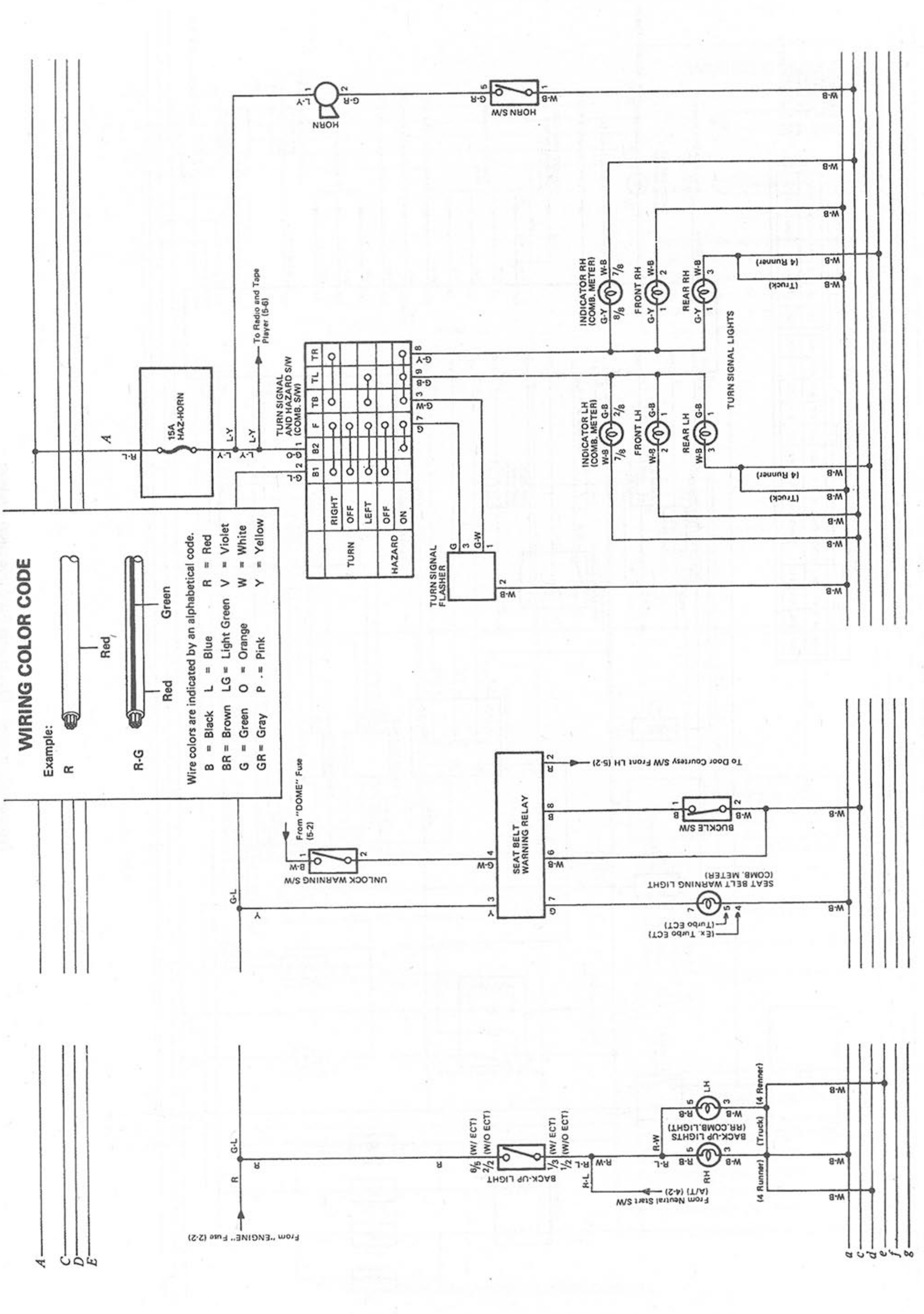
Typical late model - starting system



Typical late model - ignition system



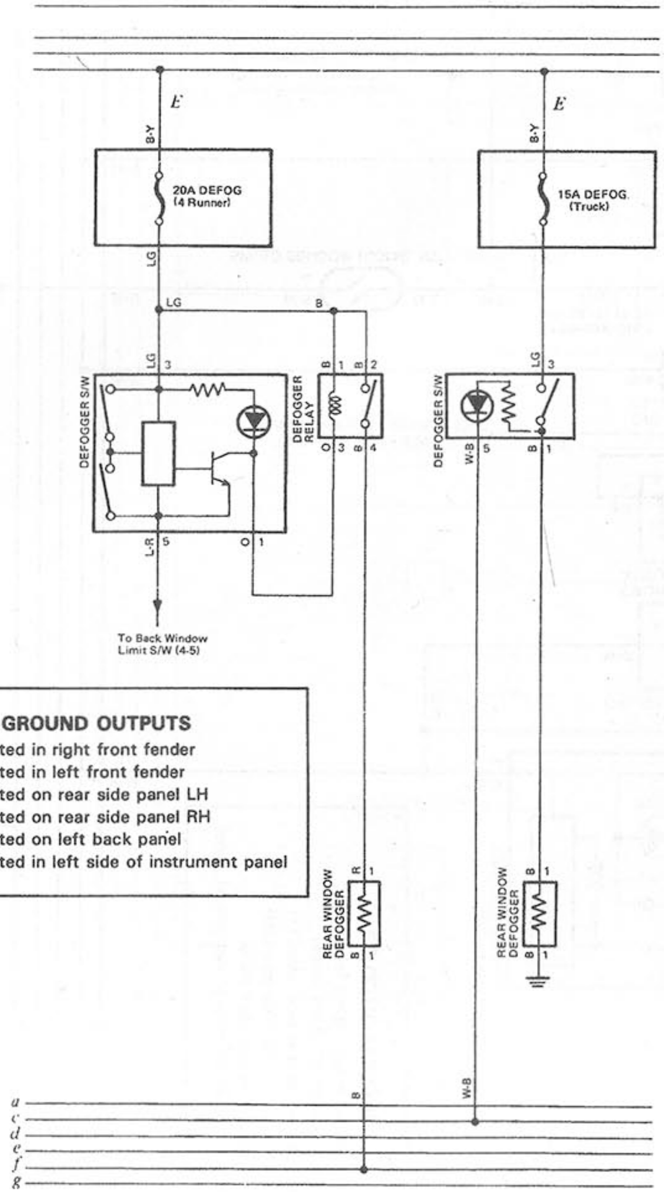
Typical late model - Electronic Fuel Injection system



Typical late model - turn signal and hazard lights

Typical late model - unlock and seat belt warning system

Typical late model - back-up lights



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- c = Located in left front fender
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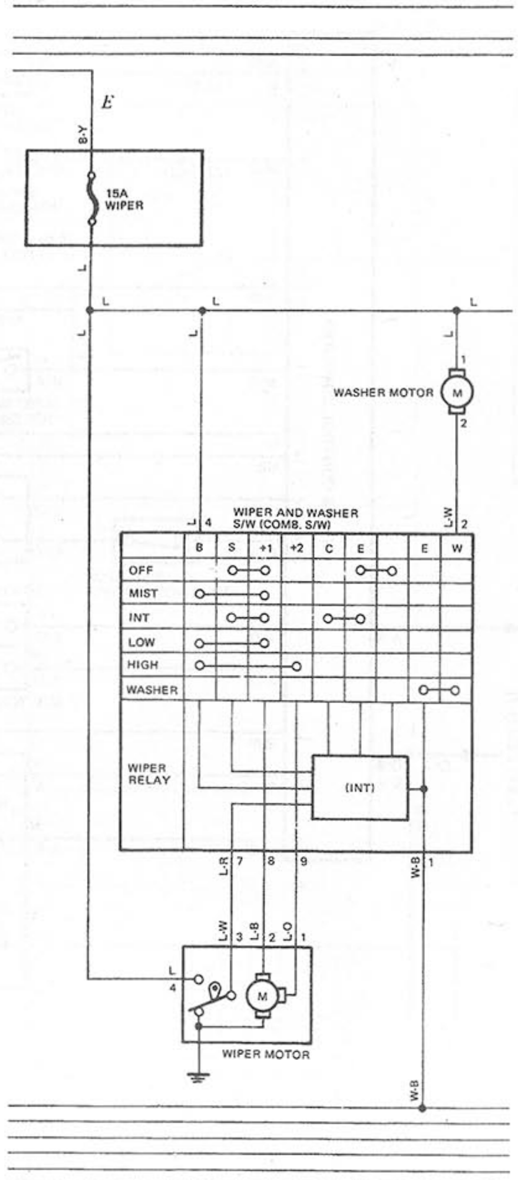
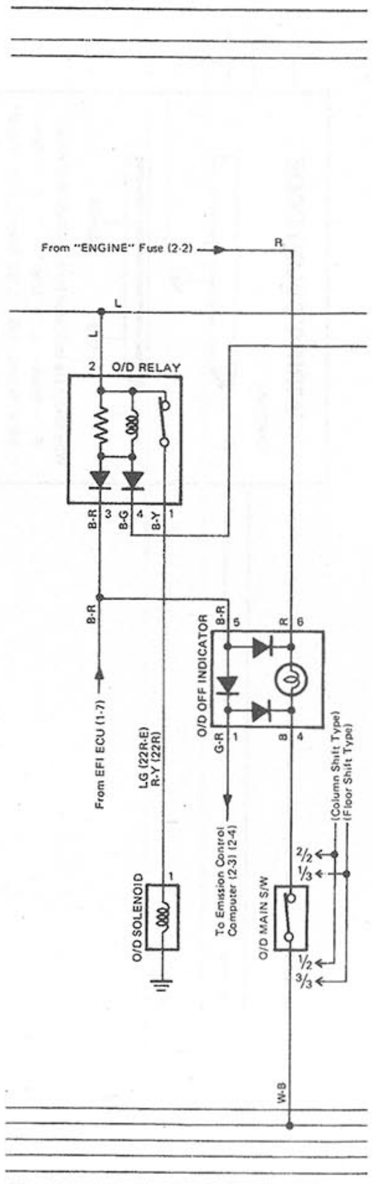
- e = Located on rear side panel RH
- f = Located on left back panel
- g = Located in left side of instrument panel

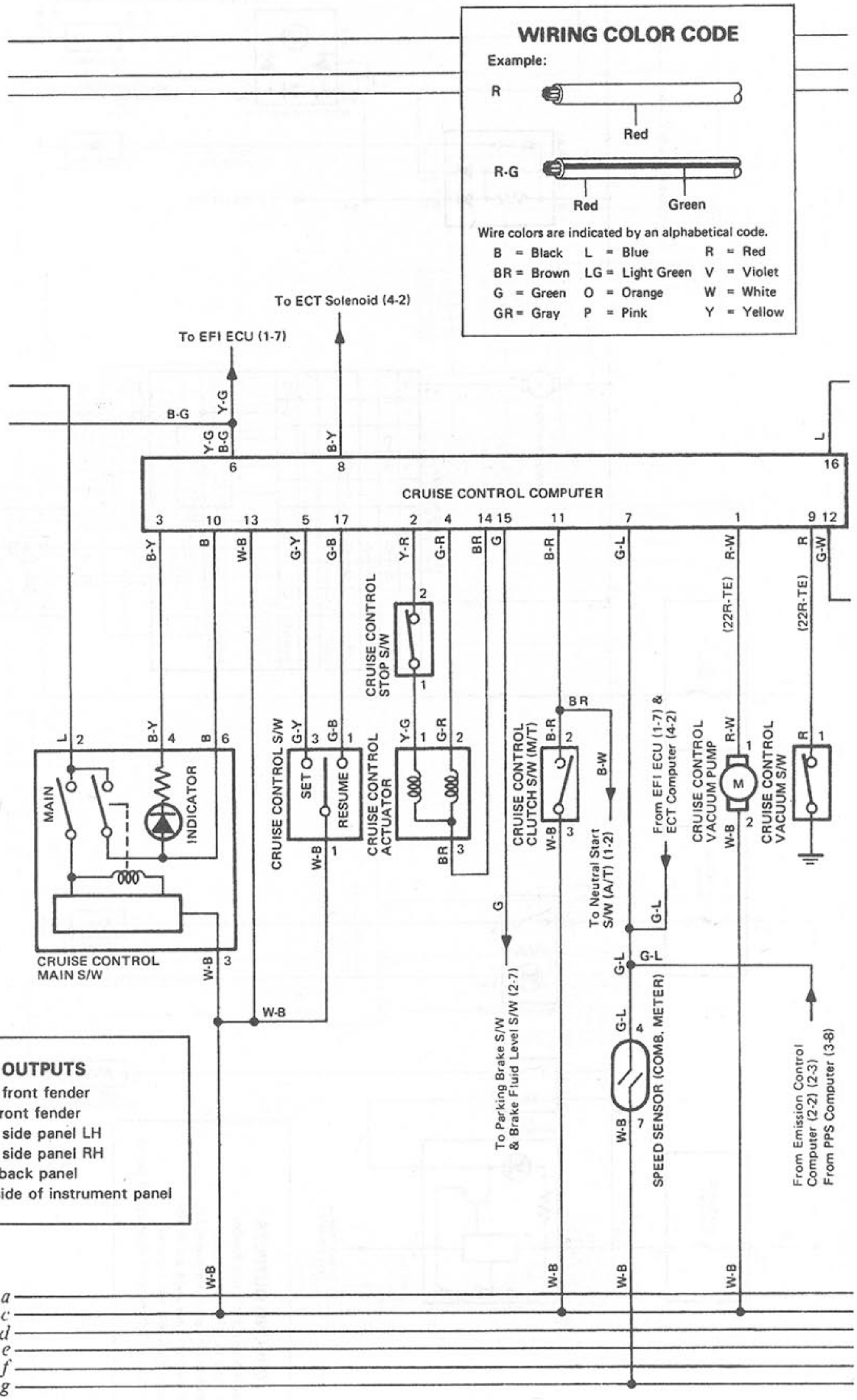
Typical late model - rear window defogger



Typical late model - front wiper and washer



Typical late model - overdrive



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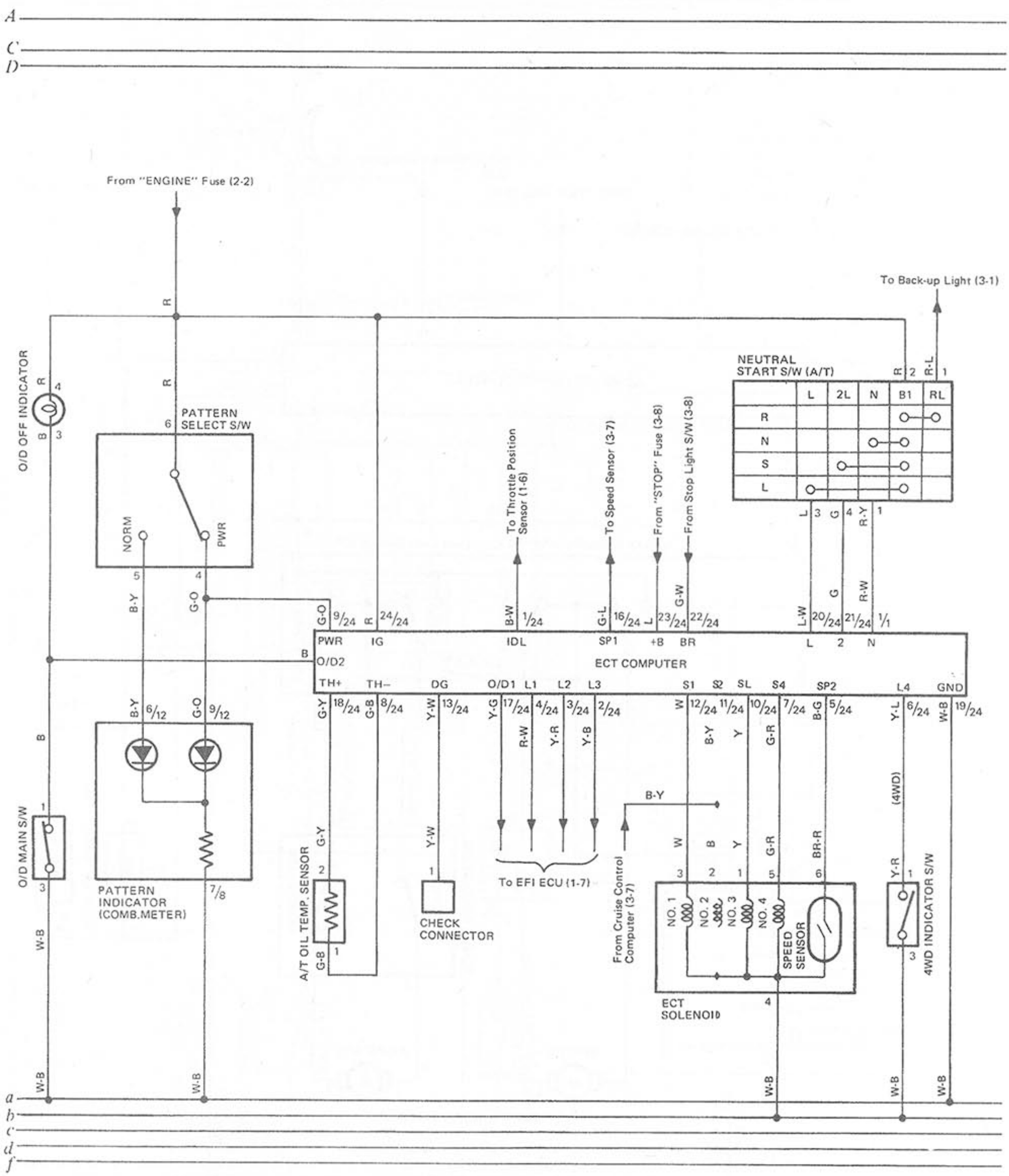
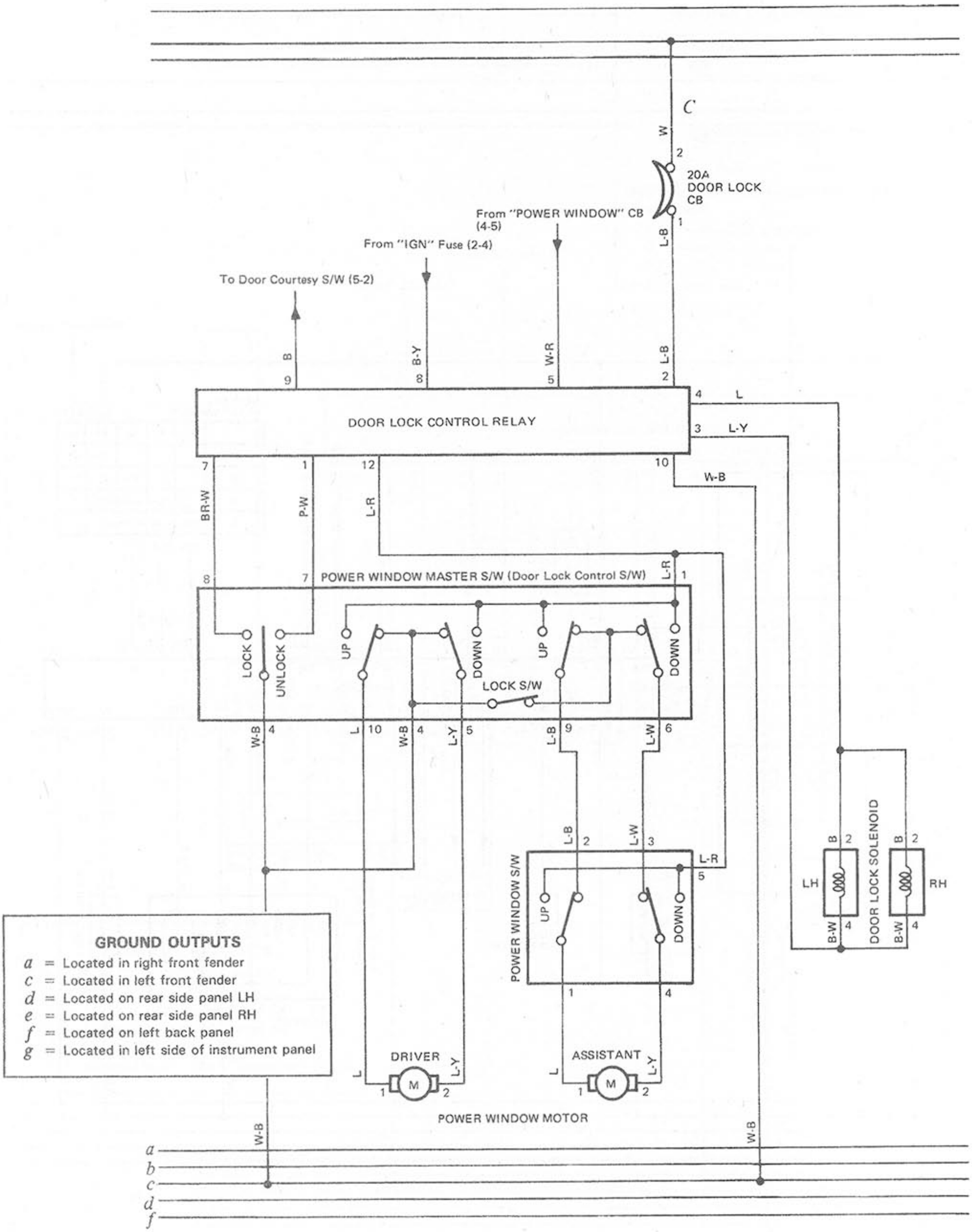
- *d* = Located on rear side panel LH
- *e* = Located on rear side panel RH
- *f* = Located on left back panel
- *g* = Located in left side of instrument panel

Typical late model - cruise control



Typical late model - Electronic Control Transmission (ECT)



GROUND OUTPUTS

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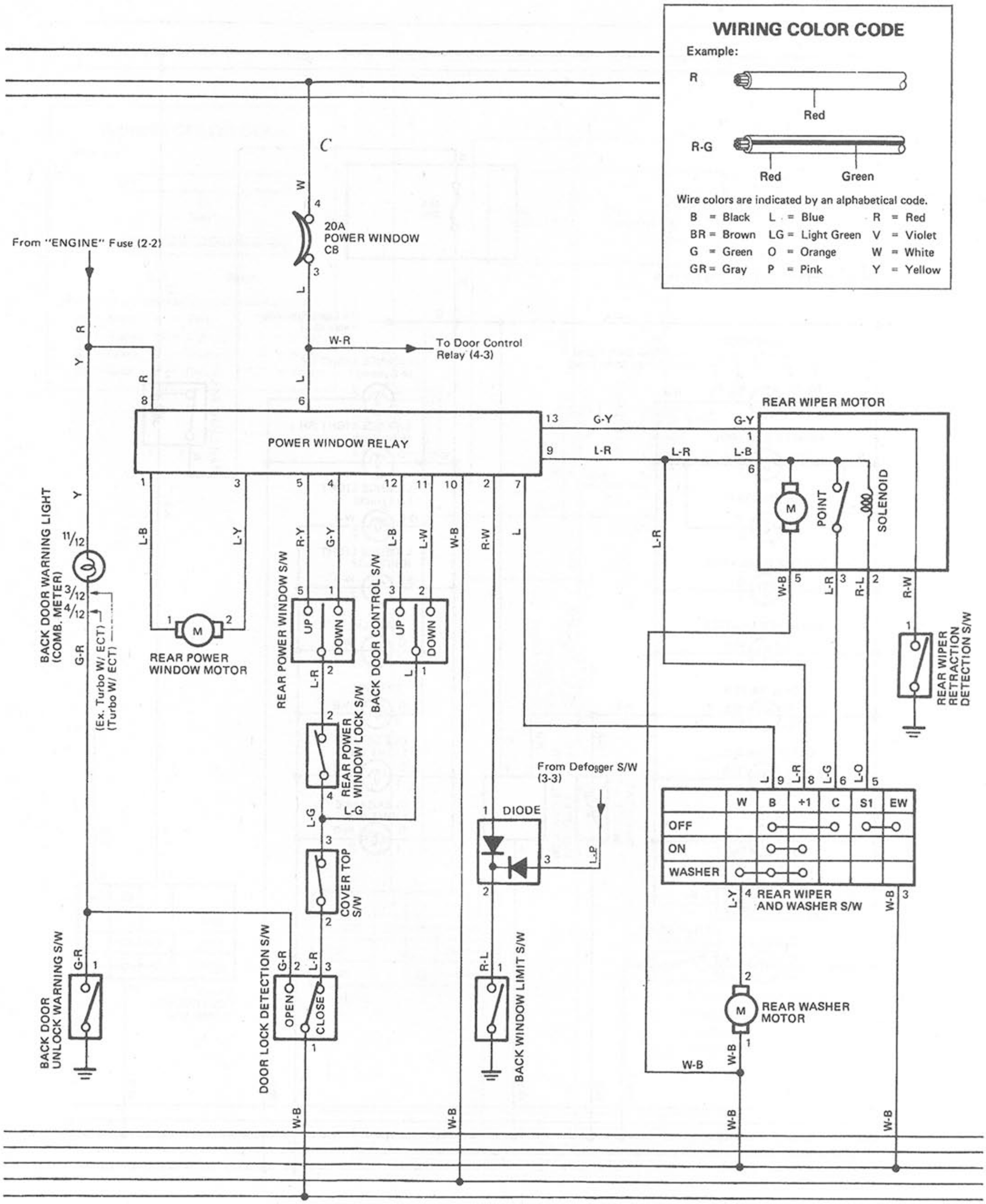
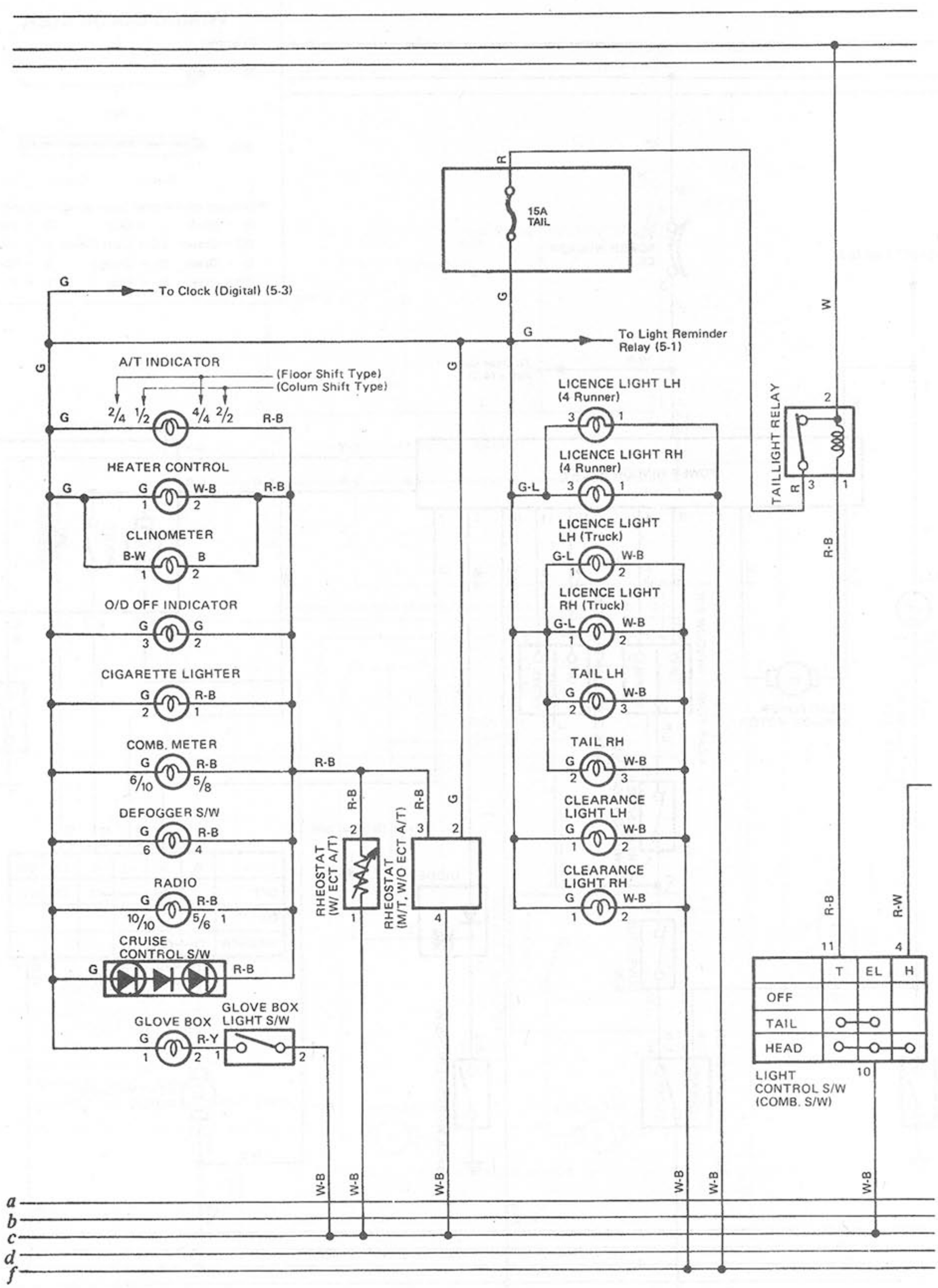
c = Located in left front fender
d = Located on rear side panel LH
e = Located on rear side panel RH
f = Located on left back panel
g = Located in left side of instrument panel

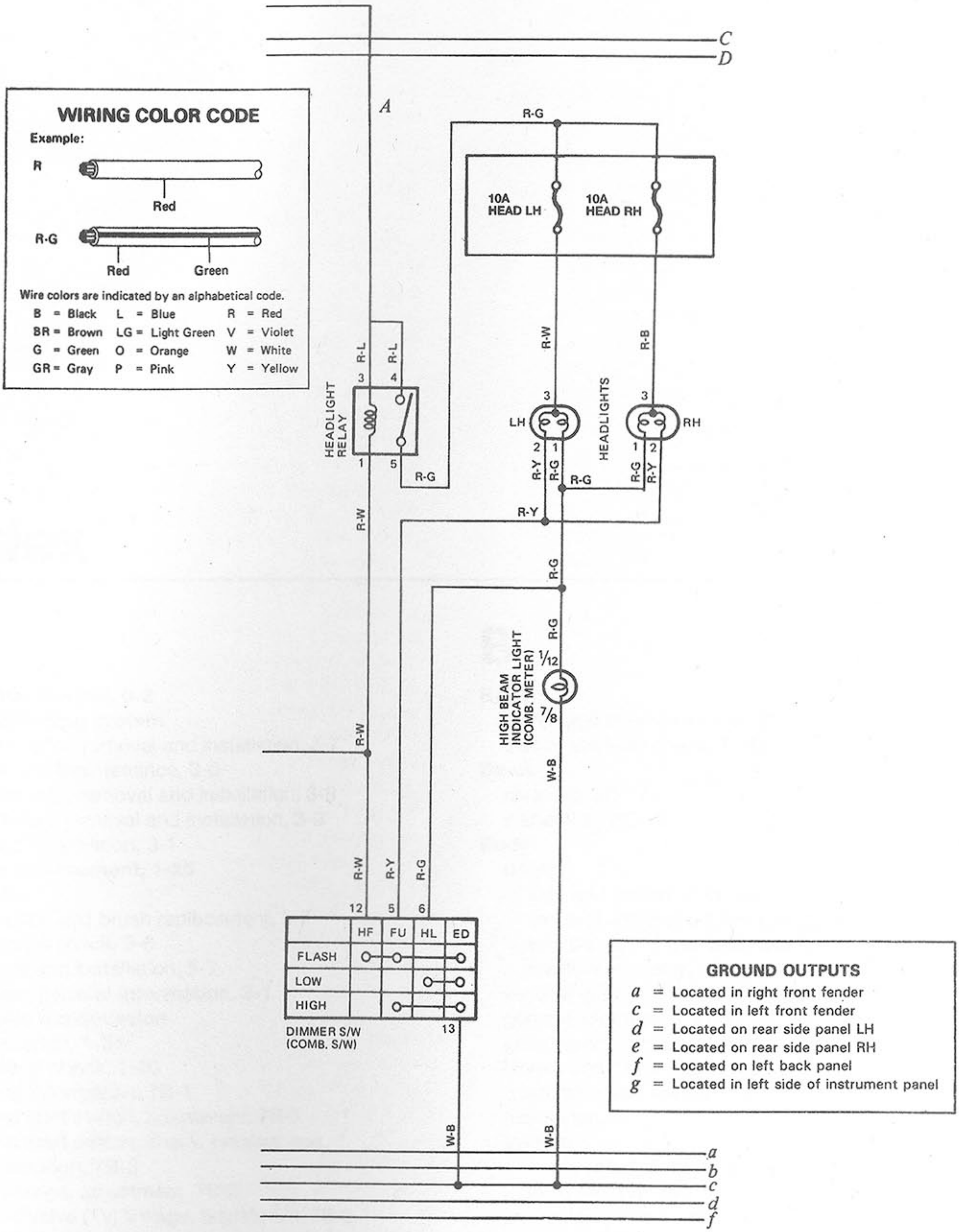
Typical late model - power windows and door locks



Typical late model - 4-Runner power window and wiper/washer



Typical late model - taillights and illumination



Typical late model - headlights

Notes

Index

A

About this manual, 0-2
Air conditioning system
accumulator, removal and installation, 3-7
check and maintenance, 3-6
compressor, removal and installation, 3-8
condenser, removal and installation, 3-9
general information, 3-1
Air filter replacement, 1-25
Alternator
inspection and brush replacement, 5-7
on vehicle check, 5-6
removal and installation, 5-7
Antifreeze general information, 3-1
Automatic transmission
fluid change, 1-31
fluid level check, 1-10
general information, 7B-1
neutral start switch, adjustment, 7B-3
neutral start switch, check, removal and installation, 7B-3
shift linkage, adjustment, 7B-2
throttle valve (TV) linkage, adjustment, 7B-2
Automotive chemicals and lubricants, 0-13
Axle
axleshaft, front, removal and installation, 8-19
oil change, 1-32
oil level check, 1-25

B

Battery
check and maintenance, 1-13
electrolyte level check, 1-10
Block
cleaning, 2C-17
inspection, 2C-18
Body
door
lock and handle, removal and installation, 11-8
removal, installation and adjustment, 11-9
trim panel, removal and installation, 11-3
window regulator, removal and installation, 11-8
window glass, removal and installation, 11-6, 11-7
general information, 11-1
grille, removal and installation, 11-12
hinges and locks, maintenance, 11-2
hood, removal, installation and adjustment, 11-11
maintenance, 11-1
tailgate
lock control, removal and installation, 11-12
lock, removal and installation, 11-12
windshield removal and installation, 11-10
Booster battery starting, 0-12
Brakes
bleeding, 9-15
booster check, removal and installation, 9-16
brake shoe replacement, 9-7

caliper, removal, overhaul and installation, 9-5
check, 1-21
disc inspection, removal and installation, 9-6
fluid level check, 1-8
general information, 9-2
load sensing valve, removal and installation, 9-15
master cylinder, removal, overhaul
and installation, 9-12
pad replacement, 9-3
parking brake
adjustment, 9-17
cable replacement, 9-18
check, 1-22
shoe replacement, 9-7
pedal check and adjustment, 1-13
specifications, 9-1
wheel cylinder, removal, overhaul and installation, 9-11
Bulb replacement, 12-5
Buying parts, 0-6

C

Caliper, removal, overhaul and installation, 9-5
Camshaft bearing inspection, 2A-7
Camshaft, removal and installation
four-cylinder engine, 2A-6
V6 engine, 2B-8
Carburetor
adjustment, 4-5
choke check, 1-29
general information, 4-2
overhaul, 4-4
removal and installation, 4-5
Carpet maintenance, 11-2
Charcoal canister filter replacement (EVAP system), 1-26
Charging system
alternator brush replacement, 5-7
alternator, removal and installation, 5-7
check, 5-5
general information, 5-2
Chassis lubrication, 1-16
Chemicals, 0-13
Clutch
bleeding, 8-6
fluid level check, 1-10
general information, 8-2
master cylinder, removal, overhaul and installation, 8-6
operating cylinder, removal, overhaul and
installation, 8-6
pedal free play, check and adjustment, 1-25
pedal, removal and installation, 8-7
release bearing, removal and installation, 8-5
removal, inspection and installation, 8-3
Coil, removal and installation, 5-3
Compression check, 2C-6
Connecting rod
bearing, inspection, 2C-20
bearing, oil clearance check, 2C-26
inspection, 2C-19
installation, 2C-26
removal, 2C-15
Conversion factors, 0-14
Coolant
level check, 1-8
reservoir, removal and installation, 3-3
Cooling system
antifreeze, general information, 3-1
check, 1-15
fan (and clutch), removal and installation, 3-2
general information, 3-1
radiator, removal and installation, 3-3
reservoir, removal and installation, 3-3
servicing, 1-28
specifications, 3-1
temperature sending unit check and
replacement, 3-4
thermostat check and replacement, 3-2
water pump
check, 3-3
removal and installation, 3-3
Crankshaft
inspection, 2C-20
main bearing inspection, 2C-20
oil clearance check, 2C-23
oil seal replacement,
removal, 2C-16
Cylinder head
cleaning and inspection, 2C-13
disassembly, 2C-13
reassembly, 2C-15
removal and installation
four-cylinder engine, 2A-6, 2A-8
V6 engine, 2B-10
Cylinder honing, 2C-18

D

Differential
oil change, 1-32
oil level check, 1-25
oil seal replacement
2WD, 8-12
4WD, 8-22
removal and installation
2WD, 8-14
4WD, 8-14
Disc brake
caliper, removal, overhaul and installation, 9-5
disc, inspection, removal and installation, 9-6
pad, replacement, 9-3

Distributor
cap check and replacement, 1-28
removal and installation, 5-5
rotor check and replacement, 1-28
Door
lock, removal and installation, 11-8
removal, installation and adjustment, 11-9
trim panel, removal and installation, 11-3
window glass and regulator, removal an
d installation, 11-8
Door removal, installation and adjustment, 11-9
Driveaxle (front, 4WD)
boot, replacement, 8-21
removal and installation, 8-20
Drivebelt, check and adjustment, 1-18
Driveshaft
check, 8-9
removal and installation, 8-9
Drum brake shoe, replacement, 9-7

E

Electrical system
alternator
brush replacement, 5-7
removal and installation, 5-7
bulbs, 12-5
charging system
check, 5-5
general information, 5-2
fuses, 12-2
fusible link general information, 12-2
hazard flasher, 12-3
headlight
adjustment, 12-5
removal and installation, 12-4
starter
check, 5-10
general information, 5-10
removal and installation, 5-10
switch, removal and installation, 12-3
troubleshooting, 12-1
turn signal flasher, 12-3
wiring diagrams, 12-7 through 12-26
Electronic spark timing control system, 6-22
Emissions systems
Air Injection (AI) system, 6-25
Air Suction (AS) system, 6-26
Automatic choke system, 6-30
Auxiliary Accelerator Pump (AAP) system, 6-33
Catalytic converter system, 6-28
Cold Mixture Heater (CMH) system, 6-35
Dashpot (DP) system, 6-23
Deceleration fuel cut system, 6-33
EFI system self-diagnosis capability, 6-36
Exhaust Gas Recirculation (EGR) system, 6-25
Engine
block
cleaning, 2C-17
inspection, 2C-18
break-in, 2C-27
camshaft
bearing inspection, 2A-7
lifter, removal, 2B-8
oil seal replacement, 2B-7
removal and installation
four-cylinder engine, 2A-6
V6 engine, 2B-8
compression check, 2C-6
coolant temperature sending unit, 3-4
crankshaft
inspection, 2C-20
installation, 2C-23
oil clearance check, 2C-23
oil seal replacement
four-cylinder engine, 2A-13
V6 engine, 2B-13
cylinder head
cleaning and inspection, 2C-13
disassembly, 2C-13
reassembly, 2C-15
removal and installation
four-cylinder engine, 2A-6, 2A-8
V6 engine, 2B-4
disassembly sequence, 2C-9
exhaust manifold, removal and installation
four-cylinder engine, 2A-4
V6 engine, 2B-4
firing order
four-cylinder engine, 2A-1
V6 engine, 2B-2
general information, 2A-2, 2B-2, 2C-5
honing, 2C-18
initial start-up after overhaul, 2C-27
intake manifold, removal and installation
four-cylinder engine, 2A-4
V6 engine, 2B-3
lifter, removal and installation (V6 engine), 2B-8
main bearing
inspection, 2C-20
oil clearance check, 2C-23
main seal, replacement
four-cylinder engine, 2C-25
V6 engine, 2C-25
mounts, check and replacement
four-cylinder engine, 2A-14
V6 engine, 2B-14
numbers, identification, 0-5

oil pan, removal and installation
four-cylinder engine, 2A-11
V6 engine, 2B-11
oil pump, removal and installation
four-cylinder engine, 2A-12
V6 engine, 2B-12
oil seal, replacement
four-cylinder engine, 2A-13
V6 engine, 2B-13
overhaul, general information, 2C-5
piston and rod
bearing oil clearance check, 2C-26
inspection, 2C-20
installation, 2C-26
removal, 2C-15
piston ring installation, 2C-23
reassembly sequence, 2C-22
rebuilding alternatives, 2C-8
removal and installation, 2C-6
removal methods and precautions, 2C-6
repair operations possible with the engine in the vehicle
four-cylinder engine, 2A-2
V6 engine, 2B-2
ring installation, 2C-23
rocker arm cover, removal and installation
four-cylinder engine, 2A-3
V6 engine, 2B-3
rocker arm, removal and installation (four-cylinder engine), 2A-3
rod bearing
inspection, 2C-20
oil clearance check, 2C-26
timing belt, removal, installation and adjustment (V6 engine), 2B-5
timing chain and sprocket, removal and installation (four-cylinder engine), 2A-10
timing cover, removal and installation, 2A-9
top dead center, locating
four-cylinder engine, 2A-3
V6 engine, 2B-2
valve
adjustment (four-cylinder engines), 1-19
servicing, 2C-15
vibration damper/pulley, removal and installation
four-cylinder engine, 2A-9
V6 engine, 2B-4
Evaporative Emission Control (EVAP) system, 6-17
Exhaust Gas Recirculation (EGR) system, 6-25
Exhaust manifold, removal and installation
four-cylinder engine, 2A-4
V6 engine, 2B-4
Exhaust system
catalytic converter, 6-28
check, 1-16
component replacement, 4-18

F

Fan and clutch, removal and installation, 3-2
Fasteners, 0-7
Firing order
four-cylinder engine, 2A-1
V6 engine, 2B-2
Fluid level checks, 1-8
Four-wheel drive system
driveaxle boot, replacement, 8-21
driveaxle, removal and installation, 8-20
driveshaft, removal and installation, 8-9
freewheel hub, removal and installation, 8-15
front differential oil seal, replacement, 8-22
front differential, removal and installation, 8-14
front hub and knuckle, removal and installation, 8-15
front wheel bearing and grease seal, removal, installation and adjustment, 1-24
transfer case, removal and installation, 7C-2
Freewheel hub (4WD), removal and installation, 8-15
Front seal, replacement
four-cylinder engine, 2A-9
V6 engine, 2B-7
Front wheel bearing check, repack and adjustment
2WD, 1-22
4WD, 1-24
Fuel Evaporative Control (EVAP) system canister replacement, 1-26
Fuel Evaporative Emission Control (EVAP) system, 6-17
general information, 6-1
High Altitude Compensation (HAC) system, 6-29
Hot Air Intake (HAI) system, 6-30
idle advance system, 6-34
Mixture Control (MC) system, 6-21
Positive Crankcase Ventilation (PCV) system, 6-17
Positive Crankcase Ventilation (PCV) valve replacement, 1-26
secondary slow circuit fuel cut system, 6-34
Spark Control (SC) system, 6-22
thermostatically-controlled air cleaner check, 1-29
Throttle Positioner (TP) system, 6-20
vacuum schematics, 6-2 through 6-17
Fuel filter replacement, 1-31
Fuel hose, 1-20
Fuel injection
general information and precautions, 4-6
injector, check and replacement, 4-15
pressure relief, 4-6
throttle body, removal, adjustment and installation, 4-14
Fuel pump, removal and installation, 4-3
Fuel system
carburetor
adjustment, 4-5

choke check, 1-29
overhaul, 4-4
removal and installation, 4-5
check, 1-20
filter replacement, 1-31
fuel injection, general information, 4-6
fuel line, repair and replacement, 4-8
fuel pump, removal and installation, 4-3
general information, 4-2
injector replacement, 4-15
pressure relief, 4-6
specifications, 4-1, 4-2
throttle body, removal and installation, 4-14
Fuel tank
cleaning and repair, 4-2
removal and installation, 4-2
Fuses, 12-2
Fusible links, 12-2

G

Glass replacement, 11-6, 11-7, 11-8, 11-10

H

Head
cleaning and inspection, 2C-13
disassembly, 2C-13
reassembly, 2C-15
removal and installation
four-cylinder engine, 2A-6, 2A-8
V6 engine, 2B-10
Headlight
adjustment, 12-5
removal and installation, 12-4
Heater blower, removal and installation, 3-4
Heater core, removal and installation, 3-5
Hinge maintenance, 11-2
Honing, 2C-18
Hood, removal and Installation, 11-11
Hose
check and replacement, 1-15
removal tips, 0-8

I

Identification numbers, 0-5
Idle speed check and adjustment, 1-19
Ignition switch replacement, 12-3
Ignition system
coil check and replacement, 5-3
distributor, removal and installation, 5-5
general information, 5-2
igniter, removal and installation, 5-4
pickup coil, removal and installation, 5-5
testing, 5-3
Ignition timing check and adjustment, 1-30
Instrument cluster, removal and installation, 12-4
Intake manifold, removal and installation
four-cylinder engine, 2A-4
V6 engine, 2B-3
Introduction to the Toyota pick-ups and 4-Runner, 0-4

J

Jacking and towing, 0-12
Jump starting, 0-12

K

Kickdown linkage adjustment, 7B-2

L

Leaf spring, removal and Installation, 10B-2, 10B-5
License plate light bulb replacement, 12-5
Light bulb replacement, 12-5
Light switch, removal and installation, 12-3
Lock maintenance, 11-2
Lubricants, 0-13, 1-1
Lubrication, 1-16

M

Main bearing
inspection, 2C-20
oil clearance check, 2C-23
Main seal replacement
four-cylinder engine, 2A-9, 2A-13
V6 engine, 2B-7, 2B-13
Maintenance schedule, 1-4
Maintenance techniques, tools and working facilities, 0-6
Manual transmission, 7A-1 through 7A-10
disassembly, overhaul and reassembly, 7A-2, 7A-8
general information, 7A-1
oil change, 1-31
oil level check, 1-25
oil seal replacement, 7A-1
removal and installation, 7A-4

Master cylinder, removal, overhaul and installation, 9-12
Metal lines, 1-16
Metric conversion, 0-14
Mounts, engine, check and replacement
four-cylinder engine, 2A-14
V6 engine, 2B-14

O

Oil
change, 1-17
filter change, 1-17
level check, 1-8
viscosity recommendations, 1-1
Oil pan
removal and Installation
four-cylinder engine, 2A-11
V6 engine, 2B-11
Oil pressure switch, 2C-5
Oil pump
removal and Installation
four-cylinder engine, 2A-12
V6 engine, 2B-12
Oil seal replacement
four-cylinder engine, 2A-9, 2A-13
V6 engine, 2B-7, 2B-13
Overhaul, general information, 2C-5
Oxygen sensor, replacement, 1-32

P

Parking brake
adjustment, 9-17
check, 1-22
control and cable replacement, 9-18
PCV valve, check and replacement, 1-26
Pinion oil seal, replacement, 8-12
Piston and connecting rod
inspection, 2C-19
installation, 2C-26
removal, 2C-15
Piston rings, installation, 2C-23
Pitman arm, removal and installation, 10A-13, 10B-7
Positive Crankcase Ventilation (PCV) system, 6-17
Power brake booster, check, removal and installation, 9-16
Power steering
bleeding, 10A-15
fluid level check, 1-11
gear, removal and installation, 10A-14
pump, removal and installation, 10A-14

R

Radiator, removal and installation, 3-3
Rear main seal, replacement
four-cylinder engine, 2A-9, 2C-25
V6 engine, 2B-7, 2C-25
Rebuilding alternatives, 2C-8
Recommended lubricants and fluids, 0-13, 1-1
Ring installation, 2C-23
Rocker arm, removal and installation (four-cylinder engine), 2A-5
Rocker arm cover, removal and Installation (four-cylinder engine), 2A-3
Rod
bearing inspection, 2C-20
bearing oil clearance check, 2C-26
inspection, 2C-19
installation, 2C-26
removal, 2C-15
Rotor (brake) inspection, removal and installation, 9-6
Routine maintenance, 1-1

S

Safety first! 0-15
Sealants, 0-13
Shift linkage adjustment, 7B-2
Shock absorber, removal and installation, 10A-4, 10A-10, 10B-2
Side marker light bulb, replacement, 12-5
Spark plug, replacement, 1-26
Spark plug wire check and replacement, 1-27
Stabilizer bar, removal and installation, 10A-4, 10A-10, 10B-2
Starter
check, 5-10
general information, 5-10
removal and installation, 5-10
Steering system
check, 1-20
general information, 10A-3, 10B-1
maintenance and inspection, 1-20
manual steering gear, removal and installation, 10A-14
Pitman arm, removal and installation, 10A-13, 10B-7
power steering, bleeding, 10A-15
power steering gear, removal and installation, 10A-14
power steering pump, removal and installation, 10A-14
steering gear, removal and installation, 10B-7
steering intermediate shaft, removal and installation, 10B-7
steering knuckle, removal and installation, 10A-9, 10B-5

steering linkage, removal and installation, 10B-5
steering wheel, removal and installation, 10A-12
swivel hub, removal and installation, 10B-8
wheels and tires, general information, 10A-16
Suspension system
balljoints, replacement, 10B-5
check, 1-20
front leaf spring (4WD), removal and installation, 10B-2
general information, 10A-3, 10B-1
lower suspension arm (and balljoint), removal and installation, 10A-8, 10B-4
rear leaf spring, removal and installation, 10A-10, 10B-5
shock absorber, removal and installation, 10A-4, 10A-10, 10B-2
stabilizer bar, removal and installation
front, 10A-4, 10B-2
rear, 10A-10
strut bar, removal and installation, 10A-4
torsion bar, removal and installation, 10A-5, 10B-3
upper suspension arm, removal and installation, 10A-7, 10B-4
Switch, ignition, removal and installation, 12-3

T

Thermostat check and replacement, 3-2
Thermostatic air cleaner, 1-29
Timing belt, removal, installation and adjustment (V6 engine), 2B-5
Timing chain and sprockets, removal and installation (four-cylinder engine), 2A-10
Timing chain cover, removal and installation, 2A-9
Timing, check and adjustment, 1-30
Tire and tire pressure checks, 1-11
Tire rotation, 1-20
Tools, 0-8
Top dead center, locating
four-cylinder engine, 2A-3
V6 engine, 2B-2
Towing, 0-12
Transfer case (4WD)
oil change, 1-32
oil level check, 1-25
removal and installation, 7C-2
Trouble codes, 6-37
Troubleshooting, 0-16
Tune-up, general information, 1-8
Turn signal light bulb replacement, 12-5
Turn signal switch, removal and installation, 12-3

U

Underhood hose check and replacement, 1-15
Universal joint replacement, 8-11
Upholstery maintenance, 11-2

V

Vacuum booster, removal and installation, 9-16
Vacuum hoses, 1-15
Valve adjustment (four-cylinder engines), 1-19
Valve seal replacement, 2C-15
Valve servicing, 2C-15
Valve spring replacement, 2C-15
Vehicle Emissions Control Information (VECI) label, 0-5, 6-1
Vehicle identification numbers, 0-5

W

Water pump
check, 3-3
removal and installation, 3-3
Wheel bearing check, repack and adjustment
2WD, 1-22
4WD, 1-24
Wheel cylinder, removal, overhaul and installation, 9-11
Wheels and tires, general information, 10A-16
Window glass and regulator, removal and installation, 11-6 through 11-8
Windshield
replacement, 11-10
washer fluid level check, 1-9
wiper arm, removal and installation, 12-3
wiper blade check and replacement, 1-13
Wiring diagrams, 12-7 through 12-26
Working facilities, 0-11

Haynes Automotive Manuals

NOTE: If you do not see a listing for your vehicle, consult your local Haynes dealer for the latest product information.

Haynes Xtreme Customizing

11101 Sport Compact Customizing
11102 Sport Compact Performance
11110 In-car Entertainment
11150 Sport Utility Vehicle Customizing
11213 Acura
11255 GM Full-size Pick-ups
11314 Ford Focus
11315 Full-size Ford Pick-ups
11373 Honda Civic

ACURA

12020 Integra '86 thru '89 **& Legend** '86 thru '90
12021 Integra '90 thru '93 **& Legend** '91 thru '95

AMC

Jeep CJ - *see JEEP (50020)*
14020 Mid-size models '70 thru '83
14025 (Renault) Alliance & Encore '83 thru '87

AUDI

15020 4000 all models '80 thru '87
15025 5000 all models '77 thru '83
15026 5000 all models '84 thru '88

AUSTIN-HEALEY

Sprite - *see MG Midget (66015)*

BMW

18020 3/5 Series not including diesel or all-wheel drive models '82 thru '92
18021 3-Series incl. Z3 models '92 thru '98
18025 320i all 4 cyl models '75 thru '83
18050 1500 thru 2002 except Turbo '59 thru '77

BUICK

19010 Buick Century '97 thru '02
Century (front-wheel drive) - *see GM (38005)*
19020 Buick, Oldsmobile & Pontiac Full-size (Front-wheel drive) '85 thru '02
Buick Electra, LeSabre and Park Avenue; **Oldsmobile** Delta 88 Royale, Ninety Eight and Regency; **Pontiac** Bonneville
19025 Buick Oldsmobile & Pontiac Full-size (Rear wheel drive)
Buick Estate '70 thru '90, Electra'70 thru '84, LeSabre '70 thru '85, Limited '74 thru '79
Oldsmobile Custom Cruiser '70 thru '90, Delta 88 '70 thru '85,Ninety-eight '70 thru '84
Pontiac Bonneville '70 thru '81, Catalina '70 thru '81, Grandville '70 thru '75, Parisienne '83 thru '86
19030 Mid-size Regal & Century all rear-drive models with V6, V8 and Turbo '74 thru '87
Regal - *see GENERAL MOTORS (38010)*
Riviera - *see GENERAL MOTORS (38030)*
Roadmaster - *see CHEVROLET (24046)*
Skyhawk - *see GENERAL MOTORS (38015)*
Skylark - *see GM (38020, 38025)*
Somerset - *see GENERAL MOTORS (38025)*

CADILLAC

21030 Cadillac Rear Wheel Drive all gasoline models '70 thru '93
Cimarron - *see GENERAL MOTORS (38015)*
DeVille - *see GM (38031 & 38032)*
Eldorado - *see GM (38030 & 38031)*
Fleetwood - *see GM (38031)*
Seville - *see GM (38030, 38031 & 38032)*

CHEVROLET

24010 Astro & GMC Safari Mini-vans '85 thru '03
24015 Camaro V8 all models '70 thru '81
24016 Camaro all models '82 thru '92
24017 Camaro & Firebird '93 thru '02
Cavalier - *see GENERAL MOTORS (38016)*
Celebrity - *see GENERAL MOTORS (38005)*
24020 Chevelle, Malibu & El Camino '69 thru '87
24024 Chevette & Pontiac T1000 '76 thru '87
Citation - *see GENERAL MOTORS (38020)*
24032 Corsica/Beretta all models '87 thru '96
24040 Corvette all V8 models '68 thru '82
24041 Corvette all models '84 thru '96
10305 Chevrolet Engine Overhaul Manual
24045 Full-size Sedans Caprice, Impala, Biscayne, Bel Air & Wagons '69 thru '90
24046 Impala SS & Caprice and Buick Roadmaster '91 thru '96
Impala - *see LUMINA (24048)*
Lumina '90 thru '94 - *see GM (38010)*
24048 Lumina & Monte Carlo '95 thru '03
Lumina APV - *see GM (38035)*
24050 Luv Pick-up all 2WD & 4WD '72 thru '82
Malibu '97 thru '00 - *see GM (38026)*
24055 Monte Carlo all models '70 thru '88
Monte Carlo '95 thru '01 - *see LUMINA (24048)*
24059 Nova all V8 models '69 thru '79
24060 Nova and Geo Prizm '85 thru '92
24064 Pick-ups '67 thru '87 - Chevrolet & GMC, all V8 & in-line 6 cyl, 2WD & 4WD '67 thru '87; Suburbans, Blazers & Jimmys '67 thru '91
24065 Pick-ups '88 thru '98 - Chevrolet & GMC, full-size pick-ups '88 thru '98, C/K Classic '99 & '00, Blazer & Jimmy '92 thru '94; Suburban '92 thru '99; Tahoe & Yukon '95 thru '99
24066 Pick-ups '99 thru '03 - Chevrolet Silverado & GMC Sierra full-size pick-ups '99 thru '05, Suburban/Tahoe/Yukon/Yukon XL '00 thru '05
24070 S-10 & S-15 Pick-ups '82 thru '93, **Blazer & Jimmy** '83 thru '94,
24071 S-10 & Sonoma Pick-ups '94 thru '04, **Blazer & Jimmy** '95 thru '04, **Hombre** '96 thru '01
24072 Chevrolet TrailBlazer & TrailBlazer EXT, GMC Envoy & Envoy XL, Oldsmobile Bravada '02 and '03
24075 Sprint '85 thru '88 **& Geo Metro** '89 thru '01
24080 Vans - Chevrolet & GMC '68 thru '96
24081 Chevrolet Express & GMC Savana Full-size Vans '96 thru '05

CHRYSLER

25015 Chrysler Cirrus, Dodge Stratus, Plymouth Breeze '95 thru '00
10310 Chrysler Engine Overhaul Manual
25020 Full-size Front-Wheel Drive '88 thru '93
K-Cars - *see DODGE Aries (30008)*
Laser - *see DODGE Daytona (30030)*
25025 Chrysler LHS, Concorde, New Yorker, Dodge Intrepid, **Eagle** Vision, '93 thru '97
25026 Chrysler LHS, Concorde, 300M, Dodge Intrepid, '98 thru '03
25030 Chrysler & Plymouth Mid-size front wheel drive '82 thru '95
Rear-wheel Drive - *see Dodge (30050)*
25035 PT Cruiser all models '01 thru '03
25040 Chrysler Sebring, **Dodge** Avenger '95 thru '02

DATSUN

28005 200SX all models '80 thru '83
28007 B-210 all models '73 thru '78
28009 210 all models '79 thru '82
28012 240Z, 260Z & 280Z Coupe '70 thru '78
28014 280ZX Coupe & 2+2 '79 thru '83
300ZX - *see NISSAN (72010)*
28018 510 & PL521 Pick-up '68 thru '73
28020 510 all models '78 thru '81
28022 620 Series Pick-up all models '73 thru '79
720 Series Pick-up - *see NISSAN (72030)*
28025 810/Maxima all gasoline models, '77 thru '84

DODGE

400 & 600 - *see CHRYSLER (25030)*
30008 Aries & Plymouth Reliant '81 thru '89
30010 Caravan & Plymouth Voyager '84 thru '95
30011 Caravan & Plymouth Voyager '96 thru '02
30012 Challenger/Plymouth Saporro '78 thru '83
30016 Colt & Plymouth Champ '78 thru '87
30020 Dakota Pick-ups all models '87 thru '96
30021 Durango '98 & '99, **Dakota** '97 thru '99
30022 Dodge Durango models '00 thru '03
Dodge Dakota models '00 thru '03
30025 Dart, Demon, Plymouth Barracuda, Duster & Valiant 6 cyl models '67 thru '76
30030 Daytona & Chrysler Laser '84 thru '89
Intrepid - *see CHRYSLER (25025, 25026)*
30034 Neon all models '95 thru '99
30035 Omni & Plymouth Horizon '78 thru '90
30036 Dodge and Plymouth Neon '00 thru'03
30040 Pick-ups all full-size models '74 thru '93
30041 Pick-ups all full-size models '94 thru '01
30042 Dodge Full-size Pick-ups '02 thru '05
30045 Ram 50/D50 Pick-ups & Raider and Plymouth Arrow Pick-ups '79 thru '93
30050 Dodge/Plymouth/Chrysler RWD '71 thru '89
30055 Shadow & Plymouth Sundance '87 thru '94
30060 Spirit & Plymouth Acclaim '89 thru '95
30065 Vans - Dodge & Plymouth '71 thru '03

EAGLE

Talon - *see MITSUBISHI (68030, 68031)*
Vision - *see CHRYSLER (25025)*

FIAT

34010 124 Sport Coupe & Spider '68 thru '78
34025 X1/9 all models '74 thru '80

FORD

10355 Ford Automatic Transmission Overhaul
36004 Aerostar Mini-vans all models '86 thru '97
36006 Contour & Mercury Mystique '95 thru '00
36008 Courier Pick-up all models '72 thru '82
36012 Crown Victoria & Mercury Grand Marquis '88 thru '00
10320 Ford Engine Overhaul Manual
36016 Escort/Mercury Lynx all models '81 thru '90
36020 Escort/Mercury Tracer '91 thru '00
36022 Ford Escape & Mazda Tribute '01 thru '03
36024 Explorer & Mazda Navajo '91 thru '01
36025 Ford Explorer & Mercury Mountaineer '02 and '03
36028 Fairmont & Mercury Zephyr '78 thru '83
36030 Festiva & Aspire '88 thru '97
36032 Fiesta all models '77 thru '80
36034 Focus all models '00 thru '05
36036 Ford & Mercury Full-size '75 thru '87
36044 Ford & Mercury Mid-size '75 thru '86
36048 Mustang V8 all models '64-1/2 thru '73
36049 Mustang II 4 cyl, V6 & V8 models '74 thru '78
36050 Mustang & Mercury Capri all models Mustang, '79 thru '93; Capri, '79 thru '86
36051 Mustang all models '94 thru '03
36054 Pick-ups & Bronco '73 thru '79
36058 Pick-ups & Bronco '80 thru '96
36059 F-150 & Expedition '97 thru '02, **F-250** '97 thru '99 **& Lincoln Navigator** '98 thru '02
36060 Super Duty Pick-ups, Excursion '99 thru '02
36062 Pinto & Mercury Bobcat '75 thru '80
36066 Probe all models '89 thru '92
36070 Ranger/Bronco II gasoline models '83 thru '92
36071 Ranger '93 thru '05 & **Mazda Pick-ups** '94 thru '05
36074 Taurus & Mercury Sable '86 thru '95
36075 Taurus & Mercury Sable '96 thru '05
36078 Tempo & Mercury Topaz '84 thru '94
36082 Thunderbird/Mercury Cougar '83 thru '88
36086 Thunderbird/Mercury Cougar '89 and '97
36090 Vans all V8 Econoline models '69 thru '91
36094 Vans full size '92 thru '01
36097 Windstar Mini-van '95 thru '03

GENERAL MOTORS

10360 GM Automatic Transmission Overhaul
38005 Buick Century, Chevrolet Celebrity, Oldsmobile Cutlass Ciera & Pontiac 6000 all models '82 thru '96
38010 Buick Regal, Chevrolet Lumina, Oldsmobile Cutlass Supreme & Pontiac Grand Prix (FWD) '88 thru '02
38015 Buick Skyhawk, Cadillac Cimarron, Chevrolet Cavalier, Oldsmobile Firenza & Pontiac J-2000 & Sunbird '82 thru '94
38016 Chevrolet Cavalier & Pontiac Sunfire '95 thru '04
38020 Buick Skylark, Chevrolet Citation, Olds Omega, Pontiac Phoenix '80 thru '85
38025 Buick Skylark & Somerset, Oldsmobile Achieva & Calais and Pontiac Grand Am all models '85 thru '98
38026 Chevrolet Malibu, Olds Alero & Cutlass, Pontiac Grand Am '97 thru '03
38030 Cadillac Eldorado '71 thru '85, **Seville** '80 thru '85, **Oldsmobile** Toronado '71 thru '85, **Buick Riviera** '79 thru '85
38031 Cadillac Eldorado & Seville '86 thru '91, **DeVille** '86 thru '93, **Fleetwood & Olds Toronado** '86 thru '92, **Buick Riviera** '86 thru '93
38032 Cadillac DeVille '94 thru '02 **& Seville** - '92 thru '02
38035 Chevrolet Lumina APV, Olds Silhouette & Pontiac Trans Sport all models '90 thru '96
38036 Chevrolet Venture, Olds Silhouette, Pontiac Trans Sport & Montana '97 thru '01
General Motors Full-size Rear-wheel Drive - see BUICK (19025)

GEO

Metro - *see CHEVROLET Sprint (24075)*
Prizm - *'85 thru '92 see CHEVY (24060), '93 thru '02 see TOYOTA Corolla (92036)*
40030 Storm all models '90 thru '93
Tracker - *see SUZUKI Samurai (90010)*

(Continued on other side)

Haynes Automotive Manuals (continued)

NOTE: If you do not see a listing for your vehicle, consult your local Haynes dealer for the latest product information.

GMC
Vans & Pick-ups - *see CHEVROLET*

HONDA
42010 **Accord CVCC** all models '76 thru '83
42011 **Accord** all models '84 thru '89
42012 **Accord** all models '90 thru '93
42013 **Accord** all models '94 thru '97
42014 **Accord** all models '98 thru '02
42015 **Honda Accord** models '03 thru '05
42020 **Civic 1200** all models '73 thru '79
42021 **Civic 1300 & 1500 CVCC** '80 thru '83
42022 **Civic 1500 CVCC** all models '75 thru '79
42023 **Civic** all models '84 thru '91
42024 **Civic & del Sol** '92 thru '95
42025 **Civic** '96 thru '00, **CR-V** '97 thru '01, **Acura Integra** '94 thru '00
42026 **Civic** '01 thru '04, **CR-V** '02 thru '04
42035 **Honda Odyssey** all models '99 thru '04
42040 **Prelude CVCC** all models '79 thru '89

HYUNDAI
43010 **Elantra** all models '96 thru '01
43015 **Excel & Accent** all models '86 thru '98

ISUZU
Hombre - *see CHEVROLET S-10 (24071)*
47017 **Rodeo** '91 thru '02; **Amigo** '89 thru '94 and '98 thru '02; **Honda Passport** '95 thru '02
47020 **Trooper & Pick-up** '81 thru '93

JAGUAR
49010 **XJ6** all 6 cyl models '68 thru '86
49011 **XJ6** all models '88 thru '94
49015 **XJ12 & XJS** all 12 cyl models '72 thru '85

JEEP
50010 **Cherokee, Comanche & Wagoneer Limited** all models '84 thru '01
50020 **CJ** all models '49 thru '86
50025 **Grand Cherokee** all models '93 thru '04
50029 **Grand Wagoneer & Pick-up** '72 thru '91 Grand Wagoneer '84 thru '91, Cherokee & Wagoneer '72 thru '83, Pick-up '72 thru '88
50030 **Wrangler** all models '87 thru '03
50035 **Liberty** '02 thru '04

KIA
54070 **Sephia** '94 thru '01, **Spectra** '00 thru '04

LEXUS
ES 300 - *see TOYOTA Camry (92007)*

LINCOLN
Navigator - *see FORD Pick-up (36059)*
59010 **Rear-Wheel Drive** all models '70 thru '01

MAZDA
61010 **GLC Hatchback (rear-wheel drive)** '77 thru '83
61011 **GLC (front-wheel drive)** '81 thru '85
61015 **323 & Protogé** '90 thru '00
61016 **MX-5 Miata** '90 thru '97
61020 **MPV** all models '89 thru '94
Navajo - *see Ford Explorer (36024)*
61030 **Pick-ups** '72 thru '93
Pick-ups '94 thru '00 - *see Ford Ranger (36071)*
61035 **RX-7** all models '79 thru '85
61036 **RX-7** all models '86 thru '91
61040 **626** (rear-wheel drive) all models '79 thru '82
61041 **626/MX-6 (front-wheel drive)** '83 thru '92
61042 **626** '93 thru '01, **MX-6/Ford Probe** '93 thru '01

MERCEDES-BENZ
63012 **123 Series Diesel** '76 thru '85
63015 **190 Series** four-cyl gas models, '84 thru '88
63020 **230/250/280** 6 cyl sohc models '68 thru '72
63025 **280 123 Series** gasoline models '77 thru '81
63030 **350 & 450** all models '71 thru '80

MERCURY
64200 **Villager & Nissan Quest** '93 thru '01
All other titles, see FORD Listing.

MG
66010 **MGB** Roadster & GT Coupe '62 thru '80
66015 **MG Midget, Austin Healey Sprite** '58 thru '80

MITSUBISHI
68020 **Cordia, Tredia, Galant, Precis & Mirage** '83 thru '93
68030 **Eclipse, Eagle Talon & Ply. Laser** '90 thru '94
68031 **Eclipse** '95 thru '01, **Eagle Talon** '95 thru '98
68035 **Mitsubishi Galant** '94 thru '03
68040 **Pick-up** '83 thru '96 & **Montero** '83 thru '93

NISSAN
72010 **300ZX** all models including Turbo '84 thru '89
72015 **Altima** all models '93 thru '04
72020 **Maxima** all models '85 thru '92
72021 **Maxima** all models '93 thru '04
72030 **Pick-ups** '80 thru '97 **Pathfinder** '87 thru '95
72031 **Frontier Pick-up** '98 thru '01, **Xterra** '00 & '01, **Pathfinder** '96 thru '01
72040 **Pulsar** all models '83 thru '86
Quest - *see MERCURY Villager (64200)*
72050 **Sentra** all models '82 thru '94
72051 **Sentra & 200SX** all models '95 thru '99
72060 **Stanza** all models '82 thru '90

OLDSMOBILE
73015 **Cutlass** V6 & V8 gas models '74 thru '88
For other OLDSMOBILE titles, see BUICK, CHEVROLET or GENERAL MOTORS listing.

PLYMOUTH
For PLYMOUTH titles, see DODGE listing.

PONTIAC
79008 **Fiero** all models '84 thru '88
79018 **Firebird** V8 models except Turbo '70 thru '81
79019 **Firebird** all models '82 thru '92
79040 **Mid-size Rear-wheel Drive** '70 thru '87
For other PONTIAC titles, see BUICK, CHEVROLET or GENERAL MOTORS listing.

PORSCHE
80020 **911** except Turbo & Carrera 4 '65 thru '89
80025 **914** all 4 cyl models '69 thru '76
80030 **924** all models including Turbo '76 thru '82
80035 **944** all models including Turbo '83 thru '89

RENAULT
Alliance & Encore - *see AMC (14020)*

SAAB
84010 **900** all models including Turbo '79 thru '88

SATURN
87010 **Saturn** all models '91 thru '02
87020 **Saturn** all L-series models '00 thru '04

SUBARU
89002 **1100, 1300, 1400 & 1600** '71 thru '79
89003 **1600 & 1800** 2WD & 4WD '80 thru '94
89100 **Legacy** all models '90 thru '98

SUZUKI
90010 **Samurai/Sidekick & Geo Tracker** '86 thru '01

TOYOTA
92005 **Camry** all models '83 thru '91
92006 **Camry** all models '92 thru '96
92007 **Camry, Avalon, Solara, Lexus ES 300** '97 thru '01
92008 **Toyota Camry, Avalon and Solara and Lexus ES 300/330** all models '02 thru '05
92015 **Celica Rear Wheel Drive** '71 thru '85
92020 **Celica Front Wheel Drive** '86 thru '99
92025 **Celica Supra** all models '79 thru '92
92030 **Corolla** all models '75 thru '79
92032 **Corolla** all rear wheel drive models '80 thru '87
92035 **Corolla** all front wheel drive models '84 thru '92
92036 **Corolla & Geo Prizm** '93 thru '02
92040 **Corolla Tercel** all models '80 thru '82
92045 **Corona** all models '74 thru '82
92050 **Cressida** all models '78 thru '82
92055 **Land Cruiser** FJ40, 43, 45, 55 '68 thru '82
92056 **Land Cruiser** FJ60, 62, 80, FZJ80 '80 thru '96
92065 **MR2** all models '85 thru '87
92070 **Pick-up** all models '69 thru '78
92075 **Pick-up** all models '79 thru '95
92076 **Tacoma** '95 thru '00, **4Runner** '96 thru '00, **& T100** '93 thru '98
92078 **Tundra** '00 thru '02 **& Sequoia** '01 thru '02
92080 **Previa** all models '91 thru '95
92082 **RAV4** all models '96 thru '02
92085 **Tercel** all models '87 thru '94
92090 **Toyota Sienna** all models '98 through '02

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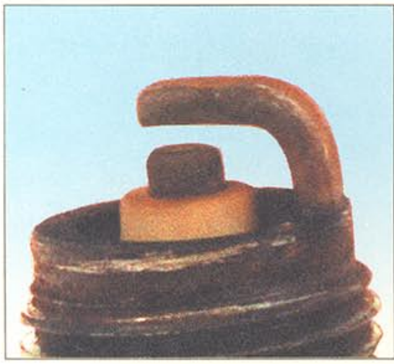
Common spark plug conditions



NORMAL

Symptoms: Brown to grayish-tan color and slight electrode wear. Correct heat range for engine and operating conditions.
Recommendation: When new spark plugs are installed, replace with plugs of the same heat range.

WORN

Symptoms: Rounded electrodes with a small amount of deposits on the firing end. Normal color. Causes hard starting in damp or cold weather and poor fuel economy.
Recommendation: Plugs have been left in the engine too long. Replace with new plugs of the same heat range. Follow the recommended maintenance schedule.

CARBON DEPOSITS

Symptoms: Dry sooty deposits indicate a rich mixture or weak ignition. Causes misfiring, hard starting and hesitation.
Recommendation: Make sure the plug has the correct heat range. Check for a clogged air filter or problem in the fuel system or engine management system. Also check for ignition system problems.

ASH DEPOSITS

Symptoms: Light brown deposits encrusted on the side or center electrodes or both. Derived from oil and/or fuel additives. Excessive amounts may mask the spark, causing misfiring and hesitation during acceleration.
Recommendation: If excessive deposits accumulate over a short time or low mileage, install new valve guide seals to prevent seepage of oil into the combustion chambers. Also try changing gasoline brands.

OIL DEPOSITS

Symptoms: Oily coating caused by poor oil control. Oil is leaking past worn valve guides or piston rings into the combustion chamber. Causes hard starting, misfiring and hesitation.
Recommendation: Correct the mechanical condition with necessary repairs and install new plugs.

GAP BRIDGING

Symptoms: Combustion deposits lodge between the electrodes. Heavy deposits accumulate and bridge the electrode gap. The plug ceases to fire, resulting in a dead cylinder.
Recommendation: Locate the faulty plug and remove the deposits from between the electrodes.

TOO HOT

Symptoms: Blistered, white insulator, eroded electrode and absence of deposits. Results in shortened plug life.
Recommendation: Check for the correct plug heat range, over-advanced ignition timing, lean fuel mixture, intake manifold vacuum leaks, sticking valves and insufficient engine cooling.

PREIGNITION

Symptoms: Melted electrodes. Insulators are white, but may be dirty due to misfiring or flying debris in the combustion chamber. Can lead to engine damage.
Recommendation: Check for the correct plug heat range, over-advanced ignition timing, lean fuel mixture, insufficient engine cooling and lack of lubrication.

HIGH SPEED GLAZING

Symptoms: Insulator has yellowish, glazed appearance. Indicates that combustion chamber temperatures have risen suddenly during hard acceleration. Normal deposits melt to form a conductive coating. Causes misfiring at high speeds.
Recommendation: Install new plugs. Consider using a colder plug if driving habits warrant.

DETONATION

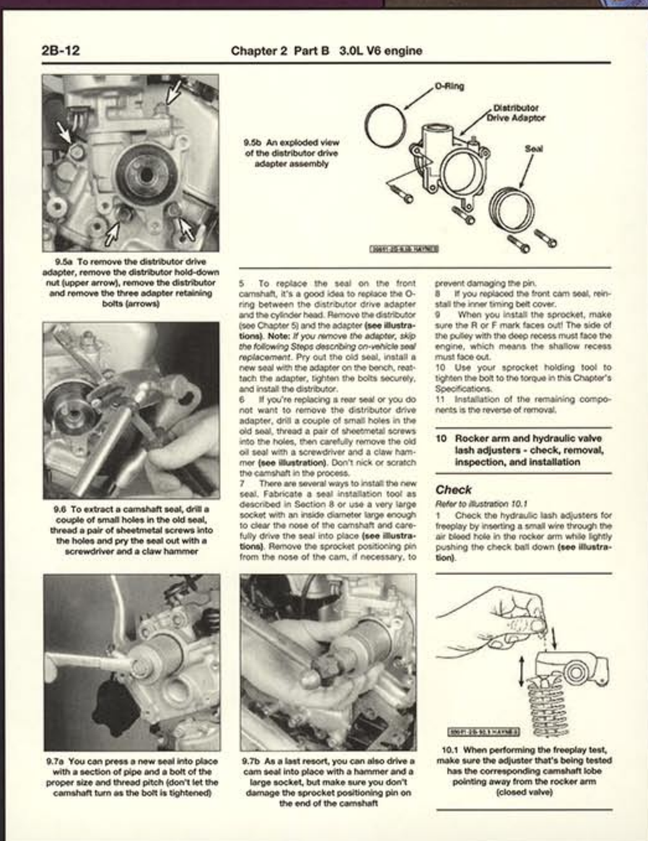
Symptoms: Insulators may be cracked or chipped. Improper gap setting techniques can also result in a fractured insulator tip. Can lead to piston damage.
Recommendation: Make sure the fuel anti-knock values meet engine requirements. Use care when setting the gaps on new plugs. Avoid lugging the engine.

MECHANICAL DAMAGE

Symptoms: May be caused by a foreign object in the combustion chamber or the piston striking an incorrect reach (too long) plug. Causes a dead cylinder and could result in piston damage.
Recommendation: Repair the mechanical damage. Remove the foreign object from the engine and/or install the correct reach plug.

Inside this manual:

- Routine maintenance
- Tune-up procedures
- Engine repair
- Cooling and heating
- Air conditioning
- Fuel and exhaust
- Emissions control
- Ignition
- Brakes
- Suspension and steering
- Electrical systems
- Wiring diagrams


2B-12 Chapter 2 Part B 3.0L V6 engine

9.5a To remove the distributor drive adapter, remove the distributor hold-down nut (upper arrow), remove the distributor and remove the three adapter retaining bolts (arrows)

9.5b An exploded view of the distributor drive adapter assembly

5 To replace the seal on the front camshaft, it's a good idea to replace the O-ring between the distributor drive adapter and the cylinder head. Remove the distributor (see Chapter 5) and the adapter **(see illustrations)**. **Note:** *If you remove the adapter, skip the following Steps describing on-vehicle seal replacement.* Pry out the old seal, install a new seal with the adapter on the bench, reattach the adapter, tighten the bolts securely, and install the distributor.

6 If you're replacing a rear seal or you do not want to remove the distributor drive adapter, drill a couple of small holes in the old seal, thread a pair of sheetmetal screws into the holes, then carefully remove the old oil seal with a screwdriver and a claw hammer **(see illustration)**. Don't nick or scratch the camshaft in the process.

7 There are several ways to install the new seal. Fabricate a seal installation tool as described in Section 8 or use a very large socket with an inside diameter large enough to clear the nose of the camshaft and carefully drive the seal into place **(see illustrations)**. Remove the sprocket positioning pin from the nose of the cam, if necessary, to prevent damaging the pin.

8 If you replaced the front cam seal, reinstall the inner timing belt cover.

9 When you install the sprocket, make sure the R or F mark faces out! The side of the pulley with the deep recess must face the engine, which means the shallow recess must face out.

10 Use your sprocket holding tool to tighten the bolt to the torque in this Chapter's Specifications.

11 Installation of the remaining components is the reverse of removal.

10 Rocker arm and hydraulic valve lash adjusters - check, removal, inspection, and installation

Check

Refer to illustration 10.1

1 Check the hydraulic lash adjusters for freeplay by inserting a small wire through the air bleed hole in the rocker arm while lightly pushing the check ball down **(see illustration)**.

9.6 To extract a camshaft seal, drill a couple of small holes in the old seal, thread a pair of sheetmetal screws into the holes and pry the seal out with a screwdriver and a claw hammer

9.7a You can press a new seal into place with a section of pipe and a bolt of the proper size and thread pitch (don't let the camshaft turn as the bolt is tightened)

9.7b As a last resort, you can also drive a cam seal into place with a hammer and a large socket, but make sure you don't damage the sprocket positioning pin on the end of the camshaft

10.1 When performing the freeplay test, make sure the adjuster that's being tested has the corresponding camshaft lobe pointing away from the rocker arm (closed valve)

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