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GENERAL MOTORS FULL-SIZE TRUCKS 1999-06 REPAIR MANUAL

CHILTON

Covers U.S. and Canadian models of
Chevrolet Silverado, GMC Sierra and Sierra Denali
Pick-ups (1999 thru 2006 and 2007 "Classic" models),
Chevrolet Suburban and Tahoe, GMC Yukon,
Yukon XL and Yukon Denali (2000 thru 2006),
Chevrolet Avalanche (2002 thru 2006)
Two- and four-wheel drive, gasoline engine versions

The First Step In Repair

INCLUDES WIRING DIAGRAMS

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Does not include 1999 and 2000 C/K Classic, 1999 and 2000 Sierra Classic, or information specific to diesel engine models, 8.1L engine models, CNG models, hybrids, models equipped with rear-wheel steering or heavy-duty models

by Jeff Kibler, A.S.E.

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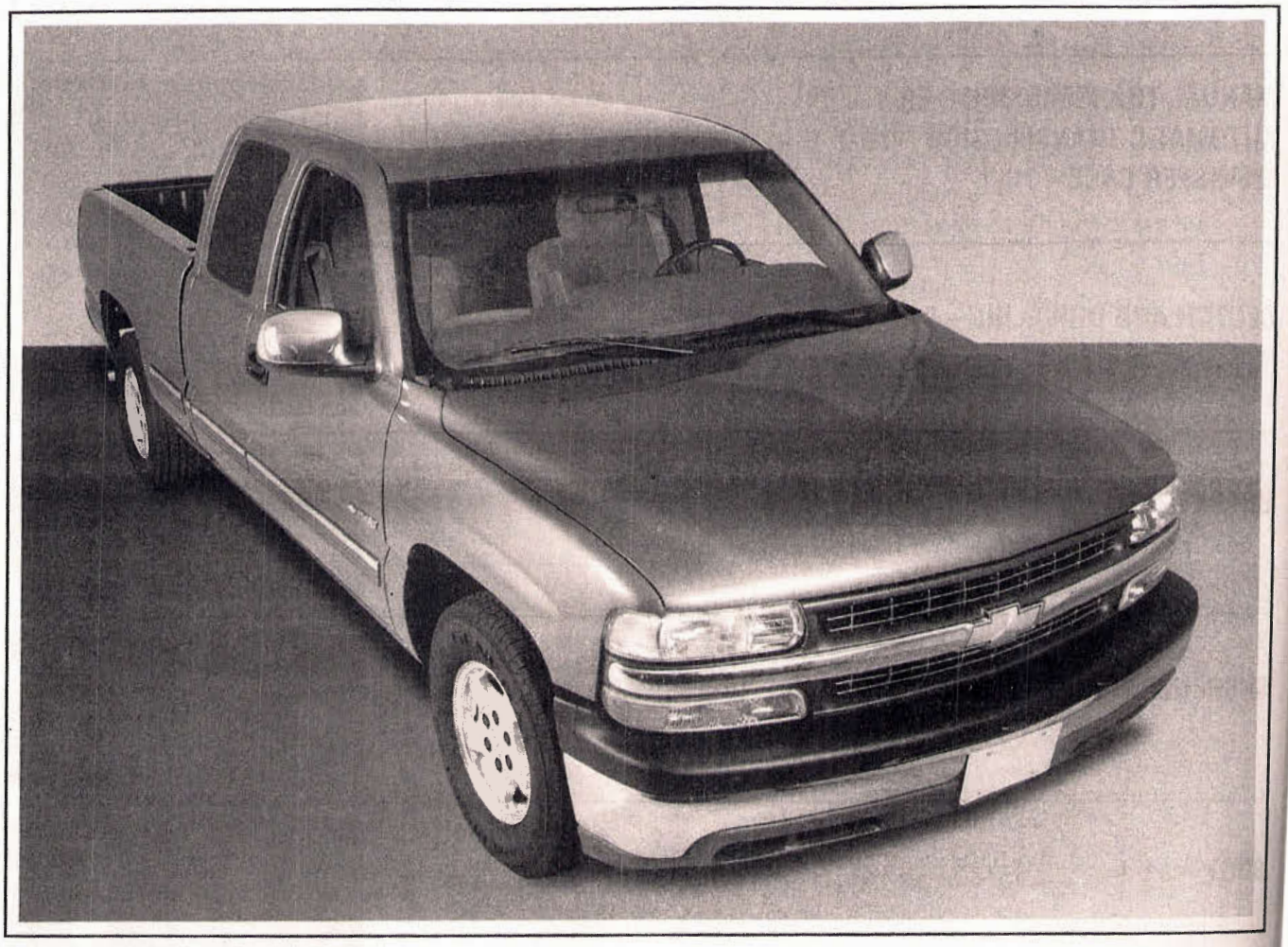
MASTER INDEX



2000 Chevrolet Silverado pick-up

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While every attempt is made to ensure that the information in this manual is correct, no liability can be accepted by the authors or publishers for loss, damage or injury caused by any errors in, or om issions from, the information given.

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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. Each Section consists of consecutively numbered paragraphs.

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

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

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

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

➡NOTE

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

CAUTION

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

WARNING

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

Introduction

The 1999 and later model year Silverado and Sierra models, while similar in appearance to earlier models, are a new design. Pick-ups are available as standard two-door bodies, or with a third (smaller) door behind the right passenger door, and an optional fourth door behind the driver's door on extended-cab models. The sport utility models, introduced in 2000, are all four-doors, with either a liftgate or optional twin doors at the rear. Engines are either V6 or V8, equipped with electronic, sequential multi-port fuel injection.

The chassis layout is conventional with the engine mounted at the front and the power being transmitted through either a four-speed automatic or five-speed manual transmission or driveshaft to the rear axle. On 4WD models a transfer case transmits the power to the front differential and then to the front wheels through independent driveaxles.

These models feature independent front suspension with coil springs (2WD pick-up models) or torsion bars (4WD pick-ups and all SUV models) and shock absorbers at the front. At the rear, all models have a solid rear axle supported by leaf springs and shock absorbers on pick-ups and 2500 series SUV models, and coil springs with shock absorbers on 1500 series SUV models.

The power-assisted steering is either rack-and-pinion (2WD 1500 pick-ups) or conventional recirculating ball type (all other models). The rack-and-pinion steering unit is mounted in front of the engine and the conventional steering box is located on the left-side frame rail.

Some 2002 and later models are equipped with an optional four-wheel steering system called Quadrasteer™. The system allows the driver to choose between several steering modes that can improve maneuverability under certain low-speed, high-speed or towing conditions.

Most models have a power assisted disc-type front and rear brake system with Anti-lock Brake System (ABS) standard. Some later models are equipped with rear drum brakes.

Vehicle identification numbers

VEHICLE IDENTIFICATION NUMBERS

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

VEHICLE IDENTIFICATION NUMBER (VIN)

The Vehicle Identification Number (VIN), which appears on the Vehicle Certificate of Title and Registration, is also embossed on a gray plate located on the upper left (driver's side) corner of the dashboard, near the windshield (see illustration). The VIN tells you when and where a vehicle was manufactured, its country of origin, make, type, passenger safety system, line, series, body style, engine and assembly plant.

VIN ENGINE AND MODEL YEAR CODES

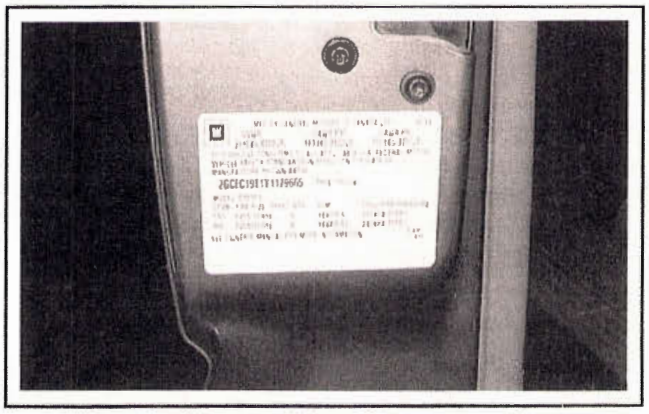
Two particularly important pieces of information found in the VIN are the engine code and the model year code. Counting from the left, the engine code letter designation is the 8th character and the model year code is the 10th character.

On the model years covered by this manual the engine codes are:

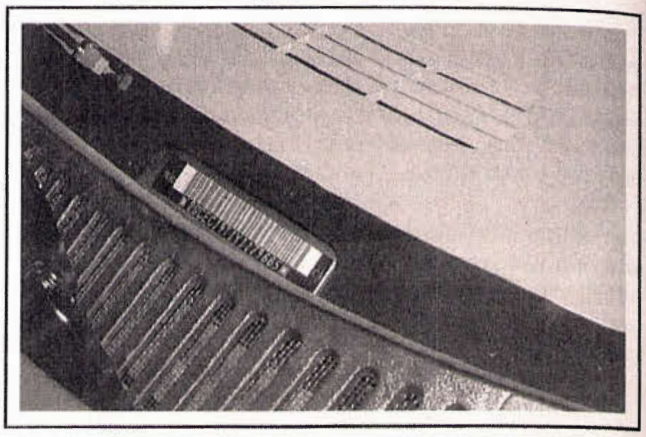
B..... 5.3L V8 (L33)
N..... 6.0L V8 (LQ9)
T..... 5.3L V8 (LM7)
U..... 6.0L V8 (LQ4)
V..... 4.8L V8 (LR4)
W..... 4.3L V6 (L35)
X..... 4.3L V6 (LU3)
Z..... 5.3L V8 (L59)

On the models covered by this manual the model year codes are:

X..... 1999
Y..... 2000
1..... 2001



The Vehicle Safety Certification label is affixed to the drivers side door end or post



The VIN plate is visible from the outside of the vehicle, through the driver's side of the windshield

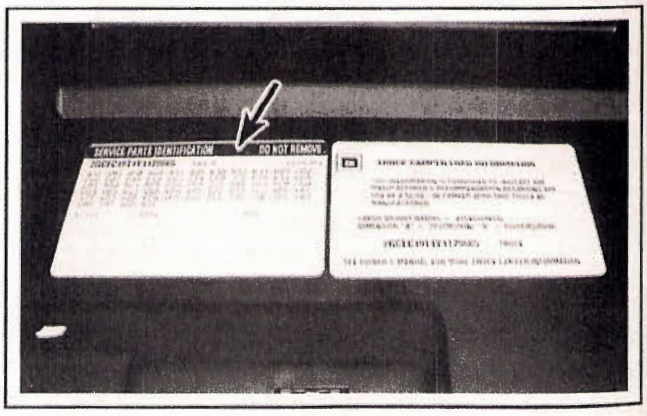
2..... 2002
3..... 2003
4..... 2004
5..... 2005
6..... 2006
7..... 2007

VEHICLE SAFETY CERTIFICATION LABEL

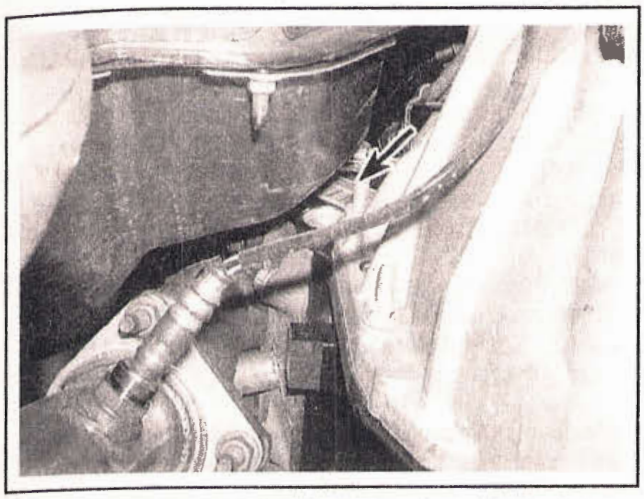
The Vehicle Safety Certification label is attached to the rear edge of the driver's door (see illustration). The label contains the name of the manufacturer, the month and year of production, the Gross Vehicle Weight Rating (GVWR), the Gross Axle Weight Rating (GAWR) and the certification statement. On most models, the label also includes the OEM tire sizes and pressures.

SERVICE PARTS IDENTIFICATION LABEL

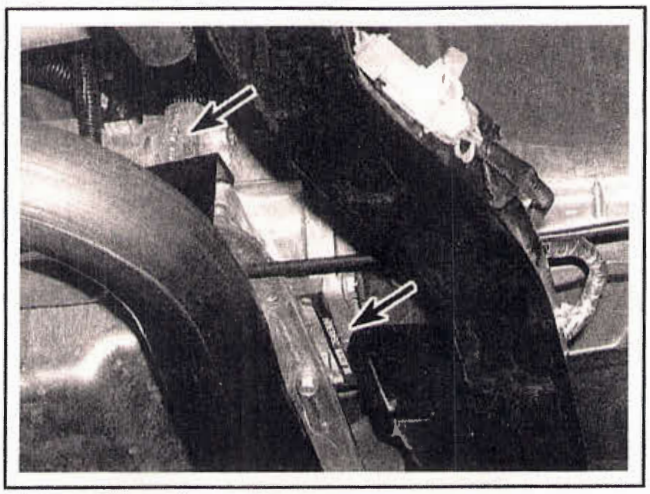
Located on the inside of the glove compartment lid, this label contains information about the options on your vehicle and the paint and trim codes (see illustration). This information is important when ordering parts or when bodywork and repainting is done.



The Service Parts Identification label (arrow) contains information on options and trim/paint codes



On V8 engines the identification number (arrow) is located at the left rear of the engine (seen here from below)



Typical automatic transmission identification number locations

ENGINE IDENTIFICATION NUMBER (EIN)

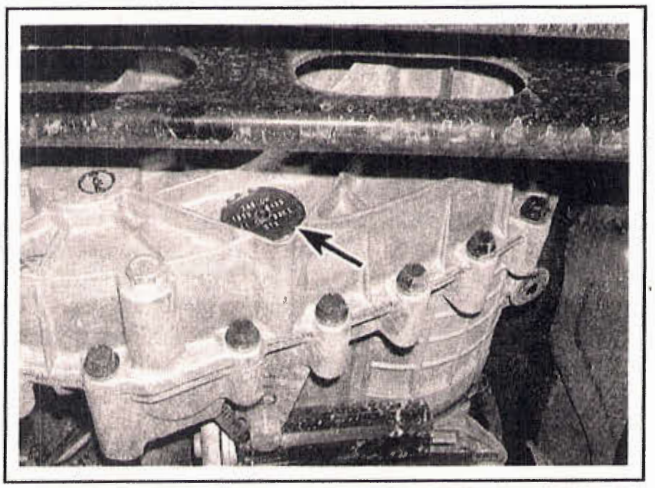
The V8 Engine Identification Number (EIN) is stamped into the rear of the engine block just below the left cylinder head (see illustration). On V6 engines the EIN is located either on the block below the left cylinder head or on the rear of the block near the right side cylinder head.

TRANSMISSION IDENTIFICATION NUMBER (TIN)

The manual Transmission Identification Number (TIN) is located on a tag or label on top of the left portion of the bellhousing area of the transmission. On automatic transmissions the TIN is stamped into the transmission case (see illustration).

TRANSFER CASE IDENTIFICATION LABEL

The transfer case identification information is on a tag affixed to the rear side of the case (see illustration).



Location of the transfer case identification tag

Buying parts

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

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

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

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

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

Maintenance techniques, tools and working facilities

MAINTENANCE TECHNIQUES

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

Fasteners

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

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

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

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

Fastener sizes

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

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

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

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

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

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

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

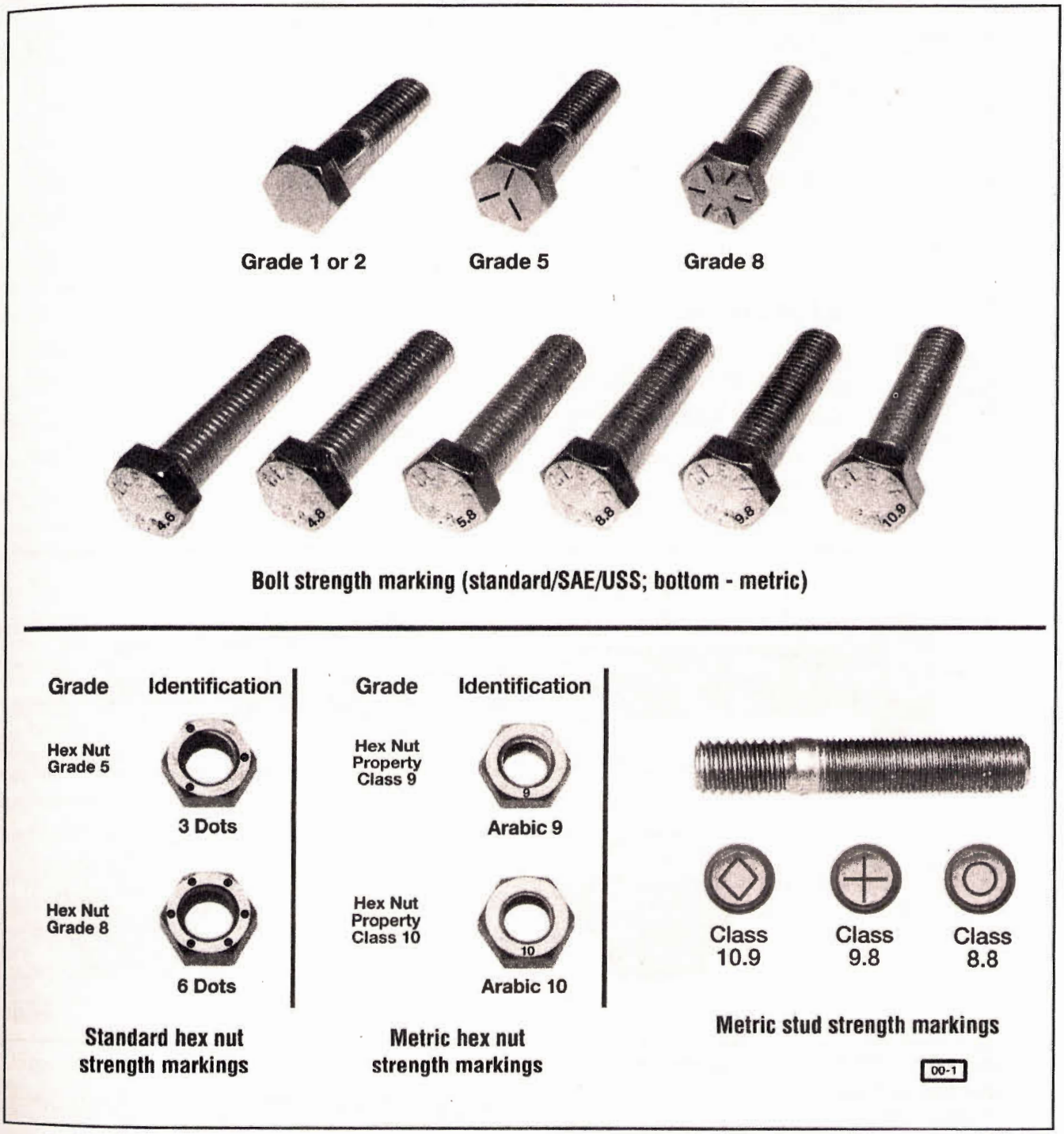
Since fasteners of the same size (both standard and metric) may have different strength ratings, be sure to reinstall any bolts, studs or nuts removed from your vehicle in their original locations. Also, when replacing a fastener with a new one, make sure that the new one has a strength rating equal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

Tightening sequences and procedures

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

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

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

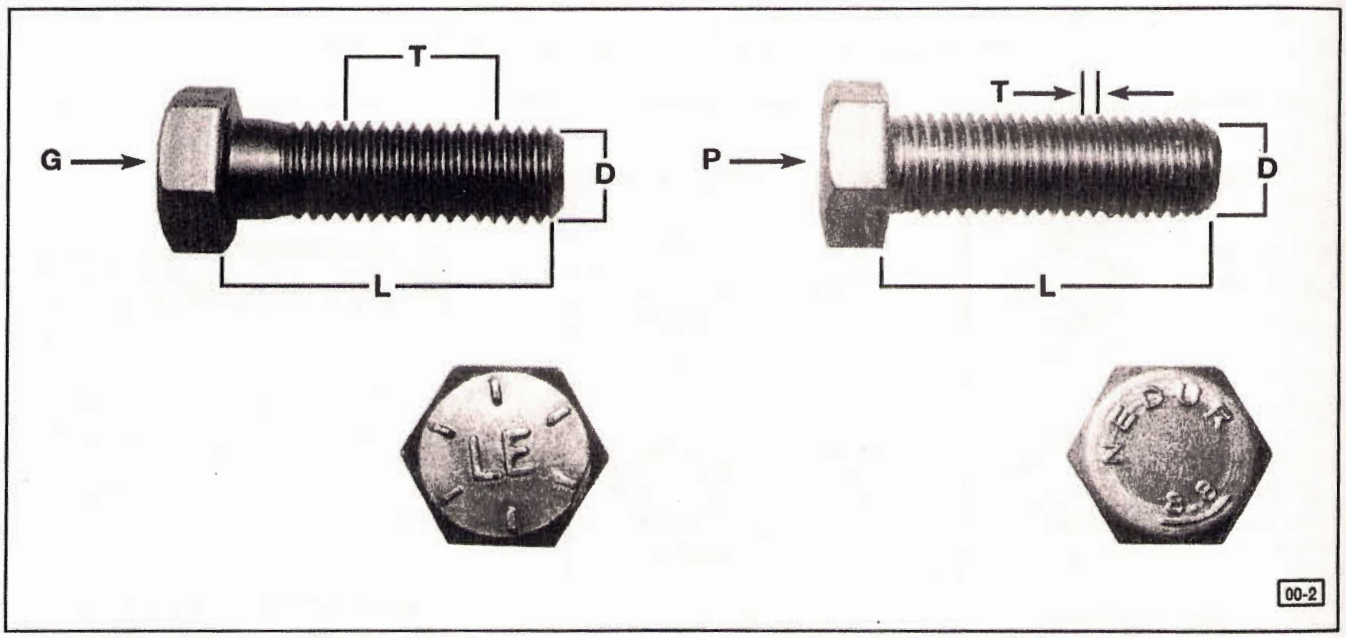


Component disassembly

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

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

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*

valve train or interior dash and trim pieces. The cavities can be marked with paint or tape to identify the contents.

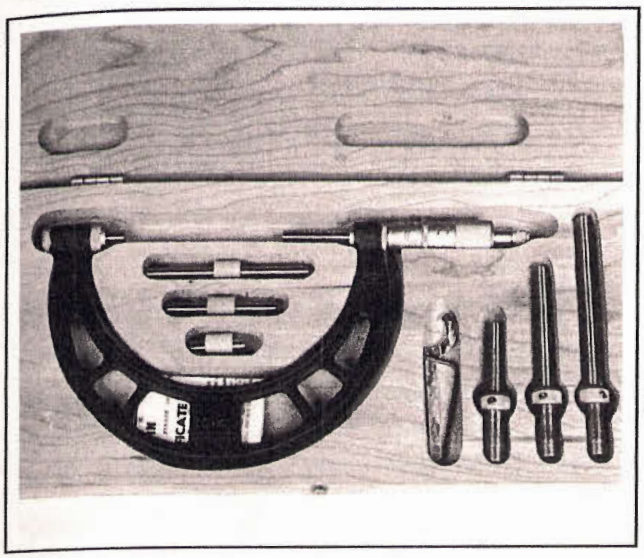
Whenever wiring looms, harnesses or connectors are separated, it is a good idea to identify the two halves with numbered pieces of masking tape so they can be easily reconnected.

Gasket sealing surfaces

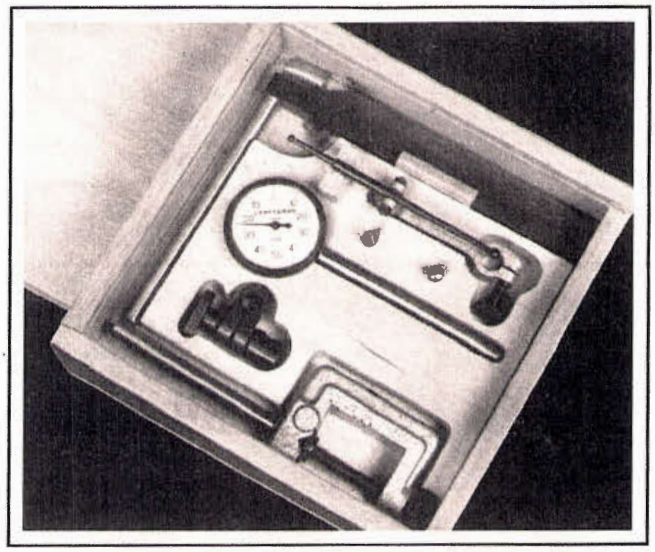
Throughout any vehicle, gaskets are used to seal the mating surfaces between two parts and keep lubricants, fluids, vacuum or pressure contained in an assembly.

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



Micrometer set



Dial indicator set

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.

CAUTION:

Never use gasket removal solutions or caustic chemicals on plastic or other composite components.

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

Hose removal tips

WARNING:

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

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

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

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

TOOLS

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

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

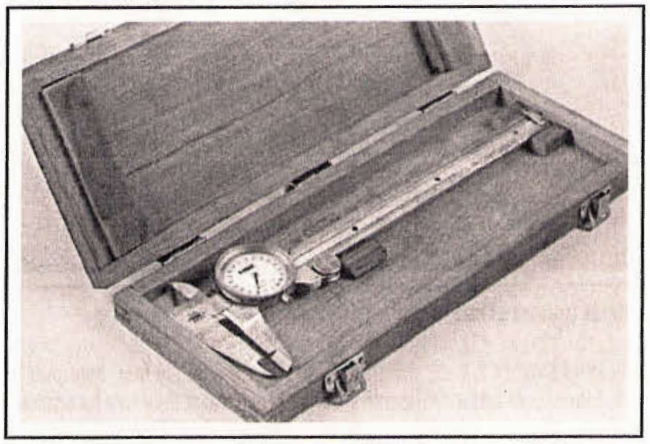
The newcomer to practical mechanics should start off with the *maintenance and minor repair* tool kit, which is adequate for the simpler jobs performed on a vehicle. Then, as confidence and experience grow, the owner can tackle more difficult tasks, buying additional tools as they are needed. Eventually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

Maintenance and minor repair tool kit

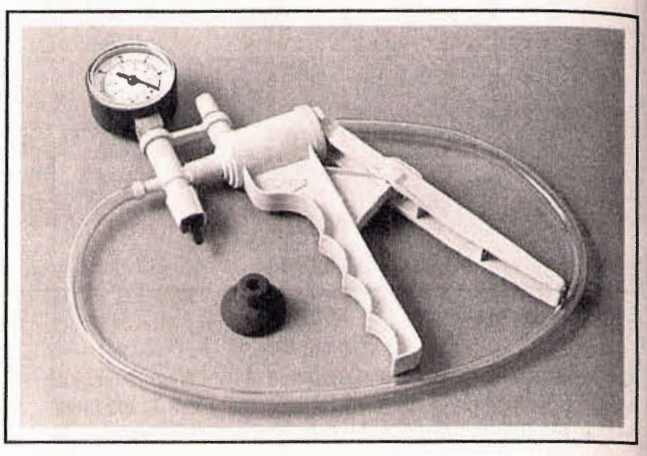
The tools in this list should be considered the minimum required for performance of routine maintenance, servicing and minor repair work. We recommend the purchase of combination wrenches (box-end and open-end combined in one wrench). While more expensive than open end wrenches, they offer the advantages of both types of wrench.

Combination wrench set (1/4-inch to 1 inch or 6 mm to 19 mm)

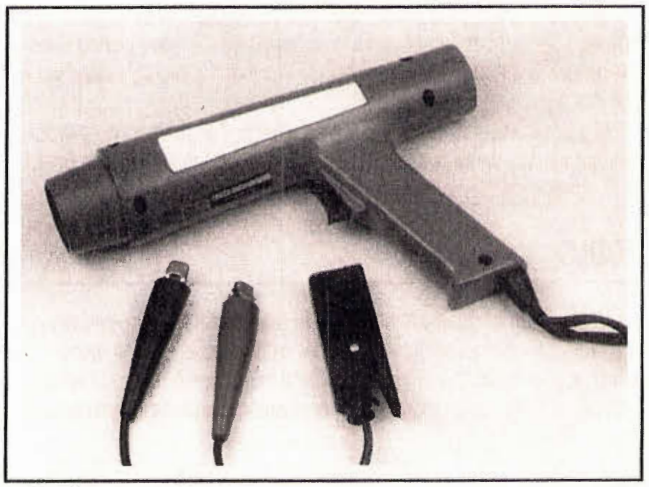
Adjustable wrench, 8 inch
Spark plug wrench with rubber insert
Spark plug gap adjusting tool
Feeler gauge set
Brake bleeder wrench
Standard screwdriver (5/16-inch x 6 inch)
Phillips screwdriver (No. 2 x 6 inch)
Combination pliers - 6 inch
Hacksaw and assortment of blades
Tire pressure gauge
Grease gun
Oil can
Fine emery cloth
Wire brush
Battery post and cable cleaning tool
Oil filter wrench



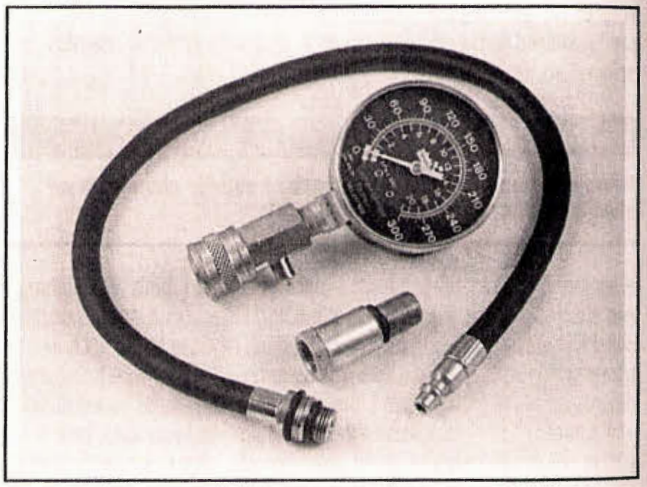
Dial caliper



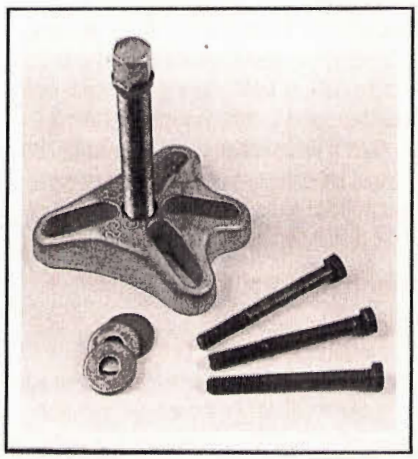
Hand-operated vacuum pump



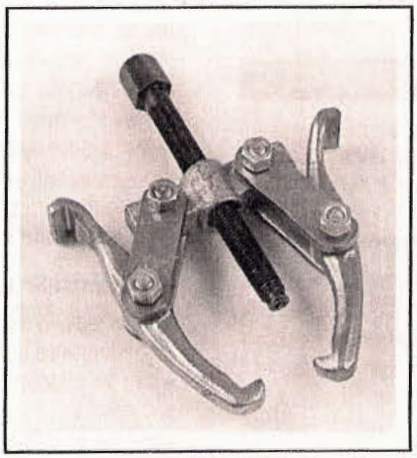
Timing light



Compression gauge with spark plug hole adapter



Damper/steering wheel puller



General purpose puller

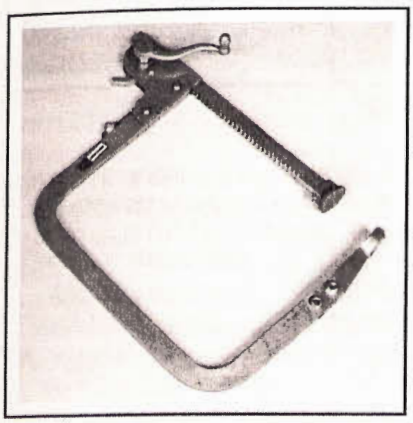
Hydraulic lifter removal tool

Funnel (medium size)
Safety goggles
Jackstands (2)
Drain pan

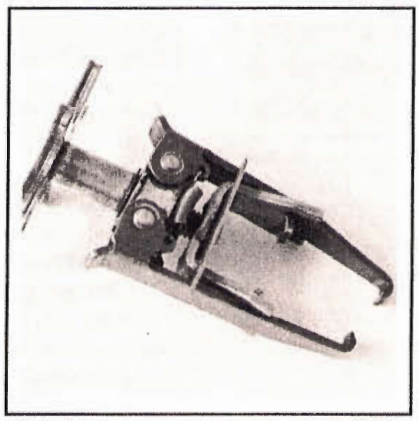
➡Note: If basic tune-ups are going to be part of routine maintenance, it will be necessary to purchase a good quality stroboscopic timing light and combination tachometer/dwell meter. Although they are included in the list of special tools, it is mentioned here because they are absolutely necessary for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

Repair and overhaul tool set

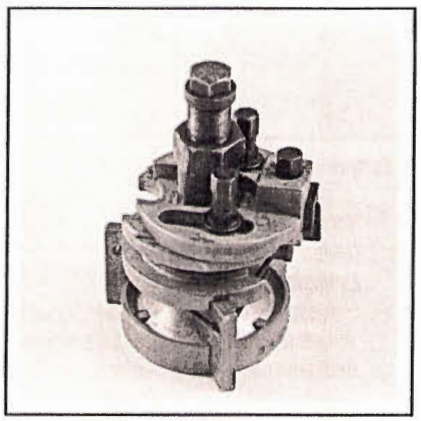
These tools are essential for anyone who plans to perform major repairs and are in addition to those in the maintenance and minor repair tool kit. Included is a comprehensive set of sockets which, though expensive, are invaluable because of their versatility, especially when various extensions and drives 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.



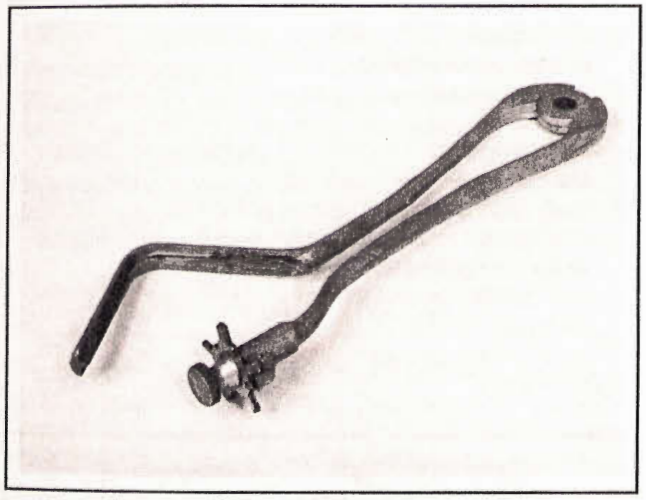
Valve spring compressor



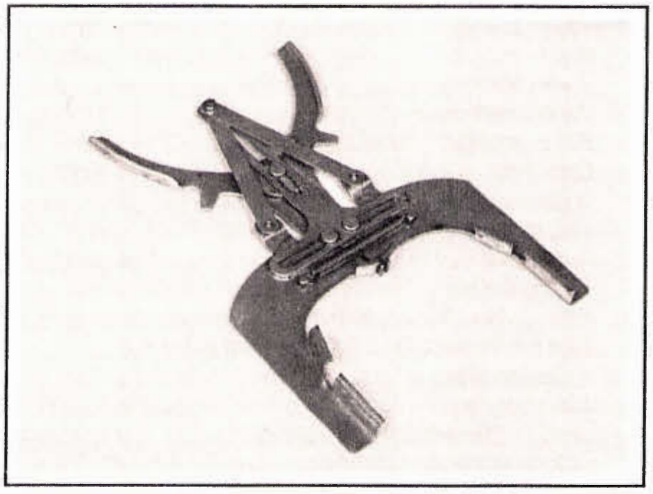
Valve spring compressor



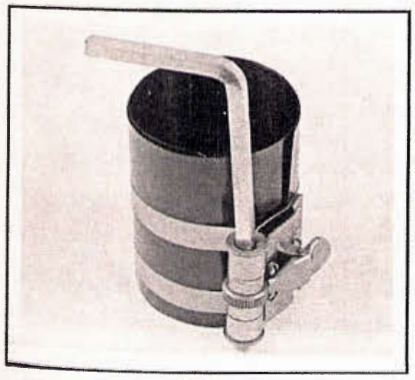
Ridge reamer



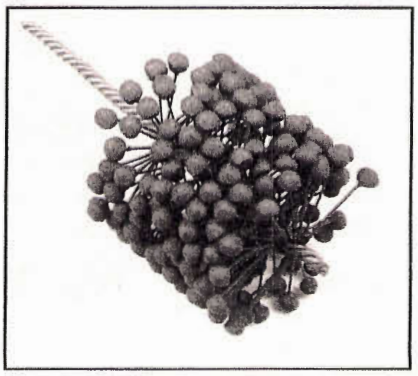
Piston ring groove cleaning tool



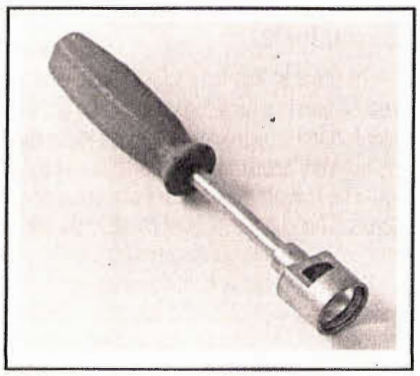
Ring removal/installation tool



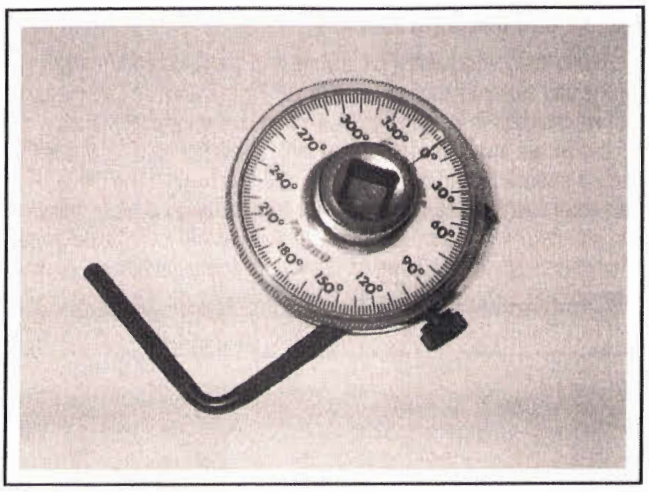
Ring compressor



Cylinder hone



Brake hold-down spring tool



Torque angle gauge

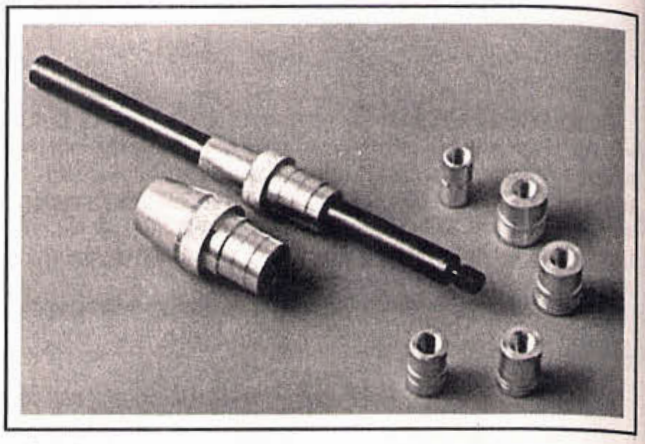
Socket set(s)
Reversible ratchet
Extension - 10 inch
Universal joint
Torque wrench (same size drive as sockets)
Ball peen hammer - 8 ounce
Soft-face hammer (plastic/rubber)
Standard screwdriver (1/4-inch x 6 inch)
Standard screwdriver (stubby - 5/16-inch)
Phillips screwdriver (No. 3 x 8 inch)
Phillips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

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

Special tools

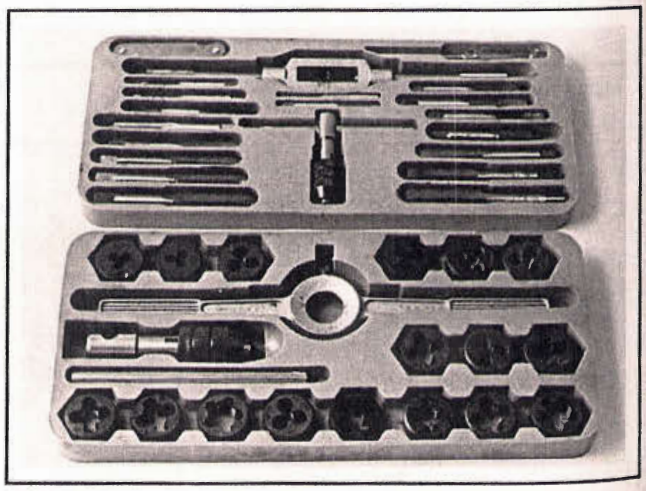
The tools in this list include those which are not used regularly, are expensive to buy, or which need to be used in accordance with their manufacturer's instructions. Unless these tools will be used frequently, it is not very economical to purchase many of them. A consideration would be to split the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

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



Clutch plate alignment tool

Valve spring compressor
Piston ring groove cleaning tool
Piston ring compressor
Piston ring installation tool
Cylinder compression gauge
Cylinder ridge reamer
Cylinder surfacing hone
Cylinder bore gauge
Micrometers and/or dial calipers
Hydraulic lifter removal tool
Balljoint separator
Universal-type puller
Impact screwdriver
Dial indicator set
Stroboscopic timing light (inductive pick-up)
Hand operated vacuum/pressure pump
Tachometer/dwell meter
Universal electrical multimeter
Cable hoist
Brake spring removal and installation tools
Floor jack



Tap and die set

Buying tools

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

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

Care and maintenance of tools

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

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

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

HOW TO REPAIR DAMAGED THREADS

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

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

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

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

WORKING FACILITIES

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

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

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

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

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

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

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

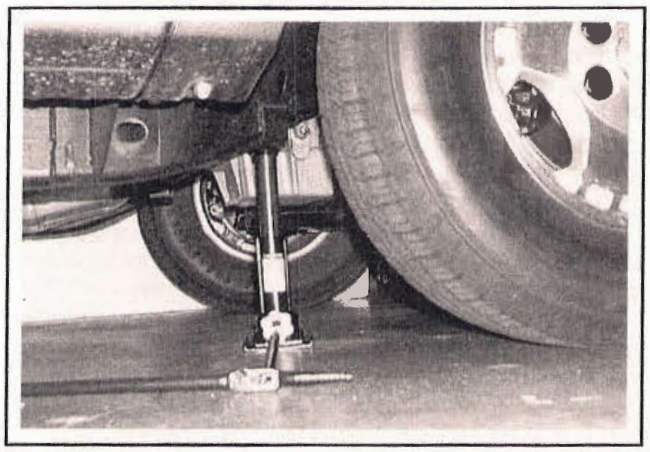
Jacking and towing

JACKING

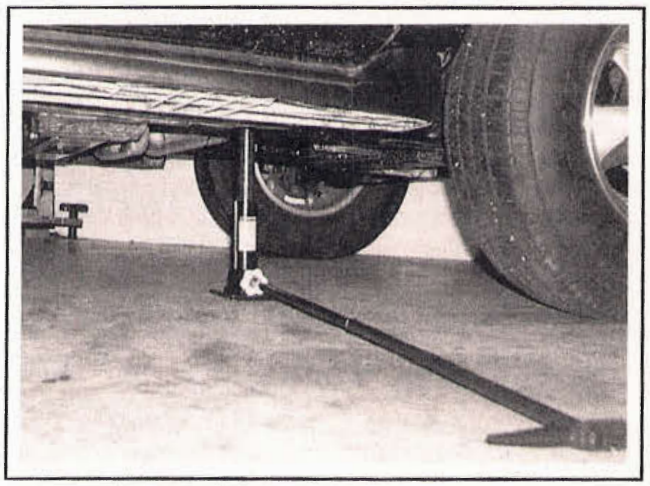
The jack supplied with the vehicle should only be used for raising the vehicle when changing a tire or placing jackstands under the frame. NEVER work under the vehicle or start the engine when the vehicle supported only by a jack.

The vehicle should be parked on level ground with the wheels blocked, the parking brake applied and the transmission in Park (automatic) or Reverse (manual). If the vehicle is parked alongside the roadway, or in any other hazardous situation, turn on the emergency hazard flashers. If a tire is to be changed, loosen the lug nuts one-half turn before raising off the ground.

Place the jack under the vehicle in the indicated positions (see illustrations). Operate the jack with a slow, smooth motion until the wheel is raised off the ground. Remove the lug nuts, pull off the wheel, install the spare and thread the lug nuts back on with the beveled side facing in. Tighten the lug nuts snugly, lower the vehicle until some weight is on the wheel, tighten them completely in a criss-cross pattern and remove the jack.



Front jacking position for two-wheel drive pick-ups with the factory jack



Front jacking position with factory jack on all other Series

TOWING

Equipment specifically designed for towing should be used and attached to the main structural members of the vehicle. Optional tow hooks may be attached to the frame at both ends of the vehicle; they are intended for emergency use only, for rescuing a stranded vehicle. Do not use the tow hooks for highway towing. Stand clear when using tow straps or chains (they may break, causing serious injury.)

The manufacturer recommends that these vehicles be towed only by wheel-lift equipment or a flatbed car-carrier.

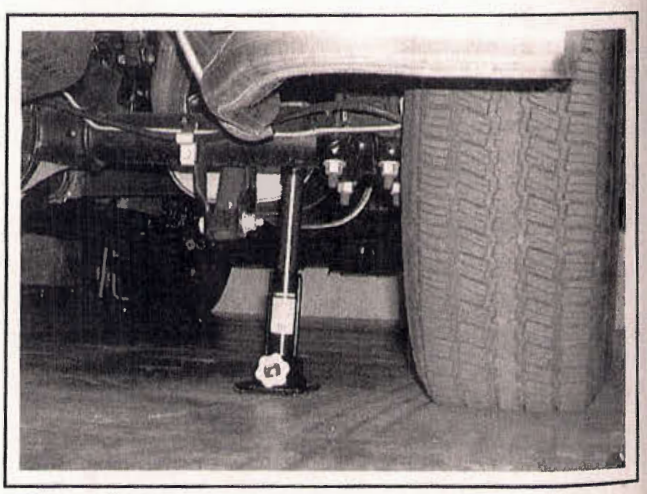
Safety is a major consideration when towing and all applicable state and local laws must be obeyed. In addition to a tow bar, a safety chain must be used for all towing.

Two-wheel drive vehicles with automatic transmission may be towed with the rear wheels on a towing dolly with no mileage restriction (at posted highway speeds). If the front wheels are on the dolly, speed should be no more than 35 mph for no more than 50 miles, or damage may be done to the automatic transmission.

Two-wheel drive vehicles with manual transmission can be towed 50 miles with the ignition lock in the Off position and the transmission in Neutral.

Four-wheel drive vehicles should be towed with the transfer case in Neutral. With the front end lifted, towing is not limited, but if the rear end is lifted and the front is on the ground, towing is restricted to a maximum of 50 miles distance.

If any vehicle is to be towed with the front wheels on the ground and the rear wheels raised, the ignition key must be turned to the OFF position to unlock the steering column and a steering wheel clamping device designed for towing must be used or damage to the steering column lock may occur.



Rear jacking position - the axle must be secure in the jack head grooves

Booster battery (jump) starting

Observe these precautions when using a booster battery to start a vehicle:

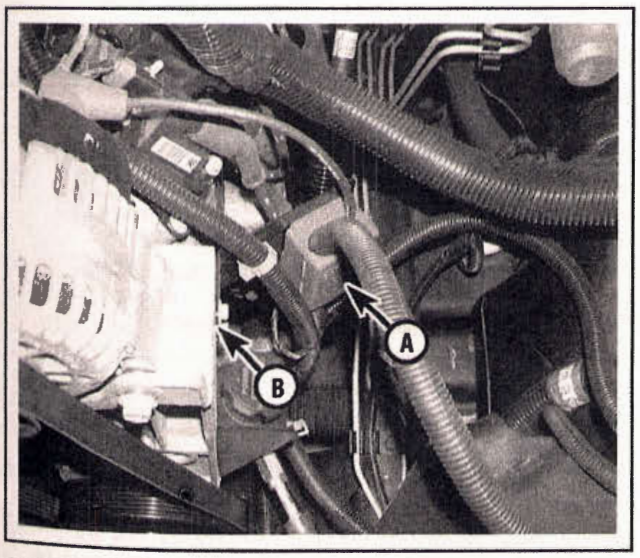
a) *Before connecting the booster battery, make sure the ignition switch is in the Off position.*
b) *Turn off the lights, heater and other electrical loads.*
c) *Your eyes should be shielded. Safety goggles are a good idea.*
d) *Make sure the booster battery is the same voltage as the dead one in the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

The main battery on these vehicles (some models have an optional second battery) is located in the left front corner of the engine compartment, where the battery cable connections are difficult to access with jumper cables. Due to the lack of accessibility, remote battery connections are provided inside the engine compartment for jump-starting (see illustration).

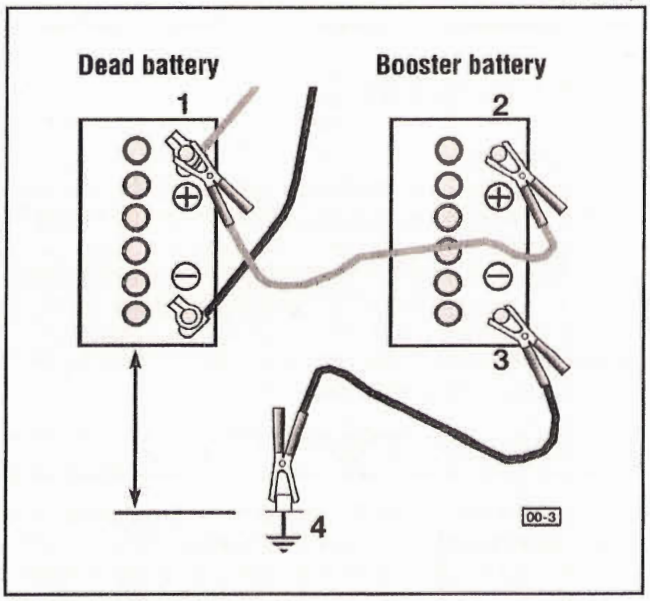
Connect the red jumper cable to the positive (+) terminals of each battery.

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

Start the engine using the booster battery, then run the booster vehicle at a fast idle for a few minutes to instill some charge in the dead battery. Let the engine idle, then disconnect the jumper cables in the reverse order of connection. The vehicle with the dead battery may have to be driven for 20 minutes or more to sufficiently recharge the battery for independent starting.



On these vehicles it's easier to attach the battery jumper cables to these remote terminals, rather than the battery itself - open this red plastic cover (A) and connect the positive cable to the stud inside. Attach the negative booster cable clamp to the metal grounding ledge (B) below the alternator



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)

Anti-theft audio system

WARNING:

Refer to the Warning and Caution in Chapter 5, Section 1 under "Battery disconnection" before proceeding with the following Steps.

GENERAL INFORMATION

1 Some of these models are equipped with THEFTLOCK audio systems, which include an anti-theft feature that will render the stereo inoperative if stolen. If the power source to the stereo is cut with the anti-theft feature activated, the stereo will be inoperative. Even if the power source is immediately re-connected, the stereo will not function.

2 If your vehicle is equipped with this anti-theft system, do not disconnect the battery, remove the stereo or disconnect related components unless you have either turned off the feature or have the individual ID (code) number for the stereo.

DISABLING THE ANTI-THEFT FEATURE

3 Press the stereo's 1 and 4 buttons at the same time for five seconds with the ignition on and the radio power off. The display will show SEC, indicating the unit is in the secure mode (anti-theft feature enabled).

4 Press the MN button. The display will show "000".

5 Press the MN button until the last two numbers are the same as your secret code.

6 Press HR until the first one or two numbers displayed match your code. The numbers will be displayed as entered.

7 Press AM/FM. If the display shows "_ _ _" you have successfully disabled the anti-theft feature. If SEC is displayed, the code you entered was incorrect and the anti-theft feature is still enabled.

UNLOCKING THE STEREO AFTER A POWER LOSS

8 When the power is restored to the stereo, the stereo won't turn on and LOC will appear on the display. Enter your ID code as follows, without pausing more than 15 seconds between Steps.

9 Turn the ignition switch to ON, but leave the stereo off.

10 Press the MN button. "000" should display.

11 Press the HR button to make the last two numbers match your code, then release the button.

12 Press the HR button until the first one or two numbers match your code.

13 Press AM/FM. SEC should appear, indicating the stereo is unlocked. If LOC appears, the numbers you entered were not correct and the stereo is still inoperative.

14 You should have the code written down in a secure place, for use in unlocking the THEFTLOCK feature.

➡Note: When performing the above procedures, you are allowed only eight tries. After that, the system shuts down for an hour, with the radio displaying "INOP." At the end of that period, you have another three tries, after which you will have to bring the vehicle to your dealer for activation.

CONVERSION FACTORS

LENGTH (distance)

Inches (in)	X 25.4	= Millimeters (mm)	X 0.0394	= Inches (in)
Feet (ft)	X 0.305	= Meters (m)	X 3.281	= Feet (ft)
Miles	X 1.609	= Kilometers (km)	X 0.621	= Miles

VOLUME (capacity)

Cubic inches (cu in; in^3)	X 16.387	= Cubic centimeters (cc; cm^3)	X 0.061	= Cubic inches (cu in; in^3)
Imperial pints (Imp pt)	X 0.568	= Liters (l)	X 1.76	= Imperial pints (Imp pt)
Imperial quarts (Imp qt)	X 1.137	= Liters (l)	X 0.88	= Imperial quarts (Imp qt)
Imperial quarts (Imp qt)	X 1.201	= US quarts (US qt)	X 0.833	= Imperial quarts (Imp qt)
US quarts (US qt)	X 0.946	= Liters (l)	X 1.057	= US quarts (US qt)
Imperial gallons (Imp gal)	X 4.546	= Liters (l)	X 0.22	= Imperial gallons (Imp gal)
Imperial gallons (Imp gal)	X 1.201	= US gallons (US gal)	X 0.833	= Imperial gallons (Imp gal)
US gallons (US gal)	X 3.785	= Liters (l)	X 0.264	= US gallons (US gal)

MASS (weight)

Ounces (oz)	X 28.35	= Grams (g)	X 0.035	= Ounces (oz)
Pounds (lb)	X 0.454	= Kilograms (kg)	X 2.205	= Pounds (lb)

FORCE

Ounces-force (ozf; oz)	X 0.278	= Newtons (N)	X 3.6	= Ounces-force (ozf; oz)
Pounds-force (lbf; lb)	X 4.448	= Newtons (N)	X 0.225	= Pounds-force (lbf; lb)
Newtons (N)	X 0.1	= Kilograms-force (kgf; kg)	X 9.81	= Newtons (N)

PRESSURE

Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.070	= Kilograms-force per square centimeter (kgf/cm^2; kg/cm^2)	X 14.223	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.068	= Atmospheres (atm)	X 14.696	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.069	= Bars	X 14.5	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 6.895	= Kilopascals (kPa)	X 0.145	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Kilopascals (kPa)	X 0.01	= Kilograms-force per square centimeter (kgf/cm^2; kg/cm^2)	X 98.1	= Kilopascals (kPa)

TORQUE (moment of force)

Pounds-force inches (lbf in; lb in)	X 1.152	= Kilograms-force centimeter (kgf cm; kg cm)	X 0.868	= Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	X 0.113	= Newton meters (Nm)	X 8.85	= Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	X 0.083	= Pounds-force feet (lbf ft; lb ft)	X 12	= Pounds-force inches (lbf in; lb in)
Pounds-force feet (lbf ft; lb ft)	X 0.138	= Kilograms-force meters (kgf m; kg m)	X 7.233	= Pounds-force feet (lbf ft; lb ft)
Pounds-force feet (lbf ft; lb ft)	X 1.356	= Newton meters (Nm)	X 0.738	= Pounds-force feet (lbf ft; lb ft)
Newton meters (Nm)	X 0.102	= Kilograms-force meters (kgf m; kg m)	X 9.804	= Newton meters (Nm)

VACUUM

Inches mercury (in. Hg)	X 3.377	= Kilopascals (kPa)	X 0.2961	= Inches mercury
Inches mercury (in. Hg)	X 25.4	= Millimeters mercury (mm Hg)	X 0.0394	= Inches mercury

POWER

Horsepower (hp)	X 745.7	= Watts (W)	X 0.0013	= Horsepower (hp)

VELOCITY (speed)

Miles per hour (miles/hr; mph)	X 1.609	= Kilometers per hour (km/hr; kph)	X 0.621	= Miles per hour (miles/hr; mph)

FUEL CONSUMPTION *

Miles per gallon, Imperial (mpg)	X 0.354	= Kilometers per liter (km/l)	X 2.825	= Miles per gallon, Imperial (mpg)
Miles per gallon, US (mpg)	X 0.425	= Kilometers per liter (km/l)	X 2.352	= Miles per gallon, US (mpg)

TEMPERATURE

Degrees Fahrenheit = (°C x 1.8) + 32

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

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

FRACTION/DECIMAL/MILLIMETER EQUIVALENTS

DECIMALS TO MILLIMETERS

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

FRACTIONS TO DECIMALS TO MILLIMETERS

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

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 brake dust, 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 and non-corrosive.

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

LUBRICANTS

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

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

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

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

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

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

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

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

SEALANTS

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

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

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

CHEMICALS

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

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

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

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

MISCELLANEOUS

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

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

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

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

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.

STEERING, SUSPENSION AND BRAKES

These systems are essential to driving safety, so make sure you have a qualified shop or individual check your work. Also, compressed suspension springs can cause injury if released suddenly - be sure to use a spring compressor.

AIRBAGS

Airbags are explosive devices that can CAUSE injury if they deploy while you're working on the vehicle. Follow the manufacturer's instructions to disable the airbag whenever you're working in the vicinity of airbag components.

ASBESTOS

Certain friction, insulating, sealing, and other products - such as brake linings, brake bands, clutch linings, torque converters, gaskets, etc. - may contain asbestos or other hazardous friction material. 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 have any kind of open flame around when working on a vehicle. But the risk do not end there. A spark caused by an electrical short circuit, by two metal surfac contacting each other, or even by static electricity built up in your body under ce tain conditions, can ignite gasoline vapors, which in a confined space are high explosive. Do not, under any circumstances, use gasoline for cleaning parts. U: an approved safety solvent.

Always disconnect the battery ground (-) cable at the battery before workir on any part of the fuel system or electrical system. Never risk spilling fuel on a h engine or exhaust component. It is strongly recommended that a fire extinguish suitable for use on fuel and electrical fires be kept handy in the garage or worksh 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 an even death if inhaled to any extent. Gasoline vapor falls into this category, as d the vapors from some cleaning solvents. Any draining or pouring of such volatil fluids should be done in a well ventilated area.

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

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

THE BATTERY

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

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

If possible, loosen the filler caps or cover when charging the battery from ar external source (this does not apply to sealed or maintenance-free batteries). D 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 shoul 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.

HYDROFLUORIC ACID

This extremely corrosive acid is formed when certain types of synthetic rubber, found in some O-rings, oil seals, fuel hoses, etc. are exposed to temperatures above 750-degrees F (400-degrees C). The rubber changes into a charred or sticky substance containing the acid. *Once formed, the acid remains dangerous for years. If it gets onto the skin, it may be necessary to amputate the limb concerned.*

When dealing with a vehicle which has suffered a fire, or with components salvaged from such a vehicle, wear protective gloves and discard them after use.

Troubleshooting

CONTENTS

Section Symptom

Engine

1 Engine will not rotate when attempting to start
2 Engine rotates but will not start
3 Starter motor operates without rotating engine
4 Engine hard to start when cold
5 Engine hard to start when hot
6 Starter motor noisy or excessively rough in engagement
7 Engine starts but stops immediately
8 Engine lopes while idling or idles erratically
9 Engine misses at idle speed
10 Engine misses throughout driving speed range
11 Engine stalls
12 Engine lacks power
13 Engine backfires
14 Pinging or knocking engine sounds during acceleration or uphill
15 Engine diesels (continues to run) after switching off

Engine electrical system

16 Battery will not hold a charge
17 Alternator light fails to go out.
18 Alternator light fails to come on when key is turned on

Fuel system

19 Excessive fuel consumption
20 Fuel leakage and/or fuel odor

Cooling system

21 Overheating
22 Overcooling
23 External coolant leakage
24 Internal coolant leakage
25 Coolant loss
26 Poor coolant circulation

Clutch

27 Fails to release (pedal pressed to the floor - shift lever does not move freely in and out of Reverse)
28 Clutch slips (engine speed increases with no increase in vehicle speed)
29 Grabbing (chattering) as clutch is engaged
30 Squeal or rumble with clutch fully engaged (pedal released)
31 Squeal or rumble with clutch fully disengaged (pedal depressed)
32 Clutch pedal stays on floor when disengaged

Manual transmission

33 Noisy in Neutral with engine running
34 Noisy in all gears
35 Noisy in one particular gear
36 Slips out of high gear
37 Difficulty in engaging gears
38 Oil leakage

Section Symptom

Automatic transmission

39 General shift mechanism problems
40 Transmission will not downshift with accelerator pedal pressed to the floor
41 Transmission slips, shifts rough, is noisy or has no drive in forward or reverse gears
42 Fluid leakage

Transfer case

43 Transfer case is difficult to shift into the desired range
44 Transfer case noisy in all gears
45 Noisy or jumps out of four-wheel drive Low range
46 Lubricant leaks from the vent or output shaft seals

Driveshaft

47 Oil leak at front of driveshaft
48 Knock or clunk when the transmission is under initial load (just after transmission is put into gear)
49 Metallic grinding sound consistent with vehicle speed
50 Vibration

Axles

51 Noise
52 Vibration
53 Oil leakage

Driveaxles (4WD)

54 Clicking
55 Shudder on acceleration
56 Vibration on highway

Brakes

57 Vehicle pulls to one side during braking
58 Noise (high-pitched squeal with the brakes applied)
59 Excessive brake pedal travel
60 Brake pedal feels spongy when depressed
61 Excessive effort required to stop vehicle
62 Pedal travels to the floor with little resistance
63 Brake pedal pulsates during brake application

Suspension and steering systems

64 Vehicle pulls to one side
65 Shimmy, shake or vibration
66 Excessive pitching and/or rolling around corners or during braking
67 Excessively stiff steering
68 Excessive play in steering
69 Lack of power assistance
70 Excessive tire wear (not specific to one area)
71 Excessive tire wear on outside edge
72 Excessive tire wear on inside edge
73 Tire tread worn in one place

This section provides an easy reference guide to the more common problems that may occur during the operation of your vehicle. These problems and possible causes are grouped under various components or systems; i.e. Engine, Cooling System, etc., and also refer to the Chapter and/or Section that deals with the problem.

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

Finally, always get clear in your mind 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 that 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

1 Engine will not rotate when attempting to start

1 Battery terminal connections loose or corroded. Check the cable terminals at the battery. Tighten the cable or remove corrosion as necessary.

2 Battery discharged or faulty. If the cable connections are clean and tight on the battery posts, turn the key to the On position and switch on the headlights and/or windshield wipers. If they fail to function, the battery is discharged.

3 Automatic transmission not completely engaged in Park or Neutral or clutch pedal not completely depressed.

4 Broken, loose or disconnected wiring in the starting circuit. Inspect all wiring and connectors at the battery, starter solenoid and ignition switch.

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 and inspect pinion and flywheel at earliest convenience (Chapter 5).

6 Starter solenoid faulty (Chapter 5).

7 Starter motor faulty (Chapter 5).

8 Ignition switch faulty (Chapter 12).

2 Engine rotates but will not start

1 Fuel tank empty, fuel filter plugged or fuel line restricted.

2 Fault in the fuel injection system (Chapter 4).

3 Battery discharged (engine rotates slowly). Check the operation of electrical components as described in the previous Section.

4 Battery terminal connections loose or corroded (see previous Section).

5 Fuel pump faulty (Chapter 4).

6 Excessive moisture on, or damage to, ignition components (see Chapter 5).

7 Worn, faulty or incorrectly gapped spark plugs (Chapter 1).

8 Broken, loose or disconnected wiring in the starting circuit (see previous Section).

9 Broken, loose or disconnected wires at the ignition coils (Chapter 5).

3 Starter motor operates without rotating engine

1 Starter pinion sticking. Remove the starter (Chapter 5) and inspect.

2 Starter pinion or flywheel teeth worn or broken. Remove the flywheel/driveplate access cover and inspect.

4 Engine hard to start when cold

1 Discharged or low battery. Check as described in Section 1.

2 Fault in the fuel or ignition systems (Chapters 4 and 5).

3 Injector(s) leaking (Chapter 4).

4 Distributor rotor carbon-tracked (Chapter 1).

5 Engine hard to start when hot

1 Air filter clogged (Chapter 1).

2 Fault in the fuel or ignition systems (Chapters 4 and 5).

3 Fuel not reaching the injectors (see Chapter 4).

4 Low cylinder compression (Chapter 2).

5 Malfunctioning EVAP system (Chapter 6).

6 Starter motor noisy or excessively rough in engagement

1 Pinion or flywheel gear teeth worn or broken. Remove the cover at the rear of the engine (if equipped) and inspect.

2 Starter motor mounting bolts loose or missing.

7 Engine starts but stops immediately

1 Loose or faulty electrical connections at the distributor (V6), coils or alternator.

2 Fault in the fuel or ignition systems (Chapters 4 and 5).

3 Vacuum leak at the gasket surfaces of the intake manifold or throttle body. Make sure all mounting bolts/nuts are tightened securely and all vacuum hoses connected to the manifold are positioned properly and in good condition.

4 Restricted intake or exhaust systems (Chapter 4).

8 Engine lopes while idling or idles erratically

1 Vacuum leakage. Check the mounting bolts/nuts at the throttle body and intake manifold for tightness. Make sure 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.

2 Fault in the fuel or ignition systems (Chapters 4 and 5).

3 Plugged PCV valve or hose (see Chapters 1 and 6).

4 Air filter clogged (Chapter 1).

5 Fuel pump not delivering sufficient fuel to the fuel injectors (see Chapter 4).

6 Leaking head gasket. Perform a compression check (Chapter 2C).

7 Camshaft lobes worn (Chapter 2).

9 Engine misses at idle speed

1 Spark plugs worn, fouled or not gapped properly (Chapter 1).

2 Fault in the fuel or ignition systems (Chapters 4 and 5).

3 Faulty spark plug wires (Chapter 1).

4 Vacuum leaks at intake manifold or hose connections. Check as described in Section 8.

5 Uneven or low cylinder compression. Check compression as described in Chapter 2C.

10 Engine misses throughout driving speed range

1 Fuel filter clogged and/or impurities in the fuel system (Chapter 1).
2 Faulty or incorrectly gapped spark plugs (Chapter 1).
3 Fault in the fuel or ignition systems (Chapters 4 and 5).
4 Defective spark plug wires (Chapter 1).
5 Faulty emissions system components (Chapter 6).
6 Low or uneven cylinder compression pressures. Remove the spark plugs and test the compression with a gauge (Chapter 2C).
8 Vacuum leaks at the throttle body, intake manifold or vacuum hoses (see Section 8).

11 Engine stalls

1 Fuel filter clogged and/or water and impurities in the fuel system (Chapter 1).
2 Fault in the fuel system or sensors (Chapters 4 and 6).
3 Faulty emissions system components (Chapter 6)
4 Faulty or incorrectly gapped spark plugs (Chapter 1). Also check the spark plug wires (Chapter 1).
5 Vacuum leak at the throttle body, intake manifold or vacuum hoses. Check as described in Section 8.

12 Engine lacks power

1 Fault in the fuel or ignition systems (Chapters 4 and 5).
2 Faulty or incorrectly gapped spark plugs (Chapter 1).
3 Faulty coils (Chapter 5).
4 Brakes binding (Chapter 1).
5 Automatic transmission fluid level incorrect (Chapter 1).
6 Clutch slipping (Chapter 8).
7 Fuel filter clogged and/or impurities in the fuel system (Chapter 1).
8 Emissions control system not functioning properly (Chapter 6).
9 Use of substandard fuel. Fill the tank with the proper fuel.
10 Low or uneven cylinder compression pressures. Test with a compression tester, which will detect leaking valves and/or a blown head gasket (Chapter 2).
11 Restriction in the intake or exhaust system (Chapter 4).

13 Engine backfires

1 Emissions system not functioning properly (Chapter 6).
2 Fault in the fuel or ignition systems (Chapters 4 and 5).
3 Faulty secondary ignition system (cracked spark plug insulator or faulty plug wires) (Chapters 1 and 5).
4 Fuel injection system not functioning properly (Chapter 4).
5 Vacuum leak at the throttle body, intake manifold or vacuum hoses. Check as described in Section 8.
6 Valves sticking (Chapter 2).
7 Crossed plug wires (Chapter 1).

14 Pinging or knocking engine sounds during acceleration or uphill

1 Incorrect grade of fuel. Fill the tank with fuel of the proper octane rating.
2 Fault in the fuel or ignition systems (Chapters 4 and 5).
3 Improper spark plugs. Check the plug type against the VECI label located in the engine compartment. Also check the plugs and wires for damage (Chapter 1).
4 Faulty emissions system (Chapter 6).
5 Vacuum leak. Check as described in Section 9.

15 Engine diesels (continues to run) after switching off

1 Idle speed too high (Chapter 4).
2 Fault in the fuel or ignition systems (Chapters 4 and 5).
3 Excessive engine operating temperature. Probable causes of this are a low coolant level (see Chapter 1), malfunctioning thermostat, clogged radiator or faulty water pump (see Chapter 3).

ENGINE ELECTRICAL SYSTEM

16 Battery will not hold a charge

1 Alternator drivebelt defective or not adjusted properly (Chapter 1).
2 Electrolyte level low or battery discharged (Chapter 1).
3 Battery terminals loose or corroded (Chapter 1).
4 Alternator not charging properly (Chapter 5).
5 Loose, broken or faulty wiring in the charging circuit (Chapter 5).
6 Short in the vehicle wiring causing a continuous drain on the battery (refer to Chapter 12 and the Wiring Diagrams).
7 Battery defective internally.

17 Alternator light fails to go out

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

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

1 Instrument cluster warning light bulb defective (Chapter 12).
2 Alternator faulty (Chapter 5).
3 Fault in the instrument cluster printed circuit, dashboard wiring or bulb holder (Chapter 12).

FUEL SYSTEM

19 Excessive fuel consumption

1 Dirty or clogged air filter element (Chapter 1).
2 Emissions system not functioning properly (Chapter 6).
3 Fault in the fuel or ignition systems (Chapters 4 and 5).
4 Low tire pressure or incorrect tire size (Chapter 1).
5 Restricted exhaust system (Chapter 4).

20 Fuel leakage and/or fuel odor

1 Leak in a fuel feed or vent line (Chapter 4).
2 Tank overfilled. Fill only to automatic shut-off.
3 Evaporative emissions system canister clogged (Chapter 6).
4 Vapor leaks from system lines or injectors (Chapter 4).

COOLING SYSTEM

21 Overheating

1 Insufficient coolant in the system (Chapter 1).
2 Water pump drivebelt defective or not adjusted properly (Chapter 1).

3 Radiator core blocked or radiator grille dirty and restricted (see Chapter 3).
4 Thermostat faulty (Chapter 3).
5 Fan blades broken or cracked (Chapter 3).
6 Surge tank cap not maintaining proper pressure. Have the cap pressure tested by a gas station or repair shop.
7 Fault in electrical circuit for cooling fans (Chapter 3).

22 Overcooling

1 Thermostat faulty (Chapter 3).
2 Inaccurate temperature gauge (Chapter 12).
3 Fault in electrical circuit for cooling fans (Chapter 3).

23 External coolant leakage

1 Deteriorated or damaged hoses or loose clamps. Replace hoses and/or tighten the clamps at the 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 the radiator core or side tank(s). This will require the radiator to be professionally repaired (see Chapter 3 for removal procedures).
4 Engine drain plug(s) leaking (Chapter 1) or water jacket core plugs leaking (see Chapter 2C).
5 Leakage at the heater core. Signs of leakage should show up on interior carpeting (Chapter 3).

24 Internal coolant leakage

➡Note: Internal coolant leaks can usually be detected by examining the oil. Check the dipstick and inside of the valve cover for water deposits and an oil consistency like that of a milkshake.

1 Leaking cylinder head gasket. Have the cooling system pressure tested.
2 Cracked cylinder bore or cylinder head. Remove the head(s) and inspect (Chapter 2).
3 Leaking intake manifold gasket (Chapter 2).

25 Coolant loss

1 Too much coolant in the system (Chapter 1).
2 Coolant boiling away due to overheating (see Section 15).
3 External or internal leakage (see Sections 23 and 24).
4 Faulty surge tank cap. Have the cap pressure tested.

26 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 let it loose. You should feel the surge of coolant if the pump is working properly (see Chapter 1).
2 Restriction in the cooling system. Drain, flush and refill the system (Chapter 1). If necessary, remove the radiator (Chapter 3) and have it reverse flushed.
3 Water pump drivebelt defective or not adjusted properly (Chapter 1).
4 Thermostat sticking (Chapter 3).
5 Drivebelt incorrectly routed, causing the pump to turn backward (Chapter 1).

CLUTCH

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

1 Leak in the clutch hydraulic system. Check the master cylinder, slave cylinder and lines (Chapters 1 and 8).
2 Clutch plate warped or damaged (Chapter 8).
3 Broken release bearing (Chapter 8).

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

1 Clutch plate oil-soaked or lining worn. Remove clutch (Chapter 8) and inspect.
2 Clutch plate not seated. It may take 30 or 40 normal starts for a new one to seat.
3 Pressure plate worn (Chapter 8).

29 Grabbing (chattering) as clutch is engaged

1 Oil on clutch plate lining. Remove (Chapter 8) and inspect. Correct any leakage source.
2 Worn or loose engine or transmission mounts. These units move slightly when the clutch is released. Inspect the mounts and bolts (Chapter 2).
3 Worn splines on clutch plate hub. Remove the clutch components (Chapter 8) and inspect.
4 Warped pressure plate or flywheel. Remove the clutch components and inspect.

30 Squeal or rumble with clutch fully engaged (pedal released)

Release bearing binding on transmission bearing retainer. Remove clutch components (Chapter 8) and check slave cylinder and release bearing assembly. Remove any burrs or nicks; clean and relubricate before installing.

31 Squeal or rumble with clutch fully disengaged (pedal depressed)

1 Worn, defective or broken release bearing (Chapter 8).
2 Worn or broken pressure plate springs (or diaphragm fingers) (Chapter 8).

32 Clutch pedal stays on floor when disengaged

1 Release bearing binding, or a fault in the hydraulic system (Chapter 8).
2 Clutch master cylinder faulty (Chapter 8).

MANUAL TRANSMISSION

➡Note: All the following references are in Chapter 7A, unless noted.

33 Noisy in Neutral with engine running

1 Input shaft bearing worn.
2 Damaged main drive gear bearing.

3 Worn countershaft bearings.
4 Worn or damaged countershaft endplay shims.

34 Noisy in all gears

1 Any of the above causes, and/or:
2 Insufficient lubricant (see the checking procedures in Chapter 1).

35 Noisy in one particular gear

1 Worn, damaged or chipped gear teeth for that particular gear.
2 Worn or damaged synchronizer for that particular gear.

36 Slips out of high gear

1 Transmission loose on clutch housing.
2 Dirt between the transmission case and engine or misalignment of the transmission.

37 Difficulty in engaging gears

1 Clutch not releasing completely (see clutch adjustment in Chapter 1).
2 Loose or damaged shifter. Make a thorough inspection, replacing parts as necessary.

38 Oil leakage

1 Excessive amount of lubricant in the transmission (see Chapter 1 for correct checking procedures). Drain lubricant as required.
2 Transmission oil seal in need of replacement.

AUTOMATIC TRANSMISSION

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

39 General shift mechanism problems

1 Chapter 7B deals with checking and adjusting the shift cable on automatic transmissions. Common problems that may be attributed to poorly adjusted cable are:

a) Engine starting in gears other than Park or Neutral.
b) Indicator on shifter pointing to a gear other than the one actually being selected.
c) Vehicle moves when in Park.

2 Refer to Chapter 7A to adjust the linkage.
3 Problem with the electronic shift solenoid. Check for Diagnostic Trouble Codes (Chapter 6).

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

Transmission pressure control solenoid valve faulty. Check for Diagnostic Trouble Codes (Chapter 6).

41 Transmission slips, shifts rough, is noisy or has no drive in forward or reverse gears

1 Of the many probable causes for the above problems, the home mechanic should be concerned with only one possibility - fluid level.
2 Before taking the vehicle to a repair shop, check the level and condition of the fluid as described in Chapter 1. Correct fluid level as necessary or change the fluid and filter if needed. If the problem persists, have a professional diagnose the probable cause.
3 If the transmission shifts late and the shifts are harsh, suspect a faulty transmission pressure control solenoid valve. Check for Diagnostic Trouble Codes (Chapter 6).

42 Fluid leakage

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

*a) **Pan:** Tighten the mounting bolts and/or replace the pan gasket as necessary (see Chapter 1).*
*b) **Filler pipe:** Replace the rubber seal where the pipe enters the transmission case.*
*c) **Transmission oil lines:** Tighten the connectors where the lines enter the transmission case and/or replace the lines.*
*d) **Vent pipe:** Transmission overfilled and/or water in fluid (see checking procedures, Chapter 1).*
*e) **Speed sensor connector:** Replace the O-ring where the vehicle speed sensor enters the transmission case (Chapter 6).*

TRANSFER CASE

43 Transfer case is difficult to shift into the desired range

1 Speed may be too great to permit engagement. Stop the vehicle and shift into the desired range.
2 Shift linkage loose, bent or binding. Check the linkage for damage or wear and replace or lubricate as necessary (Chapter 7C).
3 If the vehicle has been driven on a paved surface for some time, the driveline torque can make shifting difficult. Stop and shift into two-wheel drive on paved or hard surfaces.
4 Insufficient or incorrect grade of lubricant. Drain and refill the transfer case with the specified lubricant (Chapter 1).
5 Worn or damaged internal components. Disassembly and overhaul of the transfer case, by a qualified shop, may be necessary.
6 Fault in the electrical system of the front axle or automatic transfer case. Check for Diagnostic Trouble Codes (Chapter 6).

44 Transfer case noisy in all gears

Insufficient or incorrect grade of lubricant. Drain and refill (Chapter 1).

45 Noisy or jumps out of four-wheel drive Low range

1 Transfer case not fully engaged. Stop the vehicle, shift into Neutral and then engage 4L.
2 Shift linkage loose, worn or binding. Tighten, repair or lubricate linkage as necessary.

3 Shift fork cracked, inserts worn or fork binding on the rail. Disassemble and repair as necessary (Chapter 7C).

4 Fault in the electrical system of the front axle or automatic transfer case. Check for Diagnostic Trouble Codes (Chapter 6).

46 Lubricant leaks from the vent or output shaft seals

1 Transfer case is overfilled. Drain to the proper level (Chapter 1).

2 Vent is clogged or jammed closed. Clear or replace the vent.

3 Output shaft seal incorrectly installed or damaged. Replace the seal and check contact surfaces for nicks and scoring.

DRIVESHAFT

47 Oil leak at seal end of driveshaft

Defective transmission or transfer case oil seal. See Chapter 7 for replacement procedures. While this is done, check the splined yoke for burrs or a rough condition that may be damaging the seal. Burrs can be removed with crocus cloth or a fine whetstone.

48 Knock or clunk when the transmission is under initial load (just after transmission is put into gear)

1 Loose or disconnected rear suspension components. Check all mounting bolts, nuts and bushings (see Chapter 10).

2 Loose driveshaft bolts. Inspect all bolts and nuts and tighten them to the specified torque.

3 Worn or damaged universal joint bearings. Check for wear (see Chapter 8).

49 Metallic grinding sound consistent with vehicle speed

Pronounced wear in the universal joint bearings. Check as described in Chapter 8.

50 Vibration

➡Note: Before assuming that the driveshaft is at fault, 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 (see Chapter 8).

5 Undercoating or built-up dirt, etc. on the driveshaft. Clean the shaft thoroughly and recheck.

6 Worn universal joint bearings. Remove and inspect (see Chapter 8).

7 Driveshaft and/or companion flange out of balance. Check for missing weights on the shaft. Remove the driveshaft (see Chapter 8) and reinstall 180-degrees from original position, then retest. Have the driveshaft professionally balanced if the problem persists.

AXLES

51 Noise

1 Road noise. No corrective procedures available.

2 Tire noise. Inspect tires and check tire pressures (Chapter 1).

3 Rear wheel bearings worn or damaged (Chapter 8).

52 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 rear wheels by hand. Listen for evidence of rough (noisy) bearings. Remove and inspect (see Chapter 8).

53 Oil leakage

1 Pinion seal damaged (see Chapter 8).

2 Axleshaft oil seals damaged (see Chapter 8).

3 Differential inspection cover leaking. Tighten the bolts or replace the gasket as required (see Chapter 8).

DRIVEAXLES (4WD)

54 Clicking noise on turns

Worn or damaged outboard CV joints (Chapter 8).

55 Shudder or vibration during acceleration

1 Excessive toe-in. Have alignment checked.

2 Incorrect spring heights (Chapter 10).

3 Worn or damaged inboard or outboard CV joints (Chapter 8).

4 Sticking inboard CV joint assembly (Chapter 8).

56 Vibration at highway speeds

1 Out-of-balance front wheels and/or tires (Chapters 1 and 10).

2 Out-of-round front tires (Chapters 1 and 10).

3 Worn CV joints (Chapter 8).

BRAKES

➡Note: Before assuming that a brake problem exists, make sure that the tires are in good condition and inflated properly (see Chapter 1), that the front-end alignment is correct and that the vehicle is not loaded with weight in an unequal manner.

57 Vehicle pulls to one side during braking

1 Defective, damaged or oil contaminated disc brake pads on one side. Inspect as described in Chapter 9.

2 Excessive wear of brake pad material or disc on one side. Inspect

and correct as necessary.

3 Loose or disconnected front suspension components. Inspect and tighten all bolts to the specified torque (Chapter 10).

4 Defective brake caliper assembly. Remove the caliper and inspect for a stuck piston or other damage (Chapter 9).

5 Inadequate lubrication of front brake caliper slide pins. Remove caliper and lubricate slide pins (Chapter 9).

58 Noise (high-pitched squeal with the brakes applied)

1 Disc brake pads worn out. The noise comes from the wear sensor rubbing against the disc (does not apply to all vehicles) or the actual pad backing plate itself if the material is completely worn away. Replace the pads with new ones immediately (Chapter 9). If the pad material has worn completely away, the brake discs should be inspected for damage as described in Chapter 9.

2 Linings contaminated with dirt or grease. Replace pads.

3 Incorrect linings. Replace with correct linings.

59 Excessive brake pedal travel

1 Partial brake system failure. Inspect the entire system (Chapter 9) and correct as required.

2 Insufficient fluid in the master cylinder. Check (Chapter 1), add fluid and bleed the system if necessary (Chapter 9).

60 Brake pedal feels spongy when depressed

1 Air in the hydraulic lines. Bleed the brake system (Chapter 9).

2 Faulty flexible hoses. Inspect all system hoses and lines. Replace parts as necessary.

3 Master cylinder mounting bolts/nuts loose.

4 Master cylinder defective (Chapter 9).

61 Excessive effort required to stop vehicle

1 Power brake booster not operating properly (see check in Chapter 1, repairs in Chapter 9).

2 Excessively worn pads. Inspect and replace if necessary (Chapter 9).

3 One or more caliper pistons seized or sticking. Inspect and rebuild as required (Chapter 9).

4 Brake pads contaminated with oil or grease. Inspect and replace as required (Chapter 9).

5 New pads installed and not yet seated. It will take a while for the new material to seat against the disc.

62 Pedal travels to the floor with little resistance

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

2 Worn master cylinder seals (Chapter 9).

63 Brake pedal pulsates during brake application

1 Caliper improperly installed. Remove and inspect (Chapter 9).

2 Disc(s) defective. Remove (Chapter 9) and check for excessive lateral runout and parallelism. Have the disc(s) resurfaced or replace it with a new one.

SUSPENSION AND STEERING SYSTEMS

64 Vehicle pulls to one side

1 Tire pressures uneven or tires mismatched (Chapter 1).

2 Defective tire (Chapter 1).

3 Excessive wear in suspension or steering components (Chapter 10).

4 Front end in need of alignment.

5 Front brakes dragging. Inspect the brakes as described in Chapter 9.

65 Shimmy, shake or vibration

1 Tire or wheel out-of-balance or out-of-round. Have professionally balanced.

2 Loose, worn or out-of-adjustment front wheel bearings (Chapter 1).

3 Shock absorbers and/or suspension components worn or damaged (Chapter 10).

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

1 Defective shock absorbers. Replace as a set (Chapter 10).

2 Broken or weak springs and/or suspension components. Inspect as described in Chapters 1 and 10.

67 Excessively stiff steering

1 Lack of fluid in power steering fluid reservoir (Chapter 1).

2 Incorrect tire pressures (Chapter 1).

3 Lack of lubrication at steering joints (see Chapter 1).

4 Front end out of alignment.

5 Lack of power assistance (see Section 69).

68 Excessive play in steering

1 Loose front wheel bearings (Chapters 1 and 10).

2 Excessive wear in suspension or steering components (Chapter 10).

3 Steering gearbox damaged or out of adjustment (Chapter 10).

69 Lack of power assistance

1 Steering pump drivebelt faulty or not adjusted properly (Chapter 1).

2 Fluid level low (Chapter 1).

3 Hoses or lines restricted. Inspect and replace parts as necessary.

4 Air in power steering system. Bleed the system (Chapter 10).

70 Excessive tire wear (not specific to one area)

1 Incorrect tire pressures (Chapter 1).

2 Tires out-of-balance. Have professionally balanced.

3 Wheels damaged. Inspect and replace as necessary.

4 Suspension or steering components excessively worn (Chapter 10).

71 Excessive tire wear on outside edge

1 Inflation pressures incorrect (Chapter 1).

2 Excessive speed in turns.

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

72 Excessive tire wear on inside edge

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

73 Tire tread worn in one place

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