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Nissan Patrol

About this manual

Its purpose

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

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

Using the manual

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

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

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

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

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

NOTE

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

CAUTION

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

WARNING

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

Introduction to the Nissan Patrol/Ford Maverick

Nissan Patrols/Ford Mavericks are available in two-door hardtop, four-door station wagon, utility and cab-and-chassis models.

They are available with both petrol and diesel engines. The 4.2 litre diesel engine is covered by this manual as are the 3.0 litre and 4.2 litre petrol engines.

The 3.0 litre in-line six-cylinder engine is equipped with a carburettor and electronic ignition. The 4.2 litre in-line six cylinder petrol engine originally came with a carburettor and breaker-point ignition. It was later upgraded to computer-controlled fuel injection and electronic ignition.

The engine drives the front and rear solid axles through either a manual or automatic transmission, a transfer case and driveshafts. All models are equipped with four wheel drive.

Two suspension systems are used. Coil springs and shock absorbers with control arms are used on hardtop and wagons. Most utility and cab chassis models are equipped with leaf springs and shock absorbers.

The steering gearbox is mounted to the right of the engine and is connected to the steering knuckles by a rod or series of rods.

The brakes are disc at the front and disc or drum at the rear. The parking brake is mounted to the rear of the transfer case.

Vehicle Identification Numbers

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

Vehicle Identification Number (VIN)

This very important identification number is stamped on a plate attached to the right inner fender near the windscreen washer reservoir **(see illustration)**. The VIN also appears on the Vehicle Certificate of Title and Registration. It contains information such as where and when the vehicle was manufactured, the model year and the body style.

Engine serial number

On 4.2 litre engines, the serial number is stamped on the engine block at the left front. On 3.0 litre engines, it is stamped at the lower left side of the engine block below the exhaust manifold.

Compliance plate

This tag is riveted to the firewall on the upper right side above the master cylinder **(see illustration)**. The plate contains the name of the manufacturer, the month and year of production, the Gross Vehicle Weight Rating (GVWR) and the certification statement **(see illustration)**.

Build date plate

This plate, located at the extreme left front of the engine compartment identifies the date of manufacture for the vehicle **(see illustration)**.

Vehicle Emission Control Information (VECI) label

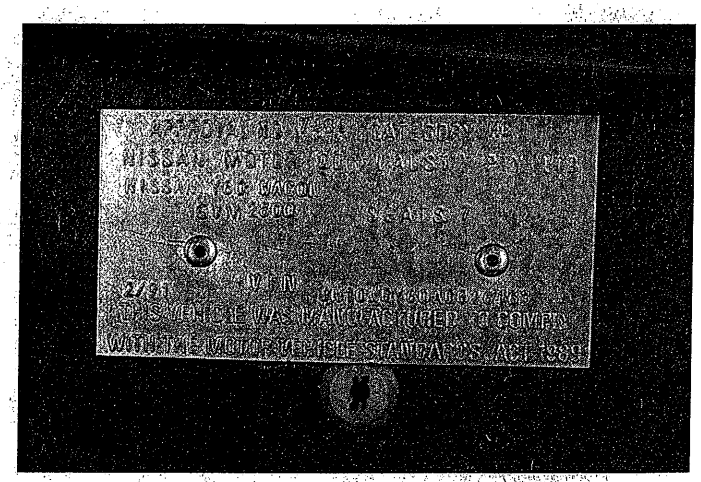
The VECI label is affixed to the valve cover on most models. It contains information on the emission control systems fitted on the vehicle as well as the tune-up specifications **(see illustration)**.

Transmission and transfer case serial numbers

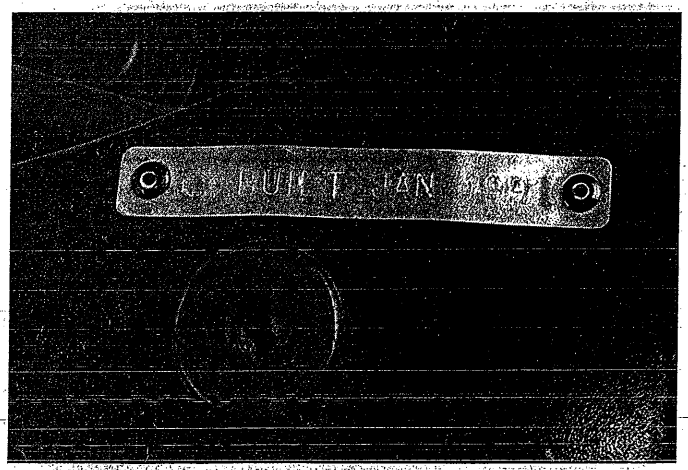
The manual transmission has a tag affixed to the top cover towards the front. The automatic transmission serial tag is secured to the right side of the transmission towards the rear.

The transfer case identification number is found on the left rear of the unit.

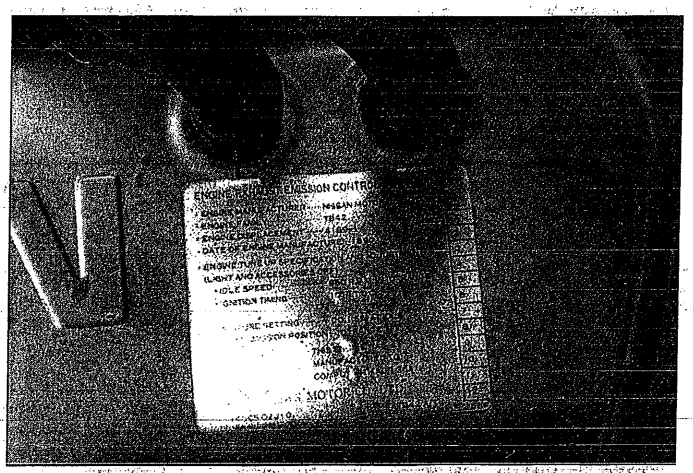
The vehicle identification plate has important information concerning the vehicle. It is behind the windscreen washer reservoir attached with special rivets to the inner fender



The compliance plate is fixed to the firewall



The build date plate is located on the left side of the radiator support



The VECI label gives the proper tune-up specifications for the engine. Its information supersedes all other specifications

Buying parts

Spares are available from many sources, which generally fall into one of two categories - authorised 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.

Authorised 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 spares 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 organised 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 renewing all damaged nuts and bolts. Special locknuts with nylon or fibre inserts can only be used once. If they are removed, they lose their locking ability and must be renewed.

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 chiselled 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 fitted exactly as removed. Renew any damaged washers. Never use a lockwasher on any soft metal surface (such as aluminium), 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 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 millimetres (the same is true for nuts). As a result, a standard spanner should not be used on a metric bolt and a metric spanner should not be used on a standard bolt. Also, most standard bolts have slashes radiating out from the centre 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, moulded 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.

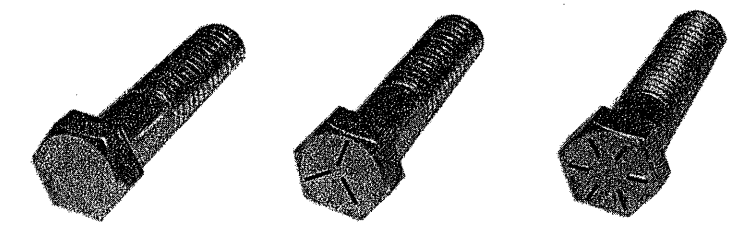
Strength markings can also be used to distinguish standard hex nuts from metric hex nuts. Many standard nuts have dots stamped into one side, while metric nuts are marked with a number. The greater the number of dots, or the higher the number, the greater the strength of the nut.

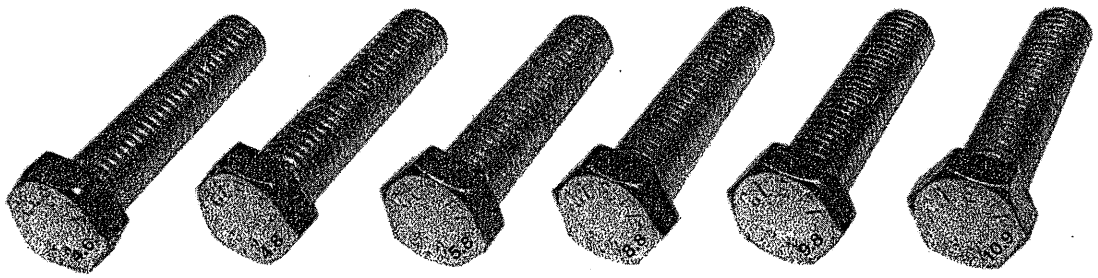
Metric studs are also marked on their ends according to property class (grade). Larger studs are numbered (the same as metric bolts), while smaller studs carry a geometric code to denote grade.

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.

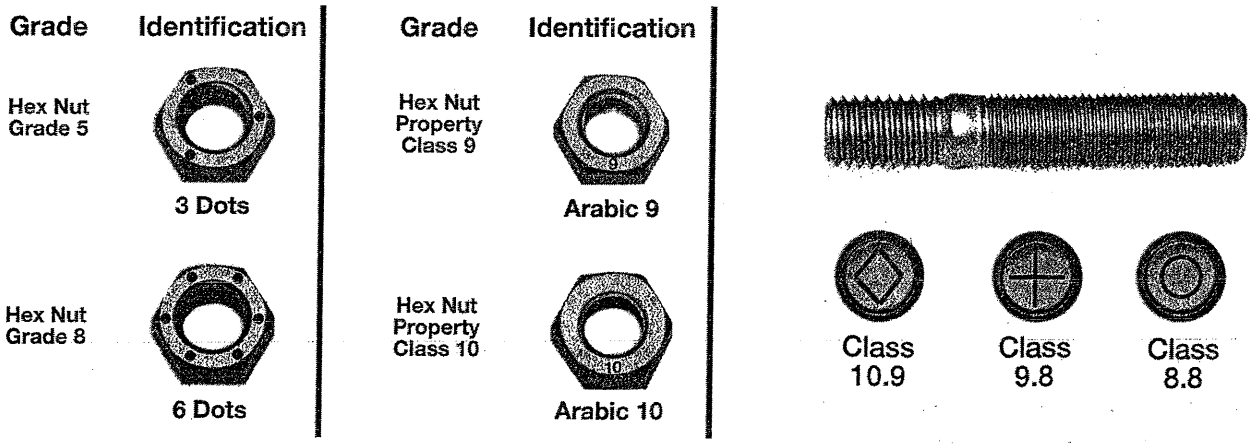
Standard fasteners are often referred to as SAE, as opposed to metric. However, it should be noted that SAE technically refers to a non-metric fine thread fastener only. Coarse thread non-metric fasteners are referred to as USS sizes.

Since fasteners of the same size (both





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



Standard hex nut strength markings

Metric hex nut strength markings

Metric stud strength markings

00-1 HAYNES

standard and metric) may have different strength ratings, be sure to refit any bolts, studs or nuts removed from your vehicle in their original locations. Also, when renewing a fastener, make sure that the new one has a strength rating equal to or greater than the original.

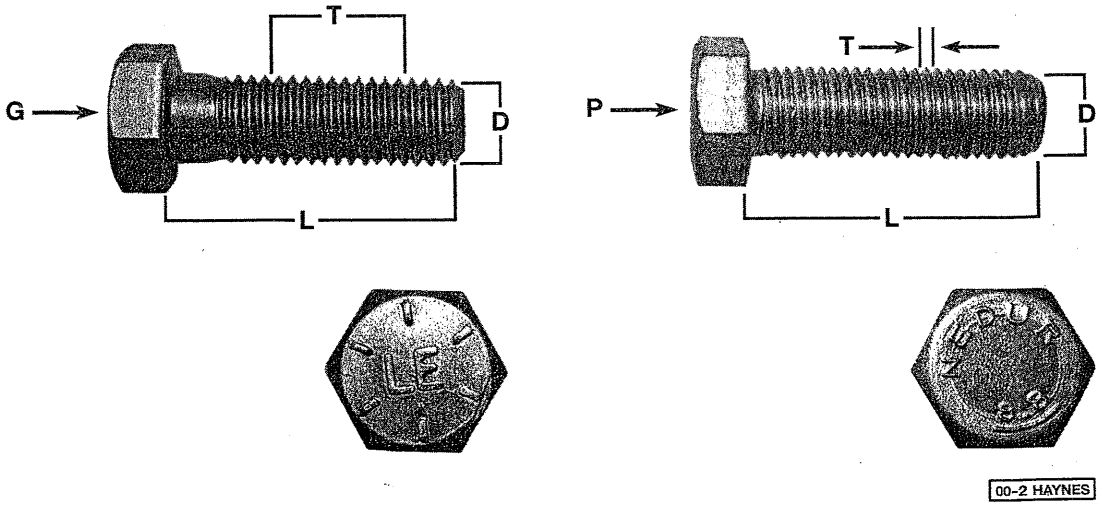
Tightening sequences and procedures

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

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



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 millimetres)*
T *Thread pitch (distance between threads in millimetres)*
D *Diameter*

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

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

Gasket sealing surfaces

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

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

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

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

Hose removal tips

Warning: *If the vehicle is equipped with air conditioning, do not disconnect any of the A/C hoses without first having the system depressurised 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 fitting.

As a last resort (and if the hose is to be renewed 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.

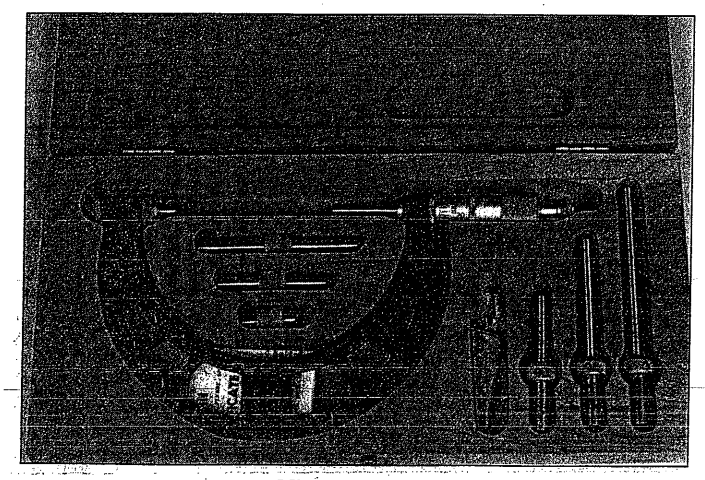
If a hose clamp is broken or damaged, do not reuse it. Wire-type clamps usually weaken with age, so it is a good idea to renew them with screw-type clamps whenever a hose is removed.

Tools

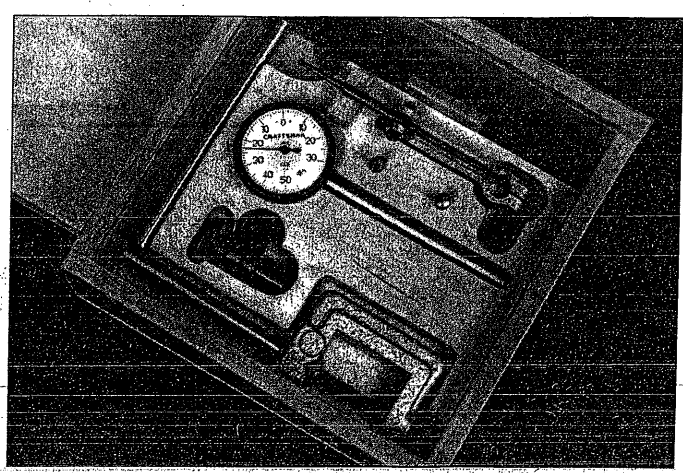
A selection of good tools is a basic requirement for anyone who plans to maintain and repair his or her own vehicle. For the owner who has few tools, the initial investment might seem high, but when compared to the spiralling costs of professional auto maintenance and repair, it is a wise one.

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.*

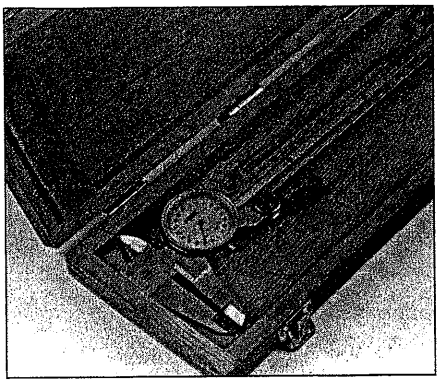
The newcomer to practical mechanics should start off with the *maintenance and minor repair* tool kit, which is adequate for the simpler jobs performed on a vehicle. Then, as confidence and experience grow, the owner can tackle more difficult tasks, buying additional tools as they are needed.



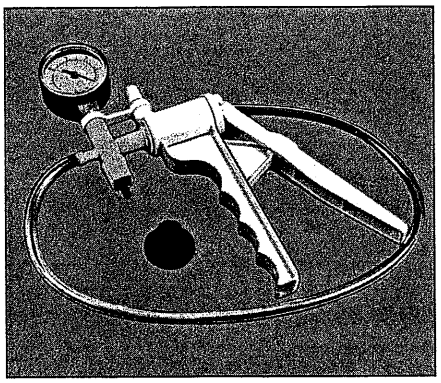
Micrometer set



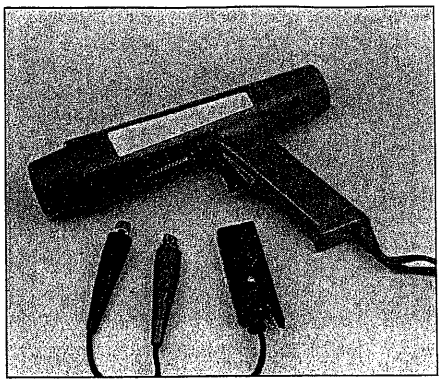
Dial indicator set



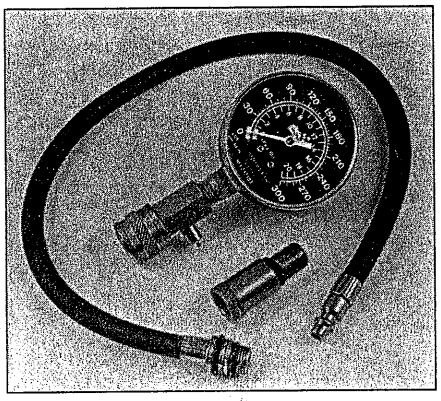
Dial caliper



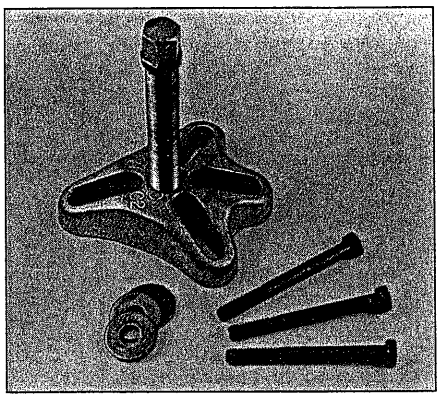
Hand-operated vacuum pump



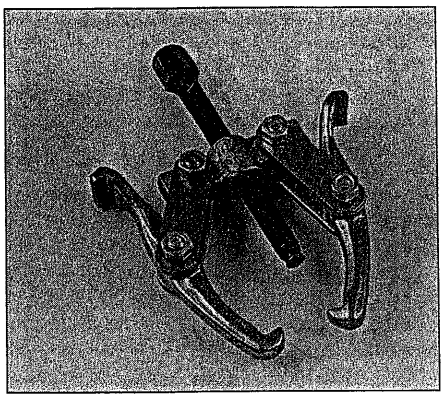
Timing light



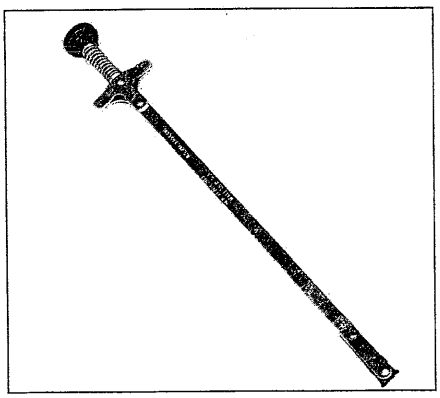
Compression gauge with spark plug hole adaptor



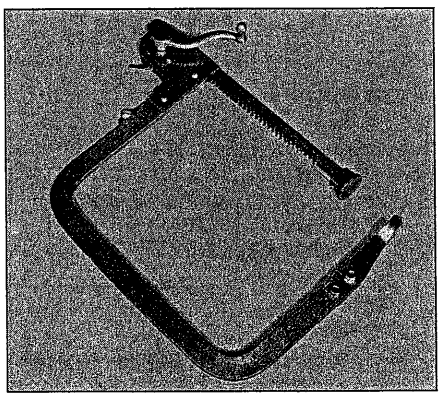
Damper/steering wheel puller



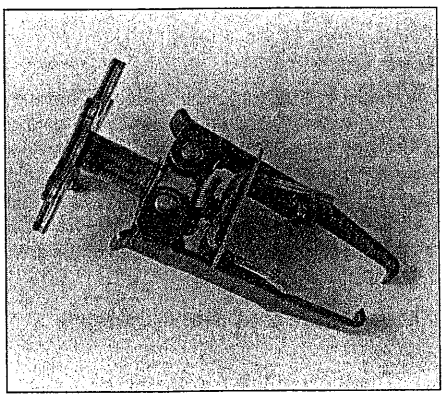
General purpose puller



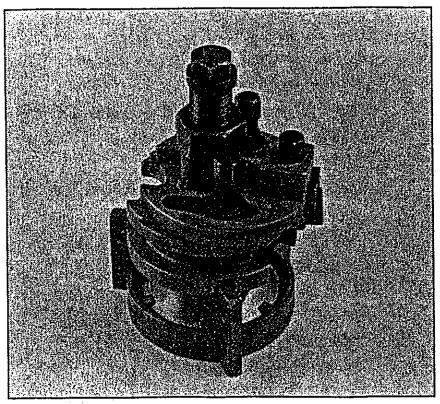
Hydraulic lifter removal tool



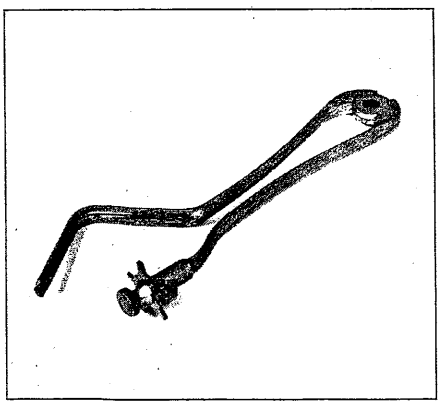
Valve spring compressor



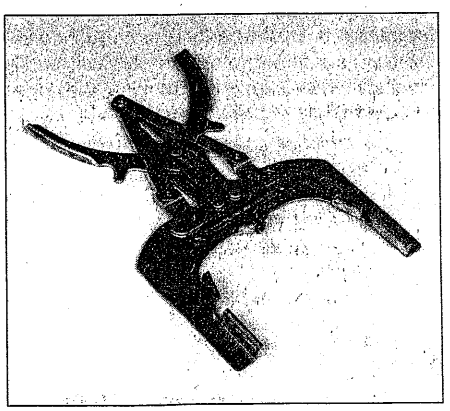
Valve spring compressor



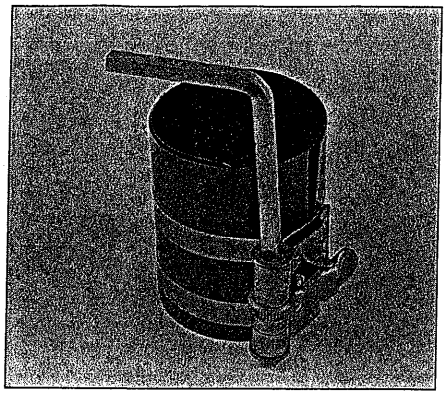
Ridge reamer



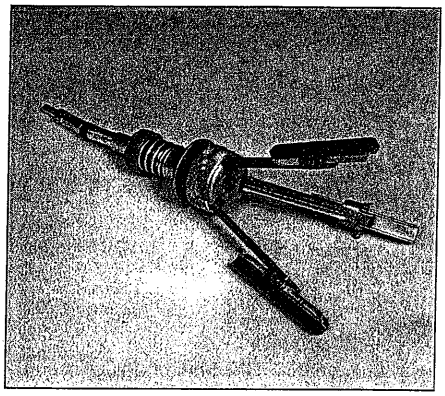
Piston ring groove cleaning tool



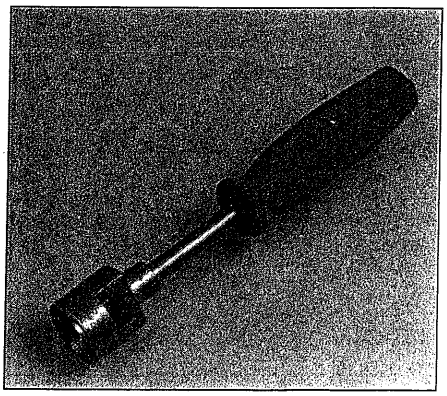
Ring removal/fitting tool



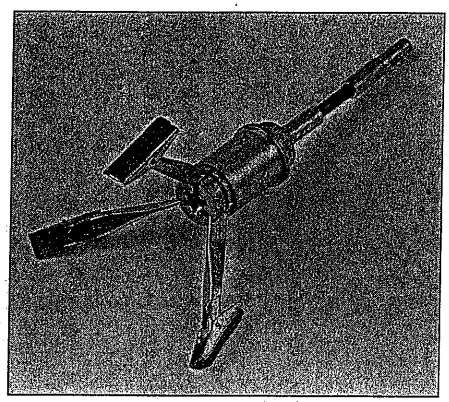
Ring compressor



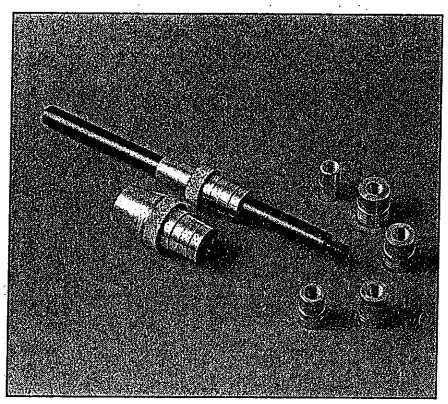
Cylinder hone



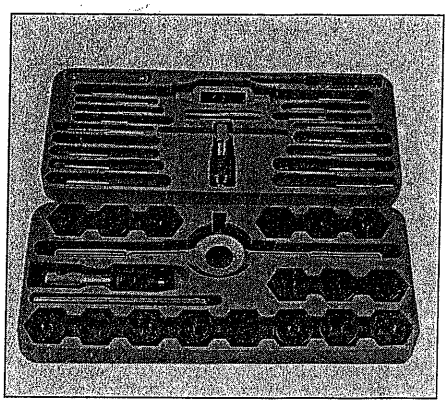
Brake hold-down spring tool



Brake cylinder hone



Clutch plate alignment tool



Tap and die set

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 spanners (box-end and open-end combined in one spanner). While more expensive than open end spanners, they offer the advantages of both types of spanners.

- *Combination spanner set (6 mm to 19 mm)*
- *Adjustable spanner*
- *Spark plug socket with rubber insert*
- *Spark plug gap adjusting tool*
- *Feeler gauge set*
- *Brake bleeder spanner*
- *Standard screwdriver*
- *Phillips screwdriver*
- *Combination pliers*
- *Hacksaw and assortment of blades*
- *Tyre pressure gauge*
- *Grease gun*
- *Oil can*
- *Fine emery cloth*
- *Wire brush*
- *Battery post and cable cleaning tool*
- *Oil filter wrench*
- *Funnel (medium size)*
- *Safety goggles*
- *Jackstands (2)*
- *Drain pan*

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

Repair and overhaul tool set

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

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

Note: *Another tool which is often useful is an electric drill with a chuck capacity of 10 mm and a set of good quality drill bits.*

Special tools

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

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

Valve spring compressor
Piston ring groove cleaning tool
Piston ring compressor
Piston ring fitting 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 fitting tools
Floor jack

Buying tools

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

Tool stores will often be the only source of some of the special tools that are needed, 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 renewing 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 useable 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 bonnet for tools that may have been left there so they won't get lost during a test drive.

Some tools, such as screwdrivers, pliers, spanners 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, metres, 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, renew 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 aluminium parts, because aluminium 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 fit 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. Fit 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 vice that has a jaw opening of at least 10 centimetres.

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 authorised disposal site or recycling centre. 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 bonnet, 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 for changing a tyre or placing jackstands under the frame. **Warning:** *Never crawl under the vehicle or start the engine when the jack is being used as the only means of support.*

All vehicles are supplied with a screw-type jack. When jacking the vehicle, it must be directly under the front or rear axle housing **(see illustration)**. Follow the instructions provided with the jack.

The vehicle should be on level ground with the wheels blocked and the transmission in Park (automatic) or Reverse (manual). Loosen the lug nuts one-half turn and leave them in place until the wheel is raised off the ground.

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

With the bevelled side in, renew the lug nuts and tighten them until snug. Lower the vehicle by turning the jackscrew counterclockwise. Remove the jack and tighten the nuts in a diagonal pattern to the torque listed in the Chapter 1 Specifications. If a torque wrench is not available, have the torque checked by a service station as soon as possible. Renew the hubcap by placing it in position and using the heel of your hand or a rubber mallet to seat it.

Towing

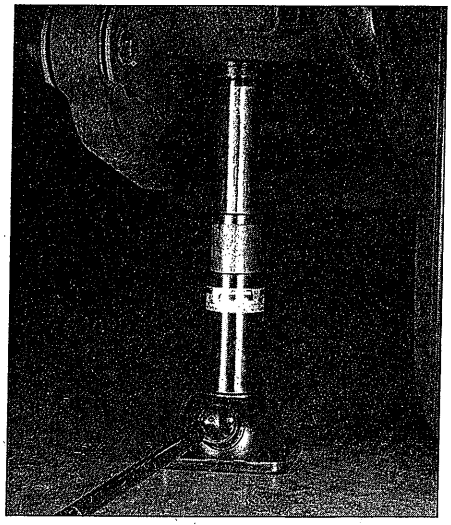
Manual transmission-equipped vehicles can be towed with all four wheels on the ground. Automatic transmission-equipped models should only be towed with all four wheels on the ground if speeds do not exceed 55 kph and the distance is not over 50 kilometres, otherwise transmission damage can result.

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

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

While towing, the parking brake should be released and the transmission should be in Neutral. Front hubs should always be set to the unlocked position.

The steering must be unlocked (ignition switch in the Off position). Remember that power steering and power brakes will not work with the engine off.



Front and rear jacking point - place the jack under the outer end of the axle housing

Booster battery (jump) starting

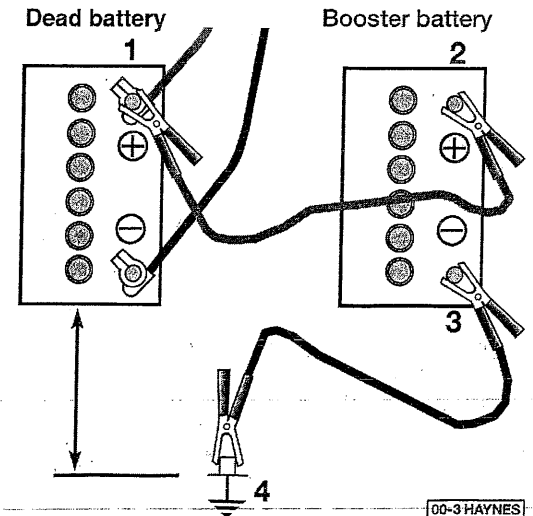
Observe these precautions when using a booster battery to start a vehicle:

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 transmission 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.*

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

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

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



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

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

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

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

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

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

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

Lubricants

Motor oil is the lubricant formulated for use in engines. It normally contains a wide variety of additives to prevent corrosion and reduce foaming and wear. Motor oil comes in various weights (viscosity ratings) from 5 to 80. The recommended weight of the oil depends on the season, temperature and the demands on the engine. Light oil is used in cold climates and under light load conditions. Heavy oil is used in hot climates and where high loads are encountered. Multi-viscosity oils are designed to have characteristics of both light and heavy oils and are available in a number of weights from 5W-20 to 20W-50.

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

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

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

White grease is a heavy grease for metal-to-metal applications where water is a problem. White grease stays soft under both low and high temperatures (usually from -56 to +106-degrees C), 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 seized, rusted and corroded fasteners and prevent future rusting or freezing.

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

Sealants

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

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

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

Chemicals

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

Anaerobic locking compounds are used to keep fasteners from vibrating or working loose and cure only after fitting, 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.

Fuel additives perform several functions, depending on their chemical makeup. They usually contain solvents that help dissolve gum and varnish that build up on carburettor, 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 fuel 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 luggage compartment 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 utilise a chemical or abrasive cleaner to help remove the top layer of oxidised (dull) paint on older vehicles. In recent years many non-wax polishes that contain a wide variety of chemicals such as polymers and silicones have been introduced. These non-wax polishes are usually easier to apply and last longer than conventional waxes and polishes.

Conversion factors

Length (distance)					
Inches (in)	X 25.4	= Millimetres (mm)	X 0.0394	= Inches (in)
Feet (ft)	X 0.305	= Metres (m)	X 3.281	= Feet (ft)
Miles	X 1.609	= Kilometres (km)	X 0.621	= Miles
Volume (capacity)				
Cubic inches (cu in; in^3)	X 16.387	= Cubic centimetres (cc; cm^3)	X 0.061	= Cubic inches (cu in; in^3)
Imperial pints (Imp pt)	X 0.568	= Litres (l)	X 1.76	= Imperial pints (Imp pt)
Imperial quarts (Imp qt)	X 1.137	= Litres (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	= Litres (l)	X 1.057	= US quarts (US qt)
Imperial gallons (Imp gal)	X 4.546	= Litres (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	= Litres (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 centimetre (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 centimetre (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 centimetre (kgf cm; kg cm)	X 0.868	= Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	X 0.113	= Newton metres (Nm)	X 8.85	= Pounds-force 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 metres (kgf m; kg m)	X 7.233	= Pounds-force feet (lbf ft; lb ft)
Pounds-force feet (lbf ft; lb ft)	X 1.356	= Newton metres (Nm)	X 0.738	= Pounds-force feet (lbf ft; lb ft)
Newton metres (Nm)	X 0.102	= Kilograms-force metres (kgf m; kg m)	X 9.804	= Newton metres (Nm)
Vacuum				
Inches mercury (in. Hg)	X 3.377	= Kilopascals (kPa)	X 0.2961	= Inches mercury
Inches mercury (in. Hg)	X 25.4	= Millimetres 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	= Kilometres per hour (km/hr; kph)	X 0.621	= Miles per hour (miles/hr; mph)
Fuel consumption*				
Miles per gallon, Imperial (mpg)	X 0.354	= Kilometres per litre (km/l)	X 2.825	= Miles per gallon, Imperial (mpg)
Miles per gallon, US (mpg)	X 0.425	= Kilometres per litre (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 litres/100 kilometres (l/100km), where mpg (Imperial) x l/100 km = 282 and mpg (US) x l/100 km = 235*

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 jeopardised. 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 petrol, 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 spanners or other tools which may slip and cause injury.
DON'T push on spanners when loosening or tightening nuts or bolts. Always try to pull the spanner toward you. If the situation calls for pushing the spanner away, push with an open hand to avoid scraped knuckles if the spanner should slip.
DON'T attempt to lift a heavy component alone - get someone to help you.
DON'T rush or take unsafe shortcuts to finish a job.
DON'T allow children or animals in or around the vehicle while you are working on it.
DO wear eye protection when using power tools such as a drill, sander, bench grinder, etc. and when working under a vehicle.
DO keep loose clothing and long hair well out of the way of moving parts.
DO make sure that any hoist used has a safe working load rating adequate for the job.
DO get someone to check on you periodically when working alone on a vehicle.
DO carry out work in a logical sequence and make sure that everything is correctly assembled and tightened.
DO keep chemicals and fluids tightly capped and out of the reach of children and pets.
DO remember that your vehicle's safety affects that of yourself and others. If in doubt on any point, get professional advice.

Asbestos

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

Fire

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

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

Fumes

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

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

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

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

The battery

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

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

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

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

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

Household current

When using an electric power tool, inspection light, etc., which operates on household current, always make sure that the tool is correctly connected to its plug and that, where necessary, it is properly earthed. 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 vapour.

Secondary ignition system voltage

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

Troubleshooting

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Engine and performance

1 Engine will not rotate when attempting to start

1 Battery terminal connections loose or corroded. Check the cable terminals at the battery; tighten cable clamp and/or clean off corrosion as necessary (see Chapter 1).
2 Battery discharged or faulty. If the cable ends are clean and tight on the battery posts, turn the key to the On position and switch on the headlights or windscreen wipers. If they won't run, the battery is discharged.
3 Automatic transmission not engaged in park (P) or Neutral (N); faulty inhibitor switch (Chapter 7B).
4 Broken, loose or disconnected wires in the starting circuit. Inspect all wires and connectors at the battery, starter solenoid and ignition switch (on steering column).
5 Starter motor pinion jammed in flywheel ring gear. If manual transmission, place transmission in gear and rock the vehicle to manually turn the engine. Remove starter (Chapter 5) and inspect pinion and flywheel (Chapter 2) at earliest convenience.
6 Starter solenoid faulty (Chapter 5).
7 Starter motor faulty (Chapter 5).
8 Ignition switch faulty (Chapter 12).
9 Engine seized. Try to turn the crankshaft with a large socket and breaker bar on the pulley bolt.

2 Engine rotates but will not start

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

3 Starter motor operates without turning engine

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

4 Engine hard to start when cold

1 Battery discharged or low. Check as described in Chapter 1.
2 Fuel not reaching the carburettor or fuel injectors. Check the fuel filter, lines and fuel pump (Chapters 1 and 4).
3 Choke inoperative (Chapters 1 and 4).
4 Defective spark plugs (petrol engines) (Chapter 1).
5 Glow plugs(diesel) not operational (Chapter 4C).

5 Engine hard to start when hot

1 Air filter dirty (Chapter 1).
2 Fuel not reaching carburettor or fuel injectors (see Chapter 4). Check for a vapour lock situation, brought about by clogged fuel tank vent lines.
3 Bad engine earth connection.
4 Choke sticking (Chapter 1).
5 Defective pick-up coil in distributor (petrol engines) (Chapter 5).
6 Float level too high (petrol engines) (Chapter 4A).
7 Faulty engine temperature sensor (Chapter 6).
8 Contaminated diesel fuel (Chapter 4C).
9 Defective diesel injection pump (diesel engine).
10 Incorrect diesel fuel injection pump timing (diesel engine).

6 Starter motor noisy or engages roughly

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

7 Engine starts but stops immediately

1 Loose or damaged wire harness connections at distributor, coil or alternator.
2 Inlet manifold vacuum leaks(petrol engines). Make sure all mounting bolts/nuts are tight and all vacuum hoses connected to the manifold are attached properly and in good condition (Chapters 2A, 4A, 4B).
3 Insufficient fuel flow to carburettor or fuel injectors (Chapter 4).
4 Idle speed incorrect (Chapter 1).
5 Contaminated diesel fuel (Chapter 4C).
6 Defective diesel injection pump (diesel engine).
7 Incorrect diesel fuel injection pump timing (diesel engine).

8 Engine 'lopes' while idling or idles erratically

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

15 Idle speed out of adjustment (Chapter 1).
16 Diesel injection pump timing incorrect (Chapter 4C).
17 Air or water in diesel fuel (Chapter 4C).
18 Defective diesel fuel injection pump (Chapter 4C).

9 Engine misses at idle speed

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

10 Excessively high idle speed

1 Sticking throttle linkage (Chapter 4A).
2 Choke opened excessively at idle (petrol engines) (Chapter 4A).
3 Idle speed incorrectly adjusted (Chapter 1).
4 Valve clearances incorrectly adjusted - Chapter 1.
5 Hand throttle misadjusted (Chapter 4A).

11 Battery will not hold a charge

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

12 Alternator light stays on

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

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

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

14 Engine misses throughout driving speed range

1 Fuel filter clogged and/or impurities in the fuel system. Check fuel filter (Chapter 1) or clean system (Chapter 4).
2 Faulty or incorrectly gapped spark plugs (petrol engines) (Chapter 1).
3 Incorrect ignition timing (petrol engines) (Chapter 1).
4 Cracked distributor cap, disconnected distributor wires or damaged distributor components (petrol engines) (Chapter 1).
5 Defective spark plug wires (petrol engines) (Chapter 1).
6 Emissions system components faulty (Chapter 6).
7 Low or uneven cylinder compression pressures. Check as described in Chapter 2.
8 Weak or faulty ignition coil (petrol engines) (Chapter 5).
9 Weak or faulty ignition system (petrol engines) (Chapter 5).
10 Vacuum leaks at inlet manifold or vacuum hoses (petrol engines) (see Section 8).
11 Dirty or clogged carburettor or fuel injector (Chapter 4).
12 Leaky EGR valve (Chapter 6).
13 Carburettor out of adjustment (Chapter 4A).
14 Diesel injection pump timing incorrect (Chapter 4C).
15 Air or water in diesel fuel (Chapter 4C).
16 Defective diesel fuel injection pump (Chapter 4C).
17 Clogged fuel filter (Chapter 1).

15 Hesitation or stumble during acceleration

1 Ignition timing incorrect (petrol engines) (Chapter 1).
2 Ignition system not operating properly (petrol engines) (Chapter 5).
3 Dirty or clogged carburettor or fuel injector (Chapter 4A, 4B).
4 Low fuel pressure. Check for proper operation of the fuel pump and for restrictions in the fuel filter and lines (Chapter 4A).
5 Carburettor out of adjustment (Chapter 4A).
6 Carburettor accelerator pump worn (Chapter 4A).
7 Diesel injection pump timing incorrect (Chapter 4C).
8 Air or water in diesel fuel (Chapter 4C).
9 Defective diesel fuel injection pump (Chapter 4C).

16 Engine stalls

1 Idle speed incorrect (Chapter 1).
2 Fuel filter clogged and/or water and impurities in the fuel system (Chapter 1).
3 Choke not operating properly (Chapter 1).
4 Damaged or wet distributor cap and wires (petrol engines).
5 Emissions system components faulty (Chapter 6).
6 Faulty or incorrectly gapped spark plugs (petrol engines) (Chapter 1). Also check the spark plug wires and the ignition points (petrol engines) (Chapter 1).
7 Vacuum leak at the carburettor, inlet manifold or vacuum hoses. Check as described in Section 8.
8 Valve clearances incorrect - Chapter 1.
9 Diesel injection pump timing incorrect (Chapter 4C).
10 Air or water in diesel fuel (Chapter 4C).
11 Defective diesel fuel injection pump (Chapter 4C).

17 Engine lacks power

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

18 Engine backfires

1 EGR system not functioning properly (Chapter 6).
2 Ignition timing incorrect (petrol engines) (Chapter 1).
3 Thermostatic air cleaner system not operating properly (petrol engines) (Chapter 6).
4 Vacuum leak (petrol engines) (refer to Section 8).
5 Valve clearances incorrect - Chapter 1 .
6 Damaged valve springs or sticking valves (Chapter 2).
7 Intake air leak (see Section 8).
8 Carburettor float level out of adjustment (Chapter 4A).
9 Diesel fuel injection pump timing incorrect (Chapter 4C).

19 Engine surges while holding accelerator steady

1 Intake air leak (see Section 8).
2 Fuel pump not working properly (Chapter 4A, 4B).
3 Air or water in the diesel fuel supply (Chapter 4C).
4 Internal diesel injection pump problem (Chapter 4C).

20 Pinging or knocking engine sounds when engine is under load

1 Incorrect grade of fuel. Fill tank with fuel of the proper octane rating.
2 Ignition timing incorrect (petrol engines) (Chapter 1).
3 Carbon build-up in combustion chambers. Remove cylinder head(s) and clean combustion chambers (Chapter 2).
4 Incorrect spark plugs (petrol engines) (Chapter 1).
5 Contaminated diesel fuel (Chapter 4C).
6 Diesel fuel injection pump timing incorrect (Chapter 4C).

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

1 Idle speed too high (Chapter 1).
2 Ignition timing incorrect (petrol engines) (Chapter 1).
3 Incorrect spark plug heat range (petrol engines) (Chapter 1).
4 Intake air leak (see Section 8).
5 Carbon build-up in combustion chambers.
6 Valves sticking (Chapter 2).
7 Valve clearances incorrect (Chapter 1).
8 EGR system not operating properly (Chapter 4).
9 Fuel shut-off system not operating properly (Chapter 6).
10 Check for causes of overheating (Section 27).

22 Low oil pressure

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

23 Excessive oil consumption

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

24 Excessive fuel consumption

1 Dirty or clogged air filter element (Chapter 1).
2 Incorrect ignition timing or dwell (Chapter 1).
3 Incorrect idle speed (Chapter 1).
4 Low tyre pressure or incorrect tyre size (Chapter 11).
5 Fuel leakage. Check all connections, lines and components in the fuel system (Chapter 4A).
6 Choke not operating properly (Chapter 1).
7 Dirty or clogged carburettor jets or fuel injectors (Chapter 4A or 4B).

25 Fuel odour

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

26 Miscellaneous engine noises

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

Cooling system

27 Overheating

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

28 Overcooling

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

29 External coolant leakage

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

30 Internal coolant leakage

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

1 Leaking cylinder head gasket. Have the system pressure tested or remove the cylinder head (Chapter 2) and inspect.
2 Cracked cylinder bore or cylinder head. Dismantle engine and inspect (Chapter 2).
3 Loose cylinder head bolts (tighten as described in Chapter 2).

31 Abnormal coolant loss

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

32 Poor coolant circulation

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

33 Corrosion

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

Clutch

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

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

1 Freeplay incorrectly adjusted (see Chapter 8).
2 Clutch plate warped, distorted or otherwise damaged.
3 Diaphragm spring fatigued. Remove clutch cover/pressure plate assembly and inspect.
4 Broken, binding or damaged release cable (cable-operated clutch).
5 Leakage of fluid from clutch hydraulic system. Inspect master cylinder, operating cylinder and connecting lines.
6 Air in clutch hydraulic system. Bleed the system.
7 Insufficient pedal stroke. Check and adjust as necessary.
8 Piston seal in operating cylinder deformed or damaged.
9 Lack of grease on pilot bearing.

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

1 Worn or oil-soaked clutch plate.
2 Diaphragm spring weak or damaged. Remove clutch cover/pressure plate assembly and inspect.
3 Flywheel warped (Chapter 2).
4 Debris in master cylinder preventing the piston from returning to its normal position.
5 Clutch hydraulic line damaged.
6 Binding in the release mechanism.

36 Grabbing (chattering) as clutch is engaged

1 Oil on clutch plate. Remove and inspect. Repair any leaks.
2 Worn or loose engine or transmission mounts. They may move slightly when clutch is released. Inspect mounts and bolts.
3 Worn splines on transmission input shaft. Remove clutch components and inspect.
4 Warped pressure plate or flywheel. Remove clutch components and inspect.
5 Diaphragm spring fatigued. Remove clutch cover/pressure plate assembly and inspect.
6 Clutch linings hardened or warped.
7 Clutch lining rivets loose.

37 Squeal or rumble with clutch engaged (pedal released)

1 Improper pedal adjustment. Adjust pedal freeplay (Chapter 8).
2 Release bearing binding on transmission shaft. Remove clutch components and check bearing. Remove any burrs or nicks, clean and relubricate before refitting.
3 Pilot bush worn or damaged.
4 Clutch rivets loose.
5 Clutch plate cracked.
6 Fatigued clutch plate torsion springs. Renew clutch plate.
7 Worn transmission bearing.

38 Squeal or rumble with clutch disengaged (pedal depressed)

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

39 Clutch pedal stays on floor when disengaged

Binding linkage or release bearing. Inspect linkage or remove clutch components as necessary.

Manual transmission

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

40 Noisy in Neutral with engine running

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

41 Noisy in all gears

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

42 Noisy in one particular gear

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

43 Slips out of gear

1 Worn gear.
2 Transmission loose on clutch housing.
3 Stiff shift lever seal.
4 Shift linkage binding.
5 Broken or loose input gear bearing retainer.
6 Dirt between clutch lever and engine housing.
7 Worn linkage.
8 Damaged or worn check balls, fork rod ball grooves or check springs.
9 Worn mainshaft or countershaft bearings.
10 Loose engine mounts (Chapter 2).
11 Excessive gear end play.
12 Worn synchronisers.

44 Oil leaks

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

45 Difficulty engaging gears

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

46 Noise occurs while shifting gears

1 Check for proper operation of the clutch (Chapter 8).
2 Faulty synchroniser assemblies.

Automatic transmission

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

47 Fluid leakage

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

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

48 General shift mechanism problems

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

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

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

Throttle sensor faulty.

50 Engine will start in gears other than Park or Neutral

Chapter 7 deals with adjusting the inhibitor switch fitted on automatic transmissions.

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

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

Driveshaft

Note: *Refer to Chapter 8, unless otherwise specified, for service information.*

52 Leaks at front of driveshaft

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

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

1 Loose or disconnected rear suspension components. Check all mounting bolts and bushes (Chapters 7 and 10).

2 Loose driveshaft bolts. Inspect all bolts and nuts and tighten them securely.
3 Worn or damaged universal joint bearings. Inspect the universal joints (Chapter 8).
4 Worn sleeve yoke and mainshaft spline.

54 Metallic grating sound consistent with vehicle speed

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

55 Vibration

Note: *Before blaming the driveshaft, make sure the tyres are perfectly balanced and perform the following test.*
1 Fit 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 renew as necessary.
5 Undercoating or built-up dirt, etc. on the driveshaft. Clean the shaft thoroughly.
6 Worn universal joint bearings. Renew the U-joints or driveshaft as necessary.
7 Driveshaft and/or companion flange out of balance. Check for missing weights on the shaft. Remove driveshaft and refit 180-degrees from original position, then recheck. Have the driveshaft balanced if problem persists.
8 Loose driveshaft mounting bolts/nuts.
9 Defective centre bearing, if so equipped.
10 Worn transmission rear bush (Chapter 7).

56 Scraping noise

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

57 Whining or whistling noise

Debris rubbing on drivebelt.

Rear axle and differential

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

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

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

59 Knocking sound when starting or shifting gears

Defective or incorrectly adjusted differential.

60 Noise when turning

Defective differential.

61 Vibration

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

62 Oil leaks

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

Transfer case

Note: *Unless otherwise specified, refer to Chapter 7C for service and repair information.*

63 Gear jumping out of mesh

1 Incorrect control lever freeplay.
2 Internal wear or incorrect adjustments.

64 Difficult shifting

1 Lack of oil.
2 Internal wear, damage or incorrect adjustment.
3 Damaged linkage.

65 Noise

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

Brakes

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

66 Vehicle pulls to one side during braking

1 Defective, damaged or oil contaminated brake pad on one side. Inspect as described in Chapter 1. Refer to Chapter 10 if renewal is required.
2 Excessive wear of brake pad material or disc on one side. Inspect and repair as necessary.
3 Loose or disconnected front suspension components. Inspect and tighten all bolts securely (Chapters 1 and 11).
4 Defective caliper assembly. Remove caliper and inspect for stuck piston or damage.
5 Brake pad-to-disc adjustment needed. Inspect automatic adjusting mechanism for proper operation.
6 Scored or out of round disc.
7 Loose caliper mounting bolts.
8 Incorrect wheel bearing adjustment.

67 Noise (high-pitched squeal)

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

68 Excessive brake pedal travel

1 Partial brake system failure. Inspect entire system (Chapter 1) and correct as required.
2 Insufficient fluid in master cylinder. Check (Chapter 1) and add fluid - bleed system if necessary.
3 Air in system. Bleed system.

4 Excessive lateral disc runout.
5 Brakes out of adjustment. Check the operation of the automatic adjusters.
6 Defective proportioning valve. Renew valve and bleed system.

69 Brake pedal feels spongy when depressed

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

70 Excessive effort required to stop vehicle

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

71 Pedal travels to the floor with little resistance

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

72 Brake pedal pulsates during brake application

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

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

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

74 Rear brakes lock up under light brake application

1 Tyre pressures too high.
2 Tyres excessively worn (Chapter 1).
3 Load sensing valve problem.

75 Rear brakes lock up under heavy brake application

1 Tyre pressures too high.
2 Tyres excessively worn (Chapter 1).
3 Front brake pads contaminated with oil, mud or water. Clean or renew the pads.
4 Front brake pads excessively worn.
5 Defective master cylinder or caliper assembly.
6 Load sensing valve problem.

Suspension and steering

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

76 Vehicle pulls to one side

1 Tyre pressures uneven (Chapter 1).
2 Defective tyre (Chapter 1).
3 Excessive wear in suspension or steering components (Chapter 1).
4 Wheel alignment incorrect.
5 Front brakes dragging. Inspect as described in Section 73.
6 Wheel bearings improperly adjusted (Chapter 1 or 8).
7 Wheel lug nuts loose.

77 Shimmy, shake or vibration

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

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

1 Defective shock absorbers. Renew as a set.
2 Broken or weak leaf springs and/or suspension components.
3 Worn or damaged stabiliser bar or bushes.
4 Rear stabiliser bar released.

79 Wandering or general instability

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

80 Excessively stiff steering

1 Lack of lubricant in power steering fluid reservoir, where appropriate (Chapter 1).
2 Incorrect tyre pressures (Chapter 1).
3 Lack of lubrication at hubs (Chapter 1).
4 Steering gear out of adjustment or lacking lubrication.
5 Improperly adjusted wheel bearings.
6 Worn or damaged steering gear.
7 Low tyre pressures.
8 Worn or damaged hubs.
9 Worn or damaged steering linkage.
10 See also Section 79.

81 Excessive play in steering

1 Worn steering linkage.
2 Excessive wear in suspension bushes (Chapter 1).
3 Steering gear improperly adjusted.
4 Incorrect wheel alignment.
5 Steering gear mounting bolts loose.

82 Lack of power assistance

1 Steering pump drivebelt faulty or not adjusted properly (Chapter 1).
2 Fluid level low (Chapter 1).
3 Hoses or pipes restricting the flow. Inspect and renew parts as necessary.
4 Air in power steering system. Bleed system.
5 Defective power steering pump.
6 Defective steering gear.

83 Steering wheel fails to return to straight-ahead position

1 Incorrect front end alignment.
2 Tyre pressures low.
3 Worn or damaged balljoint.
4 Worn or damaged steering linkage.
5 Insufficient oil in steering gear.
6 Lack of fluid in power steering pump.

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

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

85 Noisy power steering pump

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

86 Miscellaneous noises

1 Improper tyre pressures.
2 Insufficiently lubricated hub or steering linkage.
3 Loose or worn steering gear, steering linkage or suspension components.
4 Defective shock absorber.
5 Defective wheel bearing.
6 Worn or damaged suspension bushes.
7 Damaged leaf spring.
8 Loose wheel lug nuts.
9 Worn or damaged axleshaft spline.
10 Worn or damaged shock absorber mounting bush.
11 Incorrect rear axle end play.
12 See also causes of noises at the rear axle and driveshaft.

87 Excessive tyre wear (not specific to one area).
1 Incorrect tyre pressures.
2 Tyres out of balance. Have them balanced on the vehicle.
3 Wheels damaged. Inspect and renew as necessary.
4 Suspension or steering components worn (Chapter 1).

88 Excessive tyre wear on outside edge

1 Incorrect tyre pressure.
2 Excessive speed in turns.
3 Front end alignment incorrect (excessive toe-in).

89 Excessive tyre wear on inside edge

1 Incorrect tyre pressure.
2 Front end alignment incorrect (toe-out).
3 Loose or damaged steering components (Chapter 1).

90 Tyre tread worn in one place

1 Tyres out of balance. Have them balanced on the vehicle.
2 Damaged or buckled wheel. Inspect and renew if necessary.
3 Defective tyre.