Special notes concerning the use of this CD-ROM

This publication covers virtually all petrol-engined cars and light commercial vehicles up to 3.5 tonnes gross vehicle weight (GVW) which have been available in the last ten years. Its layout is designed for the easiest possible usage and is therefore generally self-explanatory. However, the following notes make comment on some of the slightly less-obvious aspects of the data, and should be read before consulting the main part of the book.

Year - The year in the model heading area may refer to manufacturers' model years, usually August 1st to July 31st, eg. 1993 may mean August 1st 1992 to July 31st 1993.

Emissions regulations - abbreviations such as *15.04, 15.05, US83, US93, ECE R 83A* and *91/441/EEC* appear throughout this book. They refer to EC emissions regulations currently in operation in European countries. 91/441/EEC is one of the most stringent with regard to permitted emission levels, largely replacing the old US83 level, and is also known as EC96. All vehicles with these emission levels are fitted with Catalytic converters. 15.04 and 15.05 are less stringent, and do not require that Catalytic converters be fitted. ECE R 83A replaces the old 15.04. These regulations are constantly being amended, with each version becoming more stringent than the previous one.

Valve clearances - these are specified COLD unless otherwise stated.

Exhaust gas analysis - with impending legislation in the UK requiring annual four-gas testing, provision has been made for the inclusion of CO, HC, CO_2 and O_2 data, although currently few manufacturers provide such data. Note that exhaust gas analysis on vehicles equipped with catalytic converters should be taken at the CO-measuring pipe unless stated otherwise. See *Workshop practice - Exhaust emissions.*

Carburettor - where two main jet sizes are given, the primary is quoted first, followed by the secondary.

Fuel grade - the octane number quoted is the *minimum* RON requirement recommended by the vehicle manufacturer.

Unleaded fuel - is currently sold in the UK in grades of 95 RON (Premium) or 98 RON (Super). General comments concerning its use are given along with the octane rating in this Data Book. Where the unleaded requirement is shown as 91 RON (Regular), this is for use in countries where such fuel is available, and it can be assumed that 95 or 98 RON is satisfactory for use in the UK. Some manufacturers lay down certain requirements which are to be met, usually regarding the non-continuous use of unleaded fuel, adjustment of ignition timing, etc. As such requirements can change at short notice, it is recommended that the manufacturers are consulted for the most up-to-date information if any doubt exists. It should be noted that some vehicles which can run on 95 RON unleaded fuel with adjustments may be able to run on 98 RON unleaded fuel without any such adjustments. *Vehicles fitted with catalytic converters must only be run on unleaded fuel; use of conventional leaded fuel will cause damage to the catalyst.*

Ignition timing - this should be checked with the engine at normal operating temperature. Unless otherwise indicated, illustrations depicting ignition timing marks generally show them aligned for the correct setting for the engine specified; *it should be noted that this is not necessarily TDC.*

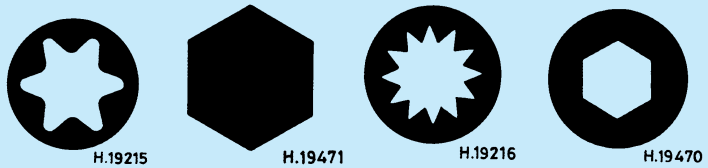
Battery - the ampere-hour (Ah) capacity quoted for a battery is largely being superseded by two other figures indicating its 'performance' ability. These usually appear on the labelling of the battery, and show the Cold Cranking (CC) current and the Reserve Capacity (RC). The CC figure indicates the battery's cold starting performance and is defined as the discharge current (in amps) which it can maintain from the fully charged condition for one minute at -18°C before the voltage in each cell drops to 1.4. The RC figure shows the time (in minutes) taken for the voltage in each cell to drop to 1.75 whilst discharging the battery under a 25 amp load at 25°C from the fully charged condition. Where the RC is not quoted by the manufacturer, the battery capacity is shown in ampere-hours (Ah).

Brakes - minimum friction material thickness - where this is not quoted by the manufacturers, it is suggested that the following is used for general guidance: Disc brake pads should be renewed if the *friction material* thickness is less than 1.5mm or will reach this state before the next service is due. Drum brake shoes should similarly be renewed if the *friction material* thickness is less than 2.0mm for *bonded* shoe linings, or is within 1.0mm of the rivet heads for *riveted* shoe linings.

Tyres - tyre pressures are quoted COLD with the vehicle unladen, and are typical examples only. Space considerations prevent the inclusion of all possible vehicle type/tyre size/loading combinations. Always follow the manufacturer's recommendations for correct tyre pressures wherever possible. *Note that pressures for compact/space saver spare tyres are not quoted*. With regard to tyre sizes, these do not generally include the relevant speed/load rating. It is therefore important to refer to the manufacturer's or a tyre specialist's recommendations regarding this aspect, especially for light commercial vehicles.

Wheel alignment/suspension geometry - figures are generally quoted with the vehicle UNLADEN unless otherwise specified. Certain vehicles, in particular those produced by Renault and Ford, are set at specific vehicle ride heights, and figures quoted are therefore nominal values only.

Torque wrench settings - the correct assembly of certain cylinder heads, main bearings and wheel hubs often depends on special procedures being strictly adhered to. When using the torque wrench settings given for these items, it is recommended that reference is made to the appropriate workshop manual for the vehicle for further details of any such special procedures. It should be noted that new bolts or nuts should be used as specified by the manufacturer, especially where angular torque tightening methods are used. In some cases, when referring to 'stretch bolts', maximum bolt lengths are specified; if the bolt exceeds this length, it should be replaced. Note that in some cases certain bolts fitted to the cylinder head are required to be tightened 'hand-tight'. This equates to a torque wrench setting of approximately 25 Nm. Take special note of any requirements regarding cylinder head bolt types so that the appropriate torque wrench setting is used. Reference is made to *Torx, splined, hex (hexagon)* and *Allen* type bolts, and it is vital to use the correct setting according to type. *See illustrations for reference.*



Torx *Hex (hexagon)* *Splined* *Allen*

Cylinder head bolt types

Illustrations - these are provided to clearly show the relevant carburettor/fuel injection adjustment points, ignition timing marks and cylinder head bolt/nut tightening sequence and valve positions. With regard to the latter type of illustration, the location of the engine flywheel is clearly visible to aid correct identification of the cylinder locations. The valve *head* positions are indicated, rather than the locations of the adjustment points (eg. rocker arm adjusters). It should be noted that where tamperproofing devices are fitted to carburettor/fuel injection adjustment points, these are not always shown in the relevant illustrations. Inevitably these devices will be damaged in the course of removal to allow adjustment. New items should therefore be fitted once the adjustment procedures have been completed.

Nissan vehicles - the section covering this range also incorporates data on vehicles originally manufactured under the DATSUN marque name.

Peugeot-Talbot vehicles - the section covering this range also incorporates data on vehicles originally manufactured under the TALBOT marque name.

Rover vehicles - the section covering this range also incorporates data on vehicles originally manufactured under the AUSTIN ROVER or BRITISH LEYLAND marque names, including Austin, MG and Rover.

Vauxhall/Opel vehicles - the section covering this range also incorporates data on vehicles originally manufactured under the BEDFORD marque name.

Information not available - where the relevant technical data is not quoted by the vehicle manufacturer, this is indicated by a dash (-). A dash may also show that the particular item of data is not applicable to the model in question.

Abbreviations used in this publication - most abbreviations are well-known and will therefore be familiar to the user of this Data Book. The following list is provided to explain some of the less familiar abbreviations, although it is stressed that this is a typical selection rather than a comprehensive list:

ABS	=	Anti-lock braking system
AEI	=	Integral electronic ignition
A/C	=	Air conditioning
AT	=	Automatic transmission
C	=	Cold
CAT	=	Catalytic converter/catalyst
C/b	=	Contact breaker ignition
CC	=	Cold cranking *(see previous definition)*
CIH	=	Cam-in-head
CIS	=	Continuous (fuel) injection system
CO	=	Carbon monoxide
CO_2	=	Carbon dioxide
DME	=	Digital motor electronics
Ex	=	Emission readings taken at exhaust tailpipe
F	=	France
FoG	=	Ford of Germany
Fwd	=	Front wheel drive
H	=	Hot
HC	=	Hydrocarbons or High compression
HD	=	Heavy duty
Hg	=	Mercury
Hyd	=	Hydraulic adjusters
IRS	=	Independent rear suspension
L	=	Laden
LC	=	Low compression
LkC	=	Locking compound
MPI	=	Multi-point (fuel) injection
MT	=	Manual transmission
MY	=	Model year
N	=	New bolts
N/A	=	Not adjustable / not applicable
O2	=	Oxygen
O/D	=	Overdrive
OHB	=	Owner's handbook
PAS	=	Power assisted steering
ppm	=	Parts per million
PU	=	Pick-up
PW	=	Per wheel
RC	=	Reserve capacity *(see previous definition)*
RON	=	Research octane number
Rwd	=	Rear wheel drive
SPI	=	Single-point (fuel) injection
TWS	=	Torque wrench setting
UL	=	Unleaded fuel *(see below)*
U/L	=	Unladen
V	=	Valve(s)
VV	=	Variable venturi (carburettor)
WSM	=	Refer to workshop manual or vehicle manufacturer
WT	=	Included with transmission
1V	=	Single venturi (carburettor)
2D	=	Two door
2V	=	Twin venturi (carburettor)
3D	=	Three door
4D	=	Four door
4x4	=	Four wheel drive
5D	=	Five door
≥	=	Greater than or equal to
≤	=	Less than or equal to

(continued on page 5)

Unleaded fuel abbreviations

[R]	=	Refer to manufacturer
[U]	=	Unleaded fuel only
[L]	=	Leaded fuel only (unleaded is not suitable for use in this vehicle)
[E]	=	Either unleaded or leaded fuel may be used without adjustment
[RA]	=	Adjust engine (usually ignition timing), see accompanying note for details, or refer to manufacturer
[E 91 RON]	=	91 RON unleaded fuel is suitable for use in this vehicle
[E 95 RON]	=	95 RON unleaded fuel is suitable for use in this vehicle
[E 98 RON]	=	98 RON unleaded fuel is suitable for use in this vehicle

No 1 cylinder position abbreviations

F	=	Front
FE	=	Flywheel end
FEL	=	Flywheel end left
FER	=	Flywheel end right
FL	=	Front left
FR	=	Front right
PEL	=	Pulley end left
PER	=	Pulley end right
R	=	Rear
RL	=	Rear left
RR	=	Rear right
TBE	=	Timing belt end
TCE	=	Timing chain end
TGF	=	Timing gear front bank
TGR	=	Timing gear rear bank

Workshop practice

Whenever servicing, repair or overhaul work is carried out on a vehicle or its components, it is necessary to observe certain basic rules and procedures to ensure both personal safety and a high standard of workmanship. Much of this is common knowledge to the established tune-up specialist, but the following is provided as a reminder. It will particularly guide those entering the repair and tune-up business for the first time, or those working in less-than-ideal circumstances and with a limited range of tools and facilities.

Safety precautions

However enthusiastic you may be about getting on with the job in hand, do take the time to ensure that your safety or that of the vehicle's owner is not put at risk. A moment's lack of attention can result in an accident, as can failure to observe certain elementary precautions.

There will always be new ways of having accidents, and the following points do not pretend to be a comprehensive list of all dangers; they are intended rather to make you aware of the risks and to encourage a safety-conscious approach to all work you carry out on a vehicle.

Essential DOs and DON'Ts

DON'T rely on a single jack when working underneath the vehicle. Unless obviated by the use of a commercial hydraulic lift or hoist, always use reliable additional means of support, such as axle stands, securely placed under a part of the vehicle that you know will not give way.

DON'T attempt to loosen or tighten high-torque nuts (eg wheel hub nuts) while the vehicle is on a jack; it may be pulled off.

DON'T start the engine without first ascertaining that the transmission is in neutral (or 'Park' where applicable) and the parking brake applied.

DON'T suddenly remove the filler cap from a hot cooling system - cover it with a cloth and release the pressure gradually first, or you may get scalded by escaping coolant.

DON'T attempt to drain oil, automatic transmission fluid or coolant until you are sure it has cooled sufficiently to avoid scalding you.

DON'T grasp any part of the engine or exhaust without first ascertaining that it is sufficiently cool to avoid burning you.

DON'T allow brake fluid or antifreeze to contact vehicle paintwork.

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

DON'T inhale dust - it may be injurious to health (see *Asbestos* below).

DON'T allow any spilt oil or grease to remain on the floor - wipe it up or apply absorption granules straight away, before someone slips on it.

DON'T use ill-fitting spanners or other tools which may slip and cause injury.

DON'T attempt to lift a heavy component which may be beyond your capability - get assistance.

DON'T rush to finish a job, or take unverified short cuts.

DON'T allow children or animals in or around an unattended vehicle.

DON'T park vehicles with catalytic converters over combustible materials such as dry grass, oily rags etc if the engine has recently been run. As catalytic converters reach extremely high temperatures, any such materials in close proximity may ignite.

DON'T run vehicles equipped with catalytic converters without the exhaust system heat shields fitted.

DO remember that air bags and some seat belt pre-tensioners are activated using small explosive charges. Always refer to the vehicle manufacturer for any special precautions to be observed before tampering with these devices or any associated actuating electronic circuitry.
DO wear eye protection when using power tools such as drill, sander, bench grinder etc, and when working under the vehicle.
DO use a barrier cream on your hands prior to undertaking dirty jobs - it will protect your skin from infection as well as making the dirt easier to remove afterwards; but make sure your hands aren't left slippery. Note that long-term contact with used engine oil can be a health hazard.
DO keep loose clothing (cuffs, tie etc) and long hair well out of the way of moving mechanical parts.
DO remove rings, wristwatch etc, before working on the vehicle - especially the electrical system.
DO ensure that any lifting tackle or jacking equipment used has a safe working load rating adequate for the job, and is used precisely as recommended by the manufacturer.
DO keep your work area tidy - it is only too easy to fall over articles left lying around.
DO get someone to check periodically that all is well when working alone on the vehicle.
DO carry out work in a logical sequence and check that everything is correctly assembled and tightened afterwards.
DO remember that the vehicle's safety affects that of the driver and others. If in doubt on any point, get a second opinion.
IF, in spite of following these precautions, you are unfortunate enough to injure yourself, seek medical attention as soon as possible.

Asbestos

Certain friction, insulating, sealing, and other products - such as brake linings, brake bands, clutch linings, 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 naked flame around, when working on the vehicle. But the risk does not end there - a spark caused by an electrical short-circuit, by two metal surfaces contacting each other, by careless use of tools, or even by static electricity built up in your body under certain conditions, can ignite petrol vapour, which in a confined space is highly explosive.

Whenever possible, disconnect the battery earth terminal before working on any part of the fuel or electrical system, and never risk spilling fuel on to a hot engine or exhaust.

Catalytic converters run at extremely high temperatures, and consequently can be an additional fire hazard. Observe the precautions outlined elsewhere in this section.

It is recommended that a fire extinguisher of a type suitable for fuel and electrical fires is kept handy in the garage or workplace 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, especially if inhalation takes place through a lighted cigarette or pipe. Petrol vapour comes into this category, as do the vapours from certain solvents such as trichloroethylene. 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 carefully. Never use materials from unmarked containers - they may give off poisonous vapours.

Never run the engine of a motor vehicle in an enclosed space such as a garage unless it is equipped with a fume extraction system. Exhaust fumes contain carbon monoxide which is extremely poisonous; if you need to run the engine, and an extraction system is not available, always do so in the open air or at least have the rear of the vehicle outside the workplace. Although vehicles fitted with catalytic converters have greatly reduced toxic exhaust emissions, the above precautions should still be observed.

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 standing over it; the fumes, being heavier than air, will concentrate in the pit with possibly lethal results.

The battery

Batteries which are sealed for life require special precautions which are normally outlined on a label attached to the battery. Such precautions are primarily related to situations involving battery charging and jump starting from another vehicle.

With a conventional battery, never cause a spark, or allow a naked light, in close proximity to it. It will normally be giving off a certain amount of hydrogen gas, which is highly explosive.

Whenever possible, disconnect the battery earth terminal before working on the fuel or electrical systems.

If possible, loosen the filler plugs or cover when charging the battery from an external source. Do not charge at an excessive rate or the battery may burst. Special care should be taken with the use of high charge-rate boost chargers to prevent the battery from overheating.

Take care when topping up and when carrying the battery. The acid electrolyte, even when diluted, is very corrosive and should not be allowed to contact the eyes or skin.

If you ever need to prepare electrolyte yourself, always add the acid slowly to the water, and never the other way round. Protect against splashes by wearing rubber gloves and goggles.

When jump starting a car using a booster battery, for negative earth vehicles, connect the jump leads in the following sequence: First connect one jump lead between the positive (+) terminals of the two batteries. Then connect the other jump lead first to the negative (-) terminal of the booster battery, and then to a good earthing point on the vehicle to be started, at least 45 cm from the battery if possible. Ensure that hands and jump leads are clear of any moving parts, and that the two vehicles do not touch. Disconnect the leads in the reverse order.

Mains electricity and electrical equipment

When using an electrical power tool, inspection light, diagnostic equipment etc, which works from the mains, always ensure that the appliance is correctly connected to its plug and that, where necessary, it is properly earthed. Do not use such appliances in damp conditions and, again, beware of creating a spark or applying excessive heat in the vicinity of fuel or fuel vapour. In particular, some diagnostic equipment may incorporate high voltage circuitry, and any special safety precautions outlined in its accompanying instruction booklet should be observed. Also ensure that the appliances meet the relevant national safety standards.

Ignition HT voltage

A severe electric shock can result from touching certain parts of the ignition system, such as the HT leads, when the engine is running or being cranked, particularly if components are damp or the insulation is defective. Where an electronic ignition system is fitted, the HT voltage is much higher and could prove fatal, especially to wearers of heart pacemakers.

Workshop jacking and vehicle support

Professional garages and tune-up establishments are usually equipped with a commercial hydraulic lift or hoist system. Such equipment has in-built safety devices to ensure that anyone working on a suspended vehicle is not at risk from the vehicle suddenly descending! However, for those who do not have such equipment at their disposal, the following points should be carefully noted.

The jack provided with the vehicle is designed primarily for emergency wheel changing, and its use for servicing and overhaul work on the vehicle is best avoided. Instead, a substantial workshop jack (trolley jack or similar) should be used. Whichever type is employed, it is essential that additional safety support is provided by means of axle stands designed for this purpose. Never use makeshift means such as wooden blocks or piles of house bricks, as these can easily topple or, in the case of bricks, disintegrate under the weight of the vehicle.

If removal of the wheels is not required, the use of drive-on ramps is recommended. Caution should be exercised to ensure that they are correctly aligned with the wheels, and that the vehicle is not driven too far along them so that it promptly falls off the other ends or tips the ramps.

General repair procedures

The following comments will assist in carrying out general repairs efficiently and professionally, thus reducing the possibility of component damage to a minimum. Brief mention is also made regarding care and use of tools.

Joint mating faces and gaskets

When separating components at their mating faces, never insert screwdrivers or similar implements into the joint between the faces in order to prise them apart. This can cause severe damage which results in oil leaks, coolant leaks, etc upon reassembly. Separation is usually achieved by tapping along the joint with a soft-faced hammer in order to break the seal. However, note that this method may not be suitable where dowels are used for component location.

Where a gasket is used between the mating faces of two components, ensure that it is renewed on reassembly, and fit it dry unless otherwise stated in the relevant repair manual. Make sure that the mating faces are clean and dry with all traces of old gasket removed. When cleaning a joint face, use a tool which is not likely to score or damage the face, and remove any burrs or nicks with an oilstone or fine file.

Make sure that tapped holes are cleaned with a pipe cleaner, and keep them free of jointing compound if this is being used unless specifically instructed otherwise.

Ensure that all orifices, channels or pipes are clear and blow through them, preferably using compressed air.

Oil seals

Oil seals can be removed by levering them out using a wide flat-bladed screwdriver or similar implement. Alternatively, a number of self-tapping screws may be screwed into the seal and these used as a purchase for pliers or some similar device in order to pull the seal free.

Whenever an oil seal is removed from its working location, either individually or as part of an assembly, it should be renewed.

The very fine sealing lip of the seal is easily damaged and will not seal if the surface it contacts is not completely clean and free from scratches, nicks or grooves. If the original sealing surface of the component cannot be restored and the manufacturer has not made provision for slight relocation of the seal relative to the sealing surface, the component should be renewed.

Protect the lips of the seal from any surface which may damage them in the course of fitting. Use tape or a conical sleeve where possible. Lubricate the seal lips with oil before fitting and, on dual lipped seals, fill the space between the lips with grease.

Unless otherwise stated, oil seals must be fitted with their sealing lips toward the lubricant to be sealed.

Use a tubular drift or block of wood of the appropriate size to install the seal and, if the seal housing is shouldered, drive the seal down to the shoulder. If the seal housing is unshouldered, the seal should be fitted with its face flush with the housing top face (unless otherwise instructed).

Screw threads and fastenings

Seized nuts, bolts and screws are quite a common occurrence where corrosion has set in, and the use of penetrating oil or releasing fluid will often overcome this problem if the offending item is soaked for a while before attempting to release it. The use of an impact driver may also provide a means of releasing such stubborn fastening devices when used in conjunction with the appropriate screwdriver bit or socket. If none of these methods works, it may be necessary to resort to the careful application of heat, or the use of a hacksaw or nut splitter device.

Studs are usually removed by locking two nuts together on the threaded part and then using a spanner on the lower nut to unscrew the stud. Studs or bolts which have broken off below the surface of the component in which they are mounted can sometimes be removed by using a proprietary stud extractor.

It should be noted that certain bolts used in critical areas such as big-end bearing cap/connecting rod or cylinder head retention applications should not be re-used once removed. The relevant repair manual usually gives guidance on this point.

Always ensure that a blind tapped hole is completely free from oil, grease, water or other fluid before installing the bolt or stud. Failure to do this could cause the housing to crack due to the hydraulic action of the bolt or stud as it is screwed in.

When tightening a castellated nut to accept a split pin, tighten the nut to the specified torque, where applicable, and then tighten further to the next split pin hole. Never slacken the nut to align a split pin hole unless stated in the repair procedure.

When checking or retightening a nut or bolt to a specified torque setting, slacken the nut or bolt by a quarter of a turn, and then retighten to the specified setting. However, this should not be attempted where angular tightening has been used.

For some screw fastenings, notably cylinder head bolts or nuts, torque wrench settings are no longer specified for the later stages of tightening, ‘angular tightening’ being called up instead. Typically, a fairly low torque wrench setting will be applied to the bolts/nuts in the correct sequence, followed by one or more stages of tightening through specified angles.

Locknuts, locktabs and washers

Any fastening which will rotate against a component or housing in the course of tightening should always have a washer between it and the relevant component or housing.

Spring or split washers should always be renewed when they are used to lock a critical component such as a big-end bearing retaining nut or bolt.

Locktabs which are folded over to retain a nut or bolt should always be renewed.

Self-locking nuts can be re-used in non-critical areas, providing resistance can be felt when the locking portion passes over the bolt or stud thread. However, it should be noted that self-locking stiffnuts tend to lose their effectiveness after long periods of use, and in such cases should be renewed as a matter of course.

Split pins must always be replaced with new ones of the correct size for the hole.

When thread locking compound is found on the threads of a fastener which is to be re-used, it should be cleaned off with a wire brush and solvent, and fresh compound applied on reassembly.

Care and maintenance of tools

Having invested a substantial amount of money in a tool kit and diagnostic equipment, it is worthwhile taking reasonable care to keep them in a clean serviceable condition. After use, always wipe off any dirt, grease and metal particles using a clean, dry cloth, before putting the tools away. Never leave them lying around after they have been used. Any measuring instruments, gauges, meters etc, must be carefully stored where they cannot be damaged or become rusty.

Take a little care when tools are used. Hammer heads inevitably become marked and screwdrivers lose the keen edge on their blades from time to time. A little timely attention with emery cloth or a file will soon restore items like this to a good serviceable finish.

With regard to diagnostic equipment, special care should be exercised to ensure that it is kept in dry, dust-free conditions. As such equipment is not weatherproof, it should never be used outside in snow or rain. Obviously the accuracy of the equipment is dependent upon correct calibration. Therefore, from time to time the calibration should be checked according to the instructions provided by the manufacturer.

Environmental considerations

When disposing of used engine oil, brake fluid, antifreeze etc, give due consideration to any detrimental environmental effects. Do not, for instance, pour any of the above liquids down drains into the general sewage system or onto the ground to soak away. If a commercial oil disposal service is not available, consult your local Environmental Health Department for further advice.

Exhaust emissions

With the universal tightening-up of legislation regarding the emission of environmentally harmful substances from motor vehicles, most current vehicles have tamperproof devices fitted to the main adjustment points of the fuel system. These devices are primarily designed to prevent unqualified persons from adjusting the mixture with the chance of a consequent increase in toxic emissions. Indeed, in certain European countries such adjustments by unqualified persons are illegal. If such devices are encountered in tune-up or overhaul, they should be renewed or refitted in accordance with the vehicle manufacturer's requirements or current legislation.

In the UK, legislation brought in on 1st November 1991, and revised in September 1995, resulted in the requirement for exhaust gas testing in the Department of Transport annual vehicle test ('MOT'). The emission levels to be met are, for vehicles without Catalytic converters, 4.5% CO by volume for vehicles first used on or after 1st August 1975 and before 31st July 1986; and 3.5% CO by volume for vehicles first used on or after 1st August 1986 and before 31st July 1992; and 1200 ppm HC (hydrocarbons) for vehicles first used on or after 1st August 1975 and before 31st July 1992. For vehicles fitted with Catalytic converters, the original manufacturers' specifications must be strictly adhered to, but where these are not available, the **maximum** permitted emission levels at an engine speed between 2500 rpm and 3000 rpm are 0.3% CO by volume and 200 ppm HC, with a Lambda reading of between 0.97 and 1.03; at engine idle speed (between 550 rpm and 1100 rpm) the maximum CO level is 0.5%. (The regulations are constantly being amended, and will require more stringent emission levels - see *Exhaust gas analysis* on page II). It should be noted that these are the maximum allowable levels, and that in practice the vehicle manufacturers' recommendations are often much lower. It is essential that vehicles are maintained in the correct state of tune in order to comply with current legislation. Improved economy and smooth running of the vehicle will be an automatic benefit.

High levels of CO are primarily caused by the carburettor or fuel injection system administering too rich a mixture to the engine,

either through poor adjustment, or through component malfunction. The incorrect fuel/air ratio results in only partial combustion of the fuel, causing the emission of CO where more complete combustion would promote the formation of the less-damaging CO_2. Restrictions in the air intake path for the fuel system (eg clogged air filter) or the engine crankcase breather system could have similar results.

High levels of HC are usually caused by engine faults which result in incomplete combustion of the fuel. Such faults very often originate in the ignition system (eg coil, distributor or spark plug malfunction which may cause engine misfiring; over-advanced ignition timing), although severely worn engine components (pistons/rings, valves etc) or fuel system faults may also cause high HC levels.