LAND ROVER SERIES III PETROL P/U

1981-86

IDENTIFICATION: Introduced **1981:** Available in both petrol and ADE 4 cyl. Diesel versions. Similar in appearance to series II Land Rover, but with changes to front grill which has been broadened and redisigned seats. Cigarette lighter, hazard warning lights & anti-burst door locks have been added as standard fittings.

Year	Sept. New List Price	Number Sold
1981	11 750	484
1982	14 360	478
1983	15 550	472
1984	17 215	326
1985	24 250	80
1986	24 250	1

1981 MODEL

SPECIFICATIONS:

ENGINE:

Type	Petrol (R6) 6 cyl. OHC 2623 cm^3.
Bore and Stroke	76,2 × 95,76 mm
Idling speed	600 r/min
Power (Max)	82 kW (ISO) at 4750 r/min
Torque (Max)	202 N.m (ISO) at 2200 r/min
Compression ratio	8,75:1
Injection order	1-5-3-6-2-4; No. 1 at Front
Radiator Cap Pressure	105 kPa

CARBURETTOR:

Make/Model	Twin SU HIF6 side draught

TRANSMISSION:

Clutch type & dia	Single Dry Plate 241,3 mm
Gearbox	4 speed synchromesh manual, Plus (Hi & Low transfer box),
Rear Axle type	Fully Floating
Final Drive type & ratio	Sprial Bevel 4,7:1

SUSPENSION:

Front	Leaf spring
Rear	Leaf spring

STEERING:

Type	Recirculating ball
Turning circle	14,3

TYRES AND WHEELS:

Size	7,50 × 16 Cross Ply; Rim size 5,50 FX16
Pressures	Front: 176 kPa; Rear (Unladen): 176 kPa Rear (Laden): 310 kPa

BRAKES:

Type	Front: Drum; Rear: Drum
Dia	Front: 279 mm; Rear: 279 mm
Servo Assisted	Yes

CAPACITIES (in litres):

Sump	6,85
Gearbox	Manual: 2,0
Transfer box	2,5
Final Drive	Front: 1,75; Rear: 2,5
Cooling system	8,0
Fuel Tank	90

GENERAL DIMENSIONS:

Overall Length	4450 mm
Width	1690 mm
Height	1920 mm
Wheelbase:	2767 mm
Track	Front: 1395; Rear: 1395 mm
Kerb mass	1594 kg
G.V.M.	2681 kg
Carrying capacity	1000 kg

TUNE UP DATA:

VALVES:

Working Clearance (Hot)	In: 0,40; Exh: 0,46
Timing Clearance:	In.: 0,40/0,45; Exh: 0,51/0,56
Timing:	
In. Opens: 9° 4' BTDC; Closes: 50° 56' ABDC	
Exh. Opens: 48° 56' BBDC; Closes: 11° 4' ATDC	
Spring free length	45,64 mm
Spring rate	231 N.m at fitted length
Seat angle	45° 5'

PISTONS AND RINGS

Piston Clearance (in Bore)	0,203/0,330 mm
Oversizes	0,254; 0,508 mm
No. of Rings:	2 Compression; 1 Oil
Groove clearance:	Compression: 0,038 mm Oil: 0,038 mm
Ring Gap: (in Bore)	Compression: 0,203/0,430 mm Oil.0,203/0,430 mm

CRANKSHAFT:

7 Main bearings	Dia.: 60,353/60,371 mm
Undersizes	0,254; 0,508; 0,766; 1,016 mm
Clearance	0,023/0,063 mm
Crankpin: (Big end)	Dia.: 47,643/47,661 mm
Undersizes	0,254; 0,508 mm
Clearance	0,025/0,063 mm

TORQUE SETTINGS:

Flywheel bolts	81/88 N.m
Cyl. head/Cold	81 N.m
Big ends	42/47 N.m
Main Bearings	95 N.m
O.H.C. Bearing Caps	27 N.m

IGNITION AND ELECTRICAL:

Distributor Type	Lucas 45 D6
Stroboscopic Setting	12° BTDC at 1000 r/min.
Position of timing marks	On flywheel
Contact Breaker gap	0,35/0,40 mm
Dwell angle	33° ± 5°
Spark plug	Champion N 9Y
Spark plug gap	0,58/0,66 mm
Battery	12 v 58 A.h. - Negative earth
Alternator	Lucas 21 ACR
Charging rate	0,66 kW
Regulator type	Integral in alternator

STEERING (Condition for checking — Unladen)

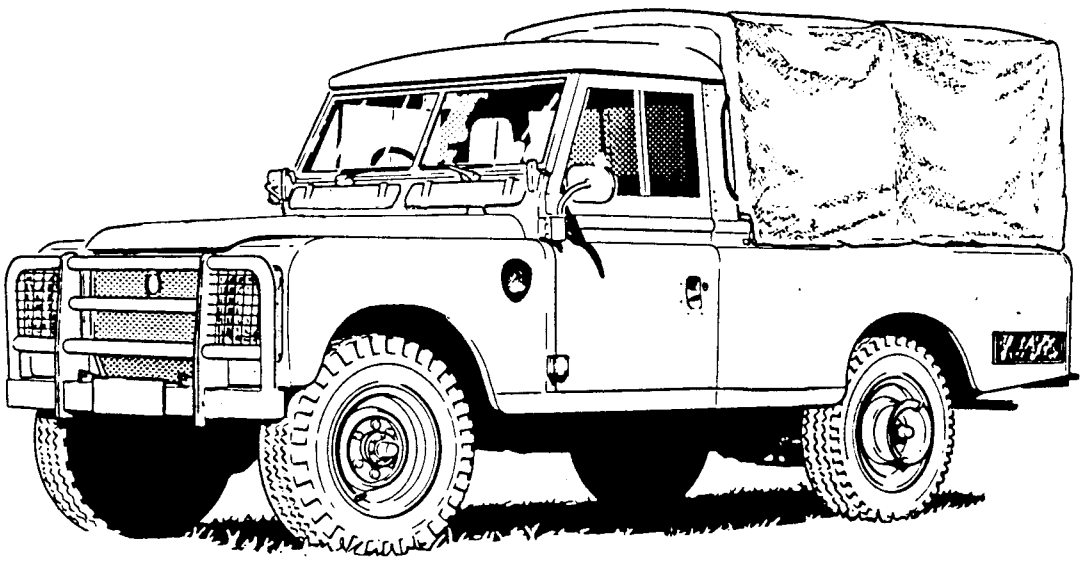
Camber	1,5°
Castor	3°
Toe-in (Front)	1,2/2,4 mm
Kingpin inclination	7°

WORKSHOP REPAIR MANUAL

FOR

LAND ROVER SERIES III S

ALLIED AUTO ELEC. c.c.
REG. No. CK 87/06137/23



VOLUME 1 : SECTIONS	A - GENERAL INFORMATION AND SPECIFICATIONS
	B - MAIN POWER UNIT
	C - FUEL SYSTEM
	D - IGNITION SYSTEM
	E - COOLING SYSTEM
	F - EXHAUST SYSTEM
	G - AIR CLEANING SYSTEM

DATA INFORMATION SHEET

Make ..... Land Rover 109"

Model ..... PUPR6 Series IIIS

Engine Type R6

Gearbox/Transfer Box Type ..... M S A

Front Differential Type ..... Salisbury

Rear Differential Type ..... Salisbury 8HA

Fuel Pump Type ..... Facit - Electrical

WORKSHOP REPAIR MANUAL SET PART NO.

PREFACE

GENERAL

1. The manual is intended to provide guidance to workshop personnel carrying out minor and major adjustments and repairs to the Land Rover Series IIIS. The instructions contained herein are set out in a step-by-step format and should enable workshop personnel unfamiliar with the vehicle to carry out all adjustments and repairs necessary to maintain the vehicle in good working order.

2. All necessary information and the correct sequence for carrying out replacement and repair work are detailed in this manual and are in accordance with the correct repair procedures as considered necessary by the manufacturers. It is not advisable to deviate from these instructions.

ARRANGEMENT AND LAYOUT OF THE MANUAL

3. The manual is divided into three volumes. The content of each volume is shown in the main contents page at the front of each volume. The division between volumes is selected so that allied subjects are contained in one complete volume. Typically, the arrangement is as follows:

a. VOLUME 1: Engine and associated systems such as fuel, cooling, ignition and exhaust systems.

b. VOLUME 2: Transmission system from the gearbox through to and including the front and rear axles and hubs.

c. VOLUME 3: All other systems such as brakes, steering, body, electrical etc not covered in Volumes 1 and 2.

INSTRUCTIONS CONTAINED IN THE MANUAL

4. All instructions contained in this manual are arranged in a logical step-by-step format. Where necessary to support the description, an illustration is provided. This illustration is positioned above the relevant steps explaining that part of the procedure.

5. Although in certain instances it is possible to vary the order of removal and replacement, workshop personnel are strongly advised to carry out the procedures in the order given. This will ensure that all components are correctly fitted and that all fasteners are tight.

6. For most removal and replacement procedures it is recommended that these are carried out on a hard surface such as concrete. Where this is not possible due to operational considerations it is essential that whatever improvisation is used, first consideration is given to the safety of personnel and the protection of the vehicle.

DIVISION OF SUBJECTS

7. The manual as a whole is divided into Sections, each Section covering one main subject. For example, Section B deals with the power unit and Section C with the fuel system. Where necessary, each Section is further sub-divided into Sub-sections, Sub-sub-sections or Chapters.

8. Where applicable the content of each Section is arranged in the following sequence:

a. Brief description and specifications including tightening specifications for assembly or component fixings.

b. Fault finding and corrective procedures.

c. Testing procedures.

d. Adjustments.

e. Removal and replacement procedures.

f. Repair, cleaning or overhaul instructions.

g. Maintenance.

h. Special workshop tools.

USE AND PRESENTATION OF THE MANUAL

9. Each sub-division deals with one particular aspect or major component directly related to the main subject. Typically, checks and adjustments, removal and replacement, overhaul and repairs, etc are contained separately in individual sub-divisions. Therefore, to locate instructions for removing the engine for example, the user should refer to the Contents page which precedes Section B (Power Unit). Then, on the page given for removal and replacement procedures, the reader will find that Chapter 1 of Sub-section B4 deals with this subject.

MAIN CONTENTS LIST

SECTION CONTENTS LIST

SECTION A

GENERAL INFORMATION AND SPECIFICATIONS

SECTION A

CHAPTER 1

LOCATION OF IDENTIFICATION PLATES

INTRODUCTION

1. The identification plates fitted to this vehicle are described below:

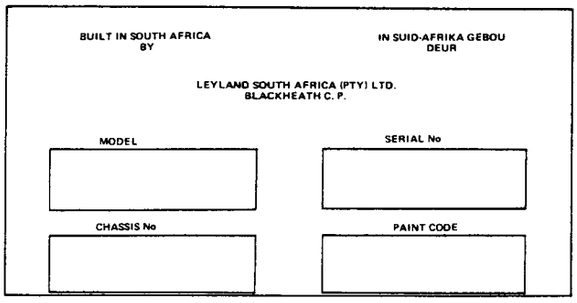


Fig A1

2. Refer to Fig A1. The plate on the right hand wing inside the engine compartment shows:

   Model
   Serial number
   Chassis number
   Paint code

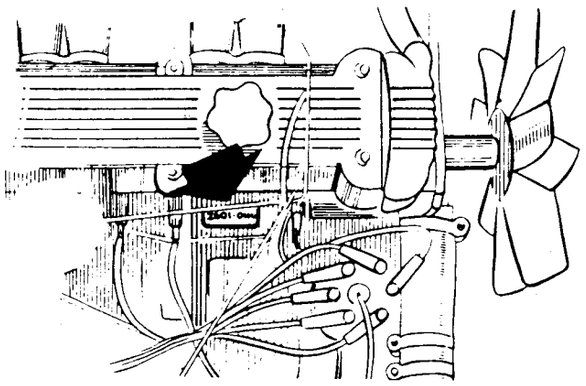


Fig A2

3. Refer to Fig A2. The engine number is stamped onto a machined surface at the right front of the engine.

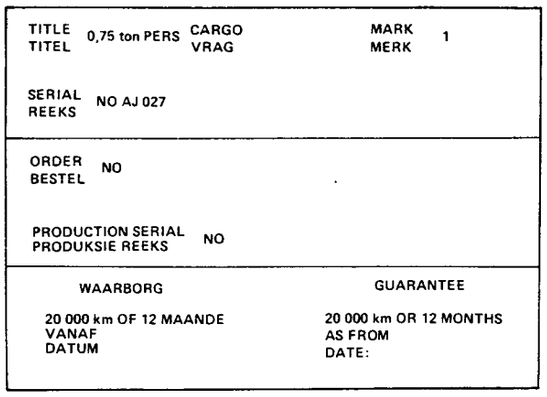


Fig A3

4. Refer to Fig A3. This plate is mounted on the passenger side seat support in the cab. It indicates:

   Title of the vehicle and mark number

   Production serial number
   Guarantee period

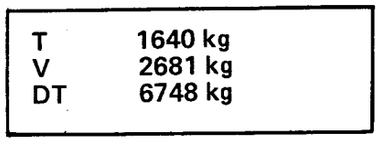


Fig A4

5. Refer to Fig A4. Vehicle masses are shown on a plate behind the left rear wheel arch. They are:

   Vehicle mass (T) : 1640 kg
   Maximum mass of vehicle and load (V) : 2681 kg
   Maximum mass of vehicle, trailer and loads (DT) : 6748 kg

SECTION A

CHAPTER 2

GENERAL INFORMATION

INTRODUCTION

1. The Land Rover is a two or four-wheel drive, general purpose vehicle designed for both on- and off-road use. The power unit is a water cooled, type R6, petrol engine which is coupled via a gearbox and a transfer box, to both the front and rear wheels.

2. The vehicle has a high performance under normal driving conditions. The suspension and overall construction enables the vehicle to reliably traverse rugged terrain with minimum driver discomfort.

POWER UNIT AND TRANSMISSION

3. The power unit is a water cooled, six cylinder petrol engine rated at 82.0 kW at 4750 r/min.

4. Drive is transmitted via a single plate, diaphragm spring clutch to the gearbox. The clutch is hydraulically operated and enclosed within a bell-shaped housing, which is bolted to the front of the gearbox.

5. The gearbox is manually operated and has four forward gears and reverse. All forward gears are of the synchromesh type.

6. The transfer box provides a high and a low range which are selected manually.

AXLES

7. The rear axle and differential assembly is of the spiral bevel type, with fully floating shafts. The ratio to the rear wheels is 4,7:1.

8. The front axle and differential assembly is of the spiral bevel type, with fully encased constant velocity joints transmitting the drive from the differential to the front wheels. The ratio to the front wheels is 4,7:1.

SUSPENSION

9. Leaf springs are fitted longitudinally between the axles and the underside of the chassis. Hydraulic, telescopic shock absorbers are fitted to both axles.

BRAKES

10. The hydraulic braking system is dual line, servo assisted, operating on front and rear wheels. The lockable handbrake acts mechanically on the rear wheels, via a mechanical brake unit mounted on the output shaft from the transfer box.

BODY

11. The body is of solid unitary construction and is mounted on a chassis. The aluminium alloy body panels will not rust or corrode under normal circumstances. Inside the driver's cab, the controls are placed conveniently within reach and vision of the driver.

STEERING

12. The recirculating ball type steering only requires three comma five (3,5) turns from lock to lock. A steering lock is combined with the ignition switch.

ELECTRICAL SYSTEM

13. The electrical system is negative earth, and energised by a 12 V battery. The battery is maintained in a charged state by an alternator. A pre-engaged type starter is fitted for engine starting.

FUEL

14. Twin SU type carburetters fed by an electrically operated fuel pump. A fuel filter unit is fitted to provide additional filtration. The air cleaner is a single element, dry type, fitted with a removable dust cup.

MAINTENANCE REQUIREMENTS

15. The vehicle is designed to minimise maintenance. However, to maintain the vehicle at peak performance, periodic checks and adjustments are necessary. Typically, regular inspections must be made to check oil levels, tightness of fasteners, drive belt tensions, clutch fluid levels, operation of the vehicle, etc. At less frequent intervals it is necessary to repack hubs with grease, check tappet clearances, condition of brake linings, clutch pedal adjustments, specific gravity of battery electrolyte and so on.

16. Maintenance requirements for each assembly or component are detailed at the end of the appropriate Section. It is essential that the maintenance instructions are strictly observed and carried out at the periods indicated.

WORKSHOP REPAIRS TO THE VEHICLE - GENERAL NOTES

17. Many assemblies and components fitted to the vehicles are large and heavy. It is essential, therefore to observe all safety measures when working on the vehicle. Stands and supports should be underrated so that a considerable safety margin is available and to allow for miscalculations of the mass to be supported.

18. Due to the large mass of many assemblies and components, removal and replacement of heavy items should be carried out on a firm surface. Preference should be given to thick concrete floors laid on a well prepared and compact base. If doubt exists or the surface is known to be soft, strong planks should be used if replacement under dangerous conditions cannot be avoided.

19. When recovery vehicles are used in operational areas for removing the engine (for example) it is important that the capacity of the gantry in the extended position is correctly calculated. Once again it is stressed that capacity should be underrated. Preference

should be given to recovery vehicles which are fitted with a gantry which can be extended its length smoothly with the load attached. Recovery vehicles with short gantrys and the need to move the recovery vehicle or the vehicle under repair are not recommended.

20. Dirt, grit, sand, metal filings, etc, cause moving parts to wear quickly. Working areas and parts being repaired must, therefore, be kept clean. Components which are to be refitted must not be placed on dirty surfaces or into dirty containers. Floors and working surfaces should be kept free of oil. When draining oils or disconnecting fuel lines use a suitable container with sufficient size and capacity to avoid spillage. Tools and hands should be kept as clean as is practical and frequent cleaning is recommended. A plentiful supply of clean rags for frequent cleaning of hands and tools is essential. Dirty and oily hands and tools are not only detrimental to good repairs but also prevent safe handling.

SECTION A

CHAPTER 3

VEHICLE SPECIFICATIONS

INTRODUCTION

1. The specifications contained in this Chapter are only intended to provide an overall description of the basic vehicle's content. Detailed specifications of each major component are contained in each Section or Sub-section as appropriate.

ENGINE

2. The main power unit is a normally aspirated, water cooled, petrol engine. The six cylinders are arranged in line, with valve operation via an overhead camshaft.

3. A forced feed lubrication system is employed and a replaceable oil filter filters the oil in the main lubrication circuit.

4. The engine type is as follows:

   a. Type R6
   b. Cylinder capacity 2623 cm^3

FUEL SYSTEM

5. Twin SU type, semi-downdraught carburetters fed by a Facit electric fuel pump. A renewable element type fuel filter is fitted.

6. Petrol is contained in a 90 litre tank under the chassis frame at the rear of the vehicle.

GEARBOX

7. The gearbox is a single helical constant mesh type with synchromesh on all forward gears and the following input/output ratios:

   a. Forward gears: First 3,65:1; Second 2,22:1; Third 1,497:1, Fourth direct

   b. Reverse gear 4,06:1

TRANSFER GEARBOX

8. The transfer gearbox provides a two-speed reduction on the main gearbox output and allows selection of two- or four-wheel drive. The following are the input/output ratios for the transfer box:

   a. High transfer 1,148:1

   b. Low transfer 2,346:1

FRONT AXLE

9. The front axle uses a spiral bevel differential and has enclosed universal joints. Reduction ratio to the wheels is 4,7:1.

REAR AXLE

10. Spiral bevel type with floating shafts. Reduction ratio is 4,7:1.

SUSPENSION

11. Semi-eliptical springs are used for both front and rear suspension and are damped by hydraulic, double acting telescopic shock absorbers.

12. The front of each spring is bolted to brackets fixed to the chassis while the rear is bolted to shackle plates.

WHEELS AND TYRES

13. The wheel size is 550F x 16 and takes cross ply 7.50 x 16 tyres.

BRAKES

14. The following braking systems are fitted to the vehicle:

   a. Footbrake: Hydraulic, dual line, servo assisted system operating drums front and rear.

   b. Handbrake: Drum type, cable operated onto the rear propellor shaft.

HEATING AND VENTILATION

15. Hot engine coolant is switched to a heat exchanger. Fresh air is drawn over the heat exchanger and can be switched to demist the windscreen or through foot level vents to warm the cab. With the coolant switched off, fresh air can be drawn into the cab.

16. Two hand-operated vents below the windscreen can be opened to allow fresh air into the cab.

ELECTRICAL SYSTEM

17. The main components of the electrical system are:

   a. Alternator, 12 V nominal.

   b. Battery, 12 V, 58 Ah.

   c. Starter motor, 12 V, pre-engaged.

STEERING SYSTEM

18. A recirculating ball type operating on the front wheels through a steering relay, track rod and drag link.

DIMENSIONS AND PERMISSIBLE LOADS

19. Principal vehicle dimensions are:

Wheelbase - 109 mm
Overall length - 4450 mm
Maximum width - 1690 mm
Ground clearance - 209 mm
Track - 1395 mm

20. Maximum permissible loads are:

Gross vehicle load - 2681 kg
Gross front axle load - 970 kg
Gross rear axle load - 1905 kg
Maximum trailer load - 4080 kg using trailer with four wheels and independent power brakes

MAXIMUM SPEED

21. Maximum speed for the vehicle is 130 km/h.

SECTION A

CHAPTER 4

DEFINITIONS

INTRODUCTION

1. Terminology in the motor trade varies sometimes from area to area, manufacturer to manufacturer and, therefore, it was decided to include a few defintions of what is meant by certain terms used in this Workshop Repair Manual. It must be borne in mind that the compilers of the list contained herein do not purport that these definitions are the final authority, or in any way exhaustive. This is the work of other bodies and not the purpose of these definitions.

DEFINITIONS

2. The following list of defintions is bounded by the conditions stated in Paragraph 1 :

AXIAL
Forming or belonging to an axis (refer axis).

AXIAL MOVEMENT
Axial movement is a movement of a shaft (or other object) along the line of its axis. Sometimes this is known as end-to-end movement or end play.

AXIS
The axis is an imaginary line about which a body revolves.

BOLT
A bolt is defined in several different ways, one of which includes the length of thread contained on a headed metal pin. However, for the purposes of this manual, a bolt is defined as being a metal pin threaded at one end and a head of any shape at the other end, and used in conjunction with a nut or similar fastener.

BOLTED (-TOGETHER)
The term 'bolted together' is used in this manual to indicate that two or more items are secured to each other by a headed metal pin which is threaded at one end. Nuts may be used to fasten the metal pin or used in conjunction with studs. The actual metal pin may also be a screw (studs and screws are also defined).

BORE (Noun Usage)
The noun bore is used in this manual to indicate that a hole is open at both ends and is circular in shape.

CIRCLIP
A circlip is a small flat strip of springy steel, usually having an oblong-shaped cross section, bent circular but not a complete circle. Some circlips have a hole drilled at each end to facilitate fitment. A circlip may be fitted in a groove around the inside of a bore (hole) or a groove around a shaft or spindle. Little or no side-thrust should be imposed against the circlip.

CLEVIS
A clevis is a U-shaped piece of metal at the end of a metal rod or bar, and used as a linkage. It is not unlike a short-pronged tuning fork in appearance. A hole is drilled near the ends of the two prongs, inside which a clevis pin is fitted. A clevis might be drilled and threaded internally at that part of the U or fork, opposite to the open end, so that a threaded rod can be screwed in. This type of clevis enables the length of the linkage to be adjusted by screwing the threaded rod further in or out.

CLEVIS PIN
A clevis pin fits inside the holes at the end of the two prongs and is used to couple the clevis to its associated linkage. A clevis pin may be headed at one end with a hole drilled through the shank at right angles at the other. In most instances, a split pin is fitted in the hole drilled in the shank.

COTTER
Normally consists of two half moon shaped semi-circular tapered wedges used to hold a spring retainer in position on a stem. eg A valve spring retainer.

DURLOCK BOLTS
Durlock bolts and nuts are a patented design self locking fastener. A locking action is achieved by a specially designed head, which in cross-section is serrated on the gripping face. The Durlock nut is similar in construction. When the nut or bolt is turned in the tightening direction, the sloping edges of the serrations pass normally over the material being fastened together. The peak of the serration bites deep into the material. Movement in the opposite direction (unscrewing) causes the peak of the serration to bite even deeper. Washers of any description must not be used with Durlock bolts and nuts, otherwise the self-locking action will be nullified. All types of self-locking nuts and bolts should not be re-used.

FASTENER

A fastener is a device which is used to secure two or more items together and includes, nuts, bolts, studs, screws, rivets etc. Although in its widest classification, a fastener is often used to describe split pins, circlips etc., it must be remembered that these items are truly retainers, since their inherent strength or method of fitting prohibits significant side thrust or pressure.

LIFTING TACKLE

The term 'lifting tackle' is used in this Workshop Repair Manual, and embraces any device, of sufficient capacity, which raises the item vertically from an overhead position. Block and tackle, handy-billy, endless chain, etc are typical examples of a lifting tackle.

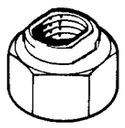
NUTS (Self-locking)

There are several types of self-locking nuts. Usually, the design of the nut is patented.

Nyloc nuts resemble standard type nuts in appearance, except that one end does not have a flat face (rounded). This end is specially designed so that Nyloc material can be inserted during manufacture. Since the hole in the Nyloc is smaller than the bolt diameter, the Nyloc grips the threads and prevents the nut from falling off.

Crimp type nuts resemble standard type nuts in appearance, except that one end does not have a flat face. The shape of this end varies according to design and several types are available. During manufacture, the non-flat face is crimped slightly, and when screwed onto a bolt, it grips the thread and prevents the nut from loosening.

NYLOC NUT



CRIMPED NUT

Durlock nuts are discussed under the heading of Durlock Bolts.

Although design requirements vary from designer to designer and in respect of application, it is not unusual for washers to be omitted when self-locking nuts are used. It is not recommended to re-use self-locking type nuts.

SPLIT PINS

A split pin is a universallv accepted shape, design and application. Its appearance in this list of definitions is only to stress that split pins should not be replaced with pieces of wire, etc. Once used, split pins should be discarded. The application of a split pin should be such that little or no side thrust is exerted against the split pin.

SPRINGS

Springs have a multitude of shapes and applications. Two types are discussed here : compression and tension springs of the coiled variety.

Compression springs are manufactured from coils of spring steel and vary in cross-section shape. The coils may be tighter wound at one end. Usually, the ends are flat and parallel. In its application, the coils of the spring are compressed thus exerting a force in an outwards direction. Springs which are tightly wound at one end should be fitted so that the loosely wound end faces in the direction of movement, ie a poppet valve spring (if tightly wound at one end) is fitted so that the loosely wound end is nearest the cotter (end of valve stem) and at the tightly wound end is nearest the cylinder head (valve seat end).

Tension (return) springs are manufactured from coils of spring steel and vary in cross-section shape. The coils are tightly wound along its entire length. Each end is hooked to enable attachment to the anchoring point and to the component which it is required to return to a desired position. The shape and arrangement of the hooks vary according to application and to suit attachment.

Springs should be replaced when they become unserviceable, such as badly rusted, pitted, cracked, etc. The length of the spring also indicates it's serviceability. A weakened compression becomes shorter and a tension spring becomes longer. Comparison with a new spring will assist in determining original length if this is not known. It should be borne in mind, however, that although of the correct length, the springiness may be insufficient for its application. If this is suspected, the doubtful spring should be compressed or stretched (depending on spring type) using a known force and its length measured. The procedure is repeated with a new spring and the results compared. If a known force is not available, both springs can be fitted end-to-end, then compressed or stretched, as appropriate, and both lengths measured while the force (must be constant) is still applied. It is important to note that whichever method is used, the spring used for comparison purposes must be known to be serviceable. The fact that it is a new spring does not necessarily mean that it is serviceable.

STUDS

The type of stud referred to in this Workshop Repair Manual is threaded at both ends and has a shank similar to a bolt (without a head). In most applications, only one end is secured by a nut, the other end screwed into a threaded hole in one of the items being secured together.

SWIVEL PINS

On a front wheel drive vehicle, drive is imparted from the front axle differential to the front road wheels. The drive is transmitted via a shaft and a constant velocity universal joint. This arrangement prevents the use of a king pin, normally fitted to a standard free-wheeling type front axle, since the king pin would have to pass through the rotating components. Therefore, to overcome this, the pin is manufactured in two halves. One half fits at the top and the other at the bottom of the universal joint housing. These halves are known as swivel pins. The manner in which swivel pins are fitted varies from manufacturer to manufacturer and application to application.

SECTION A

CHAPTER 5

CONVERSION TABLES

INTRODUCTION

1. Throughout the workshop manual, SI (International Metric System) units as approved by the South African Bureau of Standards (SABS) are used. However, since not all countries have adopted the system and others are still in the process of converting to SI units, Workshop personnel will, from time-to-time, encounter measuring devices which are not graduated in SI units.

2. SABS have published a number of very useful booklets which give guidance in these matters, including a comprehensive list of conversions to SI units. However, since these may not be readily to hand at all times, it was considered worthwhile to include a short list of conversion factors covering units of measurement that workshop personnel are likely to meet, when servicing the vehicle.

3. In this respect, two tables are provided. The first, Table A5.1, gives definitions of derived SI units which have special names. The second, Table A5.2, is a short list of useful conversion factors, arranged in alphabetical order. It should be noted that although every reasonable effort has been made to ensure accuracy, the user shall be responsible for verifying that the data given herein is correct, before applying the conversion tables contained in this Sub-section.

TABLE A5.1 DEFINITIONS OF DERIVED UNITS HAVING SPECIAL NAMES

Quantity	SI unit and symbol	Definition
Force	Newton, N	The newton is that force which when applied to a body having a mass of 1 kg, gives it an acceleration of 1 m/s^2.
Pressure, stress	Pascal, Pa	The pascal is the pressure which results when a force of 1 N is applied evenly and perpendicularly to an area of 1 m^2.
Power	Watt, W	The watt is the power which results in the production of energy at the rate of 1 J/s (joule per second).
Electric potential difference (electromotive force)	Volt, V	The volt is the potential difference between two points of a conducting wire carrying a constant current of 1 A, when the power dissipated between these points is equal to 1 W.
Capacitance	Farad, F	The farad is the capacitance of a capacitor between the plates of which there appears a potential difference of 1 V when it is charged with an electric charge equal to 1 C (Coulomb).
Electric resistance	Ohm (Ω)	The ohm is the electric resistance between two points of a conductor when a constant potential difference of 1 V, applied between these two points, produces a current of 1 A, the conductor not being the source of any electronic force.

TABLE A5.2 LIST OF CONVERSION FACTORS TO SI UNITS
(SI SYMBOLS ARE GIVEN IN BRACKETS)

To convert from	To	Multiply by
Abampere (biot)	Ampere (A)	*1 x 10
Abohm	Ohm (Ω)	*1 x 10^{-9}
Abvolt	Volt (V)	*1 x 10^{-8}
Ampere (International, 1948)	Ampere (A)	0,9998 35
Astronomical unit	Metre (m)	1,496 x 10^{11}
Atmosphere (standard)	Pascal (Pa)	*1,013 25 x 10^{5}
Atmosphere (technical) ($1\ kgf/cm^2$)	Pascal (Pa)	9,806 65 x 10^{4}
Atomic mass unit (unified)	Kilogram (kg)	1,660 531 x 10^{-27}
Bar	Pascal (Pa)	*1 x 10^{5}
Biot (abampere)	Ampere (A)	*1 x 10
Cheval vapeur or metric horsepower	Watt (W)	7,354 99 x 10^{2}
Cubic foot	Cubic metre (m^3)	2,831 685 x 10^{-2}
Cubic foot per minute	Cubic metre per second (m^3/s)	4,719 474 x 10^{-4}
Cubic foot per second	Cubic metre per second (m^3/s)	2,831 685 x 10^{-2}
Cubic inch	Cubic metre (m^3)	*1,638 706 4 x 10^{-5}
Cubic inch per minute	Cubic metre per second (m^3/s)	2,731 177 x 10^{-7}
Cubic inch per pound	Cubic metre per kilogram (m^3/kg)	3,612 729 x 10^{-5}
Cubic yard	Cubic metre (m^3)	0,7645 549
Cubic yard per minute	Cubic metre per second (m^3/s)	1,274 258 x 10^{-2}
Degree Celsius (particular temperature)	Kelvin (K)	use $T = t_C + 273,15$
Degree Celsius (temperature interval)	Kelvin (K)	*1
Degree Fahrenheit (particular temperature)	Kelvin (K)	use $T = \frac{(t_F + 459,67)}{1,8}$
Degree Fahrenheit (temperature interval)	Kelvin (K)	0,555 556
Electrostatic unit of potential	Volt (V)	2,997 925 x 10^{2}
Electrostatic unit of resistance	Ohm (Ω)	8,987 554 31 x 10^{11}
Foot pound-force (torque)	Newton metre (N.m)	1,355 818
Foot pound-force per second	Watt (W)	1,355 818
Horsepower (electrical)	Watt (W)	*7,46 x 10^{2}
Horsepower (550 foot pounds-force per second)	Watt (W)	7,456 999 x 10^{2}
Horsepower (metric or cheval vapeur)	Watt (W)	7,345 99 x 10^{2}
Inch	Metre (m)	*2,54 x 10^{-2}
Inch of mercury (32 °F)	Pascal (Pa)	3,386 389 x 10^{3}
Inch of mercury (60 °F)	Pascal (Pa)	3,376 85 x 10^{3}
Inch of water (39,2 °F)	Pascal (Pa)	2,490 82 x 10^{2}
Inch of water (60 °F)	Pascal (Pa)	2,488 4 x 10^{2}
Inch per minute	Metre per second (m/s)	4,233 333 x 10^{-4}
Kilogram-force	Newton (N)	*9,806 65
Kilogram-force metre (torque)	Newton metre (N.m)	*9,806 65
Kilogram-force per square centimetre	Pascal (Pa)	*9,806 65 x 10^{4}
Ohm (international, 1948)	Ohm (Ω)	1,000 495
Ounce-force	Newton (N)	0,2780 139
Ounce-force inch (torque)	Newton metre (N.m)	7,061 552 x 10^{-3}
Torr	Pascal (Pa)	1,333 223 7 x 10^{2}

* Exact values

SUB-SECTION A6

MISCELLANEOUS TIGHTENING RECOMMENDATIONS FOR METRIC THREADS

TABLE A6.1 STANDARD TIGHTENING TORQUE FOR NUTS AND BOLTS

CLASS OF FASTENERS		6,9	8,8	10,9	12,9
NUTS AND BOLTS		TORQUE (N.m)			
Diameter	Thread Pitch				
M4		2,4	2,9	4,1	4,9
M5		5,0	6,0	8,5	10,0
M6		8,5	10,0	14,0	17,0
M8	1	23,0	27,0	38,0	45,0
M8		21,0	25,0	35,0	41,0
M10	1	46,0	55,0	77,0	92,0
M10	1,25	44,0	52,0	73,0	88,0
M10		41,0	49,0	69,0	83,0
M12	1,25	80,0	95,0	135,0	160,0
M12	1,5	76,0	90,0	125,0	150,0
M12		72,0	86,0	120,0	145,0
M14	1,5	125,0	150,0	210,0	250,0
M14		115,0	135,0	190,0	230,0
M16	1,5	190,0	225,0	315,0	380,0
M16		185,0	210,0	295,0	355,0
M18	1,5	295,0	325,0	460,0	550,0
M18	2	265,0	310,0	440,0	530,0
M18		245,0	290,0	405,0	485,0
M20	1,5	385,0	460,0	640,0	770,0
M20	2	370,0	440,0	620,0	740,0
M20		345,0	410,0	580,0	690,0
M22	1,5	520,0	610,0	860,0	1 050,0
M22	2	500,0	600,0	840,0	1 000,0
M22		465,0	550,0	780,0	930,0
M24	1,5	690,0	820,0	1 150,0	1 400,0
M24	2	650,0	780,0	1 100,0	1 300,0
M24		600,0	710,0	1 000,0	1 200,0
M26	1,5	880,0	1 050,0	1 470,0	1 760,0
M27	2	970,0	1 150,0	1 600,0	1 950,0
M27		890,0	1 050,0	1 500,0	1 800,0
M28	1,5	1 070,0	1 270,0	1810,0	2 170,0
M30	1,5	1 400,0	1 650,0	2 300,0	2 750,0
M30	2	1 350,0	1 600,0	2 250,0	2 700,0
M30		1 300,0	1 450,0	2 000,0	2 400,0

NOTES

1. Before using the torque specifications given in Table A6.1 above, the user should verify that special methods of tightening are not applicable. Therefore, refer in the first instance to the tightening tables and instructions in the relevant section.

2. The values given in Table A6.1 apply only to untreated or phosphated bolts (unlubricated) and to instances where the same grade of material is used for both bolt and nut, ie. bolt 8,8, nut 8.

3. Special values based on the waist cross section apply to necked-down bolts (refer Table A6.4).

4. In instances where gaskets, packing, softer grade materials, unclassified fasteners, etc are used, the torque applied should not exceed 75 percent of the specifications given in Table A6.1, left column (Class 6,9). If doubt exists, the manufacturer of the fasteners should be consulted.

TABLE A6.2 TORQUE VALUES FOR PIPE CONNECTIONS

CONNECTION		
Diameter	**Thread Pitch**	**Torque (N.m)**
M10	1,0	16
M12	1,5	28
M14	1,5	33
M16	1,5	38
M18	1,5	46
M20	1,5	56
M22	1,5	68
M24	1,5	87
M26	1,5	91
M27	2,0	102
M30	1,5	105
M32	1,5	110
M35	1,5	125
M38	1,5	130
M40	1,5	160
M42	1,5	175
M45	1,5	175
M48	1,5	190

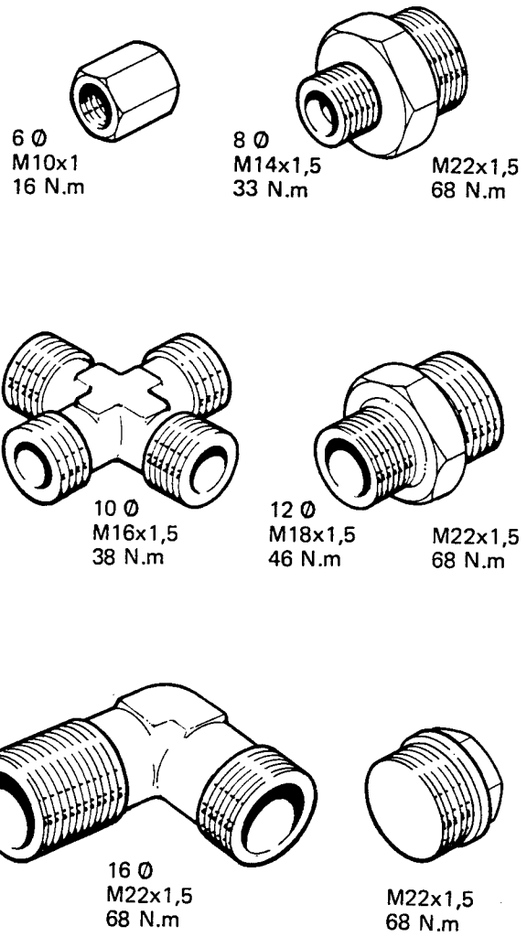
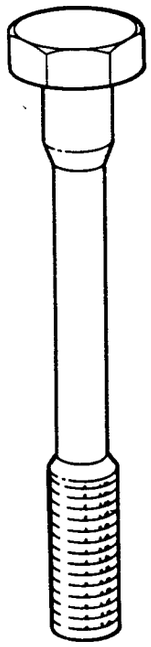


TABLE A6.3 TORQUE VALUES FOR CASTLENUTS ON BALL JOINTS

CASTLE NUT		
Diameter	**Thread Pitch**	**Torque (N.m)**
M16	1,5	100
M18	1,5	150
M20	1,5	200
M24	1,5	250

TABLE A6.4 TORQUE VALUES FOR WAISTED SHANK (NECKED-DOWN) BOLTS

CLASS OF FASTENERS		6,9	8,8	10,9	12,9
Diameter	Thread Pitch	TORQUE (N.m)			
M4		1,2	1,5	2,1	2,6
M5		2,7	3,2	4,5	5,4
M6		4,6	5,4	7,8	9,3
M8		11,7	13,7	19,6	23,5
M8	1	13,7	16,6	22,5	27,4
M10		24,5	28,4	40,2	48,0
M10	1,25	26,4	32,3	45,1	53,9
M12		43,1	51,0	72,5	86,3
M12	1,25	51,0	59,8	84,3	103,0
M12	1,5	47,0	55,9	78,4	94,1
M14		69,6	82,4	117,7	137,3
M14	1,5	79,4	94,1	132,4	156,9
M16		112,8	132,4	186,3	220,7
M16	1,5	122,6	147,1	206,0	250,1
M18		152,0	176,5	250,1	299,2
M18	1,5	186,3	220,7	300,0	372,7
M20		220,7	259,9	367,8	441,4
M20	1,5	259,9	309,0	436,5	519,9
M22		304,0	358,0	510,1	508,2
M22	1,5	358,0	421,8	598,4	716,1
M24		382,5	451,2	637,6	765,1
M24	2	441,4	519,9	735,7	882,9
M27		588,6	686,7	971,1	1 177,2
M27	2	657,2	774,9	1 079,1	1 324,3
M30		784,8	931,9	1 324,4	1 569,6
M30	2	931,9	1 128,2	1 569,6	1 863,9



NOTES

1. Before using the torque specifications given in Table A6.4 above, the user should verify that special methods of tightening are not applicable. Therefore, refer in the first instance to the tightening tables and instructions in the relevant section.

2. The values given in Table A6.4 apply only to untreated or phosphated bolts (unlubricated) and to instances where the same grade of material is used for both bolt and nut, ie. bolt 8,8 nut 8.

SECTION A

CHAPTER 7

LOCTITE USAGE INSTRUCTIONS

PRE-TREATMENT

1. All parts must be free of oil and water; using trichloroethylene, perchloroethylene, chlorothene for cleaning etc would be best, or similar grease solvents. Be sure that the solvents have completely dissipated before applying Loctite. Non-metals, parts with natural or synthetic oxide films, as well as electroplated surface layers must be pretreated with an activator to ensure normal curing. Always use activator for repairs, since this will considerably shorten the curing period. 'Activator T' is recommended.

APPLICATION

2. Apply a few drops on parts or dip parts, then assemble. When using Loctite for blind holes, the tapped hole should also be coated and not only the screw, so that the escaping air will not force the Loctite out.

CURING

3. Curing time is approximately 24 hours; 40 percent of the final hardness is already obtained after 2 to 4 hours. Heating the parts to approximately 120 ^{o}C will provide full shear strength already after approximately 15 minutes.

DISASSEMBLY

4. Connections secured with Loctite can be released again with standard tools. If strongly attached, heat parts to approximately 250 ^{o}C and dismount immediately. The lock will become tight again after cooling down.

REASSEMBLY

5. Parts previously assembled with Loctite may be used again after applying a few drops of Loctite. It is not necessary to remove hardened Loctite, but parts should be dry and free of grease. Remove loose Loctite remainders with a wire brush or compressed air.

SURFACE ROUGHNESS

6. Fixing forces increase with rising surface roughness. The most favourable result is obtained at an average peak-to-valley height of 12 microns (µ) or more.

TEMPERATURE RANGE

7. Loctite products are applicable from –80 ^{o}C to 200 ^{o}C. At temperatures of approximately 260 ^{o}C to 320 ^{o}C Loctite will begin to dissolve. Brittleness will start when temperatures are very low.

STRENGTH

8. Upon curing, Loctite has a shear strength of between 490 kPa to 34 MPa depending on type. Compression strength varies, depending on type, between 340 MPa to 490 MPa without any permanent deformation worth mentioning.

STORAGE

9. Loctite taken from its container should never be poured back, since any contamination entering the container will cure or pre-harden its content. Protect against sunshine and heat. Never store Loctite in metal containers or excluded from air. Loctite products are completely non-toxic.

SECTION A

CHAPTER 8

RECOMMENDED LUBRICANTS AND FLUIDS

INTRODUCTION

These recommendations apply to temperate climates where operation temperatures are above −10°C (14°F). Information on recommended lubricants for under extreme winter conditions can be obtained from Leyland S.A. (Pty.) Limited, Technical Department. Lubricants marked with an asterisk (*) are multi-grade oils suitable for all temperature ranges.

TABLE A8.1 - RECOMMENDED LUBRICANTS AND FLUIDS

COMPONENTS	SAE	BP	CASTROL	DUCKHAM'S	ESSO	MOBIL	CALTEX	SHELL
Engine Carburettor Dash Pots	** 20W	*BP Super Visco-Static 20-500**	*Castrol GTX	Duckham's Q20-50 Motor Oil	Extra 20W-50	Mobiloil Super or Mobiloil Special 20W-50	Supreme 5-Star 20W-50	*Shell Super Oil
Main gearbox Transfer box	90EP GL5	BP Hypo GL 5 EP 90	Castrol Hypoy B90 EP	Duckham's Hypoid 90 GL5	GX 85W-90	HD 80W/90	Multi-purpose Thuban 90 EP	Spirax HD 80W/90
Front differential Rear differential Swivel housing, R.H. Swivel housing, L.H. Steering box Steering relay	90EP	BP Hypo-gear SAE 90EP	Castrol Hypoy B90 EP	Duckham's Hypoid 90	GX 85W-90	Mobilube HD 80W/90	Multi-purpose Thuban EP 90	Spirax HD 80W/90
Drag link ball joint, R.H. Drag link ball joint, L.H. Track rod ball joint, R.H. Track rod ball joint, L.H. Longitudinal arm ball joint, front Longitudinal arm ball joint, rear Front hub, R.H. Front hub, L.H. Rear hub, R.H. Rear hub, L.H. Front propeller shaft Rear propeller shaft		BP Energrease L2	Castrol LM Grease	LB10 Grease	Esso Multi-purpose grease H	Mobil-grease MP or Mobil-grease Super	Marfak All purpose	Retinax or Darina AX
Radiator (anti-freeze solution) Any anti-freeze solution conforming to S.A.B.S.		BP Anti-frost	Castrol Anti-freeze	'Standard' Anti-freeze	Esso Anti-freeze	Mobil Per-mazone	P.I. Anti-freeze	Shell Anti-freeze
Clutch fluid reservoir Brake fluid reservoir		Castrol Girling Brake and Clutch Fluid 'Crimson'. Specification J.1703D or Unipart Brake and Clutch Fluid type 410 (coloured crimson) or type 550 (coloured green).						

NOTE

If SAE 20 grade oil is not available, SAE 30 may be used.

SECTION CONTENTS LIST

SECTION B

POWER UNIT

SUB-SECTION CONTENTS LIST

SUB-SECTION B1

DESCRIPTION AND SPECIFICATIONS

SUB-SECTION B1

CHAPTER 1

DESCRIPTION OF THE ENGINE

INTRODUCTION

1. The power unit fitted to the Land Rover is a type R6 petrol engine. The six in-line cylinders are water cooled and are fed by twin carburetters bolted to the inlet manifold on the left hand side of the engine.

CRANKSHAFT

2. The crankshaft is secured to the underside of the crankcase by seven journal bearings. Bearing shells (two halves per bearing) are fitted between the crankshaft journals and piston connecting rod big end. A timing gear and harmonic balancer/vibration damper are fitted at the front of the crankshaft and a flywheel is fitted at the rear end.

CAMSHAFT

3. An overhead camshaft is used and is chain driven from the crankshaft gear giving a 2:1 reduction. The chain runs over guides, one of which is adjustable, to give initial tension. A spring loaded tensioner is also fitted to take up wear stretch in the chain.

IGNITION

4. The spark plugs are fed from a distributor fitted to the right hand side of the engine. The distributor is driven by a worm gear on the crankshaft through a hollow shaft which also provides the drive for the oil pump.

LUBRICATION

5. The oil pump is fitted in the front of the sump and is driven by a shaft fitted inside the hollow distributor drive shaft. Oil from the pump is circulated through a cooler mounted directly under the radiator and also to various parts of the engine.

COOLING

6. A water pump, belt driven from a pulley on the crankshaft, circulates coolant through the engine and radiator. Cooling is assisted by a viscous drive fan mounted behind the radiator.

SUB-SECTION B1

CHAPTER 2

ENGINE SPECIFICATIONS

INTRODUCTION

1. General data for the engine is given in Table B1.1 and engine torque specifications are shown in Table B1.2.

TABLE B1.1 - GENERAL DATA

ITEM	DESCRIPTION
ENGINE	
Type	R6
Number of cylinders and valve operation	6 cylinder overhead camshaft
Bore	76,2 mm
Stroke	95,76 mm
Cubic capacity	2,623 litre
Firing order	1 - 5 - 3 - 6 - 2 - 4
Compression ratio	8,75 : 1
Torque	201 Nm at 2200 r/min
Maximum output	82 kW at 4750 r/min
Engine idle speed	650 r/min
Fast idle	1200 r/min
Compression pressure - Cranking (hot)	1240 kPa
Oversize bore - first	±0,254 mm
- maximum	±0,508 mm
CRANKSHAFT	
Type	7 main bearing journals
Material	Forged steel, counter balanced
Main journal diameter - standard	60,353 - 60,371 mm
Minimum permissable regrind diameter	59,337 mm
Crankpin journal diameter - standard	47,643 - 47,661 mm
Minimum permissable regrind diameter	47,135 - 47,153 mm
Crankshaft end float	0,1524 mm
Crankpin width	22,50 - 22,55 mm
MAIN BEARINGS	
Type	Replaceable thin wall shell type
Bearing material	Steel backed reticular tin aluminium
Bearing width	20,60 - 20,85 mm
Undersize bearings available	0,254 mm – 0,508 mm –0,7622 mm –1,016 mm
Thrust washer thickness - standard	2,31 - 2,36 mm
Side clearance between thrust washers and crankshaft	0,1524 mm
Thrust taken at	Centre main bearing
Diametral clearance	0,023 - 0,069 mm
Tunnel bore diameter	64,008 - 64,021 mm
BIG END BEARINGS	
Type	Replaceable thin wall shell type
Bearing material	Steel backed reticular tin aluminium
Bearing width	16,8 mm
Diametral clearance	0,025 - 0,063 mm
Undersize bearings	–0,254 mm –0,508 mm
CONNECTING RODS	
Type	Horizontally split big end. Interference fit small end
Length between centres	148,03 - 148,13 mm
Side clearance - rod to crankshaft	0,152 - 0,254 mm
Small end bore diameter	20,60 - 20,612 mm
Big end bore diameter	51,33 - 51,34 mm
Width	22,33 mm

PISTONS		
Type	Aluminium alloy-solid skirt - slotted	
Clearance bottom of skirt	0,203 - 0,033 mm	
Ovality-top of skirt	0,33 - 0,38 mm	
Piston head capacity	10 cc ± 0,25 cc	
Gudgeon pin bore diameter	20,645 - 20,650 mm	
Pistons-oversize available	+ 0,254 mm + 0,508 mm	
Compression height - centre of gudgeon to top of piston	35,63 - 35,84 mm	
PISTON RINGS		
Number per piston	3	
Top ring type	Cast iron-chrome faced	
Second ring type	Cast iron torsional scraper	
Oil control ring type	Slotted segmental	
Width - top ring	1,588 - 1,562 mm	
- second ring	1,588 - 1,562 mm	
Groove clearance - top ring	0,038 mm	
- second ring	0,038 mm	
Ring gap fitted - top ring	0,203 - 0,43 mm	
- second ring	0,203 - 0,43 mm	
GUDGEON PINS		
Type	Interference fit in connecting rod	
Fit in connecting rod (interference)	0,023 - 0,038 mm	
Fit in piston (clearance)	0,0076 - 0,0152 mm	
Outside diameter	20,635 - 20,638 mm	
CAMSHAFT		
Material	Cast iron - 4 bearings	
Journal diameter - first	49,185 - 49,197 mm	
- second	49,975 - 49,987 mm	
- third	50,762 - 50,775 mm	
- fourth	51,534 - 51,569 mm	
Diametrical bearing clearance	0,0254 - 0,0508 mm	
End float (maximum)	0,05 - 0,17 mm	
Chain pitch and number of pitches	9,50 mm x 108	
Timing marks	Sprocket and carrier marks	
TAPPETS		
Material	Forged steel - hardened	
Type	Inverted bucket	
Outside diameter	30,129 - 30,145 mm	
Clearance between tappet and bore	0,018 - 0,053 mm	
Shim adjustment	2,03 - 2,59 mm	
VALVES		
Head diameter - inlet (nominal)	38,10 mm	
- exhaust (nominal)	30,91 mm	
Stem diameter - inlet and exhaust (standard	7,912 - 7,925 mm	
- inlet and exhaust (oversize)	8,039 - 8,052 mm (Service only)	
Stem to guide clearance - inlet and exhaust	0,025 - 0,050 mm	
Seat angle - inlet and exhaust	45,5° (cylinder head 45°)	
Valve seat width - inlet (nominal)	1,72 mm	
- exhaust (nominal)	2,69 mm	
Valve clearance - inlet	0,40 - 0,46 mm	Reset when any clearance has closed
- exhaust	0,51 - 0,56 mm	to 0,31 mm
Valve timing - inlet opens	9°4′ B.T.D.C.	
- inlet closes	50°56′ A.B.D.C.	
- exhaust opens	48°56′ B.B.D.C.	at 0,53 mm valve clearance
- exhaust closes	11°4′ A.T.D.C.	
Valve lift - inlet and exhaust	9,14 mm	
VALVE SPRINGS		
Type	Left hand-single wound	
Free length - inlet and exhaust	45,64 mm	
Number of working coils - inlet and exhaust	5,5	
Fitted length - inlet and exhaust	34,92 mm	
Load at fitted length	231 N	
Length at full lift - inlet and exhaust	25,78 mm	
Load at full lift	427 N	

VALVE GUIDES	
Type	Integral with cylinder head
Inside diameter	7,950 - 7,962 mm
Distance spring seat to top of guide - inlet	28,20 mm
- exhaust	25,40 mm
FLYWHEEL	
Number of teeth - ring gear	156
Outside Diameter	296,275 - 295,199 mm
Ring gear - inside diameter	294,141 - 294,168 mm
Flywheel - Run-out (assembled to crank)	0,203 mm maximum
Flywheel thickness	50 mm
ENGINE LUBRICATION SYSTEM	
Oil pump - make	Concentric
- type	Eccentric rotor
- relief valve	Sealed unit
- relief valve opens	425 kPa
Oil filter - make	G.U.D.Z120
- type	Full flow sealed unit
- by-pass valve opens	48,2-68,8 kPa
Oil pressure - normal running	276-475 kPa at 4000 engine r/min
- minimum idling	138 kPa at 650 engine r/min

TABLE B1.2 - TORQUE SPECIFICATIONS

ITEM	TORQUE (N.m)
Cylinder head bolts	90
Cam carrier to cylinder head	27
Camshaft sprocket	47
Camshaft cover	8
Thermostat housing to cylinder head	10-13
Manifold to cylinder head	24-27
Carburetter studs	8-10
Water pump set screws	24-27
Water pump pulley	24
Crankshaft pulley bolt	81-95
Timing chain guide strips	24-27
Timing cover	24-27
Pivot pin	24-27
Front cover bolts	27
Big end nuts	42-47
Main bearing bolts	95
Flywheel bolts	81-88
Oil pump mounting bolt 1/4 in. UNC	8-10
Oil pump mounting bolt 3/8 in. UNC	27-33
Oil reservoir 1/4 in. UNF bolts	34
Oil reservoir no. 10 screws	17
Oil reservoir drain plug	16-20

SUB-SECTION B2

FAULT DIAGNOSIS AND CORRECTIVE ACTION

INTRODUCTION

1. This sub-section deals with fault diagnosis and suggested action to cure a fault. Table B2.1 gives a list of symptons, the probable cause and necessary remedial action. The Table is not exhaustive and faults may occur which are not listed. In this case the suspected components should be removed for closer inspection and/or overhaul.

TABLE B2.1 - ENGINE FAULT DIAGNOSIS CHART

SYMPTON	POSSIBLE CAUSE	REMEDY
Engine fails to start	Incorrect starting procedure.	See instruction manual.
	Starter motor speed too slow.	Check battery and connections.
	Faulty ignition system.	Rectify or renew.
	Water or dirt in fuel system.	Rectify.
	Carburetter(s) flooding.	Rectify.
	Defective fuel pump system.	Rectify or renew.
	Defective starter motor.	Rectify or renew.
	Starter pinion not engaging.	Remove starter motor and investigate.
Engine stalls	Low idling speed.	Adjust carburetter.
	Faulty sparking plugs.	Clean and test, renew if necessary.
	Faulty coil or condenser.	Renew.
	Faulty distributor points.	Rectify or renew.
	Incorrect mixture.	Adjust carburetter.
	Foreign matter in fuel system.	Rectify.
Lack of power	Poor compression.	If the compression is appreciably less than the correct figure, the piston rings or valves are faulty. Low pressure in adjoining cylinders indicates a faulty cylinder head gasket.
	Badly seating valves.	Rectify or renew.
	Faulty exhaust silencer.	Renew.
	Incorrect ignition timing.	Rectify.
	Leaks or restrictions in fuel system.	Rectify.
	Faulty sparking plugs.	Rectify.
	Excessive carbon deposit.	Decarbonise.
	Brakes binding.	Rectify.
	Faulty coil, condenser or battery.	Rectify or renew.
Engine runs erratically	Faulty electrical connections.	Rectify.
	Defective sparking plugs.	Rectify or renew.
	Low battery charge.	Recharge battery.
	Defective distributor.	Rectify.
	Foreign matter in fuel system.	Rectify.
	Faulty fuel pump.	Renew.
	Sticking valves.	Rectify or renew.
	Defective valve springs.	Renew.
	Incorrect ignition timing.	Rectify.
	Worn valve guides or valves.	Renew.
	Faulty cylinder head gasket.	Renew.
	Damaged exhaust system.	Rectify or renew.
	Vacuum pipes disconnected at inlet manifold or distributor.	Refit pipes.
Engine starts, but stops immediately	Faulty electrical connections.	Check HT leads for cracked insulation: check low tension circuit.

	Foreign matter in fuel system. Faulty fuel pump. Low fuel level in tank.	Rectify. Renew. Replenish.
Engine fails to idle	Incorrect carburetter setting. Faulty fuel pump. Sticking valves. Faulty cylinder head gasket(s).	Rectify. Renew. Rectify or renew. Renew.
Engine misfires on acceleration	Distributor points incorrectly set. Faulty coil or condenser. Faulty sparking plugs. Faulty carburetter. Vacuum pipes disconnected at inlet manifold.	Rectify. Renew. Rectify. Rectify or renew. Check all vacuum connections.
Engine backfires	Ignition defect. Carburetter defect. Sticking valve. Weak valve spring. Badly seating valves. Excessively worn valve stems and guides. Excessive carbon deposit. Incorrect sparking plug gap. Air leak in induction or exhaust systems.	Rectify. Rectify. Rectify. Renew. Rectify or renew. Renew. Decarbonise. Reset. Renew faulty gaskets or components.
Burned valves	Sticking valves. Weak valve springs. Excessive deposit on valve seats. Distorted valves. Excessive mileage between overhauls.	Rectify. Renew. Recut. Renew. Decarbonise.
Noisy valve mechanism	Worn or scored parts in valve operating mechanism. Valves and seats cut down excessively, raising end of valve stem 1,27 mm (0.50 in) above normal position. Sticking valves. Weak valve springs. Worn timing chain or chain-wheels.	Replace faulty parts. Grind off end of valve stem or replace parts. Rectify. Renew. Renew worn parts.
Main bearing rattle	Low oil level. Low oil pressure. Excessive bearing clearance. Burnt-out bearings. Loose bearing caps.	Replenish as necessary. See next sympton. Renew bearings; grind crank-shaft. Renew. Tighten.
Low oil pressure warning light remains on, engine running.	Thin or diluted oil. Low oil level. Choked pump strainer. Faulty release valve. Excessive bearing clearance. Oil pressure switch unserviceable. Electrical fault. Relief valve plunger sticking. Weak relief valve spring. Pump rotors excessively worn. Excessively worn bearings; main connecting rod, big end, camshaft etc.	Drain and refill with correct oil. Replenish. Clean. Rectify. Rectify. Renew. Check circuit. Remove and ascertain cause. Renew. Renew. Ascertain which bearings and rectify.
Rattle in lubrication system	Oil pressure relief valve plunger sticking.	Remove and clean.
Engine overheating	Low coolant level. Faulty cooling system. Faulty thermostat. Incorrect timing. Defective lubrication system.	Check for leaks. Rectify. Renew. Rectify. Rectify.

SUB-SECTION B3

VALVE CLEARANCE - CHECK AND ADJUST

PRELIMINARIES

1. Before the valve clearance can be checked the following should be carried out:

   (1) Remove the cam cover (see Sub-section B4, Chapter 11).

   (2) Remove the spark plugs ((4) on Fig B3.1).

CHECKING CLEARANCES

2. Check as follows:

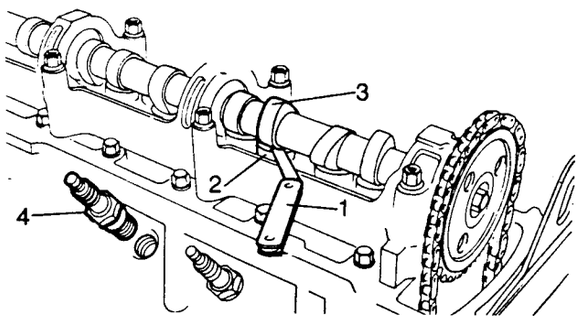


Fig B3.1

(1) Refer to Fig B3.1. To check the clearance use a feeler gauge (1) between the cam lobe (2) and cam follower (3) of each valve and record the clearance measured.

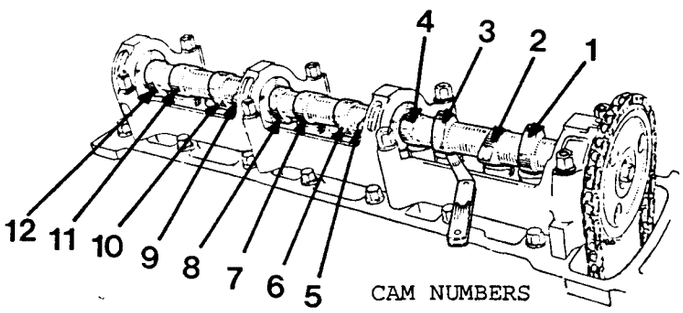


Fig B3.2

(2) Refer to Fig B3.2. Turn the camshaft against the normal direction of rotation and measure the clearance in the following order:

Check cam No	With cam No fully open
1	12
7	6
9	4
2	11
5	8
10	3
12	1
6	7
4	9
11	2
8	5
3	10

3. Under a normal service check, adjustment is only necessary if the clearance (inlet and exhaust) is less than 0,31 mm. When new components have been fitted or valves have been reground, adjust the tappet clearances to the standard settings given in Sub-section B1, Chapter 2.

ADJUSTING

4. All cams which have recorded measurements outside the recommended tolerances should be adjusted at the same time. Make sure which cams are to be adjusted, then:

   (1) Remove the cam followers (see Sub-section B4, Chapter 4, steps (1) to (8).

   (2) On the bench, remove the cam followers of the valves to be adjusted, keeping them separate and referring them to their respective guides.

   (3) Calculate the shim thickness required for each follower in turn by:

      i. Remove the shim from the cam follower and make a note of its thickness.

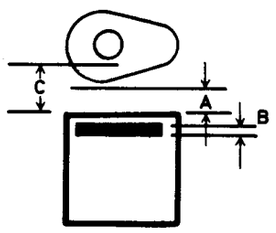


Fig B3.3

      ii. Refer to Fig B3.3. Call the measured clearance A, the shim thickness B and the required clearance C.
      Note that C = 0,40 to 0,46 mm for inlet valves and 0,51 to 0,56 mm for exhaust valves.