W4 LOADER AND FORKLIFT
TABLE OF CONTENTS

Reprinted

CASE CORPORATION

8-33652

Printed in U.S.A.
January 1980
Revised June 1980
Revised May 1982

SERVICE MANUAL

W4

Loader
and
Forklift

8-33652

1. Trim along dashed line.
2. Slide into pocket on Binder Spine.

TYPE 1-4

SERVICE MANUAL

W4

Loader
and
Forklift

8-33652

1. Trim along dashed line.
2. Slide into pocket on Binder Spine.

TYPE 1-4

SERVICE MANUAL

W4

Loader
and
Forklift

8-33652

1. Trim along dashed line.
2. Slide into pocket on Binder Spine.

TYPE 1-4

SERVICE MANUAL

W4

Loader
and
Forklift

8-33652

1. Trim along dashed line.
2. Slide into pocket on Binder Spine.

TYPE 1-4

NOTES

Section 1001

SAFETY RULES
SERVICE MANUAL INTRODUCTION
AND
TORQUE SPECIFICATIONS

Written In *Clear And Simple English*

CASE CORPORATION

8-33921

Printed in U.S.A.
January 1980
Revised May 1982

SAFETY RULES

This Symbol Shows Important Information About Safety In This Manual. When You See This Symbol, Carefully Read The Information That Follows and Understand The Possible Causes of Injury Or Death. 1-1-A

IMPORTANT: *To prevent injury on job, follow the Warning, Caution, and Danger notes in this section and other sections throughout this manual. Follow the instructions carefully.*

The procedures recommended and shown in this manual are good, effective service methods. However, all possible procedures and service hazards may not be covered. Therefore, if you use a tool or procedure not recommended, you must make sure that the method you select is a safe method.

DANGER: *Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust pipe extension. If you do not have an exhaust pipe extension, open the doors and get outside air into the area.* 48-56

WARNING: *Read operator's manual to familiarize yourself with control lever functions.* 46-27

WARNING: *Operate tractor and equipment controls from the seat position only. Any other method could result in serious injury.* 48-55

WARNING: *This is a one man machine, no riders allowed.* 35-8

WARNING: *If you wear clothing that is too loose or do not use the correct safety equipment for your job, you can be injured. Always wear clothing that will not catch on objects. Extra safety equipment that can be required includes hard hat, safety shoes, ear protection, eye or face protection, heavy gloves and reflector clothing.* 45-3-A

WARNING: *When working in the area of the fan belt with the engine running, avoid loose clothing if possible, and use extreme caution.* 35-4

WARNING: *Whenever the bucket must be raised to aid in servicing, block the loader arms in place with lift cylinder support strut or a suitable safety stand.* 23-7-B

WARNING: *When doing checks and tests on the equipment hydraulics, follow the procedures as they are written. DO NOT change the procedure.* 47-44

WARNING: *When putting the hydraulic cylinders on this machine through the necessary cycles to check operation or to remove air from a circuit, make sure all people are out of the way.* 47-45

WARNING: *Locate the machine on level ground and block the wheels securely before working under the machine. Failure to follow the above procedure can result in personal injury.* 46-77

WARNING: *Use insulated gloves or mittens when working with hot parts.* 47-41A

CAUTION: *Pin sized and smaller streams of hydraulic oil under pressure can penetrate the skin and result in serious infection. If hydraulic oil under pressure does penetrate the skin, seek medical treatment immediately. Maintain all hoses and tubes in good condition. Make sure all connections are tight. Make a replacement of any tube or hose that is damaged or thought to be damaged. DO NOT use your hand to check for leaks; use a piece of cardboard or wood.* 40-6-A

CAUTION: *When removing hardened pins such as a pivot pin, or a hardened shaft, use a soft head (brass or bronze) hammer or use a driver made from brass or bronze and a steel head hammer.* 46-17

CAUTION: *When using a hammer to remove and install pivot pins or separate parts, using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protectors).* 46-13

CAUTION: *When servicing or repairing the machine, keep the shop floor and operator's compartment and steps free of oil, water, grease, tools, etc. Use an oil absorbing material and/or shop cloths as required. Use safe practices at all times.* 40-8

CAUTION: *Use suitable floor (service) jacks or chain hoists to raise wheels or track off the floor. Always block machine in place with suitable safety stands.* 40-7-A

CAUTION: *Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in this service manual.* 40-10

SERVICE MANUAL INTRODUCTION

This service manual has been prepared with the latest service information available. Trouble-shooting, removal, disassembly, inspection and installation procedures, and complete specifications and tightening references can be found in most sections. Some sections have drawings without a written procedure because the job is so easily done. This service manual is one of the most important tools available to the service technician.

Right-Hand and Left-Hand

The terms right-hand and left-hand and front and rear as used in this manual indicate the right and left sides, and front and rear of the machine as seen from the operator's seat for correct operation of the machine or attachment.

Text

If the service manual is for more than one machine or different models of components (planetary axles, gear boxes, control valves, etc.) the procedures have the steps necessary to service each model.

Table of Contents

A Table of Contents is in the front of this manual. The Table of Contents shows the main divisions and the sections that are in each division. The individual sections, where necessary, have a Table of Contents on the second page of that section.

Page Numbers

All page numbers are made of two numbers separated by a dash, such as 4002-9. The number before the dash is the section number. The number following the dash is the page number in that section. Page numbers will be found at the upper right or left of each page.

Illustrations

Illustrations are put as near as possible to the text and are to be used as part of the text.

Torque Specifications

The most common grades of fasteners (bolts, nuts, and screws) used on Case machines are grade 5 and grade 8. See page 1001-6 for torque specifications and identification marks.

The specifications in this section are standard torque values and are to be used on all fasteners during assembly and installation unless special torque values are shown in a section.

P.I.N., Serial and Model Numbers

When replacement parts are needed, it is necessary to give the parts department one or all of the numbers. The model number is normally found on the Product Identification Number plate or Serial Number plate.

The Product Identification Number (P.I.N.) and serial numbers will be found in the following locations.

Machine - Product Identification Number plate fastened to the front frame above the parking brake.

1.8 Litre Diesel Engine - A serial number plate is on the left-hand side of the engine below the preheaters.

2.1 Litre Diesel Engine - A serial number is stamped on the left-hand side of the engine in front of the tachometer drive.

ROPS - Serial number plate fastened to the left-hand side of the ROPS.

Forklift - Serial number is stamped on the right-hand side of the outer frame assembly.

Components - A serial number plate is on many components such as starters, alternators, pumps, etc.

Classification of Lubricants

The SAE number is the viscosity of engine oils; for example, SAE 30, a single viscosity oil. SAE 10W30 is a variable viscosity oil.

The API classification (SD, CD, etc.) is the oil performance in terms of engine usage. Only oil specified in Section 1002 can be used. These oils have the needed chemical additives to give maximum engine protection. Both the SAE grade and API classification must be found on the container.

Gear Lubricant and Grease

Gear lubricant and grease for each application is specified in Section 1002.

Decals and Painting

All decals about operation of the machine and/or attachments must be in a condition so that you can read the decals easily. Replace any decal that is damaged or cannot be read.

All decals that start with the words WARNING, CAUTION, or DANGER must be in a condition so that you can read the decals easily. Replace any decal that is damaged or cannot be read.

When you paint the machine or attachment, put covers over the good decals and remove the decals which have damage or cannot be read easily. Use enamel thinner to make the decal easier to remove.

Remove the old decal before you install a new decal. Use enamel thinner to make the old decal easier to remove.

Special Tools

Special tools are needed to remove and install, disassemble and assemble, check and adjust some component parts of this machine. Some special tools can be easily made locally and the necessary information to make the tool is in this service manual. Other special tools are more difficult to make locally and are available from Service Tools in the U.S. and from Jobborn Manufacturing in Canada. Use these tools according to the instructions in this service manual for your personal safety and to do the job correctly.

Order special tools from either of the following companies:

Service Tools
P.O. Box 314
Owatonna, Minnesota 55060

Jobborn Manufacturing Co.
97 Frid Street
Hamilton, Ontario L8P 4M3
Canada

U.S. AND METRIC TORQUE SPECIFICATIONS

Torque values for all situations unless special torque is specified

Grade 5 Bolts, Nuts, and Studs

Thread Size	Pound-Feet	Newton metres	Kilogram metres
1/4 - 20	7-9	9-12	1.0-1.2
1/4 - 28	11-13	15-18	1.5-1.8
6.4 mm			
5/16 - 18	10-15	15-20	1.4-2.1
5/16 - 24	15-20	20-25	2.1-2.8
7.9 mm			
3/8 - 16	20-25	25-35	2.8-3.4
3/8 - 24	25-30	35-40	3.4-4.1
9.5 mm			
7/16 - 14	30-40	40-55	4.1-5.5
7/16 - 20	35-45	45-60	4.8-6.2
11.1 mm			
1/2 - 13	50-60	70-80	6.9-8.3
1/2 - 20	60-70	80-95	8.3-9.7
12.7 mm			
9/16 - 12	70-90	95-120	9.7-12.4
9/16 - 18	80-100	110-135	11.0-13.8
14.3 mm			
5/8 - 11	100-120	135-160	13.8-16.6
5/8 - 18	120-150	160-200	16.6-20.7
15.9 mm			
3/4 - 10	180-220	245-300	24.9-30.4
3/4 - 16	200-240	270-325	27.7-33.2
19.0 mm			
7/8 - 9	290-350	390-475	40.1-48.4
7/8 - 14	325-400	440-540	44.9-55.3
22.2 mm			
1 - 8	430-530	580-720	59.4-73.3
1 - 12	480-580	650-785	66.4-80.2
25.4 mm			
1-1/8 - 7	540-660	730-895	74.7-91.2
1-1/8 - 12	595-725	805-980	82.3-100.2
28.6 mm			
1-1/4 - 7	755-925	1025-1255	104.4-127.9
1-1/4 - 12	830-1010	1125-1370	114.8-139.6
31.8 mm			
1-3/8 - 6	990-1210	1340-1640	136.9-167.3
1-3/8 - 12	1135-1385	1540-1860	156.9-191.5
34.9 mm			
1-1/2 - 6	1315-1610	1780-2180	181.8-222.6
1-1/2 - 12	1475-1800	2000-2440	203.9-248.9
38.1 mm			

Grade 8 Bolts, Nuts, and Studs

Thread Size	Pound-Feet	Newton metres	Kilogram metres
1/4 - 20	5-10	7-15	.7-1.4
1/4 - 28	10-15	15-20	1.4-2.1
6.4 mm			
5/16 - 18	15-20	20-30	2.1-2.8
5/16 - 24	20-25	30-35	2.8-3.4
7.9 mm			
3/8 - 16	30-40	40-50	4.1-5.5
3/8 - 24	35-40	40-55	4.8-5.5
9.5 mm			
7/16 - 14	40-60	55-80	5.5-8.3
7/16 - 20	55-65	75-90	7.6-9.0
11.1 mm			
1/2 - 13	70-90	95-120	9.7-12.4
1/2 - 20	80-100	110-135	11.1-13.8
12.7 mm			
9/16 - 12	100-120	135-160	13.8-16.6
9/16 - 18	120-140	160-190	16.6-19.4
14.3 mm			
5/8 - 11	150-190	200-260	20.7-26.3
5/8 - 18	160-200	220-270	22.1-27.7
15.9 mm			
3/4 - 10	250-310	340-420	34.6-42.9
3/4 - 16	290-350	390-475	40.1-48.4
19.0 mm			
7/8 - 9	415-505	560-685	57.4-69.8
7/8 - 14	450-550	610-745	62.2-76.0
22.2 mm			
1 - 8	610-750	870-1015	84.3-103.7
1 - 12	665-815	900-1105	91.9-112.7
25.4 mm			
1-1/8 - 7	865-1055	1170-1430	119.6-145.9
1-1/8 - 12	970-1190	1315-1610	134.1-164.5
28.6 mm			
1-1/4 - 7	1225-1495	1660-2025	169.4-206.7
1-1/4 - 12	1350-1650	1830-2235	186.6-228.1
31.8 mm			
1-3/8 - 6	1600-1960	2170-2655	221.2-271.0
1-3/8 - 12	1835-2245	2490-3045	253.8.-310.4
34.9 mm			
1-1/2 - 6	2125-2595	2880-3520	293.8-358.8
1-1/2 - 12	2395-2925	3245-3965	331.1-404.4
38.1 mm			

Rev. May 1982

TORQUE SPECIFICATIONS - STEEL HYDRAULIC FITTINGS

Tube OD Hose ID	Thread Size	Pound-Feet	Newton metres	Kilogram metres
37 Degree Flare Fittings				
1/4 in 6.4 mm	7/16-20	6-12	8-16	0.8-1.7
5/16 in 7.9 mm	1/2-20	8-16	11-21	1.1-2.2
3/8 in 9.5 mm	9/16-18	10-25	14-33	1.4-3.5
1/2 in 12.7 mm	3/4-16	15-42	20-56	2.1-5.8
5/8 in 15.9 mm	7/8-14	25-58	34-78	3.5-8.0
3/4 in 19.0 mm	1-1/16-12	40-80	54-108	5.5-11.1
7/8 in 22.2 mm	1-3/16-12	60-100	81-135	8.3-13.9
1.0 in 25.4 mm	1-5/16-12	75-117	102-158	10.4-16.2
1-1/4 in 31.8 mm	1-5/8-12	125-165	169-223	17.3-22.8
1-1/2 in 38.1 mm	1-7/8-12	210-250	285-338	29.0-34.6

Tube OD Hose ID	Thread Size	Pound-Feet	Newton metres	Kilogram metres
Straight Threads with O-ring				
1/4 in 6.4 mm	7/16-20	12-19	16-25	1.7-2.6
5/16 in 7.9 mm	1/2-20	16-25	22-33	2.2-3.5
3/8 in 9.5 mm	9/16-18	25-40	34-54	3.5-5.5
1/2 in 12.7 mm	3/4-16	42-67	57-90	5.8-9.3
5/8 in 15.9 mm	7/8-14	58-92	79-124	8.0-12.7
3/4 in 19.0 mm	1-1/16-12	80-128	108-174	11.1-17.8
7/8 in 22.2 mm	1-3/16-12	100-160	136-216	13.8-22.1
1.0 in 25.4 mm	1-5/16-12	117-187	159-253	16.2-25.9
1-1/4 in 31.8 mm	1-5/8-12	165-264	224-357	22.8-36.5
1-1/2 in 38.1 mm	1-7/8-12	250-400	339-542	34.6-55.3

Split Flange Mounting Bolts			
Size	Pound-Feet	Newton metres	Kilogram metres
5/16-18	15-20	20-27	2.1-2.8
3/8-16	20-25	26-33	2.8-3.5
7/16-14	35-45	47-61	4.7-6.2
1/2-13	55-65	74-88	7.6-9.0
5/8-11	140-150	190-203	19.4-20.7

811361A

NOTES

Section 1002

MAINTENANCE AND LUBRICATION

Written In *Clear And Simple English*

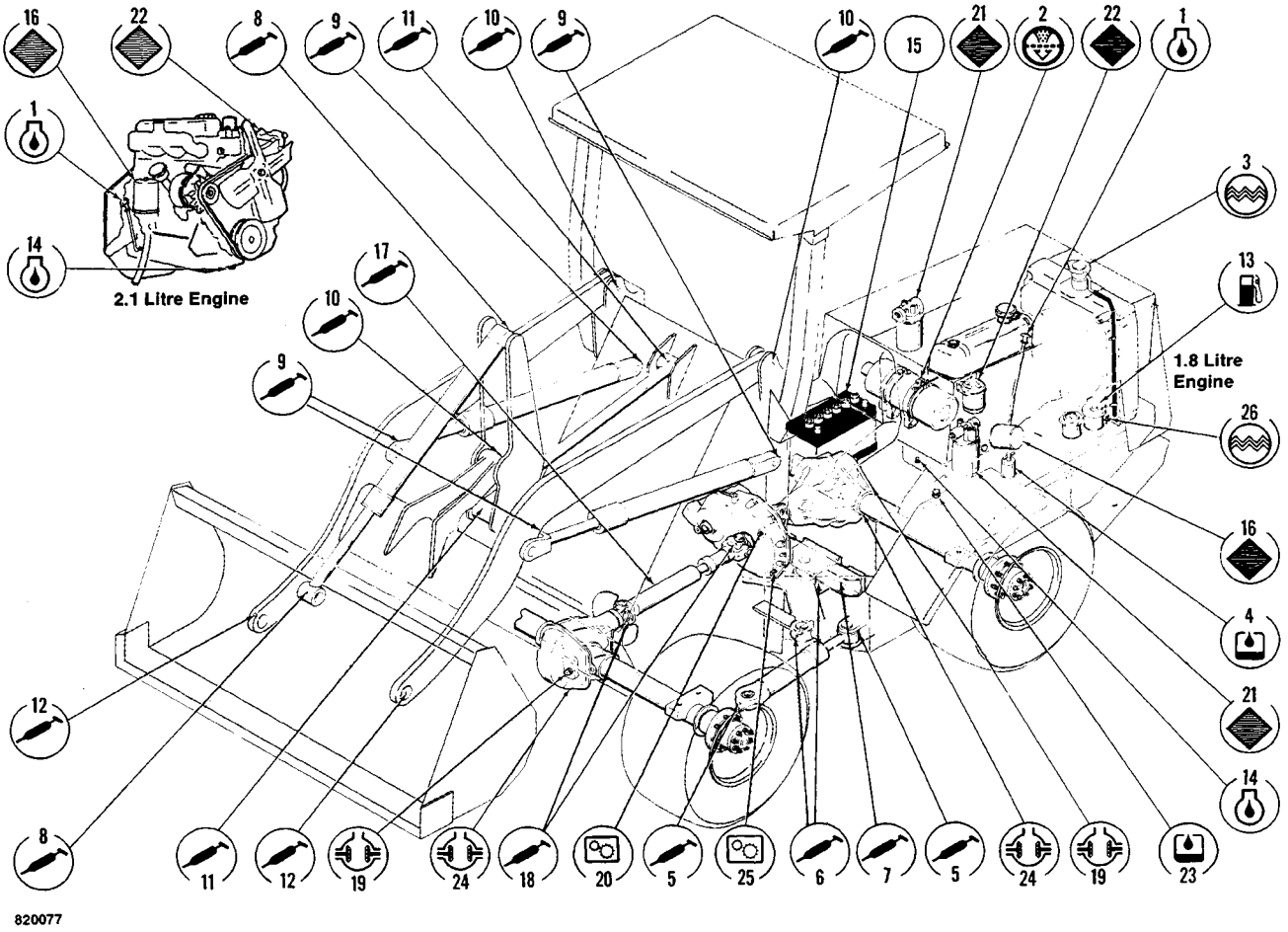
CASE CORPORATION

8-33921

Printed in U.S.A.
January 1982
Revised May 1982

TABLE OF CONTENTS

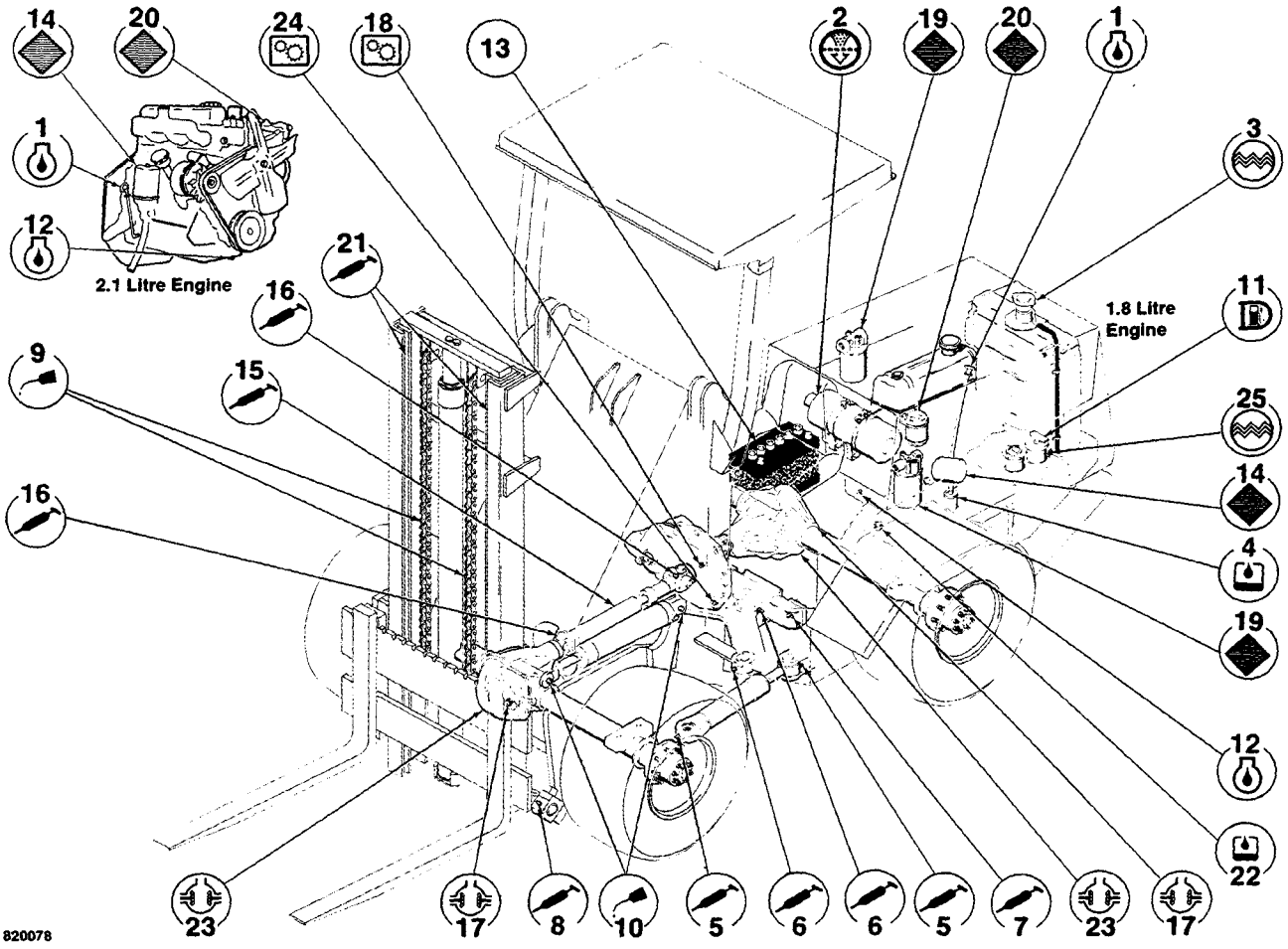
LOADER SERVICE POINTS



REF NO.	SERVICE POINT	SERVICE REQUIRED	FREQUENCY
1	Engine Oil Dipstick	*Check level - fill as required	Daily or after every 10 hours of operation
2	Engine Air Cleaner	Check and service as required	
3	Radiator	Check coolant level. Add coolant as required	
4	Hydraulic Oil Reservoir	Check level - fill as required	
5	Steering Cylinder (both ends)	Lubricate with No. 2 Lithium Base Grease	
6	Center Pivot Grease Fitting (2 places)	Lubricate with No. 2 Lithium Base Grease	
7	Slide Grease Fitting (2 places if equipped)	Lubricate with No. 2 Lithium Base Grease	
8	Bucket Cylinder Pivots	Lubricate with No. 2 Lithium Base Grease	
9	Lift Cylinder Pivots	Lubricate with No. 2 Lithium Base Grease	
10	Lift Arm Pivots	Lubricate with No. 2 Lithium Base Grease	
11	Bucket Leveler Arm (3 places)	Lubricate with No. 2 Lithium Base Grease	
12	Bucket Pivots	Lubricate with No. 2 Lithium Base Grease	
13	Fuel Tank	Fill at the end of each day of operation	Daily
14	Engine Oil Drain	*Drain and fill with new oil	After every 50 hours of operation
15	Battery	Check and service as required	After every 50 hours of operation or weekly
16	Engine Oil Filter	*Replace with new filter	After every 100 hours of operation
17	Drive Shaft Grease Fitting	Lubricate with No. 2 Lithium Base Grease	
18	Front and rear U-Joint Grease Fitting	Lubricate with No. 2 Lithium Base Grease	
19	Front and rear Axles	Check fluid level - fill as required	
20	2-Speed Transmission	Check fluid level - fill as required	
21	Hydraulic Oil Filters	**Replace with new filters	After every 250 hours of operation
22	Fuel Filter	Replace with new filter	
23	Hydraulic Oil Reservoir Drain	Drain and fill with new oil	After every 100 hours of operation or yearly
24	Front and Rear Axle Drain	Drain and fill with new oil	
25	2-Speed Transmission Drain	Drain and fill with new oil	
26	Radiator Drain	Drain and flush cooling system. Fill with new coolant	After every 2000 hours or yearly

*The engine oil and filter must be changed initially after the first 25 hours of operation. Check oil level at 3 hour intervals during this period.
**The hydraulic oil filters must be changed initially after the first 25 hours of operation.

FORKLIFT SERVICE POINTS



REF NO.	SERVICE POINT	SERVICE REQUIRED	FREQUENCY
1	Engine Oil Dipstick	*Check level - fill as required	Daily or after every 10 hours of operation
2	Engine Air Cleaner	Check and service as required	
3	Radiator	Check coolant level. Add coolant as required	
4	Hydraulic Oil Reservoir	Check level - fill as required	
5	Steering Cylinder (both ends)	Lubricate with No. 2 Lithium Base Grease	
6	Center Pivot Grease Fitting (2 places)	Lubricate with No. 2 Lithium Base Grease	
7	Slide Grease Fitting (2 places if equipped)	Lubricate with No. 2 Lithium Base Grease	
8	Mast Tilt Pivots (2)	Lubricate with No. 2 Lithium Base Grease	
9	Forklift Chain	Lubricate with Case Chain and Cable Lubricant (Part No. B17082)	
10	Mast Tilt Cylinders	Lubricate with Case Chain and Cable Lubricant (Part No. B17082)	
11	Fuel Tank	Fill at the end of each day of operation	Daily
12	Engine Oil Drain	*Drain and fill with new oil	After every 50 hours of operation
13	Battery	Check and service as required	After every 50 hours of operation or weekly
14	Engine Oil Filter	*Replace with new filter	After every 100 hours of operation
15	Drive Shaft Grease Fitting	Lubricate with No. 2 Lithium Base Grease	
16	Front and Rear U-Joint Grease Fitting	Lubricate with No. 2 Lithium Base Grease	
17	Front and Rear Axles	Check fluid level - fill as required	
18	2-Speed Transmission	Check fluid level - fill as required	
19	Hydraulic Oil Filters	**Replace with new filters	After every 250 hours of operation
20	Fuel Filter	Replace with new filter	
21	Forklift Mast Slides	Lubricate with No. 2 Lithium Base Grease	
22	Hydraulic Oil Reservoir Drain	Drain and fill with new oil	After every 1000 hours of operation or yearly
23	Front and Rear Axle Drain	Drain and fill with new oil	
24	2-Speed Transmission Drain	Drain and fill with new oil	
25	Radiator Drain	Drain and flush cooling system. Fill with new coolant	After every 2000 hours or yearly

*The engine oil and filter must be changed initially after the first 25 hours of operation. Check oil level at 3 hour intervals during this period.
**The hydraulic oil filters must be changed initially after the first 25 hours of operation.

FLUIDS AND LUBRICANTS

Component	Capacity		Specifications
	U.S.	Metric	
Fuel tank	13.2 gallons	49.8 litres	Diesel Fuel, See Operators Manual
Engine crankcase, 1.8 litre diesel engine Without filter change With filter change	 4.0 quarts 5.0 quarts	 3.8 litres 4.8 litres	Case HDM Oil Alternate engine oil: CD-Commercial class D Above 68°F (20°C) .....SAE 30 15 to 85°F (-10 to 30°C) .....SAE 20W Below 32°F (0°C) .....SAE 10W
Engine crankcase, 2.1 litre diesel engine Without filter change With filter change	 6.0 quarts 7.0 quarts	 5.7 litres 6.7 litres	Case HDM Oil Alternate engine oil: CD-Commercial class D Above 104°F (40°C) .....SAE 40 25 to 104°F (-5 to 40°C) .....SAE 30 10 to 25°F (-15 to -5°C) .....SAE 20W20 Below 10°F (-15°C) .....SAE 10W
Hydraulic oil reservoir Hydraulic system	10.0 gallons 15.0 gallons	38 litres 57 litres	Automatic transmission fluid (ATF) type "F"
Transmission	2.7 pints	1.3 litres	Multipurpose Gear Lubricant (API-GL-5) SAE 80-90
Front and Rear Axles (each)	4.0 quarts	3.8 litres	Multipurpose Gear Lubricant (API-GL-5) SAE 80 - 90. **IMPORTANT:** *If the axle has a limited slip differential, the lubricant must have a limited slip additive.*
Engine cooling system 1.8 litre diesel engine 2.1 litre diesel engine	 8.0 quarts 10.0 quarts	 7.6 litres 9.5 litres	Mix an ethylene glycol coolant with water for the lowest outside temperature that is expected. The mixture must be at least 50/50.
Battery	As required		Add drinking water or distilled water
Grease fittings	As required		Number 2 Lithium base grease

Austin Morris

Power Systems

1.8 Litre Diesel Engine

REPAIR OPERATION MANUAL

Publication Part No. AKM 3934 (2nd Edition)

Published by Austin Morris Limited
A subsidiary of BL Cars Limited

SPECIFICATION

Purchasers are advised that the specification details set out in this Manual apply to a range of engines and not to any particular engine. For the specification of any particular engine purchasers should consult their supplier.

The manufacturers reserve the right to vary their specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the manufacturer's policy of constant product improvement. ment.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the manufacturer nor the supplier, by whom this Manual is supplied, shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

COPYRIGHT

CONTENTS

MAINTENANCE 10

ENGINE

continued

CONTENTS

INTRODUCTION

The purpose of this Manual is to assist skilled mechanics in the efficient repair and maintenance of the range of engines given on the title-page. The procedures detailed, carried out in the sequence given and using the appropriate service tools, will enable the operations to be completed in the time stated in the Repair Operation Times.

Indexing
The contents pages list the titles and reference numbers of the divisions in alphabetical order.

Operation Numbering
Each operation is followed by the number allocated to it in a master index. The number consists of six digits arranged in three pairs.

The master index of operations has been compiled for universal application to engines manufactured by BL Cars Limited and therefore continuity of the numbering sequence is not maintained throughout this Manual.

Each instruction within an operation has a sequence number, and to complete the operation in the minimum time it is essential that these instructions are performed in the numerical sequence commencing at 1 unless otherwise stated. Where applicable, the sequence numbers identify the components in the appropriate illustration.

Service Tools
Where performance of an operation requires the use of a service tool, the tool number is quoted under the operation heading and is repeated in the instruction involving its use.

An illustrated list of all service tools necessary to complete the operations described in the Manual is also included.

Definitions
Remove and refit – the removing of an existing part, fitting of a new or replacement part.
Overhaul – includes removing a component, fitting new parts, adjusting and its refitting.

References
The water pump end of the engine is referred to as the front.

To reduce repetition, operations covered in this Manual do not include reference to testing the engine after repair. It is essential that work is inspected and tested after completion, particularly where safety-related items are concerned.

Dimensions
The dimensions quoted are to design engineering specification. Alternative unit eq alents have been converted from the original specification.

During the period of running-in from new, certain adjustments may vary from the spe cation figures given in this Manual. These adjustments will be reset by the supplier a After Sales Service, and thereafter should be maintained at the figures specified ir Manual.

REPAIRS AND REPLACEMENTS

When service parts are required it is essential that only genuine **BL** or **Unipart** rep ments are used.

Attention is particularly drawn to the following points concerning repairs and the fitt of replacements parts and accessories:

The performance and durability of the engine may be impaired if other than genuine pa are fitted. In certain territories, legislation prohibits the fitting of parts not to the engi manufacturer's specification. Torque wrench setting figures given in this Manual must strictly adhered to. Locking devices, where specified, must be fitted. If the efficiency c locking device is impaired during removal, it must be renewed. When purchasing accesso while travelling abroad ensure that the accessory and its fitted location conform to requirements existing in their country of origin. The engine warranty may be invalidated the fitting of other than genuine **BL** or **Unipart** parts.

All **BL** and **Unipart** replacements have the full backing of the factory warranty.

SERVICE PARTS

Genuine BL and UNIPART Service parts are designed and tested for your engine and ha the full backing of the BL Factory Warranty. ONLY WHEN GENUINE BL or UNIPAR SERVICE PARTS ARE USED CAN RESPONSIBILITY BE CONSIDERED UNDER TH TERMS OF THE WARRANTY.

Genuine parts are supplied in cartons bearing one or both of these symbols:

ABBREVIATIONS AND SYMBOLS IN THIS MANUAL

Across flats (bolt size)	A.F.
After bottom dead centre	A.B.D.C.
After top dead centre	A.T.D.C.
Alternating current	a.c.
Amperes	A
Ampere-hour	Ah
Atmospheres	Atm
Before bottom dead centre	B.B.D.C.
Before top dead centre	B.T.D.C.
Bottom dead centre	B.D.C.
Brake horse power	b.h.p.
Brake mean effective pressure	b.m.e.p.
British Standards	B.S.
Carbon monoxide	CO
Centigrade (Celsius)	C
Centimetres	cm
Cubic centimetres	cm^3
Cubic inches	in^3
Cycles per minute	c/min
Degree (angle)	deg. or °
Degree (temperature)	deg. or °
Diameter	dia.
Direct current	d.c.
Fahrenheit	F
Feet	ft
Feet per minute	ft/min
Fifth	5th
Figure (illustration)	Fig.
First	1st
Fourth	4th
Gallons (Imperial)	gal
Gallons (U.S.)	U.S. gal
Grammes (force)	gf
Grammes (mass)	g
High compression	h.c.
High tension (electrical)	h.t.
Horse-power	hp
Hundredweight	cwt
Inches	in
Inches of mercury	inHg
Independent front suspension	i.f.s.
Internal diameter	i.dia.
Kilogrammes (force)	kgf
Kilogrammes (mass)	kg
Kilogramme centimetre	kgf cm
Kilogramme metres	kgf m
Kilogrammes per square centimetre	kgf/cm^2
Kilometres	km
Kilometres per hour	km/h
Kilovolts	kV
King pin inclination	k.p.i.
Left-hand	L.H.
Left-hand steering	L.H.Stg.
Left-hand thread	L.H.Thd.
Low compression	l.c.
Low tension	l.t.
Maximum	max.
Metres	m
Miniature Edison Screw	MES
Miles per gallon	m.p.g.
Miles per hour	m.p.h.
Millimetres	mm
Millimetres of mercury	mmHg
Minimum	min.
Minus (of tolerance)	−
Minute (of angle)	′
Negative (electrical)	−
Newton metre	Nm
Number	No.
Ounces (force)	ozf
Ounces (mass)	oz
Ounce inch (torque)	ozf in
Outside diameter	o.dia
Overdrive	O/D
Paragraphs	para.
Part Number	Part No.
Percentage	%
Pints (Imperial)	pt
Pints (U.S.)	U.S. pt
Plus or minus	±
Plus (tolerance)	+
Positive (electrical)	+
Pounds (force)	lbf
Pounds (mass)	lb
Pounds feet (torque)	lbf ft
Pounds inches (torque)	lbf in
Pounds per square inch	lbf/in^2
Radius	r
Ratio	:
Reference	ref.
Revolutions per minute	rev/min
Right-hand	R.H.
Right-hand steering	R.H.Stg.
Second (angle)	″
Second (numerical order)	2nd
Single carburetter	SC
Society of Automobile Engineers	S.A.E.
Specific gravity	sp. gr.
Square centimetres	cm^2
Square inches	in^2
Standard	std.
Standard wire gauge	s.w.g.
Synchronizer/synchromesh	synchro.
Third	3rd
Top dead centre	T.D.C.
Twin carburetters	TC
United Kingdom	UK
Volts	V
Watts	W
Screw threads	
American Standard Taper Pipe	N.P.T.F.
British Association	B.A.
British Standard Fine	B.S.F.
British Standard Pipe	B.S.P.
British Standard Whitworth	B.S.W.
Unified Coarse	U.N.C.
Unified Fine	U.N.F.

GENERAL SPECIFICATION DATA

The symbol [1] in this Manual refers to engines with engine numbers prior to:

18P/885B/D1102 — 18V/738B/D460 — 18V/744B/D19001 — 18V/745B/D251 — 18V/886B/D501

The symbol [2] refers to engines with engine numbers commencing at those above, and all engine numbers beginning 18B/919B/D or 18V/920B/D or 18P/830A/D.

ENGINE — Diesel 1.8 litre

Type	18V– – – –D
Number of cylinders	4
Bore	3.16 in (80.26 mm)
Stroke	3.5 in (88.9 mm)
Capacity	109.8 in³ (1799 cm³)
Injection order	1, 3, 4, 2
Valve operation	Overhead by push-rod
Compression ratio: [1]**	21.47 : 1
[2]	22.3 : 1
Torque (gross)	107 Nm, 79 lbf ft, 10.92 kgf m at 2,400 rev/min

Crankshaft

Main journal diameter	2.1262 to 2.1270 in (54.01 to 54.03 mm)
Crankpin journal diameter	1.8759 to 1.8764 in (47.64 to 47.65 mm)
Crankshaft end-thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0.001 to 0.0055 in (0.025 to 0.139 mm)

Main bearings

Number and type	5 Steel backed lead indium
Length: Front, centre and rear	1.120 to 1.130 in (28.45 to 28.70 mm)
Intermediate	0.760 to 0.770 in (19.30 to 19.55 mm)
Diametrical clearance	0.001 to 0.0027 in (0.03 to 0.07 mm)

Connecting rods

Type	Horizontally split big-end, plain small end
Length between centres	6.220 to 6.222 in (157.9 to 158.0 mm)

Big-end bearings

Type	Steel backed lead indium
Length	0.775 to 0.785 in (19.68 to 19.93 mm)
Diametrical clearance	0.001 to 0.0027 in (0.03 to 0.07 mm)

Gudgeon pin

Type	Fully floating with circlip location
Fit in piston	0.0001 to 0.0003 in (0.002 to 0.007 mm) clearance
Fit in connecting rod	0.0002 to 0.0009 in (0.02 to 0.04 mm) clearance
Diameter (outer)	0.9998 to 1.0000 in (25.39 to 25.40 mm)

Pistons

Type	Aluminium alloy, solid skirt, with open combustion cavity
Clearances:	
Top land	0.0171 to 0.0211 in (0.43 to 0.57 mm)
Bottom land	0.0137 to 0.0172 in (0.35 to 0.44 mm)
Bottom of skirt	0.004 to 0.005 in (0.10 to 0.13 mm)
Oversizes	0.020 in (0.51 mm)

Piston rings

Compression:	
Type: Top	Chrome-faced
Second	Tapered, cast iron alloy
Width	0.0771 to 0.0781 in (1.96 to 1.98 mm)
Fitted gap: Top	0.012 to 0.017 in (0.30 to 0.43 mm)
Second	0.009 to 0.014 in (0.23 to 0.35 mm)
Ring to groove clearance: Top	0.0025 to 0.0045 in (0.06 to 0.11 mm)
Second	0.0015 to 0.0035 in (0.04 to 0.09 mm)
Oil control	
Type	Slotted scraper
Fitted gap	0.012 to 0.017 in (0.30 to 0.43 mm)
Ring to groove clearance	0.0015 to 0.0035 in (0.04 to 0.09 mm)

Camshaft [1]

Journal diameters: Front	1.78875 to 1.78925 in (45.43 to 45.44 mm)
Centre	1.72875 to 1.72925 in (43.91 to 43.93 mm)
Rear	1.62275 to 1.62325 in (41.22 to 41.23 mm)
Bearing liner inside diameter (reamed after fitting):	
Front	1.79025 to 1.79075 in (45.47 to 45.48 mm)
Centre	1.73025 to 1.73075 in (43.95 to 43.96 mm)
Rear	1.62425 to 1.62475 in (40.26 to 40.27 mm)
Diametrical clearance	0.001 to 0.002 in (0.02 to 0.05 mm)
End-thrust	Taken on locating plate
End-float	0.003 to 0.007 in (0.08 to 0.18 mm)

Camshaft [2]

Journal diameters: Front	1.95125 to 1.95175 in (49.652 to 49.574 m
Centre	1.91975 to 1.92025 in (48.762 to 48.774 m
Rear	1.72875 to 1.72925 in (43.910 to 43.923 m
Diametral clearance	0.001 to 0.002 in (0.02 to 0.05 mm)
End-thrust	Taken on locating plate
End-float	0.003 to 0.007 in (0.08 to 0.18 mm)

Rocker gear

Rocker shaft diameter	0.624 to 0.625 in (15.85 to 15.87 mm)
Rocker bush inside diameter (reamed in position)	0.6255 to 0.6260 in (15.89 to 15.90 mm)

Tappets

Type	Bucket
Outside diameter	0.8125 in (20.65 mm)
Length	1.495 to 1.505 in (37.97 to 38.23 mm)

** [1] [2] see page 7

continued

Valves

Seat angle: Inlet	45°
Exhaust	45°
Head diameter: Inlet	1.434 to 1.439 in (36.42 to 36.55 mm)
Exhaust	1.207 to 1.212 in (30.64 to 30.78 mm)
Stem diameter: Inlet	0.3428 to 0.3433 in (8.71 to 8.73 mm)
Exhaust	0.3422 to 0.3427 in (8.69 to 8.70 mm)
Stem to guide clearance: Inlet	0.0008 to 0.0020 in (0.02 to 0.05 mm)
Exhaust	0.0014 to 0.0026 in (0.03 to 0.06 mm)
Valve lift: Inlet and exhaust	0.384 in (9.75 mm)
Valve stand down: [1]**	0.0445 to 0.0505 in (1.13 to 1.28 mm)
[2]	0.020 to 0.030 in (0.508 to 0.762 mm)

Valve guides

Length: Inlet and exhaust	2.22 in (56.39 mm)
Outside diameter: Inlet and exhaust	0.5635 to 0.5640 in (14.31 to 14.33 mm)
Inside diameter (reamed after fitting): Inlet and exhaust	0.3441 to 0.3448 in (8.74 to 8.76 mm)
Fitted height above spring seat: Inlet and exhaust	0.55 to 0.56 in (13.9 to 14.2 mm)
Interference fit in head: Inlet and exhaust	0.0005 to 0.00175 in (0.01 to 0.04 mm)

Valve springs

Free length	1.92 in (48.77 mm)
Fitted length	1.44 in (36.57 mm)
Load at fitted length	82 lbf, 37.19 kgf, 364 N
Load at top of lift	142 lbf, 64.4 kgf, 631 N
Number of working coils	4½

Valve timing

Timing marks	Dimples on timing wheels, marks on flywheel
Rocker clearance: [1] **Running	0.017 in (0.43 mm)
Timing	0.024 in (0.61 mm)
[2] Running	0.014 in (0.36 mm)
Timing	0.016 in (0.41 mm)

	[1]	[2]
Inlet valve: Opens	8° B.T.D.C.	8° B.T.D.C.
Closes	42° A.B.D.C.	44° A.B.D.C.
Exhaust valve: Opens	60° B.B.D.C.	50° B.B.D.C.
Closes	12° A.T.D.C.	10° A.T.D.C.

Lubrication

System	Wet sump, pressure fed
System pressure: Running	3.5 bar, 50 lbf/in², 3.52 kgf/cm²
Idling	1.0 bar, 15 lbf/in², 1.05 kgf/cm²
Oil pump	Rotor type
Oil filter	Full flow; disposable cartridge type
Oil pressure relief valve	3.5 bar, 50 lbf/in², 3.52 kgf/cm²
Relief valve springs: Free length	3 in (76 mm)
Fitted length	2.156 in (54.77 mm)
Load at fitted length	15.5 to 16.5 lbf, 7.0 to 7.4 kgf, 69 to 73 N

FUEL SYSTEM

Fuel injection pump	C.A.V
Type	DPA.3247F180, DPA.3247F260, DPA.3342F710 or DPA3342F720
Injection timing	18° B.T.D.C.
Fuel lift pump	A.C. Mechanical
Fuel injectors	C.A.V. Pintaux
Nozzle type	BDN.OSPC.6651
Nozzle holder type	BKB.35SD.5188
Opening pressure	135 Atm
Main fuel filter	C.A.V.
Type	FS583 6B130
Heater plugs	
Champion	AG32

COOLING SYSTEM

Thermostat:	
Standard	82° C (180° F)
Hot climates	72° C (162° F)
Cold climates	88° C (190° F)
Fan belt tension	See **'Maintenance'**

CLUTCH

Type	Single dry plate
Clutch plate diameter	9 in (228.6 mm)

ELECTRICAL

Alternator

Type: Lucas	16ACR	18ACR
Output at 14V and 6000 rev/min	34 A	43 A
Rotor winding resistance at 20°C (68°F)	3.3 ohm ± 5%	3.2 ohm ± 5%
Maximum permissible rotor speed	15 000 rev/min	15 000 rev/min
Brush length new	0.5 in (12.7 mm)	0.5 in (12.7 mm)
Brush spring tension, brush face flush with brush box	3 to 4 N, 9 to 13 ozf, 255 to 368 gf	3 to 4 N, 9 to 13 ozf, 255 to 368 gf

Starter motor

Type: Lucas	M45G pre-engaged
Light running current	100 amp at 5000 to 6000 rev/min
Lock torque at 940 amp	29 lbf ft (4.01 kgf m, 39 Nm)
Minimum brush length	0.31 in (8.0 mm)
Brush spring tension	42 ozf (1.2 kgf, 11 N)

** [1] [2] see page 7

ENGINE TUNING DATA

ENGINE – Diesel 1.8 litre

Type	18–/––––/D
Displacement	109.7 in³ (1798 cm³)
Injection order	1, 3, 4, 2
Compression ratio	21.47 : 1
Valve rocker clearance (cold) [1] **	0.017 in (0.43 mm)
[2]	0.014 in (0.36 mm)
Idle speed:	
Engines with hydraulic governer	650 rev/min minimum †
Engines with mechanical governer	800 rev/min minimum †
Maximum governed light running speed	4,900 rev/min †

Fuel injection pump

Make and type	C.A.V. DPA.3247F180, DPA.3247F260, DPA.3342F710 or DPA.3342F720
Injection pump timing	18° B.T.D.C.

Fuel injectors

Make and type	C.A.V. Pintaux
Nozzle type	BDN.OSPC.6651
Nozzle holder type	BKB.35SD.5188
Opening pressure	135 Atm

Heater plugs

Make and type	Champion AG32

† For exact settings see injection pump code and/or Equipment manufacturers settings.

** [1] [2] see page 7

TORQUE WRENCH SETTINGS

	lbf ft	kgf m	Nm
Cylinder head nuts	75	10.4	102
Rocker bracket nuts	25	3.5	34
Manifold nuts	15	2.1	20
Big-end nuts	35	4.8	47
Main bearing set screws	75	10.4	102
Flywheel bolts	40	5.5	54
Timing cover bolts: ¼ in	6	0.8	8
$\frac{5}{16}$ in	20	2.8	27
Rear plate bolts: $\frac{5}{16}$ in	20	2.8	27
$\frac{3}{8}$ in	30	4.1	41
Camshaft nut	65	9.0	88
Crankshaft bolt	115*	16	156
Idler gear hub bolt	30	4.1	41
Cylinder side cover set screws	4	0.5	5
Rocker cover nuts	4	0.5	5
Sump bolts	6	0.8	8
Oil filter adaptor	30	4.1	41
Oil pump nuts	16	2.2	22
Oil release valve – domed nut	45	6.2	61
Starter motor bolts	35	4.8	47
Clutch to flywheel	25	3.5	34
Fuel lift pump nuts	12	1.7	16
Injector nozzle nut	50	6.9	68
Injection pump nuts	18	2.5	24
Injector nuts	12	1.7	16
Injection pump driving flange set screws	10	1.4	14
Water pump bolts	17	2.3	23
Water pump pulley set screws	18	2.5	24
Alternator pulley nut	27	3.7	36
Thermal transmitter	16	2.2	22

*Discard lock washer

SERVICE LUBRICANTS, FUEL, FLUIDS AND CAPACITIES

Lubricants

The lubrication system of your new engine is filled with high quality oil. You should always use a high quality oil of the correct viscosity range in the engine during subsequent maintenance operations or when topping up. The use of oils not to the correct specification can lead to high oil and fuel consumption and ultimately to damage to components.

Oil to the correct specification contains additives which disperse the corrosive acids formed by combustion and also prevent the formation of sludge which can block oilways. **Additional oil additives should not be used.** Service intervals must be adhered to.

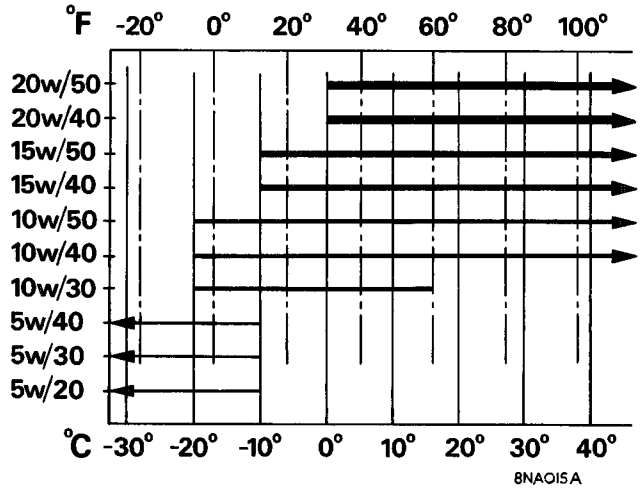
Engine

Use a well known brand of oil to B.L.S. OL.02 or MIL-L-2104B or MIL-L-46152 or A.P.I, SE/CC quality, with a viscosity band spanning the temperature range of your locality.

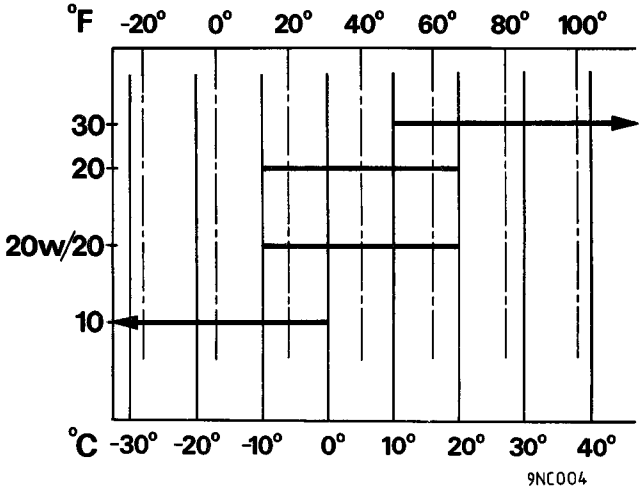
The use of monograde oils is permissible providing that it is of the correct viscosity for the ambient temperature of your locality. It should also be of the same quality MIL-L-46152, MIL-L-2104B or A.P.I., SE/CC as the preferred multigrade oils.

For sustained high speed operation or operation for long periods in a high ambient temperature, the use of a multigrade oil of the correct viscosity and quality is recommended.

Multigrade Oils Viscosity/Temperature Ranges



Monograde Oils Viscosity/Temperature Ranges



Fuel

Use fuel oils generally known as Diesel fuel oil, distillate Diesel fuel, automotive gas oil or Derv fuel conforming to British Standard 2869: 1967, Class A1 or A2.

Anti-Freeze Solutions

Use **UNIPART UNIVERSAL Anti-freeze** to protect the cooling system.

If **UNIPART** Universal is not available any anti-freeze conforming to Specification B.S. 3151 or 3152 may be used. Anti-freezes to these specifications are compatible with **UNIPART** Universal and can be used with it. **UNIPART** Universal should not be mixed with other universal anti-freezes.

The overall anti-freeze concentration should not fall below 30% by volume, to ensure that the anti-corrosion properties of the coolant are maintained.

After filling with anti-freeze solution, attach a warning label in a prominent position stating the type of anti-freeze contained in the cooling system to ensure that the correct type is used for topping-up.

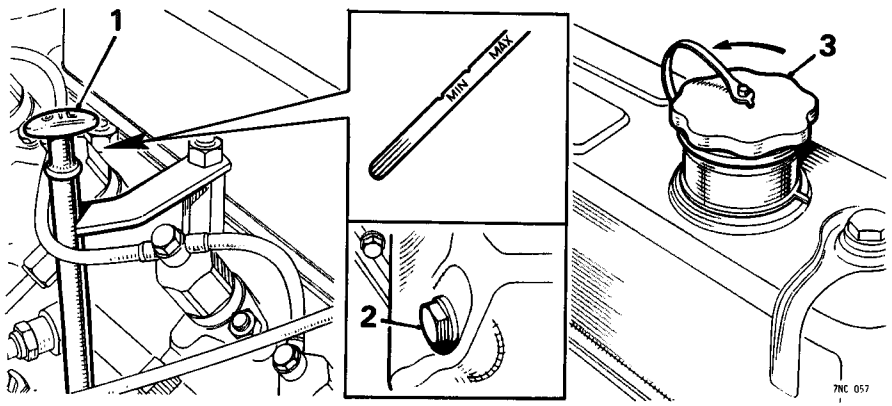
Solution	*Commences to freeze*		*Frozen solid*	
%	*°C*	*°F*	*°C*	*°F*
33½	−19	−2	−36	−33
50	−36	−33	−48	−53

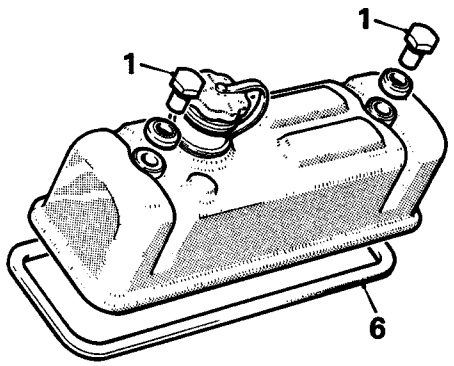
Capacities (approx.)

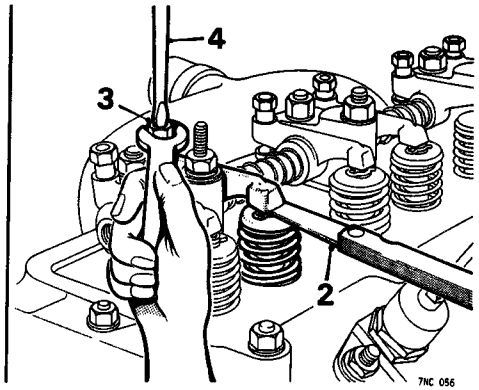
Engine sump (including filter)	8¼ pt, 4.68 litres, 9.9 U.S. pt
Filter only	1¼ pt, 0.71 litre, 1.5 U.S. pt

LUBRICANTS

	FORECOURT OILS			FLEET OIL		
Minimum performance level	MIL-L-2104B A.P.I.-SE/CC or MIL-L-46152					
Climatic Conditions	**Temperatures above −10°C (10°F)**	**Temperatures −20°C (−5°F) to 10°C (50°F)**	**Temperatures below −10°C (10°F)**	**Temperatures above −10°C (10°F)**	**Temperatures −20°C (−5°F) to 10°C (50°F)**	**Temperatures below −10°C (10°F)**
UNIPART	Unipart Super Multigrade Motor Oil 15W/50					
BP	BP Super Visco-Static 20W/50 BP Vanellus C3 Multi-grade BP Visco 2000*	BP Super Visco Static 10W/30 or 10W/40*	BP Super Visco-Static 5W/20*	BP Vanellus M 20–50 BP Vanellus C3 Multigrade	BP Vanellus M 10W/30 or 10W/40*	BP Super Visco-Static 5W/20*
CASTROL	Castrol GTX 20W/50 Castrol GTX-2 15W/20	Castrolite 10W/30 or 10W/40 Castrol GTZ 10W/40 (Sweden)	Castrol Super GTX 5W/30 (Canada) Castrol GTZ 5W/40 (Finland)	Castrol Deusol RX Super 15W/40		
DUCKHAMS	Duckhams Q Motor Oil 20W/50	*Not available in the U.K.		Fleetol Multi-V 20W/50 Fleetmaster	Fleetol Multilite 10W/30	
ESSO	Esso Uniflo 15W/50	Esso Uniflo 10W/40	Esso Uniflo 5W/40	Essolube HDX Plus 20W/50 Esso Uniflo 15W/50	Essolube HDX Plus 10W/30 Esso Uniflo 10W/40	Essolube MDX Plus 10W/30 Esso Uniflo 5W/40
MOBIL	Mobiloil Super 15W/50	Mobiloil SHC 10W/50	Mobiloil 1 5W/20 Mobiloil 5W/20	Mobil Delvac Super 15W/40 Delvac Special 20W/50	Mobil Delvac Special 10W/30	Mobiloil 5W/20
PETROFINA	Fina Supergrade Motor Oil 20W/50	Fina Supergrade Motor Oil 10W/40		Fina Delta Multigrade 20W/50	Fina Delta Multigrade 10W/30	
SHELL	Shell Super Motor Oil U.K. 20W/50 Europe 15W/50	Shell Super Motor Oil 10W/40 (Norway, Sweden, Canada) 10W/50 (Rest of Europe, U.S.A.)	Shell Super Motor Oil 5W/40 (Finland) 5W/30 (Canada)	Rotella SX Rotella TX 20W/40 Rotella SX 20W/30 (Sweden)	Rotella TX 10W/30 Rotella SX 10W/20 (Sweden)	Rotella TX 5W/20 (Finland, Canada)
TEXACO	Texaco URSA Oil LA 15W/40			Eurotex Motor Oil HD 20W/50	Eurotex Motor Oil HD 10W/30	







ENGINE

Lubrication

Checking oil level

1 Maintain the level between the 'MIN' and 'MAX' mark on the dipstick.

Draining and refilling

2 Drain the oil while the engine is warm: check the drain plug copper washer before refitting.

3 Refill with the correct quantity and grade of oil. Run the engine for a short while, then allow it to stand for a few minutes before re-checking the level.

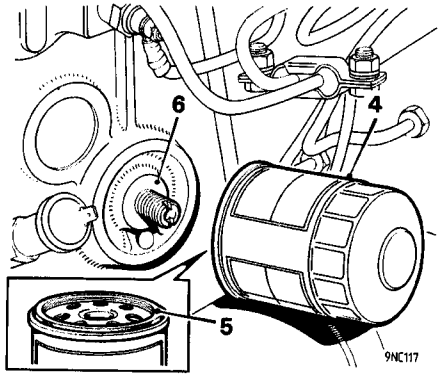
Disposable cartridge filter renewal

4 Unscrew the old cartridge with a tourniquet type wrench; a quantity of oil will be released. Discard the cartridge and seal (5).

5 Wet the new seal with engine oil and ensure that it is located correctly in its groove in the new cartridge.

6 Screw the new cartridge to the filter head, **using hand force only.**

7 Start the engine and check the filter for leaks. Stop the engine, and re-check the oil level after waiting for a few minutes.



Valve rocker adjustment

1 Remove the rocker cover.

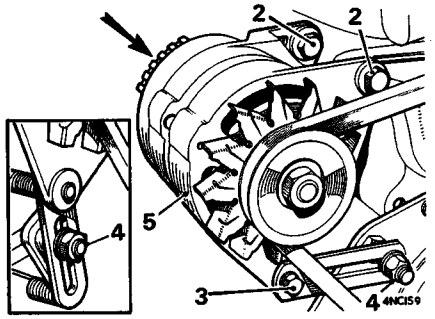
2 Check the clearance between the valve rocker arms and valve stems with a feeler gauge.
Clearance: see **'ENGINE TUNING DATA'.**
The gauge should be a sliding fit when the engine is cold.
Check the clearance of each valve in the following order:
Check No. 1 valve with No. 8 fully open.
" " 3 " " " 6 " "
" " 5 " " " 4 " "
" " 2 " " " 7 " "
" " 8 " " " 1 " "
" " 6 " " " 3 " "
" " 4 " " " 5 " "
" " 7 " " " 2 " "

3 Slacken the locknut.

4 Rotate screw, clockwise to decrease or anti-clockwise to increase the clearance.

5 Retighten the locknut when the clearance is correct, holding the screw against rotation.

6 Refit the rocker cover checking that the gasket is serviceable.



DRIVE BELT TENSION

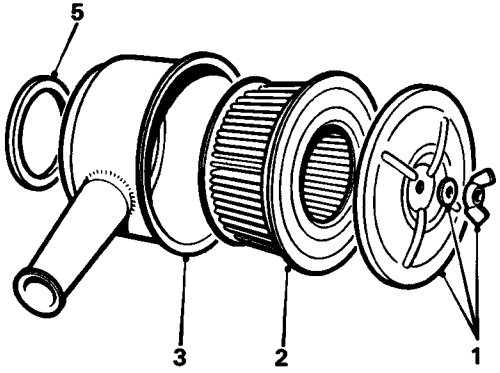
Checking

1 Use one of the following methods of checking the belt tension:
   a Use a torque spanner and apply a load of 14.9 to 15.6 Nm (1.5 to 1.6 kgf m, 11.0 to 11.5 lbf ft) in a clockwise direction to the alternator pulley retaining nut. If the belt tension is correct the belt will slip at this torque loading.
   b Apply a load of 33.4 to 36.4 N (3.3 to 3.6 kgf, 7.5 to 8.2 lbf) at right angles to the belt midway between pulleys. The belt should deflect 6 mm (0.25 m). It is important that the belt tension is set correctly.

NOTE: Fit a new belt with a moderate degree of tension, run the engine for five minutes at 1000 rev/min, stop the engine then set the belt to the correct tension.

Adjusting

2 Slacken the alternator securing bolts.
3 Slacken the bolt securing the adjusting link to the alternator.
4 Slacken the adjusting link to engine securing nut.
5 Move the alternator to the required position: avoid over-tightening. Apply any leverage necessary to the alternator drive end bracket only, using a wood or soft metal lever.
6 Tighten the securing nuts and bolts.



FUEL SYSTEM

Air cleaner elements

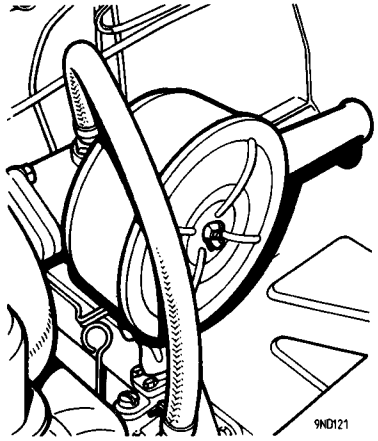
Renew the air cleaner element. In dusty operating conditions the element may require changing more frequently than recommended.

Removing

1 Unscrew the wing nut, remove the fibre washer and withdraw the cover.
2 Withdraw and discard the element.
3 Clean the interior of the container.

Refitting

4 Fit the element.
5 Check that the sealing ring is in good condition.
6 Refit the cover, fibre washer and nut.



SERVICE OPERATIONS – Summary

Every 150 hours

Change engine oil

Operation	Every 300 hours	Every 600 hours
Check/adjust drive belt tension	X	X
Check/adjust valve clearances	X	X
Renew main fuel filter element	X	X
Change engine oil and filter element	X	X
Test injectors for spray		X
Remove heater plugs and clean carbon from each plug orifice in cylinder head – check heater plug operation		X
Renew oil filler cap		X
Clean/renew air filter element	X	X
Check governor settings		X
Retorque cylinder head nuts	X	X

NOTE: More frequent air cleaner element servicing may be necessary in dirty/dusty conditions.

FUEL INJECTION PUMP HUB

Remove and refit 12.10.26

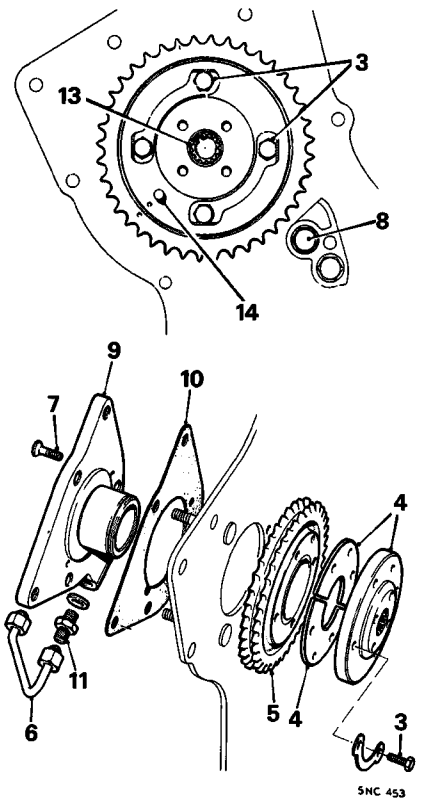
Fuel injection pump gear 1 to 5 and 12 to 18 12.10.25

Removing

1 Remove the timing chain, see 12.65.14.
2 Remove the injection pump, see 19.30.07.
3 Remove the four bolts from the injection pump driving flange.
4 Withdraw the driving flange and collect the two locating half plates.
5 Withdraw the injection pump gear.
6 Remove the injection pump drive oil feed pipe.
7 Remove the countersunk screw from the injection pump hub.
8 Remove the upper bolt from the chain vibration damper.
9 Remove the injection pump hub.
10 Remove the hub gasket.
11 Remove the oil pipe union from the hub.

Refitting

12 Reverse the procedure in 5 to 11.
13 Ensure that the circlip is correctly located in its groove in the splined bore of the injection pump driving flange.
14 Fit one of the locating half plates to its groove in the injection pump hub, and position it by inserting a $\frac{7}{32}$ in (5.5 mm) peg through the timing hole in the locating plate and into the timing hole in the gear.
15 Fit the second locating half plate and then fit the driving flange, engaging the driving flange timing hole with the peg.
16 Fit and tighten the driving flange bolts to 10 lbf ft (1.4 kgf m, 14 Nm); ensure that the peg can be withdrawn from the timing hole and lock the bolts with their lockplates.
17 Fit the timing chain, see 12.65.14, but do not connect the battery.
18 Fit the injection pump, see 19.30.07.



5NC 453

OIL PUMP DRIVE SHAFT

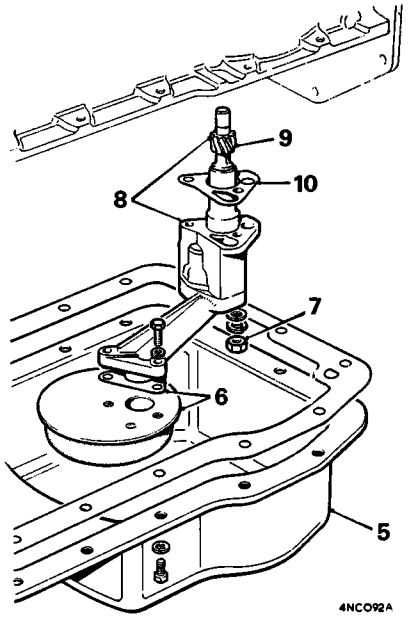
Remove and refit 12.10.30
Oil pump 12.60.26
Oil pick-up strainer 12.60.20

Removing

1 Disconnect the battery.
2 Drain the sump.
3 Disconnect the oil cooler pipe from the L.H. side of the crankcase.
4 Release the oil pipe clip from the gearbox mounting plate and move the oil pipe aside.
5 Remove the sump.
6 Remove the oil strainer and gasket.
7 Remove the three oil pump securing nuts.
8 Withdraw the oil pump and its drive shaft.
9 Withdraw the drive shaft from the oil pump.
10 Remove the oil pump gasket.

Refitting

11 Reverse the procedure in 1 to 10, tightening the oil pump securing nuts to 16 lbf ft (2.2 kgf m, 22 Nm).



4NC092A

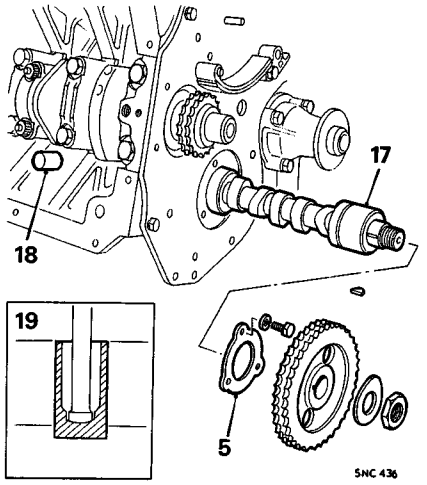
TAPPETS

Remove and refit 12.29.57
Camshaft 1 to 17 and 20 to 32 12.13.02

Service tool: 18G 694

Removing

1 Disconnect the battery.
2 Drain the sump.
3 Remove the engine.
4 Remove the timing chain and the camshaft gear, see 12.65.12.
5 Remove the camshaft locating plate.
6 Remove the fuel lift pump.
7 Remove the rocker cover and gasket.
8 Slacken evenly and remove the eight nuts retaining the rocker shaft brackets.
9 Remove the locking plate from the rocker shaft rear bracket.
10 Remove the rocker shaft assembly and the shim under each centre bracket.
11 Withdraw the push-rods and retain their order for refitting.

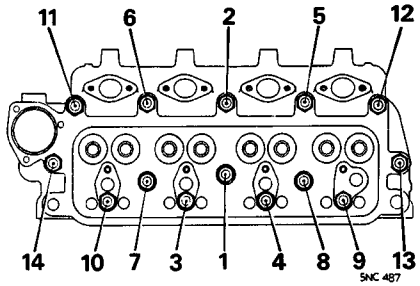


5NC 436

12 Lay the engine on its side with the cylinder head slightly downwards.
13 Withdraw the dipstick.
14 Remove the sump.
15 Remove the oil pump and its drive shaft.
16 Rotate the camshaft to position all the tappets away from their cams.
17 Withdraw the camshaft.
18 Withdraw the tappets and retain their order for refitting.

Refitting

19 Fit the tappets with their open ends towards the cylinder head.
20 Fit the camshaft.
21 Fit the oil pump and its drive shaft, tightening the retaining nuts to 16 lbf ft (2.2 kgf m, 22 Nm).
22 Fit the sump.
23 Fit the dipstick.
24 Place the engine in an upright position.
25 Fit the push-rods.
26 Fit the rocker shaft assembly, noting:
   a Ensure that the shim is fitted under both centre brackets.
   b Fit the locking plate to the rear bracket.
   c Tighten the cylinder head nuts to 75 lbf ft (10.4 kgf m, 102 Nm) in the sequence shown, using tool 18G 694 to reach the centre row.
   d Tighten the rocker bracket nuts to 25 lbf ft (3.5 kgf m, 34 Nm).
27 Fit the fuel lift pump.
28 Fit the camshaft locating plate.
29 Fit the camshaft gear, timing chain, and timing gear cover, see 12.65.12.
   NOTE: Do not leave the crankshaft pulley in position.
30 Adjust the valve rocker clearance, see 12.29.48.
31 Fit the rocker cover and its gasket.
32 Fit the engine.
33 Run the engine for a minimum of 5 miles, 8 km or 15 mins and on return slacken the cylinder head nuts approximately ⅛ of a turn in the sequence shown before retightening them to 75 lbf ft (10.4 kgf m, 102 Nm) in the sequence shown. Check the valve rocker clearances.



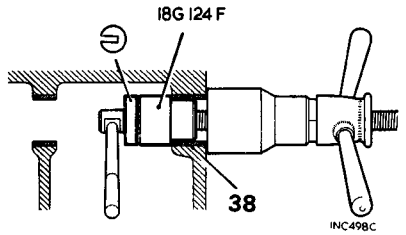
CAMSHAFT BEARINGS – [1]**

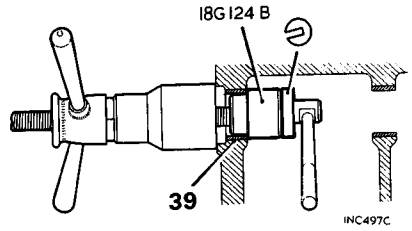
Remove and refit 12.13.13

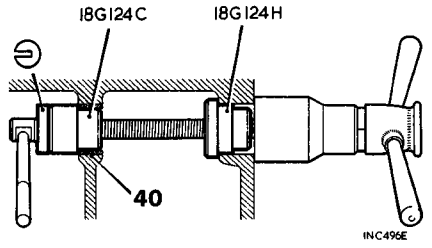
Service tools: 18G 55 A, 18G 123 A, 18G 123 B, 18G 123 E, 18G 123 F, 18G 123 L, 18G 123 T, 18G 123 AB, 18G 123 AC, 18G 123 AD, 18G 124 A, 18G 124 B, 18G 124 C, 18G 124 F, 18G 124 H, 18G 134, 18G 134 CQ, 18G 284, 18G 284 A, 18G 284 AC, 18G 694, 18G 1108, 18G 1195

Removing

1 Disconnect the battery.
2 Drain the sump.
3 Remove the engine.
4 Remove the clutch assembly.
5 Remove the flywheel.
6 Remove the crankshaft rear oil seal retainer.
7 Remove the bolts securing the gearbox adaptor plate and pull the adaptor plate off its two locating dowels.
8 Remove the two adaptor plate gaskets.
9 Remove the alternator.
10 Remove the high-pressure pipes from the injectors and pump.
11 Remove the injection pump drive oil feed pipe.
12 Remove the timing chain and the camshaft gear, see 12.65.12.
13 Remove the camshaft locating plate.
14 Remove the chain vibration damper.
15 Remove the bolt securing each front mounting bracket to the crankcase.
16 Remove the two bolts securing the front mounting plate to the crankcase.
17 Lift off the front mounting plate, complete with injection pump, front mounting brackets, chain tensioner stop-pin, and chain tensioner shoe.
18 Remove the fuel lift pump.
19 Withdraw the dipstick.
20 Release the dipstick tube from the cylinder head nut and withdraw the tube from the crankcase.
21 Disconnect and remove No. 1 heater plug.
22 Remove the rocker cover and gasket.
23 Remove the rocker shaft assembly, noting the locking plate on the rear bracket and the shim under each centre bracket.
24 Withdraw the push-rods, retaining their order for refitting.
25 Remove the cylinder head nuts.
26 Lift off the cylinder head.
   NOTE: The combustion chamber inserts (if fitted) may drop out of the cylinder head as it is lifted; they **MUST** be refitted in their original positions.
27 Remove the cylinder head gasket.
28 Lay the engine on its side with the cylinder head face slightly downwards.
29 Remove the sump.
30 Remove the oil pump and its drive shaft.
31 Remove the big-end bearing caps and bearing halves.
32 Remove the main bearing caps and bearing halves, using tools 18G 284, 18G 284 A, and 18G 284 AC.
33 Lift out the crankshaft and remove the bearing and thrust washer halves.
34 Withdraw the connecting rod and piston assemblies.
35 Rotate the camshaft to position all the tappets away from their cams.
36 Withdraw the camshaft.
37 Withdraw the tappets and retain their order for refitting.
38 Remove the camshaft front bearing liner, using tools 18G 124 A and 18G 124 F as shown.
39 Remove the camshaft rear bearing liner, using tools 18G 124 A and 18G 124 B as shown.
40 Remove the camshaft centre bearing liner, using tools 18G 124 A, 18G 124 C, and 18G 124 H as shown.







** [1] [2] see page 7

continued

Refitting

NOTE: When fitting each new bearing liner ensure that its oil holes are lined up with those in the crankcase.

41 Fit a new camshaft front bearing liner, using tools 18G 124 A and 18G 124 F as shown.

42 Fit a new camshaft rear bearing liner, using tools 18G 124 A and 18G 124 B as shown.

43 Fit a new camshaft centre bearing liner, using tools 18G 124 A, 18G 124 C, and 18G 124 H as shown.

NOTE: Lightly lubricate the arbor before assembling the cutters and pilots to it.

Feed the reamers very slowly and keep the cutters dry.

Keep the cutter flutes clear of swarf during reaming.

44 Ream the front and rear bearing liners using tools 18G 123 A, 18G 123 L, 18G 123 E (in position '10' on the arbor), 18G 123 AB, 18G 123 B (in position '6' on the arbor), and 18G 123 AC as shown.

45 Ream the centre bearing liner, using tools 18G 123 A, 18G 123 T, 18G 123 F (in position '9' on the arbor), and 18G 123 AD as shown.

46 Ensure that the oil holes of the bearing liners are still lined up with those in the crankcase.

47 Thoroughly clean all swarf from the cylinder block and crankcase.

48 Fit the tappets with their open ends towards the cylinder head.

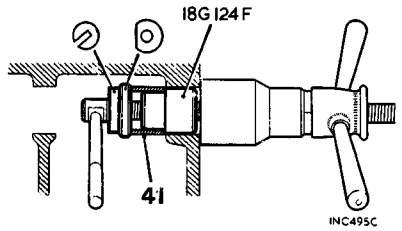
49 Fit the camshaft.

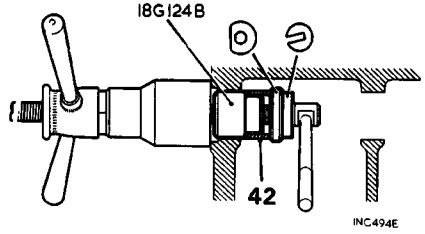
50 Fit the connecting rod and piston assemblies with the combustion cavities on the R.H. side of the engine, using tool 18G 55 A.

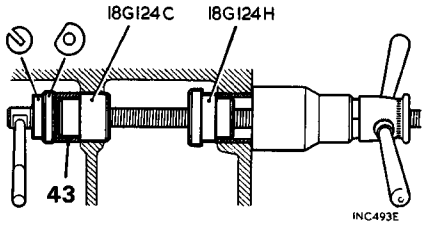
51 Fit the crankshaft main bearings, and thrust washers (grooved side towards the crankshaft) to the crankcase.

52 Fit the main bearing caps, noting:

- a Caps Nos. 2 and 4 are each stamped with their number.
- b Fit caps 2, 3 and 4 with the cast word 'FRONT' towards the front of the engine.
- c Using a straight-edge, align the front and rear bearing caps with the front and rear faces of the crankcase.







- d Tighten the main bearing bolts to 75 lbf ft (10.4 kgf m, 102 Nm).

53 Check the crankshaft end-float against the figure in DATA, and fit alternative thrust washers if necessary.

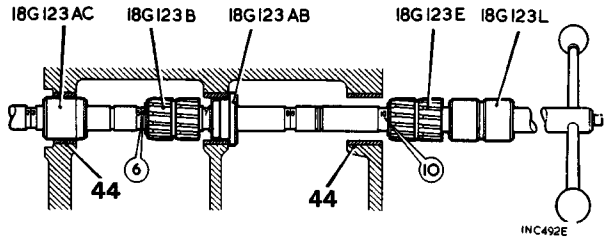
54 Fit the big-end bearings and caps, ensuring that the connecting rod and cap markings are aligned.

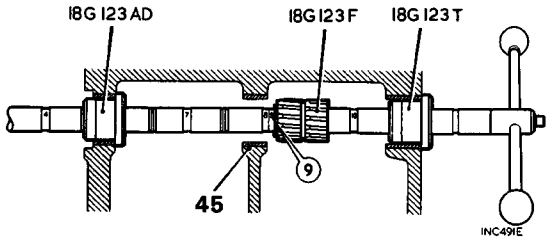
55 Tighten the big-end nuts to 35 lbf ft (4.8 kgf m, 47 Nm).

56 Fit the oil pump and its drive shaft, tightening the retaining nuts to 16 lbf ft (2.2 kgf m, 22 Nm).

57 Soak the cork sealing strips in engine oil, then fit them to the front and rear main bearing caps.

58 Fit the sump.





59 Position the front mounting plate assembly on the engine and locate it by fitting the camshaft locating plate bolts and the chain tensioner retaining screw.

60 Fit the two bolts to secure the mounting plate to the crankcase.

61 Fit the two bolts to secure both front mounting brackets to the crankcase.

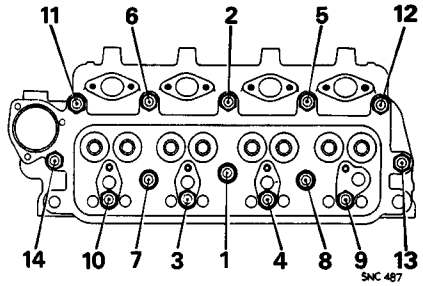
62 Fit the chain vibration damper.

63 Fit the camshaft locating plate.

64 Fit the camshaft gear, timing chain, and timing gear cover, see 12.65.12.

65 Reverse the procedure in 18 to 27, noting:

- a Fit the cylinder head gasket with the face marked 'TOP' uppermost.
- b Ensure that the combustion chamber inserts (if fitted) are flush with the cylinder head face.
- c Leave the cylinder head nuts finger tight until the rocker shaft assembly has been fitted.
- d Tighten the cylinder head nuts to 75 lbf ft (10.4 kgf m, 102 Nm) in the sequence shown, using tool 18G 694 to reach the centre row.



- e Tighten the rocker bracket nuts to 25 lbf ft (3.5 kgf m, 34 Nm).
- f Adjust the valve rocker clearance, see 12.29.48.
- g Apply Loctite to the bottom of the dipstick tube.

66 Reverse the procedure in 4 to 11, noting:

- a Use tools 18G 134 and 18G 134 CQ to fit the new rear oil seal.
- b Use tool 18G 1108 to protect the seal when fitting the adaptor plate.
- c Tighten the adaptor plate bolts to 30 lbf ft (4.2 kgf m, 41 Nm).

NOTE: Fit the two longer bolts in the two top holes.

d Tighten the oil seal retainer bolts to 20 lbf ft (2.8 kgf m, 27 Nm).
e Tighten the flywheel bolts to 40 lbf ft (5.5 kgf m, 54 Nm).
f Fit the clutch driven plate with the 'FLYWHEEL SIDE' marking towards the flywheel, using tool 18G 1195 to centralise the driven plate.

67 Fit the engine.

68 Run the engine for a minimum of 5 miles, 8 km or 15 mins and on return slacken the cylinder head nuts approximately ⅛ of a turn in the sequence shown before retightening them to 75 lbf ft (10.4 kgf m, 102 Nm) in the sequence shown. Check the valve rocker clearances.

DATA

Crankshaft end-float	0.001 to 0.0055 in (0.03 to 0.14 mm)
Thrust washer thicknesses	0.0885 to 0.0905 in (2.25 to 2.30 mm), 0.091 to 0.093 in (2.31 to 2.36 mm) and 0.0935 to 0.0955 in (2.37 to 2.43 mm)

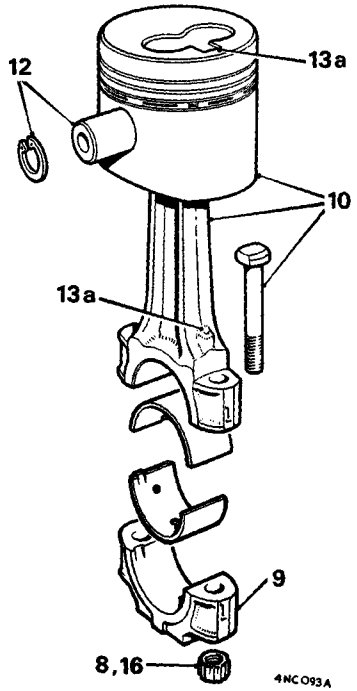
CONNECTING RODS AND PISTONS

Remove and refit 12.17.01

Service tool: 18G 55 A

Removing

1 Disconnect the battery.
2 Drain the sump.
3 Drain the cooling system.
4 Remove the cylinder head gasket, see 12.29.02.
5 Disconnect the oil cooler pipe from the L.H. side of the crankcase.
6 Release the oil cooler pipe clip from the gearbox mounting plate and move the oil pipe aside.
7 Remove the sump.
8 Remove the big-end nuts.
9 Remove the big-end caps and bearing halves.
10 Withdraw the connecting rod and piston assemblies.
11 Mark the pistons and connecting rods for reassembly.
12 Remove the circlips and the gudgeon pins and separate the pistons from the connecting rods.



Refitting

13 Reverse the procedure in 8 to 12, noting:
a Assemble the pistons to the connecting rods with the combustion cavities on the oil hole side of the connecting rods.
b If new piston rings are being used ensure that the ring gaps are correct, see 12.17.10.
c Use tool 18G 55 A to compress the piston rings.
d Fit the connecting rod and piston assemblies with the combustion cavities on the R.H. side of the engine.
14 If the connecting rods or piston(s) have been renewed, rotate the crankshaft and measure the amount by which each piston stands proud of the cylinder block face at T.D.C.
15 If piston stand-proud is outside the limits given in DATA, fit suitable alternative piston(s) from the range available.
NOTE: It is not necessary for the pistons in an engine to be of the same height grade.
16 Tighten the big-end nuts to 35 lbf ft (4.8 kgf m, 47 Nm).
17 Reverse the procedure in 1 to 7.

DATA

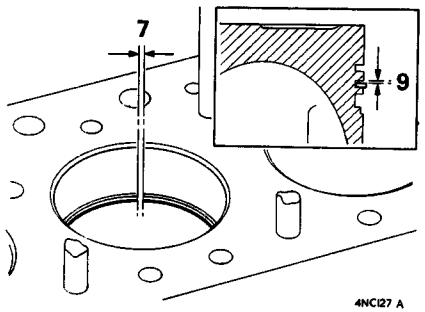
Piston stand-proud	0.013 to 0.021 in (0.33 to 0.53 mm)
Piston compression height	1.977 to 1.979 in (50.22 to 50.27 mm)

CONNECTING RODS AND PISTONS

Overhaul 12.17.10

Connecting rods 1 to 5 and 10 to 12
Pistons 1 to 9 and 12

1 Disconnect the battery.
2 Drain the sump.
3 Drain the cooling system.
4 Remove the cylinder head gasket, see 12.29.02.
5 Remove and separate the connecting rods and pistons, see 12.17.01.
6 Remove the rings from the pistons.
7 Check the piston ring gaps, in an unworn part of the cylinder bore, against the figures in DATA. If necessary, increase the gap(s) by filing the end of the ring(s).
8 Fit the piston rings, noting:
  a Fit the oil control ring expander spring first, ensuring that the latch pin enters both ends of the spring.
  b Fit the oil control ring with its gap 180° from the expander latch pin.
  c Fit the second ring with the word 'TOP' uppermost.



9 Check the piston ring groove clearance against the figures in DATA.
10 Check the gudgeon pin clearance in the connecting rod bush (see DATA). If the clearance is excessive, renew the bush, noting:
  a Position the bush with its hole and oil grooves towards the top.
  b Finish-ream the bush to the dimension given in DATA.
11 Ensure that the connecting rod alignment is within the figure given in DATA.
12 Reverse the procedure in 1 to 5.

DATA

Connecting rod alignment	
Maximum out-of-parallel of big-end and little-end	0.004 in per inch (0.004 cm per cm) effective mandrel length
Connecting rod bush	
Clearance on gudgeon pin	0.0002 to 0.0009 in (0.02 to 0.04 mm)
Inside diameter (reamed after fitting)	1.0002 to 1.0007 in (25.41 to 25.42 mm)
Piston rings	
Fitted gap:	
Top compression	0.012 to 0.017 in (0.30 to 0.43 mm)
Second compression	0.009 to 0.014 in (0.23 to 0.35 mm)
Oil control	0.012 to 0.017 in (0.30 to 0.43 mm)
Ring to groove clearance:	
Top compression	0.0025 to 0.0045 in (0.06 to 0.11 mm)
Second compression	0.0015 to 0.0035 in (0.04 to 0.09 mm)
Oil control	0.0015 to 0.0035 in (0.04 to 0.09 mm)

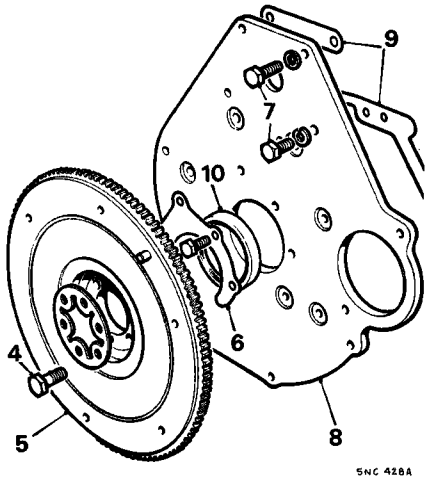
CRANKSHAFT REAR OIL SEAL

Remove and refit 12.21.20
Gearbox adaptor plate 12.53.03
Flywheel 1 to 8 and 15 12.53.07

Service tools: 18G 134, 18G 134 CQ, 18G 1108

Removing
1 Disconnect the battery.
2 Remove the gearbox.
3 Remove the clutch assembly, see 33.10.01.
4 Remove the flywheel securing bolts.
5 Lift off the flywheel.
6 Remove the oil seal retainer.
7 Remove the 10 bolts securing the gearbox adaptor plate.
8 Pull the adaptor plate off its two locating dowels.
9 Remove the two adaptor plate gaskets.
10 Remove the oil seal from the adaptor plate.

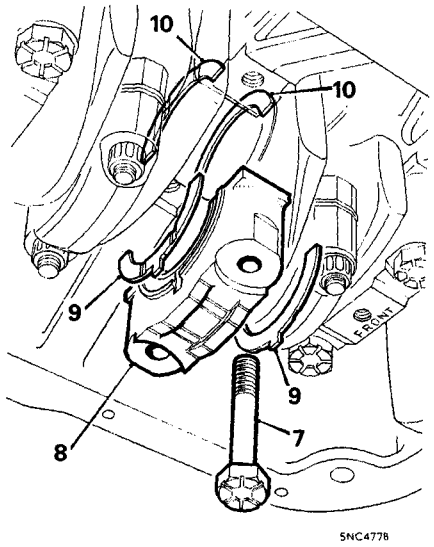
Refitting
11 Fit the new oil seal flush with the rear face of the adaptor plate, using tools 18G 134 and 18G 134 CQ.
12 Reverse the procedure in 1 to 10, noting:
  a Use tool 18G 1108 to protect the oil seal when fitting the adaptor plate.
  b Tighten the adaptor plate bolts to 30 lbf ft (4.2 kgf m, 41 Nm).
  NOTE: Fit the two longer bolts in the two top holes.
  c Tighten the oil seal retainer bolts to 20 lbf ft (2.8 kgf m, 27 Nm).
  d Tighten the flywheel bolts to 40 lbf ft (5.5 kgf m, 54 Nm).



CRANKSHAFT END-FLOAT

Check and adjust 12.21.26

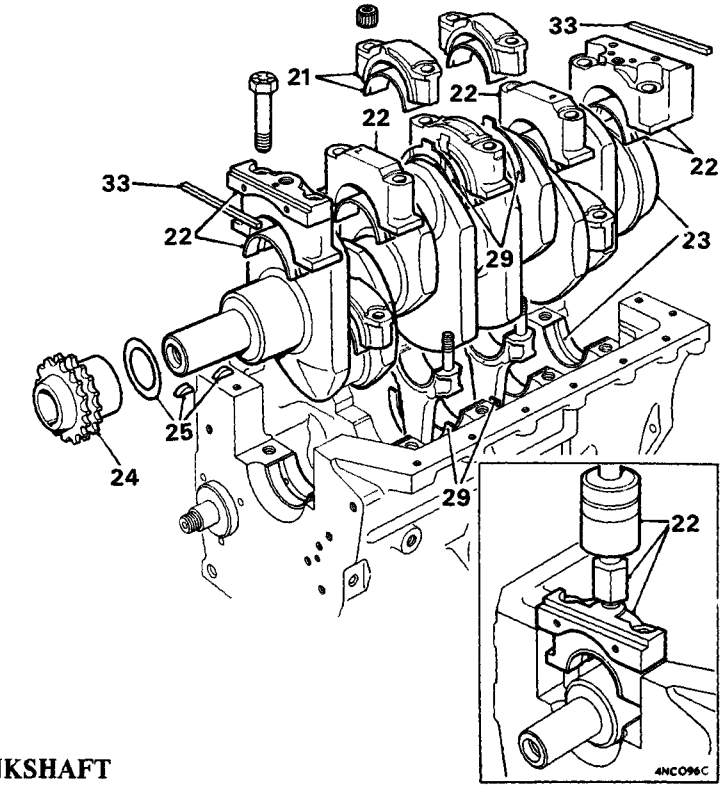
1 Disconnect the battery.
2 Check the crankshaft end-float using a dial gauge against the crankshaft pulley bolt. If end-float is outside the limits given in DATA, change the thrust washers as described in the following paragraphs.
3 Drain the sump.
4 Release the oil pipe clip from the gearbox mounting plate and move the oil pipe aside.
5 Remove the sump.
6 Remove the oil pump and its drive shaft.
7 Remove the two bolts from the centre main bearing cap.
8 Remove the centre main bearing cap.
9 Remove the bottom halves of the thrust washers from the cap or crankshaft.
10 Slide the upper halves of the thrust washers around the crank and remove them.
11 Select a set of thrust washers to give the correct end-float (see DATA).
12 Reverse the procedure in 3 to 10, noting:
   a Fit the thrust washers with their grooved sides towards the crankshaft.
   b Fit the main bearing cap with the 'FRONT' mark towards the front of the engine.



   c Tighten the main bearing cap bolts to 75 lbf ft (10.4 kgf m, 102 Nm).
   d Ensure that the end-float is correct after tightening the main bearing cap bolts.
   e Tighten the oil pump securing nuts to 16 lbf ft (2.2 kgf m, 22 Nm).
13 Connect the battery.

DATA

Crankshaft end-float	0.001 to 0.0055 in (0.03 to 0.14 mm)
Thrust washer thicknesses	0.0885 to 0.0905 in (2.25 to 2.30 mm) 0.091 to 0.093 in (2.31 to 2.36 mm) and 0.0935 to 0.0955 in (2.37 to 2.43 mm)



CRANKSHAFT

Remove and refit 12.21.33

Service tools: 18G 134, 18G 134 CQ, 18G 284, 18G 284 AC, 18G 1108, 18G 1195

Removing

1 Disconnect the battery.
2 Drain the sump.
3 Remove the engine.
4 Remove the clutch assembly.
5 Remove the flywheel.
6 Remove the crankshaft rear oil seal retainer.
7 Remove the bolts securing the gearbox adaptor plate and pull the adaptor plate off its two locating dowels.
8 Remove the two adaptor plate gaskets.
9 Remove the alternator.
10 Disconnect the high-pressure pipes from the injectors.
11 Remove the injection pump drive and feed pipe.
12 Remove the timing chain and the camshaft gear, see 12.65.12.
13 Remove the camshaft locating plate
14 Remove the chain vibration damper
15 Remove the bolt securing each front mounting bracket to the crankcase.
16 Remove the two bolts securing the front mounting plate to the crankcase
17 Lift off the front mounting plate complete with injection pump, front mounting brackets, chain tensioner stop-pin, and chain tensioner shoe.
18 Withdraw the dipstick.
19 Remove the sump.

continued

20 Remove the oil pump and its drive shaft.
21 Remove the big-end bearing caps and bearing halves.
NOTE: If the crankshaft has to be rotated, be careful not to apply any force which could cause damage if a piston touches a valve.
22 Remove the main bearing caps and bearing halves, using tools 18G 284 and 18G 284 AC on the front and rear caps if necessary.
23 Lift out the crankshaft and remove the bearing and thrust washer halves.
24 Remove the crankshaft gear.
25 Remove the crankshaft keys and lift off the shim(s).

Refitting
26 Fit the shim(s), keys and gear to the crankshaft.
27 Fit the crankshaft, main bearings, and thrust washers (grooved side towards the crankshaft) to the crankcase.
28 Fit the main bearing caps, noting:
a Caps Nos. 2 and 4 are each stamped with their number.
b Fit caps 2, 3, and 4 with the cast word 'FRONT' towards the front of the engine.
c Using a straight-edge, align the front and rear bearing caps with the front and rear faces of the crankcase.
d Tighten the main bearing bolts to 75 lbf ft (10.4 kgf m, 102 Nm).
29 Check the crankshaft end-float against the figure in DATA, and fit alternative thrust washers if necessary.
30 Fit the big-end bearings and caps, ensuring that the connecting rod and cap markings are aligned.
31 Tighten the big-end nuts to 35 lbf ft (4.8 kgf m, 47 Nm).
32 Fit the oil pump and its drive shaft, tightening the retaining nuts to 16 lbf ft (2.2 kgf m, 22 Nm).
33 Soak the cork sealing strips in engine oil, then fit them to the front and rear main bearing caps.
34 Fit the sump.
35 Fit the dipstick.
36 Position the front mounting plate assembly on the engine and locate it by fitting the camshaft locating plate bolts and the chain tensioner retaining screw.
37 Fit the two bolts to secure the front mountig plate to the crankcase.
38 Fit the two bolts to secure both front mounting plate to the crankcase.
39 Fit the chain vibration damper.
40 Fit the camshaft locating plate.
41 Fit the camshaft gear, timing chain, and timing gear cover, see 12.65.12.
NOTE: Do not leave the crankshaft pulley in position.
42 Reverse the procedure in 4 to 11, noting:
a Use tools 18G 134 and 18G 134 CQ to fit the new rear oil seal.
b Use tool 18G 1108 to protect the seal when fitting the adaptor plate.
c Tighten the adaptor plate bolts to 30 lbf ft (4.2 kgf m, 41 Nm).
NOTE: Fit the two longer bolts in the two top holes.
d Tighten the oil seal retainer bolts to 20 lbf ft (2.8 kgf m, 27 Nm).
e Tighten the flywheel bolts to 40 lbf ft (5.5 kgf m, 54 Nm).
f Fit the clutch driven plate with the 'FLYWHEEL SIDE' marking towards the flywheel, using tool 18G 1195 to centralize the driven plate.
43 Fit the engine.

DATA

Main journal diameter	2.1262 to 2.1270 in (54.01 to 54.03 mm)
Crankpin diameter	1.8759 to 1.8764 in (47.64 to 47.65 mm)
Clearance in bearings (journals and crankpin)	0.001 to 0.0027 in (0.03 to 0.07 mm)
Crankshaft end-float	0.001 to 0.0055 in (0.03 to 0.14 mm)
Thrust washer thicknesses	0.0885 to 0.0905 in (2.25 to 2.30 mm), 0.091 to 0.093 in (2.31 to 2.36 mm) and 0.0935 to 0.0955 in (2.37 to 2.43 mm)

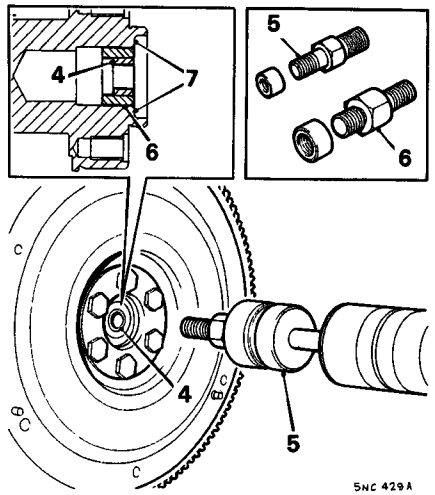
CRANKSHAFT SPIGOT BUSH

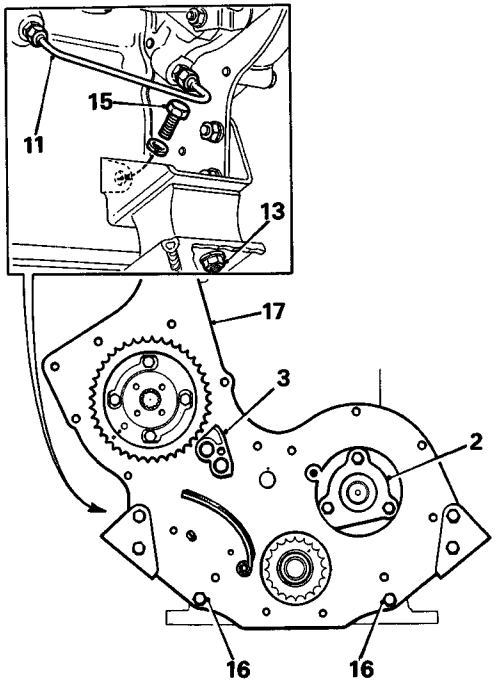
Remove and refit 12.21.45

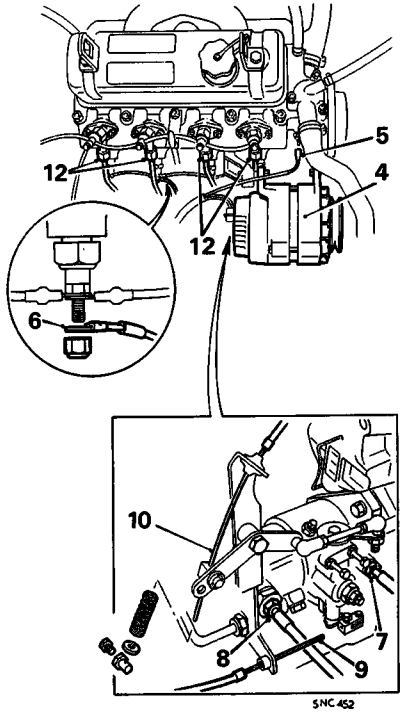
Service tools: 18G 284, 18G 284 AAF

Removing
1 Disconnect the battery.
2 Remove the gearbox, see 37.20.01.
3 Remove the clutch assembly, see 33.10.01.
4 Cut a thread in the spigot bush, using a $\frac{5}{16}$ in U.N.F. tap.
5 Remove the bush, using tool 18G 284 and the appropriate adaptor 18G 284 AAF.
6 If the spigot bush is a composite type, remove the larger (steel) bush by repeating operations 4 and 5 using a ½ in B.S.P. threadform tap.

Refitting
7 Fit the new spigot bush flush with the crankshaft counterbore.
8 Reverse the procedure in 1 to 3.







ENGINE FRONT MOUNTING PLATE GASKET

Remove and refit 12.25.10

Removing

1 Remove the timing chain and the camshaft gear, see 12.65.12.
2 Remove the camshaft locating plate.
3 Remove the chain vibration damper.
4 Remove the alternator.
5 Disconnect the thermal transmitter and move the wiring harness aside.
6 Disconnect the supply lead from the heater plugs.
7 Disconnect the fuel return pipe from the injection pump.
8 Disconnect the fuel supply pipe from the injection pump.
9 Disconnect the stop control cable from the injection pump.
10 Disconnect the throttle cable from the injection pump bracket and bell-crank lever.
11 Remove the injection pump drive oil feed pipe.
12 Disconnect the high-pressure pipes from the injectors.
13 Remove the nuts and washers from the underside of both engine front mountings.
14 Raise the engine sufficiently to clear the lower studs in the front mountings.
15 Remove the bolt securing each front mounting bracket to the crankcase.
16 Remove the two bolts and washers securing the front mounting plate to the crankcase.
17 Lift off the front mounting plate, complete with injection pump, front mountings, chain tensioner stop-pin, and chain tensioner shoe.
18 Remove the front mounting plate gasket.

Refitting

19 Fit the front mounting plate gasket.
20 Position the front mounting plate assembly on the engine and locate it by fitting the camshaft locating plate bolts and the chain tensioner retaining screw.
21 Reverse the procedure in 1 to 16, noting:
   a With the throttle cable connected to the inner hole in the bell-crank lever, ensure that the injection pump throttle lever is operated through its full range of movement by the throttle pedal.
   b When the stop control cable is connected, ensure that the stop control has sufficient travel to permit removal of the master/starter switch key.
22 Bleed the fuel system, see 19.50.07.

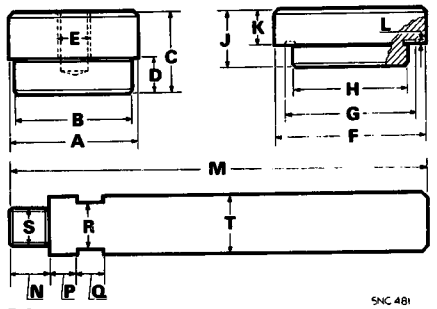
CYLINDER LINERS

Remove and refit 12.25.26

NOTE: If the condition of the cylinder bores is such that they cannot be cleaned up to accept oversize pistons, dry cylinder liners can be fitted (see DATA).

Pilots should be made to the dimensions given, from case-hardening steel and case-hardened.

The pilot extension should be made from 55-ton hardening and tempering steel, hardened in oil, and then tempered at 550°C (1020°F).

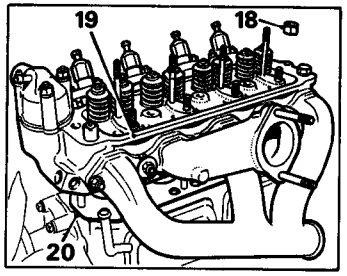


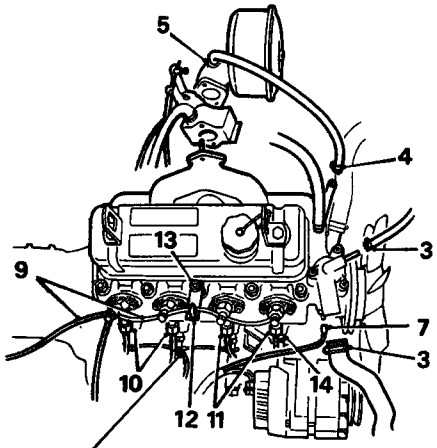
Pilots

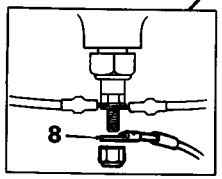
Pressing-out pilot:	A.	3.25 $^{-0.005}_{-0.000}$ in (82.55 $^{-0.13}_{-0.00}$ mm)
	B.	3.157 $^{+0.000}_{-0.005}$ in (80.19 $^{+0.00}_{-0.13}$ mm)
	C.	1.75 in (44.45 mm)
	D.	0.75 in (19 mm)
	E.	¾ in B.S.W. thread
Pressing-in pilot:	F.	3.625 in (92.07 mm
	G.	3.312 in (84.14 mm
	H.	3.133 $^{+0.000}_{-0.005}$ in (79.58 $^{+0.00}_{-0.13}$ mm)
	J.	1.25 in (31.75 mm)
	K.	0.75 in (19 mm)
	L.	0.015 in (0.38 mm)
Pilot extension:	M.	14.50 in (36.83 cm)
	N.	0.875 in (22.22 mm
	P.	0.625 in (15.87 mm
	Q.	0.625 in (15.87 mm
	R.	Two flats 1 in (25.4 mm) across
	S.	¾ in B.S.W. thread
	T.	1.25 in (31.75 mm)

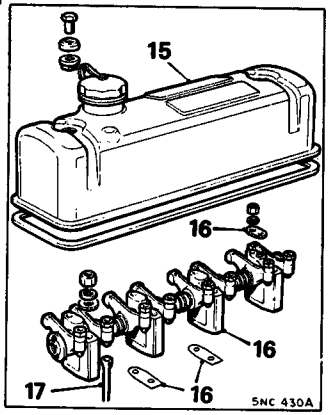
DATA

Cylinder block	
Bore: Standard	3.1595 to 3.1606 in (80.25 to 80.28 mm)
Oversize maximum (without cylinder liner)	0.040 in (1.02 mm)
To accept cylinder liner	3.2615 to 3.2620 in (82.84 to 82.86 mm)
Cylinder liners	
Outside diameter	3.2645 to 3.2660 in (82.92 to 82.96 mm)
Bore: Standard (machined after fitting)	3.1595 to 3.1606 in (80.25 to 80.28 mm)
Oversize (maximum)	0.020 in (0.51 mm)









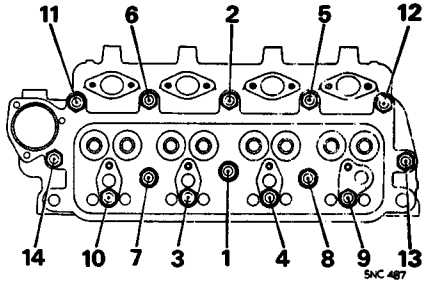
CYLINDER HEAD GASKET

Remove and refit 12.29.02

Service tool: 18G 694

Removing

1 Disconnect the battery.
2 Drain the cooling system.
3 Disconnect both hoses from the water outlet elbow.
4 Disconnect the breather hose from the cylinder side cover.
5 Remove the air cleaner and elbow.
6 Remove the clamp and separate the exhaust pipe from the manifold.
7 Disconnect the lead from the thermal transmitter.
8 Disconnect the supply lead from the heater plugs.
9 Disconnect the spill rail and return pipe from the injectors and lay the spill rail aside.
10 Remove Nos. 3 and 4 injector pipes.
11 Remove Nos. 1 and 2 injector pipes.
12 Remove the oil dipstick.
13 Release the dipstick tube from the cylinder head nut and withdraw the tube from the crankcase.
14 Disconnect and remove No. 1 heater plug.
15 Remove the rocker cover and gasket.
16 Remove the rocker shaft assembly, noting the locking plate on the rear bracket and the shim under each centre bracket.
17 Withdraw the push-rods, retaining their order for refitting.
18 Remove the cylinder head nuts.
19 Lift off the cylinder head.
NOTE: The combustion chamber inserts (if fitted) may drop out of the cylinder head as it is lifted; they **MUST** be refitted in their original positions.
20 Remove the cylinder head gasket.



Refitting

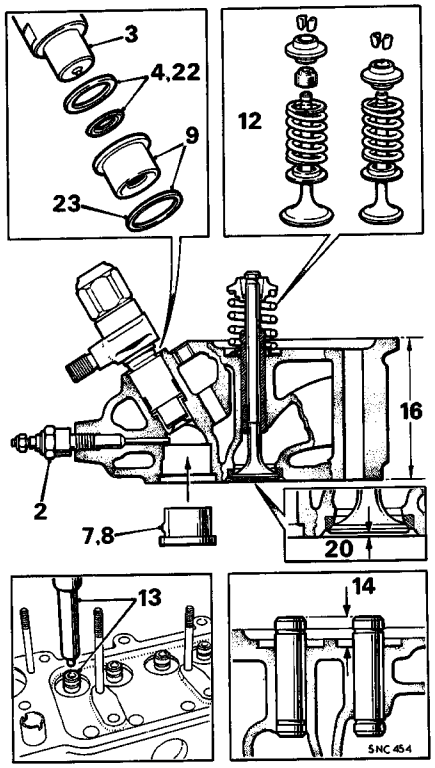
21 Reverse the procedure in 1 to 20, noting:
a Fit the cylinder head gasket with the face marked 'TOP' uppermost.
b Ensure that the combustion chamber inserts (if fitted) are flush with the cylinder head face.
c Leave the cylinder head nuts finger tight until the rocker shaft assembly has been fitted.
d Tighten the cylinder head nuts to 75 lbf ft (10.4 kgf m, 102 Nm) in the sequence shown, using tool 18G 694 to reach the centre row.
e Tighten the rocker brackets nuts to 25 lbf ft (3.5 kgf m, 34 Nm).
f Adjust the valve rocker clearance, see 12.29.48.
g Bleed the fuel system, see 19.50.05.
h Apply Loctite to the bottom of the dipstick tube.
22 Run the engine for a minimum of 5 miles, 8 km or 15 mins and on return slacken the cylinder head nuts approximately ¼ of a turn in the sequence shown before retightening them to 75 lbf ft (10.4 kgf m, 102 Nm) in the sequence shown. Check the valve rocker clearances.

CYLINDER HEAD

Overhaul **12.29.19**

Service tools: 18G 27 or MS 76, 18G 29, 18G 45 (18G 167, 18G 167 A and 18G 167 B) or MS 204, 18G 167 C (18G 174, 18G 174 A and 18G 174 B) or MS 621, 18G 174 D or MS 150-8.5, 18G 284, 18G 284 P

1 Remove the cylinder head gasket, see 12.29.02.
2 Remove the three remaining heater plugs from the cylinder head.
3 Remove the injectors, using tools 18G 284, and 18G 284 P.
4 Remove the two sealing washers from each injector position.
5 Remove the heater hose from the cylinder head.
6 Remove the manifolds and gasket.
7 Mark the combustion chamber inserts for refitting in their original positions.
8 Remove the combustion chamber inserts, if necessary using a soft drift through the injector holes.
9 Push out the injector heat shields and their sealing washers.
10 Remove the water outlet elbow and its gasket.
11 Lift out the thermostat.
12 Remove the valves and their components, using tool 18G 45.
NOTE: Seals are fitted to the inlet valve guides.
13 If the valve guides are worn (see DATA), press them out in the direction of the valve seats.
14 To fit new valve guides, press them in from the top of the cylinder head until they protrude by the amount stated in DATA. Protrusion is measured from the top of the valve guide to the bottom of the counter bore for the valve spring.
15 Ream new valve guides to the size given in DATA, recut the valve seats and grind in the valves.
16 Check the cylinder head face for flatness and, if necessary, reface the cylinder head without reducing its depth below the figure given in DATA.
NOTE: The combustion chamber



inserts (if fitted) must be faced level with the cylinder head.
17 If necessary, reface the valves to the angle given in DATA, removing the minimum of material.
18 If necessary, recut the valve seats in the cylinder head, using the following tools:
NOTE: Adjustable valve seat cutters MS 204 (exhaust), MS 621 (inlet) and expandable pilot MS 150-8.5, together with basic handle set MS 76, can be used as alternatives to the following glazing, cutting and narrowing tools.
a 18G 27 Handle.
b 18G 174 D Pilot.
c 18G 174 A Glaze breaker for inlet seats.
d 18G 174 Cutter for inlet seats.
e 18G 174 B Top narrowing cutter for inlet seats.
f 18G 174 C Bottom narrowing cutter for inlet seats.
g 18G 167 A Glaze breaker for exhaust seats.
h 18G 167 Cutter for exhaust seats.
j 18G 167 B Top narrowing cutter for exhaust seats.
k 18G 167 C Bottom narrowing cutter for exhaust seats.
19 Lap the valves onto their seats, using tool 18G 29.
20 Check that the valve stand-down is within the limits given in DATA.
21 Renew the valve springs if they are not as specified in DATA.
22 Renew the sealing washers for the injectors.
23 Renew the sealing washers for the injector heat shields.
24 Reverse the procedure in 1 to 12.

DATA

Cylinder head	
Depth after refacing	3.16 in (80.26 mm) minimum
Valve guides	
Inside diameter (reamed after fitting)	0.3441 to 0.3448 in (8.74 to 8.76 mm)
Protrusion (from bottom of counterbore)	0.550 to 0.560 in (13.97 to 14.22 mm)
Valves	
Seat angle	45°
Stand down: [1] **	0.0445 to 0.0505 in (1.13 to 1.28 mm)
[2] **	0.02 to 0.03 in (0.508 to 0.762 mm)
Stem diameter: Inlet	0.3428 to 0.3422 in (8.71 to 8.73 mm)
Exhaust	0.3422 to 0.3427 in (8.69 to 8.70 mm)
Valve springs	
Free length (approximate)	1 $\frac{29}{32}$ in (48.75 mm)
Load when compressed to 1.44 in (36.58 mm)	82 lbf, 37.20 kgf, 364 N

** [1] [2] see page 7