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# SERVICE MANUAL

## PERKINS DIESEL ENGINE 4.2032

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# **workshop manual for 4.2032 diesel engines**

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**Perkins Engines Limited**  
Peterborough England

1979

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This publication is written for world wide use. In territories where legal requirements govern engine smoke emission, noise, safety factors etc., then all instructions, data and dimensions given must be applied in such a way that, after servicing (preventive maintenance) or repairing an engine, it does not contravene the local regulations when in use.

## PERKINS COMPANIES

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## ASSOCIATE COMPANIES & MANUFACTURING LICENSEES

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<b>KOREA</b>	Hyundai Motor Co. Ltd. Hyundai Building, 178 Sejong-Ro, Jongro-Ku, Seoul, Korea. Telephone: 74-8311 and 75-6511. Telex: Hdmoco K2391.
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<b>PERU</b>	Motores Diesel Andinos S.A. Antero Aspillaga No. 585, Apartado 111 79, Lima 14, Peru. Telephone: 406882. Telex: 21076.
<b>SINGAPORE</b>	Perkins Engines Eastern Ltd. 549 Upper Thomson Road, Singapore 20. Telephone: 4524471/4521841. Telex: Perkoil R23360.
<b>SPAIN</b>	Motor Iberica S.A. (Division Zona 2) Carretera del Aero-Club, Carabanchel Alto, Madrid, Spain. Telephone: 203 52-40, 208 96-40, 208 98-40. Telex: 27324. Cables: 'Perki-e' Madrid.
<b>URUGUAY</b>	Perkins Rio de la Plata S.A. Av. Juan Carlos Gomez 1492, Montevideo, Uruguay. Telephone: 290-726. Telex: 278.
<b>YUGOSLAVIA</b>	Industrija Motora Rakovica Patrijarha Dimitrija 7-13 Rakovica, Belgrade, Yugoslavia. Telephone: 562-043/562-322/562-992. Telex: 11341 YU IMR. Cables: 'Indmotor' Beograd.

In addition to the above, there are Perkins Distributors in the majority of countries throughout the world. For further details, apply to Perkins Engines Ltd., Peterborough, or to one of the above companies.

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## FOREWORD

This Workshop Manual has been compiled for use in conjunction with normal workshop practice. Mention of certain accepted practices, therefore, has been purposely omitted in order to avoid repetition.

Reference to renewing joints and cleaning off joint faces, has not always been made as it is understood that this will be carried out where applicable.

Similarly, it is understood that in re-assembly and inspection, all parts are to be thoroughly cleaned, and burrs and scale are to be removed if necessary.

All open ports of high precision components, e.g. fuel injection equipment, exposed by dismantling, should be blanked off until re-assembled, to prevent the ingress of dust and dirt.

Throughout this manual, whenever "left" or "right" hand side of the engine is referred to, it is that side of the engine when viewed from the flywheel end.

### Running in Procedure

It is not necessary to gradually run-in a new or factory rebuilt engine and any prolonged light load running during the early life of the engine can in fact prove harmful to the bedding in of piston rings and liners.

Full load can be applied on a new or factory rebuilt engine as soon as the engine is used, **provided that the engine is first allowed to reach a coolant temperature of at least 140° F (60° C).**

### SERVICE LITERATURE

Other service literature is available from your normal source of supply at a nominal charge.

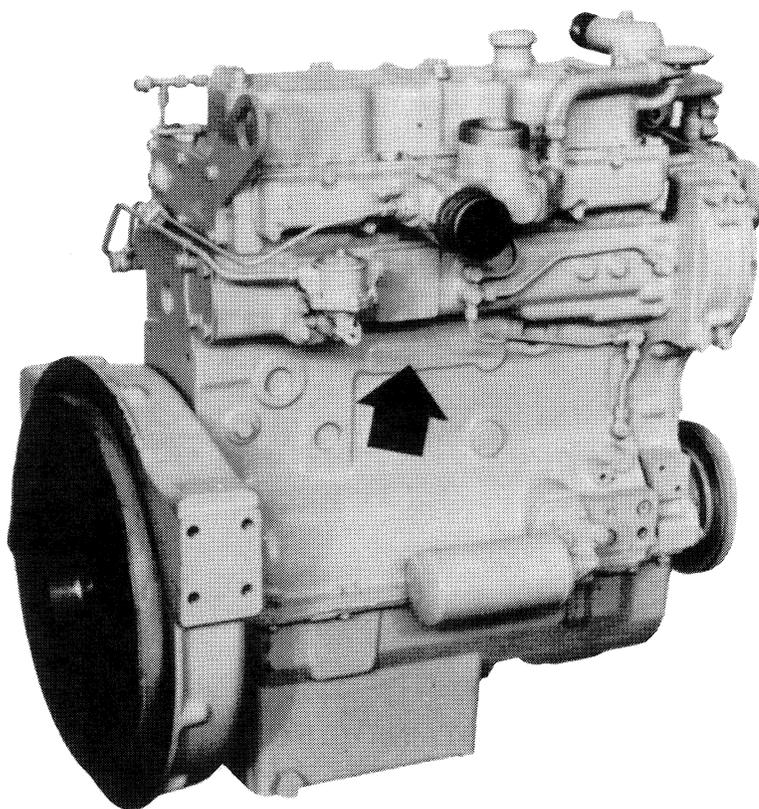
Users Handbooks by engine family.

Fault Finding Guide — all engines.

Engine Brake Testing Data.

## ENGINE NUMBER

When entering into any correspondence or discussions concerning this engine, always quote the full engine number which is to be found stamped on a machined face in the middle of the right hand side of the cylinder block just below the camshaft tunnel, see below.



This Publication is produced by the Service Publications Department of Perkins Engines Ltd., and every endeavour is made to ensure that the information contained in this Manual is correct at the date of publication but due to continuous developments, the manufacturers reserve the right to make alterations without notice.

**USE ONLY  
GENUINE  
PERKINS PARTS**

TO ENSURE YOU OBTAIN THE BEST RESULTS FROM YOUR ENGINE AND TO SAFEGUARD YOUR OWN GUARANTEE, FIT ONLY GENUINE PERKINS PARTS. THESE ARE READILY OBTAINABLE THROUGHOUT THE WORLD.

# **SECTION A**

## **Technical Data**

## TECHNICAL DATA — A.2

Type	Four Cylinder, Four Stroke
Combustion System	Direct Injection
Bore	3.6 in (91,44 mm)*
Stroke	5 in (127 mm)
Cubic Capacity	203 in <sup>3</sup> (3,33 Litres)
Compression Ratio	19:1
Firing Order	1, 3, 4, 2.
Tappet Clearance (cold)	
inlet	0.008 in (0,20 mm)
exhaust	0.012 in (0,30 mm)

\*Nominal — for actual bore size, refer to inside diameter of finished liner. Page A.3.

### Engine Ratings

Standard	60 bhp (44,7 kW) at 2,600 rev/min
Maximum Torque	156 lbf ft (21,5 kgf m or 210 Nm) at 1,500 rev/min
Alternative Rating	52 bhp (39 kW) at 2,600 rev/min
Maximum Torque	141 lbf ft (19,5 kgf m or 190 Nm) at 1,500 rev/min

### Recommended Torque Tensions

	lbf ft	kgf m	Nm
Cylinder Head Nuts and Setscrews	70	9,68	95
Connecting Rod Nuts	45	6,2	60
Main Bearing Setscrews	115	15,9	155
Camshaft Gear to Camshaft Setscrew	21	2,9	28
Idle Gear Hub Nuts	21	2,9	28
Flywheel Setscrews	80	11,1	110
Water Pump Pulley Retaining Nut	55	7,6	75
Crankshaft Pulley Retaining Setscrew	110	15,2	150
Atomiser Securing Nuts	12	1,6	15
High Pressure Fuel Pipe Nuts	15	2,1	20
Thermostart	10	1,4	13,6
Thermostart Adaptor (where fitted)	10	1,4	13,6

### Engine Weights, Dry

Engines with standard basic accessories, i.e. water pump, fuel pump and alternator	520 lb — 236 kg
Typical weight, dry, of standard basic engines plus flywheel, housing, starter motor, air cleaner, fan and filters	745 lb — 338 kg

Altitude	Maximum fuel delivery de-rating*
0 — 2,000 ft ( 600 metre)	No change
2,000 — 4,000 ft (1,200 metre)	6%
4,000 — 6,000 ft (1,800 metre)	12%
6,000 — 8,000 ft (2,400 metre)	18%
8,000 — 10,000 ft (3,000 metre)	24%
10,000 — 12,000 ft (3600 metre)	30%

### De-Rating for Altitude

Where engines are called upon to operate in rarefied atmospheres occasioned by altitude, such engines should be de-rated.

The following table is given as a general guide which may be applied on a percentage basis where specific figures for a particular engine rating are not available.

\*Measured at the pump setting speed as given in the Fuel Pump Setting Code.

Any necessary adjustments in this respect to the fuel pump should be carried out by the C.A.V. dealer for the territory concerned.

For any further information, apply to Service Department, Perkins Engines Ltd., Peterborough, or to those Overseas Companies listed on page 2.

**MANUFACTURING DATA & DIMENSIONS**

The data regarding clearances and tolerances are given as a guide for personnel engaged upon major overhauls and the figures given are those used in the factory for production purposes.

**Cylinder Block**

Height of Cylinder Block between Top and Bottom Faces	...	...	...	...	13.7405/13.7435 in (349,01/349,08 mm)
Parent Bore Diameter for Cylinder Liner	...	...	...	...	3.6875/3.6885 in (93,66/93,69 mm)
Depth of Recess for Liner Flange	...	...	...	...	0.148/0.152 in (3,76/3,86mm)
Dia. of Recess for Liner Flange	...	...	...	...	3.820/3.825 in (97,03/97,16 mm)
Main Bearing Parent Bore	...	...	...	...	2.9165/2.9175 in (74,08/74,10 mm)
No. 1 Bore (bushed) for camshaft	...	...	...	...	1.872/1.874 in (47,55/47,60 mm)
No. 2 Bore for Camshaft	...	...	...	...	1.864/1.867 in (47,34/47,42 mm)
No. 3 Bore for Camshaft	...	...	...	...	1.844/1.847 in (46,84/46,91 mm)

**Cylinder Liners**

Type	...	...	...	...	...	Dry — Transition Fit
Outside Diameter of Liner	...	...	...	...	...	3.6875/3.6885 in (93,66/93,69 mm)
Transition Fit in Cylinder Block	...	...	...	...	...	0.001/0.001 in (0,03/0,03 mm)
Flange Thickness	...	...	...	...	...	0.148/0.150 in (3,76/3,81 mm)
Outside Diameter of Flange	...	...	...	...	...	3.803/3.808 in (96,60/96,72 mm)
Depth of Liner Flange relative to Top Face of Cylinder Block	...	...	...	...	...	+ 0.002/- 0.004 in (+ 0,05/- 0,10 mm)
Inside Diameter of Finished Liner in Cylinder Block	...	...	...	...	...	3.6015/3.6025 in (91,48/91,50 mm)

**Service Cast Iron**

Type	...	...	...	...	...	Dry — Interference Fit
Outside Diameter of Liner	...	...	...	...	...	3.6895/3.6905 in (93,71/93,74 mm)
Interference Fit of Liner in Cylinder Block	...	...	...	...	...	0.001/0.003 in (0,03/0,08 mm)
Flange Thickness	...	...	...	...	...	0.148/0.150 in (3,76/3,81 mm)
Outside Diameter of Flange	...	...	...	...	...	3.803/3.808 in (96,60/96,72 mm)
Depth of Liner Flange Relative to Top Face of Cylinder Block	...	...	...	...	...	+ 0.002 in/- 0.004 in (+ 0,05/- 0,10 mm)
Inside Diameter of Finished Liner in Cylinder Block	...	...	...	...	...	3.6015/3.6025 in (91,48/91,50 mm)

**Cylinder Liners**

Type	...	...	...	...	...	Re-Entrant Chamber in Crown (Squish Lip)
Overall Height — Skirt to Crown	...	...	...	...	...	4.308/4.310 in (109,42/109,47 mm)
“H” Grade (see Page D.5)	...	...	...	...	...	4.3032 in (109,30 mm)
“L” Grade (see Page D.5)	...	...	...	...	...	
Centre Line of Gudgeon Pin to Crown	...	...	...	...	...	2.4329/2.4349 in (61,80/61,85 mm)
“H” Grade (see Page D.5)	...	...	...	...	...	2.4274/2.4289 in (61,66/61,69 mm)
“L” Grade (see Page D.5)	...	...	...	...	...	3.5975 in (91,38 mm)
Skirt Diameter— across Thrust	...	...	...	...	...	
Height in relation to Cylinder Block	...	...	...	...	...	0.0065 in (0,17 mm) BELOW to 0.0012 in (0,03 mm) ABOVE
Top Face	...	...	...	...	...	
Bore Diameter for Gudgeon Pin	...	...	...	...	...	1.2499/1.2501 in (31,747/31,753 mm)
Compression Ring Groove Width— No. 1	...	...	...	...	...	0.0957/0.0977 in (2,43/2,48 mm)
Compression Ring Groove Width— Nos. 2 and 3	...	...	...	...	...	0.0957/0.0967 in (2,43/2,46 mm)
Scraper Ring Groove Width	...	...	...	...	...	0.1895/0.1905 in (4,81/4,84 mm)

**Production Cast Iron**

Type	...	...	...	...	...	Re-Entrant Chamber in Crown (Squish Lip)
Overall Height — Skirt to Crown	...	...	...	...	...	4.308/4.310 in (109,42/109,47 mm)
“H” Grade (see Page D.5)	...	...	...	...	...	4.3032 in (109,30 mm)
“L” Grade (see Page D.5)	...	...	...	...	...	
Centre Line of Gudgeon Pin to Crown	...	...	...	...	...	2.4329/2.4349 in (61,80/61,85 mm)
“H” Grade (see Page D.5)	...	...	...	...	...	2.4274/2.4289 in (61,66/61,69 mm)
“L” Grade (see Page D.5)	...	...	...	...	...	3.5975 in (91,38 mm)
Skirt Diameter— across Thrust	...	...	...	...	...	
Height in relation to Cylinder Block	...	...	...	...	...	0.0065 in (0,17 mm) BELOW to 0.0012 in (0,03 mm) ABOVE
Top Face	...	...	...	...	...	
Bore Diameter for Gudgeon Pin	...	...	...	...	...	1.2499/1.2501 in (31,747/31,753 mm)
Compression Ring Groove Width— No. 1	...	...	...	...	...	0.0957/0.0977 in (2,43/2,48 mm)
Compression Ring Groove Width— Nos. 2 and 3	...	...	...	...	...	0.0957/0.0967 in (2,43/2,46 mm)
Scraper Ring Groove Width	...	...	...	...	...	0.1895/0.1905 in (4,81/4,84 mm)

**Pistons**

Type	...	...	...	...	...	Re-Entrant Chamber in Crown (Squish Lip)
Overall Height — Skirt to Crown	...	...	...	...	...	4.308/4.310 in (109,42/109,47 mm)
“H” Grade (see Page D.5)	...	...	...	...	...	4.3032 in (109,30 mm)
“L” Grade (see Page D.5)	...	...	...	...	...	
Centre Line of Gudgeon Pin to Crown	...	...	...	...	...	2.4329/2.4349 in (61,80/61,85 mm)
“H” Grade (see Page D.5)	...	...	...	...	...	2.4274/2.4289 in (61,66/61,69 mm)
“L” Grade (see Page D.5)	...	...	...	...	...	3.5975 in (91,38 mm)
Skirt Diameter— across Thrust	...	...	...	...	...	
Height in relation to Cylinder Block	...	...	...	...	...	0.0065 in (0,17 mm) BELOW to 0.0012 in (0,03 mm) ABOVE
Top Face	...	...	...	...	...	
Bore Diameter for Gudgeon Pin	...	...	...	...	...	1.2499/1.2501 in (31,747/31,753 mm)
Compression Ring Groove Width— No. 1	...	...	...	...	...	0.0957/0.0977 in (2,43/2,48 mm)
Compression Ring Groove Width— Nos. 2 and 3	...	...	...	...	...	0.0957/0.0967 in (2,43/2,46 mm)
Scraper Ring Groove Width	...	...	...	...	...	0.1895/0.1905 in (4,81/4,84 mm)

## TECHNICAL DATA — A.4

### Piston Rings

Top Compression	...	...	...	...	Parallel Faced, Chrome Inserted, Copper Plated
2nd and 3rd Compression	...	...	...	...	Internally Stepped, Copper Plated
4th Oil Control	...	...	...	...	Conformable, Chrome Plated, Spring Loaded Slotted Scraper
Top—2nd and 3rd Width	...	...	...	...	0.0928/0.0938 in (2,36/2,38 mm)
Top Ring Clearance in Groove	...	...	...	...	0.0019/0.0049 in (0,05/0,13 mm)
2nd and 3rd Ring Clearance in Groove	...	...	...	...	0.0019/0.0039 in (0,05/0,10 mm)
4th Ring Width	...	...	...	...	0.1865/0.1875 in (4,74/4,76 mm)
4th Ring Clearance in Groove	...	...	...	...	0.002/0.004 in (0,05/0,10 mm)
Ring Gap— No. 1	...	...	...	...	0.012/0.026 in (0,30/0,66 mm) with Copper Plating
...	...	...	...	...	0.015/0.032 in (0,38/0,81 mm) without Copper Plating
Ring Gap— Nos. 2 and 3	...	...	...	...	0.008/0.022 in (0,20/0,56 mm) with Copper Plating
...	...	...	...	...	0.011/0.028 in (0,28/0,71 mm) without Copper Plating
Ring Gap— No. 4	...	...	...	...	0.014/0.027 in (0,36/0,69 mm)

Ring gaps given are for when checking in an unworn portion of the cylinder bore. Compression rings are copper plated for running-in purposes, (see D.6).

### Gudgeon Pin

Type	...	...	...	...	Fully Floating
Outside Diameter	...	...	...	...	1.24975/1.250 in (31,74/31,75 mm)
Fit in Piston Boss	...	...	...	...	Transition
Clearance in Small End Bush	...	...	...	...	0.0005/0.00175 in (0,01/0,04 mm)
Length	...	...	...	...	2.9606/2.9646 in (75,2/75,3 mm)

### Small End Bush

Type	...	...	...	...	Steel Backed, Lead Bronze Lined
Outside Diameter	...	...	...	...	1.3785/1.380 in (35,01/35,05 mm)
Length	...	...	...	...	1.0475/1.0575 in (26,61/26,86 mm)
Inside Diameter after Reaming	...	...	...	...	1.2505/1.2515 in (31,76/31,79 mm)

### Connecting Rod

Type	...	...	...	...	"H" Section
Big End Parent Bore Diameter	...	...	...	...	2.395/2.3955 in (60,83/60,85 mm)
Small End Parent Bore Diameter	...	...	...	...	1.37475/1.3762 in (34,92/34,95 mm)
Big End Width	...	...	...	...	1.5502/1.5525 in (39,37/39,43 mm)
Big End Side Clearance on Crankpin	...	...	...	...	0.0095/0.0148 in (0,24/0,38 mm)

Connecting rod nuts if removed should be replaced by new ones.

### Connecting Rod Alignment

Large and small end connecting rod bores must be square and parallel with each other within the limit of  $\pm 0.010$  in (0,25 mm) measured 5 in (127 mm) each side of the axis of the rod on test mandrel as shown in Fig. A.1. With the small end bush fitted, the limit of  $\pm 0.010$  in (0,25 mm) is reduced to  $\pm 0.0025$  in (0,06 mm).

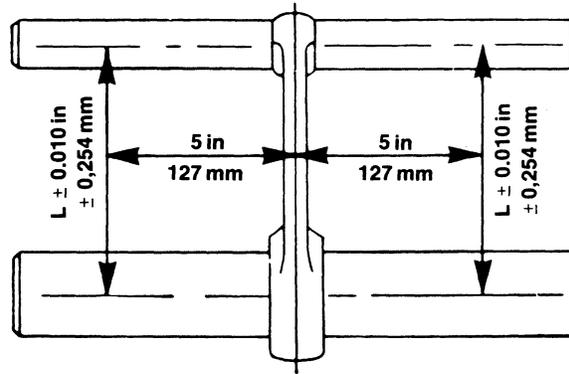


Fig. A.1.

**Crankshaft**

Main Journal Diameter	...	...	...	2.7485/2.7493 in (69,81/69,83 mm)
Main Journal Width—Rear	...	...	...	1.8427/1.8457 in (46,80/46,88 mm)
Fillet Radii, Main Journals, Nos. 1, 2 and 4	...	...	...	0.125/0.140 in (3,17/3,56 mm)
Fillet Radii, Main Journals, Centre and Rear	...	...	...	0.1562/0.1662 in (3,97/4,22 mm)
Crankpin Diameter	...	...	...	2.2484/2.2492 in (57,11/57,12 mm)
Crankpin Width	...	...	...	1.562/1.565 in (39,67/39,75 mm)
Fillet Radii, Crankpins	...	...	...	0.1875/0.2031 in (4,76/5,16 mm)
Surface Finish, All Pins and Journals	...	...	...	8 to 16 micro inches (0,2 to 0,4 microns)
Crankshaft End Float	...	...	...	0.002/0.014 in (0,05/0,26 mm)
Regrind Undersizes, Mains and Pins	...	...	...	0.010 in (0,25 mm), 0.020 in (0,51 mm) 0.030 in (0,76 mm)

**Crankshaft Thrust Washers**

Type	...	...	...	Aluminium Tin, Steel Backed
Position in Engine	...	...	...	Cylinder block, Rear Main Bearing Housing
Thrust Washer Thickness (STD)	...	...	...	0.121/0.123 in (3,07/3,12 mm)
Thrust Washer Thickness (O/S)	...	...	...	0.1285/0.1305 in (3,26/3,31 mm)

**Main Bearings**

Type	...	...	...	Steel Backed, Aluminium Tin
Shell Width, Centre and Rear	...	...	...	1.532/1.542 in (38,91/39,17 mm)
Shell Width, No. 1	...	...	...	1.264/1.274 in (32,11/32,36 mm)
Shell Width, Nos. 2 and 4	...	...	...	0.927/0.937 in (23,55/23,80 mm)
Inside Diameter, Fitted	...	...	...	2.7510/2.7525 in (69,86/69,91 mm)
Main Bearing Running Clearance	...	...	...	0.0017/0.004 in (0,04/0,10 mm)

Inside diameters for main bearings quoted are for standard sizes. For undersizes, subtract 0.010 in (0,25 mm), 0.020 in (0,51 mm) or 0.030 in (0,76 mm).

**Connecting Rod Bearings**

Type	...	...	...	Pre-finished, Steel backed, Aluminium Tin Lined
Inside Diameter	...	...	...	2.251/2.252 in (57,17/57,20 mm)
Bearing Running Clearance	...	...	...	0.002/0.0035 in (0,05/0,09 mm)
For Undersizes, subtract	...	...	...	0.010 in (0,25 mm), 0.020 in (0,51 mm) or 0.030 in (0,76 mm)

## TECHNICAL DATA — A.6

### Camshaft

No. 1 Journal Diameter	...	...	...	1.869/1.870 in (47,47/47,50 mm)
Running Clearance	...	...	...	0.002/0.005 in (0,05/0,13 mm)
No. 2 Journal Diameter	...	...	...	1.859/1.860 in (47,22/47,24 mm)
Running Clearance	...	...	...	0.004/0.008 in (0,10/0,20 mm)
No. 3 Journal Diameter	...	...	...	1.839/1.840 in (46,71/46,74 mm)
Running Clearance	...	...	...	0.004/0.008 in (0,10/0,20 mm)
Cam Lift	...	...	...	0.308/0.322 in (7,82/8,18 mm)
Diameter of Camshaft Spigot	...	...	...	1.9985/1.9995 in (50,76/50,79 mm)

### Cylinder Head

Skimming Allowance on Head Face	...	...	A maximum of 0.012 in (0,30 mm) may be removed from the head face providing the atomiser nozzle protrusion does not exceed 0.249 in (6,32 mm)
Leak Test	...	...	30 lbf/in <sup>2</sup> (2,11 kgf/cm <sup>2</sup> ) or 207 kN/m <sup>2</sup>
Valve Seat Angle	...	...	35°
Valve Depth below Cylinder Head Face			
Inlet	...	...	0.052/0.064 in (1,32/1,63 mm)
Exhaust	...	...	0.063/0.0755 in (1,60/1,92 mm)
Tappet Bore Diameter	...	...	0.6245/0.62575 in (15,86/15,89 mm)

### Valve Guides (inlet)

Inside Diameter	...	...	0.314/0.315 in (7,98/8,00 mm)
Outside Diameter	...	...	0.5021/0.5026 in (12,75/12,77 mm)
Overall Length	...	...	2.219 in (56,36 mm)
Guide Protrusion above Cylinder Head Top Face	...	...	0.362/0.376 in (9,19/9,55 mm)

### Valve Guides (exhaust)

Inside Diameter	...	...	0.314/0.3155 in (7,98/8,01 mm)
Outside Diameter	...	...	0.5021/0.5026 in (12,75/12,77 mm)
Overall Length	...	...	2.440 in (61,98 mm)
Guide Protrusion above Cylinder Head Top Face	...	...	0.584/0.594 in (14,83/15,08 mm)

### Inlet and Exhaust Valves

Valve Stem Diameter	...	...	0.311/0.312 in (7,90/7,92 mm)
Clearance Fit of Valve in Guide	...	...	0.002/0.004 in (0,05/0,10 mm)
Valve Face Angle	...	...	35°

### Inner Valve Springs (inlet valves only)

Fitted Length	...	...	1.1875 in (30,16 mm)
Load at Fitted Length	...	...	8.0 lb +/- 1 lb (3,63 kg +/- 0,45 kg)
Free Length	...	...	1.365/1.405 in (34,67/35,68 mm)

### Outer Valve Springs

Fitted Length	...	...	1.500 in (38,10 mm)
Load at Fitted Length	...	...	22.75 lb +/- 2 lb (10,34 kg +/- 0,90 kg)
Free Length	...	...	1.783/1.803 in (45,29/45,80 mm)

**Tappets**

Tappet Shank Diameter	...	...	...	0.62225/0.62375 in (15,80/15,84 mm)
Running Clearance in Cylinder Head	...	...	...	0.00075/0.0035 in (0,02/0,09 mm)
Outside Diameter of Tappet Foot	...	...	...	1.125 in (28,57 mm)

**Rocker Shaft**

Outside Diameter	...	...	...	0.62225/0.62375 in (15,80/15,84 mm)
Overall Length of Shaft	...	...	...	16,875 in (428,62 mm)

**Rocker Lever**

Bush Bore Diameter	...	...	...	0.6245/0.62575 in (15,86/15,89 mm)
Running Clearance of Bush on Shaft	...	...	...	0.00075/0.0035 in (0,02/0,09 mm)

**Valve Timing**

Refer to Page H.4.

**Camshaft Gear**

Diameter of Gear Bore	...	...	...	2.000/2.0012 in (50,80/50,83 mm)
Clearance of Gear on Camshaft Spigot	...	...	...	0.0005/0.0027 in (0,01/0,07 mm)

**Upper Idler Gear and Hub**

Idler Gear Hub Diameter	...	...	...	1.996/1.997 in (50,70/50,72 mm)
Diameter of Gear Bore	...	...	...	1.9998/2.0007 in (50,79/50,82 mm)
Running Clearance of Gear on Hub	...	...	...	0.0028/0.0047 in (0,07/0,12 mm)
Idler Gear End Float	...	...	...	0.001/0.007 in (0,02/0,18 mm)

**Lower Idler Gear, Bush and Hub**

Idler Gear Hub Diameter	...	...	...	1.996/1.997 in (50,70/50,72 mm)
Diameter of Gear Bush Bore	...	...	...	1.9998/2.0007 in (50,79/50,82 mm)
Running Clearance of Gear on Hub	...	...	...	0.0028/0.0047 in (0,07/0,12 mm)
Hub Width	...	...	...	1.1905/1.1935 in (30,24/30,31 mm)
Width of Gear with Bushes	...	...	...	1.1865/1.1875 in (30,14/30,16 mm)
Idler Gear End Float	...	...	...	0.001/0.007 in (0,03/0,18 mm)

Note: The bore and faces of bushes to be turn finished *in situ* to dimensions quoted.

**Fuel Pump Gear**

Diameter of Gear Bore	...	...	...	1.750/1.751 in (44,45/44,47 mm)
Outside Diameter of Fuel Pump Shaft	...	...	...	1.748/1.7488 in (44,40/44,42 mm)
Clearance Fit of Gear on Shaft	...	...	...	0.0012/0.003 in (0,03/0,08 mm)

## TECHNICAL DATA — A.8

### Crankshaft Gear

Diameter of Gear Bore ... ..	1.4995/1.501 in (38,09/38,13 mm)
Diameter of Crankshaft for Gear ... ..	1.500/1.5005 in (38,10/38,11 mm)
Transition Fit of Gear on Shaft ... ..	0.001/0.001 in (0,03/0,03 mm)

### Timing Gear Backlash

All Gears ... ..	0.003 in (0,08 mm) minimum
------------------	----------------------------

### Lubrication System

Lubricating Oil Pressure ... ..	30/60 lbf/in <sup>2</sup> (2,1/4,2 kgf/cm <sup>2</sup> ) or 207/414 kN/m <sup>2</sup> at max. engine speed and normal working temperature.
---------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------

### Sump Capacity

The lubricating oil level should be maintained in accordance with the marks on the dipstick. Only approved oils as listed in Section J should be used.

Actual sump capacities vary according to application and for further details, apply to Service Department, Perkins Engines Ltd., Peterborough.

### Lubricating Oil Pump Idler Gear, Bush and Shaft

Diameter of Gear Bore ... ..	0.750/0.751 in (19,05/19,07 mm)
Outside Diameter of Bush ... ..	0.7522/0.7532 in (19,10/19,13 mm)
Interference Fit of Bush in Gear ... ..	0.0012/0.0032 in (0,03/0,08 mm)
Outside Diameter of Idler Gear Shaft ... ..	0.6547/0.6553 in (16,63/16,64 mm)
Inside Diameter of Bush ... ..	0.6562/0.6572 in (16,67/16,69 mm)
Running Fit of Bush on Shaft ... ..	0.0009/0.0025 in (0,02/0,06 mm)

### Lubricating Oil Pump Assembly

Type ... ..	Rotor
No. of Lobes— Drive Rotor ... ..	Five
No. of Lobes— Driven Rotor ... ..	Six

### Oil Pump Clearances

Between Inner and Outer Rotor ... ..	0.0025/0.0045 in (0,06/0,11 mm)
Inner Rotor End Clearance ... ..	0.0015/0.0035 in (0,04/0,09 mm)
Outer Rotor End Clearance ... ..	0.001/0.003 in (0,03/0,08 mm)

### Lubricating Oil Pump Relief Valve

Type ... ..	Plunger
Pressure Setting ... ..	50/65 lbf/in <sup>2</sup> (3,52/4,57 kgf/cm <sup>2</sup> ) or 345/448 kN/m <sup>2</sup>

### Lubricating Oil Filter

Type ... ..	Full Flow
Element ... ..	Replaceable canister
By-Pass Valve Setting ... ..	13/17 lbf/in <sup>2</sup> (0,91/1,2 kgf/cm <sup>2</sup> ) or 90/117 kN/m <sup>2</sup>

**Cooling System**

Type						
Cylinder Head	...	...	...	...		Water Pump Circulation
Cylinder Block	...	...	...	...		Thermo-syphon
Cooling System Capacity, engine only	...	...	...	...		10.5 U.K. pt. (6,0 litres)

**Thermostat**

Type	...	...	...	...	...	Wax Capsule
Opening Temperature	...	...	...	...	...	82° C (180° F)
Fully Open	...	...	...	...	...	98° C (208° F)

Note: If the thermostat does not function properly, replace with a new unit.

**Water Pump**

Type	...	...	...	...	...	Centrifugal
Outside Diameter of Shaft for Pulley	...	...	...	...	...	0.5906/0.5909 in (15,00/15,01 mm)
Inside Diameter of Pulley Bore	...	...	...	...	...	0.588/0.589 in (14,93/14,96 mm)
Interference Fit of Pulley on Shaft	...	...	...	...	...	0.0016/0.0029 in (0,04/0,07 mm)
Outside Diameter of Shaft for Impeller	...	...	...	...	...	0.6262/0.6267 in (15,90/15,92 mm)
Inside Diameter of Impeller Bore	...	...	...	...	...	0.625/0.6257 in (15,87/15,89 mm)
Interference Fit of Impeller on Shaft	...	...	...	...	...	0.0005/0.0017 in (0,01/0,05 mm)
Impeller to Body Clearance	...	...	...	...	...	0.005/0.035 in (0,13/0,89 mm)

**Fuel System**

**Fuel Oil Specifications**

United Kingdom	BS.2869: 1967	Class A.1 or A.2
United States	VV-F-800a	Grades DF-A, DF-1 or DF-2
	A.S.T.M./D975-66T	Nos. 1-D or 2-D
France	(J.O. 14/9/57)	Gas Oil or Fuel Domestique
India	IS: 1460/1968	Grade Special or Grade A
Germany	DIN-51601 (1967)	
Italy	CUNA-gas Oil NC-630-01 (1957)	
Sweden	SIS. 15 54 32 (1969)	
Switzerland	Federal Military Spec. 9140-335-1404 (1965)	

Fuel oils available in territories other than those listed above which are to an equivalent specification may be used.

**Fuel Lift Pump**

Type	...	...	...	...	...	AC Delco
Method of Drive	...	...	...	...	...	Eccentric on Camshaft
Delivery Pressure	...	...	...	...	...	5/8 lbf/in <sup>2</sup> (0,35/0,56 kgf/cm <sup>2</sup> ) or 34/54 kN/m <sup>2</sup>
Diaphragm Spring Colour	...	...	...	...	...	Blue

**Fuel Filter**

Element Type	...	...	...	...	...	Paper
Valve Type	...	...	...	...	...	Orifice Controlled Vent Valve



**Service Wear Limits**

The following “wear limits” indicate the condition when it is recommended that the respective items should be serviced or replaced.

Cylinder Head Bow					
Transverse	...	...	...	...	0.003 in (0,08 mm)
Longitudinal	...	...	...	...	0.006 in (0,15 mm)
Maximum Bore Wear					
(when new liners are necessary)	...	...	...	...	0.007 in (0,18 mm)
Maximum Top Piston Ring Clearance in Groove	...	...	...	...	0.007 in (0,18 mm)
Crankshaft, Main and Big End Journals Ovality and Wear					
...	...	...	...	...	0.0015 in (0,04 mm)
Maximum Crankshaft End Float	...	...	...	...	0.020 in (0,51 mm)
Valve Stem to Guide Bore Clearance					
Inlet	...	...	...	...	0.006 in (0,15 mm)
Exhaust	...	...	...	...	0.0055 in (0,14 mm)
Valve Head Depth below Cylinder Head Face	...	...	...	...	PRODUCTION LIMITS MUST BE MAINTAINED
Rocker Clearance on Shaft	...	...	...	...	0.005 in (0,13 mm)
Camshaft Journals, Ovality and Wear	...	...	...	...	0.002 in (0,05 mm)
Idle Gear End Float	...	...	...	...	0.010 in (0,25 mm)



# **SECTION B**

## **Maintenance**

## **MAINTENANCE — B.2**

### **PREVENTIVE MAINTENANCE**

Operators of engines are reminded that the following preventive maintenance periods are general in application. They should be compared with the schedules specified by the manufacturer of the machine to which the engine is fitted and where necessary, the shorter periods should be adopted.

Whilst we have given specific periods for preventive maintenance, you should have due regard for the local regulations concerning your machine and ensure that the engine is operating within those regulations.

#### **Daily or every 8 hours (whichever occurs first)**

Check coolant level.

Check sump level.

Check oil pressures (where gauge fitted).

In extreme dust conditions, clean oil bath air cleaners or empty dust bowl on dry type air cleaner.

#### **Every 200 hours or 4 months (whichever occurs first)**

Clean oil bath air cleaner or empty dust bowl on dry type air cleaner.

Check drive belt tension.

Check for oil, water or fuel leaks.

Clean fuel water trap (where fitted).

Clean lift pump pre-filter (where fitted).

#### **Every 400 hours or 12 months (whichever occurs first)**

Drain and renew engine lubricating oil. (See list of approved lubricating oils in Section J.)

Renew lubricating oil filter canister.

Renew final fuel element.

Check and adjust tappets.

Check hoses and clips.

Clean element of dry type air cleaner or renew (if not indicated earlier).

#### **Every 800 hours**

Service atomisers.

#### **Every 2,400 hours**

Arrange for examination and service of proprietary equipment, i.e. starter motor, generator etc.

### **Post-Delivery Inspection**

After a customer has taken delivery of his Perkins Diesel an inspection of the engine is to be carried out after the first 25/50 hours in service.

It is also recommended that the following procedure be adopted where an engine has been shut down for a considerable period before it is again put into service.

The inspection should comprise the following points:

1. Drain lubricating oil sump and re-fill up to the full mark on the dipstick with new clean oil (Do not overfill). See list of Approved Lubricating Oils in Section J. When the sump is drained and it is possible to gain access to the sump strainer, it should be removed and cleaned.
2. Renew the lubricating oil filter canister.
3. Check external nuts for tightness.
4. Adjust tappet clearance to 0.008 in (0,20 mm) for inlet valves and 0.012 in (0,30 mm) for exhaust valves with the engine cold.
5. Check fuel pipes from tank to fuel injection pump for leaks.
6. Examine engine for lubricating oil leaks, and rectify if necessary.
7. Check cooling system for leaks and inspect radiator water level.
8. Check fan belt for tension.
9. Check engine mounting bolts for tightness.
10. Carry out test to check general performance of engine.

It is assumed that electrical equipment will have already been checked for such points as generator rate of charge, effectiveness of connections and circuits, etc.

Thereafter maintenance periods should be in accordance with the instructions given on Page B.2.

### **Preservation during prolonged shut-down**

Where an application which is powered by a Perkins engine is to be laid-up for several months it is advisable that some protection be given to the engine to ensure that it suffers no ill effect during the intervening period before operations are recommenced.

The following procedure should be adopted and applied immediately the unit is withdrawn from service.

1. Thoroughly clean all external parts of the engine.
2. Run the engine until warmed through. Stop the engine and drain lubricating oil sump.
3. Remove and clean gauze strainer in sump and renew lubricating oil filter canister.
4. Clean out engine breather.

5. After replacing filters fill sump to correct level with clean, new lubricating oil or with a suitable preservative fluid.
6. If a preservative fuel is to be used, drain all fuel oil from fuel tank and filters. Put into the fuel tank at least one gallon (4,5 litre) of one of the oils listed under "Recommended Oils for Preservation of the Fuel System". If, because of the construction of the fuel tank, this quantity of oil is inadequate, break the fuel feed line before the first filter and connect a small capacity auxiliary tank. Prime the fuel system as detailed in Section L.
7. Run the engine at half speed for at least fifteen minutes to circulate the oil.
8. Seal the air vent in the fuel tank or filler cap with waterproof adhesive tape.
9. Drain water from radiator and engine cylinder block.
10. Remove atomisers and spray into cylinder bores a ¼ pint (0,14 litre) of lubricating oil divided between the cylinders.
11. Turn engine slowly over compressions, and replace atomisers.
12. Remove air cleaner and any intake pipe which may be fitted between the air cleaner and air intake. Carefully seal air intake orifice with waterproof adhesive tape or some other suitable medium.
13. Remove exhaust pipe and seal opening in manifold as in '12'.
14. Disconnect battery and store in fully charged condition. Before storing the battery, terminals should be treated to prevent corrosion.
15. Remove fan belt and store for re-fitment to engine before return to service.

The fuel system may either be drained and filled with a suitable preservative or alternatively, it may be left primed with normal fuel oil.

Where the latter course is taken it should be noted that deterioration of the fuel oil may occur during the months the machine is idle.

If this occurs, the fuel oil will wax-out and clog the fuel filtering arrangement once the engine is returned to service.

Therefore, before commencing operations in respect of a unit primed with normal fuel oil which has lain idle for several months it is recommended that the fuel tank be drained and the interior of the tank thoroughly cleaned. The fuel oil drained off should be discarded as unfit for further use.

Fuel oil contained in the remainder of the fuel system should also be dispelled and the paper element in the final fuel filter renewed, following which the system may then be recharged with fresh clean fuel oil.

## MAINTENANCE — B.4

Where a preservative is used in the lubricating oil sump, this should be drained off and replaced by normal lubricant prior to re-starting the engine at the end of the storage period. In the case of a preservative being utilised to charge the fuel system, this need not necessarily be drained off before returning the engine to service. Therefore, where a preservative is used in this respect, the relevant manufacturers of the fluid should be contacted seeking their guidance as to whether their product should be drained away prior to re-starting the engine.

### Recommended Oils for Preservation of the Fuel System\*

	Lowest Temperature during Lay-up
Esso IL815	25° F (-4° C)
Esso IL1047	0° F (-18° C)
Shell Calibration Fluid "C" (U.K.)	0° F (-18° C)
Shell Calibration Fluid "B" (Overseas)	-70° F (-57° C)
Shell Fusus "A"	-15° F (-26° C)
Shell Fusus "A" (Old Type)	25° F (-4° C)

No attempt should be made to restart the engine until the temperature has been at least 15° F (8° C) above that shown in the table for not less than 24 hours. Otherwise there may be difficulty in obtaining a free flow of fuel.

\*The proprietary brands of oils listed may not be available in all parts of the world, but suitable oils may be obtained by reference to the oil companies: the specifications should include the following: **Viscosity:** Should not be greater than 22 centistokes at the lowest ambient temperature likely to be experienced on restarting.

**Pour Point:** Must be at least 15° F (8° C) lower than the lowest ambient temperature to be experienced on restarting and should preferably be lower than the lowest temperature likely to be met during the lay-up period.

The oils selected are not necessarily suitable for calibrating or testing pumps.

### Frost Precautions

Precautions against damage by frost should be taken if the engine is to be left exposed to inclement weather either by adequately draining the water system or where this is not convenient, an anti-freeze of reputable make and incorporating a suitable corrosion inhibitor may be used.

Should it be the policy to protect engines from frost damage by adding anti-freeze to the cooling system, it is advisable that the manufacturers of the relevant

mixture be contacted to ascertain whether their products are suitable for use in Perkins engines and also to ensure that their products will have no harmful effect on the cooling system generally. It is our experience that the best results are obtained from an anti-freeze which conforms to British Standard 3151 or has been tested in accordance with BS5117 Clause 5 to give at least as good a result as BS3151.

The coolant solution containing 25 per cent anti-freeze manufactured to BS3151 in water in a properly maintained engine should maintain its anti-freeze and anti-corrosive properties throughout the winter season in the U.K. and in general, a safe life of 12 months may reasonably be expected.

When draining the water circulating system it is not enough merely to open the radiator drain tap. The drain plug on right hand side of the cylinder block near the flywheel housing must also be removed.

Where a pressurised radiator filler cap is fitted, this should be removed slowly, before draining the cooling system.

When draining coolant, ensure engine is level.

When the engine is drained, in the majority of applications the water pump is also drained, but rotation of the pump may be prevented by:

- (a) Locking of the impeller by ice due to the pump drain hole being blocked by sediment.
- (b) The locking of the seal through the freezing of globules of moisture between the seal and the gland.

Operators are therefore advised to take these precautions when operating in temperatures below freezing point.

1. Before starting the engine, turn the fan and water pump by hand; this will indicate if freezing has taken place. If so, this should free any ice formation.
2. If it is impossible to turn the pump by hand, the radiator and engine should be filled with warm water.

After an anti-freeze solution has been used, the cooling system should be thoroughly flushed in accordance with the manufacturer's instructions before refilling with normal coolant.

If the foregoing action is taken, no harmful effects should be experienced, but Perkins Engines Ltd., cannot be held responsible for any frost damage or corrosion which may be incurred.

# **SECTION C**

## **Cylinder Head**

## CYLINDER HEAD — C.2

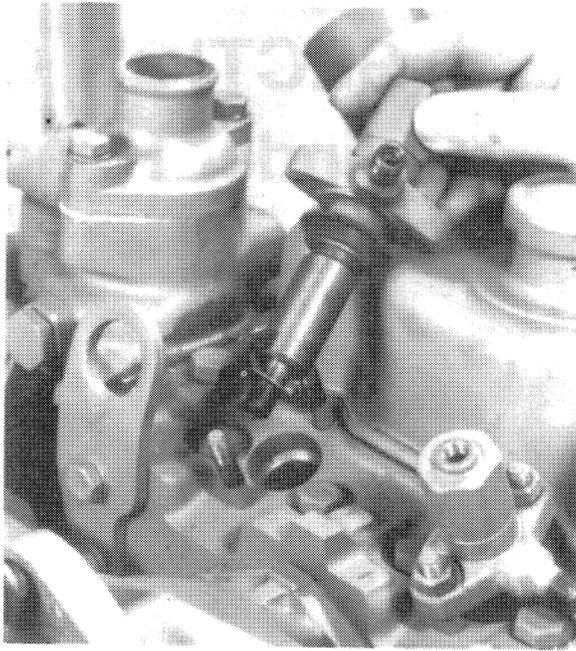


Fig. C.1.  
Removing an Atomiser.

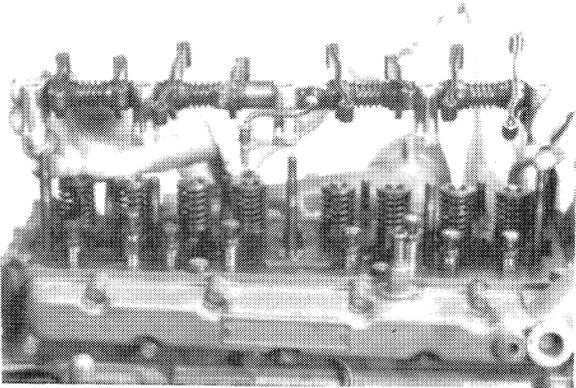


Fig. C.2.  
Removing Rocker Shaft Assembly.

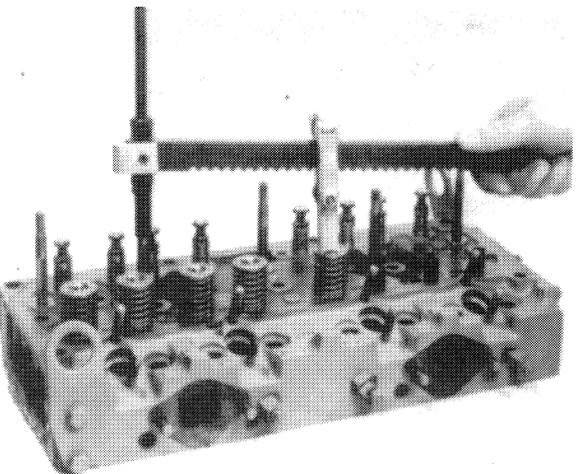


Fig. C.3.  
Removing Valve from Cylinder Head.

### To Remove the Cylinder Head from the Engine

Ensure that the cooling system is completely drained. A drain plug is provided on the right hand side of the cylinder block near the flywheel housing and a tap is usually provided at the base of the radiator.

Remove the lub. oil pipe between the camshaft chamber and the cylinder head.

Remove the fuel injection pipes taking care to cover the fuel injection pump outlets with suitable caps or clean non-fluffy cloth.

Remove all connections to the cylinder head.

Remove the cylinder head securing nuts and set-screws.

Remove the cylinder head.

### To Overhaul the Cylinder Head

Remove the induction and exhaust manifolds.

#### Valves

Remove the valves from the cylinder head by depressing the valve springs and retaining caps and removing the split collets (Fig. C.3).

The valve springs, spring retainer, collets and locating washer are shown in Fig. C.4.

Remove all traces of carbon from the valves, valve guides, and cylinder head ports.

If the valve face is found to be pitted or distorted it should be refaced on a suitable valve grinding machine to an angle of 35 degrees. This operation should continue only until the face is clean and true, as the removal of an excessive amount of metal may reduce the thickness of the edge of the valve head to such an extent that it will burn or distort under operating conditions, the valve may be unduly lowered in its seating in the cylinder head and "pocketing" will result.

Valves are not numbered. Where valves are to be re-used, they should be suitably marked to ensure they are replaced in their original respective positions.

Key to Fig. C.4

1. Half-Conical Collets.
2. Spring Cap.
3. Outer Spring.
4. Inner Spring (inlet valves only).
5. Locating Washer.
6. Valve.
7. Seal (inlet valves only).

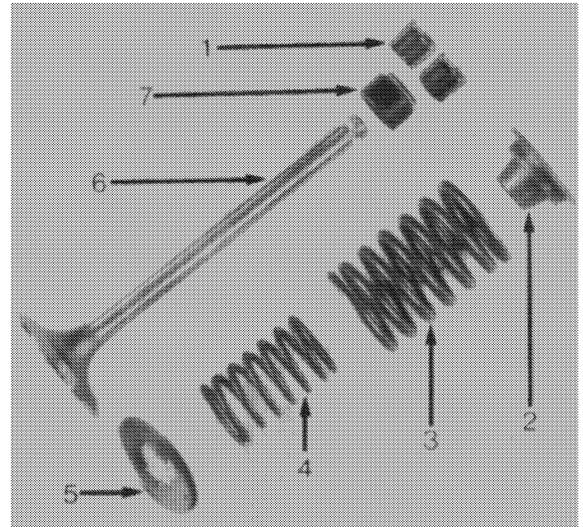


Fig. C.4.  
Valve and Valve Spring Assembly.

### Valve Springs

An inner and outer valve spring is fitted to inlet valves and a single outer valve spring to exhaust valves. The outer valve springs are similar for both inlet and exhaust valves.

Before being refitted they should be carefully examined paying particular regard to the squareness of the ends. They should always be renewed during major overhaul.

### Valve Guides

The valve guides are a press fit in the cylinder head.

All the guides should be examined for damage or wear on the internal bore.

Removal of a valve guide is accomplished by use of a special tool (see Fig. C.5). Pass the rod of the tool through the valve guide from the top face of the cylinder head until the step on the rod abuts against the top of the valve guide. Fit the spacer to the lower end of the rod and screw on the knurled retainer. Turn the winged nut on the main tool and the guide will be drawn from the cylinder head.

Replacement of a valve guide is accomplished by use of the same tool but using the angled adaptor. (See Fig. C.6.) Pass the rod of the tool through the valve guide bore from the cylinder head bottom face so that the angled adaptor fitted into the main tool body abuts against the valve seat in the cylinder head. Locate the valve guide on the rod and retain in position with the adaptor and knurled nut. Turn the winged nut and the valve guide will be drawn into its bore in the cylinder head.

A light application of engine oil to the valve guide will assist its entry into the parent bore.

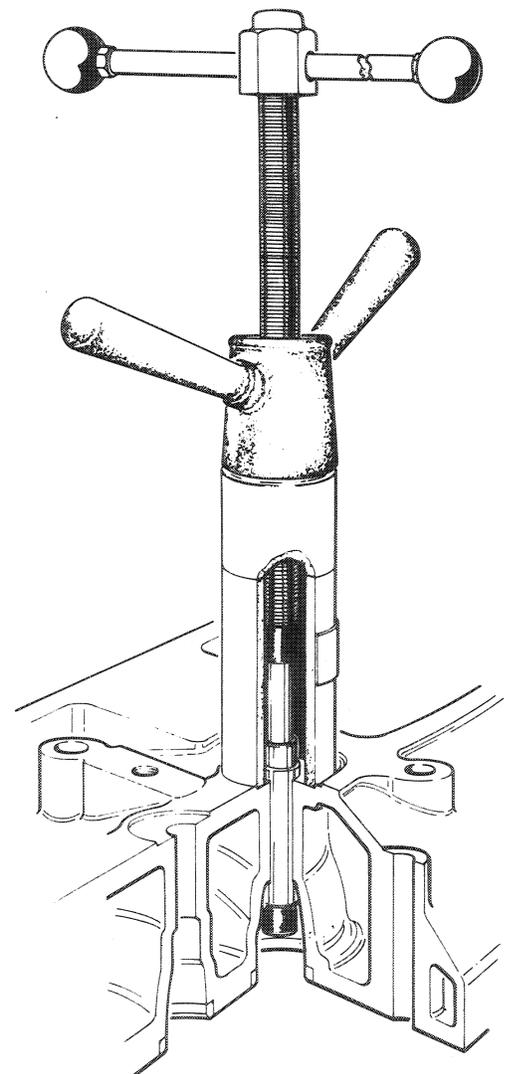


Fig. C.5.  
Removing a Valve Guide.

## CYLINDER HEAD — C.4

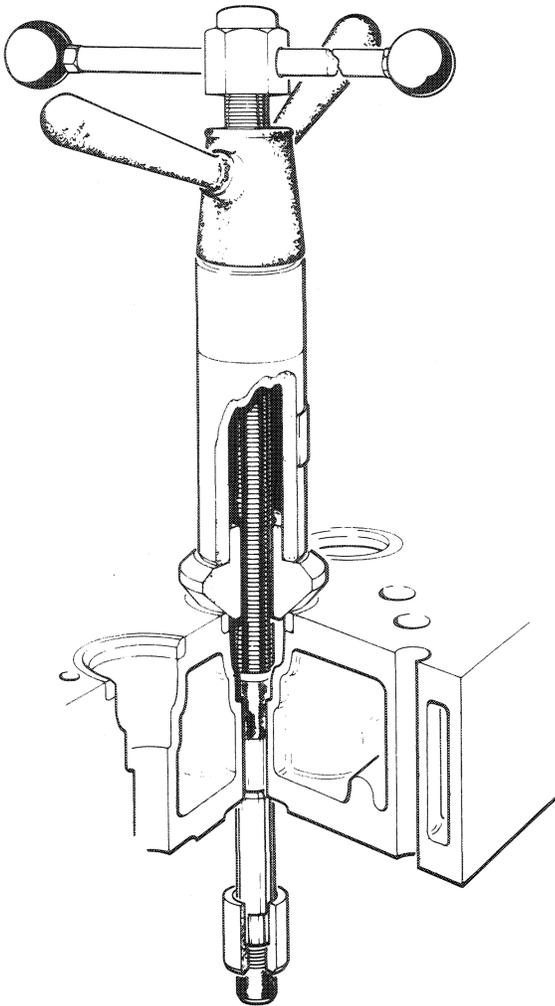


Fig. C.6.  
Replacing a Valve Guide.

Shoulderless valve guides are fitted. Both ends are chamfered, one at 45°, the other at 20°. The end which is chamfered at 20° is also recessed in its bore. This end should be inserted into the cylinder head top face and pulled into its parent bore until the opposite end (chamfered at 45°) protrudes 0.362/0.376 in (9,20/9,55 mm) for inlet valve guides and 0.580/0.594 in (14,73/15,09 mm) for exhaust valve guides.

N.B. — WHERE A NEW VALVE GUIDE IS FITTED, IT IS ESSENTIAL THAT THE VALVE SEATING IN THE CYLINDER HEAD BE RECUT TO ENSURE CONCENTRICITY OF THE SEAT WITH THE GUIDE.

When fitting is completed the guide should be inspected to ensure that it is free from burrs.

### Valve Seats

The valve seat angles are 35°.

If they show signs of pitting, burning or other evidence of gas leakage they should be machined or hand ground according to condition. Hand grinding is only a finishing process and on no account should prolonged grinding be attempted otherwise seat angles may be altered and seat widths increased excessively.

N.B. — WHEN RECUTTING VALVE SEATS IT IS ESSENTIAL THAT THE MINIMUM AMOUNT OF METAL BE REMOVED, OTHERWISE THE MAXIMUM VALVE RECESSION TOLERANCE MAY BE EXCEEDED.

On completion of this work, a check should be made to ensure that the depth of the valve head below the level of the cylinder head face is within the limits quoted on Page A.6 (See Fig. C.7).

### Grinding in Valves

If the previous reconditioning processes to valves and seats have been carefully carried out, very little grinding will be necessary to produce an even, clean, seat of matt grey finish.

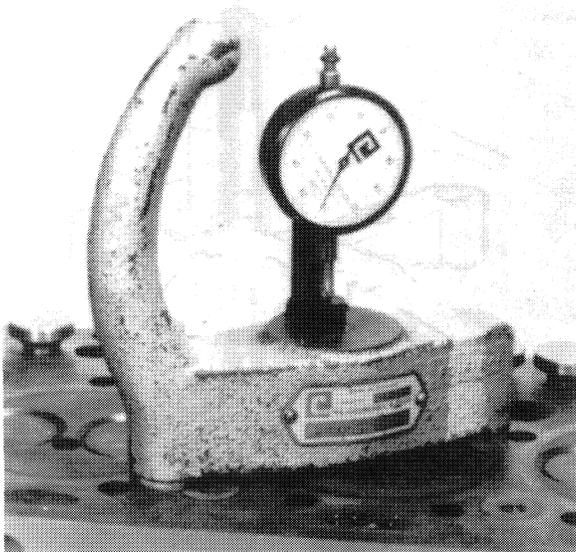


Fig. C.7.  
Checking Valve Depths.

Medium or fine grinding paste should be used, and with the aid of a suction grinding tool, the valve should be rotated backwards and forwards frequently lifting it from its seat and turning it to a new position.

On completion of this operation, all traces of grinding paste must be removed from the valves, seats, and cylinder head.

**Skimming of Cylinder Head**

If the bottom face of the cylinder head is bowed or damaged, then it may be skimmed by a maximum of 0.012 in (0,30 mm), providing the atomiser nozzle protrusion does not exceed 0.249 in (6,32 mm).

**Tappets**

These should be examined for wear and to ensure that they can operate freely.

**Rocker Assembly**

Before attempting to dismantle the rocker assembly, it should be noted that the slot in the end of the rocker shaft is in line with a punch mark on the support bracket. When this slot is positioned vertically then the minimum oil flow to the rocker assembly is obtained. In production the slot is set at 30 degrees before the vertical and this position is indicated by the punch mark on the rear support bracket (See Fig. C.8).

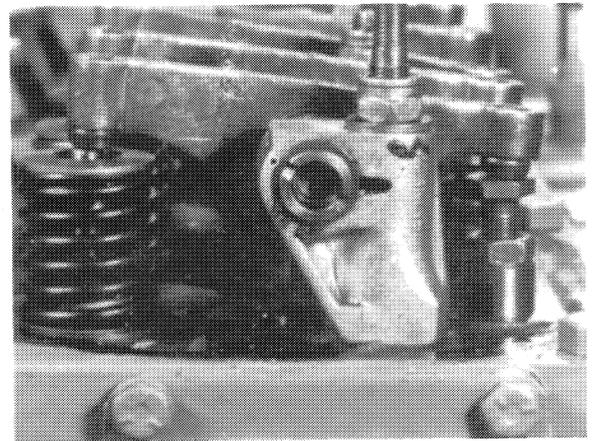


Fig. C.8.  
Positioning of Rocker Shaft.

To dismantle the rocker gear assembly, remove the circlips from the ends of the rocker shaft and slide off the components noting the positions of support brackets, rocker arms, springs, spacers and lub. oil supply pipe.

If on inspection it is found that rocker arms are worn or damaged, or the bushes are worn, then replacement arms must be fitted since the bushes are not replaceable. When ordering, it is essential to note whether left handed or right handed rocker arms are required.

When re-assembling ensure that all components are fitted to the rocker shaft in the correct order (Fig. C.9) and that new circlips are fitted to the ends of the shaft.

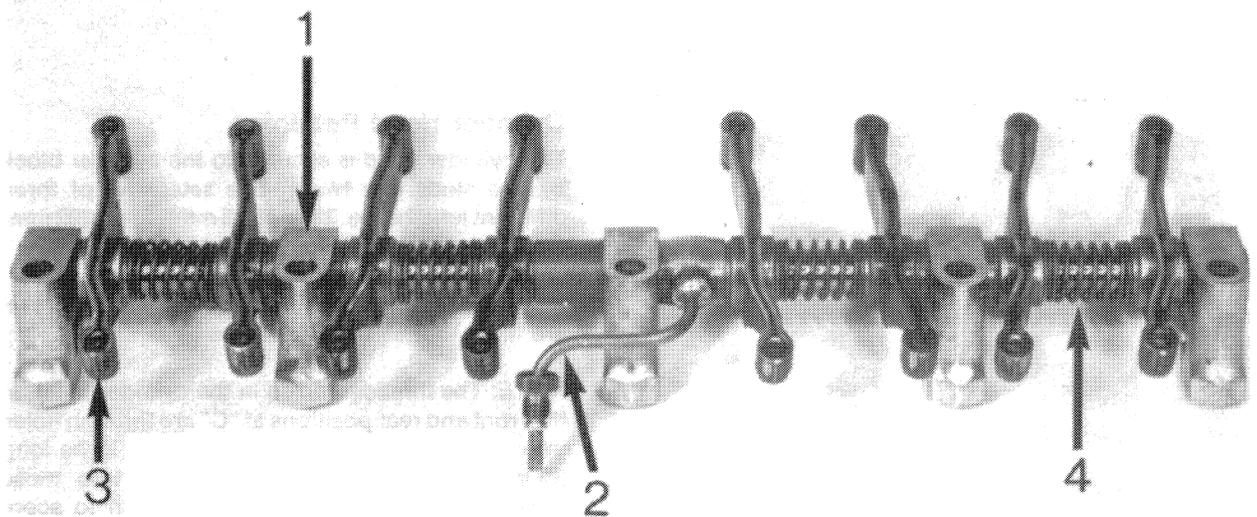


Fig. C.9.  
Rocker Shaft Assembly.

- |                                  |                  |
|----------------------------------|------------------|
| 1. Rocker Shaft Support Bracket. | 3. Rocker Lever. |
| 2. Oil Feed Pipe.                | 4. Spring.       |

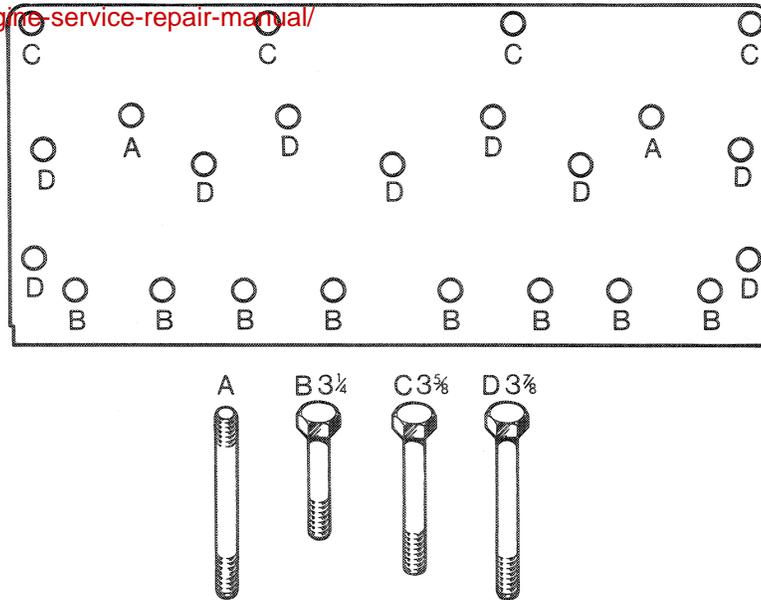


Fig. C.10.  
Cylinder Head Fixings.

### To Re-assemble the Cylinder Head

Lubricate the valve stems and valve guides with engine oil and place the valves in their respective guides. Replace in the following order. Locating washer, inner valve spring and oil seal (inlet valves only), outer valve spring and spring retaining cap.

Refit induction and exhaust manifolds using new joints.

### Cylinder Head Retaining

The cylinder head is secured to the cylinder block by two studs and twenty-one setscrews of three different lengths, i.e.  $3/4$  in (82,5 mm),  $3/8$  in (92 mm) and  $3/8$  in (98,5 mm), see Fig. C.10.

It is important that the studs and correct setscrews are fitted to their respective positions.

NOTE: The threaded holes in the cylinder block at the front and rear positions at "C" are through holes into the camshaft journal housings and if the long  $3/8$  in (98,5 mm) setscrews are fitted into these positions, they can protrude far enough to score the rear camshaft journal or compress the bush at the front camshaft journal.

There is also a possibility of an oil leak from the cylinder head gasket since the tightening torque will be registered when the setscrews bottom on the thread rather than the clamping of the cylinder head.