DAVID BROWN

FOUR-CYLINDER DIESEL ENGINE

(SERIES AD4/47)

REPAIR MANUAL

PUBLICATION TP 644

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DAVID BROWN TRACTORS LIMITED
MELTHAM · YORKSHIRE · ENGLAND HD7 3AR

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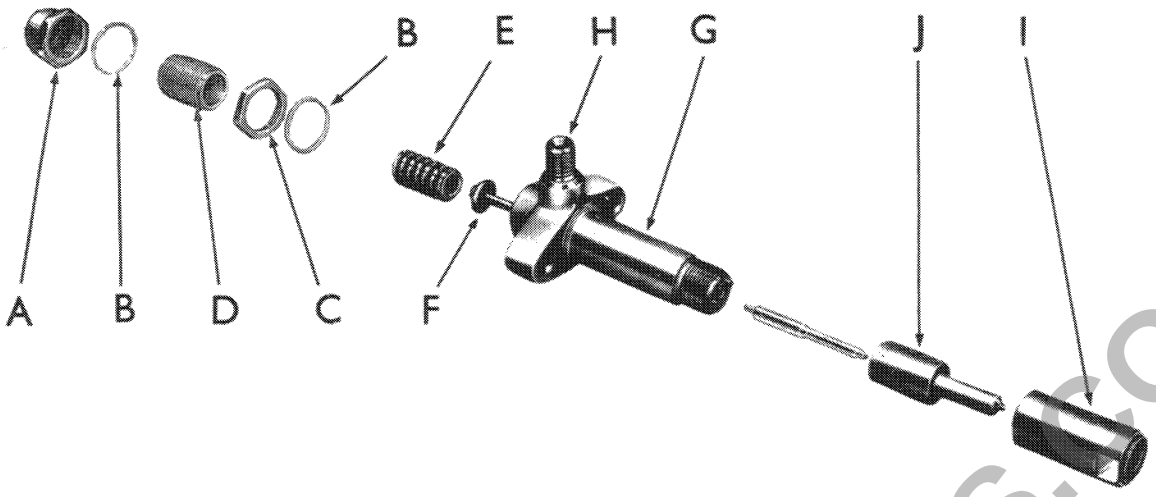


Figure 12. EXPLODED VIEW OF INJECTOR

A. Cap
B. Sealing washer
C. Locknut
D. Adjusting screw
E. Spring
F. Plunger
G. Holder
H. Fuel inlet connection
I. Nozzle nut
J. Nozzle

If the nozzle is not damaged it should be cleaned using the special tools provided in the nozzle cleaning kit shown in Fig. 13 and Tool Leaflet C2. Firstly clean fuel oil channels and bores in the nozzle. Scrape carbon from valve seat with the brass scraper.

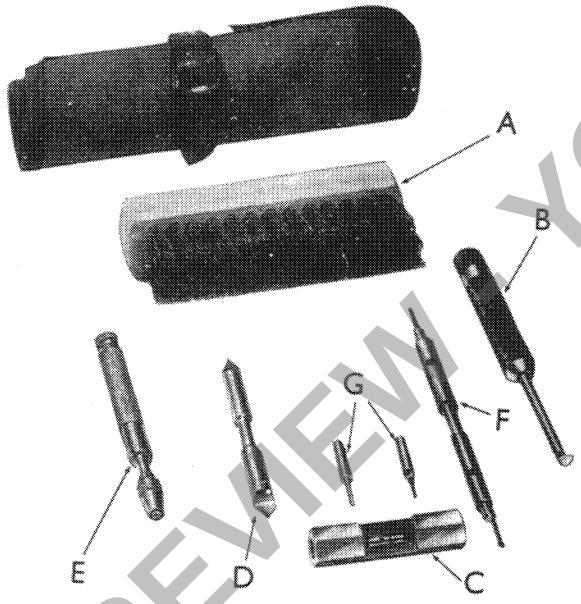


Figure 13. C.A.V. NOZZLE CLEANING KIT

A. Brass wire brush
B. Nozzle body groove scraper
C. Nozzle plunger cleaner
D. Nozzle body seat scraper
E. Holder—probing needle
F. *Pintle hole cleaner
G. *Probes—pintle hole cleaner

* Not required for D.B. nozzles.

Using the special groove scraper clear carbon deposits from oil gallery. Clean spray holes with probing tool fitted with a probing wire of the correct diameter.

If a wire is broken off in the hole it is often impossible to remove it, and the nozzle is then useless. Great care should be exercised when using the probing wires. After clearing the holes scrape carbon from valve seat with the V-tipped brass tool. Next use the tool with the thin blade radiused at its tip to clean carbon out of the sac. After cleaning with the tools, the nozzle should be thoroughly cleaned with fuel. This should be done by placing the nozzle, without needle, in the reverse flushing attachment and connecting to the nozzle pressure tester in place of an injector. Operation of the tester will then thoroughly flush all particles of loose carbon from the nozzle.

With the brass wire brush, gently clean needle valve, paying particular attention to valve seat and needle tip. Brush carbon from nozzle stem and tip.

Reassembly: The needle valve should be fitted to nozzle whilst both are under the surface of clean fuel oil or test oil. Only in this way can dust be excluded from assembly. The needle should slide smoothly in the nozzle and this should be tried several times whilst under the surface of fluid. Needle and nozzle are assembled as a pair and under no account should they be interchanged.

The nozzle should then be assembled on to injector body. In order to avoid distorting needle or plunger the pressure on pressure spring should be released. Remove dome cap, slacken locknut and slacken pressure adjusting screw right back until there is no pressure on spring. Make sure that mating surfaces between nozzle and injector body are perfectly clean. Place nozzle on body with the dowels in correct engagement so that the two faces are in perfect contact, i.e., not held apart by spring pressure. Place the cap over nozzle and tighten adequately but not overtight. Retighten pressure adjusting screw and reset the pressure on spray tester. Test the spray, leak back, etc. If the injector is not required for immediate use it should be stored in a sealed plastic bag or similar container. (Fig. 14.)

It is essential that the copper washer be used under

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DIMENSIONAL DATA

Torque Figures

Big-end bearing nuts	50 lb ft	6·92 kg metres
Breather filter cover nut	10 lb ft	1·38 kg metres
Camshaft gear bolt	40 lb ft	5·53 kg metres
Cylinder head nuts and bolts	90 lb ft	12·4 kg metres
Cylinder head studs into block	35 lb ft	4·84 kg metres
Flywheel housing to engine bolts	30 lb ft	4·14 kg metres
Flywheel nuts	50 lb ft	6·92 kg metres
Front extension to main frame bolts	50 lb ft	6·92 kg metres
Fuel Injection Pump:		
Automatic retard fixing bolt	120 lb in	1·38 kg metres
Governor housing nuts (Permanite gasket)	40 lb in	0·46 kg metres
Governor housing nuts (cork gasket)	30 lb in	0·35 kg metres
Head-side fixing bolts	170 lb in	1·96 kg metres
Inspection cover nuts	30 lb in	0·35 kg metres
Inspection pipe banjo bolts	270 lb in	3·11 kg metres
Manual lock fixing bolt	350 lb in	4·02 kg metres
Throttle and stop lever nuts	30 lb in	0·35 kg metres
Main bearing cap bolts	140 lb ft	19·3 kg metres
Main frame to engine bolts	30 lb ft	4·14 kg metres
Main frame to flywheel housing bolts	50 lb ft	6·92 kg metres
Oil filter bowl bolt	10 lb ft	1·38 kg metres
Sump to main frame bolts	20 lb ft	2·76 kg metres
Valve rocker adjusting nuts	14 lb ft	1·94 kg metres

The following figures apply to bolts of standard material with either coarse (UNC) or fine (UNF) threads and may be used for all bolts and nuts not listed in the previous table.

Thread Diameter	Torque	
$\frac{1}{4}$ in	7 lb ft	0·97 kg metres
$\frac{5}{16}$ in	15 lb ft	2·07 kg metres
$\frac{3}{8}$ in	25 lb ft	3·46 kg metres
$\frac{7}{16}$ in	45 lb ft	6·22 kg metres
$\frac{1}{2}$ in	65 lb ft	8·98 kg metres
$\frac{5}{8}$ in	110 lb ft	15·2 kg metres
$\frac{3}{4}$ in	140 lb ft	19·3 kg metres

Capacities

Cooling system	3 gal	12·6 litres
Engine lubricating oil	13 pints	7·4 litres
Steering-box oil	2 pints	1·1 litres
Air-cleaner oil bath	1¼ pints	0·7 litres
Fuel tank	13½ gal	61·4 litres

Wear Limits

The following figures are only intended to serve as a guide to determine when a component should be renewed:

Crankshaft big-end journals should be reground if ovality exceeds 0·005 in. (0·127 mm).

Crankshaft main-bearing journals should be reground if wear exceeds 0·005 in. (0·127 mm).

Piston rings should be replaced if the ring gap exceeds 0·060 in. (1·524 mm) when checked in the unworn part of the cylinder.

When there is evidence of ring and slight bore wear causing oil consumption, fit oil control rings. These should control oil consumption if the bore wear is not greater than 0·010 in. (0·25 mm) and are available to suit either standard or oversize bores. If oil consumption exists and oil control rings have already been fitted it will be necessary to renew the cylinder liners and pistons.

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7. **Air Cleaner**: Clean out oil bath and replenish with the correct oil. Wash out gauze filter and clean tube and pre-cleaner. If a paper pre-cleaner is fitted, clean or renew the element. (See Page 1.)

Decarbonising the Engine

When compression is low or engine is down in power due to an accumulation of carbon inside combustion chamber, the cylinder head should be removed, cleaned of carbon deposits and the valves re-seated.

To Remove Cylinder Head

1. Remove the bonnet, disconnect the battery and drain the cylinder block.
2. Remove injector leak-off pipe and four high-pressure injector pipes.
3. Remove injectors and copper sealing washers. Before refitting, injectors will require servicing and testing. (See Page 7.)
4. Remove breather pipe from air cleaner and unscrew the four domed nuts and remove rocker cover and gasket.
5. Slacken clips on by-pass hose.
6. Remove rocker shaft oil-feed pipe.
7. Remove rocker shaft assembly and push-rods.
8. Remove the ten nuts, seven bolts and two lifting nuts, holding the head to cylinder block, in reverse order to tightening procedure, to prevent distortion of head.
9. Lift off cylinder head and place on the bench.
10. Remove gasket, clean cylinder-block face and oil the bores before covering over with a cloth or sheet of paper for protection.

Dismantling the Cylinder Head and Cleaning

1. Remove inlet and exhaust manifolds, scraping out ports in exhaust manifold and washing to clean away carbon.
2. Mark all valves on head with a number to ensure re-assembly in same order.
3. Remove valve springs, cotters, collars and inlet valve seals and wash in paraffin.
4. Clean the head, scraping all carbon from valve ports, then wash and clean with an air jet.

Valves and Seats

The valve stems operate direct in micro-finished bores in the cylinder head (no separate guides). The inlet valves are fitted with taper cotters which grip the valve stem and prevent it from rotating, but the exhaust valve cotters are parallel and the valve has a loose cap on the end of the stem. The valve rocker does not, therefore, operate directly on the valve stem but operates against the cap so that the valve is free of pressure at the beginning and end of each opening period. This allows the valve to rotate, keeping it free of carbon and prolonging seat life.

Clean the valves and reface if necessary, using a suitable valve grinder. The valve faces should be ground at 45° and care must be taken not to remove too much metal as the exhaust valves will overheat if heads are ground to a knife-edge finish.

Examine the ends of the inlet valve stems and if worn, lightly skim on a valve refacing machine, using the V-support guide to ensure that the end is ground square with the valve stem.

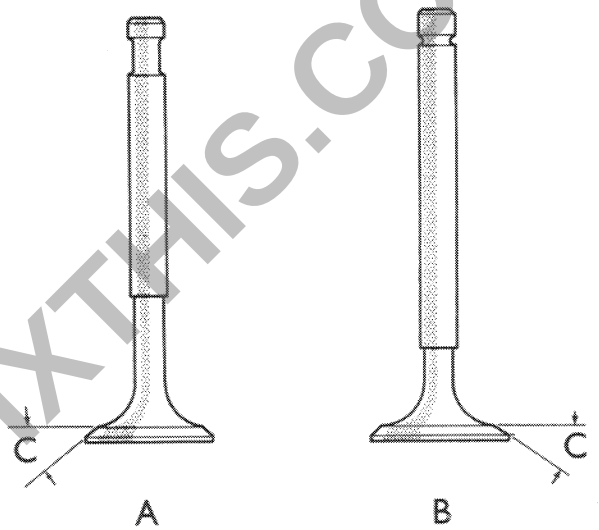


Figure 29. INLET AND EXHAUST VALVES
A. Exhaust valve B. Inlet valve
C. Seat angle 45°

Examine valve seats. If seats are in good condition but only discoloured, lapping-in the valves will be sufficient to obtain a good seat, but if seats are pitted it may be necessary to recut them before lapping-in the valves. Use a valve seat cutter, or grinder, with a pilot of the correct diameter, to ensure an accurate seat (see Tool Leaflet B9). Do not remove more metal than is necessary. If valve seat becomes wider than 0·065 in. (1·65 mm), the seat insert should be removed and a new insert fitted. To remove the insert, weaken by drilling almost through then crack it with a sharp chisel, taking care not to damage cylinder head, and covering insert with a piece of cloth, to prevent injury from flying particles. Clean the head counterbore and after cooling new insert with dry ice (solid carbon dioxide) quickly tap it into position using Service Tool 960602. The seat must be fitted with its chamfered edge into the head counterbore and then ground flush with the head face before the seat is cut.

Oversize Valves

The valve guides are cast integral with cylinder head and if excessive wear takes place the guide can be reamed true and new valves with oversize stems fitted. Valves with 0·010 in. and 0·020 in. oversize stems are available and the appropriate size reamer

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LUBRICATION SYSTEM

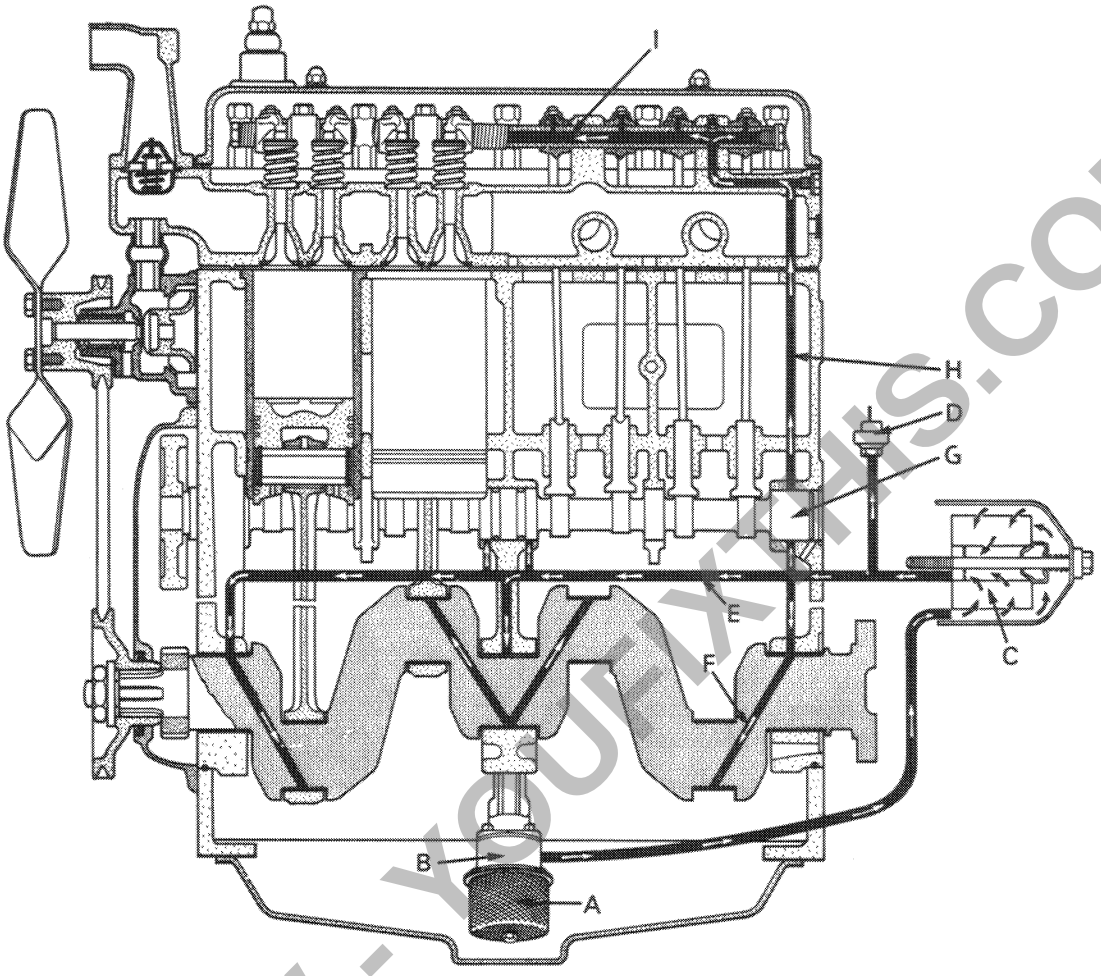


Figure 19. LUBRICATION SYSTEM

A. Inlet gauze
B. Oil pump
C. Filter
D. Warning light switch
E. Oil gallery
F. Crankshaft oil passage
G. Camshaft rear bearing
H. Valve gear feed
I. Rocker shaft

Engine Lubrication

Oil is drawn from the sump by the gear-driven rotary oil pump and delivered under pressure to the oil filter. After filtration the oil passes to the main oil gallery in the cylinder block and so, via oilways in the block webs, to the crankshaft main journals and then on, through further oilways in the cylinder block, to pressure lubricate the camshaft bearings. The big-end bearings are lubricated by drillings in the crankshaft webs.

The rocker shaft and valve rockers are intermittently fed with oil from the camshaft rear bearing through oilways in block and head and an external connecting pipe. The camshaft is drilled off-centre so that the oilways are connected only once in each revolution. (See Fig. 20.) The oil lubricates the tappets and push rods as it returns to the sump.

The intermediate gear is pressure fed via its hollow shaft and an oil-way in the cylinder block. A connection at the front end of the main oil gallery supplies a reduced flow of oil to the injection pump drive gear. Surplus oil in the timing cover forms an oil bath which splash lubricates the timing gears.

A full-flow oil filter is mounted on the left-hand side of the cylinder block. The filter incorporates a by-pass valve so that if the pressure difference between the filter inlet and outlet exceeds 10 lb/sq in. the valve opens and allows oil to by-pass the element and flow straight into the oil gallery. The engine is not, therefore, starved of oil if the element is allowed to become choked, but it is supplied with unfiltered oil. The replaceable paper element should be renewed at the intervals specified on Page 1. A new element should also be fitted when an engine is overhauled and also if a cylinder head gasket fails.

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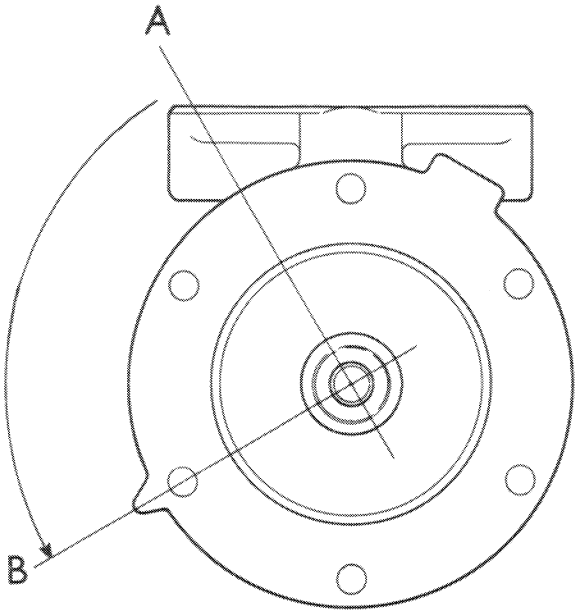


Figure 10. REFITTING FEED PUMP DIAPHRAGM

With the diaphragm tab at position A, fit the diaphragm on to the pump body until the pull-rod enters the link slot, then turn the diaphragm 90°, so that the tab is at position B, to lock the pull-rod in the link slot.

Injector Servicing

Nozzle Testing: The hand tester shown in Fig. 11 is adequate for testing and pressure setting injectors.

Attach the injector to the spray tester and place a canister round the nozzle to ensure that spray does not contact the body. The force of the spray is such that it will easily penetrate the skin, even through clothing. The resultant oil under the skin is very difficult to treat and can be a very uncomfortable wound. The canister will also help to condense the very fine spray which forms an objectionable atmosphere. If regular nozzle testing is contemplated a totally enclosed test chamber with exhauster is advocated.

Pressure Test: With injector mounted in the test outfit, depress hand lever several times to fill the injector and expel any air. Depress lever very slowly and observe highest pressure reading that is obtained before needle on pressure gauge flicks. This is the pressure at which injection takes place. The correct pressure for new injectors is 185 atmospheres, and for used injectors 175 atmospheres.

If the pressure is incorrect but the nozzle is clean and otherwise satisfactory, it should be set to the correct figure as follows: Remove dome cap and slacken locknut, and using a large screwdriver in the pressure adjusting screw D (Fig. 12) adjust the pressure. Only a very small movement will be required unless the nozzle has only just been assembled and the pressure not previously set. When the screw has been adjusted, tighten locknut and recheck pressure.

Back Leakage Test: Operate hand pump until pressure is about 170 atmospheres. Release the handle quickly and measure, with a stop-watch, the time taken between pressure gauge pointer passing the marks for 150 and 100 atmospheres as it gradually falls. For a satisfactory nozzle the time taken should be between 6 and 25 seconds.

Dry Seat Test: Carefully wipe nozzle dry. Build up pressure to 10 atmospheres below the injection pressure. Examine nozzle whilst under this pressure. It should be dry and free from leakage. If the nozzle is inadvertently caused to inject, the tip should be re-wiped dry and tested again.

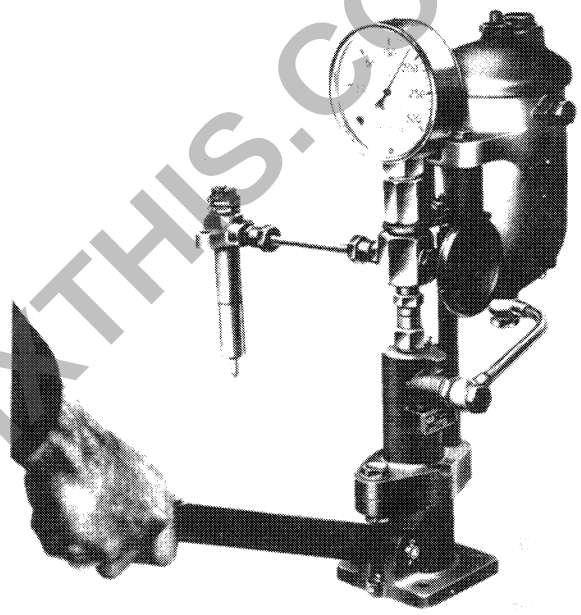


Figure 11. INJECTOR TESTING
Using Service Tool 7044/122FF

Atomisation Test: Isolate pressure gauge by closing valve. Apply eight quick jerks and examine the spray quality. The sprays should be free from coarse or solid streaks and the tip should remain dry. There should be four sprays equally spaced at an inclusive angle of 140°. They are offset 10° to allow for the tilt of the injector in the cylinder head.

Examine injector for signs of leakage at nozzle cap nut, spring adjusting nut, and copper sealing washers.

Nozzle Cleaning: If the injector fails to pass any of the above tests it must be dismantled, cleaned and retested. Note the spring pressure must be released before removing a nozzle. Unscrew the nozzle cap (Fig. 12), using a close-fitting spanner on the flats provided, and remove nozzle, noting that it will only fit in one position because of the locating dowels. Remove needle valve and place in petrol to soften the carbon. Examine nozzle and needle for damage, overheating or scratch marks on the lapped working surfaces. If excessive overheating has occurred, denoted by a dark blue colour of the needle, or if the seat or working surfaces are damaged, reconditioning will be required and a new nozzle should be fitted.

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Piston groove clearance should not exceed 0·010 in. (0·25 mm) when checked with a new ring.

Oversize valves should be fitted if the bore in the cylinder head is worn in excess of 0·006 in. (0·15 mm). For details of oversize reamers and seat cutter pilots see Service Tool Leaflet A28.

Piston Dimensions (new)

Nominal diameter	3⅝ in	92·075 mm
Piston skirt diameter (at right-angles to gudgeon pin bore)	3·619 — 3·618 in	91·93 — 91·91 mm
Piston weight variation (maximum in one set)	½ oz	14 gm
Piston ring side clearance	0·002 — 0·0035 in	0·050 — 0·088 mm
Piston ring gap	0·010 — 0·015 in	0·254 — 0·374 mm
Gudgeon pin diameter	1·2503 — 1·250 in	31·757 — 31·750 mm

(Push-fit in connecting rod bush, light-drive fit in piston)

Sleeve Dimensions (new)

Bore	3·655 — 3·6250 in	92·088 — 92·076 mm
Taper (maximum)	0·0005 in	0·0127 mm
Ovality (maximum)	0·0005 in	0·0127 mm
Protrusion (excluding ridge)	0·002 — 0·005 in	0·0508 — 0·127 mm

Valve Clearance (set cold)

Inlet and Exhausts to AD4/47A 60389 and AD4/47B 40724	0·015 in	0·35 mm
Exhaust to AD4/47A 60389 and AD4/47B 40724	0·012 in	0·30 mm
Inlet and Exhausts from AD4/47A 60390 and AD4/47B 40725	0·010 in	0·25 mm
Exhaust from AD4/47A 60390 and AD4/47B 40725	0·007 in	0·18 mm

Valve Springs (inlet and exhaust)

Free length	1·970 in	5·0 cm
Length at 40 lb load	1·530 in	
Length at 80 lb load	1·102 in	
Length at 15 kg load		4·08 cm
Length at 30 kg load		3·15 cm

Valve Stem Diameters (inlet and exhaust)

Standard	0·3732 — 0·3722 in	9·479 — 9·454 mm
Oversize 0·010 in. (0·007 mm)	0·3832 — 0·3822 in	9·733 — 9·708 mm
Oversize 0·020 in. (0·014 mm)	0·3932 — 0·3922 in	9·987 — 9·962 mm
Valve seat angle	45°	45°
Valve guide bore	0·375 — 0·374 in	9·525 — 9·499 mm
Valve tappet diameter	0·624 — 0·623 in	15·850 — 15·824 mm

Valve Timing

Inlet opens	8° before top dead centre
Inlet closes	38° after bottom dead centre
Exhaust opens	36° before bottom dead centre
Exhaust closes	10° after top dead centre

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