

TECHNICAL DATA—C.2

Engine Data

No. of cylinders	...	...	...	...	...	...	3
Cycle	...	...	...	...	...	...	Four stroke
Combustion system	3.152	...	...	...	...	...	Indirect injection
Combustion system - All other engines	...	...	...	...	...	...	Direct injection
Nominal bore	...	...	...	...	...	...	91,44 mm (3,6 in)
Stroke	...	...	...	...	...	...	127 mm (5 in)
Compression ratio - 3.152	...	...	...	...	...	...	17.4:1
- D3.152	...	...	...	...	...	...	18.5:1
- Up rated D3.152	...	...	...	...	...	...	16.5:1
- 3.1522	...	...	...	...	...	...	19:1
- 3.1524	...	...	...	...	...	...	16.5:1
- T3.1524	...	...	...	...	...	...	15.5:1
Cubic capacity	...	...	...	...	...	...	2,5 litres (152 in ³)
Firing order	...	...	...	...	...	...	1, 2, 3
Tapet clearance (cold) - 3.152, D3.152	...	...	...	...	...	...	0,30 mm (0.012 in)
Tapet clearance (hot or cold) - 3.1522, 3.1524, - T3.1524	...	...	...	...	...	...	Inlet - 0,20 mm (0.008 in) Exhaust - 0,32 mm (0.0125 in)
Lubricating oil pressure	...	...	...	...	...	...	207 kN/m ² (30 lbf/in ²) 2,1 kgf/cm ² minimum at maximum engine speed and normal engine temperature
Direction of rotation	...	...	...	...	...	...	Clockwise from the front
Turbocharger boost pressure* (measured at induction manifold)	...	...	...	...	...	...	41 kN/m ² (6.0 lbf/in ²) 0,42 kgf/cm ²

*Variable according to application, load and speed.

Approximate dry engine weights (with accessories but no flywheel or backplate)

3.152	...	...	...	...	...	...	202 kg (445 lb)
D3.152	...	...	...	...	...	...	204 kg (450 lb)
3.1522	...	...	...	...	...	...	210 kg (463 lb)
3.1524	...	...	...	...	...	...	210 kg (463 lb)
T3.1524	...	...	...	...	...	...	217 kg (478 lb)

Typical dry installed engine weights

Agricultural	...	...	...	...	...	...	290 kg (640 lb)
Industrial	...	...	...	...	...	...	310 kg (685 lb)

Rating details

3.152

Maximum gross rating	...	...	...	...	...	...	33.5 kW (45 bhp) at 2,500 rev/min
Maximum torque	...	...	...	...	...	...	155 Nm (115 lbf ft) 15,9 kgf m at 1,350 rev/min

D3.152

Maximum gross rating	...	...	...	...	...	...	36 kW (49 bhp) at 2,500 rev/min
Maximum torque	...	...	...	...	...	...	160 Nm (118 lbf ft) 16,3 kgf m at 1,400 rev/min

3.1522

Maximum gross rating	...	...	...	...	...	...	33.2 kW (44.5 bhp) at 2,500 rev/min
Maximum torque	...	...	...	...	...	...	160 Nm (118 lbf ft) 16,3 kgf m at 1,400 rev/min

3.1524

Maximum gross rating	...	...	...	...	...	...	39 kW (52.0 bhp) at 2,500 rev/min
Maximum torque	...	...	...	...	...	...	174 Nm (128 lbf ft) 17,8 kgf m at 1,350 rev/min

T3.1524

Maximum gross rating	...	...	...	...	...	...	45 kW (60.0 bhp) at 2,250 rev/min
Maximum torque	...	...	...	...	...	...	210 Nm (155 lbf ft) 21,4 kgf m at 1,500 rev/min

Note: The rating and torque information given above is general for BS. AU 141a:1971 conditions and can change with different applications. For more details, apply to Technical Services Department, Perkins Engines Limited, Peterborough, England or to one of the companies given on page A6.

FAULT DIAGNOSIS—E.2

Fault diagnosis chart

Problem	Possible causes
Starter motor turns engine too slowly.	1, 2, 3, 4
Will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33, 63
Difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33, 63
Not enough power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 60, 62
Misfire	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
High fuel consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33
Black exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33, 60, 62
Blue/white exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56, 61
Low lubricating oil pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58
Engine knocks	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59
Runs erratically	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49
High lubrication oil pressure	4, 38, 41
Engine temperature too high	11, 13, 14, 16, 18, 19, 24, 25, 45, 47, 50, 51, 52, 53, 54, 57
Crankcase pressure	25, 31, 33, 34, 45, 55
Bad compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59
Starts and stops	10, 11, 12

Code list of possible causes

1. Battery capacity low.
2. Bad electrical connections.
3. Fault in starter motor.
4. Wrong grade of lubricating oil.
5. Low engine speed from starter motor.
6. Fuel tank empty.
7. Stop control fault.
8. Restriction in fuel pipe.
9. Fault in fuel lift pump.
10. Dirty fuel filter element.
11. Restriction in air filter or induction system.
12. Air in fuel system.
13. Fault in fuel injection pump.
14. Fault in atomisers or not correct type.
15. Cold start equipment not used correctly.
16. Fault in cold start equipment.
17. Broken fuel injection pump drive.
18. Fuel injection pump timing not correct.
19. Valve timing not correct.
20. Bad compression.
21. Restriction in fuel tank vent.
22. Type or grade of fuel not correct.
23. Restriction of engine speed control movement.
24. Restriction in exhaust pipe.
25. Cylinder head gasket leaks.
26. Engine temperature too high.
27. Engine temperature too low.
28. Valve tip clearances not correct.
29. Valves not free.
30. Wrong high pressure pipes.
31. Worn cylinder bores.
32. Valves and seats do not seal correctly.
33. Piston rings not free or are worn or broken.
34. Valve stems and/or guides worn.
35. Wet type air cleaner too full or wrong type of oil used.
36. Crankshaft bearings wear or damage.
37. Not enough lubricating oil in the sump.
38. Gauge not correct.
39. Lubricating oil pump worn.
40. Relief valve not free to close.
41. Relief valve not free to open.
42. Relief valve spring broken.
43. Fault in suction pipe of lubricating oil pump.
44. Dirty lubricating oil filter element.
45. Piston damage.
46. Piston height not correct.
47. Fan damage.
48. Fault in engine mounting (housing).
49. Flywheel housing or flywheel not aligned correctly.
50. Fault in thermostat or wrong type.
51. Restriction in coolant passages.
52. Water pump drive belt loose.
53. Restriction in radiator.
54. Fault in water pump.
55. Restriction in breather pipe.
56. Damage to valve stem oil seals (where used).
57. Not enough coolant in system.
58. Restriction in sump strainer.
59. Valve spring broken.
60. Turbocharger impellor damage, or dirty impellor.
61. Turbocharger lubricating oil leaks.
62. Leakage in induction system (turbocharged engines).
63. Fault in lubricating oil pressure switch or low lubricating oil pressure.

CYLINDER HEAD—F.2

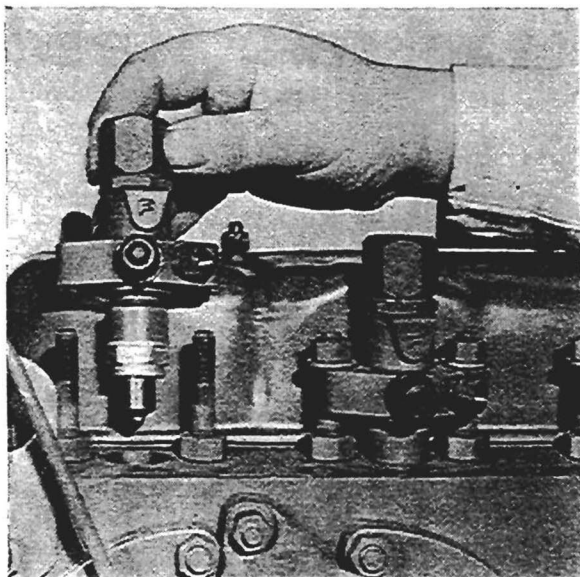


Fig. F1

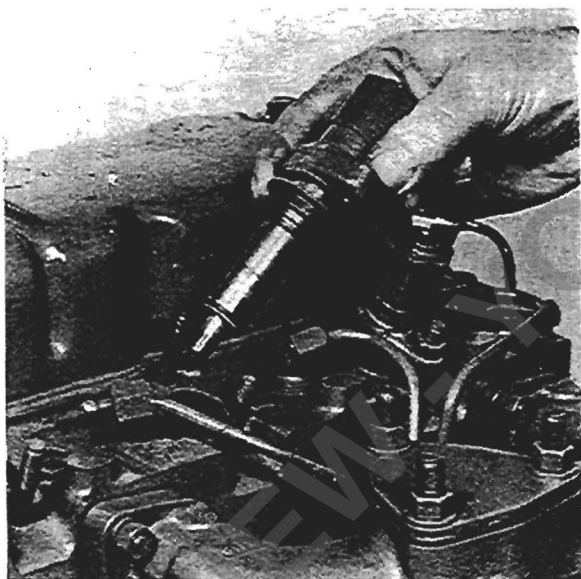


Fig. F2

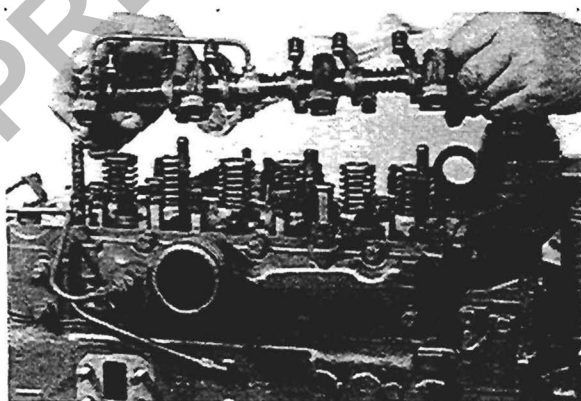


Fig. F3

To remove cylinder head

1. Drain the coolant from the radiator and cylinder block.
2. Disconnect the hose connection from the thermostat housing at the front of the cylinder head.
3. Remove crankcase vent valve and hose from cylinder head cover and induction manifold – 3.1522 engines only.
4. Remove coolant connections to and from exhaust manifold (flame-proof engines only).
5. Remove the air cleaner or filter, or disconnect the air inlet hose from the induction manifold.
6. Disconnect cold start equipment connections.
7. Remove the lubricating oil pipe from the camshaft housing to the cylinder head.
8. Disconnect the exhaust pipe from the exhaust manifold. Remove turbocharger (T3.1524 engines).
9. Disconnect and remove the high pressure fuel pipes from the fuel injection pump and atomisers. Fit suitable caps to the pump and atomiser connections.
10. Remove atomiser leak off pipes.
11. Remove atomisers (see figs. F1 or F2).
12. Where necessary, remove fuel filter and fuel pipe from filter to cold start aid. Remove clip which secures fuel pipe to rear of cylinder head.
13. Remove the cylinder head cover.
14. Disconnect lubricating oil pipe to rocker shaft and remove rocker shaft assembly with pipe (see fig. F3).
15. Remove the cylinder head nuts/setscrews in the reverse sequence to that given in figs. F15 or F16.
16. Remove the cylinder head (see fig. F4) and put it on a flat wood surface to prevent damage. Do not use a sharp tool between the cylinder head and the cylinder block.

To remove valves

Put a suitable mark on the face of each valve so that they can be fitted in their original positions if they are used again.

- Compress the valve springs with a suitable valve spring compressor (see fig. F5) and remove the split collets. Tool 6118B with adaptor PD6118-3 can be used to compress the valve springs with the head on a flat surface.

Remove the spring caps, springs, seals and spring seats and the valves can be removed.

Lubricating oil pressure

Ensure that lubricating oil pressure is shown on the gauge.

The oil pressure can be variable with different engines, but the minimum pressure at maximum engine speed and normal engine temperature is 207 kN/m^2 (30 lbf/in²) or $2,1 \text{ kgf/cm}^2$.

There can be a decrease in pressure when idling and when the engine is hot.

If the lubricating oil pressure shown on the gauge is below normal, check for the reason in the order which follows.

1. Check for correct amount of lubricating oil in sump.
2. Check oil pressure for accuracy.
3. Ensure lubricating oil filter is not dirty. If necessary, fit new canister or element.
4. Ensure sump strainer is not dirty. Clean if necessary.
5. Ensure that suction and delivery pipes to and from lubricating oil pump are tight.
6. Dirt can keep the lubricating oil relief valve open.

Lubricating oil filters

It is important that the lubricating oil filter canister or element is renewed at the correct interval as given on page D2.

The strainer in the lubricating oil sump needs no special maintenance but can be cleaned every time the sump is removed.

With current engines, the main lubricating oil filter has an element which is integral with the canister.

Earlier engines had a separate element fitted in a filter bowl.

Both types of element must be renewed and not cleaned. The correct service interval is given on page D2.

To renew lubricating oil filter element

1. Remove centre bolt on filter head (see fig. M2).
2. Remove filter bowl (see fig. M3).
3. Remove the filter element and discard.
4. Clean inside of filter bowl and fit new element.
5. Ensure that felt seal and rubber joints are in good condition. Renew them if necessary.
6. Fit element and bowl to filter head and tighten centre bolt.
7. Run engine and check for leakage. Check amount of lubricating oil in sump and fill as necessary.

The bolt which fastens the filter bowl must be checked to ensure that it is still tight after the first 20 hours of operation.

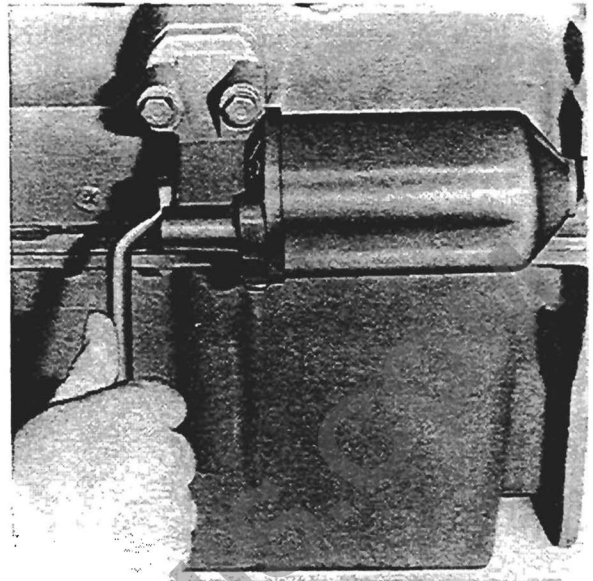


Fig. M2

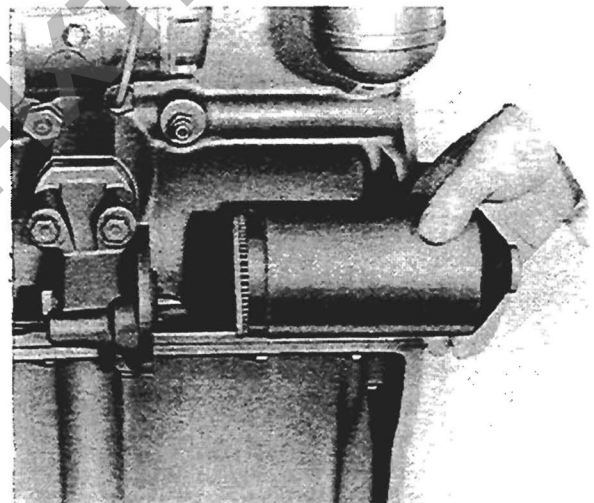


Fig. M3

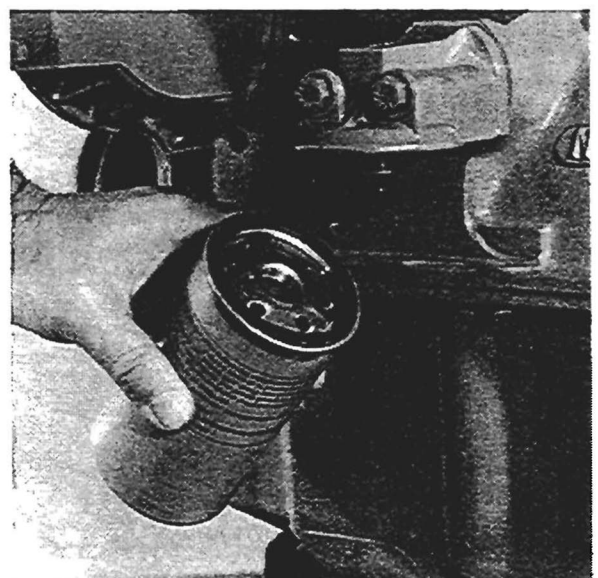


Fig. M4

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* Operating and maintenance information can be found in section 3 of the multi-lingual 3.152 Series Users handbook

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TECHNICAL DATA—C.10

Inlet valves

Valve stem diameter	...	...	...	...	...	7,90/7,92 mm (0.311/0.312 in)
Clearance fit of valve in guide	...	...	...	...	...	0,05/0,11 mm (0.0021/0.0045 in)
Maximum permissible stem/guide clearance	...	...	...	...	...	0,15 mm (0.006 in)
Face angle – 3.152	...	...	...	...	...	45°
Face angle – D3.152 before engine number	...	...	...	...	...	45° or 35° (variable with application)
CE....U584638F	...	...	...	...	...	45° or 35° (variable with application)
Face angle – D3.152 from engine number	...	...	...	...	...	35°
CE....U584638F	...	...	...	...	...	35°
Face angle – 3.1522, 3.1524, T3.1524	...	...	...	...	...	35°
Valve head depth below cylinder head face	...	...	...	...	...	
– 3.152	...	...	...	...	...	1,68/2,03 mm (0.066/0.080 in)
– D3.152 with 45° seats	...	...	...	...	...	1,50/1,89 mm (0.059/0.074 in)
– D3.152 with 35° seats	...	...	...	...	...	1,32/1,63 mm (0.052/0.064 in)
– 3.1522, 3.1524, T3.1524	...	...	...	...	...	1,32/1,63 mm (0.052/0.064 in)
Maximum permissible valve head depth in service	...	...	...	...	...	
– 3.152	...	...	...	...	...	3,50 mm (0.140 in)
– D3.152 with 45° seats	...	...	...	...	...	2,40 mm (0.094 in)
– D3.152 with 35° seats	...	...	...	...	...	2,13 mm (0.084 in)
– 3.1522, 3.1524, T3.1524	...	...	...	...	...	2,13 mm (0.084 in)

Exhaust valves

Valve stem diameter	...	...	...	...	...	7,90/7,92 mm (0.311/0.312 in)
Clearance fit of valve in guide	...	...	...	...	...	0,05/0,11 mm (0.0021/0.0045 in)
Maximum permissible stem/guide clearance	...	...	...	...	...	0,14 mm (0.0055 in)
Face angle – 3.152	...	...	...	...	...	45°
Face angle – D3.152 before engine number	...	...	...	...	...	45° or 35° (variable with application)
CE....U584638F	...	...	...	...	...	45° or 35° (variable with application)
Face angle – D3.152 from engine number	...	...	...	...	...	35°
CE....U584638F	...	...	...	...	...	35°
Face angle – 3.1522, 3.1524,	...	...	...	...	...	45° or 35° (variable with application)
Face angle – T3.1524	...	...	...	...	...	45° or 35° (variable with application)
Valve head depth below cylinder head face	...	...	...	...	...	
– 3.152	...	...	...	...	...	1,68/2,03 mm (0.066/0.080 in)
– D3.152 with 45° seats	...	...	...	...	...	1,47/1,87 mm (0.058/0.073 in)
– D3.152 with 35° seats	...	...	...	...	...	1,60/1,92 mm (0.063/0.0755 in)
– 3.1522, 3.1524, T3.1524	...	...	...	...	...	1,60/1,92 mm (0.063/0.0755 in)
Maximum permissible valve head depth in service	...	...	...	...	...	
– 3.152	...	...	...	...	...	3,50 mm (0.140 in)
– D3.152 with 45° seats	...	...	...	...	...	2,40 mm (0.094 in)
– D3.152 with 35° seats	...	...	...	...	...	2,40 mm (0.094 in)
– 3.1522, 3.1524, T3.1524	...	...	...	...	...	2,40 mm (0.094 in)

Outer valve springs

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

Inner valve springs (where fitted)

Free length	...	...	...	...	...	34,67/35,69 mm (1.365/1.405 in)
Fitted length	...	...	...	...	...	30,16 mm (1.1875 in)
Load at fitted length	...	...	...	...	...	3,63 kg ± 0,45 kg (8.0 lb ± 1 lb)

Tappets

Stem diameter	...	...	...	...	...	15,80/15,84 (0.6222/0.6237 in)
Clearance in cylinder head bore	...	...	...	...	...	0,02/0,09 mm (0.0008/0.0036 in)

Rocker shaft

Outside diameter	...	...	...	...	...	15,81/15,84 mm (0.6223/0.6238 in)
------------------	-----	-----	-----	-----	-----	-----------------------------------

Rocker levers

Bore diameter	...	...	...	...	...	15,86/15,89 mm (0.62480/0.62610 in)
Clearance fit on rocker shaft	...	...	...	...	...	0,03/0,10 mm (0.0010/0.0038 in)
Maximum permissible clearance	...	...	...	...	...	0,13 mm (0.005 in)

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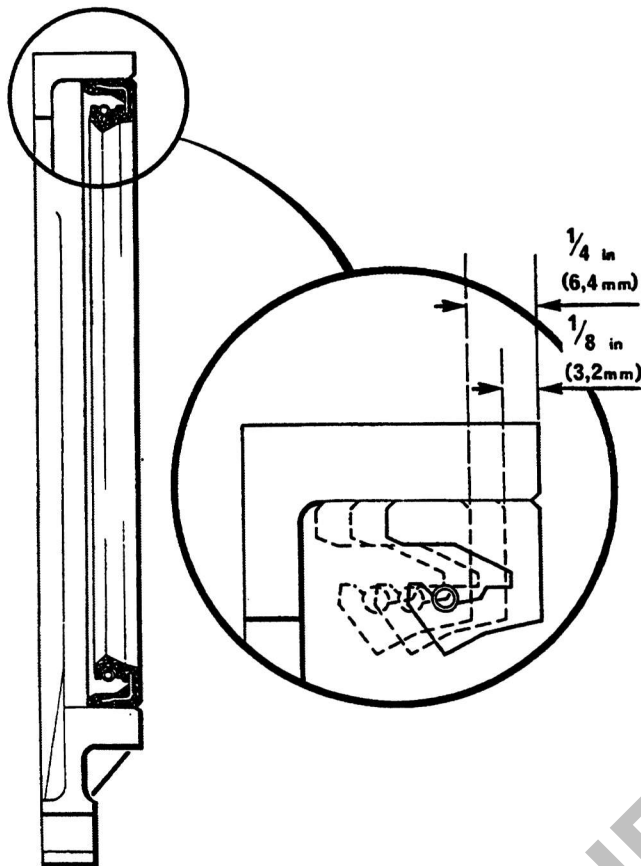


Fig. J9

Crankshaft rear end rope oil seal

This consists of a two piece housing which goes around the rear of the crankshaft which has a spiral oil groove machined to a depth of 0,10 to 0,20 mm (0.004 to 0.008 in) to return the lubricating oil to the inside of the housing. The bore of the housing is machined to take a rubber insert asbestos seal. The seal consists of two halves, one for each half of the housing.

Fit the seals as follows:-

1. Put one half housing in a vice with the seal recess to the top.
2. Fit 25 mm (1 in) of the seal at each end into the ends of the groove so that each end of the seal extends 0,25/0,50 mm (0.010/0.020 in) above the half housing end face.
3. Press the remainder of the seal into the groove by hand. Start this operation from the centre of the seal. Then use a round shaft to roll in the seal by the use of pressure on its inside diameter.
4. Fit seal to other half housing as already indicated.
5. Clean the half housing faces.
6. Lightly apply jointing compound to both sides of the joint and put the joint in position.
7. Lightly apply jointing compound to the end faces of the half housings.
8. Lubricate the inside diameter of the rope seal with graphite grease.
9. Lubricate the rear end of the crankshaft round the oil groove.
10. Put the half housing in position on the engine. Ensure that the half housing with the oil shroud is in the upper position. Fit all setscrews to cylinder block and bearing cap faces finger tight only.
11. Fit the two bolts which fasten the two housings together and tighten the nuts to 8,13 Nm (6 lbf ft) 0,83 kgf m.
12. Tighten the setscrews in the cylinder block and bearing cap to 16,3 Nm (12 lbf ft) 1,66 kgf m.
13. Tighten the two nuts to 16,3 Nm (12 lbf ft) 1,66 kgf m.

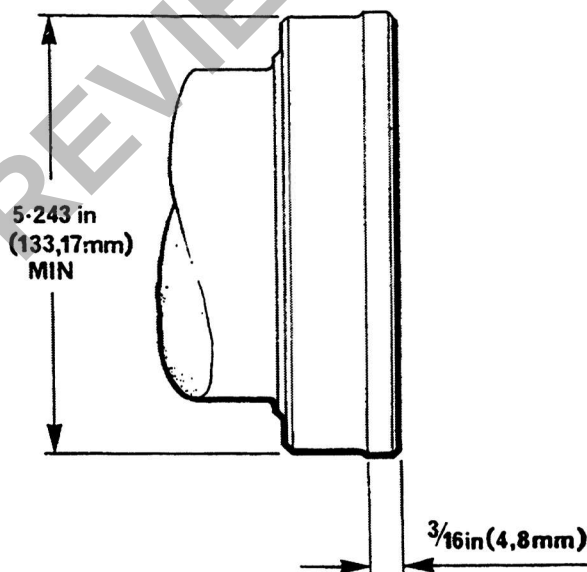


Fig. J10

LUBRICATION SYSTEM—M.6

To fit lubricating oil pump

1. Fill lubricating oil pump with clean lubricating oil.
2. Fit idler gear to shaft but do not fasten with circlip.
3. Fit lubricating oil pump to front main bearing cap and fasten with three setscrews. Connect delivery pipe from pump to cylinder block.
4. Fasten idler gear with circlip.
5. Fit suction pipe and strainer.
6. Fit timing case bottom half and tighten two nuts and washers to timing case top half.
7. Fit the three setscrews at the bottom of the timing case front cover.
8. Fit the lubricating oil sump as already given.

Note: Before the engine is started, it must be turned with the stop control operated until lubricating oil pressure is shown on the gauge.
If an electrical solenoid stop control is fitted, turn the start switch to the "R" position.

ELECTRICAL EQUIPMENT—R.2

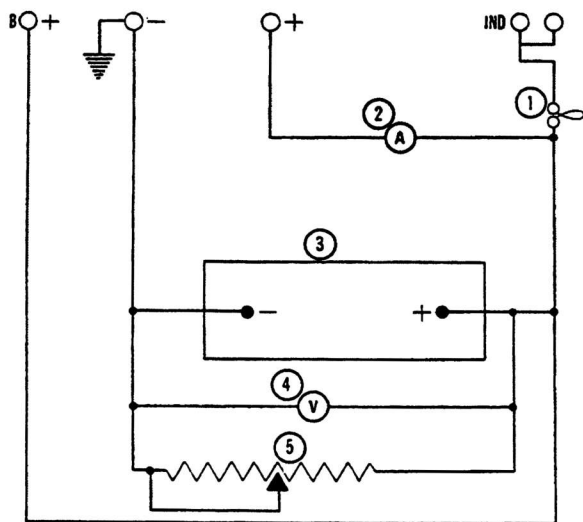


Fig. R1

Fig. R1 shows a test circuit for 15ACR and 17ACR alternators with standard terminals, battery-sensed.

Fig. R2 shows a test circuit for 15ACR and 17ACR alternators with standard terminals and two piece connection plug (machine-sensed).

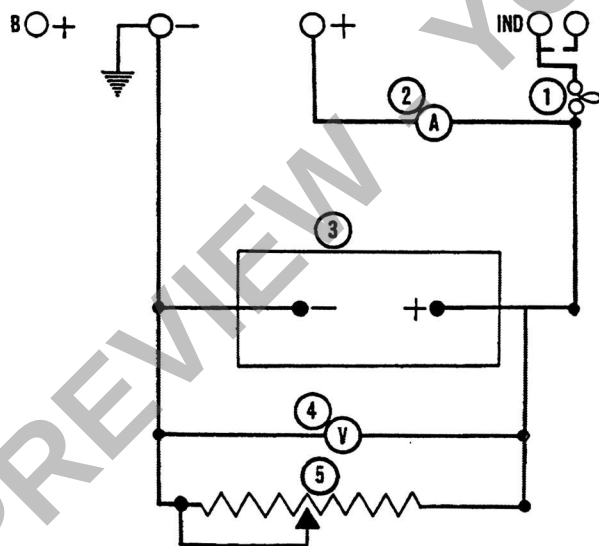


Fig. R2

Components in figs. R1 and R2.

1. 12 volt, 2.2 watt bulb.
2. 0 – 60 ammeter.
3. 12 volt battery.
4. 0 – 20 moving coil voltmeter.
5. 0 – 15 ohm 50 amp variable resistor.

ALTERNATORS

Models 15ACR, 16ACR, 17ACR, 18ACR, 23ACR, A115/36, A115/45, A127, 9AR and LR Series

Precautions

The diodes in the alternator operate as one way valves and the transistors in the regulator/control box operate as fast switches.

They do not wear or need adjustment, but the precautions which follow are necessary to ensure that no damage occurs.

1. Do not disconnect the battery while the engine is in operation. This will cause a high voltage in the alternator charge system and immediately burn out the diodes or transistors.
2. Do not disconnect a wire while the engine is in operation. Ensure all electrical switches are turned to the off position.
3. Do not cause a short circuit by the connection of wires to the wrong terminals. Always connect a wire to its correct terminal. A short circuit or wrong connection can give reverse polarity and burn out transistors or diodes.
4. Do not connect a battery into the system with wrong polarity or voltage.
5. Do not touch connections together to check for current flow. The transistors can be burnt out.

Maintenance

The alternator charge system needs little attention, but must be kept clean and a check must be made if it does not keep the battery charged.

1. Check the drive belt for correct tension or wear. Where two drive belts are used, they must both have the same tension. Loose belts will wear fast and will not turn the alternator at the correct speed.
2. Tight belts will cause too much of a load on the alternator bearings and wear will occur.
3. Where two drive belts are used, both must be renewed at the same time.
4. Clean the alternator with a cloth used with kerosene or similar fluid. Ensure that slots and air spaces for ventilation are open.
5. Remove any dirt from the regulator/control box and ensure that air can pass over the housing.

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