

HA6DTI Engine (B platform) SERVICE MANUAL



ASHOK LEYLAND



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HA57L165 CRS BSIII ENGINE

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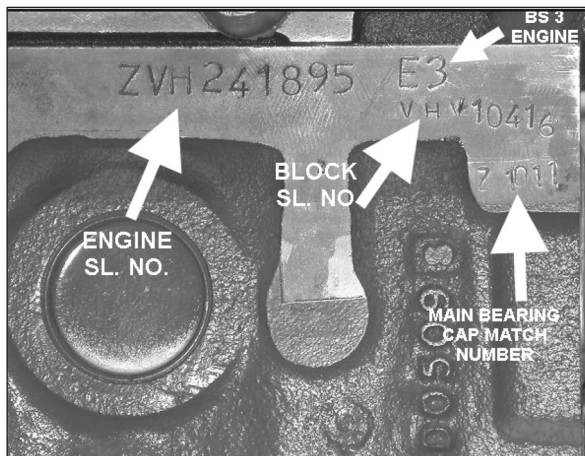
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17.0 GENERAL

17.0.0 Engine Type and Number



The engine number is punched on the left side rear top corner of the crankcase.

17.0.1 Design and Operation

HA6DIT is a 6 cylinder, water cooled 4 stroke Diesel Engine with direct fuel injection.

The engine employs a re-entrant combustion chamber which features a specially shaped combustion chamber in the piston crown.

Another characteristics is the special shape and arrangement of the intake ducts in the cylinder head which allows the air to enter only from one direction. Upon entering, the air is given a swirling motion causing the fuel to mix, which is injected through a multi hole nozzle into the combustion chamber. Combustion is initiated at the end of compression stroke.

The shape of the combustion chamber allows full use of the energy contained in the fuel, because the cooling surfaces are comparatively small in relation to the volume of the combustion chamber whilst the air swirls ensures that air and fuel are mixed uniformly.

17.0.2 General Data

Description	HA6DTI
Type	Diesel four stroke, 6 cylinder water cooled, direct injection, in line over head valve.
Aspiration	Turbo charged with Inter cooler.
No of cylinders	6
Type of cooling	Water cooled
Bore and Stroke	104 x 113 mm
Piston displacement	5.759 litres
Compression Ratio	17.5 : 1
Firing order	1-4-2-6-3-5
Direction of rotation	Counter clockwise viewed from flywheel.
Compression pressure	29 - 32 kg/cm ² @ 280 rpm (Limit - 24 kg/cm ²)
Idling revolution	600 ± 25 rpm
Engine Weight (with oil)	530 kg
Valve Timing	
Intake opens	31° Before TDC
Intake closes	43° After BDC
Exhaust opens	71° Before BDC
Exhaust closes	29° After TDC
Valve clearance (when cold)	
Intake	0.30 mm (0.012")
Exhaust	0.45 mm (0.018")
Engine Oil Pump	
Type	Full forced Pressure feed by gear pump
Drive	By timing gear

**17.0.2 General Data**

Description	HA6DTI
Engine oil cooler	Multi plates type - water cooled
Fuel Injection Equipment	Inline Fuel Pump
High Pressure Pipe (OD x ID x Length)	6.35 X 1.8 x 60 mm - 6 Nos
Injection Nozzle	
Type	Multi hole nozzle
Opening pressure	250 - 258 bar
Coolant Pump	
Type	Forced circulation by volute pump, 55 mm dia ball and roller bearing
Drive	By Poly V-belt
Impeller dia	100 mm
Thermostat	Twin thermostat, Wax type, Bottom bypass system, opens at 82° ± 2°C
Injection timing	Not applicable. Pump to be fitted when 1st cylinder is at TDC on the compression stroke
Turbo Charger	Without waste gate
Electrical	
Starter motor	24V, pre-engaged
Alternator	24V - 100 Amps

17.0.3 Repair Data

Description	Specification (Measurements in mm)	Measuring Device and Remarks
	HA6DTI	
Crankcase		
Cylinder block flatness	0.05 (limit 0.1)	Straight edge and feeler gauge
Crankcase bore for cylinder liner fitment	Refer section 17.0.8	W,X,Y,Z, punch marked on crank case LH side adjacent to each bore
Ovality / taper	0.020 (limit)	
Cylinder liner outside diameter	Refer section 17.0.8	W,X,Y,Z, paint mark given on cylinder liner OD for identification
Fitment of cylinder liner in crankcase bore	Mild interference fit	Selective assy (only MLS gasket to be used)
Cylinder liner bore: Size	104.008 - 104.040 (limit 104.15)	Bore dial gauge (To be measured at 80 mm from top)
Liner projection	0.01 - 0.08	Dial gauge with magnetic stand
Block Top Surface to Crankshaft Centre	300 ± 0.05	
Block Top Surface to sump face height	370 ± 0.1	
Main parent bore dia	77.985 - 78.00	Micro meter and bore dial gauge
Ovality / taper (Main parent bore)	0.005 (limit)	
Cylinder counter bore depth	7.98 - 8.015	Vernier depth gauge
Cylinder counter bore dia	112.12 - 112.29	Micro meter and bore dial gauge



17.0.3 Repair Data

Description	Specification (Measurements in mm)	Measuring Device and Remarks
	HA6DTI	
Piston and Connecting Rod Assembly		
Piston diameter Standard size	103.960	Micrometer (measure at skirt area perpendicular to pin axis)
Diametral piston clearance (at skirt)	0.140 - 0.172	Micrometer and dial gauge
Piston ring Groove Width		
Top	—	Vernier caliper
Second	2.53 - 2.55	
Oil Ring	3.02 - 3.04	
Piston ring width		
Top	—	Micrometer
Second	2.47 - 2.49	
Oil Ring	2.97 - 2.99	
Piston ring side clearance in groove		
Top	0.08 - 0.12	Feeler gauge
Second	0.04 - 0.08	
Oil Ring	0.03 - 0.07	
Piston Ring gap (Butt clearance)		
Top	0.30 - 0.45	Feeler gauge
2nd	0.30 - 0.45	
Oil	0.30 - 0.50	
Maximum permissible piston weight difference per set	5 gms	No need to check weight difference as pistons are serviced as set
Piston pin hole inside diameter	36.998 - 37.003 (limit 37.030)	Bore dial gauge
Gudgeon pin outside diameter	36.989 - 37.000 (limit 36.980)	Micrometer (Push fit in piston heated to 80°C)
Clearance between Piston pin and Piston pin hole	-0.002 - 0.014 (limit 0.040)	Bore dial gauge
Con rod small end bush bore	41.000 - 41.025	Bore dial gauge
Diametral clearance between gudgeon pin and con. rod small end bush bore Max. permissible clearance	0.015 - 0.036 (limit 0.08)	Bore dial gauge and micrometer
Interference fit of small end bush in connecting rod	0.035 - 0.092	Bore dial gauge and micrometer
Connecting rod centre to centre distance	181.480 - 181.520	
Connecting rod bend / twist limit	0.1 per 200	
Connecting rod big end parent bore dia	68.985 - 69.000	Bore dial gauge
Connecting rod side clearance	0.20 - 0.52 (limit 0.6)	Feeler gauge
Connecting rod Big end ovality/taper	0.004	Bore dial gauge and micrometer
Connecting rod big end bearing spread	69.75 - 70.75	Vernier calliper
Max. permissible connecting rod weight (gms) Grading	A : 1710 - 1750	Grades A, B, C, D, E are punched on big end of the connecting rod. An engine should have connecting rods of same grade.
	B : 1750 - 1790	
	C : 1790 - 1830	
	D : 1830 - 1870	
	E : 1870 - 1910	



17.0.3 Repair Data

Description	Specification (Measurements in mm)	Measuring Device and Remarks
	HA57L165	
Crankshaft		
Crankshaft journals and crankpin grinding dimensions	Refer section 17.0.6	Micrometer
Surface hardness of journals and crankpins	580 - 680 HV (Cut off 520 HV)	Hardness Tester. No further heat treatment recommended
Maximum permissible bend at 4th journal	limit 0.02	V-Blocks and dial gauge
Journals and crankpins	Refer section 17.0.5	Micrometer
Crankshaft Main Bearing Cap roundness	0.06	
Main and connecting journal sizes	Refer section 17.0.6	(Standard and undersizes)
Crankshaft end play	0.05 - 0.125	Magnetic stand and dial gauge
Maximum permissible clearance	0.4 (limit)	
Diametral clearance between main journal and bearing	0.039 - 0.09	Bore dial gauge and micrometer
Max. permissible clearance	0.13 (limit)	
Main bearing spread (upper / lower)	78.75 - 79.75	Vernier Calliper
Diametral clearance between Connecting Rod Big End Bearing & Crank pin	0.031 - 0.082 (limit 0.12)	Bore dial gauge and micrometer
Flywheel face out (parallelism for the clutch setting)	0.08	Dial gauge
Flywheel runout (concentricity for the clutch setting)	0.13	Dial gauge
Flywheel thickness (face plate)	19.00	
Cylinder Heads and Valves		
Cylinder head flatness	0.05 (limit 0.1)	Straight edge and feeler gauge
Cylinder head height	87 ± 0.1	Vernier calliper
Nozzle protrusion from cylinder head surface	2.6 ± 0.25	Depth gauge
Valve projection/sink (Valve head depth below cylinder head face)		
Inlet	0.05 - 0.35	Dial gauge
Exhaust	(-) 0.47 - (-) 0.77	
Valve stem diameter		
Inlet	8.95 - 8.97 (limit 8.9)	Micrometer
Exhaust	8.93 - 8.95 (limit 8.8)	
Intake and Exhaust Valve Guide inner dia	9.000 - 9.015	Internal micro meter
Diametral valve stem clearance in guide		
Intake	0.035 - 0.068	Plug gauge and Micrometer
Exhaust	0.050 - 0.083	
Valve seat angle		
Intake	30° - 30° 15'	Bevel Protractor (for both inlet and exhaust)
Exhaust	45° - 45° 15'	
Valve seat seating depth on cylinder head		
Inlet	8.9 ± 0.1	
Exhaust	7.3 ± 0.1	

**17.0.3 Repair Data**

Description	Specification (Measurements in mm)	Measuring Device and Remarks
	HA57L165	
Valve seat thickness Inlet Exhaust	7.5 - 7.7 6.0 - 6.2	
Valve seat seating dia on cylinder head Inlet Exhaust	46.5 (+0.016, - 0.0) 41.0 (+0.10, - 0.0)	
Outer dia of valve seat Inlet Exhaust	46.5 (+0.145 - 0.130) 41.0 (+0.145 - 0.130)	
Valve angle Intake Exhaust	29° 45' - 30° 15' 44° 45' - 45° 15'	Protractor (for both inlet and exhaust)
Valve head diameter: Inlet Exhaust	45.3 - 45.5 39.8 - 40.0	Micrometer.
Maximum permissible out of true head face head to stem	0.03	Lathe and dial gauge
Interference fit of valve guide in cylinder head	0.010 - 0.039	Plug gauge and micrometer
Height of valve guide above spring seat	14.5	
Maximum permissible out of true of valve seat to guide	0.030	
Valve spring straightness - Outer/Inner	2.0 (limit)	Tri Square
Valve spring initial load Outer Inner	27.4 ± 1.4 kg at 45.5 mm 8.8 ± 0.4 kg at 43.0 mm	Valve spring scale (inlet and exhaust)
Valve lift Intake Exhaust	12.40 mm 13.80 mm	
Timing		
Rocker arm shaft diameter	18.966 - 18.984	Micrometer
Diametral clearance between rocker lever on rocker shaft	0.036 - 0.079 (limit 0.15)	Dial gauge and micrometer
Push Rod Bend	0.3	Centres and dial gauge
Tappet Diameter	26.95 - 26.97	Micro meter
Tappet guide inside diameter	27.00 - 27.02	Internal micro meter
Diametral tappet clearance in crankcase bore Maximum permissible limit	0.025 - 0.071	Bore dial gauge and
	0.1 (limit)	Micrometer
Camshaft Bend	0.05 (limit)	Dial gauge and V blocks
Camshaft Cam lift (Intake)	6.5213 - 6.4413 (wear limit)	Vernier height gauge and V blocks
Camshaft Cam lift (Exhaust)	7.2352 - 7.1552 (wear limit)	Vernier height gauge and V blocks
Camshaft end play	0.10 - 0.18 (limit 0.3)	Dial gauge with magnetic base



17.0.3 Repair Data

Description	Specification (Measurements in mm)	Measuring Device and Remarks
	HA57L165	
Camshaft Journal Diameter		
Journal 1	56.95 - 56.97 (limit 56.85)	Micro meter
Journal 2	56.75 - 56.77 (limit 56.65)	
Journal 3	56.55 - 56.57 (limit 56.45)	
Journal 4	56.35 - 56.37 (limit 56.25)	
Camshaft Journal Bearing inside Diameter after pressing the bushes.		
Journal 1	57.0 (limit 57.070)	Bore dial gauge
Journal 2	56.8 (limit 56.870)	
Journal 3	56.6 (limit 56.670)	
Journal 4	56.4 (limit 56.470)	
Diametral camshaft clearance in bushes Max. permissible clearance	0.03 - 0.12 0.15 (limit)	Internal measuring gauge and micrometer
Idler Shaft Diameter	49.95 - 49.975 (limit 49.94)	Micrometer
Idler Gear bushing inside Diameter	50.00 - 50.025 (limit 50.05)	Internal micro meter
Diametral clearance between Idler Gear shaft and Bush	0.03 to 0.08 (limit 0.1)	Internal measuring gauge and micrometer
Idler Gear end play	0.04 - 0.10 (limit 0.15)	Dial gauge
Tooth Backlash between Crank gear and idler gear	0.068 - 0.194	Feeler gauge or dial gauge & Idler gear
Tooth Backlash between Idler gear and camshaft gear	0.065 - 0.182 (limit 0.3)	Feeler gauge or dial gauge
Tooth Backlash between Injection Pump gear & Idler gear	0.065 - 0.232	Feeler gauge or dial gauge
Tooth Backlash between Cam gear & Oil Pump gear	0.065 - 0.182 (limit 0.3)	Feeler gauge or dial gauge
Engine lubrication		
Max. oil pressure:		
Full-load	4.5/4.8 kg/cm ²	Pressure gauge
Idling	1.2/1.6 kg/cm ²	Pressure gauge
Minimum oil pressure	1.0 kg/cm ² (engine idling)	
Oil flow rate	34 litres per minute at 4 kg/cm ² pr at 1000 rpm	
Valve opening pressure: (Oil filter)		
Oil pressure relief valve	4 bar	Hydraulic pump with pressure gauge
By-pass valve for paper element	1.5 bar	
By-pass valve for heat exchanger	4 bar	
Oil Pump Gear Height	33.0 - 33.04	
Oil Pump Gear Outer Diameter	68.769 - 68.969	
Oil Pump Gear Backlash between Oil Pump Drive Gear, Camshaft and Idler Gear	0.12 ± 0.06	Feeler gauge
Oil Pump Gear Backlash between Drive and Driven Gear	0.15 ± 0.06	Feeler gauge
Drive Gear shaft Diameter	20.088 - 20.106 (limit 20.06)	Micro meter
Drive Gear inside Diameter	20.037 - 20.054	Internal micro meter



17.0.3 Repair Data

Drive Shaft Bushing Inside Diameter	20.146 - 20.173	Internal micro meter
Clearance between Drive Shaft & Bushing	0.040 - 0.085	Bore dial gauge/Micro meter
Interference between drive gear and shaft	0.034 - 0.069	Dial gauge
Driven Gear shaft Diameter	19.979 - 19.997 (limit 19.97)	Micro meter
Driven Gear Bush Inside Diameter	20.037 - 20.054	Internal micro meter
Clearance between bush and driven gear shaft	0.040 - 0.075 (limit 0.1 mm)	Dial gauge
Oil Cooler air pressure testing	6 kg/cm ²	
Cooling System		
Permissible maximum cooling temp.	95°C	Temperature gauge
Maximum water pump output	240 lpm @ 1.5 kg/cm ²	Test tank
Commencement of thermostat opening	82°C + 2°C	Test tank thermometer & vernier calliper
Thermostat working stroke at 95°C	7.5 mm or more	Test tank thermometer & vernier calliper
Recommended Coolant	Leypower Coolant5000	

17.0.4 Tightening Torques

	Kgm	lb.ft	Nm	Max. allowed No. of tightening
Liner Pressing Special Tool	5-6	36 - 42	49 - 59	
Main Bearing Cap Bolts	14 ± 1.5 & 90° ± 5°	103 ± 11 & 90° ± 5°	140 ± 15 & 90° ± 5°	4
Flywheel Housing Fitting Bolts (M8 x 1.25 - 16 mm long)	1.9 - 2.6	14 - 18	19 - 26	
Flywheel Housing Fitting Bolts (M14 x 2 - 45 mm long)	11 - 13	80 - 94	108 - 128	
Flywheel Fitting Bolts	10 ± 1 & 60° ± 5°	73 ± 7.3 & 60° ± 5°	100 ± 10 & 60° ± 5°	3
Connecting Rod Cap Bolts	10 ± 1 & 60° ± 5°	73 ± 7.3 & 60° ± 5°	100 ± 10 & 60° ± 5°	3
Timing Gear Plate Bolts	1.9 - 2.6	14 - 18	19 - 26	
Oil Pump Assembly Fitting Bolts	1.9 - 2.6	14 - 18	19 - 26	
Camshaft Drive Gear Fitting Bolt	10 ± 1 & 60° ± 5°	73 ± 7.3 & 60° ± 5°	100 ± 10 & 60° ± 5°	4
Camshaft Thrust Plate Fitting Bolts	1.9 - 2.6	14 - 18	19 - 26	
Idler Gear Fitting Bolt	10±1 & 90° ± 5°	73 ± 7.3 & 90° ± 5°	100 ± 10 & 90° ± 5°	4
Timing Gear Cover Fitting Bolts	1.9 - 2.6	14 - 18	19 - 26	
Crankshaft Pulley Fitting Nut (Damper)	93 ± 12.5	686 ± 93	930 ± 125	
Oil Strainer Fitting Bolts	1.9 - 2.6	14 - 18	19 - 26	
Oil Pan Fitting Bolts	1.9 - 2.6	14 - 18	19 - 26	
Oil Pan Drain Plug	4 - 5	29 - 32	39 - 49	
Air Compressor Fitting Bolts	4.5 - 5.0	33 - 36	44 - 49	
Air Compressor Lube Oil Banjo Bolt	1.4 - 1.8	10.32 - 13.3	14 - 18	
Water cooled Compressor Banjo Fitment (On Compressor) - Water line	2.8 - 3.4	20.65 - 25.07	28 - 34	



17.0.4 Tightening Torques

	Kgm	lb.ft	Nm	Max. allowed No. of tightening
Water cooled Compressor Banjo Fitment (On TG case) - Water line	5.7 - 6.3	42.04 - 46.46	57 - 63	
Oil Cooler Banjo Bolt Fitment	3.3 - 3.7	24.33 - 27.28	33 - 37	
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Lube Oil Banjo Bolt Fitment in Block (Two holes)	2.3 - 2.7	17 -20	23 - 27	
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Alternator Supporting Bolt & Nut	4.5 - 5.0	33 - 36	44 - 49	
Fan Belt Adjusting Bracket	4.5 - 5.0	33 - 36	44 - 49	
Water Jacket Elbow	4.5 - 5.0	33 - 36	44 - 49	
Water Drain Plug on Elbow	4.5 - 5.0	33 - 36	44 - 49	
Centre Bolt - Oil Filter	4-5	29 - 32	39 - 49	
Oil Cooler Element Fitting Nuts	1 - 1.5	8 - 10	10 - 15	
Oil Cooler Assembly Fitting Bolts	1.9 - 2.6	14-18	19 - 26	
Water Pump Assembly Fitting Bolts	1.9 - 2.6	14-18	19 - 26	
Water Pump Pulley Bolt	1.9 - 2.6	14-18	19 - 26	
Fan to Spacer Bolts	2.0 - 3.0	15 - 21	20 - 29	
Cooling Fan Fitting Bolts	1.5 - 2.2	11 - 16	15 - 22	
Cylinder Head Bolt (M12) - Short	7.1 ± 0.5 & 150° ± 5°	52 ± 4 & 150° ± 5°	70 ± 5 & 150° ± 5°	
Cylinder Head Bolt (M12) - Long	7.1 ± 0.5 & 180° ± 5°	52 ± 4 & 180° ± 5°	70 ± 5 & 180° ± 5°	
Cylinder Head Bolts (M10)	4.5 - 5.0	33 - 36	44 - 49	
Rocker Shaft Locking Bolts	0.6 - 0.7	4 - 5	6 - 7	
Rocker Shaft Assembly Fitting Bolts	1.9 - 2.6	14 -18	19 - 26	
Rocker Shaft Assembly Main Bolts	7.13 ± 0.5 & 90° ± 5°	51.63 ± 3.68 & 90° ± 5°	70 ± 5 & 90° ± 5°	
Rocker Arm Adjusting Screw Nuts	1.9 - 2.6	14-18	19 - 26	
Thermostat Case	4.5 - 5.0	33 - 36	44 - 49	
Thermostat Cover	1.9 - 2.6	14 -18	19 -26	
Injector Pipe Clip fasteners	0.5 - 1.0	3.7 - 7.2	5 - 10	
Exhaust Manifold	4.5 - 5.0	33 - 36	44 - 49	
Inlet Manifold Fitting Bolts	1.9 - 2.6	14 - 18	19 - 26	
Cylinder Head Cover Bolts	1.3 - 1.8	10 - 13	13 - 18	
Boost pressure sensor screw	0.25 - 0.35	1.8 - 2.6	2.5 - 3.5	
Engine speed sensor screw	0.6 - 1.0	4 - 7.2	6 - 10	
Water temperature Sensor	2.0 - 2.4	15 - 17.7	20 - 24	
Engine speed sensor holder	1.3 - 1.9	10 - 13	13 - 19	
Housing on FIP (M 10 studs and nuts)	4.6 - 5.1	33.2 - 36.9	45-50	
Rear bracket mounting bolt on FIP	4.5 - 5	33.2 - 36.9	45-50	
FIP Drive Gear bolt	3.7 - 4.5	26 - 32	36 - 34	
Filter mounting bracket bolts	4 - 4.5	29.5 - 33	40-45	



17.0.4 Tightening Torques

	Kgm	lb.ft	Nm	Max. allowed No. of tightening
FIP Mounting on flange	4.5	33	45	
FIP Mounting flange to timing case	1.9 - 2.6	14 - 18	19 - 26	
CR pump spline bush mounting nut	16.3 - 16.8	118 - 121	160 - 165	
FIP Injecctor connectionl Fitment (M8 nuts)	3.1 - 3.7	22.1 - 25.8	30 - 35	
Injector holding clamp nut	1.3 - 1.9	10 - 13	13 - 19	
Leak off line banjo bolt fitting	1.5 - 2.5	10 - 18.4	15-25	
Leak off banjo from rail to pump	3.1 ± 0.5	22.1 ± 3.68	30 ± 5	
Leak off banjo from pump to tank	3.1 ± 0.5	22.1 ± 3.68	30 ± 5	
Gear pump inlet banjo fitment	3.1 ± 0.5	22.1 ± 3.68	30 ± 5	
Fuel Filter inlet banjo	3.1 ± 0.5	22.1 ± 3.68	30 ± 5	
Fuel filter outlet banjo	3.1 ± 0.5	22.1 ± 3.68	30 ± 5	
FIP Drive Gear to drive shaft	1.5 - 1.7	10 - 12.5	15 - 17	
High Pressure Pipe Cap Nut	3.1 - 3.8	22.1 - 25.8	30 ± 5	

17.0.5 Crank Shaft Main Journals and Crank Journals Dimensions.

DESCRIPTION	mm
1. Std diameter of main journals	72.94 - 72.96
2. Std diameter of conrod journals	64.94 - 64.96
3. Fillet Radius main journal	2.75 - 3.25
4. Con. rod journal fillet radius	2.75 - 3.25
5. Wear limits	
Taper (across total width) - cylindricity	0.0035
Ovality - circularity	0.0035
Bend - perpendicularity	0.04
Wear limit	0.2
Concentricity - eccentricity	0.050
Maximum permissible out of round	0.02
6. Available under sizes (only 4 under sizes)	0.25/0.50/0.75/1.00

17.0.6 Main and Crank Journals Grinding Sizes

Under size (mm)	Crank pin (mm)	Main Journal (mm)
0.25	64.69 - 64.71	72.69 - 72.71
0.50	64.44 - 64.46	72.44 - 72.46
0.75	64.19 - 64.21	72.19 - 72.21
1.00	63.94 - 63.96	71.94 - 71.96

Width of crank pin - 36.00 - 36.25 mm

Note: Correct by regrinding if worn unevenly more than 0.10 mm

Regrind if the wear is more than 0.2 mm

Replace crankshaft if wear is more than 1.2 mm

17.0.7 Connecting Rod Big End Bearing Shell Sizes (Thickness)

Under size (mm)	Thickness (mm)	Tolerance
STANDARD	2.00	-0.003 To -0.013
0.25	2.125	- do -
0.50	2.250	- do -
0.75	2.375	- do -
1.00	2.500	- do -



17.0.8 Crankcase Parent Bore and Cylinder Liner Outer Dia

Crankcase Parent Bore		Cylinder Liner Outer Dia	
Grade	Size (mm)	Grade	Size (mm)
W	107 + 0.0060 + 0	W	107 + 0.011 + 0.005
X	107 + 0.0125 + 0.0060	X	107 + 0.011 + 0.018
Y	107 + 0.0190 + 0.0125	Y	107 + 0.024 + 0.018
Z	107 + 0.0250 + 0.0190	Z	107 + 0.030 + 0.024

Only Multi Layered Gasket (MLF) should be used along with Mild Interference Liners (MIF).

17.0.9 Fuel Oil (High Speed Diesel)

Users are recommended to obtain their fuel supplies from a source which can be depended upon to maintain a consistent standard of quality and service.

Fuel should be free from water and dirt, care should be taken by the user to protect fuel from contamination.

Fuel Specifications - as per IS 1460 : 2000

1.	Acidity, inorganic	...	Nil
2.	Acidity, total mg.of KOH/g (Max.)	...	0.20
3.	Ash, percent by Mass (Max.)	...	0.01
4.	Carbon residue (Ramsbottom) on 10 percent residue, percent by Mass, Max	...	0.30
5.	Cetane Number (Minimum)	...	51
6.	Cetane index (Minimum)	...	46
7.	Pour point (Max.)	...	3°C for Winter & 15°C for Summer
8.	Copper Strip Corrosion for 3 hours @ 100°C., Max., rating	...	Not worse than No.1
9.	Distillation, percent v/v, recovered:		
	a) at 350°C, Min	...	85
	b) at 370°C, Min	...	95
10.	Flash point (Min.)		
	a) Abel, °C, Min	...	35
	b) Pensky-Martens, °C, Min	...	66
11.	Kinematic viscosity, cSt, @ 40°C	...	2.0 to 4.5
12.	Sediment, percent by mass (Max.)	...	0.05
13.	Density; at 15°C., kg/m ³	...	820 - 845
14.	Total Sulphur, percent by mass (Max.)	...	0.035
15.	Water content percent by mass (Max.)	...	0.020
16..	Cold Filter Plugging Point (CFPP) max	...	6°C for Winter and 18°C for Summer
17.	Total Sediments mg per 100 ml. (max)	...	1.6
18.	Total contaminations (Particulate matter) mg/kg. (max)	...	24
19.	Oxidation stability, g/m ³ , (max)	...	25
20.	Polycyclic Aromatic Hydrocarbon (PAH), percent by mass, Max	...	11
21.	Lubricity, corrected wear scar diameter (wsd) 1.4) at 60°C, microns, Max	...	460

**17.0.10 Recommended coolant****Gulf Leypower Coolant 5000**

Gulf Leypower Coolant5000 is pre mixed coolant (pre mixed with concentrate & DM water at 50% ratio) and has been formulated with a view to offer extended service life. No addition of water is required.

The recommended coolant change interval is 5000 hours or 2 years whichever is earlier. Coolants are available in convenient pack sizes of 1, 3, 20, 50 liters & also as 210 liter barrel.



For topping up use only Gulf Leypower Coolant5000 directly. Do not dilute with plain or demineralised water for top up.

17.0.11 Recommended Lubricants

Use of correct grades of lubrication is most important to prevent the wear and tear of components. The chart shows the oil grade recommended by AL.

		Recommended Lubricant & Coolant
Aggregate	Minimum Ambient Temp. °C	Gulf Oil India
H Series B platform engine - Lubricant	-20	Gulf Leypower XLL Diesel engine oil
H Series B platform engine (Radiator Coolant)	-35	Gulf Leypower Coolant5000

Note: Do not mix lubricants of different brands/grades.

17.0.12 Filling Capacity

Aggregates	Qty (ltr.)
Engine (Including Oil Filter)	18



17.0.13 Liquid Gasket and Application Points

Use liquid gasket (Anabond 673/Loctite 587) instead of conventional sheet gaskets. The following are the liquid gasket application points.

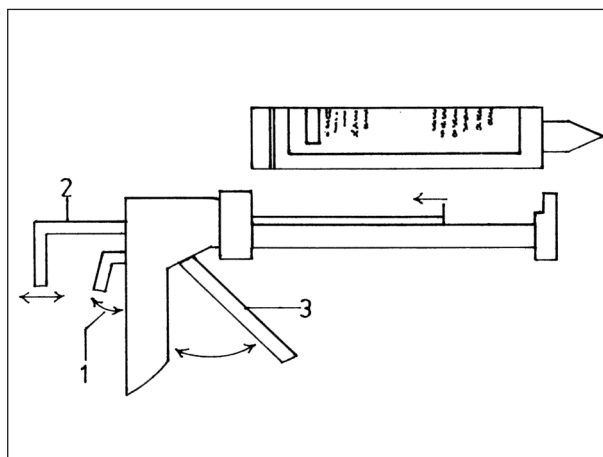
Liquid gasket application points and coating width

PARTS NAME	APPLICATION	COATING WIDTH
a) Oil pan	Flange face which mate with cylinder block, timing gear cover and flywheel housing	1.5 - 2.5 mm
b) Timing gear cover	Faces which mates with timing gear plate (flange face, boss face)	1.5 - 2.5 mm
c) Flywheel housing	Faces which mate with cylinder block (flange face, boss face)	1.5 - 2.5 mm
d) Coolant pump	Flange face which mates with timing gear cover	1.5 - 2.5 mm
e) Thermostat case	Flange face which mates with cylinder head	1.5 - 2.5 mm
f) Camshaft end plate	Flange face which mates with cylinder block	1.5 - 2.5 mm

Coating Liquid Gasket and parts Assembly Procedure

1. Completely remove old liquid gasket from each part and the respective mating part, and remove oil, water, and dirt using cloth.
2. Be careful not to apply excessive or insufficient liquid gasket. Also, be sure to overlap the start and end of each coating.
3. When assembling coated parts, be careful that there is no misalignment between mating parts. If there is any misalignment, coat the parts again.
4. Assemble the various parts within 20 minutes after applying liquid gasket. If more than 20 minutes have elapsed, remove the liquid gasket and apply it again.
5. After assembling the various parts wait for at least 15 minutes before starting the engine.

Applicator Gun



Loading Cartridge

Press lever 1 and simultaneously pull lever 2 back completely. Insert the cartridge. The open cartridge can be dispensed by pressing lever 3.

Unloading Cartridge

Press lever 1 and simultaneously pull lever 2 back completely - Remove cartridge from the gun.



17.0.15 Trouble shooting

17.0.15.0 Engine

Symptom	Possible Cause	Remedy/Prevention
Engine overheating	<p>Coolant</p> <ul style="list-style-type: none"> * Insufficient coolant * Defective thermostat * Overflow of coolant due to leakage of exhaust into cooling system * Coolant leakage from cylinder head gasket * Defective coolant pump <p>Radiator</p> <ul style="list-style-type: none"> * Clogged with rust and scale * Clogged with iron oxide due to leakage of exhaust into cooling system * Clogged radiator core due to mud or other debris * Defective radiator cap pressure valve * In correct gap between radiator and fan * Deration pipes blocked due to mud * CAC & Radiator fins out side for dust deposit. * Malfunctioning of thermo sensing fan <p>Abnormal combustion</p> <ul style="list-style-type: none"> * Poor fuel * Poor nozzle spray <p>Other problems</p> <ul style="list-style-type: none"> * Defective or deteriorated engine oil * Unsatisfactory operation of oil pump * Insufficient oil * Brake drag 	<p>Add coolant</p> <p>Replace the thermostat</p> <p>Repair</p> <p>Replace gasket.</p> <p>Repair or replace.</p> <p>Clean radiator.</p> <p>Clean coolant passage and correct exhaust leakage.</p> <p>Clean radiator.</p> <p>Replace radiator cap</p> <p>Correct the gap</p> <p>Clean and use coolant.</p> <p>Clean.</p> <p>Check and correct.</p> <p>Use good quality fuel.</p> <p>Replace nozzle.</p> <p>Change engine oil.</p> <p>Replace or repair</p> <p>Add oil.</p> <p>Repair or adjust.</p>
Excessive oil consumption	<p>Piston, cylinder liners and piston rings</p> <ul style="list-style-type: none"> * Wear of piston ring and cylinder liner * Worn, sticking or broken piston rings * Insufficient tension on piston rings * Unsuitable oil (viscosity too low) * Incorrectly fitted piston rings (upside down) * Gaps of piston rings in line with each other <p>Valve and valve guides</p> <ul style="list-style-type: none"> * Worn valve stream * Worn valve guide * Incorrectly fitted valve stem seal * Excessive lubricant on rocker arm 	<p>Replace piston rings and cylinder liner.</p> <p>Replace piston rings and cylinder liner.</p> <p>Replace piston rings and cylinder liner.</p> <p>Change oil as required and replace piston rings and cylinder liners.</p> <p>Replace piston rings.</p> <p>Reassemble piston rings.</p> <p>Replace valve and valve guide</p> <p>Replace valve guides.</p> <p>Replace the stem seal.</p> <p>Check clearance of rocker arm and shaft.</p>



Symptom	Possible Cause	Remedy/Prevention
Excessive oil consumption	Excess oil feed <ul style="list-style-type: none">* Defective oil level gauge* Oil level too high Other problems <ul style="list-style-type: none">* Overcooled engine (low temperature wear)* Oil leakage from miscellaneous parts	Replace oil level gauge Drain excess oil. Warm up engine before moving vehicle. Check cooling system . Repair.
Piston seizure	Operation <ul style="list-style-type: none">* Abrupt stoppage of engine after running at highspeed Oil <ul style="list-style-type: none">* Insufficient oil* Dirty oil* Poor quality oil* High oil temperature* Defective oil pump* Reduced performance due to worn oil pump* Suction strainer sucking air Abnormal combustion Coolant	Operate engine properly. Add oil. Change oil. Replace with proper engine oil. Repair Repair oil pump. Repair oil pump. Add oil and/or repair strainer. See symptom:"Engine overheating" See symptom:"Engine overheating"
Lack of power	Intake <ul style="list-style-type: none">* Clogged air cleaner Fuel and nozzle <ul style="list-style-type: none">* Poor nozzle spray* Clogged nozzle with carbon* Wear or seizure of nozzle* Air in fuel system* Clogged fuel filter* Use of poor fuel Abnormal combustion Piston, cylinder liners and piston rings Other problems <ul style="list-style-type: none">* Breakage of turbine or blower	Replace element. Replace injector with new one Replace injector with new one Replace injector with new one Repair and bleed air from fuel system. Replace fuel filter element Use good quality fuel. See symptom:"Piston Seizure" See symptom:"Excessive Oil Consumption" Repair



Symptom	Possible Cause	Remedy/Prevention
Difficult starting engine	<p>Electrical system</p> <ul style="list-style-type: none"> * Discharged battery * Defective wiring in starter circuit * Loose or open-circuit battery cable <p>Injection pump</p> <p>Air cleaner</p> <ul style="list-style-type: none"> * Clogged element <p>Fuel system</p> <ul style="list-style-type: none"> * No fuel in tank * Clogged fuel line * Air sucked into fuel system through fuel line connections. * Clogged fuel filter * Loose connection in high-pressure line <ul style="list-style-type: none"> * Water in fuel <p>Nozzle</p> <ul style="list-style-type: none"> * Seized nozzle <p>Oil system</p> <ul style="list-style-type: none"> * Oil viscosity too high <p>Other problems</p> <ul style="list-style-type: none"> * Seized piston * Seized bearing * Reduced compression pressure * Ring gear damaged or worn pinion. 	<p>Charge battery</p> <p>Repair wiring of starter.</p> <p>Tighten battery terminal connections or replace battery cable.</p> <p>Repair</p> <p>Replace the element.</p> <p>Supply fuel and bleed air from fuel system.</p> <p>Clean fuel line.</p> <p>Tighten fuel line connections.</p> <p>Replace element</p> <ol style="list-style-type: none"> 1. First loosen both sleeve nuts of high pressure pipes. 2. Hand tighten both the sleeve nuts to ensure that the seating of HP pipe is proper. 3. Apply the specified torque. <p>Drain and clean fuel system</p> <p>Replace injector with new one.</p> <p>Use proper viscosity oil, or install an oil immersion heater and warm up oil.</p> <p>Replace piston, piston rings ,and liner.</p> <p>Replace bearing and /or crankshaft</p> <p>Overhaul engine</p> <p>Replace the ring gear and/or starter</p>
Rough idling	<p>Injection pump</p> <p>Nozzles</p> <ul style="list-style-type: none"> * Poor nozzle spray * Carbon deposit on nozzle tip <p>Engine</p> <ul style="list-style-type: none"> * Improper valve clearance * Improper contact of valve seat * Idling speed too low * Compression pressure of cylinders markedly different from one another 	<p>Repair</p> <p>Replace injector with new one.</p> <p>Replace injector with new one</p> <p>Adjust valve clearance</p> <p>Replace or repair valve and valve seat.</p> <p>Warm up engine.</p> <p>Overhaul engine</p>



17.0.15.1 Fuel Injection Pump

Symptom	Possible Cause	Remedy/Prevention
Engine does not start	Fuel not reaching injection pump * Fuel lines clogged or damaged * Fuel filter clogged * Air in fuel caused by improper connections of fuel line between fuel tank and feed pump. * Filter incorporated in inlet side of feed pump clogged Nozzle faulty * Fuel leakage caused by loosened nozzle clamp.	Clean or replace fuel lines. Clean or replace the filter elements. Repair connections. Remove foreign material. Inspect and tighten it. If it is not OK, replace injector with new one.
Excessive smoke	Black smoke * Bad nozzle fuel spray characteristics * Faulty booster sensor White smoke * Water in fuel * Faulty coolant temperature sensor * Fuel starvation	Check and correct them. Check and replace. Check and clean fuel lines. Check and replace. Check and correct.
Engine always runs at high speed	Throttle link sticky / struck position	Check and remove stickness / adjust.
Engine starts and stops	Fuel lines clogged Air in fuel caused by damaged fuel lines of improper connection of fuel lines.	Clean or replace fuel lines. Repair fuel lines or replace fuel lines and gaskets.
Engine has low power	Pump * Feed pressure too low * EDC system faulty Nozzle faulty * Fuel leakage from nozzle holder	Repair the feed pump located on the FIP. Check with diagnostic tool and rectify. Replace injector with new one.