

SERVICE SPECIFICATIONS

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ENGINE MECHANICAL

Specifications

Engine tune-up	Engine coolant capacity		5.7 liters	6.0 US qts.	5.0 Imp. qts
	Engine oil capacity				
	Dry fill		4.2 liters	4.4 US qts.	3.7 Imp. qts
	Drain and refill				
	w/o Oil filter change		3.1 liters	3.3 US qts.	2.7 Imp. qts
	w/ Oil filter change		3.8 liters	4.0 US qts.	3.3 Imp. qts
	Battery specific gravity		1.25 – 1.27 when fully charged at 20°C (68°F)		
	Drive belt deflection with 10 kg (22.1 lb, 98 N)				
		New belt	6 – 7 mm	0.24 – 0.28 in.	
		Used belt	8 – 11 mm	0.32 – 0.43 in.	
	Drive belt tension	New belt	45 – 55 kg		
		Used belt	20 – 35 kg		
	Injection timing		0° BTDC		
	At 0.77 – 0.83 mm (0.0303 – 0.0327 in.)				
	Injection order		1 – 3 – 4 – 2		
Compression pressure	Valve clearance	Intake	0.22 – 0.28 mm	0.009 – 0.011 in.	
		Exhaust	0.27 – 0.33 mm	0.011 – 0.013 in.	
	Idle speed		700 rpm		
	Maximum speed		5,800 rpm		
	Injection nozzle opening pressure		135 – 155 kg/cm ² (1,920 – 2,205 psi, 13,239 – 15,200 kPa)		
		STD	30.0 kg-cm ²	427 psi	2,942 kPa
		Limit	25.0 kg-cm ²	356 psi	2,452 kPa
	Differential of pressure between each cylinder		Less than 5.0 kg-cm ² (71 psi, 490 kPa)		

Specifications (Cont'd)

Cylinder head	Head surface warpage	Limit	0.1 mm	0.004 in.
	Manifold surface warpage	Limit	0.2 mm	0.008 in.
	Valve seat Refacing angle		30°, 45°, 75°	
	Contacting angle		45°	
	Contacting width	Intake Exhaust	1.2 – 1.6 mm 1.6 – 2.0 mm	0.047 – 0.063 in. 0.063 – 0.079 in.
Valve guide bushing	Inner diameter		6.01 – 6.03 mm	0.2366 – 0.2374 in.
	Outer diameter	STD	11.033 – 11.044 mm	0.4344 – 0.4348 in.
		O/S type 0.05	11.083 – 11.094 mm	0.4363 – 0.4368 in.
	Replacing temperature (cylinder head side)		90°C	194°F
Valve	Valve overall length	STD	91.28 mm	3.5937 in.
		Limit	90.78 mm	3.5740 in.
	Valve face angle		44.5°	
	Stem diameter	Intake	5.970 – 5.985 mm	0.2350 – 0.2356 in.
		Exhaust	5.965 – 5.980 mm	0.2348 – 0.2354 in.
	Stem oil clearance	STD	Intake 0.025 – 0.060 mm	0.0010 – 0.0024 in.
		Exhaust	0.030 – 0.065 mm	0.0012 – 0.0026 in.
		Limit	Intake 0.08 mm	0.0031 in.
		Exhaust	0.10 mm	0.0039 in.
	Valve head edge thickness	Limit	Intake 0.08 mm	0.0031 in.
		Exhaust	0.10 mm	0.0039 in.
Valve spring	Free length		41.52 mm	1.6346 in.
	Installed length		34.16 mm	1.3449 in.
	Installed tension	STD	18.41 kg 40.6 lb 181 N	
		Limit	17.49 kg 38.6 lb 172 N	
	Squareness	Limit	2.0 mm	0.079 in.
Camshaft	Thrust clearance	STD	0.08 – 0.18 mm	0.0031 – 0.0071 in.
		Limit	0.25 mm	0.0098 in.
	Journal oil clearance	STD	0.037 – 0.073 mm	0.0015 – 0.0029 in.
		Limit	0.1 mm	0.004 in.
	Journal diameter		26.979 – 26.995 mm	1.0622 – 1.0628 in.
	Circle runout	Limit	0.02 mm	0.0008 in.
	Cam lobe hight	STD	Intake 43.84 – 43.94 mm	1.7260 – 1.7299 in.
		Exhaust	43.88 – 43.95 mm	1.7276 – 1.7303 in.
		Limit	Intake 43.54 mm	1.7142 in.
		Exhaust	43.58 mm	1.7157 in.
Valve lifter	Out diameter	STD	33.966 – 33.976 mm	1.3372 – 1.3376 in.
	Valve lifter oil clearance	STD	0.024 – 0.050 mm	0.0009 – 0.0020 in.
		Limit	0.10 mm	0.0039 in.

Specifications (Cont'd)

Intake and exhaust manifold	Manifold surface	Limit	0.2 mm	0.008 in.
Combustion chamber	Protrusion		Minus 0.03 – Plus 0.03 mm (Minus 0.0012 – Plus 0.0012 in.)	
	Flange thickness	1	4.95 – 4.98 mm	0.1949 – 0.1961 in.
		2	4.99 – 5.01 mm	0.1965 – 0.1972 in.
		3	5.02 – 5.04 mm	0.1976 – 0.1984 in.
Idle pulley tension spring	Free length		45.55 mm	1.7933 in.
	Installed tension at 52.7 mm (2.07 in.)			
		STD Limit	8.1 kg 5.4 kg	17.9 lb 11.9 lb 79 N 53 N
Cylinder block	Warpage	Limit	0.1 mm	0.004 in.
	Cylinder bore	STD	74.00 – 74.03 mm	2.9134 – 2.9146 in.
	Cylinder bore wear			
	On standard sized piston	Limit	74.23 mm	2.9224 in.
	On oversized piston (O/S 0.50)	Limit	74.73 mm	2.9421 in.
	Taper and out-of-round	Limit	0.02 mm	0.0008 in.
	Cylinder block main journal bore			
		STD 1	54.036 – 54.044 mm	2.1274 – 2.1277 in.
		2	54.045 – 54.052 mm	2.1278 – 2.1280 in.
		3	54.053 – 54.060 mm	2.1281 – 2.1283 in.
Piston and piston ring		U/S 0.25, 0.50	54.036 – 54.060 mm	2.1274 – 2.1283 in.
	Piston diameter	STD	73.955 – 73.985 mm	2.9116 – 2.9128 in.
		O/S 0.50	74.455 – 74.458 mm	2.9313 – 2.9314 in.
	Piston to clearance	STD	0.035 – 0.055 mm	0.0014 – 0.0022 in.
		Limit	0.10 mm	0.003 in.
	Piston ring end gap	STD	0.23 – 0.36 mm	0.0091 – 0.0142 in.
		No. 1	0.40 – 0.55 mm	0.0157 – 0.0217 in.
		No. 2	0.10 – 0.60 mm	0.0039 – 0.0236 in.
		Oil	0.96 mm	0.0378 in.
		Limit No. 1	1.05 mm	0.0413 in.
		No. 2	1.20 mm	0.0472 in.
		Oil	0.04 – 0.08 mm	0.0016 – 0.0031 in.
Connecting rod and bearing	Ring to ring groove clearance (New piston ring)	STD		
	Piston pin installing temperature		80°C	176°F
	Thrust clearance	STD	0.08 – 0.30 mm	0.0031 – 0.0118 in.
		Limit	0.4 mm	0.016 in.
	Big end inner diameter	STD	47.015 – 47.022 mm	1.8510 – 1.8513 in.
		1	47.023 – 47.030 mm	1.8513 – 1.8516 in.
		2	47.031 – 47.038 mm	1.8516 – 1.8519 in.
		3		

Specifications (Cont'd)

Connecting rod and bearing (Cont'd)	Connecting rod bearing center wall thickness	STD	1	1.488 – 1.492 mm	0.0586 – 0.0587 in.
			2	1.491 – 1.496 mm	0.0587 – 0.0589 in.
			3	1.496 – 1.500 mm	0.0589 – 0.0591 in.
	Bearing oil clearance	STD		0.030 – 0.058 mm	0.0012 – 0.0023 in.
		Limit		0.08 mm	0.0023 in.
	Pin to bushing oil clearance	STD		0.007 – 0.015 mm	0.0003 – 0.0006 in.
		Limit		0.05 mm	0.0020 in.
	Piston pin diameter			23.500 – 23.512 mm	0.9252 – 0.9257 in.
	Bushing inside diameter			23.511 – 23.523 mm	0.9256 – 0.9261 in.
	Rod bend per 100 mm (3.94 in.)	Limit		0.05 mm	0.0020 in.
	Rod twist per 100 mm (3.94 in.)	Limit		0.15 mm	0.0059 in.
Crankshaft	Thrust clearance	STD		0.02 – 0.22 mm	0.0008 – 0.0087 in.
		Limit		0.3 mm	0.012 in.
	Thrust washer thickness	STD		2.430 – 2.480 mm	0.0957 – 0.0976 in.
		O/S	0.125	2.493 – 2.543 mm	0.0981 – 0.1001 in.
		O/S	0.250	2.555 – 2.605 mm	0.1006 – 0.1026 in.
	Main journal oil clearance	STD		0.020 – 0.051 mm	0.0008 – 0.0020 in.
		Limit		0.08 mm	0.0031 in.
	Main journal diameter	STD		49.985 – 50.000 mm	1.9679 – 1.9685 in.
	Main journal finished diameter				
		U/S	0.25	49.745 – 49.755 mm	1.9585 – 1.9589 in.
	Main bearing center wall thickness	STD	1	2.005 – 2.008 mm	0.0789 – 0.0791 in.
			2	2.009 – 2.012 mm	0.0791 – 0.0792 in.
			3	2.013 – 2.016 mm	0.0793 – 0.0794 in.
		U/S	0.25	2.125 – 2.131 mm	0.0837 – 0.0839 in.
			0.50	2.250 – 2.256 mm	0.0886 – 0.0888 in.
	Crank pin diameter	STD		43.988 – 44.000 mm	1.7318 – 1.7323 in.
	Circle runout	Limit		0.06 mm	0.0024 in.
	Main journal taper and out-of round	Limit		0.02 mm	0.0008 in.
	Crank pin journal taper and out-of round	Limit		0.02 mm	0.0008 in.
Flywheel	Runout	Limit			
				0.1 mm	0.004 in.

Torque Specifications

Part tightened	kg-cm	ft-lb	N-m
Cylinder head x Camshaft bearing cap	140	10	14
Cylinder head x Water inlet housing	195	14	19
Cylinder head x Water outlet	195	14	19
Cylinder head x No. 1 Engine hanger	195	14	19
Cylinder head x No. 2 Engine hanger	380	27	37
Cylinder head x Cylinder head cover	80	69 in.-lb	7.8
Cylinder head x Intake manifold	195	14	19
Cylinder head x Exhaust manifold	400	29	39
Cylinder head x Water pump	195	14	19
Cylinder head x Glow plug	130	9	13
Cylinder head x Injection holder	650	47	64
Cylinder head x Cylinder block	690	50	68
	1st		
	2nd		
	3rd		
Cylinder block x Crankshaft bearing cap	600	43	59
Cylinder block x Oil nozzle	80	69 in.-lb	7.8
Cylinder block x Oil strainer	120	9	12
	Bolt		
	Nut		
Cylinder block x Oil pump	195	14	19
Cylinder block x Rear oil seal retainer	80	69 in.-lb	7.8
Cylinder block x Rear end plate	50	43 in.-lb	4.9
Cylinder block x Injection pump stay	195	14	19
Cylinder block x Water inlet pipe	185	13	18
Cylinder block x Oil pan	80	69 in.-lb	7.8
Cylinder block x Oil cooler Relief valve	1,700	123	167
Cylinder block x Alternator bracket	400	29	39
Cylinder block x RH Engine mounting bracket	440	32	43
Crankshaft x Flywheel	900	65	88
Crankshaft x Crankshaft pulley	1,200	87	118
Camshaft x Camshaft timing pulley	900	65	88
Injection pump x Injection pump drive pulley	650	47	64
Injection pump x Water pump	195	14	19
Injection pump x Injection pump stay	195	14	19
Injection pump x No. 4 Nozzle leakage pipe	225	16	22
Injection nozzle holder x No. 1 Nozzle leakage pipe	300	22	29
Connecting rod x Connecting rod cap	250	18	25
	1st		
	2nd		
Alternator belt adjusting bar x RH Engine mounting bracket	195	14	19
Alternator belt adjusting bar x Alternator	195	14	19
Alternator x Alternator bracket	400	29	39
Accelerator wire bracket x Water pump	80	69 in.-lb	7.8
Oil pan drain plug x Oil pan	250	18	25

FUEL SYSTEM

Injection nozzle	Nozzle type (Stamped on nozzle assembly)	Ex. Austria Austria	ND – DNOPD31 ND – DN1OPD41
	Nozzle opening pressure	Reused nozzle	135 – 155 kg/cm ² (1,920 – 2,205 psi, 13,239 – 15,200 kPa)
		New nozzle	145 – 155 kg/cm ² (2,062 – 2,205 psi, 14,220 – 15,200 kPa)
	Adjusting shim thickness		0.900 mm 0.0354 in.
			0.925 mm 0.0364 in.
			0.950 mm 0.0374 in.
			0.975 mm 0.0384 in.
			1.000 mm 0.0394 in.
			1.025 mm 0.0404 in.
			1.050 mm 0.0413 in.
			1.075 mm 0.0423 in.
			1.100 mm 0.0433 in.
			1.125 mm 0.0443 in.
			1.150 mm 0.0453 in.
			1.175 mm 0.0463 in.
			1.200 mm 0.0472 in.
			1.225 mm 0.0482 in.
			1.250 mm 0.0492 in.
			1.275 mm 0.0502 in.
			1.300 mm 0.0512 in.
			1.325 mm 0.0522 in.
			1.350 mm 0.0531 in.
			1.375 mm 0.0541 in.
			1.400 mm 0.0551 in.
			1.425 mm 0.0561 in.
			1.450 mm 0.0571 in.
			1.475 mm 0.0581 in.
			1.500 mm 0.0591 in.
			1.525 mm 0.0600 in.
			1.550 mm 0.0610 in.
			1.575 mm 0.0620 in.
			1.600 mm 0.0630 in.
			1.625 mm 0.0640 in.
			1.650 mm 0.0650 in.
			1.675 mm 0.0659 in.
			1.700 mm 0.0669 in.
			1.725 mm 0.0679 in.
			1.750 mm 0.0689 in.
			1.775 mm 0.0699 in.
			1.800 mm 0.0709 in.
			1.825 mm 0.0719 in.
			1.850 mm 0.0728 in.
			1.875 mm 0.0738 in.
			1.900 mm 0.0748 in.
			1.925 mm 0.0758 in.
			1.950 mm 0.0768 in.

FUEL SYSTEM (Cont'd)

Injection pump	Direction of rotation		Clockwise as seen from drive side	
	Injection order		1 – 3 – 4 – 2 (A – B – C – D)	
	Adjusting lever moving angle		42 – 52°	
	Roller height variation		0.02 mm	0.0008 in.
	Plunger spring			
	Free length	STD	30.0 mm	1.181 in.
		Limit	29.5 mm	1.161 in.
	Squareness	Limit	2.0 mm	0.079 in.
	Delivery valve spring			
	Free length	STD	24.4 mm	0.961 in.
		Limit	23.5 mm	0.925 in.
	Governor shaft protrusion		2.0 – 2.5 mm	0.079 – 0.098 in.
	Flyweight holder thrust clearance		0.15 – 0.35 mm	0.0059 – 0.0138 in.
	Plunger spring shim thickness		0.5 mm	0.020 in.
			0.8 mm	0.031 in.
			1.0 mm	0.039 in.
			1.2 mm	0.047 in.
			1.5 mm	0.057 in.
			1.8 mm	0.071 in.
			2.0 mm	0.079 in.
	Plunger adjusting shim thickness		1.9 mm	0.075 in.
			2.0 mm	0.079 in.
			2.1 mm	0.083 in.
			2.2 mm	0.087 in.
			2.3 mm	0.091 in.
			2.4 mm	0.094 in.
			2.5 mm	0.098 in.
			2.6 mm	0.102 in.
			2.7 mm	0.106 in.
			2.8 mm	0.110 in.
			2.9 mm	0.114 in.
	Governor gear adjusting washer thickness		1.05 mm	0.0413 in.
			1.25 mm	0.0492 in.
			1.45 mm	0.0571 in.
			1.65 mm	0.0650 in.
			1.85 mm	0.0728 in.
	Governor sleeve plug head thickness		3.0 mm	0.118 in.
			3.1 mm	0.122 in.
			3.2 mm	0.126 in.
			3.3 mm	0.130 in.
			3.4 mm	0.134 in.
			3.5 mm	0.138 in.
			3.6 mm	0.142 in.
			3.7 mm	0.146 in.
			3.8 mm	0.150 in.
			3.9 mm	0.154 in.
			4.0 mm	0.157 in.
			4.1 mm	0.161 in.
			4.2 mm	0.165 in.

Injection Pump Adjustment and Test

Preparations of pump tester	Test nozzle type		DN 12 SD 12		
	Test nozzle opening pressure		145 – 155 kg/cm ² (2,062 – 2,205 psi, 14,220 – 15,200 kPa)		
	Injection pipe	Outer diameter	6.0 mm	0.236 in.	
		Inner diameter	2.0 mm	0.079 in.	
		Length	840 mm	33.07 in.	
		Minimum bending radius	More than 25 mm (0.98 in.)		
	Fuel temperature	40 – 45°C 104 – 113°F			
Fuel feeding pressure	0.2 kg/cm ² 2.8 psi 20 kPa				
Fuel cut solenoid voltage	12 V				
Pre-setting	Full load injection volume	Pump revolution (rpm)	No. of measuring stroke	Injection volume cc (cu in.)	
		1,300	200	6.2 – 6.6 (0.38 – 0.40)	
	Maximum speed	Pump revolution (rpm)	No. of measuring stroke	Injection volume cc (cu in.)	
		2,900	200	1.6 – 2.8 (0.10 – 0.17)	
	Pump inner pressure	Pump revolution (rpm)	Inner pressure kg/cm ² (psi, kPa)		
		500	2.4 – 3.0 (34 – 43, 235 – 294)		
		2,900	7.6 – 8.2 (108 – 117, 745 – 804)		
	Overflow volume	Pump revolution (rpm)	Overflow volume cc/min. (cu in./min.)		
		2,900	392 – 845 (23.9 – 51.6)		
	Automatic timer	Pump revolution (rpm)		Piston strokes	
		700	0.20 – 1.20 mm	0.0079 – 0.0472 in.	
1,300		2.37 – 3.37 mm	0.0931 – 0.1327 in.		
2,300		6.06 – 7.06 mm	0.2386 – 0.2780 in.		
2,900		7.70 – 8.70 mm	0.3031 – 0.3425 in.		
Full load injection volume	Adjusting lever angle	Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	Remarks
	Plus 42 – 52°	1,300	200	6.2 – 6.6 (0.38 – 0.40)	Adjust
		500		5.1 – 5.8 (0.31 – 0.35)	—
		2,600		6.1 – 6.9 (0.37 – 0.42)	
Maximum speed	Adjusting lever angle	Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	Remarks
	Plus 42 – 52°	2,900	200	1.6 – 2.8 (0.10 – 0.17)	Adjust
		2,800		4.2 – 5.8 (0.26 – 0.35)	—
		3,100		Less than 1.5 (0.09)	

Injection Pump Adjustment and Test (Cont'd)

Injection volume	Adjusting lever angle	Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	Variation limit cc (cu in.)	Remarks
	Plus 42 – 52°	1,300	200	6.2 – 6.6 (0.38 – 0.40)	0.4 (0.02)	Basic full load injection volume
		100		6.6 – 11.4 (0.40 – 0.70)	1.2 (0.07)	Volume during starting
		500		5.1 – 5.8 (0.31 – 0.35)	0.5 (0.03)	—
		2,600		6.1 – 6.9 (0.37 – 0.42)		—
Idle speed	Pre-setting idle speed by idle adjusting screw		Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	Remarks
			500	1,000	q = 0.5 – 1.5 (0.03 – 0.09)	Adjust
			350		q plus 5 – 9 (0.31 – 0.55)	—
	Pre-setting idle speed by dash pot adjusting screw		Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	
			500	1,000	q plus 0.7 – 1.2 (0.04 – 0.07)	
	Adjust lever angle		Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	
			350	1,000	8.75 – 12.25 (0.53 – 0.75)	
	Plus 42 – 52°					

COOLING SYSTEM

Radiator	Relief valve opening pressure	STD	0.75 – 1.05 kg-cm (10.7 – 14.9 psi, 74 – 103 kPa)
		Limit	0.6 kg-cm 8.5 psi 59 kPa
Thermostat	Valve opening temperature		
	Starts to open at		80 – 84°C 176 – 183°F
	Fully opens at		95°C 203°F
	Valve opening travel		More than 8 mm (0.31 in.)

LUBRICATION SYSTEM

Oil pressure	Oil pressure at idle at 3,000 rpm	More than 0.5 kg-cm ² (7.1 psi, 49 kPa) 2.5 – 6.0 kg-cm ² (36 – 85 psi, 245 – 588 kPa)
Oil pump	Body clearance Limit Tip clearance Limit Rotor protrusion (reference) STD	0.10 – 0.17 mm 0.0039 – 0.0067 in. 0.20 mm 0.0079 in. 0.05 – 0.15 mm 0.0020 – 0.0059 in. 0.20 mm 0.0079 in. 5.00 – 5.08 mm 0.1969 – 0.2000 in.

STARTING SYSTEM

Pre-heating system	Type	Light lighting time	at 20°C (68°F)		Super glow Approx. 2 – 4 seconds	
Starter	Rated voltage and output power		12 V 1.4 kw		12 V 2.0 kw	
	No-load characteristic	Ampere rpm	90 A or less at 11.5 V 3,000 rpm or more		120 A or less at 11.5 V 4,000 rpm or more	
	Commutator					
	Outer diameter	STD	30 mm	1.18 in.	35 mm	1.38 in.
		Limit	29 mm	1.14 in.	34 mm	1.34 in.
	Undercut depth	STD	0.6 mm	0.024 in.	0.7 mm	0.028 in.
		Limit	0.2 mm	0.008 in.		←
	Circle runout	Limit	0.05 mm	0.0020 in.		←
	Brush length	STD	15.5 mm	0.610 in.	15.0 mm	0.591 in.
		Limit	10.0 mm	0.394 in.	9.0 mm	0.354 in.
	Spring installed load	STD	1.70 – 2.40 kg (3.7 – 5.3 lb, 17 – 24)		2.55 – 3.30 kg (5.6 – 7.3 lb, 25 – 32)	
		Limit	1.44 kg	3.2 lb	2.0 kg	44 lb
				14 N		20 N

CHARGING SYSTEM

Battery specific gravity When fully charged at 20°C (68°F)		1.25 – 1.27	
Drive belt deflection	New belt	6 – 7 mm	0.24 – 0.28 in.
	Used belt	8 – 11 mm	0.31 – 0.43 in.
Drive belt tension	New belt	45 – 55 kg	
	Used belt	20 – 35 kg	
Alternator	Rated output		12 V 55 A
	Rotor coil resistance		Less than 3 Ω
	Slip ring diameter	STD	14.2 – 14.4 mm
		Limit	12.8 mm
	Brush exposed length	STD	10.0 mm
		Limit	1.5 mm
Alternator regulator	Regulating voltage		13.5 – 15.1 V