

06. ADJUSTEMENTS, CLEARANCES AND WEAR LIMITS

06.1 Adjustments

Valve timing:

Inlet valves open 50° before TDC, closes 20° after BDC

Exhaust valves open 50° before BDC, closes 50° after TDC

Valve clearances, cold engine	inlet valves	0.4 mm
	exhaust valves	0.8 mm

Start of delivery	15° before TDC
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Fuel rack position at 100% load, marine diesel fuel	24.5 mm
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Opening pressure of fuel injection valve	320 bar
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Tripping speed

Nominal engine speed	Tripping speed of mechanical overspeed trip device	Tripping speed of electro-pneumatic overspeed trip device
15 r/s (900 RPM)	17.83 r/s (1070 RPM)	17.33 r/s (1040 RPM)

06.2 Clearances and wear limits (at 20°C)

Pos	Part, measuring point	Drawing dimensions (mm)	Normal clearance (mm)	Wear limit (mm)
10	Main bearing clearance (also main thrust bearing and shield bearing)		0.18...0.27	
	Journal diameter	200 +0...-0.029		
	Journal circularity	0.015		
	Journal taper	0.015/100		
	Main bearing shell thick- ness	7.440+0...-0.015		7.38
	Bore of main bearing housing	215 +0.029...-0		
	Main bearing diameter, in situ	200 +0.239...+0.180		
	Main thrust bearing, axial clearance		0.12...0.25	0.5
	Main thrust bearing width	100 -0.160...-0.210		

Pos	Part, measuring point	Drawing dimensions (mm)	Normal clearance (mm)	Wear limit (mm)
10	Corresponding crankshaft width	100 +0.035...-0		
	Camshaft bearing, clearance (also thrust)		0.10...0.18	
	Camshaft diameter	120 +0...-0.022		
	Camshaft bearing shell, thickness	4.950+0...-0.015		4.90
	Camshaft bearing housing, bore	130 +0.025...-0		
	Camshaft bearing diameter, in situ	120 +0.102...+0.157		
	Camshaft diameter at thrust bearing	75 +0...-0.019		
	Camshaft thrust bearing housing, bore	90 +0...+0.022		
	Camshaft thrust bearing diameter, in situ	75 +0.056...+0.108		
	Camshaft thrust bearing, axial clearance		0.14...0.31	
	Camshaft thrust bearing, width	70 -0.24 ...-0.37		
	Cylinder liner diameter	220.08 +0.046...-0	top : 220.45 bottom: 220.25	220.45 220.25
	Cylinder liner circularity	0.02		0.20
11	Big end bearing clearance		0.14...0.23	
	Crank pin diameter	180 +0...-0.025		179.825
	Crank pin circularity	0.015		0.05
	Crank pin taper	0.015/100		
	Big end bearing shell, thickness	4.940+0...-0.015		4.90
	Connecting rod bore, lower	190 +0.029...-0		
	Big end bearing diameter, in situ	180 +0.203...+0.144		
	Gudgeon pin bearing, clearance		0.09...0.15	
	Gudgeon pin diameter	95 +0...-0.010		
	Gudgeon pin circularity	0.0025		
	Gudgeon pin taper	0.005		
	Connecting rod bore, upper	115 +0.022...-0		
	Gudgeon pin bearing diameter, in situ	95 +0.142...+0.090		95.180
	Connecting rod axial clearance in piston		0.55...0.80	

Pos	Part, measuring point	Drawing dimensions (mm)	Normal clearance (mm)	Wear limit (mm)
	V22: Clearance between connecting rods		0.18...1.94	
	Clearance gudgeon pin - piston		0.005...0.025	
	Bore diameter in piston	95 +0.015...+0.005		
	Piston ring gap (clamped $\phi 220$)			
	compression rings		0.65...0.95	2.05
	oil scraper rings		0.80...1.05	
	Piston ring height clearance			
	compression ring 1		0.12...0.15	0.35
	"- 2		0.07...0.10	0.35
	"- 3		0.07...0.10	0.35
	oil scraper ring		0.04...0.07	0.35
	Piston ring groove height			
	groove I	4.11 +0.02...-0		
	"- II	4.06 +0.02...-0		
	"- III	4.06 +0.02...-0		
	"- IV	6.03 +0.02...-0		
	Piston clearance at bottom in cross direction of engine		0.14...0.22	
	Corresponding piston diameter	219.87 +-0.02		
	Crankshaft oil slinger (driving end)			
	axial clearance		0.39...1.03	
	radial clearance around crankshaft flange		0.62...0.93	
12	Valve guide diameter	16 +0.095...+0.075		16.20
	Valve stem diameter	16 +0 ...-0.018		15.97
	Valve stem clearance		0.06...0.11	0.20
	Valve seat deviation rela- tive guide (max. value)	0.10		
	Valve seat bore in cylinder head	78 +0.019...0		
13	Intermediate gear of cam- shaft drive			
	bearing clearance		0.03...0.09	0.20
	axial clearance		0.15...0.35	0.50
	Bearing diameter, in situ	60 +0.03...-0		
	Bearing journal diameter	60 -0.03...-0.06		

Pos	Part, measuring point	Drawing dimensions (mm)	Normal clearance (mm)	Wear limit (mm)
	Camshaft driving gear, backlash			
	Crankshaft gear - inter- mediate gear		0.10...0.45	
	Intermediate gear - camshaft gear		0.10...0.45	
	Base tangent length			
	- crankshaft gear	99.75 ± 0.024		99.60
	- large intermediate gear	146.003 ± 0.027		14
	- small intermediate gear	99.842 ± 0.024		
	- camshaft gear	130.694 ± 0.024		
14	Valve tappet, diameter	55 -0.03...-0.06		
	Guide, diameter	55 +0.03...-0		
	Diameter clearance		0.03...0.09	0.15
	Tappet roller bore diameter	30 +0.021...-0		
	Bush diameter, outer	30 -0.020...-0.033		
	Bush diameter, bore	22 +0.041...+0.020		
	Tappet pin diameter	22 -0.007...-0.020		21.95
	Bearing clearance			
	roller - bush		0.02...0.05	0.10
	bush - tappet pin		0.03...0.06	0.13
	Rocker arm bearing diameter	50 +0.050...+0.025		
	Bearing journal diameter	50 +0 ...-0.016		49.95
	Bearing clearance		0.03...0.07	0.25
	Yoke pin diameter	20 -0.040...-0.053		
	Yoke bore diameter	20 +0.033...-0		
	Diameter clearance		0.04...0.09	0.15
16	Nozzle needle lift	0.4		0.5
	Injection pump tappet:			
	Tappet roller bore diameter	36 +0.025...0		
	Bush diameter, outer	36 -0.050...-0.089		
	Bush diameter, bore	28 +0.065...+0.098		
	Tappet pin diameter	28 -0.020...-0.053		
	Bearing clearance			
	roller - bush		0.05...0.114	0.15
	bush - tappet pin		0.085...0.153	0.20
17	Fuel feed pump, engine driven			
	Shaft diameter	20 +0.009...-0.004		

Pos	Part, measuring point	Drawing dimensions (mm)	Normal clearance (mm)	Wear limit (mm)
	Bush diameter, bore	20 +0.061...+0.040		
	Bearing clearance		0.03...0.07	0.15
	Axial clearance		0.02...0.10	
	Backlash for driving gear		0.55...0.68	
	Base tangent length for pump gear	53.68 +-0.022		53.50
	Crankshaft gear for pump operation			
	Base tangent length, standard design z = 70	115.348+-0.024		115.19
	fast transm.ratio z = 73	115.159+-0.024		115.00
18	Lube oil pump for V22			
	Shaft diameter	50 -0.080...-0.105		
	Bush diameter, bore	50 +0.039...-0		
	Bearing clearance		0.08...0.15	0.22
	Axial clearance		0.27...0.36	
	Back lash for driving gear		0.36...0.49	
	Base tangent length, driving gear			
	standard design i=70/48	84.404 +-0.024		84.26
	fast transm.ratio i=73/45	84.489 +-0.024		84.35
	pump gear	42.95 +-0.030		42.50
19	Water pump, backlash for driving shaft gear		0.30...0.68	
	Base tangent length for driving gear			
	standard design i = 70/30	53.515 +-0.021		53.34
	fast transm.ratio i=73/27	53.735 +-0.021		53.55
22	Driving shaft for governor	20 +0 ...-0.021		
	Bearing for driving shaft	20 +0.053...+0.020		
	Bearing clearance		0.020...0.07	0.15
	Axial clearance		0.10...0.15	

Pos	Part, measuring point	Drawing dimensions (mm)	Normal clearance (mm)	Wear limit (mm)
23	Backlash for driving gear		0.10...0.20	0.30
	Backlash, balancing shaft gear			
	Crankshaft gear - inter- mediate gear		0.1 ...0.6	
	Intermediate gear - balancing shaft gear		0.1 ...0.5	
	Balancing shaft gear		0.1 ...0.35	