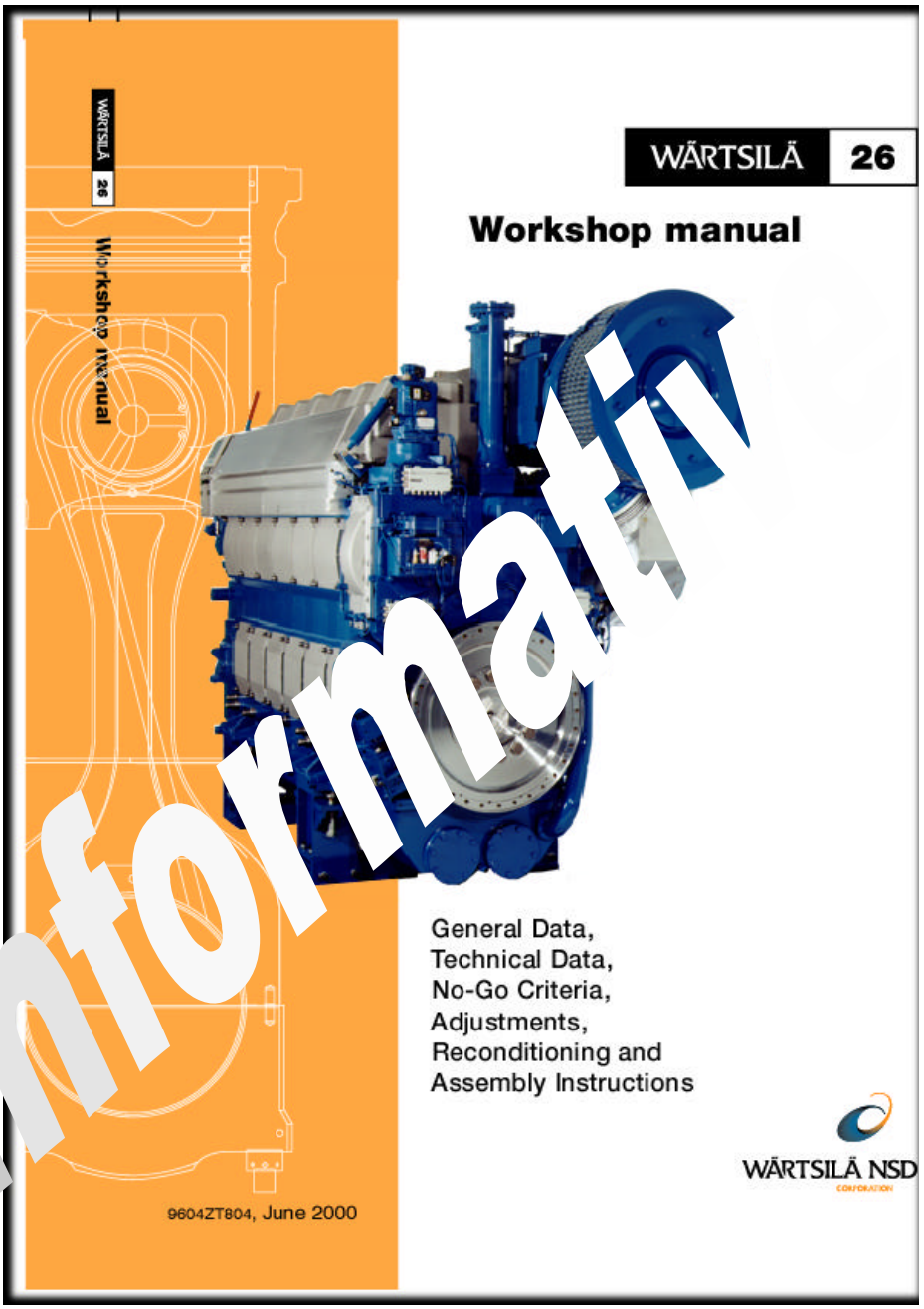
WÄRTSILÄ NSD
CORPORATION

Copy of the Workshop Manual W26, Edition June 2000



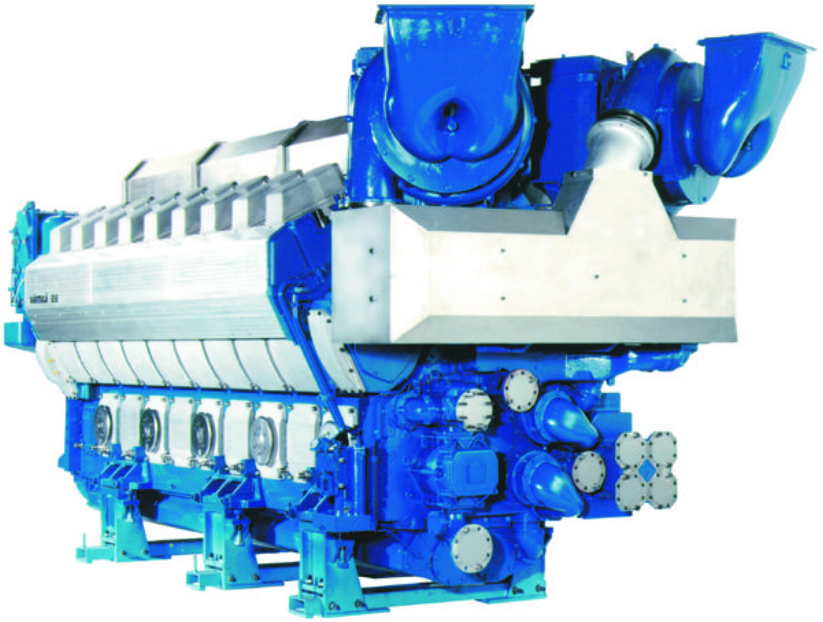
Note:

As the contents of this file may differ from the original paper copy, this information must be considered as informative only!

INTRODUCTION

The Management of the Service Department of **Wärtsilä NSD Nederland B.V.** offers you this Workshop Manual to support you in your worldwide Service activities for **W26** engines. This book must be considered as a supplement to the **W26** Engine manual and is intended to be used by **W26** engine trained personnel only**.**

Validity
In case any technical data differs from those of the engine manual or parts catalogue, the engine related engine manual or parts catalogue is normative.



Intranet
For the latest technical data (Technical Bulletins etc.) see also our Service INTRANET Site.

In case of doubt or if you have any questions, please contact your service contact person at Wärtsilä NSD in Zwolle, The Netherlands.

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Note 1: As the latest versions of Measurement records always will be published on INTRANET, see our WNSNL INTRANET Service Site.

Note 2:
To identify complete material numbers, you need to enter an additional number before the material number mentioned in this book, this is called the MG-MT code. Hereunder you will find the MG-MT codes for the different types of engines. This code consist of 5 positions before the original material number. (Example 262605611ZT185)

Engine Type	MG-MT code	Engine Type	MG-MT code
RS 150	10100	W38	63630
R 210	01010	F 240	41410
W26	*26260*	SW280	28280
TM410	61610	TM620	62620
Grabspares	00000 or 61610		

0.0 GENERAL DATA

Symbols and conversions.

Length

Unit	Symbol	Conversion
mil (=0.001 inch)	mil	25.4 x 10^{-6} m
inch	in	25.4 x 10^{-3} m
foot (= 12 inch)	ft	0.3048 m
Yard (=3 ft)	yd	0.9144 m
Fathom (=6 ft)	fath	1.8288 m
Statute mile (=1760 yd)	mi	≈1609.344 m

Volumes

Unit	Symbol	Conversion
fl.ounce (UK)	fl oz	≈ 28.413 x 10^{-6} m^3
fl ounce (US)	fl oz	≈ 29.5735 x 10^{-6} m^3
pint (UK) (=20fl oz)	pt	≈ 568.261 x 10^{-6} m^3
Liq.pint (us) (=16 fl oz)	liq.pt	≈ 473.176 x 10^{-6} m^3
quart (UK) (=2 pt)	qt	≈ 1.13652 x 10^{-3} m^3
Liq. Quart (US) (=2liq.pt)	liq.pt	≈ 0.94633 x 10^{-3} m^3
gallon (UK) (= 4 qt)	gal	≈ 4.54609 x 10^{-3} m^3
gallon (US)	gal	≈ 3.78541 x 10^{-3} m^3
Barrel (US) (=42gal US)	bbl	≈ 0.15898 x 10^{-3} m^3

Weights

Unit	Symbol	Conversion
Ounce	oz	≈ 28.3495 10^{-3} kg
Pound	lb	≈ 0.4536 kg
Stone (UK) (=16 oz)	st	≈ 6.3503 kg
Hundred weight (UK) (=112 lb)	cwt	≈ 50.8023 kg
Short ton (US) (=2000 lb)	sh tn	≈ 907.1847 kg
Long ton (US) (=2240 lb) = ton (UK)	l tn	≈ 1016.0469 kg

Units

Name	Symbol	Unit
Meter	m	Length
Second	s	Time
Kilogram	kg	Mass
Volt	V	Electrical tension
Ampere	A	Electrical current
Watt	W	Power
Newton	N	Force
Joule	J	Energy
Bar	bar	Pressure
Kelvin	K	Temperature

Prefix	Symbol	Factor
Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
Kilo	k	10^{3}
Hecto	h	10^{2}
Deca	da	10^{1}
Deci	d	10^{-1}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	µ	10^{-6}
Nano	η	10^{-9}
Pico	p	10^{-12}

Viscosity

	mm^2/s	^0E	RI
cSt	1	0.1320	4.100
^0E	7.576	1	31.06
RI	0.2439	0.0322	1

Force

	N	kgf	lbf
N	1	0.102	0.225
kgf	9.81	1	2.2
lbf	4.45	0.453	1

Pressure

	N/mm^2	bar	Pa	kgf/cm^2	mm Hg
N/mm^2	1	10	10^6	10.2	$7,5 . 10^3$
bar	0.1	1	10^5	1.02	750
Pa	10^{-6}	10^{-5}	1	$10,2.10^{-6}$	0,0075
kgf/cm^2	0.0981	0.981	$98.1.10^3$	1	736
mm Hg	$1,33 . 10^{-3}$	$1,33 . 10^{-3}$	1,33	$1,36 . 10^{-3}$	1

Energy

	ft.lb	kgf.m	J=W.s
1 ft.lb	1	0,1383	1,356
1 kgf.m	7,233	1	9,807
1 J=1 W.s	0,7376	0,102	1
1 kW.h	$2,655. 10^6$	$367,1. 10^3$	$3,6. 10^6$
1 kcal	$3,087. 10^3$	426,9	4187
1 Btu	778,6	107,6	1055

	kW.h	kcal	Btu
1 ft.lb	$376,8. 10^{-9}$	$324. 10^{-6}$	$1,286. 10^{-3}$
1 kgf.m	$2,725. 10^{-6}$	$2,344. 10^{-3}$	$9,301. 10^{-3}$
1 J=1 W.s	$277,8. 10^{-9}$	$239. 10^{-6}$	$948,4. 10^{-6}$
1 kW.h	1	860	3413
1 kcal	$1,163. 10^{-3}$	1	3,968
1 Btu	$293. 10^{-6}$	0,252	1

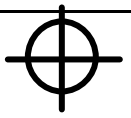
Power

	W	kgf.m/s	kcal/s	kcal/h	hp	ft.lb.f/s	btu/h
W	1	0,102	$0,239.10^{-3}$	0,86	$1,36.10^{-3}$	0,738	3,41
kgf.m/s	9,81	1	$2,34.10^{-3}$	8,43	$13,3.10^{-3}$	7.23	33,46
kcal/s	4187	427	1	3600	5,69	3088	14286
kcal/h	1,163	0,119	$0,278.10^{-3}$	1	$1,85.10^{-3}$	0,858	3,97
hp	735	75	0,176	632	1	542	2510
ft.lb.f/s	1,36	0,138	$0,324.10^{-3}$	1,17	$1,84.10^{-3}$	1	4,63
btu/h	0,293	$29,9.10^{-3}$	$0,07.10^{-3}$	0,252	$0,4.10^{-3}$	0,216	1

Power formula

Power formula		
4 Stroke diesel engine	$P_e = \frac{pme.\frac{p}{4}D^2.s.n.z}{2\times 60000}$ kW	P_e = effective power [kW] D = bore [m] pme = mean effective pressure [N/m^2] s = piston stroke [m] z = number of cylinders n = number of revolutions [1/min]
Single phase AC motor	$P = I.U_n.\cos\phi.\eta.10^{-3}$ kW	P = given off power (kW) I = current (A) U_n = nominal voltage between two phases (V) $\cos\phi$ = power factor η = efficiency factor
Three phase motor	$P = I.U_n.\cos\phi.\eta.\sqrt{3}.10^{-3}$ kW	
DC motor	$P = I.U_n.\eta.10.^{-3}$ kW	
Three phase generator	$P = I.U_n.\sqrt{3}.\cos\phi.10^{-3}$ kW	
Centrifugal pump	$\frac{P_e = 100\ p_{man}.\ \phi_e}{\eta}$	P_e = demanded power p man = manometerical pressure [n/m^2] ϕ_e = ammount of water in m^3.s^{-1} η = efficiency factor
Air fan	$P_e = \frac{f_v.p.100}{h}kW$	P_e = demanded power p = pressure increase [bar] ϕ_v = air output in m^3.s^{-1} η = efficiency factor

Form, location and run-out symbols

Toleranced characteristics	Symbols
Straightness	
Flatness	
Circularity	
Cylindricity	
Profile of any line	
Profile of any surface	
Parallelism	
Perpendicularity	
Angularity	
Position	
Condentricity and coaxiality	
Symmetry	
Circular run-out	
Total run-out	

Torques for bolts and nuts (general)

Thread Dimensions	Pitch	Bolt class	Torque [Nm]
M4	0,7	8.8 10.9 12.9	2,8 4,1 4,8
M5	0,8	8.8 10.9 12.9	5,5 8,1 9,5
M6	1,0	8.8 10.9 12.9	9,5 14,0 16,5
M8	1,25	8.8 10.9 12.9	23,0 34,0 40,0
M10	1,5	8.8 10.9 12.9	46,0 68,0 79,0
M12	1,75	8.8 10.9 12.9	79,0 117,0 135,0
M14	2,0	8.8 10.9 12.9	125,0 185,0 215,0
M16	2,0	8.8 10.9 12.9	195,0 280,0 330,0
M18	2,5	8.8 10.9 12.9	280,0 390,0 460,0
M20	2,5	8.8 10.9 12.9	390,0 560,0 650,0
M22	2,5	8.8 10.9 12.9	530,0 750,0 880,0
M24	3,0	8.8 10.9 12.9	670,0 960,0 1120,0
M30	3,5	8.8 10.9 12.9	1350,0 1900,0 2250,0

PT 100 conversion

PT 100 elements with platinum windings 0-150 ° C

°C	OHMS										
	0	1	2	3	4	5	6	7	8	9	10
0	100,000	100,391	100,781	101,172	101,562	101,952	102,343	102,733	103,123	103,512	103,902
10	103,902	104,292	104,682	105,070	105,460	105,849	106,238	106,627	107,015	107,404	107,793
20	107,793	108,181	108,569	108,957	109,345	109,733	110,121	110,509	110,897	111,284	111,672
30	111,671	112,059	112,446	112,833	113,220	113,607	113,993	114,380	114,764	115,153	115,539
40	115,539	115,925	116,311	116,697	117,083	117,468	117,854	118,239	118,624	119,010	119,395
50	119,395	119,780	120,164	120,549	120,934	121,318	121,703	122,087	122,471	122,855	123,239
60	123,239	123,623	124,006	124,390	124,773	125,157	125,540	125,923	126,306	126,689	127,071
70	127,071	127,454	127,837	128,219	128,601	128,983	129,365	129,747	130,129	130,511	130,893
80	130,893	131,274	131,655	132,037	132,418	132,799	133,180	133,560	133,941	134,322	134,702
90	134,702	135,082	135,463	135,843	136,223	136,602	136,982	137,362	137,741	138,121	138,500
100	138,500	138,879	139,258	139,637	140,016	140,395	140,773	141,152	141,530	141,908	142,286
110	142,286	142,664	143,042	143,420	143,798	144,175	144,553	144,930	145,307	145,684	146,061
120	146,061	146,438	146,815	147,191	147,568	147,944	148,321	148,697	149,073	149,449	149,824
130	149,824	150,200	150,576	150,951	151,326	151,702	152,077	152,452	152,827	153,201	153,576
140	153,576	153,951	154,325	154,699	155,074	155,448	155,822	156,195	156,569	156,943	157,316
150	157,316	157,690	158,063	158,436	158,809	159,182	159,555	159,927	160,300	160,672	161,045

Thermocouples conversion

Thermocouple type K Nickel-Chromium/Nickel-Aluminium
Reference temp 0° C

°C	Microvolts (abs)									
	0	1	2	3	4	5	6	7	8	9
0	0	39	79	119	158	198	238	277	317	357
10	397	437	477	517	557	597	637	677	718	758
20	798	838	879	919	960	1000	1041	1081	1122	1162
30	1203	1244	1285	1325	1366	1407	1448	1489	1529	1570
40	1611	1652	1693	1734	1776	1817	1858	1899	1940	1931
50	2022	2064	2105	2146	2188	2229	2270	2312	2353	2394
60	2436	2477	2519	2560	2601	2645	2684	2726	2767	2809
70	2850	2892	2933	2975	3016	3058	3100	3141	3183	3224
80	3266	3307	3349	3390	3432	3473	3515	3556	3598	3639
90	3681	3722	3764	3805	3847	3888	3930	3971	4012	4054
100	4095	4137	4178	4219	4261	4302	4343	4384	4426	4467
110	4508	4549	4590	4632	4673	4714	4755	4796	4837	4878
120	4919	4960	5001	5042	5083	5124	5164	5205	5246	5287
130	5327	5368	5409	5450	5490	5531	5571	5612	5652	5693
140	5733	5774	5814	5855	5895	5936	5976	6016	6057	6097
°C	0	10	20	30	40	50	60	70	80	90
100						6137	6539	6939	7338	7737
200	8137	8537	8938	9341	9745	10151	10560	10969	11381	11793
300	12207	12623	13039	13456	13874	14292	14712	15132	15552	15974
400	16395	16818	17241	17664	18088	18513	18938	19363	19788	20214
500	20649	21066	21493	21919	22346	22772	23198	23624	24050	24476

Roughness

Roughness in Ra, (average)	
µ in	µ m
2000	50
1000	25
500	12.5
250	6.3
125	3.2
63	1.6

Roughness in Ra, (average)	
µ in	µ m
32	0.8
16	0.4
8	0.2
4	0.1
2	0.05
1	0.025

Tolerances for linear measurements

Without tolerance specification, (acc. DIN 7168)

Nom. Measurement between [mm]		Tolerance [mm]
> 0.0	120.0	± 0.8
120.0	400.0	± 1.2
400.0	1000.0	± 2.0
1000.0	2000.0	± 3.0
2000.0	4000.0	± 4.0
4000.0	8000.0	± 5.0
8000.0	12000.0	± 6.0
12000.0	16000.0	± 7
16000.0	20000.0	± 8

Hardness conversion

Approximiate Conversion from hardness to tensile strenght of steels

Brinell Hardness Number HB	Vickers Hardness Number HV	Rockwell Hardness Number RC	Shore Sclero-scope Hardness	Tensile Tons/in^2	Tensile Kg/mm^2	Tensile Lb/in^2	Tensile (Mpa)	Tensile Mn/m^2
601	760	62	81	131	206	293,440	(2023)	2023
567	704	60	78	126	198.5	282.240	(1946)	1946
555	650	58	75	121	190.5	271.040	(1869	1869
534	609	56	72	116	183	259.840	(1792)	1792
514	572	54.5	70	112	176	250.880	(1730)	1730
495	532		66	108	170	242.920	(1668)	1668
477	517		66	104	164	232.960	(1606)	1606
461	497		64	100	157.5	224.000	(1544)	1544
444	475		61	97	153	217.280	(1498)	1498
429	455	46.5	99	94	148	210.560	(1452)	1452

Brinell Hardness Number HB	Vickers Hardness Number HV	Rockwell Hardness Number RC	Shore Sclero-scope Hardness	Tensile Tons/in^2	Tensile Kg/mm^2	Tensile Lb/in^2	Tensile (Mpa)	Tensile Mn/m^2
415	440	45	57	91	143	203.840	(1405)	1405
401	427	44	55	88	139	197.120	(1359)	1359
388	411	42.5	53	84	132	188.160	(1297)	1297
375	398		52	82	129	183.680	(1266)	1266
363	384	40.5	50	79	124.5	176.960	(1220)	1220
352	372	39	49	76	120	170.240	(1174)	1174
341	361	38	47	74	116.5	165.760	(1143)	1143
331	351	37	46	72	113.5	161.280	(1112)	1112
321	338	35.5	45	70	110	156.800	(1081)	1081
311	328	34.5	44	68	107	152.320	(1050)	1050
302	318	33.5	42	66	104	147.840	(1019)	1019
293	308	32	41	64	101	143.360	(988)	988
285	300	31	40	62	97.6	138.880	(958)	958
277	292	29.5	39	60	94.5	134.400	(927)	927
269	284	28.5	38	59	92.9	132.160	(911)	911
262	273	27	37	57	89.8	127.680	(880)	880
255	265	25.5	36	55	86.6	123.200	(849)	849
248	258	25	36	54	85.0	120.960	(834)	834
241	251	23.5	35	52	81.9	116.480	(803)	803
235	242	22	34	51	80.3	114.240	(788)	788
229	234	21	33	50	78.7	112.000	(772)	772
223	228	20	33	49	77.2	109.760	(757)	757
217	222	-	32	47	74.0	105.280	(726)	726
207	212	-	30	45	70.9	100.800	(695)	695
197	202	-	29	43	67.7	96.320	(664)	664
187	192	-	28	41	64.6	91.840	(633)	633
179	184	-	27	39.5	62.2	88.480	(610)	610
170	175	-	26	38.5	60.6	86.240	(595)	595
163	168	-	25	37.5	59.0	84.000	(579)	579
156	161	-	24	36	56.7	80.640	(556)	556
149	154	-	23	34	53.5	76.160	(525)	525
143	148	-	22	33	52.0	73.920	(510)	510
131	136	-	21	30	47.3	67.200	(463)	463
121	126	-	20	28	44.1	62.720	(432)	432
111	116	-	-	25.5	40.2	57.120	(394)	394
103	108	-	-	23.5	37.0	52.640	(363)	363
95	100	-	-	22	34.6	49.280	(340)	340

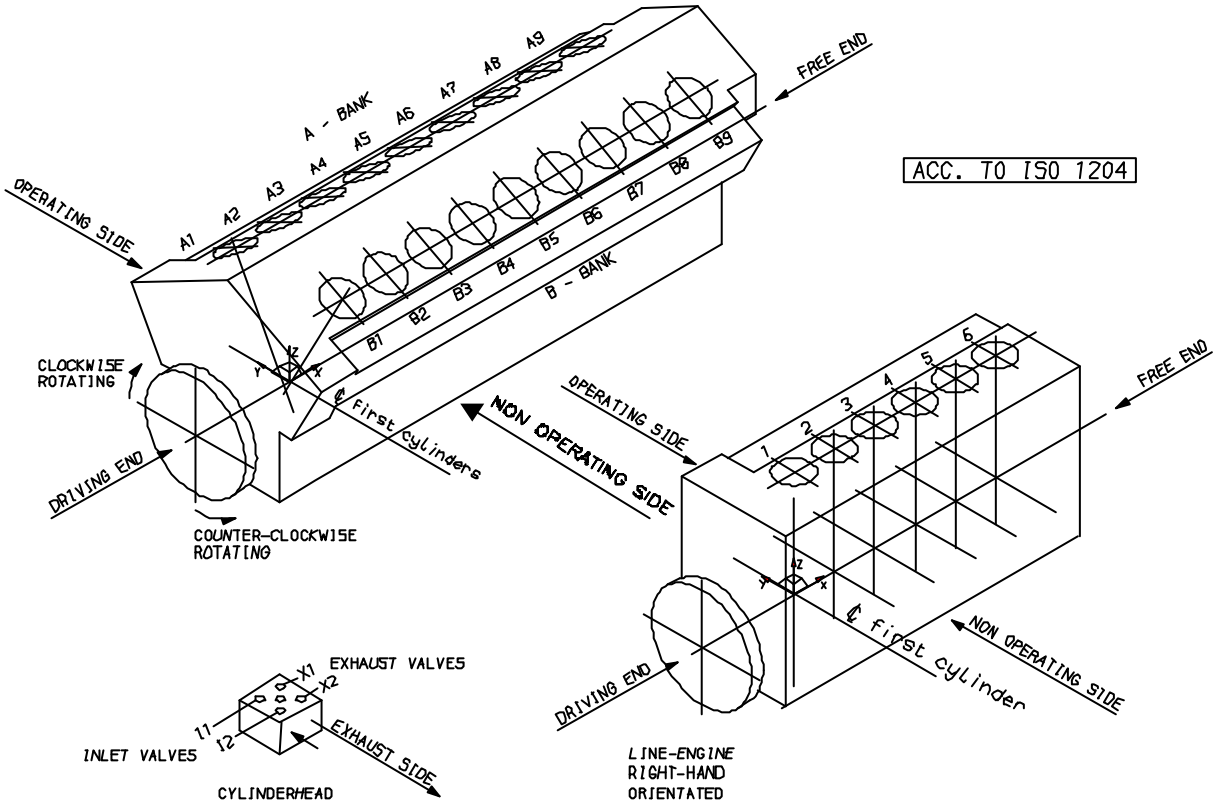
1.0 MAIN DATA

Main data of the W26 engine (general)	
Type	Four stroke - direct injection
Cylinder bore	260 mm
Stroke	320 mm
Swept volume	17 l / cyl.
Compression ratio	16:1
Configuration	6, 8, 9 cylinders in line, 12, 16, 18 cylinders in Vee
Vee-angle	55°
Max. cylinder pressure	180 bar
Pressure charging	Turbochargers and air cooler(s)

Engine definitions	
Operating side	The longitudinal side of the engine where the operating controls are located.
Non-operating side	The longitudinal side opposite the operating side.
Driving end	The end of the engine where the flywheel is located.
Free end	The end opposite the driving end.
Designation of cylinders	The designation of cylinders begins at the driving end.
Clockwise rotating	Looking against the driving end of the engine the shaft rotates clockwise.
Counter clockwise rotating	Looking against the driving end of the engine the shaft rotates counter-clockwise.

Cylinder numbering

The cylinders are progressively numbered from the flywheel. The cylinder next to the flywheel has to be the lowest number.



Combustion sequence

Engine type	clock wise
W 26 6-L	1-4-2-6-3-5
W 26 8-L	1-3-2-5-8-6-7-4
W 26 9-L	1-7-4-2-8-6-3-9-5
W 26 12-V	A1-B1-A3-B3-A5-B5-A6-B6-A4-B4-A2-B2
W 26 16-V	A1-B1-A3-B3-A2-B2-A5-B5-A8-B8-A6-B6-A7-B7-A4-B4
W 26 18-V *	A1-B8-A7-B6-A4-B3-A2-B9-A8-B5-A6-B1-A3-B7-A9-B4-A5-B2
Engine type	**anti clock wise**
W 26 6-L	1-5-3-6-2-4
W 26 8-L	1-4-7-6-8-5-2-3
W 26 9-L	1-5-9-3-6-8-2-4-7
W 26 12-V	B1-A1-B2-A2-B4-A-B6-A6-B5-A5-B3-A3
W 26 16-V	B1-A1-B4-A4-B7-A7-B6-A6-B8-A8-B5-A5-B2-A2-B3-A3
W 26 18-V *	B1-A8-B5-A2-B9-A4-B3-A7-B6-A1-B8-A5-B2-A9-B4-A3-B7-A6

Note: Interval between A1 and B1 = 360° (Crankshaft) + 55° (V engine)

HFO, MDO/LFO - Main data

Engine speed	Fuel type	Cylinder output (MCR)	Mean effective pressure
[rpm]		[kW]	[bar]
900	HFO + DMC	295	23.1
	MDO / LFO	310	24.3
1000	HFO + DMC	310	21.9
	MDO / LFO	325	23.0

The Mean Effective Pressure of the W26 engine can be calculated as follows:

pe = P / (n * 0.01416)

pe = Mean effective pressure [bar]
P = Output per cylinder [kW]
n = Engine speed [rpm]

General formula

4 Stroke diesel engine	$P_e = \frac{pme.\frac{p}{4}D^2.s.n.z}{2\times 60000}$ kW	P_e = effective power [kW] D = bore [m] pme = mean effective pressure [N/m^2] s = piston stroke [m] z = number of cylinders n = number of revolutions [1/min]

Derating conditions

Standard conditions		Max.	Nom.	Min.
Air temperature engine inlet-marine	[°C]	45	-	15
Air temperature engine inlet-power	[°C]	35	-	15
Site elevation above sea level Barometric pressure	[m] [mbar]	100 -	0 1000	- 982
L.T. coolant before air cooler-marine	[°C]	38	-	-
L.T. coolant before air cooler-power	[°C]	45	-	-
Pressure loss before the compressor of the turbocharger	[mbar]	10	-	-
Pressure loss in the air cooler at max. load of p receiver	[mbar/bar] %	(70) 2%	(35) 1%	-
Pressure loss exhaust gas after the turbocharger	[mbar]	30	-	-

Note: For exact values, see order specification

NOTE: For higher temperatures the output of the engine has to be corrected according the drawing curves or according to ISO 3046/1 (mechanical efficiency is 0,9). No compensation is allowed for conditions better than specified.

Derating of power for ambient conditions (*marine engines*)

ISO 3046-1

The derating is according to ISO 3046-1:1995(E) applying: $\eta_m = 0.90$

Substitute reference conditions for derating are:

- Ambient pressure	100	kPa
- Suction air temperature	45°C	
- Charge air coolant temperature	38°C	
- Total exhaust gas back pressure	3kPa	

The full output of the engine is available at the substitute reference conditions.
No compensation (uprating) is allowed for ambient conditions better than substitute.

Extension

- For suction air temperature < 15 ^{o}C derating is: 0.4% / ^{o}C
  (For suction air temperature < - 5 ^{o}C heating of suction air and/or special requirements may be required.)

- For total exhaust gas back pressure a factor is added to ISO 3046-1:1995(E).
  The factor shall be added if the design target of 3 kPa is exceeded.

- For certain applications where glycol-water is used as cooling media in the HT- and/or LT-cooling system derating is 0.5%/10% glycol unless the charge air coolant temperature is reduced by 1^{o}C for every 10% glycol in the water.

Maximum allowable glycol-% in water is 50%. In case glycol is applied in the cooling system the capacity of the lubricating oil cooler on the engine and all external heat exchangers has to be designed for the specified glycol-%.

Wärtsilä NSD does not recommend the use of glycol in cooling water.

Restrictions on the application of the derating calculation

Modifications to the engine may be required when the calculated power adjustment factor (α) trespasses the value of 0.95. In such case the derated output of the engine is subject to confirmation by Technology Department by means of the " Performance Request Sheet".

Adjustment of power for ambient conditions (*marine engines*)

The adjusted output for site ambient conditions is calculated with the following formula:

$P_x = \alpha \cdot P_{ra}$

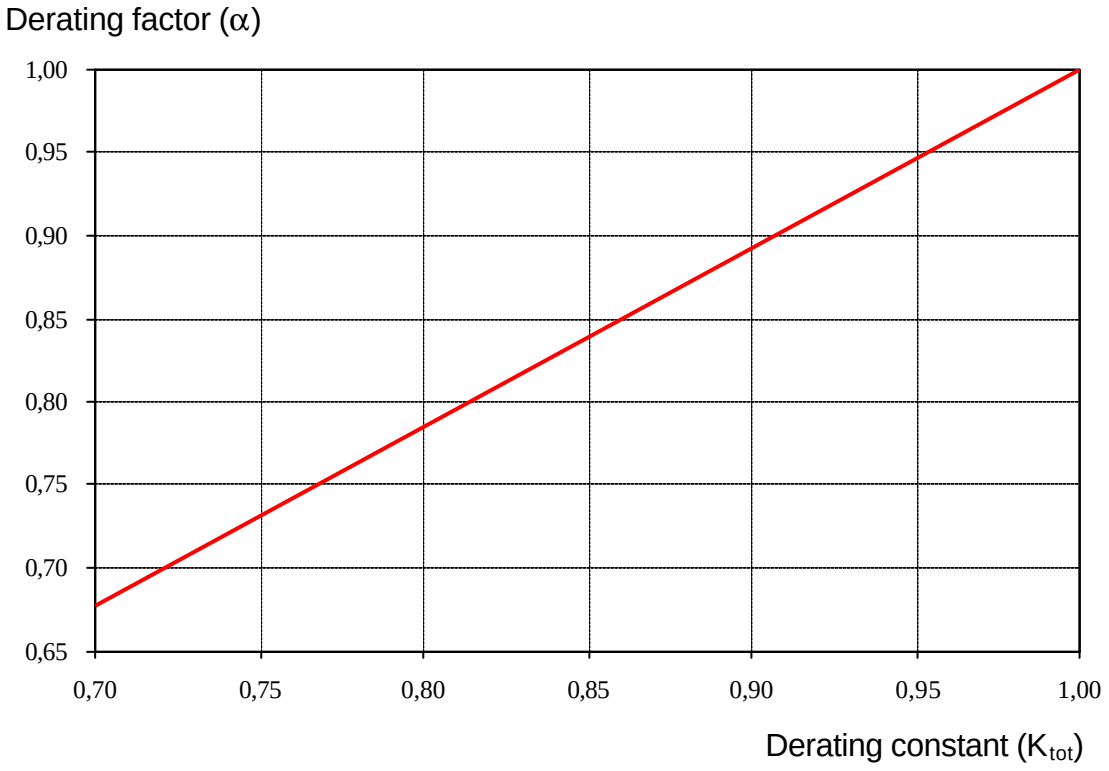
where,

P_X = Adjusted power under site conditions
P_{ra} = Power under substitute reference conditions
α = Power adjustment factor

where,

Derating constant $K_{tot} = K_1 \cdot K_2 \cdot K_3 \cdot K_4$

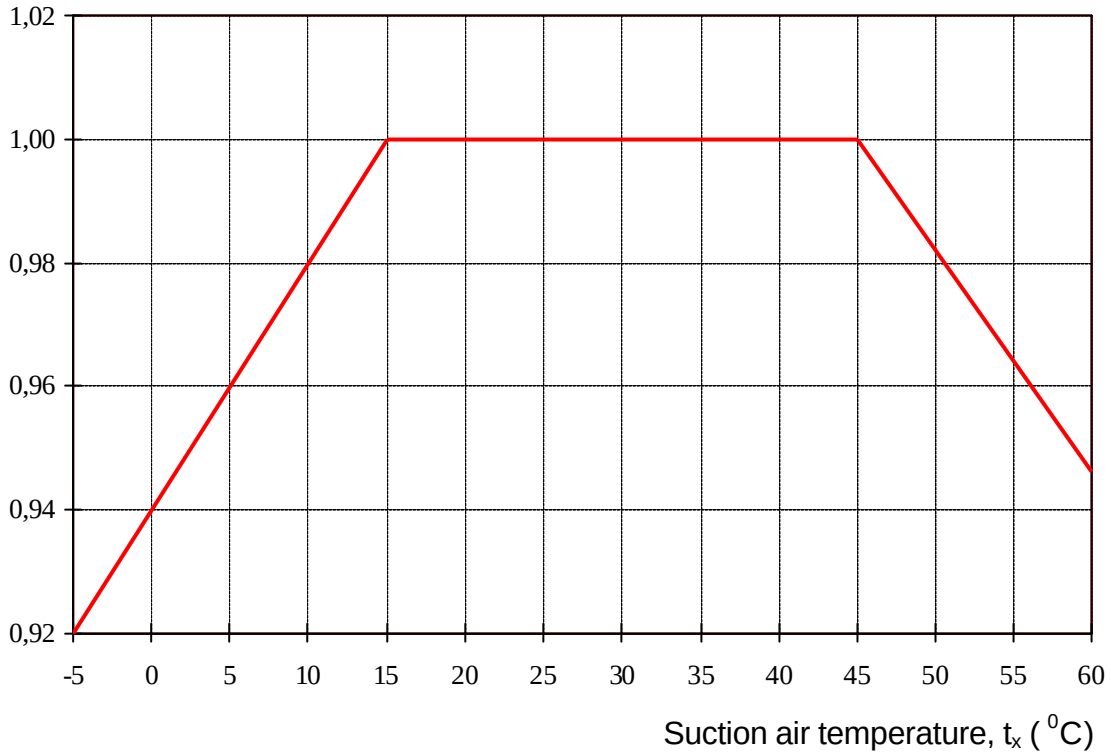
Derating constants K_1 , K_2 , K_3 and K_4 are according below.



Calculation formulae: $\alpha = K_{tot} - 0.7 \cdot (1 - K_{tot}) \cdot (1/0.9 - 1)$

Derating due to suction air temperature (*marine engines*)

Derating constant (K_1)



Calulation formulae:

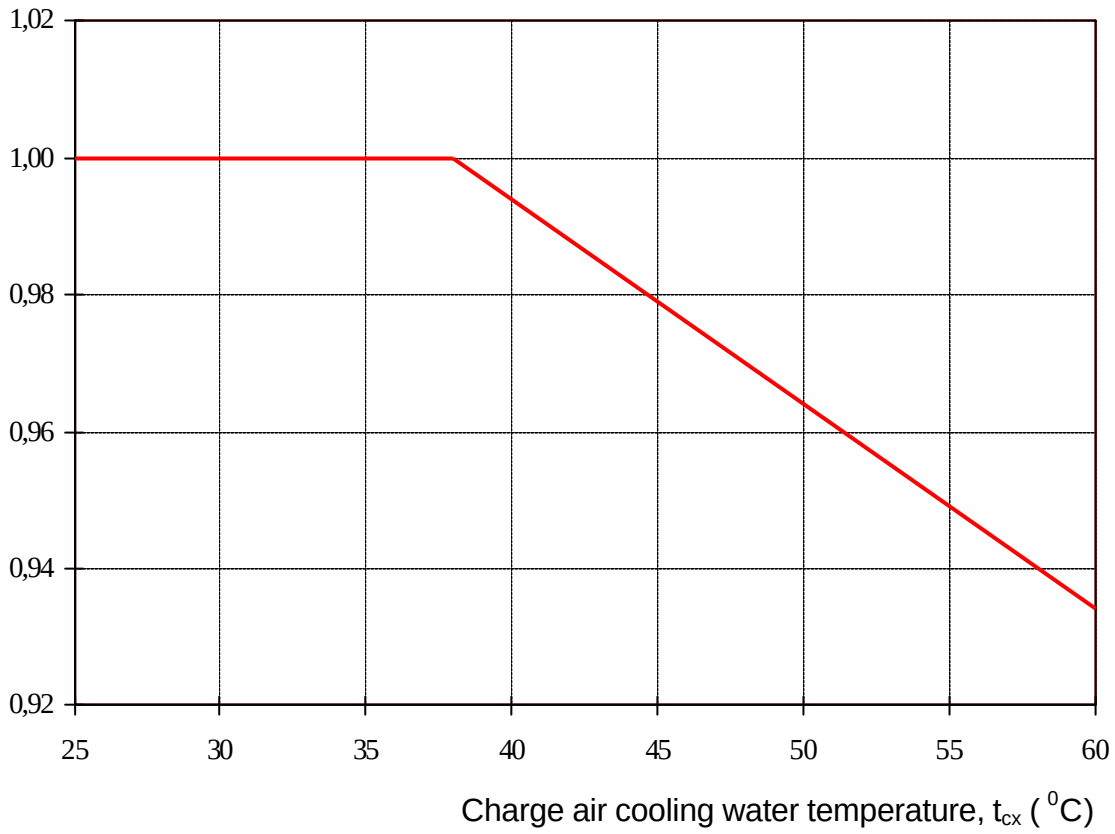
$t_x \leq 15 \Rightarrow K_1 = 1+0.004 * (t_x - 15)$

$15 \leq t_x \leq 45 \Rightarrow K_1 = 1$

$t_x \geq 45 \Rightarrow K_1 = ((273+45)/(273+t_x))^{1.2}$

Derating due to charge air coolant temperature (*marine engines*)

Derating constant (K_2)



Calculation formulae:

$t_{cx} < 38 \Rightarrow K_2 = 1$

$t_{cx} \geq 38 \Rightarrow K_2 = (273+38)/(273+t_{cx})$

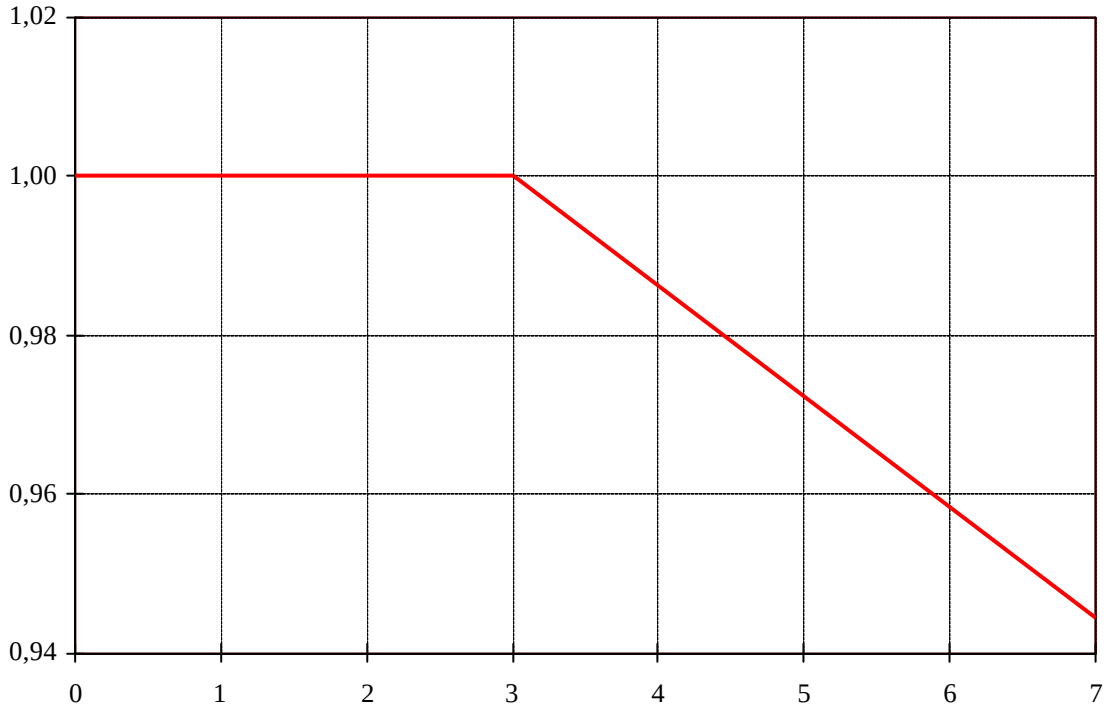
Derating due to ambient air pressure (*marine engines*)

Under the assumption that the ambient air pressure for marine applications is equal to the barometric pressure:

$K_3 = 1$

Derating due to total exhaust gas back pressure (*marine engines*)

Derating constant (K_4)



Calculation. formulae:

delta p ≤ 3 ⇒ $K_4 = 1$

delta p > 3 ⇒ K_4 = (103/(100 + delta p))^1.5

Derating of power for ambient conditions *(power plants)*

ISO 3046-1

The derating is according to ISO 3046-1:1995(E) applying: $^{n}_{m} = 0.90$

Substitute reference conditions for derating are:

- Ambient pressure	100	kPa
- Suction air temperature	35	°C
- Charge air coolant temperature	45	°C
- Sum of suction air pressure loss and exhaust gas back pressure	5	kPa

NOTE 1. The permissible pressure drop in the inlet pipe before the turbocharger maximum 1 kPa. At altitude maximum 1% of ambient pressure

The full output of the engine is available at the substitute reference conditions.
No compensation (uprating) is allowed for ambient conditions better than substitute.

Extension

- For suction air temperature < 15 °C derating is: 0.4% / °C
  (For suction air temperature < - 5 °C heating of suction air and/or special requirements may be required.)

- For suction air pressure loss and exhaust gas back pressure a factor is added to ISO 3046-1:1995(E). The factor shall be added if the design target of 5 kPa is exceeded.

- For certain applications where glycol-water is used as cooling media in the HT- and/or LT-cooling system derating is 0.5%/10% glycol unless the charge air coolant temperature is reduced by 1°C for every 10% glycol in the water.

Maximum allowable glycol-% in water is 50%. In case glycol is applied in the cooling system the capacity of the lubricating oil cooler on the engine and all external heat exchangers has to be designed for the specified glycol-%.

Attention: Wärtsilä NSD does not recommend the use of glycol in cooling water.

Restrictions on the application of the derating calculation

Modifications to the engine may be required when the calculated power adjustment factor (α) trespasses the value of 0.95. In such case the derated output of the engine is subject to confirmation by Technology Department by means of the " Performance Request Sheet".

Adjustment of power for ambient conditions *(power plants)*

The adjusted output for site ambient conditions is calculated with the following formula:

$P_X = \alpha \cdot P_{ra}$

where,

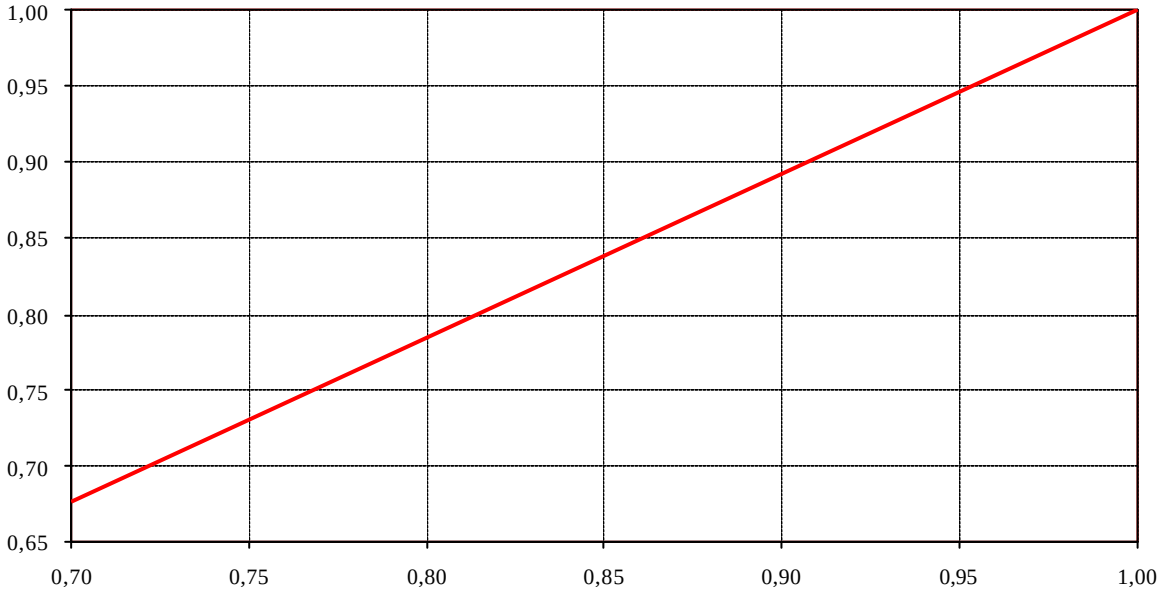
P_X = Adjusted power under site conditions
P_{ra} = Power under substitute reference conditions
α = Power adjustment factor

where,

Derating constant $K_{tot} = K_1 \cdot K_2 \cdot K_3 \cdot K_4$

Derating constants K_1 , K_2 , K_3 and K_4 are according below.

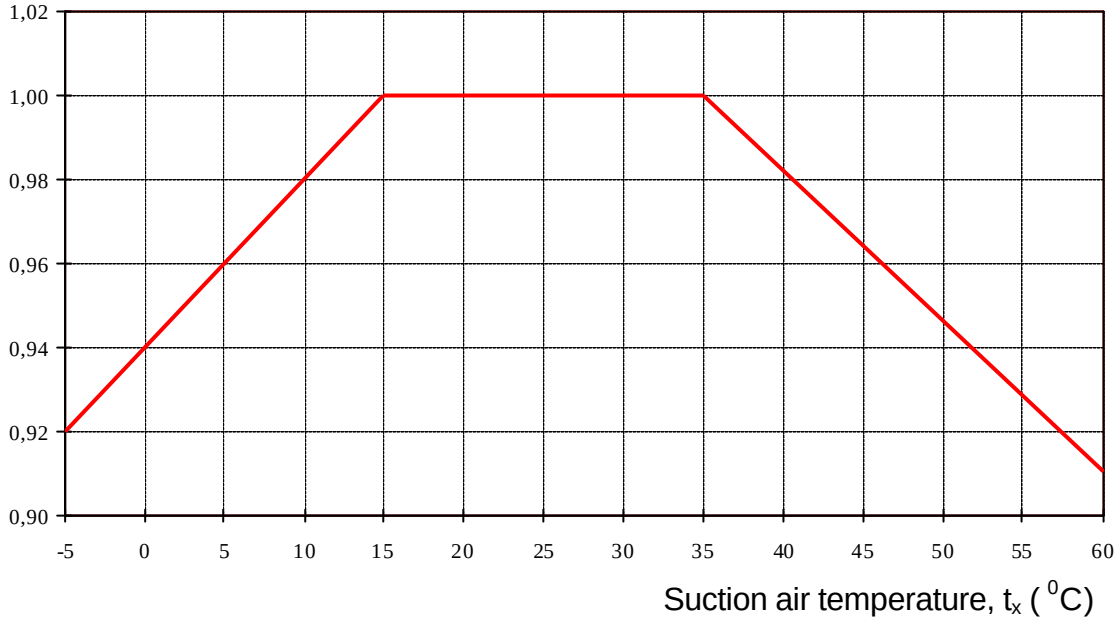
Derating factor (α)



Calculation formulae: $\alpha = K_{tot} - 0.7 \cdot (1 - K_{tot}) \cdot (1/0.90 - 1)$

Derating due to suction air temperature *(power plants)*

Derating constant (K_1)



Calculation. formulae:

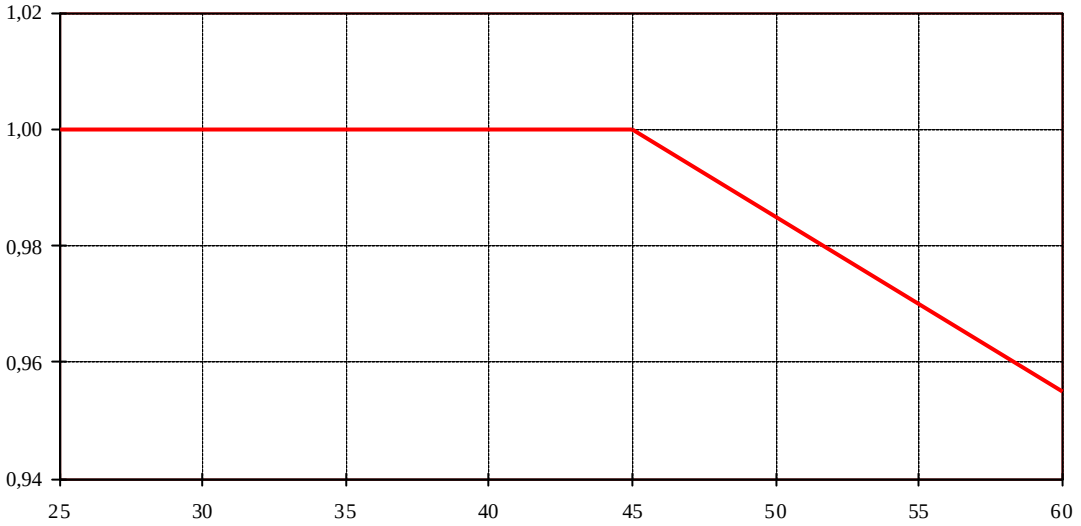
$t_x \leq 15 \Rightarrow K_1 = 1+0.004 * (t_x - 15)$

$15 \leq t_x \leq 35 \Rightarrow K_1 = 1$

$t_x \geq 35 \Rightarrow K_1 = ((273+35)/(273+t_x))^{1.2}$

Derating due to charge air coolant temperature *(power plants)*

Derating constant (K_2)



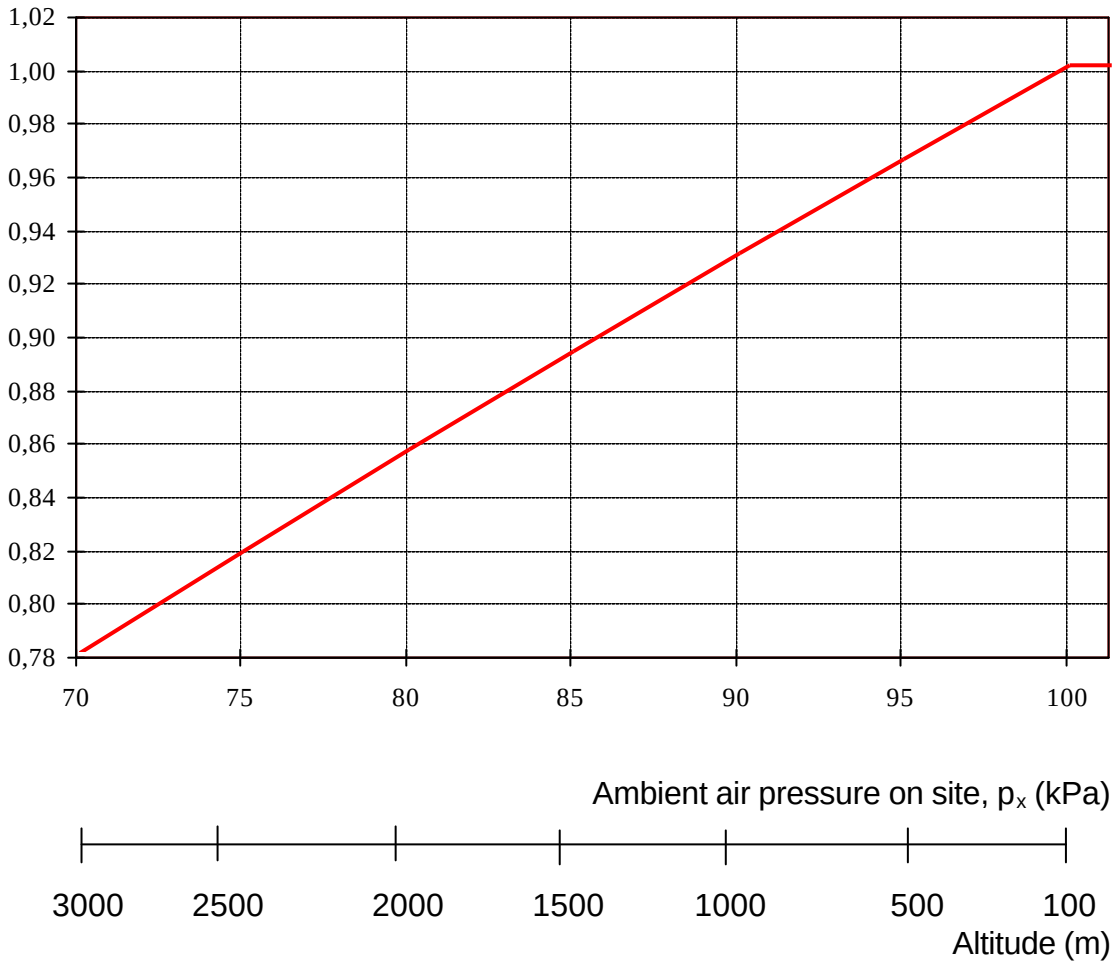
Calculation formulae:

$t_{cx} < 45 \Rightarrow K_2 = 1$

$t_{cx} \geq 45 \Rightarrow K_2 = (273+45)/(273+t_{cx})$

Derating due to ambient air pressure *(power plants)*

Derating constant (K_3)



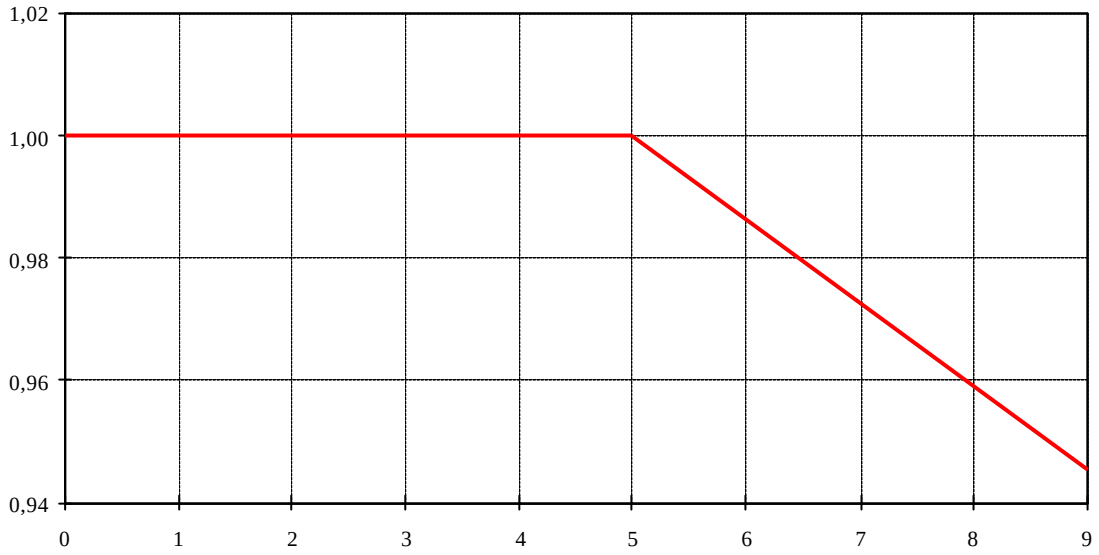
Calculation formulae:

$p_x \geq 100 \Rightarrow K_3 = 1$

$p_x < 100 \Rightarrow K_3 = (p_x/100)^{0.7}$

Sum of suction air pressure loss and exhaust gas back pressure *(power plants)*

Derating constant (K_4)



Sum of suction air pressure loss and exhaust gas back pressure, delta p (kPa)

Calculation formulae:

delta p ≤ 5 ⇒ $K_4 = 1$

delta p > 5 ⇒ K_4 = (105/(100 + delta p))^1.5

Air consumption

Air consumption and gas flows marine

	Unit	Engine speed	6L26	8L26	9L26	12V26	16V26	18V26
		[rpm]						
Combustion air flow at 100% load HFO	[kg/s]	900 1000	3.91 4.10	5.22 5.47	5.87 6.15	7.83 8.20	10.44 10.93	11.74 12.30
Exhaust gas quantity at 100% load HFO	[kg/s]	900 1000	4.01 4.20	5.35 5.61	6.02 6.31	8.02 8.41	10.70 11.21	12.04 12.61
Exhaust gas quantity at 75% load HFO	[kg/s]	900 1000	3.22 3.44	4.24 4.52	4.83 5.15	6.44 6.87	8.49 9.05	9.55 10.18
Exhaust gas quantity at 100% load MDO/LFO	[kg/s]	900 1000	4.02 4.21	5.35 5.61	6.02 6.31	8.03 8.42	10.71 11.22	12.05 12.62
Exhaust gas quantity at 75% load MDO/LFO	[kg/s]	900 1000	3.23 3.44	4.25 4.53	4.84 5.16	6.46 6.89	8.50 9.07	9.57 10.20
Average air - consumption per start. *	[nm^3] [0°C] 1 atm	900 1000	1.2	1.8	1.8	2.5	2.5	3.7

*) Starting condition 30 bar, ambient air temp 25° C, LT water 25° C. In case of the slow turning option, the consumption will increase.

Air consumption and gas flows power plants

	Unit	Engine speed	6L26	8L26	9L26	12V26	16V26	18V26
		[rpm]						
Combustion air flow at 100% load HFO	[kg/s]	900 1000	3.69 3.86	4.77 4.98	5.53 5.78	7.15 7.46	9.53 9.95	10.72 11.20
Exhaust gas quantity at 100% load HFO	[kg/s]	900 1000	3.78 3.95	4.89 5.11	5.67 5.93	7.33 7.66	9.78 10.21	11.15 11.66
Exhaust gas quantity at 75% load HFO	[kg/s]	900 1000	3.02 3.13	3.9 4.05	4.52 4.7	5.85 6.07	7.8 8.09	8.77 9.10
Exhaust gas quantity at 100% load MDO/LFO	[kg/s]	900 1000	3.83 4.01	4.96 5.18	5.75 6.02	7.43 7.77	9.91 10.36	11.15 11.66
Exhaust gas quantity at 75% load MDO/LFO	[kg/s]	900 1000	3.06 3.19	3.96 4.12	4.6 4.78	5.95 6.17	7.92 8.23	8.92 9.26
Average air - consumption per start. *	[nm^3] [0°C] 1 atm.	900 1000	1.2	1.8	1.8	2.5	2.5	3.7

* Starting condition 30 bar, ambient air temp 25° C, LT water 25° C.

In case of the slow turning option, the consumption will increase.

Main operating temperatures and pressures

Following values are valid for HFO, MDO, LFO, 1000 and 900 r.p.m.at 100% load.
For engine specific values see testbed protocol.

	[°C]
Air temperature before air cooler	210
after air cooler	50
Lub. oil temperature before engine	63
after engine	74
HT cooling water temperature before engine	70
after HT air cooler	93
LT cooling water temperature before air cooler	40

Rules of thumb temperatures

T receiver = T LT inlet + 10 °C (max. 12 °C)
T lub.oil = T LT inlet + 23 °C, T lub.oil = T LT inlet + 20 °C (extended stack)

In the HT section of the charge air cooler is the δT = 10 °C, and on the jackets is the δT = 10 °C.
On the LT system there is a δ= 10 °C over the air LT air cooler and lub.oilcooler.

	900 rpm [bar]	1000 rpm [bar]
Charge air pressure	3	
Air intake, pressure drop	10 mbar max.	
Exhaust gas back pressure	30 mbar max.	
Fuel oil pressure before engine	6 nom.,7 max., 5 min.	
Lub. oil pressure before engine (after filter)	4,0 nom.	
Lub. oil pump pressure	6	
High temperature cooling water pressure before engine	5 max.	
Low temperature cooling water pressure before engine	5 max.	

Pump data

Pump	Engine type	Engine speed	Capacity	
		[r.p.m.]	[m^3/h]	[bar]
Cooling water pump	W26-6L	900	30	2,6
		1000	33	3,3
	W26-8L	900	40	3
		1000	44	3,7
HT / LT	W26-9L	900	45	2,7
		1000	50	3,4
	W26-12V	900	60	2,6
		1000	67	3,2
	W26-16V	900	80	3,5
		1000	89	4.3
	W26-18V	900	90	3,3
		1000	100	4,0
Lubrication oil pump	W26-6L	900	60	6
		1000	67	6
	W26-8L	900	82	6
		1000	91	6
	W26-9L	900	82	6
		1000	91	6
	W26-12V	900	93	6
		1000	104	6
	W26-16V	900	127	6
		1000	141	6
	W26-18V	900	127	6
		1000	141	6

Pump data, continuation

			HFO		MDO/LFO	
Pump	**Engine type**	**Engine speed**	**Boost Pump [8bar]**	**Circulating Pump [5bar]**	**Capacity**	
		[r.p.m.]	[m^3/h]	[m^3/h]	[m^3/h]	[bar]
Fuel feed	W26-6L	900	0,5	1,8	1,6	5-7
pump		1000	0,5	1,8	1,8	5-7
	W26-8L	900	0,6	2,4	2,6	5-7
		1000	0,6	2,4	3.0	5-7
	W26-9L	900	0,7	2,7	2,6	5-7
		1000	0,7	2,7	3,0	5-7
	W26-12V	900	0,9	3,6	3,4	5-7
		1000	0,9	3,6	3,9	5-7
	W26-16V	900	1,2	4,8	4,3	5-7
		1000	1,2	4,8	4,9	5-7
	W26-18V	900	1,4	5,4	4,3	5-7
		1000	1,4	5,4	4,9	5-7

Sump data

	Dry-sump		Wet - sump (marine)
Engine type	**HFO**	**MDO / LFO**	
	[m^3]	[m^3]	[m^3]
W26-6L	2,6	1,3	1,3
W26-8L	3,5	1,7	1,6
W26-9L	3,9	1,9	1,7
W26-12V	5,2	2,6	2,4
W26-16V	7	3,5	3,0
W26-18V	7,8	3,9	3,4

Weight of engine parts

Note: All values are stated in kg.

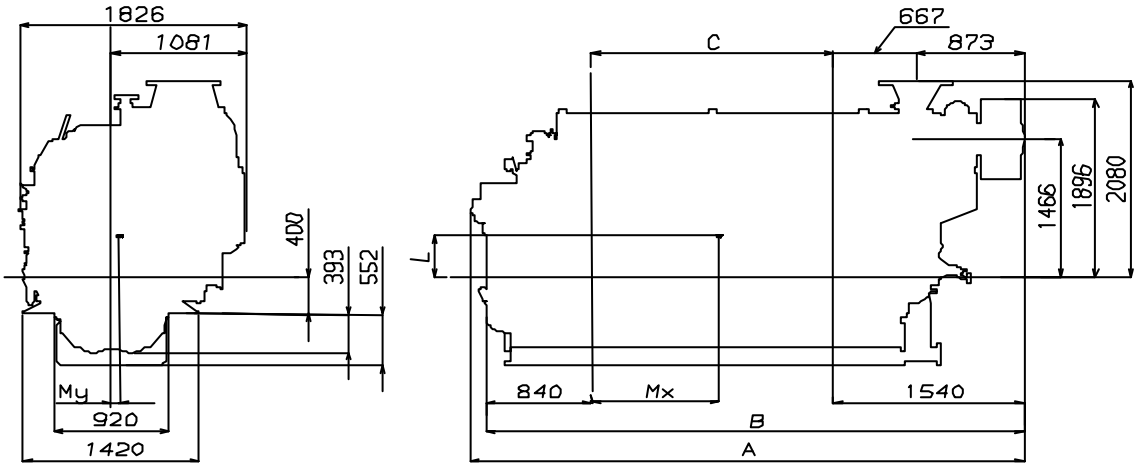
Engine type	6L26	8L26	9L26	12V26	16V26	18V26
Cylinder block	6500	8000	9200	10500	13500	15500
Cylinder head	280	280	280	280	280	280
Lubrication unit	850	880	880	1050	1050	1050
Oil sump from/to	560					800
Crankshaft	2100	3000	3200	2300	3330	3500
Flywheel	215	210	210	325	325	325
Oil cooler insert (high capacity)	40 45	45 60	45 60	2x55 2x55	2x60 2x80	2x60 2x80
Turbo charger (0-vers.) A-version	525 335	525 775	850 775	525 (2x) 775	525 2X) 775	850 2X) 775
Charge air cooler insert	470	570	570	680	725	725
Fuel pump	23.6	23.6	23.6	23.6	23.6	23.6
Engine foot	76	76	76	76	76	76
Exhaust pipes	600	800	900	1200	1600	1800
Multiduct	44	44	44	44	44	44
Camshaft (1)	770	990	1100	770	990	1100
Pump cover	990	990	990	995	995	995
Engine dry sump [t]	18,2	22	24,5	30	36,5	40
Engine wet sump [t]	18,5	22,5	25	30,5	37	40,5

Parts	Weights	Parts	Weight
Connecting rod	83	Camshaft gearwheel	85
Piston + pin	70	Cooling water pump	47
Cylinder liner	125	Air starter motor	30
Piston+conrod+liner ass.	288	Camshaft section	51/32(A)
Crankshaft gearwheel	120	Vibration damper	640
Intermediate gearwheel assembly	125 (40+85)	Extension piece for vibration damper	125

Dimensions Engine

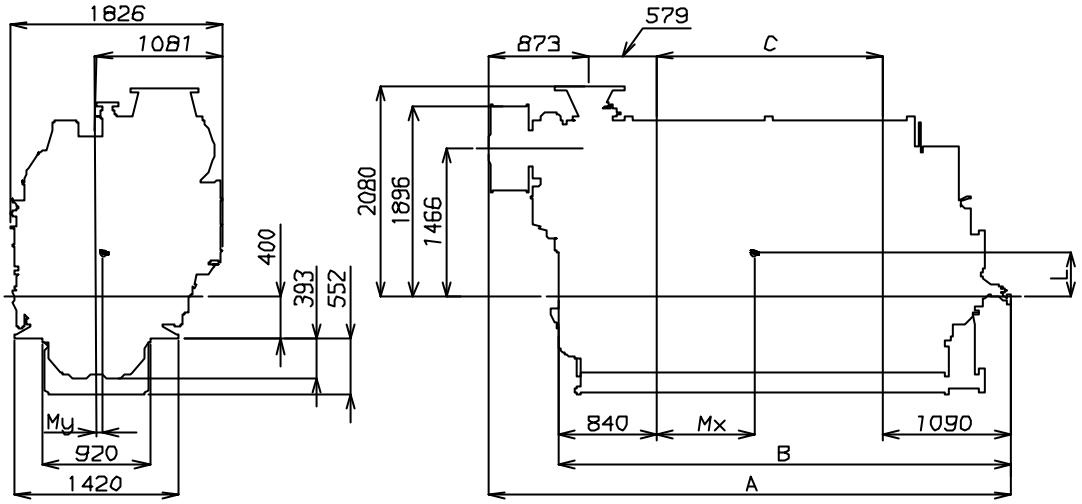
Line-engine:

In-line engine, wet and dry sump, turbocharger at free end



Engine type	A[mm]	B[mm]	C[mm]	Lw[mm]	Ld[mm]	Mx[mm]	My[mm]
6L26	4465	4325	1950	435	445	1060	75
8L26	5245	5110	2730	450	460	1460	65
9L26	5635	5500	3120	445	455	1670	60

In-line engine, wet and dry sump, turbocharger at driving end

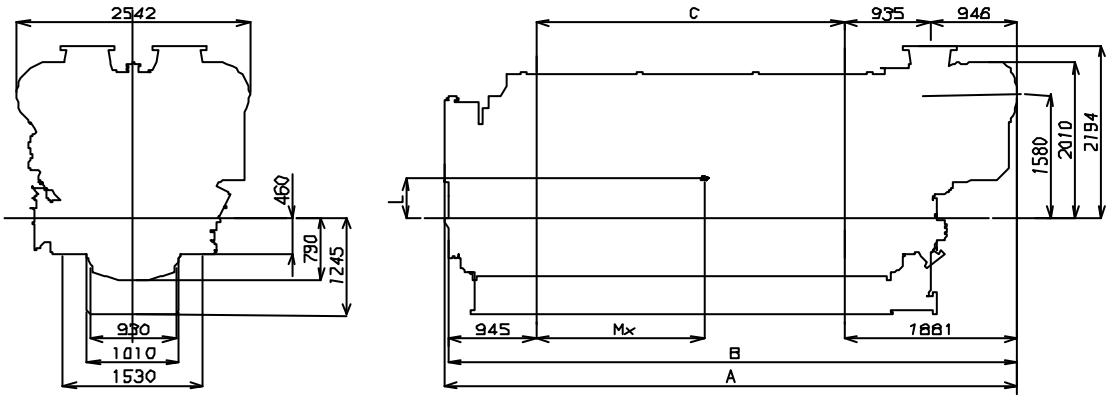


Engine type	A[mm]	B[mm]	C[mm]	Lw[mm]	Ld[mm]	Mx[mm]	My[mm]
6L26	4492	3875	1950	435	445	875	75
8L26	5272	4660	2730	450	460	1270	65
9L26	5662	5050	3120	445	455	1480	60

M = centre of gravity.

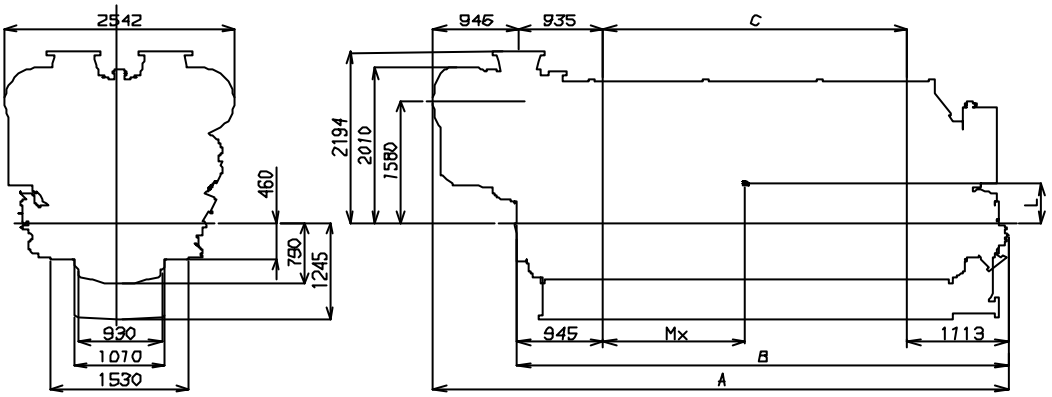
Vee-engine:

Vee-engine, wet and dry sump, turbocharger at free end



Engine type	A[mm]	B[mm]	C[mm]	Lw[mm]	Ld[mm]	Mx[mm	My[mm]
12V26	4984	4921	2100	530	545	1200	-
16V26	5824	5766	2940	535	550	1620	-
18V26	6244	6186	3360	530	550	1835	-

Vee-engine, wet and dry sump, turbocharger at driving end

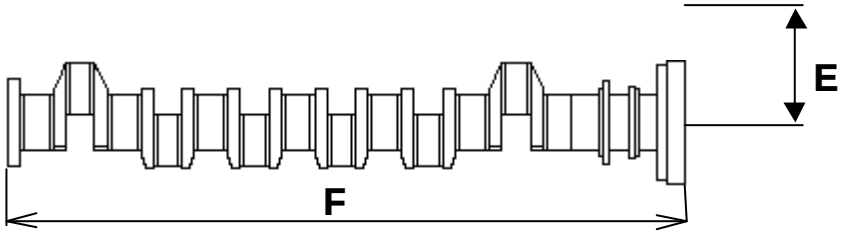


Engine type	A[mm]	B[mm]	C[mm]	Lw[mm]	Ld[mm]	Mx[mm]	My[mm]
12V26	5094	4153	2100	530	545	920	-
16V26	5934	4998	2940	535	550	1340	-
18V26	6354	5418	3360	530	550	1580	-

M = center of gravity.

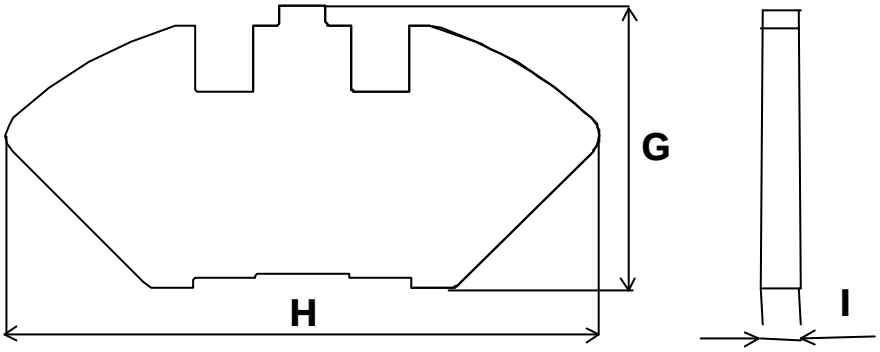
Dimensions main components.

Camshaft, dimensions



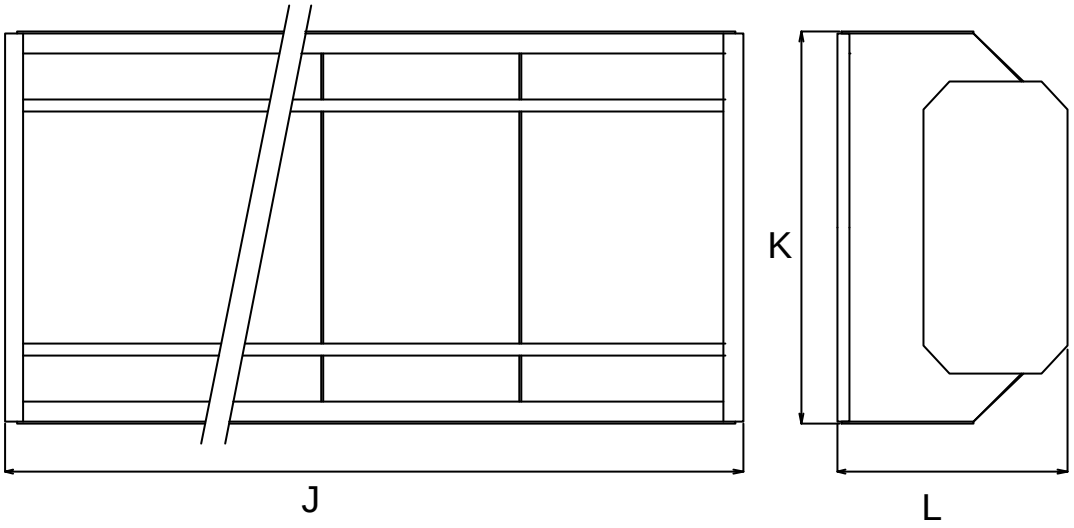
Crankshaft dimensions						
Engine	6L26	8L26	9L26	12V26	16V26	18V26
E	450	450	450	450	450	450
F	3050	3830	4220	3300	4140	4560

Counter weight, dimensions



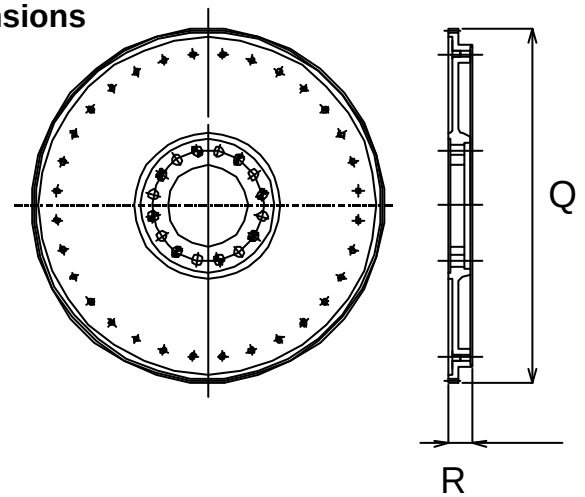
Counter weight dimensions			
Engine type	L		V
Counter weight	Small	Large	
G	168	168	342
H	505	550	725
I	80	80	60

Oil sump, dimensions



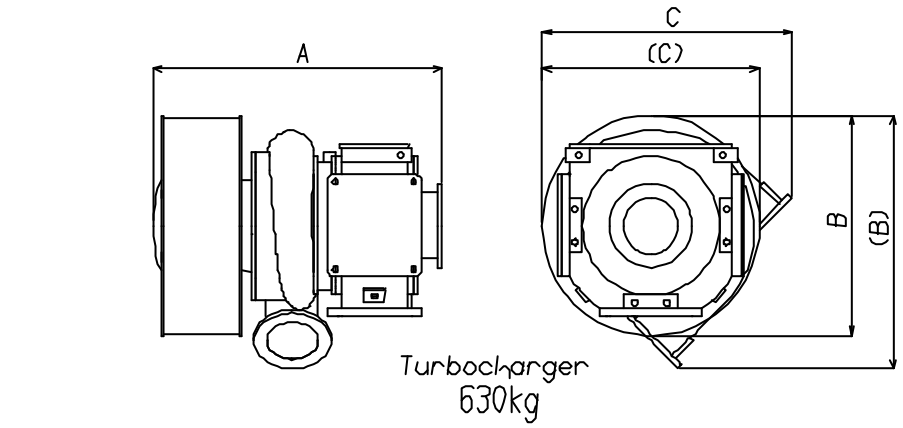
Oil sump (Wet or Dry)												
	6L26		8L26		9L26		12V26		16V26		18V26	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
J	3241		4021		4411		3322		4162		4582	
K	920		920		920		1010	930	1010	930	1010	930
L	545	393	545	393	545	393	800	340	800	340	800	340

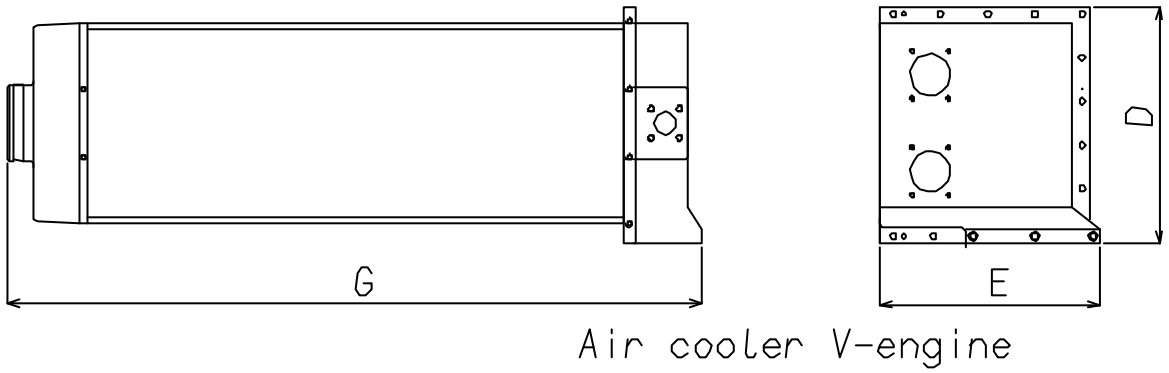
Flywheel, dimensions

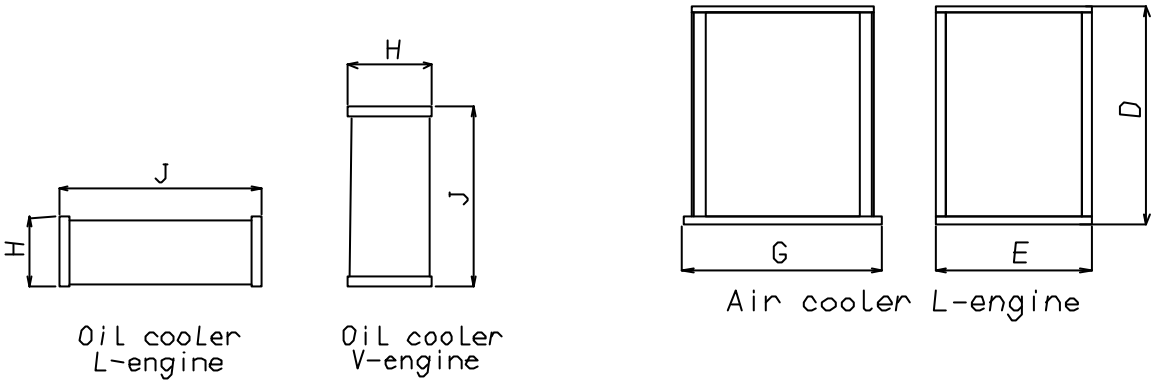


Fly wheel						
	6L38	8L38	9L38	12V38	16V38	18V38
Q	1336			1752		
R	120			120		
Number of teeth	165			217		

Turbo charger and coolers inserts, dimensions.



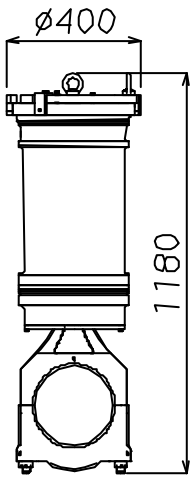




Engine	A	B	(B)	C	(C)	D	E	G	H	J	J*
6L26	1213	831	744	756	756	970	490	555	265	780	780
8L26	1185	1007	830	830	906	955	535	1010	265	780	1120
9L26	1185	1007	830	830	906	955	535	1010	265	780	1120
12V26	1185	830		978	1007	625	605	1900	325	690	690
16V26	1185	830		978	1007	625	605	1900	325	690	980
18V26	1185	830		978	1007	625	605	1900	325	690	980

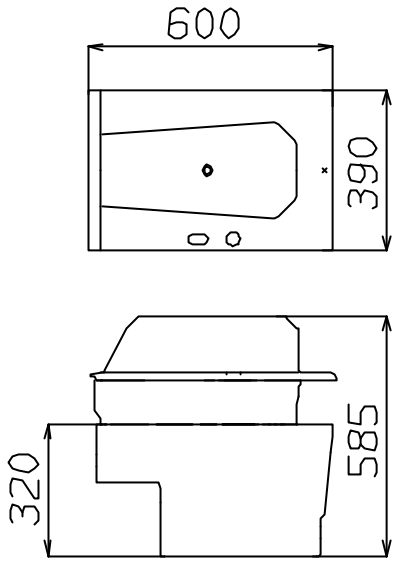
j * high capacity lub. oil cooler insert.

Driving unit dimensions

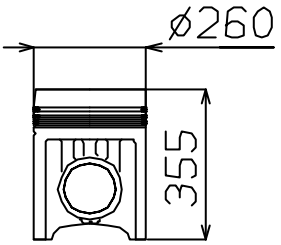


Piston + connecting rod-cylinder liner
275 Kg

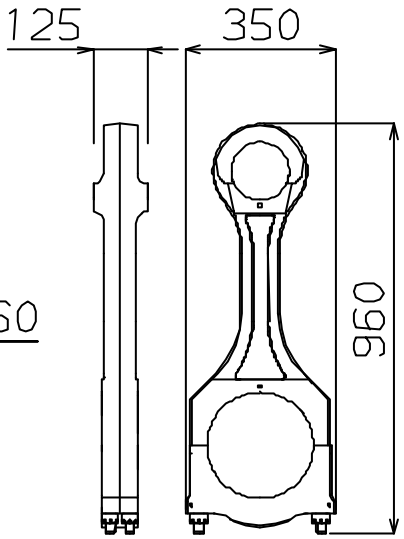
Cylinder head, piston and connecting rod, dimensions



Cylinderhead
280kg

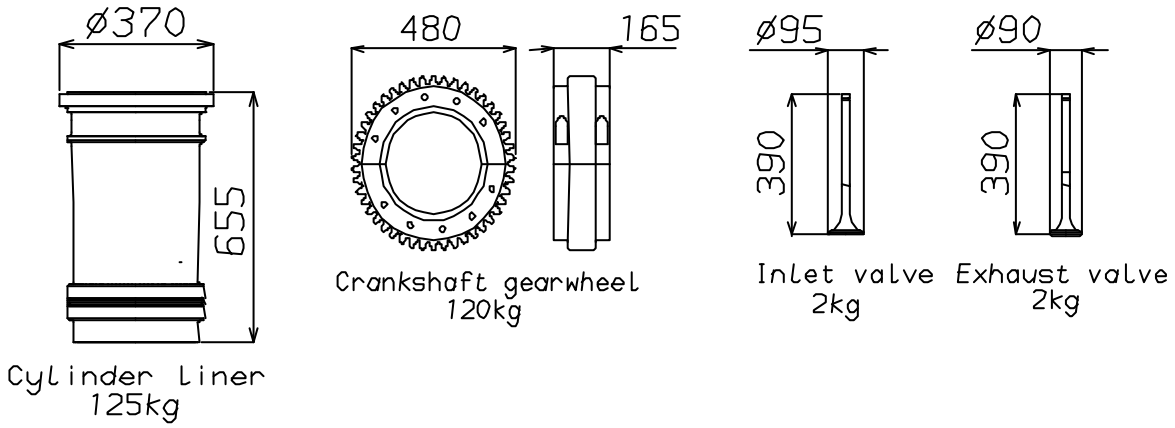


Piston + pin
70kg

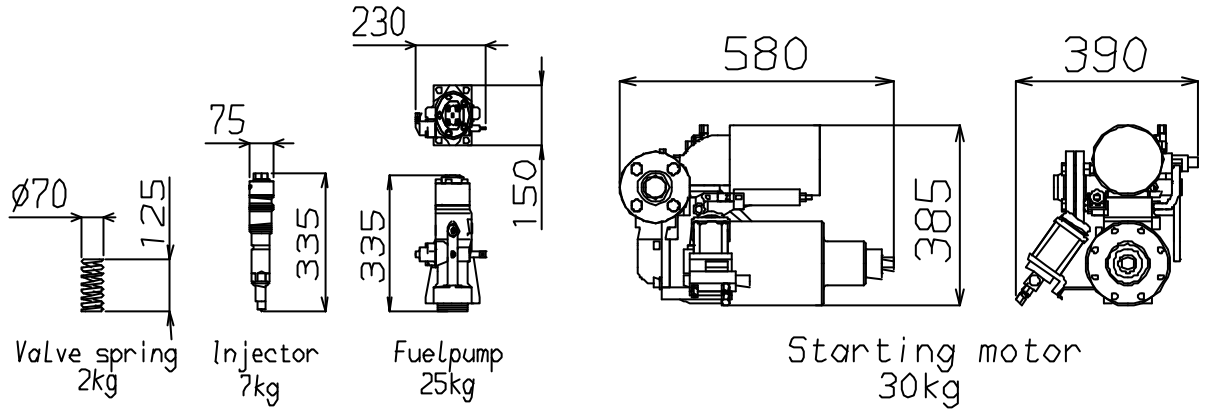


Connecting rod
83 Kg

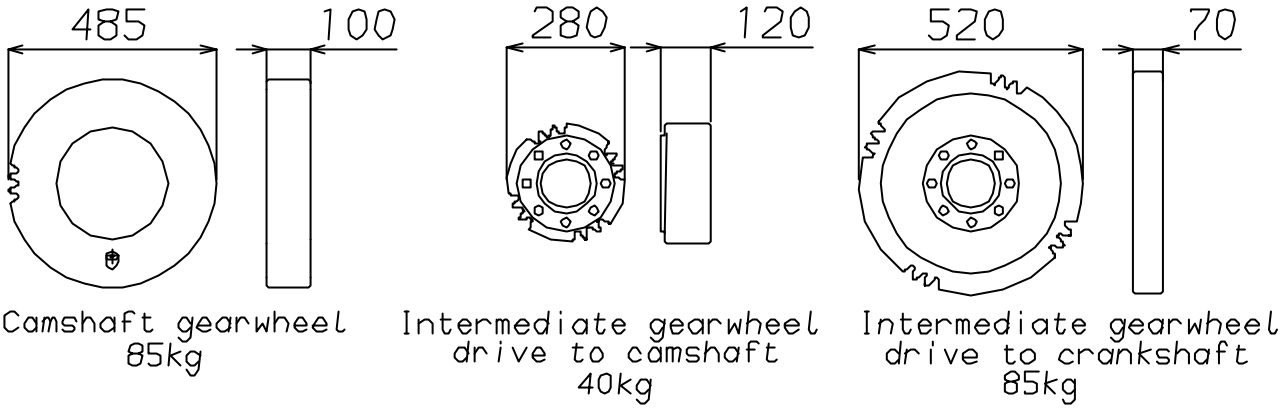
Cylinder liner, crankshaft gearwheel and valves, dimensions



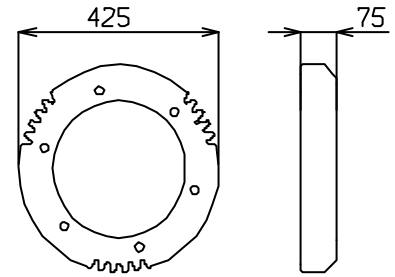
Valve springs, injectors, fuel pumps and starting motor



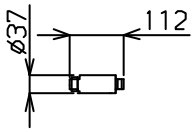
Gear wheels



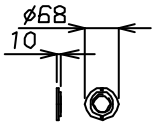
Other engine parts, dimensions



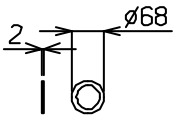
Crankshaft gearwheel drive to luboil and waterpump



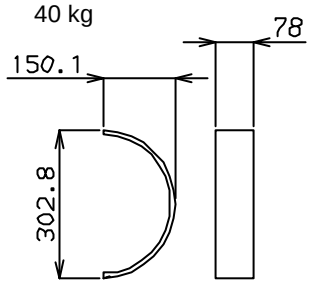
Safety valve
0.6kg



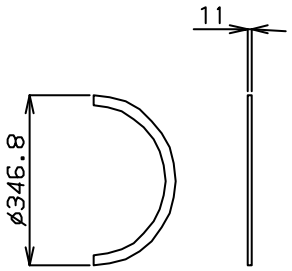
Supporting ring



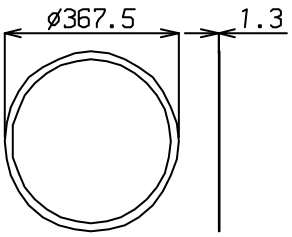
Ring



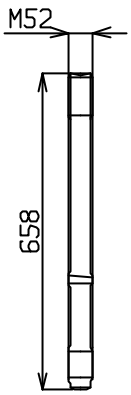
Bearing shell
2.95kg



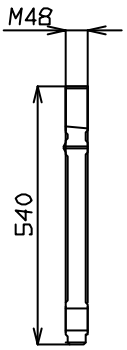
Bearing ring
1kg



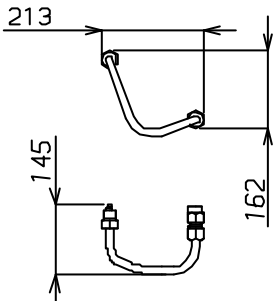
Ring cylinder gas
0.9kg



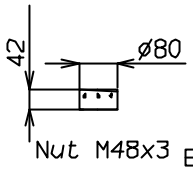
Stud cylinderhead
7.65kg



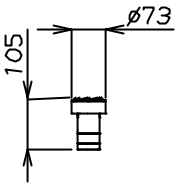
Stud mainbearing
6.05kg



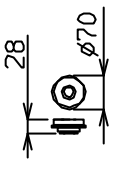
Fuel pressure pipe
1kg



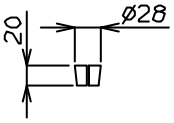
Nut M48x3
0.55kg



Exhaust valve rotor
0.85kg



Valve rotor



Half valve key (2:1)

1.1 FUEL SYSTEM

Fuel requirements, according to ISO-8217

Characteristics	Limit	Category ISO - 8217 -			
		DMX	DMA	DMB	DMC
Appearance		Visual		-	-
Density at 15°C, kg/m^3	Max.		890	900	920
Kinematic viscosity at 40°C, mm^2/s	Min. Max.	1,4 5,5	1,5 6,0	- 11,0	- 14,0
Flash point, °C	Min.	43	60	60	60
Pour point (upper), °C - winter quality - summer quality	 Max. Max.	 - -	 -6 0	 0 6	 0 6
Cloud point, °C	Max.	-16	-	-	-
Sulfur, % (m/m)	Max.	1,0	1,5	2,0	2,0
Cetane number	Min.	45	40	35	-
Carbon residue, [micro method 10% (v/v) distillation bottoms] %(m/m) Carbon residue, (micro method) % (m/m)	Max. Max.	0,3 -	0,3 -	- 0,3	- 2,5
Ash, % (m/m)	Max.	0,01	0,01	0,01	0,05
Sediment, % (m/m)	Max.	-	-	0,07	-
Total existent sediment, % (m/m)	Max.	-	-	-	0,10
Water, % (v/v)	Max.	-	-	0,3	0,3
Vanadium, mg/kg	Max.	-	-	-	100
Aluminum plus silicon, mg/kg	Max.	-	-	-	25

DM = Distillate Marine

Fuel requirements, according to ISO-8217 (continuation)

Characteristics	limit	Category ISO - 8217 -				
		RMA 10	RMB 10	RMC 10	RMD 15	RME 25
Density at 15°C, kg/m^3	Max.	975	981		985	991
Kinematic viscosity at 100°C, mm^2/s	Max.	10,0			15,0	25,0
Flash point, °C	Min.	60			60	60
Pour point (upper), °C						
- winter quality	Max.	0	24		30	30
- summer quality	Max.	6	24		30	30
Carbon residue, % (m/m)	Max.	10		14	14	15
Ash, % (m/m)	Max.	0,10			0,10	0,10
Water, % (v/v)	Max.	0,5			0,8	1,0
Sulfur, % (m/m)	Max.	3,5			4,0	5,0
Vanadium, mg/kg	Max.	150		300	350	200
Aluminum plus silicon, mg/kg	Max.	80			80	80
Total sediment, potential, % (m/m)	Max.	0,10			0,10	0,10

RM = Residual fuels

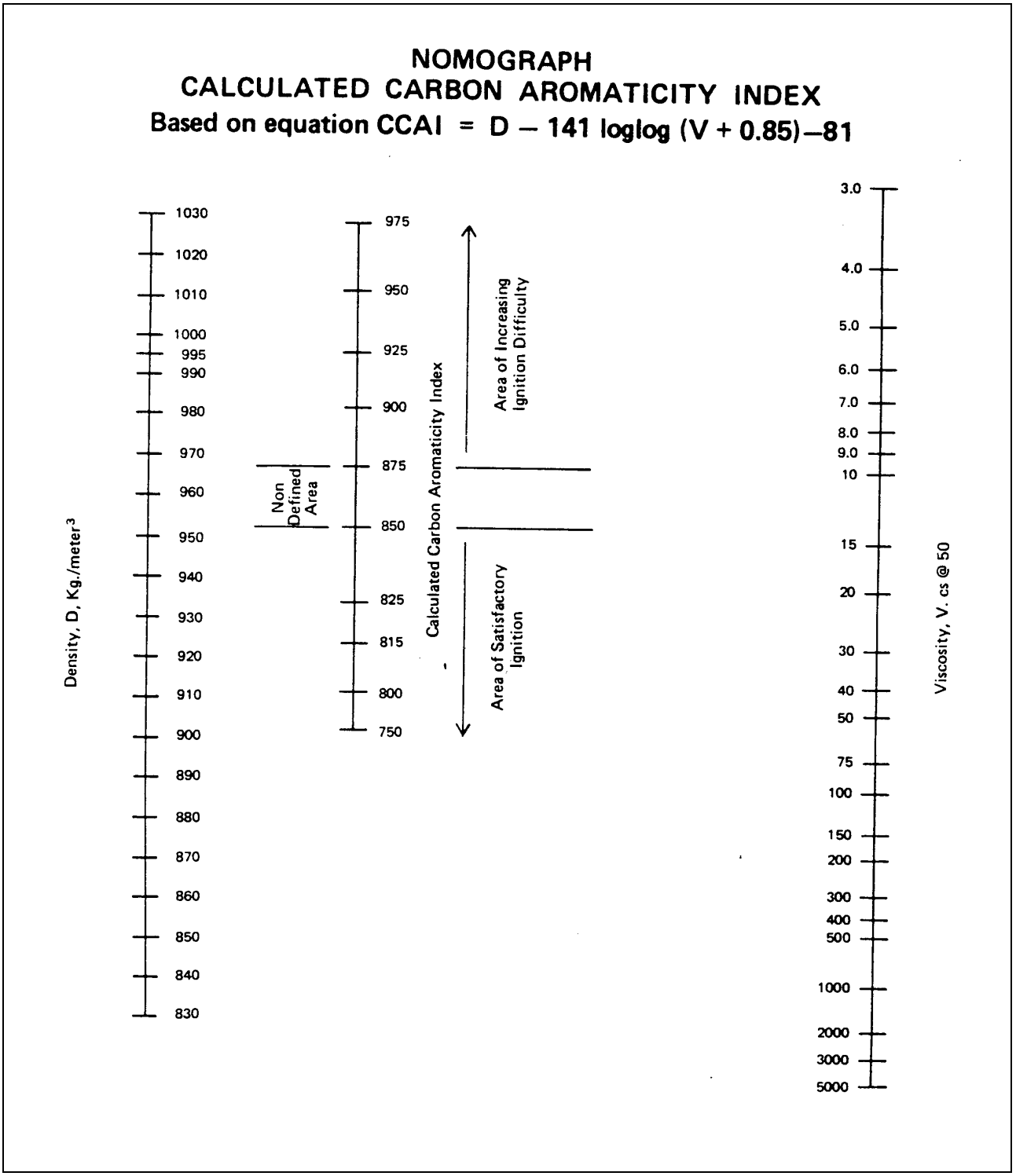
Characteristics	limit	Category ISO - 8217 -				
		RMF 25	RMG 35	RMH 35	RMK 35	RMH 45
Density at 15°C, kg/m^3	Max.	991	991		1010	991
Kinematic viscosity at 100°C, mm^2/s	Max.	25,0	35,0			45,0
Flash point, °C	Min.	60	60			60
Pour point (upper), °C						
- winter quality	Max.	30	30			30
- summer quality	Max.	30	30			30
Carbon residue, % (m/m)	Max.	20	18	22		22
Ash, % (m/m)	Max.	0,15	0,15	0,20		0,20
Water, % (v/v)	Max.	1,0	1,0			1,0
Sulfur, % (m/m)	Max.	5,0	5,0			5,0
Vanadium, mg/kg	Max.	500	300	600		600
Aluminum plus silicon, mg/kg	Max.	80	80			80
Total sediment, potential, % (m/m)	Max.	0,10	0,10			0,10

Fuel requirements, according to ISO-8217 (continuation)

Characteristics	limit	Category ISO - 8217 -				
		RMK 45	RML 45	RMH 55	RMK 55	RML 55
Density at 15°C, kg/m^3	Max.	1010	-	991	1010	-
Kinematic viscosity at 100°C, mm^2/s	Max.	45,0		55,0		
Flash point, °C	Min.	60		60		
Pour point (upper), °C - winter quality - summer quality	 Max. Max.	 30 30		 30 30		
Carbon residue, % (m/m)	Max.	22	-	22		-
Ash, % (m/m)	Max.	0,20		0,20		
Water, % (v/v)	Max.	1,0		1,0		
Sulfur, % (m/m)	Max.	5,0		5,0		
Vanadium, mg/kg	Max.	600		600		
Aluminum plus silicon, mg/kg	Max.	80		80		
Total sediment, potential, % (m/m)	Max.	0,10		0,10		

DMX	Gasoil for emergency engines	**LFO**	Distillate fuels
DMA	gasoil or marine gasoil	**LFO**	
DMB	Marine dieseloil or marine dieselfuel	**MDO**	
DMC	Blended marine dieseloil	**MDO**	Distillate fuel with small amount of residue
RM (A,B,C) 10 RMD15 RM (E,F) 25	Intermediate fuel oils or thin Fuel oils or light marine fuel oils	**HFO**	Residual fuels or heavy fuels
RM (G,H) 35 RM (K,L) 35 RMH 45 RM (K,L) 45 RML 55	Marine fuel oils or bunker C oils		

Calculated Carbon Aromaticity Index



Fuel condition requirements before engine

Pressure before injection pumps (bar)	6
Viscosity (HFO) before injection pumps (cSt)	16 - 24
Viscosity (LFO) before injection pumps, min. (cSt)	2.0 *
Quantity of clean leak fuel (100%) load, HFO (% of SFOC)	» 0.4
Fuel temperature before fuel pumps, HFO	£ 130 °C
Fuel temperature before fuel pumps, LFO	£ 50 °C
Fuel flow / consumption ratio (100%) load, min.	4:1
Water max; (% volume)	0.3
AL + SI max (mg/kg)	15

*) To avoid low viscosity or high temperature on LFO installations an extra external cooler might be necessary.

Maximum limits for fuel characteristics

Light fuel oil, as bunkered:

Property	Unit	ISO-F-DMA	ISO-F-DMB	ISO-F-DMC [1)]	Test method reference
Viscosity before injection pumps	min cSt	1.5 [2)]	2.0	2.0	ISO 3104
Viscosity, max.	cSt at 40 °C	6.0	11.0	14.0	ISO 3104
Density, max.	kg/m³ at 15 °C	890	900	920	ISO 3675 or 12185
Water max.	% volume	-	0.3	0.3	ISO 3733
Sulphur, max.	% mass	1.5	2.0	2.0	ISO 8574
Ash, max.	% mass	0.01	0.01	0.05	ISO 6245
Vanadium,	max. mg/kg	-	-	100	ISO 14597
Sodium before engine, max.	mg/kg	-	-	30	ISO 10478
Aluminum + Silicon, max.	mg/kg	-	-	25	ISO 10478
Aluminum + Silicon before engine, max.	mg/kg	-	-	15	ISO 10478
Conradson carbon residue, max.	% mass	0.30	0.30	2.50	ISO 10370
Flash point (PMCC),	min. °C	60	60	60	ISO 2719
Pour point, max [3)].	°C	0 – 6	0 – 6	0 – 6	ISO 3016
Sediment, max.	% mass	-	0.07	-	ISO 3735
Total sediment potential, max.	% mass	-	-	0.10	ISO 10307-1

1) *Use of ISO-F-DMC category fuel is allowed provided that the fuel treatment system is equipped with a fuel centrifuge.*
2) *The temperature of the fuel shall be adjusted such that the minimum viscosity before the engine is well above 2cSt.*
3) *Summer/winter quality.*

Foreign substances or chemical waste, hazardous to the safety of the installation or detrimental to the performance of engines, should not be contained in the fuel.

Heavy fuel oil, as bunkered:

Property	Unit	Typical HFO	Limit HFO	Test method reference
Viscosity, max.	cSt at 100°C cSt at 50 °C Redwood No. 1 sec. at 100 °F	55 730 7200	55 730 7200	ISO 3104
Density, max.	kg/m³ at 15 °C	991 1) 1010	991 1) 1010	ISO 3675 or 12185
CCAI, max.		850	870 2)	Shell's formula
Water max.	% volume	1.0	1.0	ISO 3733
Water before engine, max.	% volume	0.3	0.3	ISO 3733
Sulphur, max.	% mass	2.0	5.0	ISO 8754
Ash, max.	% mass	0.05	0.20	ISO 6245
Vanadium, max.	mg/kg	100	600 3)	ISO 14597
Sodium, max.	mg/kg	50	100 3)	ISO 10478
Sodium before engine, max.	mg/kg	30	30	ISO 10478
Aluminum + Silicon, max.	mg/kg	30	80	ISO 10478
Aluminum + Silicon before engine, max.	mg/kg	15	15	ISO 10478
Conradson carbon residue, max.	% mass	15	22	ISO 10370
Asphaltenes, max.	% mass	8	14	ASTM D 3279
Flash point (PMCC), min.	°C	60	60	ISO 2719
Pour point, max.	°C	30	30	ISO 3016
Total sediment potential, max.	% mass	0.10	0.10	ISO 10307-2

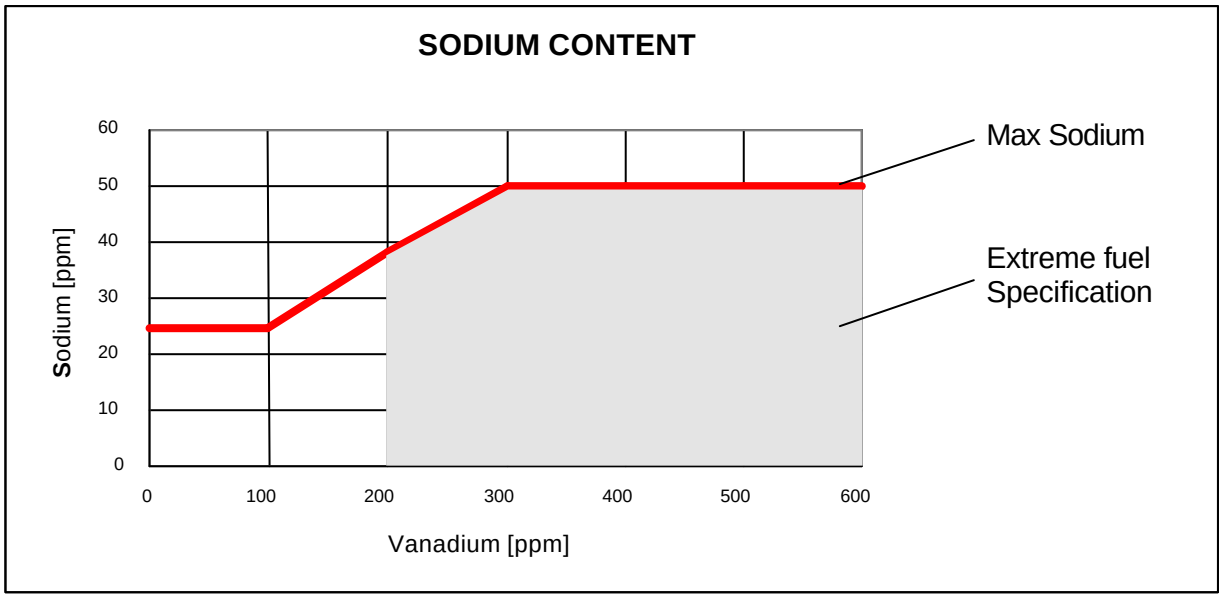
1) Max. 1010 kg/m³ at 15 °C, provided the fuel treatment system can remove water and solids.
*2) Straight run residues show **CCAI** values in the 770 to 840 range and are very good igniters. Cracked residues delivered as bunkers may range from 840 to – in exceptional cases – above 900. Most bunkers remain in the max. 850 to 870 range at the moment.*
*3) **Sodium** contributes to hot corrosion on exhaust valves when combined with high sulphur and **vanadium** contents. Sodium also strongly contributes to fouling of the exhaust gas turbine blading at high loads.*

The aggressiveness of the fuel depends on its proportions of sodium and vanadium, but also on the total amount of ash. Other ash constituents however, also influence hot corrosion and deposit formation. It is therefore difficult to set strict limits based only on the sodium and vanadium content of the fuel. Also a fuel with lower sodium and vanadium contents than specified above, can cause hot corrosion on engine components.

Foreign substances or chemical waste, hazardous to the safety of the installation or detrimental to the performance of engines, should not be contained in the fuel.

The limits above also correspond to the demands of:
- BS MA 100: 1996, RMH 55 and RMK 55
- CIMAC 1990, Class H55 and K55
- ISO 8217:1996(E), ISO-F-RMH 55 and RMK 55

Advised relation Sodium / Vanadium



Engine configuration at various use of fuel

If a HFO-engine is running for a long time (more than 500 hours) on MDO/LFO the valve rotator 1501ZT108, rotation speed 15 min^{-1} (high speed turnomat) should be replaced by 1501ZT174, rotation speed 5 min^{-1} (low speed turnomat).

Specific energy of fuel

Specific energy is not controlled in the manufacture of fuel except in secondary manner by the specification of other properties.

Specific energy (MJ/kg) can be calculated with a degree of accuracy acceptable for normal purposes from the equations given below.

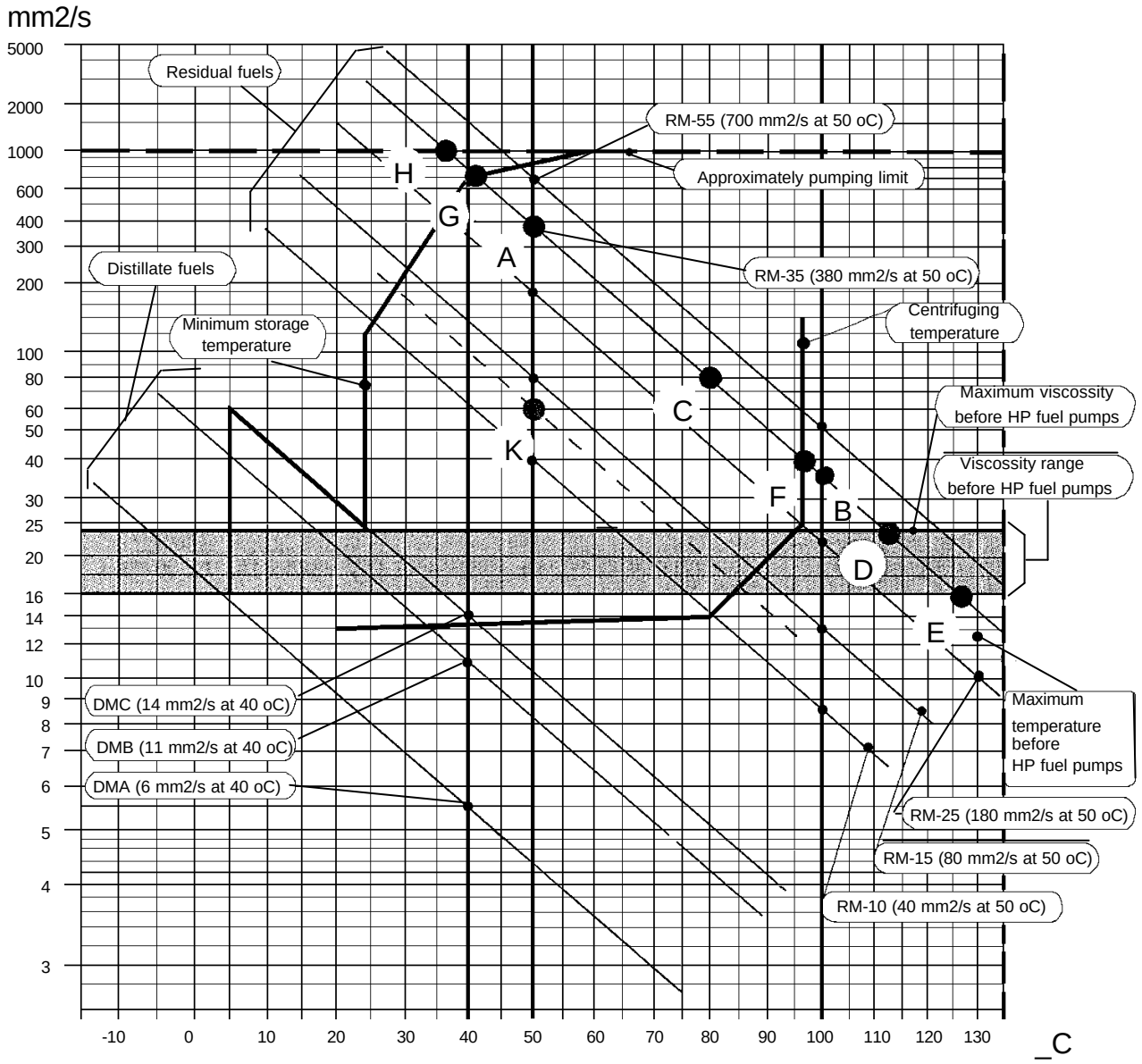
Specific energy (gross),
$Q_G = (52{,}190 - 8{,}802\rho^2 10 \text{ exp-}6) \times [1 - 0{,}01\,(x + y + s)] + 9{,}420\,(0.01s)$

Specific energy (net),
$Q_N = (46{,}704 - 8{,}802\rho^2 10 \text{ exp-}6 + 3{,}167\rho 10 \text{ exp-}3) \times [1 - 0{,}01\,(x + y + s)] + 0{,}01\,(9{,}420s - 2{,}449x)$

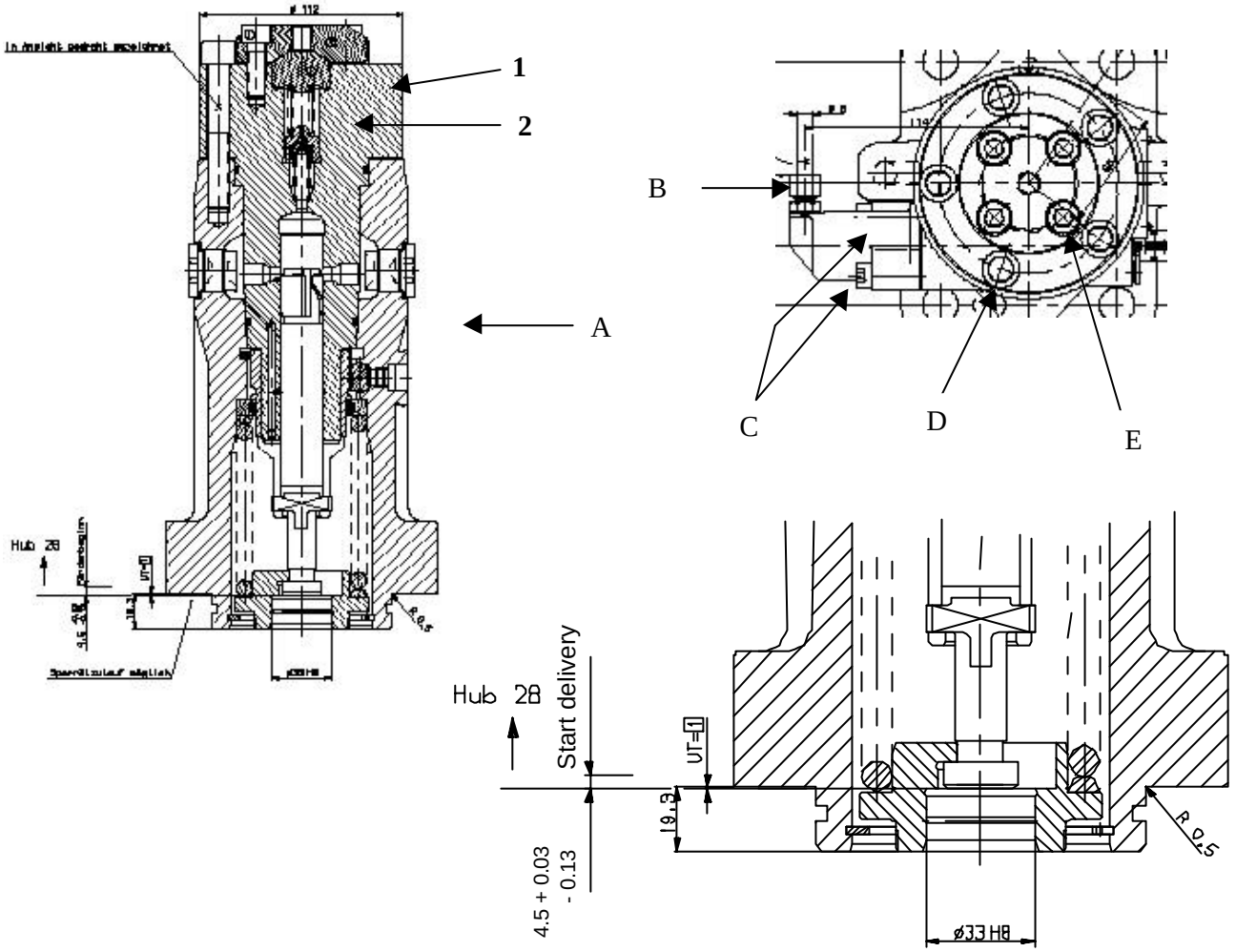
Where

ρ	is the density at 15°C, in kilograms per cubic meter;
x	is the water content, expressed as a percentage by mass;
y	is the ash content, expressed as a percentage by mass;
s	is the sulphur content, expressed as a percentage by mass.

Viscosity table



Fuel pump



Pressure unloading delivery valve: Constant pressure = 120 bar Main deliverey valve: Openings pressure = 15 bar	UT = 1 mm Pump stroke = 28 mm Delivery starts at 4.5 mm

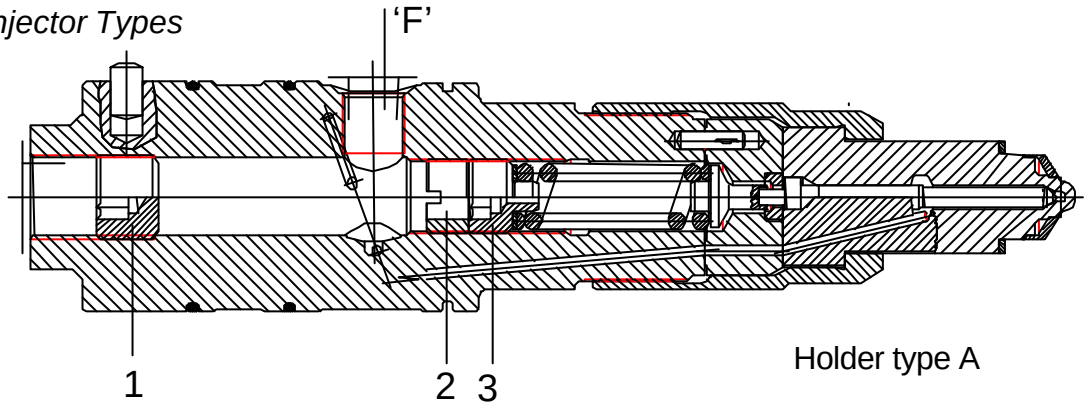
Mounting instruction / torque's fuel pump	
A	degrease the thread of the plugs ; apply Loctite 270 on the thread ; use new washers 2106ZT129 ; mount the plugs with 115 ± 5 Nm.
B	torque = 22 ± 2 Nm
C	torque = 20 ± 2 Nm
D	torque = 10 – 40 – 90 ± 3 Nm (tighten crosswise)
E	torque = 50 – 0 – 53 ± 2 Nm (torquing up the bolts crosswise to 50 Nm; inspect the parallel tolerance of // 0.3 between gland (1) and the pump body; loosen the bolts one by one to 0 Nm and retighten again in one action to 53 Nm; inspect the parallel tolerance // 0.3 between gland (1) and the pump body(2) **Note :** In case of leakage ; clean parts and inspect the sealing face of the HP fuel pump body and renew gland 2106ZT146

Fuel injectors
Summary fuel nozzles :

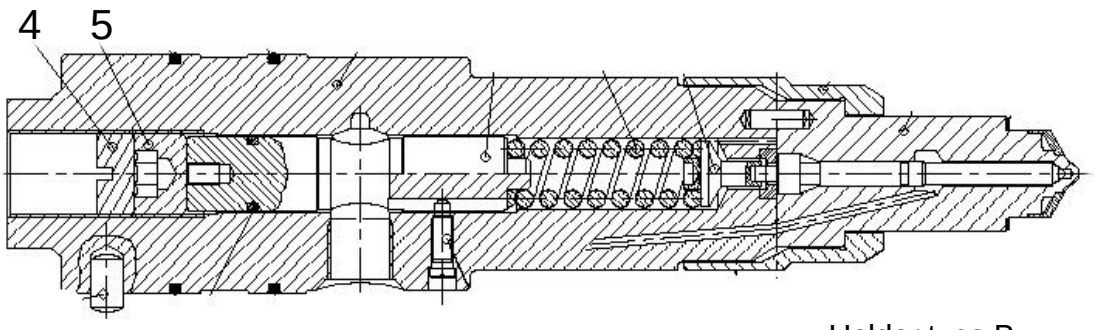
materialno. injector holder	Materialno. nozzle	Bosch code	Nozzle Specification	Holder Type
0-version:				
9502ZT966	1501ZT165*	DLF155VV3440089	10×0.485×155°	A
9512ZT909	9502ZT586	DLF155VV3440103	10×0.485×155°	A
1501ZT926	1501ZT226	DLF155VV3440108	9× 0.51×155°	A
A-version:				
1501ZT933	1501ZT228	DLF155VV3440121	9× 0.47×155°	A
1501ZT945	1501ZT228	DLF155VV3440121	9× 0.47×155°	B

) No ring is supplied

Ffuel injector Types



Holder type A



Holder type B

Fuel leak oil:

Design criteria: LFO - 1% of nominal fuel consumption.
HFO - 0.2% of nominal fuel consumption

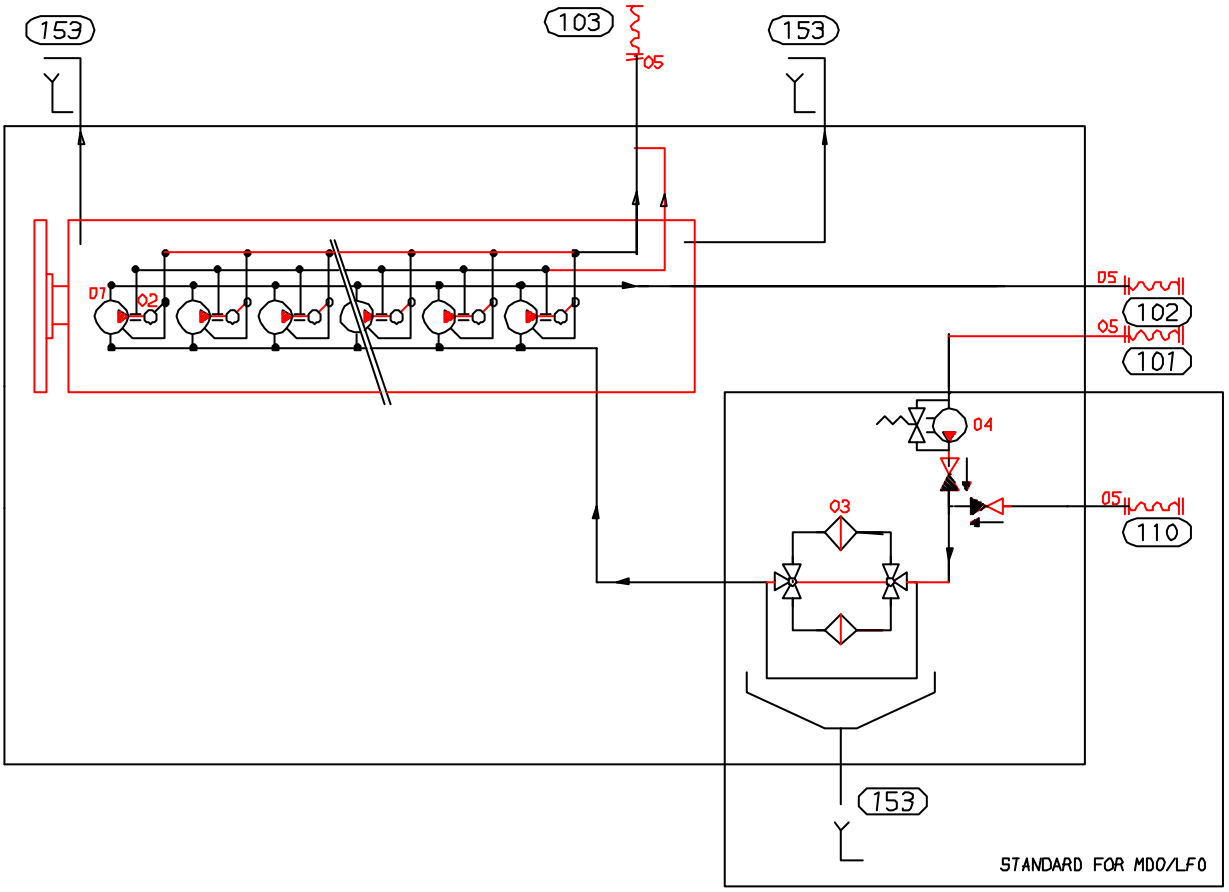
Checking opening pressure fuel injectors

1. Fill pump reservoir with absolute clean fuel or calibration fluid although a filter is mounted in the reservoir.
2. Connect injector in working position to test equipment.
3. Tighten connection.
4. Increase pump pressure slowly and watch manometer pressure commencing fuel spraying.
5. Opening pressure should be 600 ± 5 bar
6. A When injection pressure must be adjusted for holder type A (see picture):
   - Remove plug (1)
   - Disconnect fuel line from injector
   - Remove locking nut (2)
   - Turn plug (3) with tool 9612ZT187 to adjust injectors opening pressure
   - Mount locking plug (2) with tool 9612ZT186 and secure plug at 70...90 Nm.
   -.Fit plug (1) **with Loctite 222** and secure at 20...22 Nm to avoid fuel dilution in the lub. oil.
   - Before storing injector, close hole ‘F’ by plastic cap.

6 B When injection pressure must be adjusted for holder type B (see picture):
   - Remove locking nut (4)
   - Turn plug (5) to adjust the injector opening pressure
   - Mount locking plug (4) and secure plug at 50...70 Nm.
   - Before storing injector, close fuel supply hole by plastic cap.

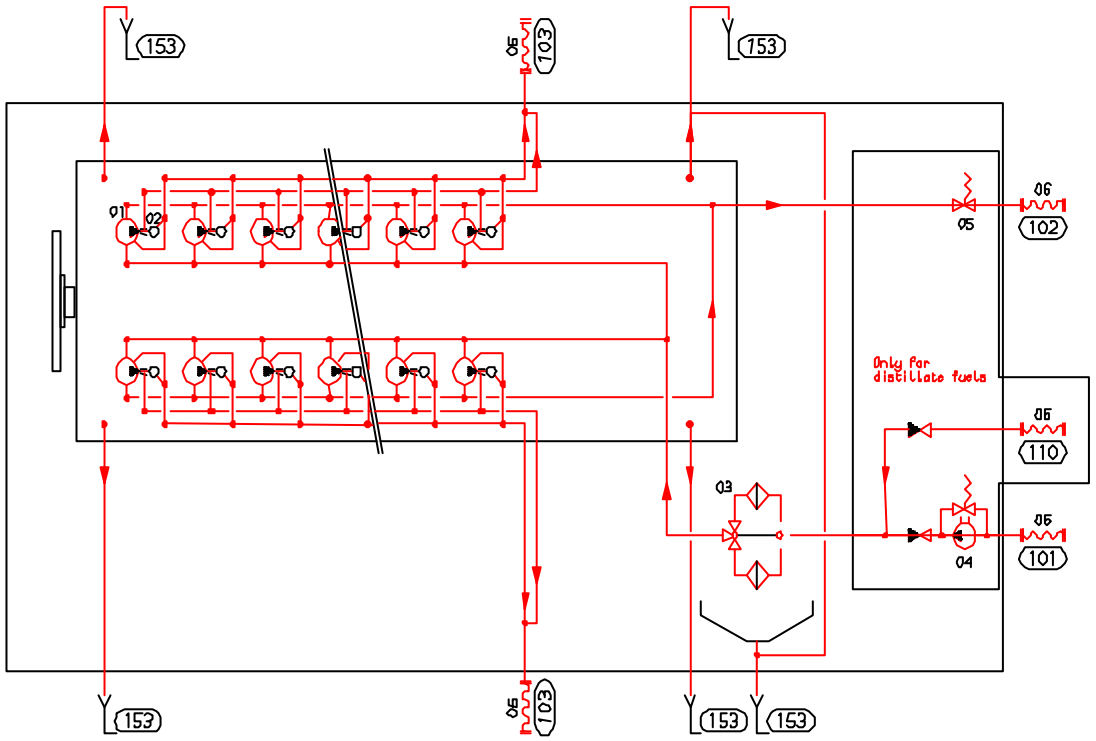
Internal fuel system

In-line engine



System components		Pipe connections		Dimensions
01	Fuel injection pump	101	Fuel inlet	DN25 Ø33,7x2,6
02	Fuel injector	102	Fuel outlet	DN25 Ø 33,7x2,6
03	Filter (duplex type) Indicator filter (HFO) Fine filter (distillate fuels)	103	Leak fuel drain, clean fuel	Ø 22x2
04	Fuel circulating pump	110	Fuel from starting/ day tank	DN25 Ø 33,7x7,6
05	Flexible pipe connection	153	Leak fuel, water and lube oil	Ø 22x2

V-engine



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04	Fuel circulating pump	110	Fuel from starting/ day tank	DN25 Ø 33,7x7,6
05	Pressure control valve	153	Leak fuel, water and lube oil	Ø 22x2
06	Flexible pipe connection			

1.2 LUBRICATION OIL

Approved lubricating oils for all medium-speed Wärtsilä and Sulzer diesel engine types

Viscosity
Viscosity class SAE 40

Viscosity Index (VI)
Min. 95

Alkalinity (BN)
The required lubricating oil alkalinity is tied to the fuel specified for the engine, which is shown in the table below.

Fuel standards and lubricating oil requirements			
Category	**Fuel standard**		**Lube oil BN**
A	ASTM D 975-94, BS MA 100: 1996 CIMAC 1990 ISO 8217: 1996(E)	GRADE 1D, 2D DMX, DMA DX, DA ISO-F-DMX, DMA	10 - 30
B	ASTM D 975-94, BS MA 100: 1996 CIMAC 1990 ISO 8217: 1996(E)	GRADE 4D DMB DB ISO-F-DMB	15 - 30
C	ASTM D 396-94, BS MA 100: 1996 CIMAC 1990, ISO 8217: 1996(E)	GRADE NO 4-6 DMC, RMA10-RMK55 DC, A10-K55 ISO-F-DMC, RMA10-RMK55	30 - 55

It is recommended to use BN 40 lubricants in heavy fuel operation. However, if the use of BN 40 lubricants is also causing short oil change intervals, it is recommended to use high BN (50-55) lubricants. If very low sulphur residual fuel is used, BN 30 lubricants can be used. BN 30 lubricants can also be used if experience shows that the lubricating oil BN equilibrium remains at an acceptable level.

Additives
The oils should contain additives that give good oxidation stability, corrosion protection, load carrying capacity, neutralisation of acid combustion and oxidation residues and should prevent deposit formation on internal engine parts (piston cooling gallery, piston ring zone and bearing surfaces in particular).

Foaming characteristics

Fresh lubricating oil should meet the following limits for foaming tendency and stability, according to the ASTM D 892-92 test method:
Sequence I: 100/0 ml
Sequence II: 100/0 ml
Sequence III: 100/0 ml

Base oils

Use of virgin base stocks is only allowed, i.e. recycled or re-refined base oils are not allowed.

Gas oil and marine diesel oil operation

If gas oil or marine diesel oil is used as fuel, a lubricating oil with a BN of 10-22 is recommended to be used. However, an approved lubricating oil with a BN of 24-30 can also be used, if the desired lower BN lubricating oil brand is not included in Table 1.

Approved system oils

Approved system oils - fuel categories A and B, recommended in the first place in gas oil or marine diesel oil installations:

Supplier	Brand name	Viscosity	BN	Fuel category
BP	Energol HPDX 40	SAE 40	12	A
Castrol	TLX 154	SAE 40	15	A,B
	TLX 204	SAE 40	20	A,B
Mobil	Mobilgard ADL 40	SAE 40	15	A,B
	Mobilgard 412	SAE 40	15	A,B
Shell	Gadinia Oil 40 (SL0391)	SAE 40	12	A
	Sirius FB Oil 40	SAE 40	13	A

Heavy fuel operation

Today's modern trunk piston diesel engines are stressing the lubricating oils heavily due to a low specific lubricating oil consumption. Also ingress of residual fuel combustion products into the lubricating oil can cause deposit formation on the surface of certain engine components resulting in severe operating problems. Due to this many lubricating oil suppliers have developed new lubricating oil formulations with better fuel and lubricating oil compatibility. The lubricating oils mentioned in Table 2 are representing a new detergent/ dispersant additive chemistry and have shown good performance in Wärtsilä engines.

Approved system oils - fuel category C, recommended in the first place:

Lubricating oils with improved detergent/dispersant additive chemistry				
Supplier	**Brand name**	**Viscosity**	**BN**	**fuel categ.**
BP	Energol IC-HFX 304	SAE 40	30	A,B,C
	Energol IC-HFX 404	SAE 40	40	A,B,C
	Energol IC-HFX 504	SAE 40	50	A,B,C
Caltex	Delo 3000 Marine SAE 40	SAE 40	30	A,B,C
	Delo 3400 Marine SAE 40	SAE 40	40	A,B,C
	Delo 3550 Marine SAE 40	SAE 40	55	A,B,C
Castrol	TLX 304	SAE 40	30	A,B,C
	TLX 404	SAE 40	40	A,B,C
	TLX 504	SAE 40	50	A,B,C
	TLX 554	SAE 40	55	A,B,C
Chevron	Delo 3000 Marine 40	SAE 40	30	A,B,C
	Delo 3400 Marine 40	SAE 40	40	A,B,C
	Delo 3550 Marine 40	SAE 40	55	A,B,C
Elf Lub Marine	Aurelia 4030	SAE 40	30	A,B,C
	Aurelia XT 4040	SAE 40	40	A,B,C
	Aurelia XT 4055	SAE 40	55	A,B,C
Esso	Exxmar 30 TP 40 PLUS	SAE 40	30	A,B,C
	Exxmar 40 TP 40 PLUS	SAE 40	40	A,B,C
	Exxmar 50 TP 40 PLUS	SAE 40	50	A,B,C
Fina	Stellano S 430	SAE 40	30	A,B,C
	Stellano S 440	SAE 40	40	A,B,C
	Stellano S 455	SAE 40	55	A,B,C
Indian Oil Corporation	Servo Marine 3040	SAE 40	30	A,B,C
	Servo Marine 4040	SAE 40	40	A,B,C
	Servo Marine 5040	SAE 40	50	A,B,C
	Servo Marine 5540	SAE 40	55	A,B,C
Mobil	Mobilgard 430	SAE 40	30	A,B,C
	Mobilgard 440	SAE 40	40	A,B,C
	Mobilgard 50 M	SAE 40	50	A,B,C
	Mobilgard SP 55	SAE 40	55	A,B,C
Petron	Petromar XC 3040	SAE 40	30	A,B,C
	Petromar XC 4040	SAE 40	40	A,B,C
	Petromar XC 5540	SAE 40	55	A,B,C
Shell	Argina T 40	SAE 40	30	A,B,C
	Argina X 40	SAE 40	40	A,B,C
	Argina XL 40	SAE 40	50	A,B,C
Texaco	Taro 30 DP 40	SAE 40	30	A,B,C
	Taro 40 XL 40	SAE 40	40	A,B,C
	Taro 50 XL 40	SAE 40	50	A,B,C

Before using a lubricating oil not listed in Tables 1-2, the engine manufacturer must be contacted. Lubricating oils that are not approved have to be tested according to engine manufacturer's procedures.

Lubricating oil condemning limits

Property	Unit	Condemning limit HFO operation	Condemning limit LFO operation
Viscosity	cSt.	-20% / +25% at 100°C	-20% / +25% at 100°C
Viscosity	cSt.	-25% / +45% at 40°C	-25% / +45% at 40°C
Water	Vol-%	Max 0.30	Max 0.30
Base number	mg KOH/g	Min.20	50% Depletion
Insolubles in n-pentane	w-%	2.0	2.0
Flashpoint (PMCC)	°C	170	170
Flashpoint (COC)	°C	190	190

Crankcase pressure

Crankcase pressure	
Normal gasflow per cylinder	50 l/min.
Normal crankcase pressure L- engine	$\leq$ 10 mm H2O
Normal crankcase pressure V- engine	$\leq$ 20 mm H2O

Information required for oil analysis

1. Name of vessel or plant.
2. Engine serial number.
3. Date sample drawn.
4. Oil brand, product name, nominal viscosity.
5. Running hours luboil.
6. Running hours engine
7. Place of sample point.

Approved lubricating oils for engine turning device

Lubricating oils for engine turning device				
Supplier	**Brand name**	**Viscosity cst at 40 °c**	**Viscosity cst at 100 °c**	**Viscosity index (vi)**
Agip	Blasia 320	300	23.0	95
BP	Energol GR-XP 460	425	27.0	88
Castrol	Alpha SP 460	460	30.5	95
Elf	Epona Z 460	470	30.3	93
Esso	Spartan EP 460	460	44.9	152
Mobil	Mobilgear 634	437	27.8	96
Shell	Omala Oil 460	460	30.8	97
Texaco	Meropa 460	460	31.6	100

Sump contents

	Dry – sump Marine		Wet – sump DPP
Engine type	**HFO**	**MDO / LFO**	**LFO / MDO / HFO**
W26	[m3]	[m3]	[m3]
6L	2,6	1,3	1,3
8L	3,5	1,7	1,6
9L	3,9	1,9	1,7
12V	5,2	2,6	2,4
16V	7	3,5	3,0
18V	7,8	3,9	3,4

Oil-pump capacities

Main pump

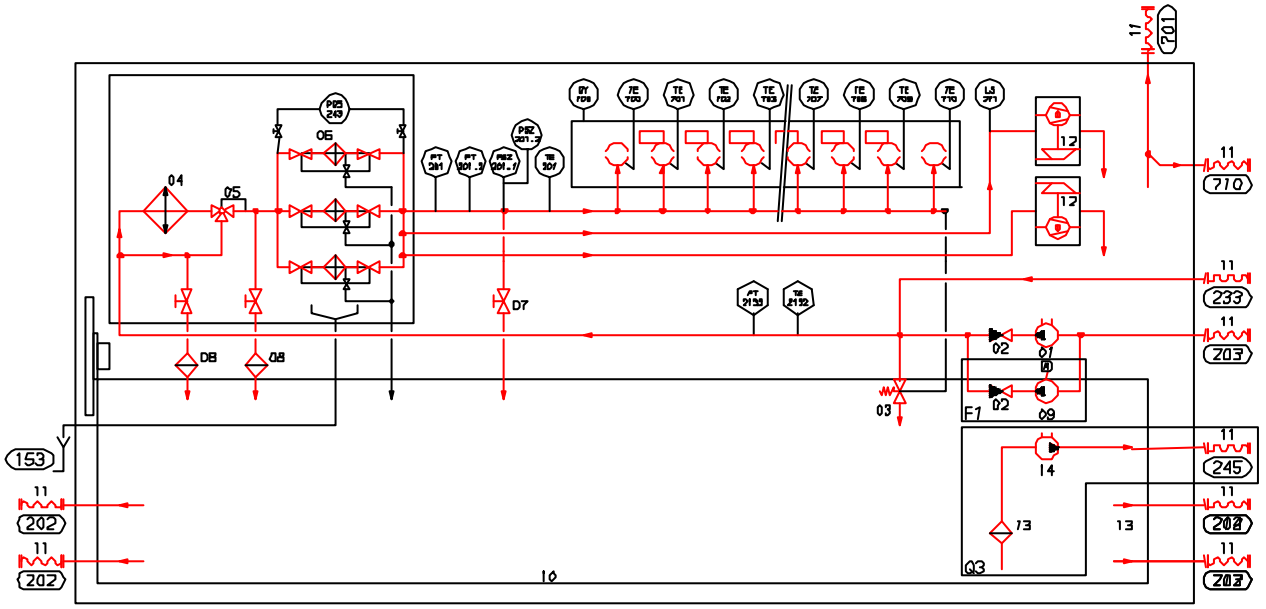
Pump capacity [m 3 /h]	6L	8L	9L	12V	16V	18V
direct driven 900 rpm	60	82	82	93	127	127
1000 rpm	67	91	91	104	141	141
Separate	50	62	68	83	103	113

Priming pump

Pump capacity [m 3 /h]	6L	8L	9L	12V	16V	18V
50 Hz	13.7	13.7	13.7	20.4	20.4	20.4
60 Hz	16.4	16.4	16.4	24.5	24.5	24.5

Internal lubricating oil system

Internal lubricating oil system in-line and v-engine, DRY SUMP

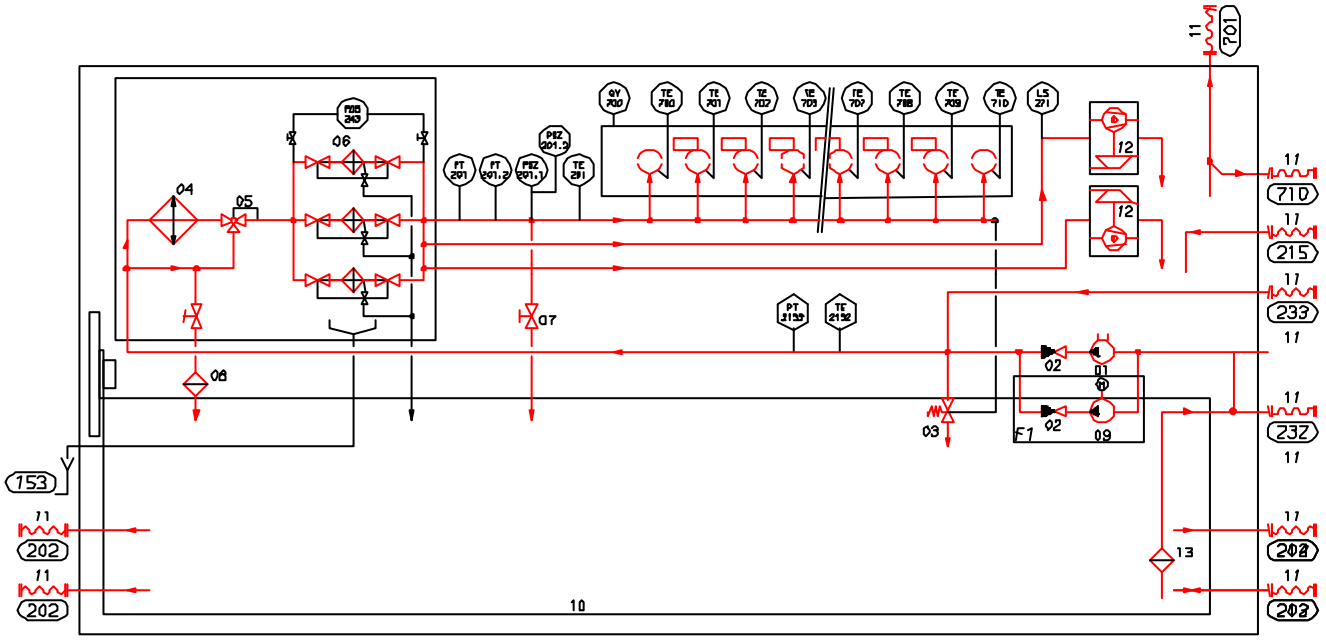


	Engine pipe connections	Dimensions:	
		L-engine	V-engine
153	Leak fuel, lubricating oil and water	22 x Ø2	22 x Ø2
202	Lubricating oil outlet from sump	2 x DN 150	4 x DN 150
203	Luboil to engine driven pump	DN 100	DN 125
209	Luboil to external filter	DN 80	DN 80
210	Luboil from external filter	DN 80	DN 80
233	Lubricating oil from stand-by pump	DN 80	DN100
245	Luboil from scavenging pump	DN100	N.A.
701	Crankcase air breather	DN 80	DN 100
710	Discharge dirty condensating oil	Ø 8 X 1	Ø 8 X 1

System components:

01	Main luboil pump	08	Centrifugal filter
02	Non-return valve	09	Prelubrication pump
03	Pressure control valve	10	Wet sump
04	Lub oil cooler	12	Turbocharger
05	Thermostatic valve	13	Strainer
06	Main luboil filter	14	Lubricating oil scavenging pump
07	Sample valve		

Internal lubricating oil system In-line and V-engine, wet sump



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	L-engine	V-engine
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05	Thermostatic valve	13	Strainer
06	Main luboil filter	14	Lubricating oil scavenging pump
07	Sample valve		

1.3 STARTING AIR SYSTEM

The engines are started by means of compressed air.
Engines delivered mid 1998 and later have 30 bar for starting and stopping.
Engines with 10 bar stopping devices are not suitable for 30 bar.

The electric starting pneumatic solenoid valve is built on the engine and is electrically operated. In case of emergency it can be manually operated. Note : In this case the alarm / safety system is not switched on !

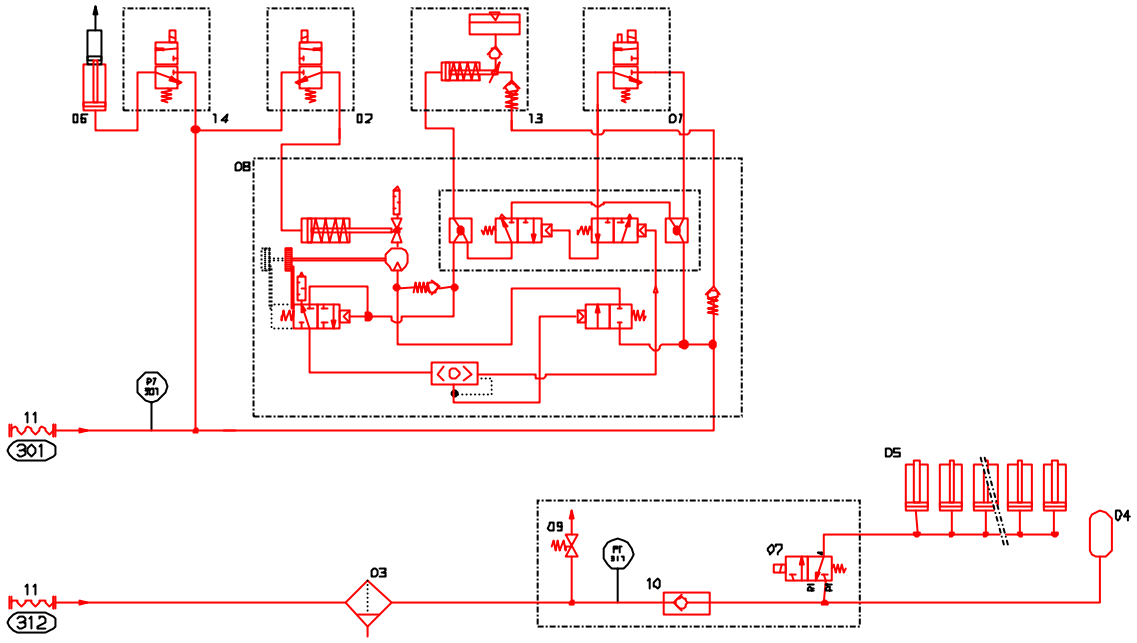
The start is performed by a pneumatic starting motor (2× for 16 and 18V26) driving the gear rim of the flywheel.

Technical data

Engine type			6L26	8L26	9L26	12V26	16V26	18V26
Air pressure	nom.	[bar]	30	30	30	30	30	30
	min.(20°C)	[bar]	15	15	15	15	15	15
	max.	[bar]	33	33	33	33	33	33
Air consumption per start	4)	[Nm^3]	1.25	1.8	1.8	2.5	3.8	3.8

4) Condition of starting air is 30 bar/20°C. In case of the slow turning option the consumption will increase.

Start-stop air system, In-line and V-engine

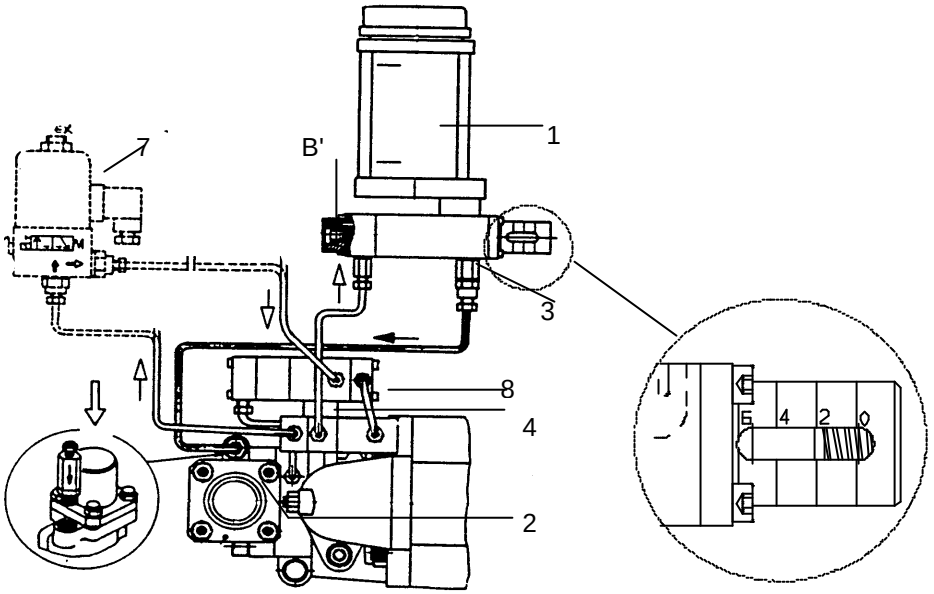


System components		Pipe connections		
1	Solenoid for starting with manual switch	301	Starting air inlet	DN40
2	Solenoid valve for slow turning	312	Stopping air inlet	Ø8x1
3	Air filter with water separator			
4	Air receiver			
5	Pneumatic stopping cylinder at each fuel injection pump			
6	Booster cylinder			
7	Solenoid valve for stopping			
8	Pneumatic starting motor (incl. slow turning) 2x for 16v26 and 18V26			
10	Non-return valve			
13	Servo lubricator			
14	Solenoid valve for booster cylinder			
	Oil mist detector (optional)			

Starting air motor

Lubrication

Important for the starting air motor is the lubrication. Never run the starting air motor without a working servo lubricator, see figure. The oil container should always be filled for a ¼ till ¾.



After activating solenoid valve (7), controlled by the engine control system, air is supplied via a distribution block (8) to the pneumatic pump (3). By displacing the air/oil plunger of the the pneumatic pump (3) an adjustable quantity of lubrication oil is displaced to points of the air motor to be lubricated. With a screw (B) the quantity of oil each stroke is displaced can be adjusted.
When the running time of starter motor is <2 sec., adjust 'B' at position 3.
When the running time of starter motor is between 3 and 6 sec. adjust 'B' at position 4.

Recommendations for the use of lubricating oils

We strongly recommend servo lubricator oil of a low viscosity index, low freezing point (less than -25°C), with good anti rust properties and compatible with air humidity. Such oils are generally used for pneumatic tools. A type SAE 10 motor oil can be used as well. In case of an extremely low temperature, below -20°C, special oil (Turbo Oil) should be used.

Trouble shooting guide for starting motor

Problem/probable cause(s)	Suggested remedy
1. On pressing push-button, starter does not respond and no air flow seems to exist in control circuit.	
a) Empty air vessels	Charge air vessels
b) Flow valve(s) closed.	Open flow valve(s).
c) Control circuit blocked.	Disconnect and clean out.
2. On pressing push-button, starter does not respond, although air flows through control circuit.	
a) Leaking control duct.	Repair or replace.
b) Insufficient air pressure.	Increase pressure in air vessel.
c) Piston or valve (x18, x17 or x16) sticking in closed position.	Remove and check both; smoothen guides or change parts.
d) Push-button stuck.	Remove and clean same
e) Excessive length of main air pipework.	Approach push-button to starter or install a solenoid valve near the latter.
3. Pinion revolves and advances, but does not engage the ring gear.	
a) Ring gear and/or pinion burrs or damaged.	Remove burrs or replace parts if necessary.
b) Lack of clearance between pinion and ring gear.	Replace pinion by a more adequate one. Check for distortion of ring gear.
4. Pinion revolves and advances, but does not advance totally.	
a) Push-rod (11) inoperative.	Disassemble, check, smoothen guide diameter; clean or replace if corrosion is visible.
b) Insufficient air pressure.	Increase pressure in air vessel.
c) Splined shaft (19) sticking.	Disassemble, clean, check spring (22) and reassemble.
d) Excessive length of control pipe.	Approach push-button to the starter or install a solenoid valve near the latter.

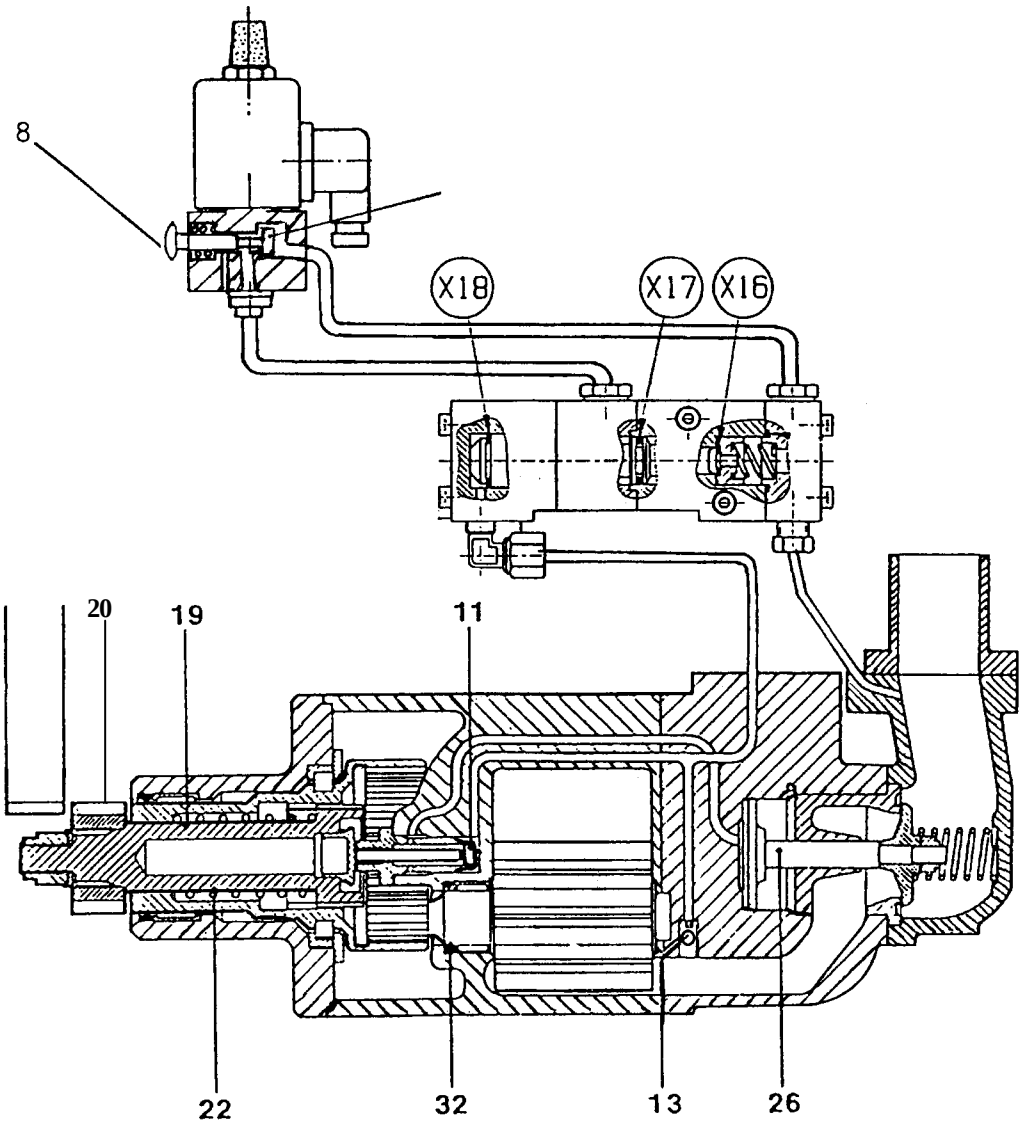
Trouble shooting (continuation)

Problem/probable cause(s)	Suggested remedy
5. Pinion advances but does not revolve	
a) Pneumatic motor inoperative	Disassemble, inspect rotors for foreign matters between teeth and for possible wear of gears, spindles and bearings. Clean, oil and reassemble. Replace worn parts.
b) Check valve/orifice (13) stuck or blocked	Disassemble, clean, oil and reassemble.
6. Pinion engages gear ring, but will not turn the engine.	
a) Main valve (26) blocked.	Disassemble, clean oil and reassemble or replace main valve.
b) Rotors worn or blocked	Disassemble, clean, oil and reassemble or replace rotors.
c) Insufficient air pressure.	Increase pressure in air vessel.
d) Main air pipework restricted or of insufficient bore.	Check all pipework and replace it if necessary.
7. Starter starts working after opening the flow valve in the feed line, although push-button (or solenoid valve) is not actuated.	
a) Incorrect connection of control pipes. (with separate solenoid valve)	Connect control pipes as per installation instructed.
b) Main valve (26) blocked and open.	Disassemble, clean, oil joint if needed.
c) Operating valve (4) is not closing properly	Disassemble, clean, oil and reassemble or replace valve if needed.
8. Lack of starter power.	
a) Main pipework choked or its bore is less than stipulated for the starter.	Check entire pipework for correct bore and replace if incorrect.
b) Air strainer (if present) clogged	Clean filter
c) Insufficient air pressure.	Increase pressure in air vessel.
d) Badly worn rotors.	Disassemble, replace rotors ,oil and reassemble.

Trouble shooting (continuation)

Problem/probable cause(s)	Suggested remedy
9. After starting the engine, pinion tries to re-engage and hits the ring gear which results in damage to both.	
a) Incorrect bore of main pipework.	Check entire pipework for correct bore and replace if incorrect.
b) Starting period unnecessarily long.	Check and adjust timer (if fitted) or press starter push-button for a shorter period.
c) Idling of main valve (26)	Disassemble, clean, oil and reassemble.
d) Sticking of operating valve (4)	Disassemble, clean, oil and reassemble or replace valve if needed.
e) Piston or leak valve (x18, x17 or x16) defective	Disassemble, clean, oil and reassemble. Replace if needed.
f) Check valve/orifice (13) stuck or blocked	Disassemble, clean, oil and reassemble.
10. Starter motor will not stop.	
a) Main valve (26) blocked.	Disassemble, clean, oil and reassemble.
b) Piston or leak valve (x18, x17 or x16) defective	Disassemble, clean, oil and reassemble. Replace if needed.
c) Check valve (13) keeps open or does not seat properly.	Disassemble, check for correct closing of the ball and check if plug presses the valve against its seat.
d) Seal ring (32) badly fitted.	This is a frequent appearing fault after changing the motor bearings. Check for correct position.
e) Incorrect adjustment of controls.	Adjust timer (if fitted), or operate push-button for shorter periods.
f) Splined shaft (19) sticking.	Disassemble, clean, check spring (22) and reassemble.

Starting motor



4	operating valve	22	spring
8	push button	26	main valve
11	piston	32	seal ring
13	check valve orifice	x16	valve
19	splined shaft	x17 and x18	piston
20	bendix		

1.4 COOLING WATER

Cooling water requirements.

The make-up water should be free of any foreign particles and gases. Supplied to the engine cooling water system it must at least meet the following requirements:

Requirements make-up water

Requirements make-up water		
Chloride content (Cl)	max. [mg/l.]	80
Sulphate content (S)	max. [mg/l.]	150
pH	min.	6.5
Hardness	°D	< 10
Hardness	mg/l CaCO3	< 170

To prevent formation of rust and scale in the cooling water system, an inhibitor on nitrate/borate basis should be added to the system through a dosing tank.
The use of inhibitors does not permit zinc , aluminium and solder (in piping, fittings and instrument sensors) in the cooling water system.

Engine requirements cooling water

Engine requirements cooling water		
HT cooling water system preheated before starting	min. [°C]	60
Static pressure inlet HT and LT cooling water pump	[bar]	0,3 - 0.8
Make up water should be free of air and foreign particles		
Make up water should be treated with (nitrate/borate) inhibitors		

Note:

In case of emergency, water up to 500 mg/l (Cl + S) may be used.
This water has to be replaced as soon as possible. The system should be rinsed and filled up with the required water quality.

Cooling water treatment

Most suppliers of cooling water additives can provide a test kit for checking the cooling water quality.

Observe the following points :

- Follow thoroughly the instructions of the supplier.
- Request the supplier of the treatment product for instructions regarding the treatment procedure, dosage and concentration control.
- Record the results of tests in the engine log book.

Engine cooling water contents

The cooling water contents (are the same for the HT and the LT systems).

Engine type	W26-6L	W26-8L	W26-9L	W26-12V	W26-16V	W26-18V
	[litres]	[litres]	[litres]	[litres]	[litres]	[litres]
Contents	550	700	750	1000	1300	1450
Expansion tank	approx. 10 % of the system water volume, min. of 160 litres					

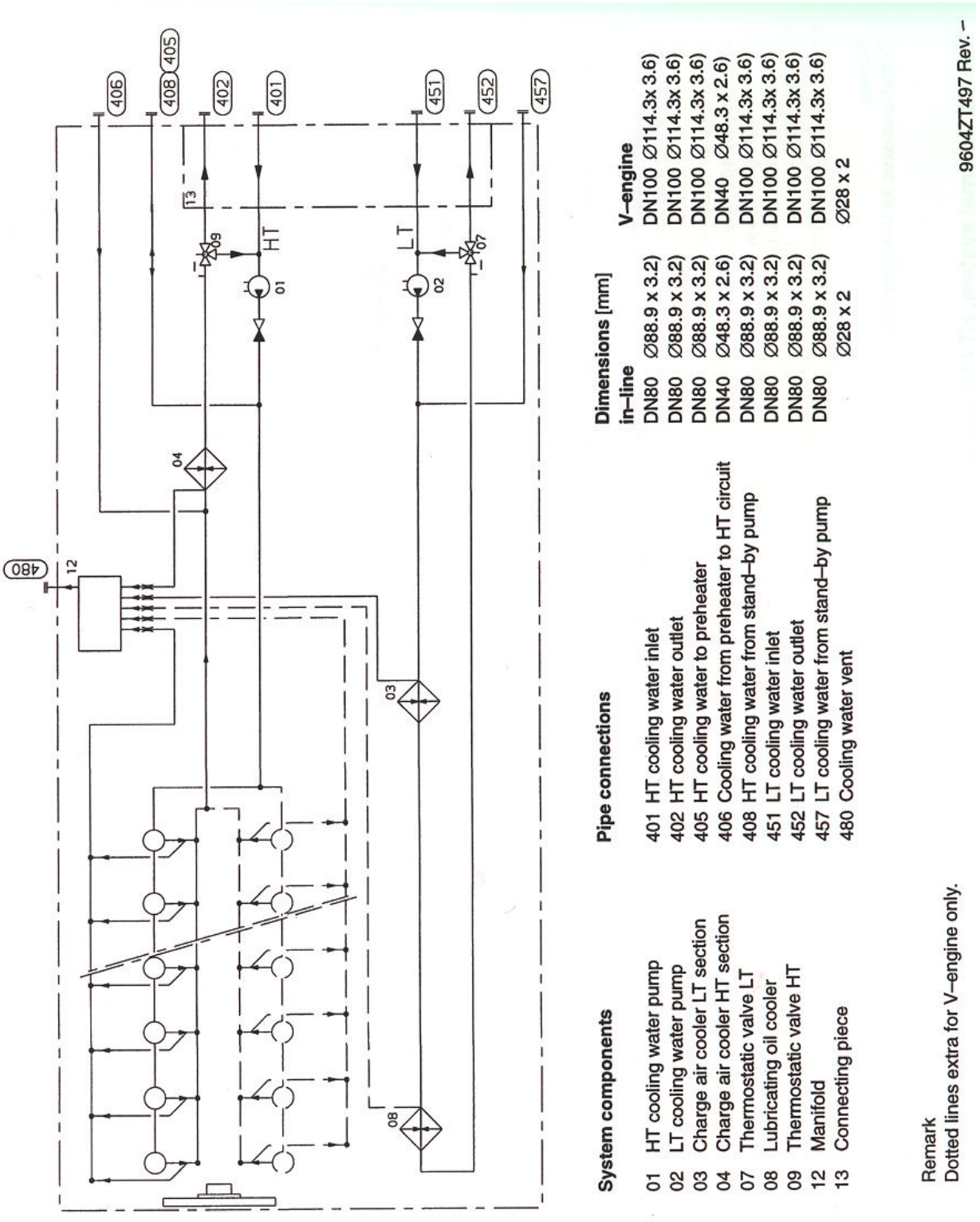
Pressure drop over engine HT / LT

Engine type	[rpm]	900	1000
6 L	[bar]	0,9	1,1
8L		1,2	1,5
9L		1,5	1,9
12 V		0,8	1,0
16 V		1,3	1,6
18 V		1,6	2,0

Pump capacity, nominal (1000 rpm)

m3 / hr	6 L	8 L	9 L	12 V	16 V	18 V
HT	33	44	50	67	89	100
LT	33	44	50	67	89	100

Separated HT and LT system



System components

01	HT cooling water pump
02	LT cooling water pump
03	Charge air cooler LT section
04	Charge air cooler HT section
07	Thermostatic valve LT
08	Lubricating oil cooler
09	Thermostatic valve HT
12	Manifold
13	Connecting piece

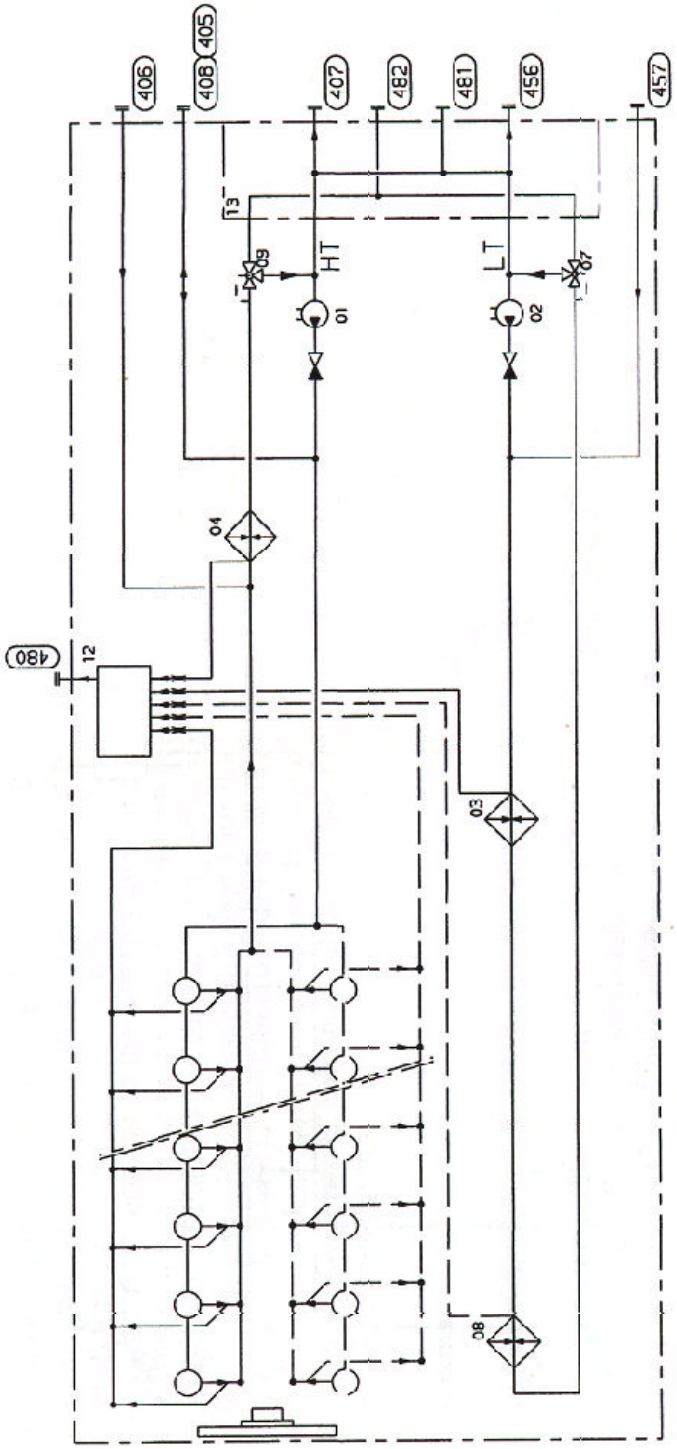
Pipe connections

		Dimensions [mm] in–line	V–engine
401	HT cooling water inlet	DN80 Ø88.9 x 3.2)	DN100 Ø114.3x 3.6)
402	HT cooling water outlet	DN80 Ø88.9 x 3.2)	DN100 Ø114.3x 3.6)
405	HT cooling water to preheater	DN80 Ø88.9 x 3.2)	DN100 Ø114.3x 3.6)
406	Cooling water from preheater to HT circuit	DN40 Ø48.3 x 2.6)	DN40 Ø48.3 x 2.6)
408	HT cooling water from stand–by pump	DN80 Ø88.9 x 3.2)	DN100 Ø114.3x 3.6)
451	LT cooling water inlet	DN80 Ø88.9 x 3.2)	DN100 Ø114.3x 3.6)
452	LT cooling water outlet	DN80 Ø88.9 x 3.2)	DN100 Ø114.3x 3.6)
457	LT cooling water from stand–by pump	DN80 Ø88.9 x 3.2)	DN100 Ø114.3x 3.6)
480	Cooling water vent	Ø28 x 2	Ø28 x 2

Remark
Dotted lines extra for V–engine only.

9604ZT497 Rev. –

Combined HT and LT system



System components	Pipe connections	Dimensions [mm] in-line	Dimensions [mm] V-engine
01 HT cooling water pump	405 HT cooling water to preheater	DN80 (Ø88.9 x 3.2)	DN100 (Ø114.3 x 3.6)
02 LT cooling water pump	406 Cooling water from preheater to HT circuit	DN40 (Ø48.3 x 2.6)	DN40 (Ø48.3 x 2.6)
03 Charge air cooler LT section	407 HT cooling water to stand-by pump	DN80 (Ø88.9 x 3.2)	DN100 (Ø114.3 x 3.6)
04 Charge air cooler HT section	408 HT cooling water from stand-by pump	DN80 (Ø88.9 x 3.2)	DN100 (Ø114.3 x 3.6)
07 Thermostatic valve LT	456 LT cooling water to stand-by pump	DN80 (Ø88.9 x 3.2))	DN100 (Ø114.3 x 3.6)
08 Lubricating oil cooler	457 LT cooling water from stand-by pump	DN80 (Ø88.9 x 3.2)	DN100 (Ø114.3 x 3.6)
09 Thermostatic valve HT	480 Cooling water vent	Ø28 x 2	Ø28 x 2
12 Manifold	481 Cooling water inlet	DN100 (Ø114.3x 3.6)	DN125 (Ø139.7 x 4)
13 Connecting piece	482 Cooling water outlet	DN100 (Ø114.3x 3.6)	DN125 (Ø139.7 x 4)

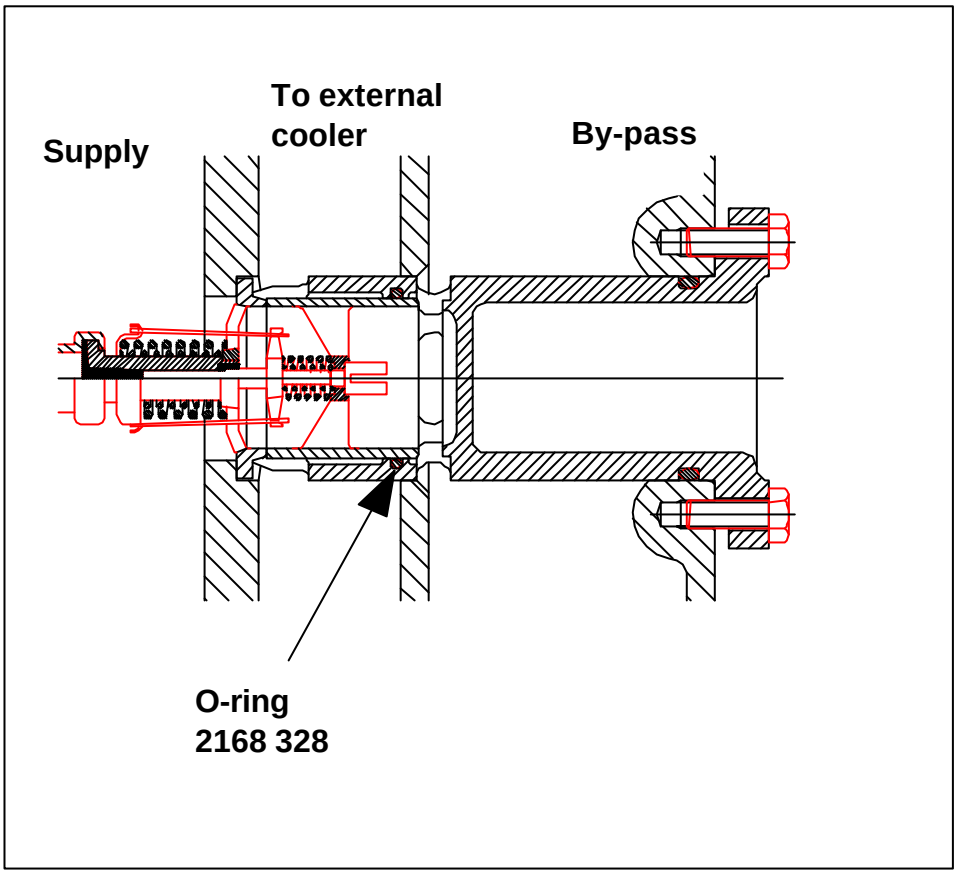
Remark
Dotted lines extra for V-engine only.

Thermostatic valves

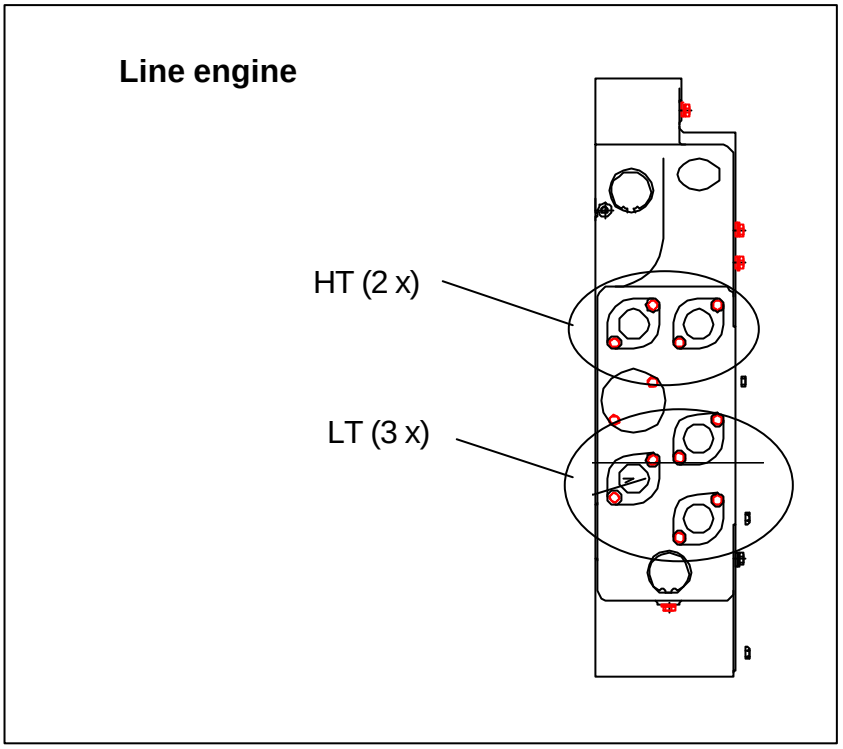
Thermostatic valves overview

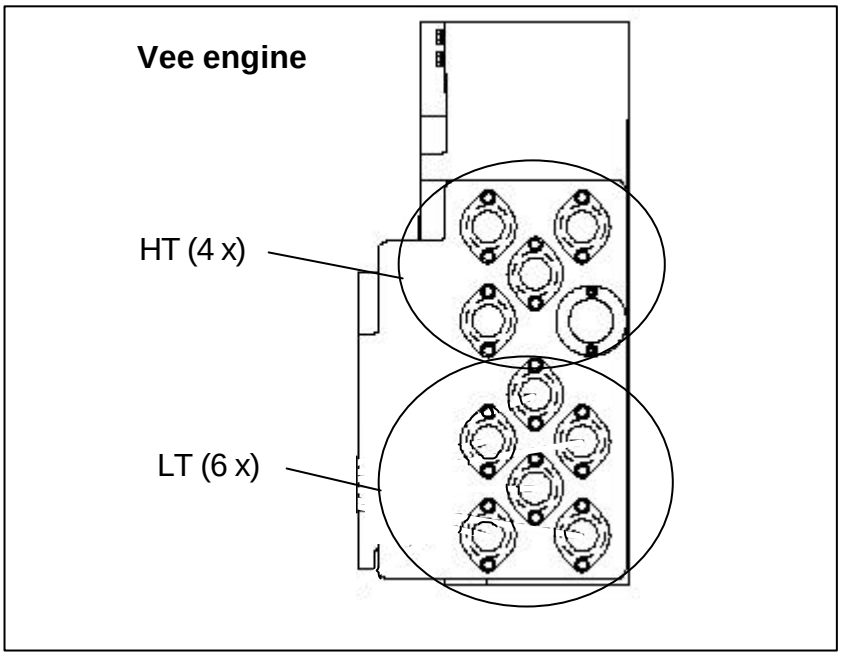
Partcode	Medium	Application	Temperature [°C]		
			Nominal	Open	To
9004zt101	LT	W26 – 0	50	46	54.4
9004zt102	HT	W26 – 0	94	90	98.3
9004zt103	OIL	W26 – 0	59.5	56.0	62.8
9004zt104	LT	W26 – 0	44	41.0	47.2
9004zt105	LT	W26 - A	46	40	50
9004zt106	HT	W26 - A	91	87	98
9004zt107	OIL	W26 - A	57	54	63
9004zt109	OIL	W26 - A	60	57	66

Note: Thermostatic elements exposed to a 10 °C above the maximum range will damage the wax elements and should be replaced.



Thermostatic valves, position





Approved cooling water additives

The use of approved cooling water additives during the warranty period of engines is mandatory and is also strongly recommended after the warranty period. The list of approved cooling water additives can be found below.

Approved cooling water treatment products	
Supplier	**Product designation**
S.A. Arteco N.V. Technologiepark-Zwijnaarde 2 B-9052 Gent/Zwijnaarde, Belgium	Havoline XLi
BetzDearborn Europe Interleuvenlaan 25 B-3001 Heverlee, Belgium	CorrShield NT 4293 (ex-Dearborn 547)
Drew Ameroid Marine Division Ashland Chemical Company One Drew Plaza Boonton, NJ 07005, USA	DEWT-NC powder Drewgard 4109 Liquidewt Maxigard Vecom CWT Diesel QC-2
Houseman Ltd The Priory, Burnham Slough SL1 7LS, UK	Cooltreat 651
Maritech AB Box 143 S-29122 Kristianstad, Sweden	Marisol CW
Nalco Chemical Company One Nalco Centre Naperville, Illinois 60566-1024 USA	Nalco 39 (L) Nalcool 2000
Nalfleet Marine Chemicals PO Box 11 Winnington Avenue, Northwich Cheshire, CW8 4DX, UK	Nalcool 2000 Nalfleet EWT 9-108 Nalfleet CWT 9-131C

Approved cooling water additives (continuation)

Approved cooling water treatment products	
Supplier	**Product designation**
Rohm & Haas La Tour de Lyon 185, Rue de Bercy 75579 Paris, Cedex 12, France	RD11 RD11M RD25
Tampereen Prosessi-Insinöörit Oy Keisarinviitta 22 33960 Pirkkala, Finland	Ruostop XM
Texaco Global Products, LLC 1111 Bagby Houston, TX 77002	Havoline XLi
Unitor ASA P.O. Box 300 Skøyen N-0212 Oslo, Norway	Dieselguard NB Rocor NB liquid
Vecom Holding BV PO Box 27 3140 AA Maassluis, The Netherlands	Vecom CWT Diesel QC-2

Cooling water additives, dosage and concentration

In order to prevent corrosion in the cooling water system, the instructions of right dosage and concentration of active corrosion inhibitors should always be followed. The information can be found in the table below.

Approved cooling water treatment products		
Product designation	**Dosage per 1 m³ of system capacity**	**Concentration of active corrosion inhibitor**
CorrShield NT 4293 (ex-Dearborn 547)	10 litres	670-1000 ppm as NO_2
DEWT-NC powder Drewgard 4109 Liquidewt Maxigard	3-4.5 kg 16-29 litres 8-12 litres 16-29 litres	1500-2250 ppm as NO_2 1100-2000 ppm as NO_2 470-700 ppm as NO_2 1100-2000 ppm as NO_2
Cooltreat 651	5 litres	800 ppm as NO_2
Marisol CW	8-16 litres	1000-2000 ppm as NO_2
Nalco 39 (L) Nalcool 2000 Nalfleet EWT 9-108 Nalfleet CWT 9-131C	16-36 litres 32-48 litres 2.2-3.4 litres 8-12 litres	550-1200 ppm as NO_2 1000-1500 ppm as NO_2 1000-1500 ppm as NO_2 1000-1500 ppm as NO_2
RD11 = RD11M RD25	5 kg 50 litres	1250 ppm as NO_2 710 ppm as Mo
Ruostop XM	20 litres	120 ppm as Mo
Havoline XLI (ex-ETX 6282)	50-100 litres	1.6-3.2 w-% of active compounds measured with a supplier's refractometer
Dieselguard NB Rocor NB liquid	2-4.8 kg 10-24 litres	1500 ppm as NO_2 1500 ppm as NO_2
Vecom CWT Diesel QC-2	6-10 litres	1500-2500 ppm as NO_2

Note: For some products the recommended minimum and maximum limits are listed in the table above. Since the amount of active corrosion inhibitors, especially nitrites, is decreasing during the service of the engines, the engine manufacturer recommends the dosage to start from the upper level.

1.5 EXHAUST GAS/CHARGE AIR SYSTEM

Air requirements / specification

The suction air must be free of:

- dust (sand, grit, etc.)
- snow, ice, etc.
- fluids
- exhaust gases
- combustible gases
- chemicals (solvents, etc.).

To ensure starting, the water temperature of the LT section of the air cooler should not be below 10 °C.
For operation the inlet air temperature should not be below -5 °C

Quality of suction air, filtration

The highest permissible dust concentration at the turbocharger inlet after filtration is max. 3 mg/m^3_N with particles above 5 µm.

In installations with extreme conditions, the highest allowable concentration of harmful components in the engine intake air after filtration is:

- Sulphur Dioxide (SO_2): 1.25 mg/ m^3_N or 0.43 vol-ppm
- Hydrogen Sulphide (H_2S): 375 $\mu g/ m^3_N$ or 0.25 vol-ppm
- Chlorides (Cl^-): 1.5 mg/ m^3_N or 1.16 mass-ppm
- Ammonia (NH_3) 94 $\mu g/m^3_N$ or 0.125 vol-ppm

Note! Nm^3 given at 0 °C and 1013 mbar.

Measurements are to be performed during a 24-hour period and the highest 1-hour average is to be compared with the above mentioned boundary values.

Weather conditions, such as wind speed, wind direction, ambient temperature and air humidity may vary considerably during one year. Therefore, a one-day measurement may not reflect the most critical situation.

A detailed investigation concerning the filtration has to be done in installations, where the air includes components that are known to be caustic, corrosive or toxic.

Receiver pressure and exhaust gas temperature

Checkpoints:
1°. Compare load and fuel rack with testbed/commission protocol.
2°. Compare turbine speed / scavenging pressure/exhaust temperature before turbine with the testbed / commissioning protocol.

Deviations of the charge air pressure can be caused by :

Decreasing of receiver pressure:
- contamination of the compressor wheel of the turbocharger
- contamination of the air filter
- contamination of the air cooler
- a high turbine exhaust back-pressure

Increasing of receiver pressure:
- contamination of turbine wheel or nozzle ring
- engine overload

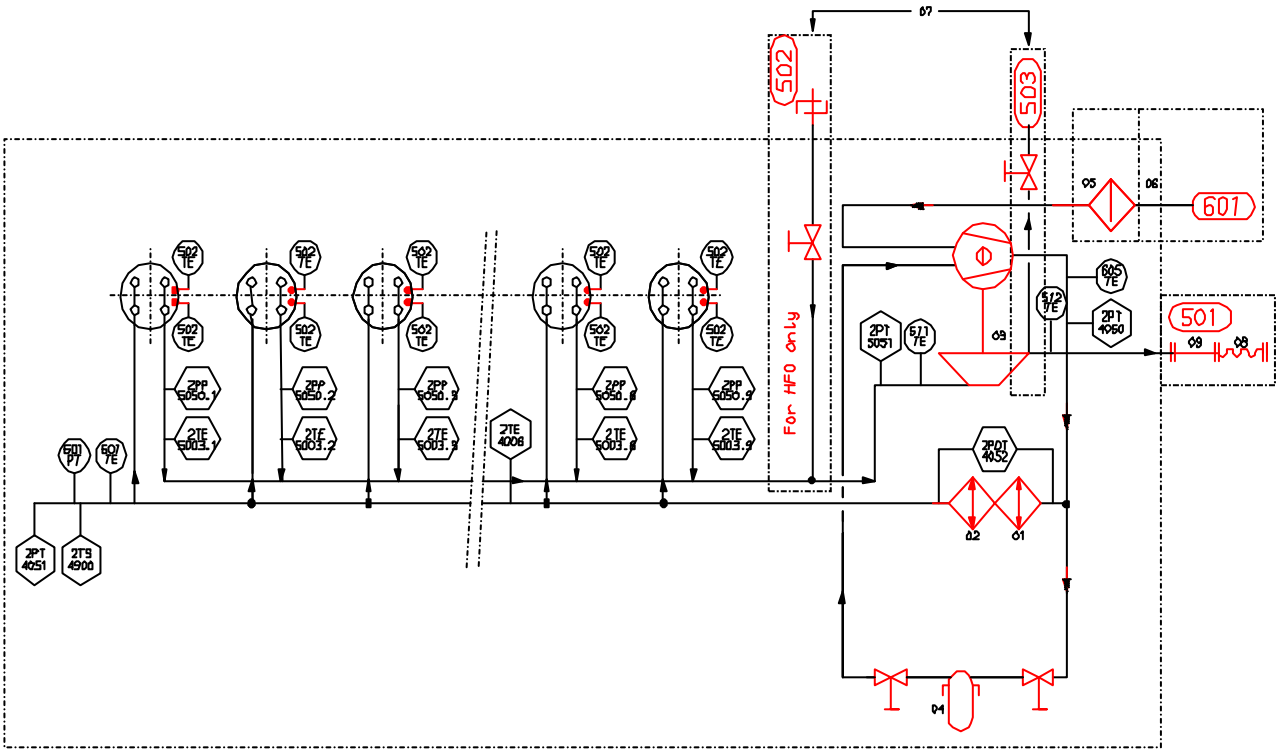
Thermal overload can occur:
- with a decrease of the receiver pressure to about 0,2 bar below the value as stated in the testbed / commissioning protocol
- by exceeding the maximum exhaust gas temperatures (see alarm settings exhaust temperature before / after turbine, see parts catalogue chapter 3; instrument data list)
- running at high load and low speed (overload)

In case of thermal overload the engine load has to be reduced to an acceptable load and exhaust gas temperature level.

Turbocharger surging

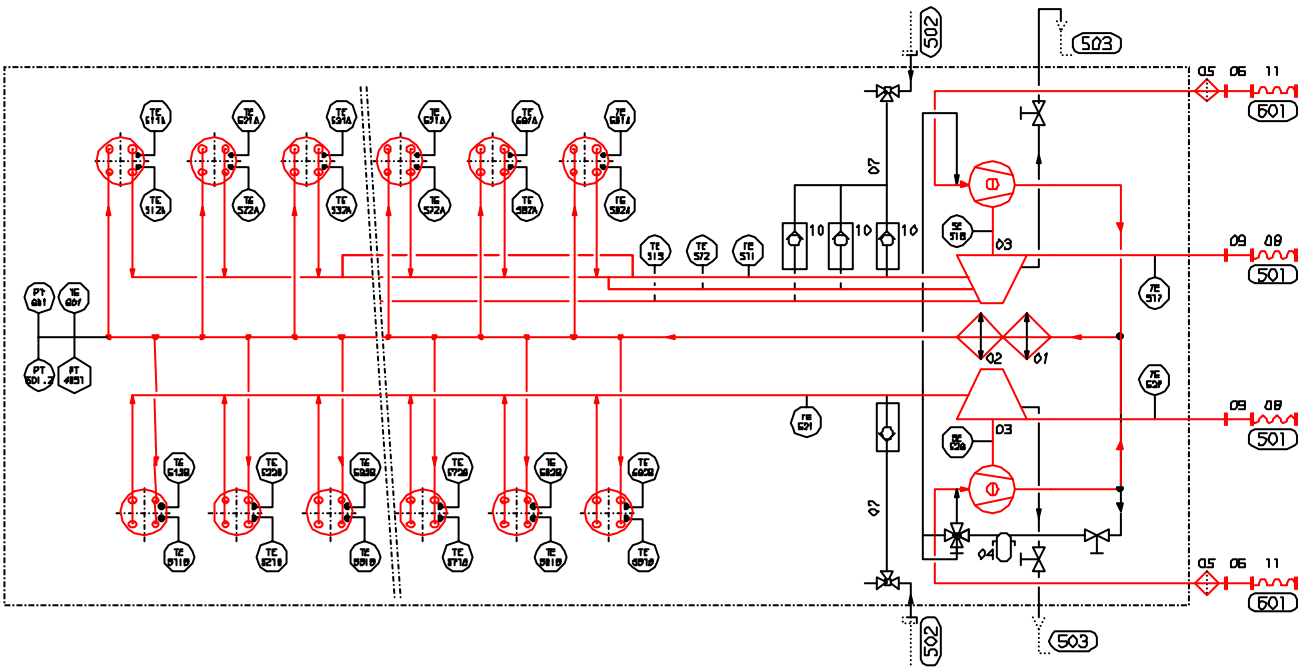
Surging (a reversal of the airflow) can be caused by the following :
- A violent change of engine load or excessive overload.
- Running the engine beyond the normal operating area.
- A too high receiver temperature.
- Fuel rack differences (per bank) / blower rpm differences A-B bank / unequal wear of fuel pumps or nozzles (old and new ones).
- A high exhaust / exhaust boiler resistance.
- A dirty air cooler (air side).
- A too high air cooler water temperature.
- A dirty nozzle ring / turbine.
- A dirty air cooler.

Internal Exhaust gas and Charge Air System Line-engine



System components		Pipe connections	
01	Charge Air cooler HT section	501	Exhaust gas outlet
02	Charge Air cooler LT section	502	Cleaning water to turbine (HFO and DMC only)
03	Turbocharger	503	Cleaning water from turbine (HFO and DMC only)
04	Compressor cleaning device	601	Air inlet to turbocharger
05	Air filter and silencer		
06	Suction pipe		
07	Turbine cleaning device (HFO and DMC only)		
08	Flexible pipe connection		
09	Adapter piece		

Internal Exhaust gas and Charge Air System Vee-engine



System components		Pipe connections	
01	Charge Air cooler HT section	501	Exhaust gas outlet
02	Charge Air cooler LT section	502	Cleaning water to turbine (HFO and DMC only)
03	Turbocharger	503	Cleaning water from turbine (HFO and DMC only)
04	Compressor cleaning device	601	Air inlet to turbocharger
05	Air filter and silencer		
06	Transition pipe		
07	Turbine cleaning device (HFO and DMC only)		
08	Flexible connection exhaust		
09	Transition piece exhaust		
10	Water injector		
11	Flexible connection air inlet		

Turbochargers

Application

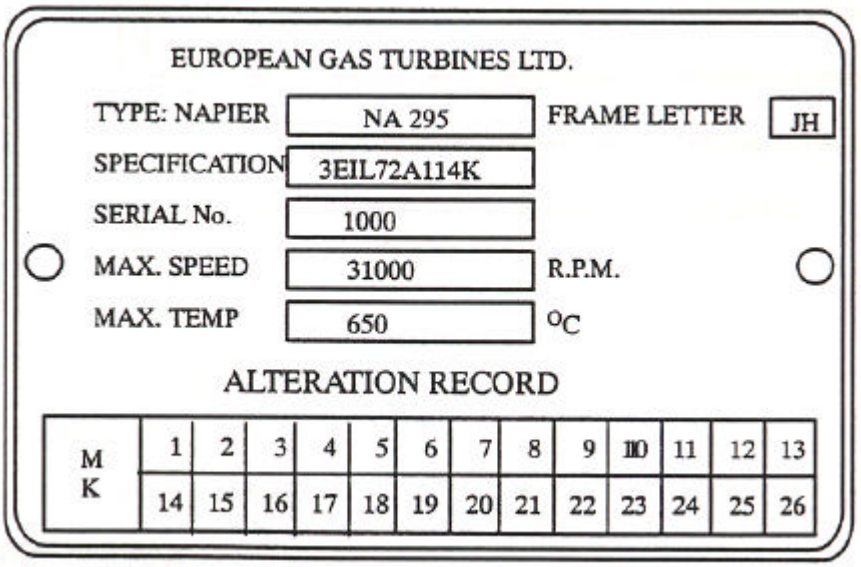
Engine type	Number of cylinders	Type of turbocharger			
		NA 295	NA 297	TPS 57D	TPL 65E
26-0	6	X			
	8	X			
	9	X			
	12	X			
	16	X			
	18	X			
26ST	16				X
26A	6			X	
	8		X		
	9		X		
	12		X		
	16		X		
	18		X		

Napier 295 and 297, Specification

Type	Pressure Ratio	Weight
NA 295	4 : 1	510 kg. approx.
NA 297	5 : 1	774 kg. approx.

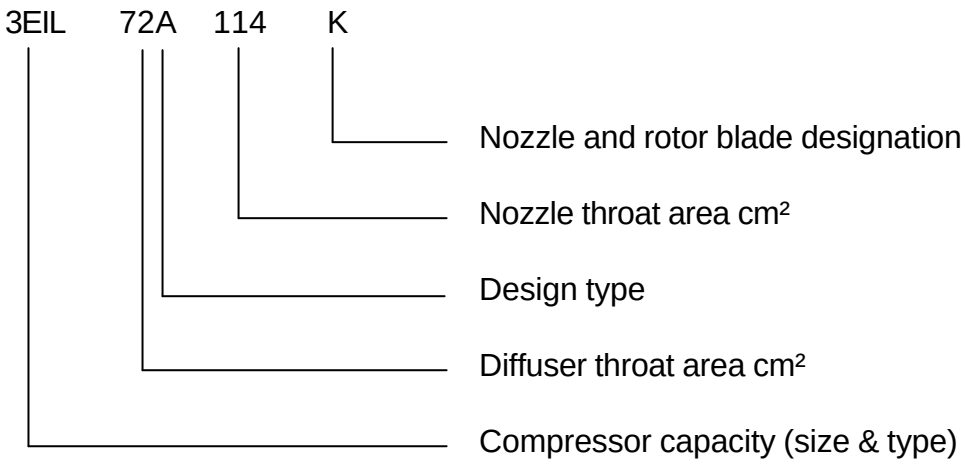
Name plates

The turbochargers have the type plate shown. This plate is mounted on the main casing.
(Example only!)



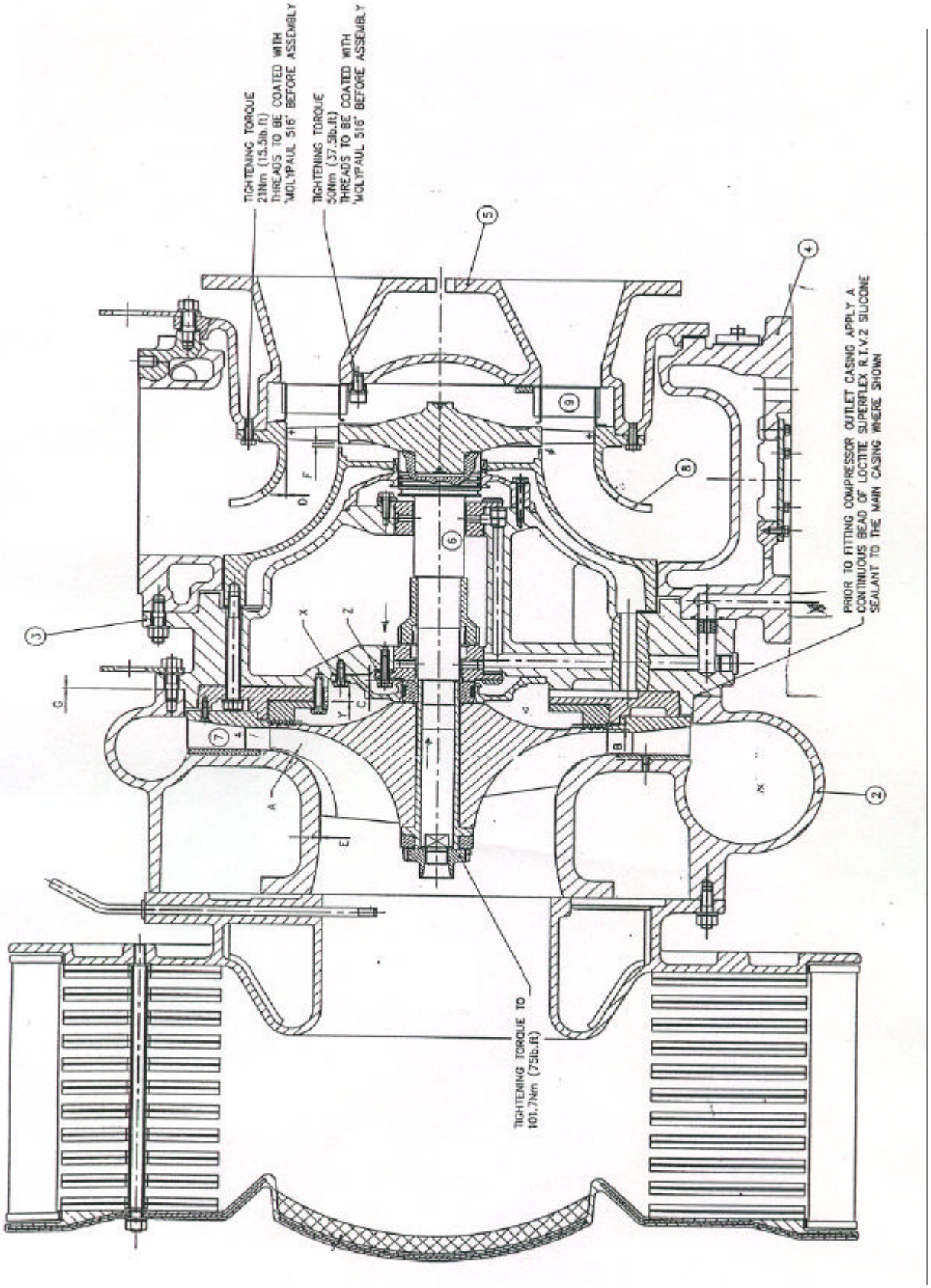
Turbocharger build reference specification.

EXAMPLE

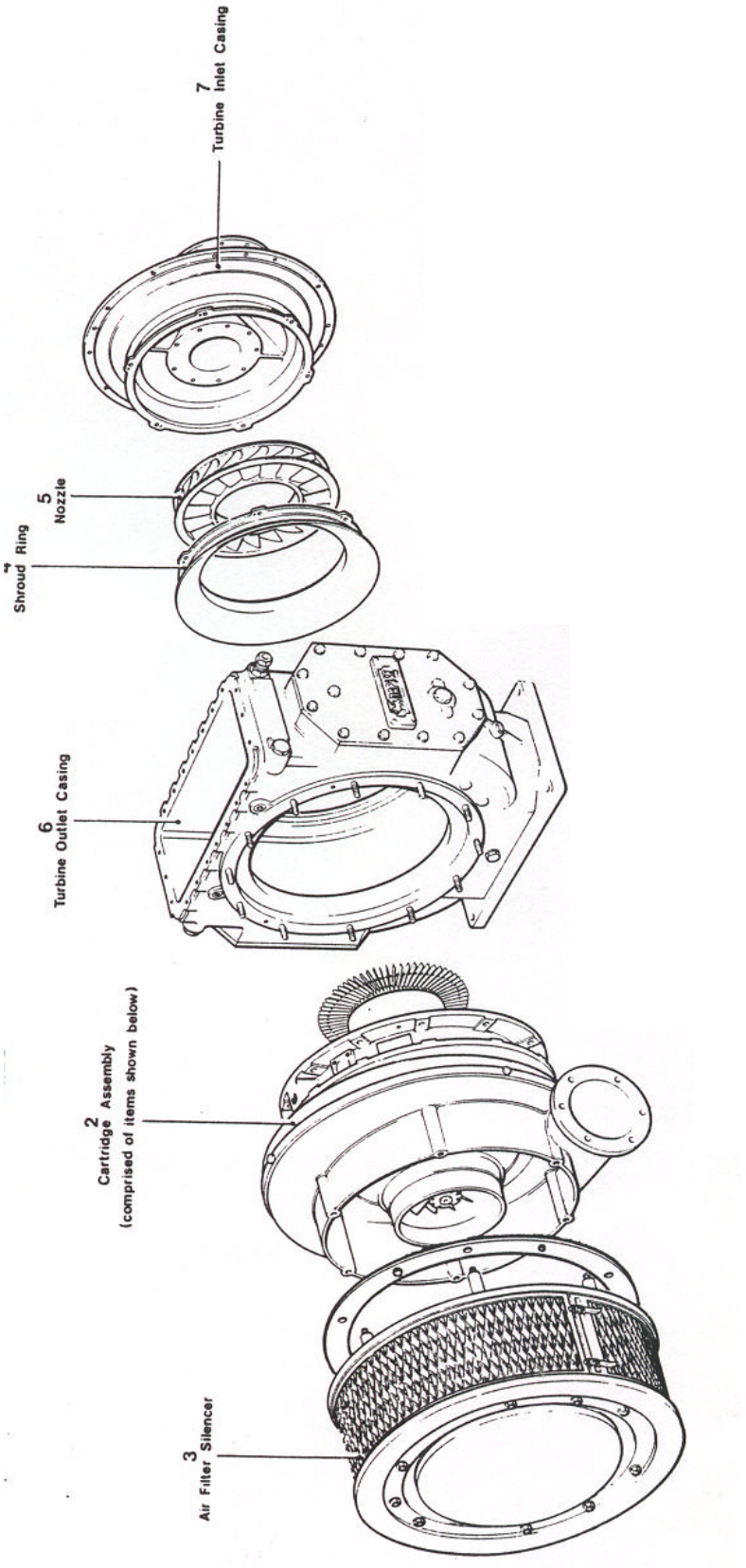


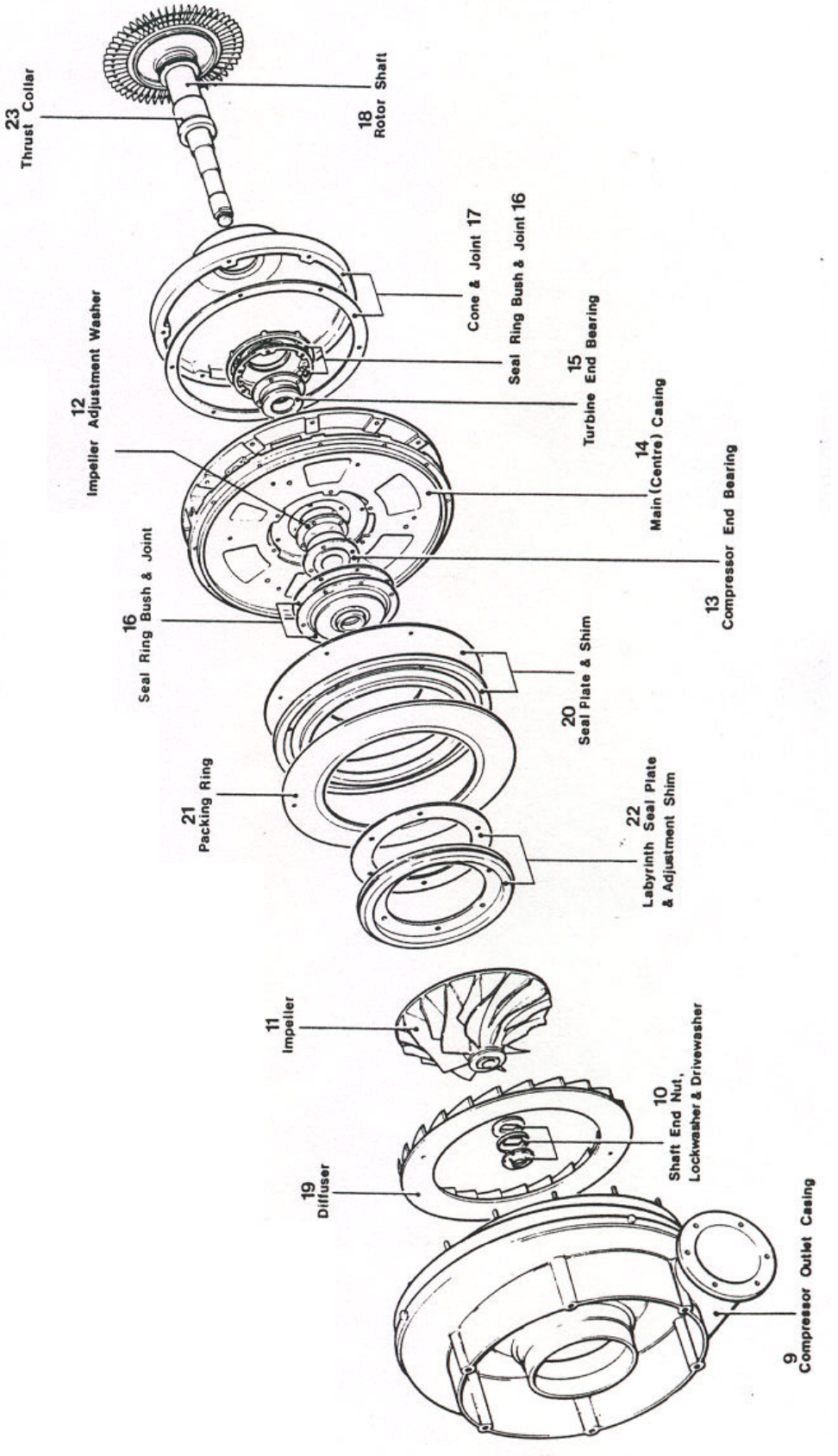
Alteration record

Alteration numbers 1 to 26 are already entered on the plate. Any alterations affecting turbo-charger interchangeability, will be indicated by obliterating the relevant numbers on the plate.



Napier 295 WD Turbocharger, GENERAL ARRANGEMENT

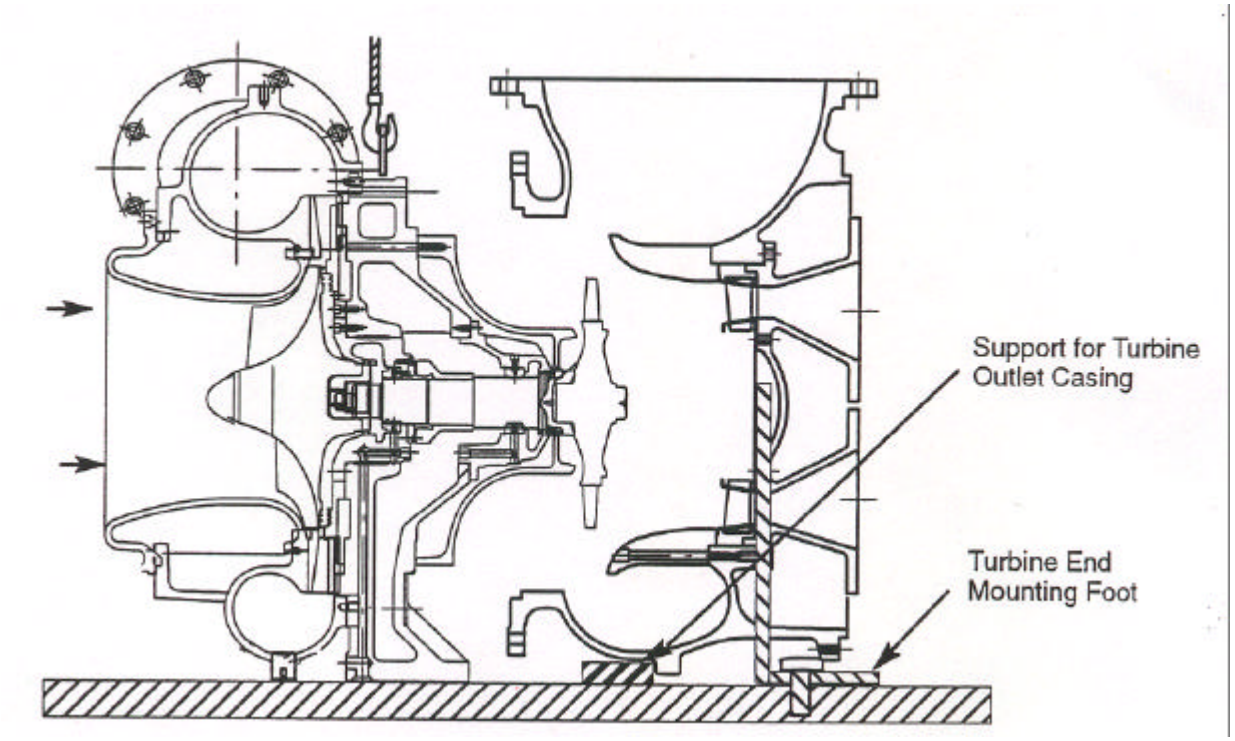

7 Turbine Inlet Casing
5 Nozzle
4 Shroud Ring
6 Turbine Outlet Casing
2 Cartridge Assembly (comprised of items shown below)
3 Air Filter Silencer



Napier NA295 Cartridge, Assembly Details

Napier NA 297, Cartridge Assembly

Caution:
Use extreme care when locating the cartridge assembly to the turbine outlet casing as turbine damage could occur. Ensure that the O-ring seals are located and not dislodged during fitting if the integrated oil system is being used.



Fitting cartridge assembly to turbine outlet casing

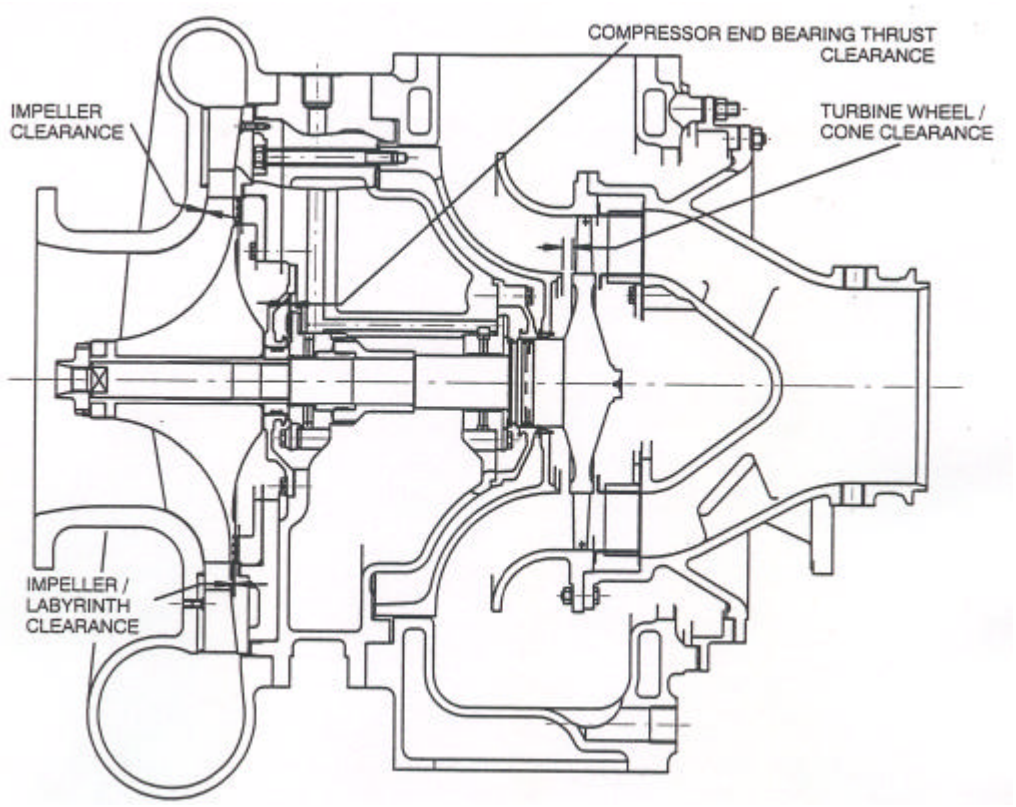
Turbocharger weights

NA 295 Description of parts	Weights in Kg. (Approximate)
Turbocharger Complete	510
Turbine Outlet Casing (complete with mounting foot and covers)	155
Turbine inlet Casing (complete with nozzle and shroud ring assembly)	55
Shroud ring	10
Cartridge Assembly (comprised of main casing assembly, rotor assembly and compressor outlet casing)	295
Main Casing Assembly complete with cone, bearing housings etc	75
Rotor Assembly, complete	23
Compressor Outlet Casing Single delivery	154
Air Filter Silencer	27
Compressor inlet Casing	25

Turbocharger weights (continuation)

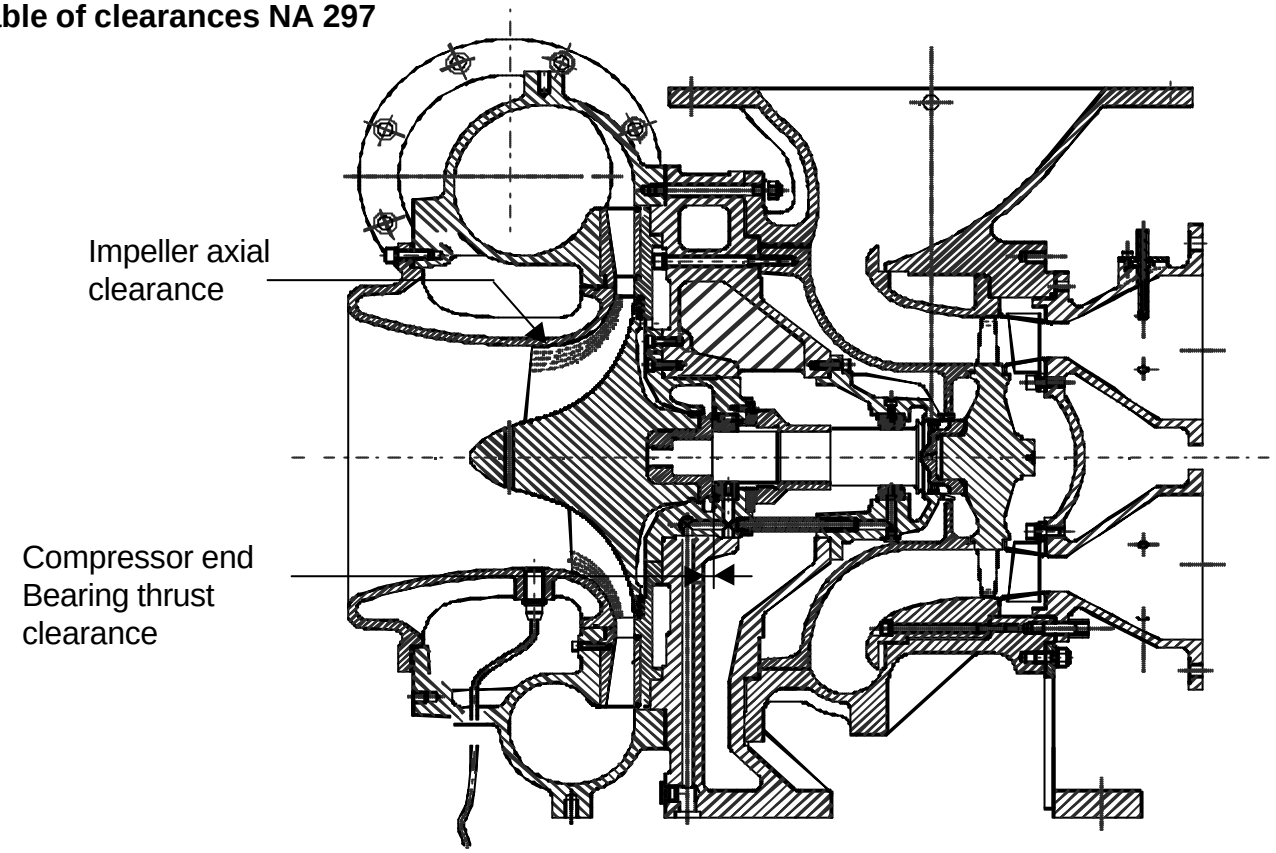
NA 297 Description of parts	Weights in Kg. (Approximate)
Turbocharger Complete	774
Main Casing	122
Turbine Outlet Casing	186
Shroud ring	38
Cone	20
Turbine inlet Casing (Single entry)	35
Turbine inlet Casing (2 entry)	25
Compressor Insert	36
Rotor Assembly	33
Compressor Outlet Casing	135
Air Filter Silencer	50

Table of clearances NA 295



NA 295 Description	Clearance in mm
Turbine wheel/cone clearance (295 WD only)	5.00 - 3.60
Impeller axial clearance (295IR,A720,A520,295WD	0.61 - 0.81
Impeller/Labyrinth clearance	0.28 - 0.33
Compressor end bearing thrust clearance	0.16 - 0.24
Note: *Clearances measured with shaft pushed towards the compressor end*	

Table of clearances NA 297



NA 297 Description	Clearance in mm
Turbine blisc/cone clearance	2.765-2.235
Impeller axial clearance	0.85 - 0.65
Compressor end bearing thrust clearance	0.095 - 0.335
Note: *Clearances measured with shaft pushed towards the compressor end*	

Torque settings NA 295/297

NA 295 The following tightening torque's are provided for general guidance

Subject	Torque in Nm
Shaft End Nut	102
Seal Plate/Cone Bolts	102
Labyrinth Seal Plate Screws	29
Seal Ring Bush T/E Set screws	29
Seal Ring Bush C/E Set screws	29
Shroud Set screws	15
Nozzle Cap Screws	50
C/E Bearing Set screws	29
T/E Bearing Set screws	29

NA 297 The following tightening torque's are provided for general guidance

Subject	Torque in Nm
Impeller	610
Turbine End Bearing Housing	40
Cone Bolts	50
Compressor End Bearing Housing	40
Labyrinth Seal Plate	40
Shroud Ring	30
Compressor insert	67
Nozzle Screws	67
Turbine End Mounting Foot Nuts	70

Lubrication NA 295/297

Subject	Value
Oil pressure turbocharger inlet	2.33 - 3.33 Bar
Oil flow.(approximate range)	16 - 25 litres/min
Heat flow rate	45 kW
Values according to speed, temperature and pressure with S.A.E. 30 grade.	

Cooling water requirements for NA 295

The jacket cooling water outlet temperature should be maintained above 60ºC

Subject	Value
Coolant flow rate	135 litres per min.
Heat flow rate	100 kW
Maximum coolant temperature	92ºC or if the system is pressurised T-17ºC, where T is equal to the boiling point at pressurisation pressure.

Starting the turbocharger for NA 295/297

The turbocharger bearings should first be pre-lubricated by means of the pre-lubricating pump before the engine is being started!

Stopping the turbocharger for NA 295/297

When shutting down, it is desirable that the turbocharger speed be allowed to stabilise, with the engine idling, before finally stopping. This procedure applies particularly where rapid load shedding occurs.
Engine driven pump - Normally the oil supply will be adequate for the run-down period
It is advised to have the pre-lubricating oil pump in operation for 2 minutes after shut down.

Emergency operation

NA295 Emergency operation. The following procedure can be used:

- Remove the cartridge and place to one side.
- Cut out a large round plate to Ø 640mm with 12 holes drilled to Ø 12mm equispaced on PCD 558.
- Fit plate to the main casing side of the turbine outlet casing ensuring that the integrated oil feed 'O' rings are fitted, to block off the oil supply.
- Using this method will mean that the receiver to the air cooler is just an open pipe and must be covered with gauze to prevent large particles entering the engine.

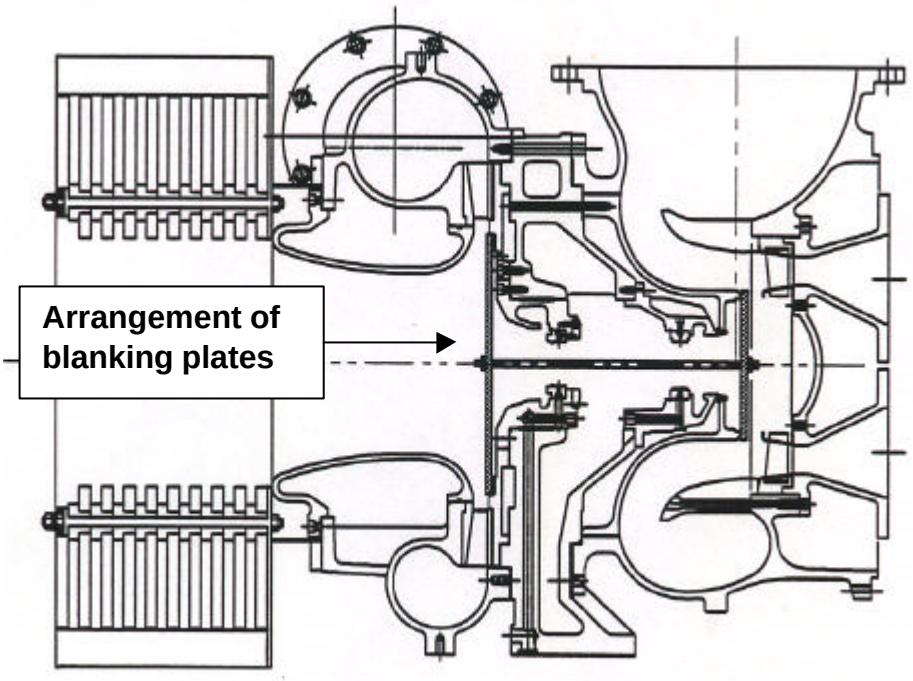
Alternatively the method described in the manual is just as effective, but it does involve a greater amount of work to strip and rebuild the turbocharger.

NA297 Emergency operation

If a defect occurs which prevents further operation of the turbocharger, the engine may still be run for a short period provided that the rotor assembly is removed and the exposed centre casing apertures are blanked off, as shown in figure below.
Coolant flow to the turbine casings must be continued during this emergency running.

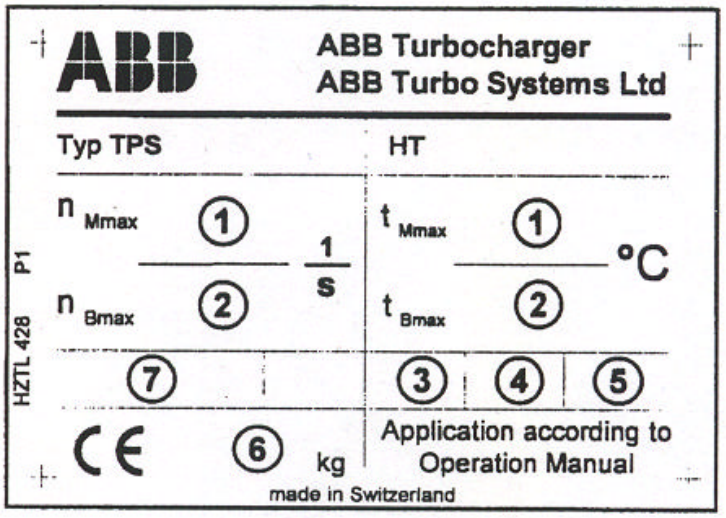
For guidance the following blanking plate details are given in figure below.

Note: Permissible engine output with blocked turbocharger is approx. 20% load. Engine output must, however, be limited not to exceed the normal full load exhaust temperatures. Maximum permissible exhaust gas tempera-ture after the cylinder at continuous operation with blocked turbocharger is 500ºC.



Turbocharger ABB TPS 57

Rating plate turbocharge



Application limits

(1) **n_{Mmax}, t_{Mmax} :** Turbocharger - application limit at engine overload (110%).
For test trials only, if not otherwise agreed with the engine manufacturer

(2) **n_{Bmax}, t_{Bmax} :** Turbocharger - application limits in service

n = Turbocharger speed
t = Exhaust gas temperature before turbine

Inspection and replacement intervals for turbocharger components

(3) Checking intervals for the plain bearings in 1.000 h

(4) Replacement interval for the compressor wheel in 1.000 h
Unless otherwise stated: I00.000 h

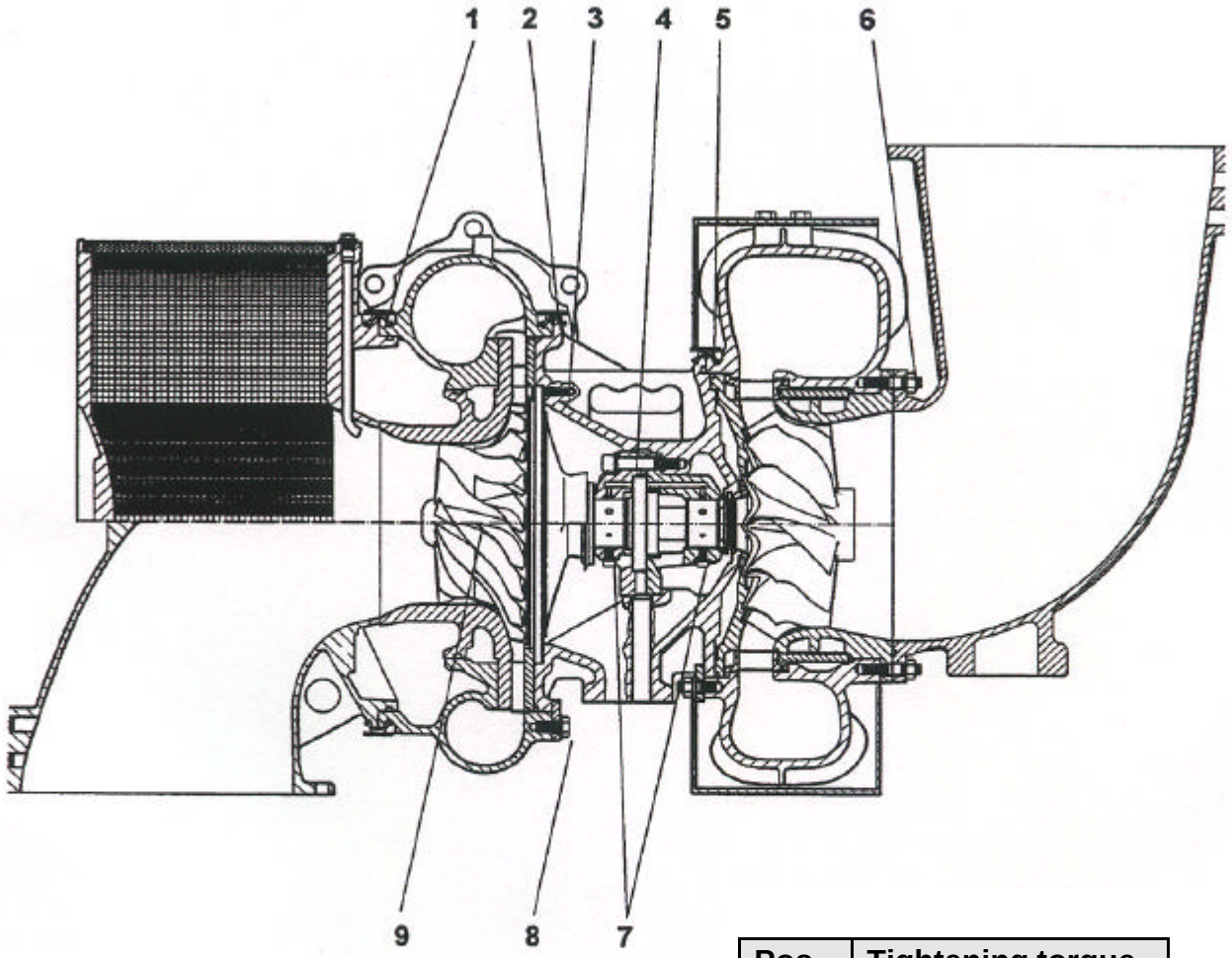
(5) Replacement interval for the bladed shaft in 1.000 h
Unless otherwise stated: 100.000 h

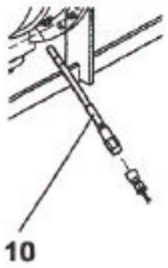
Further descriptions:

(6) Weight of the turbocharger in kg

(7) Space for the special design designation

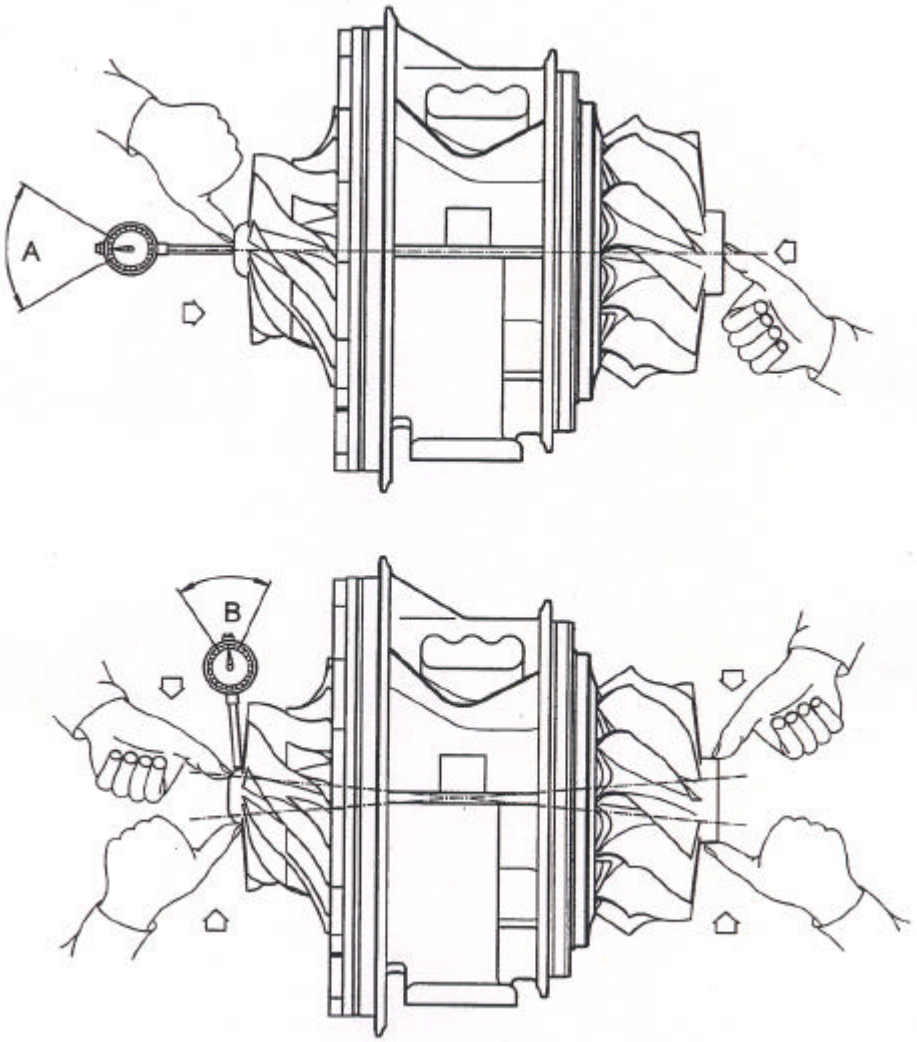
Tightening torque's, turbocharger ABB TPS 57





Pos	Tightening torque [TPS 57] in Nm
1	60
2	-
3	20
4	65
5	20
6	65
7	20
8	105
9	220
10	15

Axial and radial clearances, Turbocharger ABB TPS 57



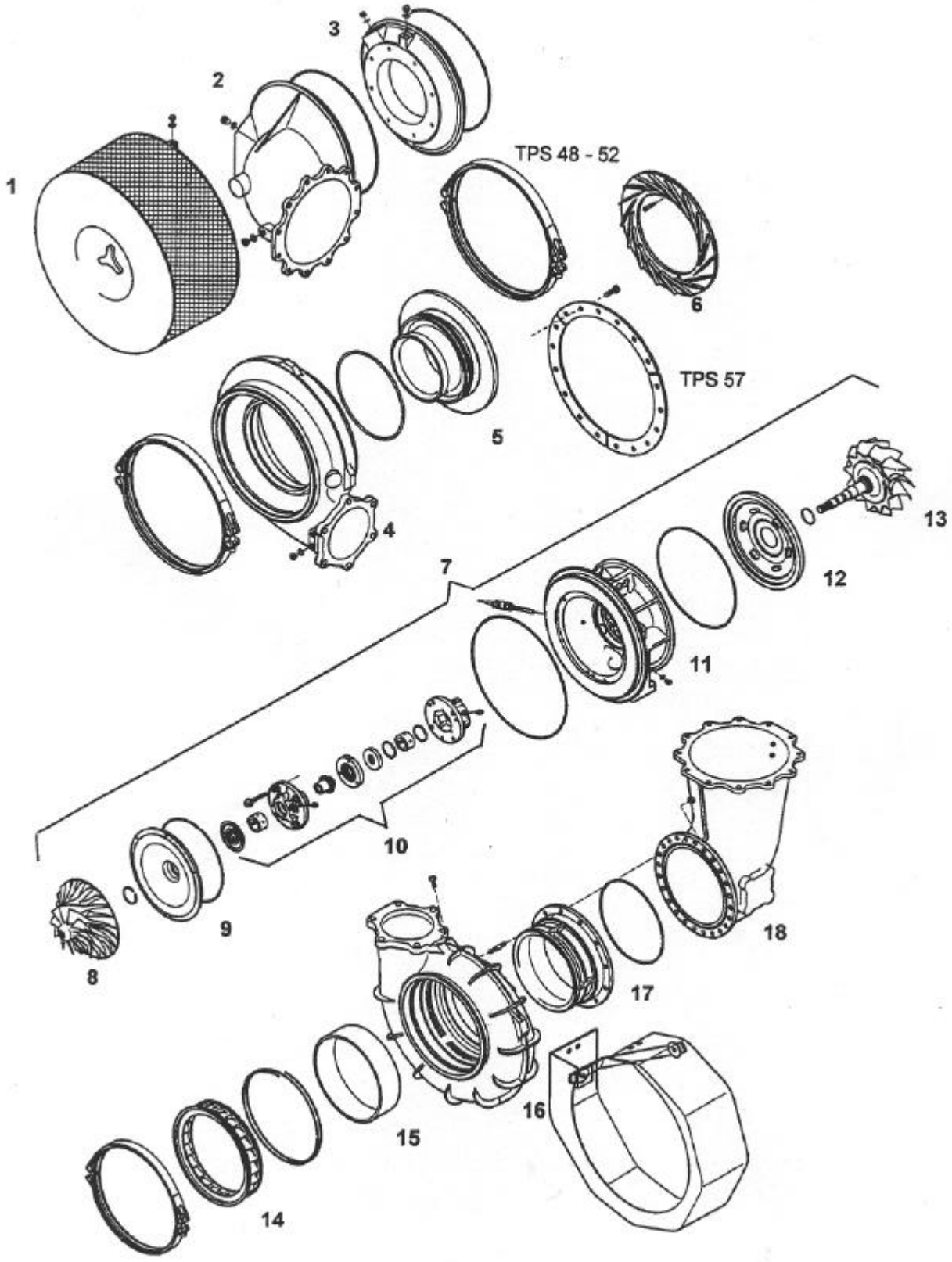
After removing and before fitting the cartridge group the axial clearance "A" and radial clearance "B" must be measured (see figure above)

The diffuser must be mounted and tightened to measure the clearances.
Raise turbine slightly for correct measurerment of axial clearance "A".

Clearance (mm)	TPS 57
A min.	0.12
A.max.	0.16
B min.	0.72
B max.	1.22

Note:
Measure and note the axial and radial clearances.
If the clearances are out of tolerance, disassemble and check the bearing parts and replace defective ones

Weight of assemblies Turbocharger ABB TPS 57



Weight of assemblies of TPS 57 turbochargers		
Position	**Designation**	**Weight in Kg**
1	Silencer	40
2	Air suction branch radial	11
3	Air suction branch axial	6
4	Compressor casing	51
5	Wall insert	18
6	Diffuser	5.5
7	Cartridge group	80.5
8	Compressor wheel	4.5
9	Bearing cover	6
10	Bearing parts complete	7.5
11	Bearing casing	42
12	Partition wall	7
13	shaft	13.5
14	Nozzle ring	3
15	Burst ring	4.5
16	Turbine casing with burst protection *)	65
17	Gas outlet flange	16
18	Gas outlet elbow	40
	Turbocharger complete **)	250

Note: *) Turbine casing with one entry.
**) Without silencer/air suction branch without gas outlet elbow.

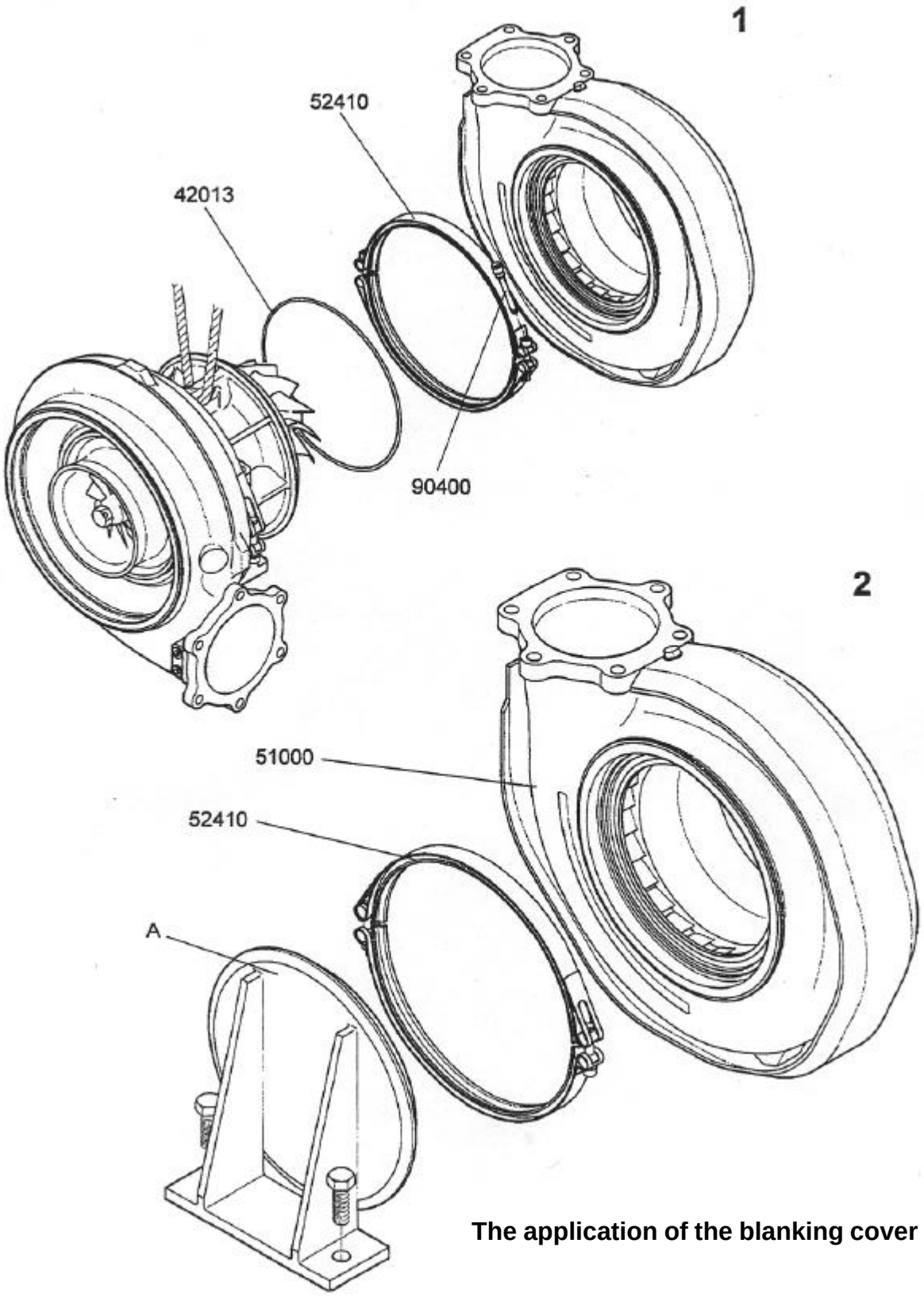
Emergency operation TPS 57

If, in case of a damaged turbocharger, the diesel engine can only be shut down for a short period for an emergency repair, then proceed as follows:

- eliminate damage with the available spare parts

  or

- fit the blanking device (see position "A" on next page)



The application of the blanking cover

1.6 CONTROL SYSTEM

There are two suppliers used for the governor and actuators in combination as mentioned in the table below.

Governors applied

Engine Type		Governor	Software	Material no.
L	Propulsion	RE-VIKING 22	V82-D2/D3/D4/D5	3001ZT114
	Power	RE-VIKING 22	V83-D2/D3/D4/D5/D6	3001ZT109
V	Propulsion	RE-VIKING 22	V82-D2/D3/D3/D5	3001ZT114
	Power	RE-VIKING 22	V83-D2/D3/D4/D5/D6	3001ZT109
	Power KW-Control	WOODWARD 721	8280-301	1)
	Power Droop/Isochronous Island mode Control	WOODWARD 721	8280-303	1)

1) No delivery of Wärtsilä Product factory.

Hand-held programmer

The instructions for proper use of the hand-held programmer see engine sub-suppliers manual.

Actuators applied

Engine type		Actuator	Ball-Head "back-up"	Acting*)	Material no.
L	Propulsion (Fixed prop)	RE-2231-1G-34T	Yes	Forward	3001ZT117
	Propulsion (CPP)	RE-2231-1G-34T	Yes	Reverse	3001ZT107
	Power	RE-2221-1G-34T	No	Forward	3001ZT108
V	Propulsion	RE-2231-1G-34T	Yes	Forward	3001ZT129
	Power	RE-2221-1G-34T	No	Forward	3001ZT108
	Power Speed control Power KW-Control Power Droop/Isochronous Island mode Control	WOODWARD PG-EG 58	No	Forward	3001ZT110

*) Forward acting means:

- ? Actuator position 0 is minimum governor output [mA].
- ? Actuator position 10 is max. governor output [mA].

In case of loss of digital governor:

- Actuator without mechanical back-up the engine stops.
- Actuator with mechanical back-up the engine will go to min speed.

Reverse acting means:

Actuator position 0 is max.governor output [mA].
Actuator position 10 is min. governor output [mA].

In case of loss of digital governor: actuator with mechanical back-up will go to nominal engine speed.

Settings

GENERAL: The settings of the specific governor with mentioned software are specified in the tables on the following pages.

Viking 22 (settings)

Blank fields are related to the engine power and speed. See manual VIKING 22 in engine Sub-supplier manual. Fields mark with * these settings must not be changed. Gray is Display (read only).

Viking 22 propulsion

Viking 22 Propulsion			V82
2 Speed setting menu			
1	Set speed	rpm	
2	Rated rpm	rpm	
3	Idle rpm	rpm	
4	Up ramp 1 /s	rpm/s	30
5	Up ramp 2 /s	rpm/s	15
6	Down ramp 1 /s	rpm/s	15
7	Down ramp 2 /s	rpm/s	30
8	Max. rpm	rpm	
9	Min. rpm	rpm	
10	Max. D rpm	rpm	
11	Min D rpm	rpm	
12	R1/R2 rpm	rpm	
13	Max rpm/mA	mA	20
14	Min rpm/mA	mA	4
3 Speed Control			
3.1 Dynamic Parameters 1			
1	Droop %	%	
2	Prop. gain		450
3	Deriv. gain		1600
4	Integ. gain		45
5	Deriv.brk		40*
6	Input.brk		3000*
7	Droop.brk		1*
3.2 Dynamic Parameters 2			
1	Droop %	%	
2	Prop. gain		450
3	Deriv. gain		1600
4	Integ. gain		45
5	Deriv.brk		40
6	Input.brk		3000
7	Droop.brk		1
3.3 Non-linear gain			
1	Data PT 0		0
2	Data PT 1		75
3	Data PT 2		150
4	Data PT 3		300
5	Data PT 4		400
6	Data PT 5		500
7	Data PT 6		600
8	Data PT 7		700
9	Data PT 8		800
10	Data PT 9		900
11	Data PT10		1000

3.4 Rpm variable gain 1			
1	Data PT 0		1000
2	Data PT 1		1000
3	Data PT 2		1000
4	Data PT 3		600
5	Data PT 4		300
6	Data PT 5		425
7	Data PT 6		550
8	Data PT 7		670
9	Data PT 8		825
10	Data PT 9		950
11	Data PT10		1000
3.5 Rpm variable gain 2			
1	Data PT 0		1000
2	Data PT 1		870
3	Data PT 2		790
4	Data PT 3		670
5	Data PT 4		550
6	Data PT 5		375
7	Data PT 6		200
8	Data PT 7		100
9	Data PT 8		0
10	Data PT 9		0
11	Data PT10		0
3.6 Load variable gain			
1	Data PT 0		1000
2	Data PT 1		1000
3	Data PT 2		1000
4	Data PT 3		800
5	Data PT 4		600
6	Data PT 5		4000
7	Data PT 6		200
8	Data PT 7		100
9	Data PT 8		1
10	Data PT 9		1
11	Data PT10		1
Fuel limit			
4.1 Boost fuel limit			
1	%Boost		
2	Data PT 0		4,5
3	Data PT 1		4,5
4	Data PT 2		5
5	Data PT 3		6
6	Data PT 4		7,1
7	Data PT 5		8,2
8	Data PT 6		9,3
9	Data PT 7		10
10	Data PT 8		11
11	Data PT 9		11
12	Data PT10		11
13	Max.bst/mA		12
14	Min.bst/mA		4

4

	4.2 Torque limit			
	1	Data PT 0		11
	2	Data PT 1		11
	3	Data PT 2		11
	4	Data PT 3		11
	5	Data PT 4		11
	6	Data PT 5		11
	7	Data PT 6		11
	8	Data PT 7		11
	9	Data PT 8		11
	10	Data PT 9		11
	11	Data PT10		11
	4.3 Additional fuel limit			
	1	%Add.		
	2	Data PT 0		11
	3	Data PT 1		11
	4	Data PT 2		11
	5	Data PT 3		11
	6	Data PT 4		11
	7	Data PT 5		11
	8	Data PT 6		11
	9	Data PT 7		11
	10	Data PT 8		11
	11	Data PT 9		11
	12	Data PT10		11
	13	Max.bst/mA		20
	14	Min.bst/mA		4
5	**System set up**			
	1	Ph1 rpm		
	2	Ph2 rpm		
	3	P1-P2 rpm		100
	4	brk count		10
	5	Id. hld. t/s		5
	6	Start FL		4,5
	7	Stop t/s		25
	8	Run rpm		80
	9	rpm Pt1		300
	10	rpm Pt2		
	11	Load Pt1		60
	12	Load Pt2		100
	13	Max load pos		10
	14	OP filter		20
	15	Tacho rpm		
	16	An set		0
	17	Alarm test		0

6	**Base set up**			
	1	Nom. rpm		
	2	Markers		
	3	Droop Null		0
	4	Act. mode		
7	**Load share**			
	1	LS stat		0,3
	2	Serial err.		
	3	GOV. no.		0
	4	LS config.		*
	5	Err count		10
	6	Integ. time		50
8	**I/O Calb/Test**			
	1			
	2			
	3			
9	**Configuration**			
	1	Engine type		
	2	Act. offset		
	3	Boost lim.		
	4	Add. lim.		
	5	Torque lim.		
	6	LVG prop.		
	7	LVG integ.		
	8	LVG deriv.		
	9	RPM VG2		

Viking 22 Power

VIKING POWER			V83
Software partnr.+rev. nr.			
2 Speed setting menu			
1 Set speed			
2	Rated rpm	rpm	
3	Idle rpm	rpm	
4	Delta rpm	rpm	
5	Up ramp 1 /s	rpm/s	30
6	Up ramp 2 /s	rpm/s	3
7	Down ramp 1 /s	rpm/s	3
8	Down ramp 2 /s	rpm/s	30
9	Max. rpm	rpm	
10	Min. rpm	rpm	
11	R1/R2 rpm	rpm	
3 Speed Control			
3.1 Dynamic Parameters 1			
1	Droop %	%	
2	Prop. gain		600
3	Deriv. gain		1600
4	Integ. gain		85
5	Deriv.brk		40
6	Input.brk		3000
7	Droop.brk		1
3.2 Dynamic Parameters 2			
1	Droop %	%	
2	Prop. gain		450
3	Deriv. gain		1300
4	Integ. gain		45
5	Deriv.brk		40
6	Input.brk		3000
7	Droop.brk		1
3.3 Non-linear gain			
1	Data PT 0		0
2	Data PT 1		100
3	Data PT 2		200
4	Data PT 3		300
5	Data PT 4		400
6	Data PT 5		500
7	Data PT 6		600
8	Data PT 7		700
9	Data PT 8		800
10	Data PT 9		900
11	Data PT10		1000

3.4 Rpm variable gain 1			
1	Data PT 0		1000
2	Data PT 1		1000
3	Data PT 2		1000
4	Data PT 3		600
5	Data PT 4		250
6	Data PT 5		450
7	Data PT 6		650
8	Data PT 7		800
9	Data PT 8		900
10	Data PT 9		1000
11	Data PT10		1000
3.5 Rpm variable gain 2			
1	Data PT 0		1000
2	Data PT 1		900
3	Data PT 2		800
4	Data PT 3		700
5	Data PT 4		550
6	Data PT 5		375
7	Data PT 6		200
8	Data PT 7		100
9	Data PT 8		0
10	Data PT 9		0
11	Data PT10		0
3.6 Load variable gain			
1	Data PT 0		1000
2	Data PT 1		1000
3	Data PT 2		1000
4	Data PT 3		800
5	Data PT 4		600
6	Data PT 5		400
7	Data PT 6		200
8	Data PT 7		100
9	Data PT 8		1
10	Data PT 9		1
11	Data PT10		1

4 Fuel limit

4.1 Boost fuel limit

1	%Boost		
2	Data PT 0		11
3	Data PT 1		11
4	Data PT 2		11
5	Data PT 3		11
6	Data PT 4		11
7	Data PT 5		11
8	Data PT 6		11
9	Data PT 7		11
10	Data PT 8		11
11	Data PT 9		11
12	Data PT10		11
13	Max.bst/mA		20
14	Min.bst/mA		4

4.2 Torque limit

1	Data PT 0		11
2	Data PT 1		11
3	Data PT 2		11
4	Data PT 3		11
5	Data PT 4		11
6	Data PT 5		11
7	Data PT 6		11
8	Data PT 7		11
9	Data PT 8		11
10	Data PT 9		11
11	Data PT10		11

4.3 Additional fuel limit

1	%Add.		
2	Data PT 0		11
3	Data PT 1		11
4	Data PT 2		11
5	Data PT 3		11
6	Data PT 4		11
7	Data PT 5		11
8	Data PT 6		11
9	Data PT 7		11
10	Data PT 8		11
11	Data PT 9		11
12	Data PT10		11
13	Max.bst/mA		20
14	Min.bst/mA		4

5 System set up

1	PH1 RPM		read only
2	PH2 RPM		read only
3	P1-P2 Rpm		100
4	No Of PHS		0,1
5	Brk.Count		10
6	Id.Hld.T/s		5
7	Start FL		4,5
8	Run RPM		200
9	Stop t/s		60
10	Alarm test		0
11	Set Rated		0,1

6 Base set up

1	Nom. rpm		1000
2	markers		
3	Droop Null		2
4	Act. mode		0,2

7 Load share

1	%kW load		
2	%kW mean		
3	%kW base		
4	%rack lim.		
5	LS stat		
6	Serial err.		
8	LS config.		0,1
7	GOV. no.		1 to *
9	Err count		10
10	Base ramp		10
11	Integ. time		25
12	Rack time		5
13	Rack limit		30
14	Load trip		5
15	Max//rpm		1100
16	Min//rpm		500
17	Droop sel		0
18	Max kW/mA		17,6
19	Min kW/mA		4
20	Max bl/mA		20
21	MinBl/mA		4
22	B.ramp On		0,1

8 I/O Calb/Test

1			
2			
3			

9	**Configuration**			
	1	Engine type		0,3
	2	Act. offset		0
	3	Boost lim.		0
	4	Add. lim.		0
	5	Torque lim.		0
	6	LVG prop.		0
	7	LVG integ.		0
	8	LVG deriv.		0
	9	RPM VG2		0

Woodward 721

Blank field are related to the engine power and speed. See manual WOODWARD 721 in engine Sub-supplier manual. Gray is Display (read Only).

Woodward 721 KW Control

721 KW Control				
Software partnr.+rev. nr.				
1	**Speed sensors**			
	1	Pulse/rev #1		286
	2	Maximum Hz #1		5900
	3	Low setpoint #1	rpm	10
	4	Pulse/rev. #2		286
	5	Maximum Hz #2		5900
	6	Low setpoint #2	rpm	10
	7	Override speed	rpm	100
2	**Engine speed**			
	1	Idle speed	rpm	600
	2	Rated speed	rpm	
	3	overspeed trip	rpm	
	4	Speed o/p @ 20 mA	rpm	1200
3	**Final driver**			
	1	Reserve acting		FALSE
4	**Engine load**			
	1	Rated load	kW	
	2	Maximum load	kW	
	3	KW @ 20 mA		
	4	KW meter @ 20 mA	kW	
5	**KW control**			
	1	Monitor grid status		TRUE
	2	Remote ref @ 4 mA	kW	0
	3	Remote ref @20 mA	kW	
	4	Rem ref meter @ 20 mA	kW	
	5	Load limit/kW ref		

6	**Fuel limiters**			
	1	Frequency 60 Hz?		
7	**Configure**			
	4	Enable setpoints		TRUE
	5	Enable calibration		FALSE
8	**Display menu**			
	1	Engine speed	rpm	
	2	Speed reference	rpm	
	3	Actuator position	%	
	4	KW load		
	5	Load reference	kW	
	6	Remote reference	kW	
	7	mA remote I/P		
	8	mA load I/P		
9	**Dynamics #1**			
	1	Gain 1		2
	2	Reset 1	s	1,5
	3	Act compensation 1	s	0,15
	4	Error window 1	rpm	25
	5	Gain ratio 1		1,5
	6	Gain slope		0
	7	Gain breakpoint	%	100
	8	Dyn select delay	s	0,2
10	**Dynamics #2**			
	1	Gain 2		2
	2	Reset 2	s	1,5
	3	Act compensation 2	s	0,15
	4	Error window 2	rpm	25
	5	Gain ratio 2		1,5
11	**KW dynamics**			
	1	Proprtional gain		0,1
	2	Integral gain	s^{-1}	0,4
	3	S.D.R.		15
12	**Limiter dynamics**			
	1	Proprtional gain		1
	2	Integral gain	s^{-1}	1
	3	S.D.R.		6
13	**Engine speed**			
	1	Speed filter	Hz	6,25

14	Speed reference		
1	Minimum speed	rpm	550
2	Maximum speed	rpm	
3	Acceleration rate	rpm/s	20
4	Synchronising rate	rpm/s	1
5	Raise speed rate	rpm/s	2
6	Lower speed rate	rmp/s	2
7	Idle/Rated switch	rpm	550
8	Synchroniser gain		2
9	Reference stability	s	0,5
10	Speed offset	rpm	2
11	Speed transfer rate	rpm/s	50
12	Speed track window	rpm	1
13	Tracking rate	rpm/s	5
15	**Start/Stop**		
1	Rundown time	s	20
2	Pulse alarm?		FALSE
3	Alarm pulse time	s	1
16	**KW control**		
1	Raise load rate	kW/s	50
2	Lower load rate	kW/s	50
3	Auto load rate	KW/s	75
4	Auto unload rate	KW/s	50
5	Unload trip level	kW	50
6	KW offset	%	5
7	KW transfer rate	kW/s	50
17	**Engine load**		
1	Droop	%	5
2	No load act %		20
3	Full load act %		80
4	KW filter	Hz	3,5
5	Load rej level	%	300
5	Load rej period	s	0,25
6	Minimum load level	kW	0
18	**Fuel limiters**		
1	Start fuel limit	%	50
2	Fuel limit switch	rpm	800
3	HS bandwidth	Hz	1
4	LS bandwidth	Hz	1
5	High limit	Hz	56
6	Low limit	Hz	53
19	**Calibration**		
1	Remote I/P offset		-0,04
2	Remote I/P gain		1
3	Load i/p offset		-0,04
4	Load i/p gain		1

20	Contacts/Relays		
1	Input A Closed		
2	Input B Closed		
3	Input C Closed		
4	Input D Closed		
5	Input E Closed		
6	Input F Closed		
7	Input G Closed		
8	Input H Closed		
8	Output #1 energised		
10	Output #2 energised		
11	Output #3 energised		
12	Alarm #1 LED		
13	Alarm #2 LED		
21	**Common alarm**		
1	Overspeed		
2	Both sensors failed		

Woodward 721 droop/isochronous

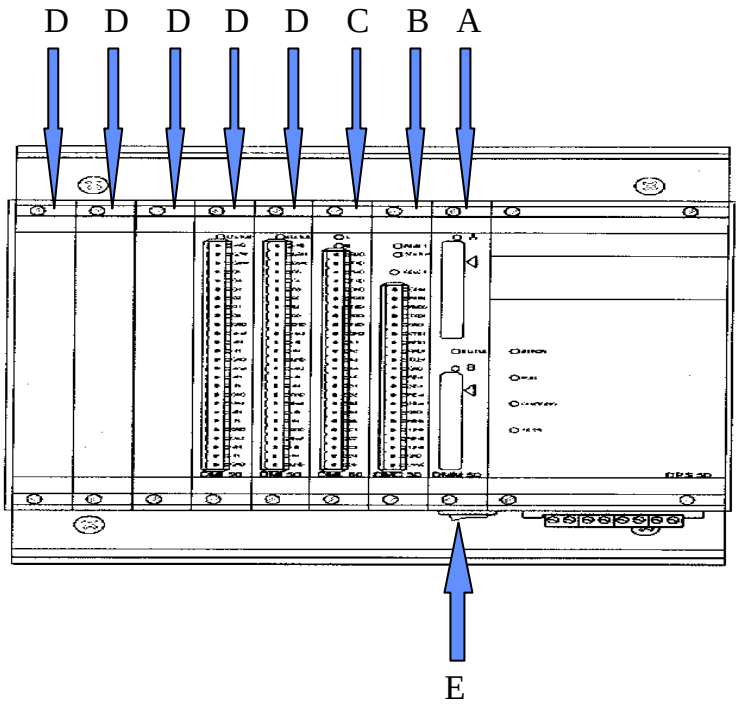
WOODWARD 721 Droop/isochronous		
Software partnr.+rev. nr.		
1 Speed sensors		
1 Pulse/rev #1		286
2 Maximum Hz #1		6197
3 Low setpoint #1	Rpm	53
4 Override speed #1	Rpm	73
5 Minimum speed #1	Rpm	84
6 Pulse/rev. #2		286
7 Maximum Hz #2		6197
8 Low setpoint #2	rpm	53
9 Override speed #2	rpm	73
10 Minimum speed #2	rpm	84
11 Two speed sensors?		FALSE
2 Engine speed		
1 Idle speed	rpm	550
2 Rated speed	rpm	
3 overspeed trip	rpm	
4 Torsional filter?		FALSE
5 Auto ramp to rated?		TRUE
6 Speed o/p @ 4 mA	rpm	0
7 Speed o/p @ 20 mA	rpm	1200

3 Final driver			
1 Reserve acting			FALSE
4 Engine load			
1 Rated load		kW	
2 KW @ 4 mA			0
3 KW @ 20 mA			6000
4 Brkr open CMD NC?			FALSE
5 KW output @ 20 mA			6000
5 Fuel limiters			
1 Man pressure @ 4 mA		bar	0
2 Man pressure @ 20 mA		bar	4
6 Configure			
1 Disable air i/p			TRUE
2 Disable load i/p			FALSE
3 Disable synch			FALSE
4 Enable setpoints			TRUE
5 Enable calibration			FALSE
8 Dynamics #1			
1 Gain 1			1,13
2 Reset 1		s	0,2
3 Act compensation 1		s	2
4 Error window 1		rpm	100
5 Gain ratio 1			1
6 Dyn select delay		s	2,5
9 Dynamics #2			
1 Gain 2			1,96
2 Reset 2		s	0,11
3 Act compensation 2		s	1,6
4 Error window 2		rpm	25
5 Gain ratio 2			2
6 Gain 2 multiplier			1
8 Min gain multiplier			1
9 As above			1
10 Load brpt #1			0
11 Load brpt #2			100
10 Engine speed			
1 Speed filter		Hz	16
2 PID filter		Hz	5
3 Sensor weight			0,5
11 Speed reference			
1 Minimum speed		rpm	
2 Maximum speed		rpm	
3 Accel/Decel rate		rpm/s	30
4 Idle/Rated switch			450
5 Inc/Dec rate #1		rpm/s	1
6 Inc/Dec rate #2		rpm/s	1
7 Synchroniser Gain			2

12 Start/Stop			
1 Rundown time		s	10
2 Pulse/Cont alarm?			FALSE
3 Alarm pulse time		s	1
13 Load sharing			
1 LS error %			2
2 Load gain			5
3 Auto load rate		KW/s	30
4 Emergency load rate		KW/s	50
5 Auto unload rate		KW/s	100
6 Unload trip level		KW	100
14 Engine load			
1 Droop		%	4
2 No load act %			20
3 Full load act %			80
4 KW filter		Hz	1
5 Load rej level		%	50
6 Load rej period		s	0,02
15 Fuel limiters			
1 Start fuel limit			55
2 Maximum fuel limit			100
3 Manifold pressure A			0
4 Actuator % A			50
5 Manifold pressure B			1
6 Actuator % B			50
7 Manifold pressure C			3
8 Actuator % C			100
9 Manifold pressure D			4
10 Acuator % D			100
16 Calibration			
1	Air i/p offset		Preset
2	Air i/p gain		Preset
3	Load i/p offset		Preset
4	Load i/p gain		Preset
5	LS lines offset		Preset
6	LS lines gain		Preset
7	LS load offset		Preset
8	LS load gain		Preset

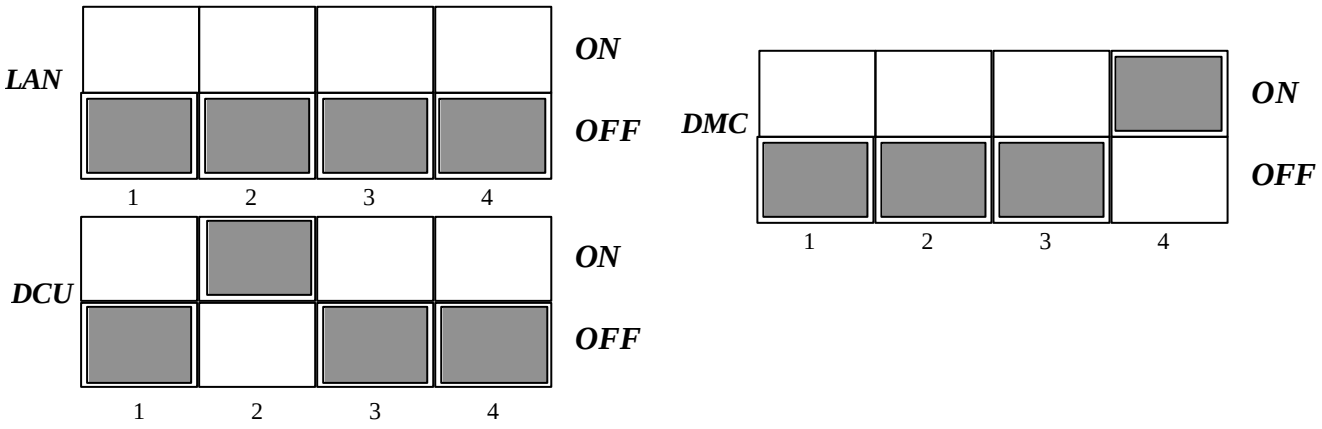
1.7 WECS 2000

WECS 2000 overview



A = DMM 50 = Memory Board
B = DMC 50 = Processor Board
C = DML 50 = LAN Board
D = DMI 50 = Interface Boards
E = ON/OFF =Switch for MCU power supply

Standard DIP-switch settings for DCU-,DMC- and LAN-Board :



WECS 2000 Software operating instructions

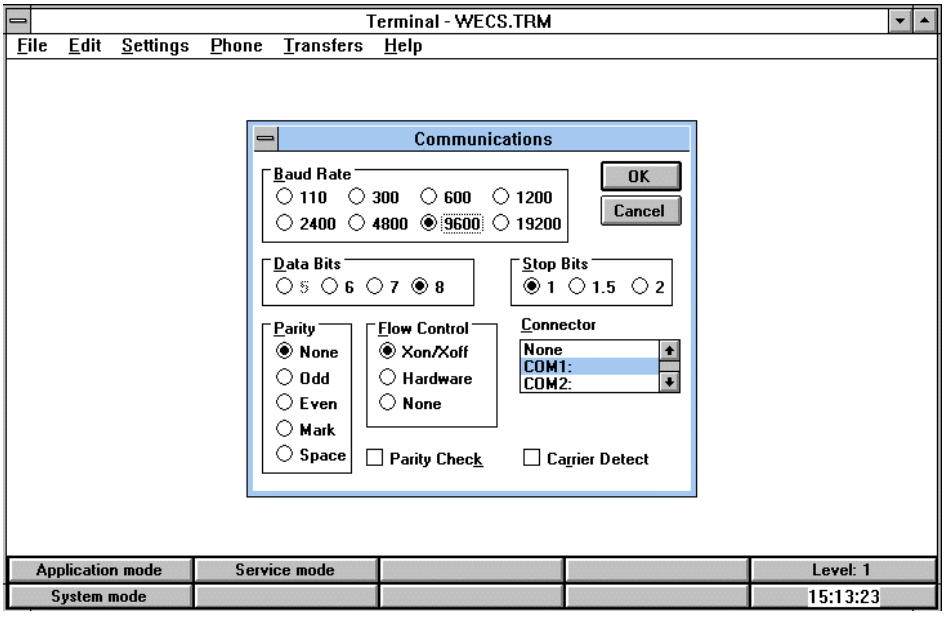
WECS-Terminal program :

- Start the WECS-Terminal program on the Service PC
- If the “WECS” icon doesn’t work, start the program using “terminal.exe” with “wecs.trm” as parameter. (“Wecs.trm” has to be in the same directory as “terminal.exe”)
- The buttons on the bottom off the screen give a complete sequence of commands for specific modes of the WECS system.

Checking communications settings

- Move the pointer to “Settings” on the menu-bar and click once to open the drop-down menu
- In the drop-down menu select “communications” and click the mouse-button once
- In the “Communications”-window you can change the communication settings. The following parameters has to be set for the communication between Service PC and WECS :

After checking the settings, choose “OK” in the communication window.



Installing system software

Processor Board (DMC 50 system software DMC 1.**.**) :

- Locate the plug containing the connecting pins 6-10 on the Processor Board
- Connect the Maintenance Terminal (laptop) to this plug with the serial cable
- Start the WECS terminal program. (Leave the system in ***application*** mode).
- Check to ensure that the SRAM card is write protected
- Place the appropriate SRAM-card in the lower slot of the Memory Board (pink side to the right).
- Push the RESET-switch on the Processor Board with a small (< 3 mm) cylindrical object and hold this switch until the yellow STATUS-LED on the Memory Board lights up. This will take about 10 seconds.
- When the data transfer is activated the WECS will emit a beep at a few seconds interval. The activity during the data transfer can be monitored on the screen of the Maintenance Terminal.

- **NOTE : If there is <u>no</u> activity shown on the Terminal-display, press the ENTER-button on the PC-keyboard twice.**

- Wait until the following text will appear on the screen :
  Copying ready.
  Remove loader card and reset system

- Remove the SRAM-card from the lower slot on the Memory Board.
- Disconnect the serial cable.
- RESET the WECS by turning the power OFF and ON or by short-pressing reset-switch on the Processor Board.
- Close WECS terminal program.

LAN Board (DML 50 system software DM 1.05.).**

- Connect the serial cable to pins 6-10 on the Processor Board to enable communication with the Terminal PC (laptop).
- Start the “WECS-terminal program” on the Service PC.
- Click on “SERVICE MODE”-button.
- Wait until “SERVICE .” prompt appears.
- Insert the SRAM-card with the proper software version into the lower slot of the Memory Board (pink side to the right). The red SRAM-LED will flash.
- Click on ”DML50 PROGRAM”.
- The SRAM-control LED will now flash continuously. During the data-transfer the red ‘B’-LED on the LAN-Board must be ON.
- The data on the SRAM-card is now being copied to the MCU.
- The text on the screen will end with “copying ready”.
- Wait until the “service>“ prompt appears on the screen.
- Remove the SRAM-card
- Type ‘SYSTEM START’ and press the ENTER-key or click on “start system”
- Wait until the ‘B’-LED on the LAN-Board distinguishes
- Remove the serial communication cable

If there is a problem, like not acceptation of “DML50 PROGRAM” use the following steps.

- Turn off the power by pressing the switch (E) which is located on the bottom of the MCU-cabinet (See page 1).
- Locate the LAN-Board in the WECS-cabinet
- Remove the LAN-Board from the cabinet
- Locate the DIP-switches on the LAN-Board
- Slide DIP-switch #2 on the block of 4 switches to the ON-position. See page 1 for standard DIP-switch settings.
- Replace the LAN-Board into its slot
- Turn the MCU ON.
- Proceed as described before, starting with: • Click on ”DML50 PROGRAM”.
- Turn the power supply of the MCU OFF
- Remove the LAN - Board
- Turn the DIP-switch #2 back to the OFF-position
- Replace the LAN-Board
- Remove the serial communication cable
- Turn the WECS ON

DCU. (DCU system software DCU 1.**.**)

- Connect the Maintenance Terminal to the pins 60-62 on the DCU-Board using the serial communication cable.
- Start the Terminal program on the Service PC. for communication between DCU and SMU.
- Locate the DIP-switches on the DCU-Board
- Turn DIP-switch #3 to the ON position. See page 1 for the standard DIP-switch settings.
- While pressing the RESET-button insert the SRAM-card containing the DCU-system software into the SRAM-slot on the DCU-Board.
- Release the RESET-button
- The orange ‘Flash’ LED on top of the DCU-cover will be on during the transfer of the system software
- Wait until LED distinguishes.
- Remove the communication cable
- Remove the SRAM-card from the DCU
- Slide DIP-switch #3 to the OFF position
- RESET the DCU by short pressing the RESET-switch on the DCU-Board
- The system software is now being loaded to the DCU

All the system software is now installed into the WECS.

Installing the configuration software

Configuration includes all the in formation that WECS needs of the sensor and device settings, command sets, measuring algo-rithms, calculations and report formats. The configuration is based on configuration files that can be created and modified in separate ways: by using Your Way configuration tools, text editor or CONWECS configuration program. These three ways of making configuration files differ a lot from each other. There is an instruction delivered with the CONWECS program, therefore CONWECS will not be introduced here. Knowledge of programming language structure or syntax is not required with any of those three methods of creating configuration files.

Compiling the configuration files to the SRAM-card.

Make sure the configuration software has been copied from the Service PC to the SRAM-card. If this is not the case, follow the subjoined 10 points.

- Place a SRAM-card into the SRAM-slot on the Service PC.
- Open the File Manager of Windows and activate the directory containing the configuration files for the specific unit (mcu, dcu 1 or dcu2)
- Select the file CO*.BAT and double click on this file or press the ENTER-key
- If the PC is correctly configured, the monitor will display a number of messages, starting with compiling results. It is important to check that there are no error messages. This process will pause with the message :

“Press CTRL-C if compiling didn’t succeed”

- Press the ‘SPACE-BAR’
- Then Results of copying to the SRAM card will be displayed ending with the following message :

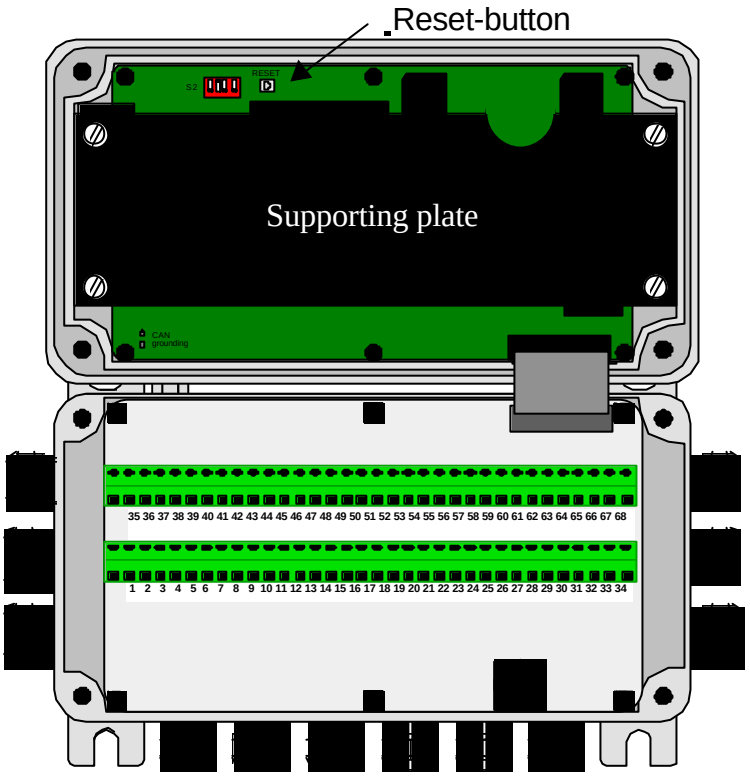
“Press CTRL-C if you don’t want to delete the produced binaries”

- Press the ‘SPACE BAR’ again
- Select in the File Manager of Windows the SRAM drive letter
- A file list of the contents of the SRAM-card will be displayed. There should be a number of file names displayed with today’s date and current time.
- Remove the SRAM-card from its slot.

Installing the configuration files to the DCU.

- Open the appropriate DCU-box, and remove supporting plate.
- While pressing the RESET-button on the DCU-Board insert the SRAM-card into the SRAM-slot on the DCU-Board
- To observe proper loading activity, WECS maintenance terminal can be connected.
- Check cover for the yellow Flash LED to be active for a few seconds and check that the CAN-LED is active again and the Status-LED is pulsating.
- Remove SRAM-card.
- Replace supporting plate and close DCU-box.

DCU



Installing configuration software to the MCU

- Make sure that the appropriate configuration files are present on a SRAM-card.
- Put the SRAM - card into the lower slot of the Memory Unit.
- Reset the WECS by pressing the reset-switch shortly.
- To observe proper loading activity, WECS maintenance terminal can be connected.
- When the SRAM-light has distinguished, remove the SRAM-card
- Reset the WECS again.
- The MCU-configuration software is now loaded.

The configuration of the SMU and DCU :

WARNING !!!

Before changing any data files make a backup of these files. For example : A data file applicable to a SMU is called MPX2.CFG.
Before editing this data-file copy the file to another name with the DOS-command :
copy mpx2.cfg mpx2-1.cfg
In this way there will always be an original data file available in case of emergency.

For editing an SMU file you can use an (ASCII-) text editor.
Use for DOS the command 'EDIT' and use for Windows the program 'Notepad'

Example of a typical SMU-configuration data file :

```
=B19200
=X111
=L3
=P3
=F5
=U2;SMU1-2 [MAR-PROP = 06TAFxxx]
=S1,00:00:00,100,25;
:r,2,TE705;0,0,1,0,160,1,1,1,0,0,100,110,105,10,1 0TK(G2)
:r,2,TE706;0,0,1,0,160,1,1,1,0,0,100,110,105,10,1 2TK(G2)
:r,2,TE707;0,0,1,0,160,1,1,1,0,0,100,110,105,10,1 4TK(G2)
:r,2,TE541A;0,0,1,0,800,50,1,1,0,0,490,,520,10,1 6TK(G2)
:r,2,TE542A;0,0,1,0,800,50,1,1,0,0,490,,520,10,1 8TK(G2)
:r,2,TE551A;0,0,1,0,800,50,1,1,0,0,490,,520,10,1 1TK(G2)
:r,2,TE552A;0,0,1,0,800,50,1,1,0,0,490,,520,10,1 3TK(G2)
:r,2,TE561A;0,0,1,0,800,50,1,1,0,0,490,,520,10,1 5TK(G2)
:r,2,TE562A;0,0,1,0,800,50,1,1,0,0,490,,520,10,1 7TK(G2)
:b,2,LS103A;0,0,1,0,1,0,3,0,0,0,1,,,1,1 9ASW
:r,2,TE841;0,0,1,-50,160,10,1,0,0,0,65,,,1,1 TIN

=END
```

Explanation of the configuration DCU/SMU (Example)

B19200	Baud rate (communication speed)
X111	File serial number
L2	Denotes how many times the parameters may be loaded
P2	Specifies how many polling tries are allowed
F10	Specifies the number of allowed polling failures
U2	Identification number of the DCU/SMU
S1	Specifies the sequence ID.
00:00:00	Synchronisation time
100	Specifies at what interval the measurement should be taken. The interval is specified in hundredth of a second.
20	Polling delay The polling delay is specified in hundredth of a second.

:r,2,T706;0,0,1,-90,1000,100,1,0,0,0,560,600, 550,0,1 0TK

:r	r=real (value) b=byte (switch)
2	2=measured value 3=calculated value
T706	Sensor code number
0	Calibration value, default = 0 range of the valid values is 0 to 2
0	Scaling factor (So) or offset. Default = 0
1	Scaling factor (S1) or gain. Default = 1
-90	Minimum value (4 mA), this value is 0 at switch signal (byte)
1000	Maximum value (20 mA), this value is 1 at switch value (byte)
100	Maximum difference between two measurements value 0 means not active
1	0 = no alarm signal 1 = alarm at maximum value 2 = alarm at minimum value 3 = alarm when switch = "ON" 4 = alarm when switch ="OFF"
0	0 = always give alarm 1 = only give alarm when motor is running
0	Time delay for activating alarm when starting-up the engine.
0	Missing check. In case there is no incoming signal : 0 = engine keeps running 1 = engine shut down
560	Alarm value Always fill in this value
600	Shutdown alarm value It is not necessary to fill in this value
550	Request for power reduction It is not necessary to fill in this value
0	Request for power reduction 0 = not active 1 = send request for power reduction 10 = send request for power reduction. If no power reduction within 180 sec, then engine shutdown
1	Update divider 1 = update database with every alarm check 100, 0.1 = update database after every 10 alarm-checks
0TK	Channel and sensor identification

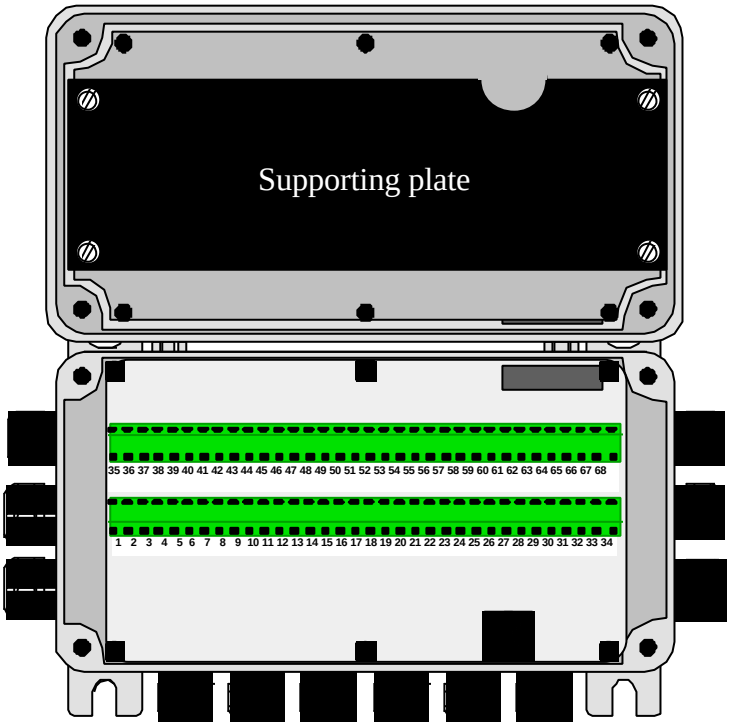
ID-Setting of the smu

Tool needed SMU ID Transceiver 8203ZT222

- Remove the connector pins 31/32 on the SMU board
- Connect the program module to connector pins 65-68. The display on the module will first display an ‘L’. After a few seconds the current SMU-ID number will be displayed.
- You can now select the desired ID-number by pressing the ↑ or the ↓ button on the programming module
- When the required ID-number is displayed, press the ENTER button. While transmitting the new ID-number, the display will show an ‘L’. If an error occurs, the display will show an ‘E’.
- Disconnect the programming module and reinstall the connector to pins 31/32
- Press the RESET button on the DCU.

The SMU - identification number has now been set.

SMU



Relay module

The relay has no processor or software. The relay module is a totally hardware driven unit.

The relay module consists of the following functional blocks:

1. Speed measuring.
2. Luboil shutdown.
3. Optional shutdown.
4. MCU stop/shutdown.
5. Hardwired stop.
6. Overspeed shutdown.
7. Emergency stop.
8. MCU watchdog.
9. Stop/shutdown override.
10. Shutdown reset.
11. Stop.
12. Hardwired start.
13. MCU start.
14. Fuel limiter.
15. Slow turning.
16. Failure.
17. Power supply.

Jumpers relay module

JP1: ON when using NC luboil switch.
OFF when using NO luboil switch.
JP2: OFF Disable MCU watchdog
JP3: ON when override function excluded
OFF when override function included
JP4: ON when speed signal 0-10 Volts.
JP5: ON when speed signal 4-20 mA.
JP6: ON when frequency range 0-1100 Hz.
OFF when frequency range 0-500 Hz.
JP7: ON when NO type emergency stop.
JP8: ON when NC type emergency stop.

Note: only one of the jumpers JP7 or JP8 can be switched ON.

Settings and indicators relay module.

Jumper settings of the relay module			
JP1	Closed		
JP2	Closed		
JP3	Open		
JP4	Closed **0-10 V**	JP4	Open
JP5	Open	JP5	Closed **4-20 mA**
JP6	Open		
JP7	Closed		
JP8	Open		

Trimmers relay module.

Trimmer	Scale	Scale	Function
RT 1	0-10 V	500/1100 Hz	Engine speed range
RT 2	0-5 V	250/550 Hz	Speed limit for blocking luboil pressure shutdown when starting.
RT 3	0-5 V	0-10 sec	Delay for blocking oil pressure shutdown when starting
RT 4	0-10 V	0-10 sec	Overspeed shutdown
RT 5	0-10 V	500-1100 Hz	Speed switch 1 300 rpm
RT 6	0-10 V	500-1100 Hz	Speed switch 2 500 rpm **Marine**
RT 6	0-10 V	500-1100 Hz	Speed switch 2 750 rpm **DPP**

Formula:

Frequency (Hz)= (RPM/2) x (number of teeth/60)

Note: number of teeth (camshaft wheel) on 26 engine is 46.

Settings relay module W26.

Note: The settings can deviate per installation, specific settings can be found in a form called " Record relay module tuning " ; see chapter 2.3 page 17.

Trimmer		setpoint
Engine speed	0-1200 rpm	0-460 Hz
Luboil blocking setpoint	300 rpm	115 Hz
Luboil blocking delay	10 sec	10 sec
Overspeed stop setpoint	1180 rpm	452.3 Hz
Speed switch 1	300 rpm	115 Hz
Speed switch 2 **marine**	500 rpm	192 Hz
Speed switch 2 **DPP**	750 rpm	287,5 Hz

Setting procedure of trimmer relay module.

Note: Before you start see the **record relay module setting** for the exact settings.

RT 1.

1. Connect Unomat on R2 (-) and R3 (+).
2. Increase overspeed setting by adjusting the RT4 a 10 turns to the right (trimmer delay time).
3. Set the Unomat on 460 Hz with and amplitude of 12 Volts
4. Connect the multimeter on R54 (-) and R55 (+) and adjust the setting of P1 for a reading of 10 volts or 20 mA.

   0 Hz = 00,00 VDC --> 0 rpm.
   460 Hz = 10,00 VDC --> 1200 rpm --> 20 mA.
   230 Hz = 05,00 VDC --> 600 rpm -->.12.3 mA

5. Check the speed pulse on R 56 referred to R 37.

RT 2. Luboil blocking < 300 rpm.

1. Adjust RT3 10 turns to the left (timer delay). At the end you will observe some clicks.
2. Put the Unomat on 115 Hz.
3. If the yellow led (luboil pressure blocking) is burning, adjust P2 slowly to the left till the led is out,
4. Check the setting for the second time by setting the unomat from 100 Hz till 115 Hz (115 Hz is 300 rpm).

RT 3. Delay time luboil blocking.

Delay time luboil blocking on 10 seconds.

1. Turn RT3 a few times to the right.
2. Unomat on 200 Hz (far above the 115 Hz)
3. Take out the + pin from the Unomat.
4. Connect the + pin to the Unomat and count the time till the yellow luboil shutdown led is out. time < 10 sec --> adjust P3 to the right
   time > 10 sec --> adjust P3 to the left
5. Put the setting of RT3 on 10 seconds.

RT 4. Overspeed stop.

1. Be sure that the red overspeed led is out. Reset with local shutdown reset.
2. Put the Unomat on 452.3 Hz (1000 rpm engine) and screw the RT 4 till the red led is burning. Overspeed is 118% nom..
3. Put the Unomat on 440 Hz, and adjust RT 4 and press local shield the reset button. Check the setting by increasing to 1180 rpm=452.3 Hz.

RT 5. Speed switch 1.

1. Speed 1300 rpm-->115 Hz
2. Put the Unomat on 115 Hz and turn RT5 till the yellow speed switch 1 led is burning.
3. Check the setting by increasing to 300 rpm=115 Hz.

RT 6. Speed switch 2.

1. Put the unomat on 192 or 288 Hz and adjust RT6 till the yellow speed switch led is burning.
2. Check the setting by increasing to 192 Hz=500 rpm or 288 Hz=750 rpm.

Note: Seal the trimmers with a drop of lacquer after setting the relay module.

Check of Backup Engine Speed value in WECS LDU

Check correct display of Engine speed backup (ST174) in appropriate screen of de LDU of the WECS (Board 2)

Wärtsilä NSD Nederland B.V.
ZWOLLE - HOLLAND

RECORD RELAY MODULE TUNING

Subtitle	Product	Made	99.03.11	CVD	Page	Document No.	REV.
STANDARD SETTINGS	26A	Apprvd	99.03.11	CVD	1	RMSET26A.xls	a

RM serial number	Engine specification number	Installation name

Engine type	Engine number	Wiring diagram number	Revision
Wärtsila 26		9510ZT2..	

PIN HEADERS

JP1 not engaged		
JP1 engaged	X	
JP2 not engaged		
JP2 engaged	X	
JP3 not engaged		
JP3 engaged	X	
JP4 not engaged	X	
JP4 engaged		
JP5 not engaged		
JP5 engaged	X	
JP6 not engaged	X	>>
JP6 engaged		>>
JP7 not engaged		
JP7 engaged	X	
JP8 not engaged	X	
JP8 engaged		

POTENTIOMETERS

RT1	0	Hz (0) rpm	4,00	mA	
	460	Hz (1200) rpm	20,00	mA	
RT2	115	Hz (300) rpm	8,00	mA	Lube oil blocking
RT3	10	sec.			Lube oil blocking delay
RT4	452	Hz (1180) rpm	19,73	mA	Overpeed back-up
RT5	115	Hz (300) rpm	8,00	mA	Running signal
RT6	440	Hz (1148) rpm	19,30	mA	Overspeed signal

LINEARISATION

C1	10 nF	X	(default value)
C1	4,7 nF		

LUBRICATING OIL SHUTDOWN DELAY

10 uF capacitor between pins 5 and 11 of integrated circuit IC3 [ ]

FAILURE ALARM OUTPUT

K10/10 - R30 cut [ ] K10/8 - R30 connected [ ]

STOP/SHUTDOWN OUTPUT

K5B/10 - R35 cut [ ] K5B/8 - R35 connected [ ]

Date	Name	Company

2.3 RUNNING IN

Running-in program W26.

Running-in.
Running-in of the engine should be done after an engine overhaul or maintenance on main engine components like bearings, liners, piston/rings etc.

1) Running-in preparation.
Start the pre-lubrication pump and check if all bearings, pistons, liners, rocker arms and gearwheels are lubricated, in particular the components that have been in maintenance.

2) Running-in first check:
Run the engine at idling speed for maximum 5 minutes.

1. Check after starting:
   - external leakages
   - pressures
   - temperatures
   - strange sounds
   - fluid levels

2. Check at idling speed, all cylinders on combustion, indicated by an increased exhaust gas temperature.

3. After two to five minutes running
   - Stop the engine.
   - Open the crankcase covers (**see note)**.

   Note: Removing the crankcase covers immediately after the stop is only allowed for the normal test running inspection after max. five minutes running, otherwise wait for at least 15 minutes.

4. Feel bearing / bearing cap temperatures by hand or check the temperature by infra-red thermometer, in particular the bearings that have been in maintenance.

5. Check main- and connecting rod bearing visually (position and bearing edges) .

6. Check if the connecting rod big-ends move easily in axial direction.

7. Inspect liners and pistons for normal running pattern from the crankcase side and check the bottom part of the cylinder liners for water leakage.

3) Running-in procedure.

The running in procedure is mainly intended for running in of piston rings and liners.

For a good running in of engine parts like piston rings / cylinder liners it is important to vary regularly the load and r.p.m.. Increase load and r.p.m. slowly in time.
The running-in procedure should preferable be performed on distillate fuel.
If after a complete overhaul the program can not be followed, load the engine slowly in time and do not load the engine fully for at least 8 hours.

Below you will find a guideline for running in:

	Time		DPP / CPP		FPP (marine)	
Step	t (min)	t (cum. hr)	n %	P %	n %	P %
1	5	0:05	40	0	35	0
2	5	0:10	50	0	50	0
3	5	0:15	75	0	35	0
4	10	0:25	100	10	50	15
5	10	0:35	100	20	60	20
6	40	1:15	100	40	75	40
7	5	1:20	100	5	50	15
8	40	2:00	100	60	85	60
9	5	2:05	100	5	50	15
10	40	2:45	100	75	90	75
11	5	2:50	100	5	50	15
12	40	3:30	100	85	95	85
13	5	3:35	100	5	50	15
14	40	4:15	100	95	98	95
15	5	4:20	100	5	50	15
16	30	4:50	100	100	100	100

Vibrations

Values & units

Vibration readings taken should always be expressed in:

- velocity-rms = v(rms) [mm/s] and for turbocharger also in
- acceleration-rms = a(rms) [m/s ^{2}]

Frequency range

With the FFT analyzer v(rms) up to 200 Hz
and on turbochargers a(rms) up to 800 Hz.

Vibration levels

Recommended vibration levels according to standards ISO 8528-9 and DIN 6280/11

Maximum vibration levels

Engine block	v(rms) = 28 mm/s
Common base plate	v(rms) = 25 mm/s
6L26, Turbocharger	v(rms) = 45 mm/s
	a(rms) = 20 m/s ^{2}
8L, 9L, 12V, 16V, 18V26	v(rms) = 40 mm/s
Turbocharger	a(rms) = 15 m/s ^{2}

Typical vibration levels

Engine block	v(rms) = <20 mm/s
Common base plate	v(rms) = <20 mm/s
Turbochargers	v(rms) = 20...40 mm/s
	a(rms) = 5...12 m/s ^{2}
Alternator bearing	v(rms) = 10…15 mm/s
Pipelines	v(rms) = 20…40 mm/s

Location of measurement points, drawings:

Engine	9604ZT791
Turbocharger 6L26	9604ZT792
Turbo charger 8L,9L,12V,16V and 18V26	9604ZT793
Bracket turbocharger / Air cooler V26	9604ZT794

Guidance values of correction of heat balances for different ambient conditions

Turbocharger air inlet temperature

Air, exhaust mass flow	(kg/s)	- 2.5 %	per 10C higher ambient temperature
Exhaust gas temperature	(C)	3.4 %	per 10C higher ambient temperature
Charge air heat, total	(kW)	6.6 %	per 10C higher ambient temperature
HT	(kW)	13.2 %	per 10C higher ambient temperature
LT	(kW)	- 2.4 %	per 10C higher ambient temperature
Jacket water heat	(kW)	1.8 %	per 10C higher ambient temperature
Lubrication oil heat	(kW)	0.8 %	per 10C higher ambient temperature
Air temp. after compressor	(C)	6.5 %	per 10C higher ambient temperature
SFOC	(g/kWh)	0.7 %	per 10C higher ambient temperature

LT-temperature before air cooler

Air, exhaust mass flow	(kg/s)	- 0.9 %	per 10C higher LT - temperature
Exhaust gas temperature	(C)	2.3 %	per 10C higher LT - temperature
Charge air heat, total	(kW)	- 6.8 %	per 10C higher LT - temperature
HT	(kW)	1.7 %	per 10C higher LT - temperature
LT	(kW)	- 20.4 %	per 10C higher LT - temperature
Jacket water heat	(kW)	2.2 %	per 10C higher LT - temperature
Lubrication oil heat	(kW)	1.0 %	per 10C higher LT - temperature
Air temp. after compressor	(C)	1.1 %	per 10C higher LT - temperature
SFOC	(g/kWh)	0.3 %	per 10C higher LT – temperature

Altitude

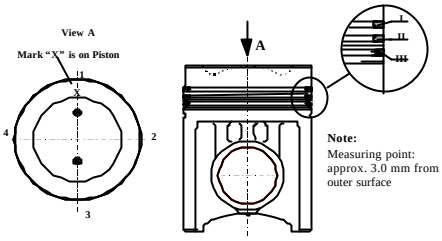
Air, exhaust mass flow	(kg/s)	- 4.7 %	per 1000 m ASL (Above sea level)
Exhaust gas temperature	(C)	5.9 %	per 1000 m ASL
Charge air heat, total	(kW)	3.0 %	per 1000 m ASL
HT	(kW)	7.7 %	per 1000 m ASL
LT	(kW)	- 4.5 %	per 1000 m ASL
Jacket water heat	(kW)	3.2 %	per 1000 m ASL
Lubrication oil heat	(kW)	1.4 %	per 1000 m ASL
Air temp. after compressor	(C)	5.5 %	per 1000 m ASL
SFOC	(g/kWh)	1.4 %	per 1000 m ASL

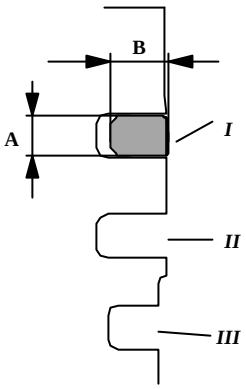
Valid up to 1000m ASL

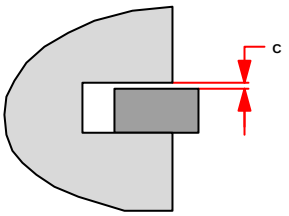
2.4 NO-GO CRITERIA, TIGHTENING TORQUES, LOCTITE AND MAINTENANCE SCHEDULE

Piston and piston ring wear limits

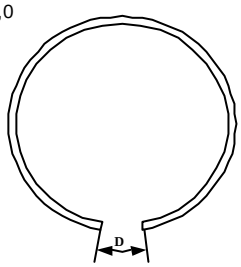
Description	Design size (mm)	Wear limit [mm]	Two piece piston with steel crown.
Piston ring groove heights :	**Piston 1421ZT . . . 114 - 116**		
Groove for :			
- Ring I :	7.23 7.18 7.21 7.16	7.35	
- Ring II :	7.18 7.18 7.16 7,16	7.35	
- Ring III :	7.06 7.06 7.04 7.04	7.15	
Clearance between new piston rings and grooves I, II, III :			
Axial clearance C:			
Groove I :	0.265 0.215 0.223 0.173	0.35	
Groove II :	0.215 0.215 0.173 0.173	0.35	
Groove III :	0.095 0.095 0.053 0.053	0.20	
Piston ring, gap D:			
Ring I :	0.90 0.90 0.60 0.60		
Ring II :	2.10 2.70 1.80 2.40		
Ring III :	1.15 1.15 0.80 0.80		



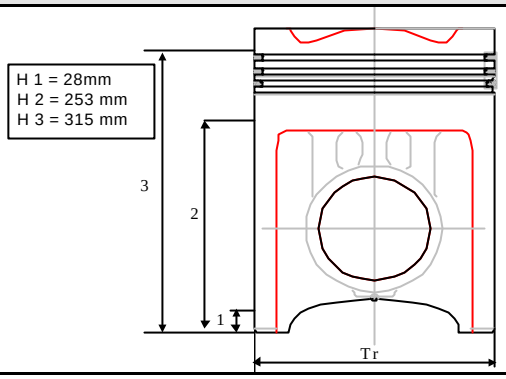
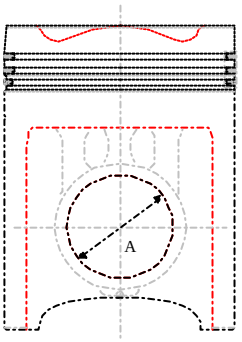
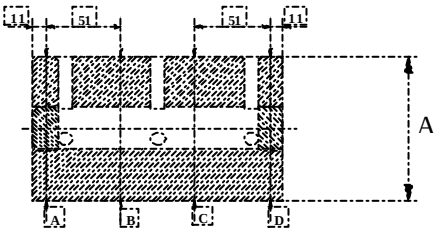




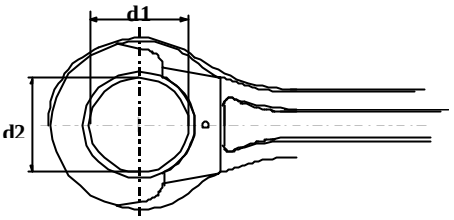
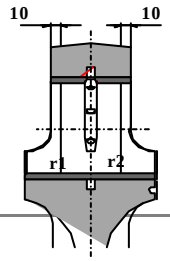
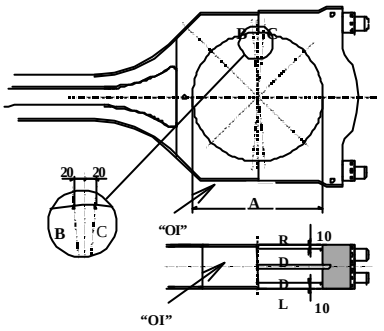
Piston ring gap measured in a new liner
Ø 260,0



Piston / gudgeon pin wear limits

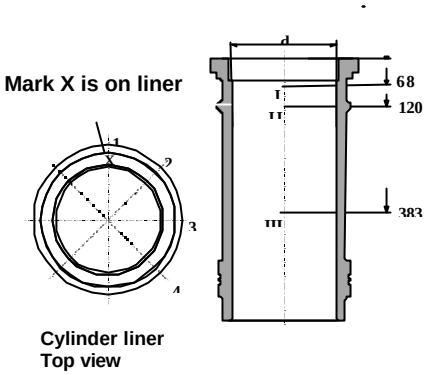
Description	Design size (mm)	Wear limit	Piston and gudgeon pin
Piston diameter Transverse diam. 1 Transverse diam. 2 Average diam. 3 * (measured every 45 degrees) * In case of scratches locally		259.7 259.6 257.5* 257.2	
Gudgeon pin Hole A -	120.070 120.045	120.09	
Gudgeon pin diameter. A	120.000 119.985	119.980	

Connecting rod wear limits

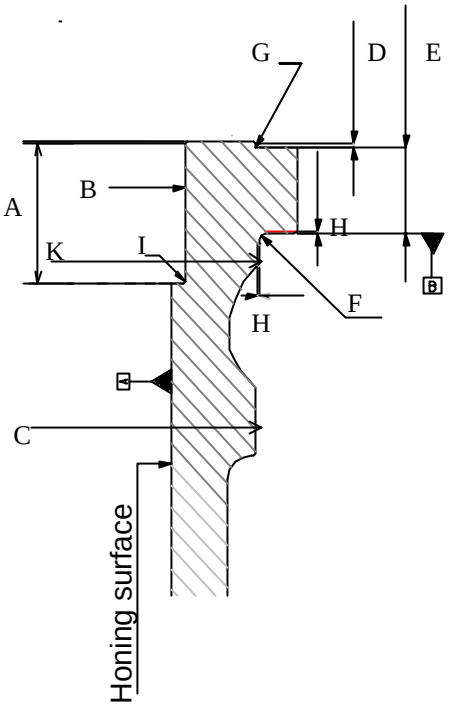
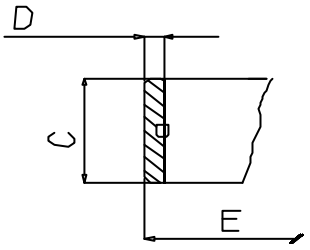
Description	Design size (mm)	Maximum allowable	Connecting rod
Small end bore diameter without bearing d1 - d2	134.975 134.950	134.985	
Circularity steelbore	0.01	0.015	
Small end bearing bush thickness	7.445 - 7.465		
Small end bore diameter with bearing bush r1 - r2	120.150 120.085		
Axial clearance small end bearing / piston	0.4 - 0.7	0.8	
Big end bore. (Steelbore)	247.000 247.029	247.050 246.970	
Big end bore assembled with bearing	235.165 235.233	MIN A 235.160 B 235.165 C 235.165 MAX A 235.255 B 235.275 C 235.275 NO-GO A > B or C	 Mark "OI" is on connecting rod
Circularity steelbore	0.015		
Straightness conrod: distance r1 - r2 (small end)to big end steelbore (without bearings)	448.898 449.025	0.04	

Cylinder liner wear limits

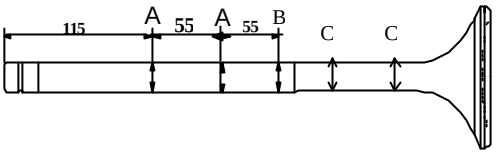
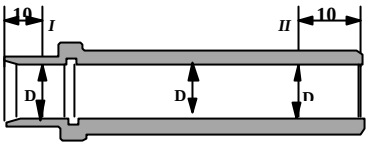
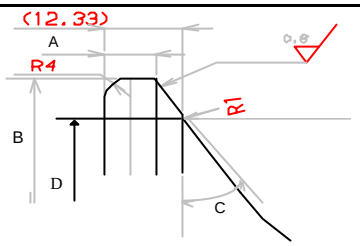
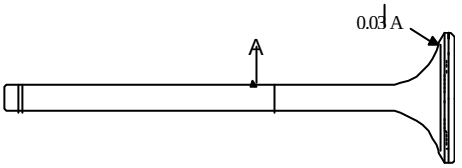
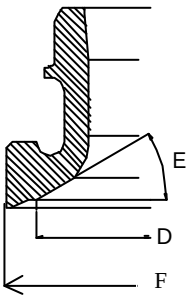
Description	Design size (mm)	Maximum allowable	Cylinder liner.
Bore	260.052 260.000		
I		260.60	
II		260.40	
III		260.23	
Circularity (measured at any level)	0.02	0.10	
Conicity, difference in diameters measured at 68 and 383 mm from top.	0.02	0.37	



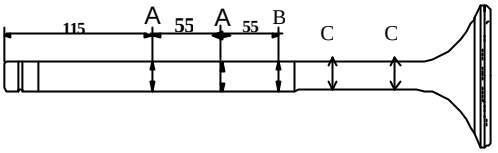
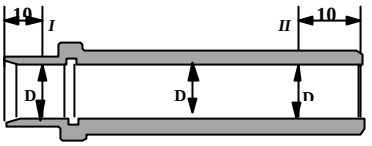
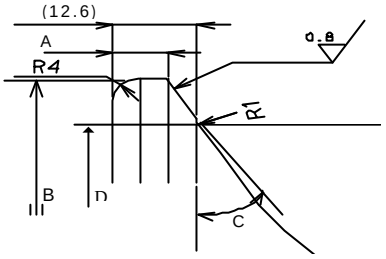
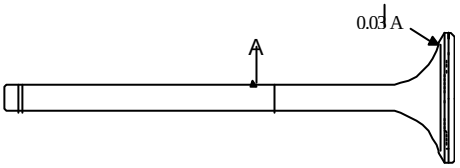
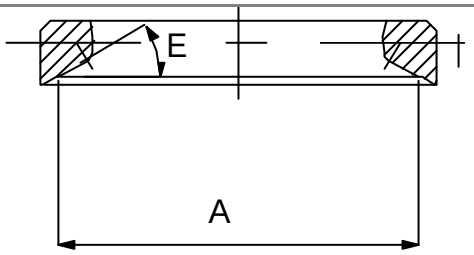
Cylinder liner
Top view

Description	Design size (mm)	Maximum allowable	Cylinder liner.
Height A :	57.20 57.40		
Diameter Liner: 1302ZT111 B:	Ø272.052 Ø272.000		
Liner 1302ZT112 B:	Ø267.052 Ø267.000		
Diameter C:	Ø333.8 Ø333.6		
Height D	2.45 2.55		
Parallelism D	0.03 B		
Height E	34.650 34.700	34.50	
Radius F	4.5 - 5.1		
Radius G	max. 0.2	0.2	
Undercut H	max.0.1	0.1	
Radius I	1.2 - 1.5		
Diameter K	Ø336.902 Ø336.938		
Anti polishing ring Height C	57.1 56.9		
Wall thickness D APR : 1302ZT109	6.50 6.45	6.35	
APR : 1302ZT113	4.00 3.95	3.85	
Diameter E APR : 1302ZT109	Ø271.951 Ø271.983		
APR : 1302ZT113	Ø266.951 Ø266.983		

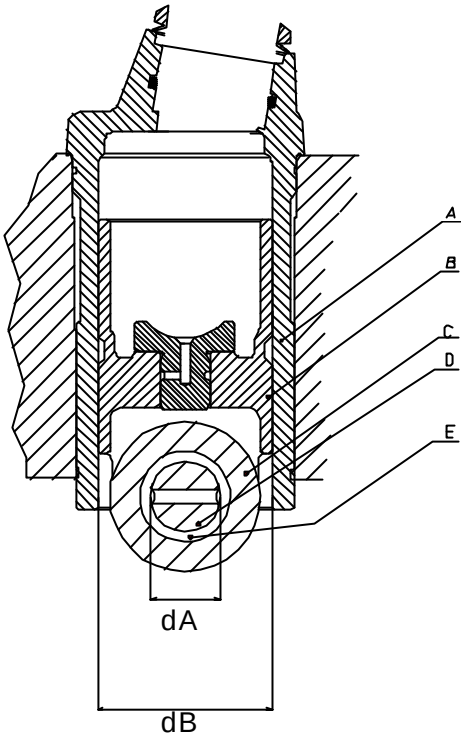
Exhaust valve and seat wear limits

Description	Design size (mm)	Maximum allowable	Exhaust Valve.
Valve stem diam. A - B C -	Ø 20.000 Ø 19.979 Ø 19 ± 0.1	 Ø 19.97 Ø 19.90	
Valve guide bore. D - Bore in cyl. head	 Ø 20.16 Ø 20.13 Ø 32.000 Ø 32.025	 Ø 20.25	
Valve disc : A - Diameter B - Angle C - Diameter D - Max. burn off at bottom	8.00 Ø 86.2 Ø 86.0 29°53'±5'	7.00 70.6 - 71.0 1.0	
Max.oscillation of valve stam and disc A -	 0.00 0.03	 0.06	
Exhaust valve seat Diam. D - Angle E - Diam F - Bore in cyl.head : first bore - second bore -	 Ø 86.2 Ø 86.0 30°+3'/-1' Ø 97.093 Ø 97.071 Ø 97.030 Ø 97.000 Ø 79.430 Ø 79.400	 Ø 88.0	

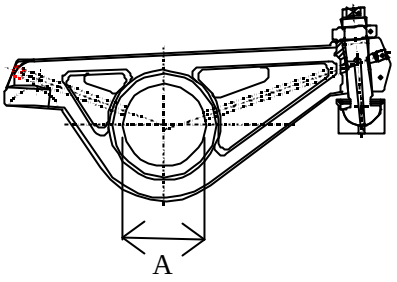
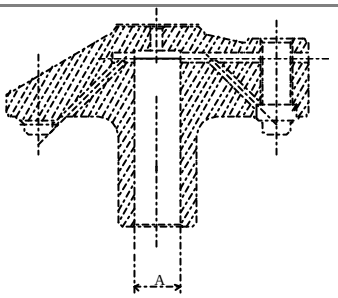
Inlet valve and seat wear limits

Description	Design size (mm)	Maximum allowable	Inlet Valve.
Valve stem diam. A	Ø 20.000 Ø 19.979	Ø 19.97	
B		Ø 19.90	
C	Ø 19 ± 0.1		
Valve guide bore. D -	Ø 20.16 Ø 20.13	Ø 20.25	
Bore in cyl. head	Ø 32.000 Ø 32.025		
Valve disc : A	8.00	7.00	
Diameter B	Ø 95.00 Ø 94.80		
Angle C	29°53'±5'		
Diameter D		78.6 - 79.0	
Max.oscillation of valve stam and disc. A	0.00 0.03	0.06	
Inlet valve seat Diam. A	Ø 95.2 Ø 95.0	Ø 97.0	
Angle E	30°+3'/-1'		
Outer diam-	Ø 105.126 Ø 105.104		
Bore in cyl.head	Ø 105.030 Ø 105.000		

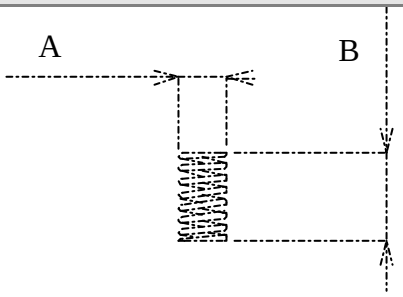
Valve drive mechanism wear limits

Description	Design size (mm)	Maximum allowable	Valve drive mechanism
Valve drive mechanism.			
Valve tappet(B) diameter dB -	∅ 69.940 ∅ 69.910		
Guide(A) diameter dB -	∅ 70.030 ∅ 70.000		
Clearance tappet / guide	0.06 - 012	0.15	
Pin bore in tappet.dA	∅ 28.021 ∅ 28.000		
Diameter pin (D) dA	∅ 28.000 ∅ 27.987		
Bearing inner bore (E) dA	∅ 28.050 ∅ 28.030		
Clearance bearing / pin	0.030 - 0.063	0.08	
Bearing (E) outer diameter	∅ 35.925 ∅ 35.950		
Roller inner diameter	∅ 36.000 ∅ 36.016		
Clearance roller / bearing	0.05-0.089	0.10	
Axial clearance roller / tappet	0.2 -0.4	0.5	

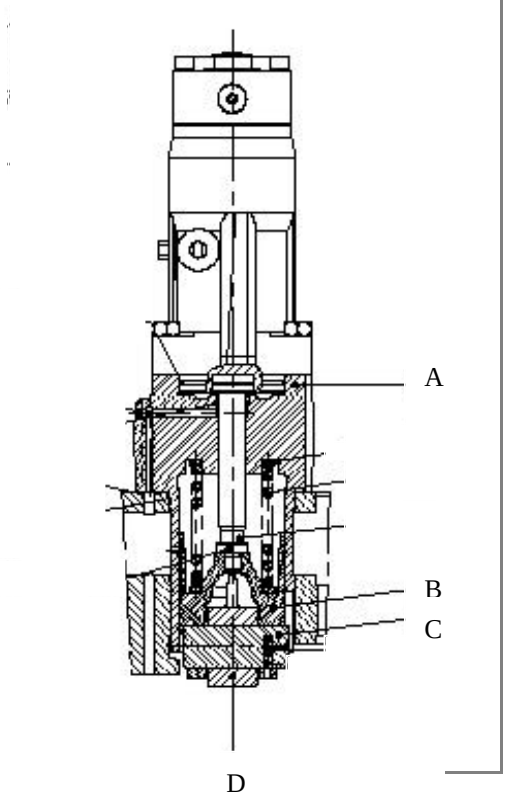
Valve drive mechanism wear limits

Description	Design size (mm)	Maximum allowable	Valve drive mechanism
Rocker arm			
Bore in rockerarm A	∅ 65.075 ∅ 65.030		
Shaft diameter A	∅ 65.000 ∅ 64.981		
Clearance bore / shaft	0.030 - 0.094	0.11	
Yoke			
Pin diameter A.	∅ 23.000 ∅ 22.987		
Yoke bore A.	∅ 23.065 ∅ 23.024		
Clearance yoke / pin	0.024 -0.078	0.10	

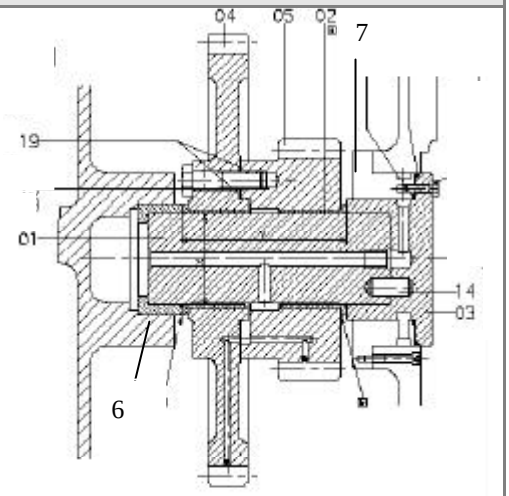
Exhaust and inlet valve spring

Description	Design size (mm)	Maximum allowable	Exh. and inlet spring
Valve spring			
Diameter A	∅ 67.5		
Length of spring (Dismantled) B	124.30	120.5	

Fuel pump drive

Description	Design size (mm)	Maximum allowable	Fuel pump bracket
Pump drive mechanism.			
Bracket fuelpump A Inner bore for roller holder	100.000 100.035		
Roller holder B Outer diameter	99.928 99.874		
Clearance bracket/holder	0.072-0.161	0.19	
Roller holder B Inner bore for pin	40.000 40.025		
Diameter pin C	40.000 39.975		
Clearance holder/pin	0.00-0.050	0.06	
Diameter pin C	40.000 39.975		
Roller, inner diameter D	40.025 40.050		
Clearance roller/pin	0.025-0.075	0.09	

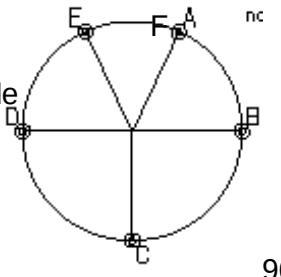
Intermediate gear drive

Description	Design size (mm)	Maximum allowable	Intermediate gear drive
Pos 19 : apply loctite 243 Ax. clearance gearwheel	0.30 – 1.50	1.60	
Inner bore bush (6)	105.058 105.038		
Outer diameter bush (6)	128.068 128.043		
Bore in cyl. block for Bush (6)	128.000 128.025		
Diameter Intermediate shaft (1)	105.000 104.978		
Inner bore collar bearing bush (2) after pressing in.	105.172 105.120		
Clearance shaft 1/ bush 2	0.120 – 0.194	0.21	
Clearance shaft 1/ bush 6	0.038 – 0.080		
Outer diameter collar bearing bush	115.076 115.054		
Inner bore gearwheel (4) / (5)	115.000 115.022		
Cover (3) Innner bore for shaft (1)	105.012 105.047		
Clearance shaft 1/cover 3	0.012 – 0.069		
Cover (3) Outer diameter	139.986 139.961		
Inner bore bush (7) cover – eng.block	140.000 140.040		
Outer diam. bush (7) cover – eng.block	200.000 199.054		
Bore in eng. block for bush (7)	200.000 200.029		

Crankshaft

Description	Design size (mm)	Maximum allowable
Crankshaft :		
Material : 42CrMo 4 (L - engines)		
42CrMo4+Ni +V (V -eng.)		
Tensile strenght: ≥800 N/ mm2 ;L-eng		
≥880 N/ mm2 ;V-eng		
Hardness : ≥ 240 HB ;L-eng		Hardness measured (average) +10%
271 - 320 HB ;V-eng		
Main journal :		
Crankshaft journal diameter	279.968 - 280.000	
Crankshaft journal parallelism (compared to first - last journal)	0.025	
Crankshaft journal straightness	0.015	
Oscillation of journal		0.10
Main bearing clearance	0.258 - 0.361	0.39
Journal roughness	Ra = 0.4µm	
Crankpin		
Crankpin diameter	234.971 - 235.000	
Crankpin parallelism (compared to adjacent - last journal)	0.02	
Crankpin straightness	0.015	
Big end bearing clearance (0 version)	0.186 - 0.283	0.31
(A version)	0.165 - 0.262	0.29
Crankpin roughness	Ra = 0.4µm	
Gearwheel		
Crankshaft diameter for gearwheel	319.964 - 320.000	
Bore gearwheel	320.000 - 320.036	
W - measurement over 6 teeth	168.683 - 168.739	+/- 0.02 over split line
Thrust bearing		
Ring thickness	10.950 - 11.000	
Axial clearance	0.15 - 0.45	0.8

Crankshaft deflections and alignment

Description	Max. mm	re-align
Measuring place of dial gauge on counter weight : 115 mm from mounting face crankshaft - counter weight (L - engine). 155 mm from mounting face crankshaft - counter weight (V - engine). The crankshaft deflection criteria : - free and driving end not coupled to the installation all cylinder - driving end coupled to the installation first cylinder - free and driving end coupled to the installation first and last cylinder	 0.08 0.16 0.16	
The deviation between adjacent cranks : - compare crankshaft deflections at the same measuring points (A-A; B-B etc.) max.:0.7 x crankshaft deflection limit (0.08))	0.055	
For L-Engines the deviation on the same crank between A and E is : For V-Engines the deviation on the same crank between A and E is :	0.015 0.03	
Checking the measurement results Average between A and E = 0.5 (A+E) = F -free and driving end not coupled to the installation, for all cylinders : Deviation between F and B / B and C / C and D / D and F -driving end coupled to the installation, for first cylinder : Deviation between F and B / B and C / C and D / D and F - free and driving end coupled to the installation, for first and last cylinder Deviation between F and B / B and C / C and D / D and F	 0.04 0.08 0.08	
operating side  non operating side 9604DT610 Rev.		
Note :-Mentioned values are with engine and foundation at ambient temperature. -if the values are > max. : -check measurements tools and measurement procedure. -check foundation and alignment of the engine and driven shaft. Re-align if necessary.		
Alignment : Axial / radial offset (clock reading) For flexible mounted engines: (see IPI-W26)	0.2	0.4

Camshaft.

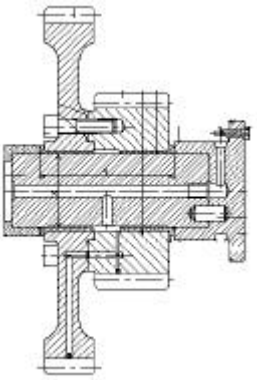
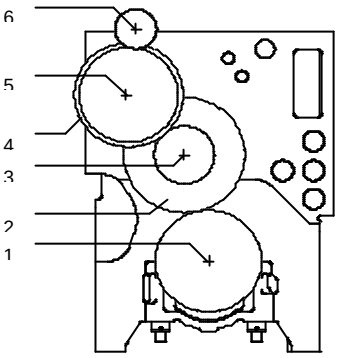
Description	Design size (mm)	Maximum allowable
Camshaft		
Camshaft part :		
Material : 17CrNiMo6		
Hardness :	60 - 62 HRc	
Depth of case :	min. 2,5 mm	
Cam roughness :	Ra = 0.8 µm	
0 version :		
Camshaft journal diameter	219.971 - 220.000	
Camshaft bearing housing bore	240.029 - 240.000	
Camshaft bearing bush thickness	9.890 - 9.910	
Assembled camshaft bearing bore	220.205-220.274	
Camshaft bearing clearance	0.205 - 0.303	0.35
Camshaft diameter (“0” bearing)	209.971 - 210.000	
Camshaft “0” bearing housing bore	240.000 - 240.029	
Camshaft “0”bearing bush thickness	14.879 - 14.908	
Assembled camshaft “0” bearing bore	210.205 -210.285	
Camshaft “0” bearing clearance	0.205 - 0.314	0.35
Camshaft trust bearing collar thickness	7.85 - 7.90	
Camshaft trust bearing axial clearance	0.15 - 0.45	0.70
A version :		
Camshaft journal diameter	179.975-180.000	
Camshaft bearing housing bore	200.000 - 200.029	
Camshaft bearing bush thickness	9.915 - 9.930	
Assembled camshaft bearing bore	180.167 - 180.224	
Camshaft bearing clearance	0.167 - 0.249	0.30
Camshaft diameter (“0” bearing)	209. 000 - 240.029	
Camshaft “0” bearing housing bore	14. 971 - 210.000	
Camshaft “0”bearing bush thickness	240.879 - 14.908	
Assembled camshaft “0” bearing bore	210.205 -210.285	
Camshaft “0” bearing clearance	0.205 - 0.314	0.35
Camshaft trust bearing collar thickness	7.85 - 7.90	
Camshaft trust bearing axial clearance	0.15 - 0.45	0.70

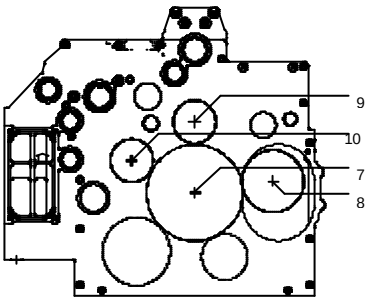
Bearing wear limits

Bearing wear limits	Design value [mm]	No – Go [mm]
The crankshaft-, camshaft- and big-end-bearings are of the socalled bimetal type. The first bonding is a high-strength AlZn4SiPb lining (0,3-0,5mm) directly onto the steel, then adding the AlSn20Cu running layer (0,2-0,4mm) by the method of roll bonding. A bearing is suitable for further use as long as the shell thickness is within the given tolerances. (see main bearing measuring record) – the bearing shell is free of any damage. – the bearing shell is free of any corrosion and cavitation. – the wear pattern is equal. – the free spread of the bearingshell is within tolerance. – the running layer is not overloaded. An overloaded bearing shell can be recognized to locally melted , cracked or smeared lining. **Note! Refitting of bearing with 5000 runninghours or more is not allowed.** For determination of wear, engine components and measuring equipment should for some hours first be acclimated at 20C° .		
<u>Main bearing thickness / inner bore :</u> - Main bearing (0 - version)	9.870 9.890	9.865
- Main bearing (A - version)	7.375 7.395	7.360
- Inner bore (bearing mounted ; 0 / A version)	280.258 280.329	
<u>Main bearing free spread :</u> - Main bearing (0 - version)	301.0 303.0	300.5
- Main bearing (A - version)	296.0 298.0	295.5
<u>Big end bearing :</u> - Big end bearing shell thickness	5.905 5.925	5.890
- Big end bearing free spread	250.0 252.0	248.0

Bearing wear limits	Design value [mm]	No – Go [mm]
Camshaft bearing bush : - Inner bore - 0 version (bearing mounted)	220.205 220.274	220.30
- Inner bore - A version (bearing mounted)	180.167 180.224	180.25

Clearances of engine parts

Gears	Clearance Nominal [mm]	Wear Limit [mm]	Example
Crankshaft gear wheel - large intermediate gear wheel (1 - 2)			
- L - engine :	L 0.10 - 0.43	0.50	
- V - engine :	V 0.10 - 0.39	0.50	
Small intermediate gear wheel - large camshaft gear wheel (3 - 4)			
- L - engine :	L 0.10 - 0.29	0.40	
- V - engine :	V 0.10 - 0.27	0.40	
Small camshaft gear wheel - governor drive (5 - 6)	0.28 - 0.40	0.50	
Intermediate gear wheel ax. clearance(2)	0.30 - 1.50	1.60	
Vibration damper gear wheel -			
- lub. pump gear wheel (7 - 8):			
- L - engine :	0.49 - 0.77	0.85	
- V - engine :	0.46 - 0.77	0.85	
- HT-pump gear wheel (7 - 9):			
- L - engine :	0.57 - 0.87	0.95	
- V - engine :	0.49 - 0.80	0.90	
- LT-pump gear wheel (7- 10):			
- L - engine :	0.50 - 0.80	0.90	
- V - engine :	0.42 - 0.74	0.85	



7. Crankshaft gearwheel
8.Lub. oil pump gearwheel
9. H.T. cooling water pump gearwheel
10. L.T. Cooling water pump

Clearances of engine parts

Subject	Clearance Nominal [mm]	Wear Limit [mm]
Crankshaft :		
Axial clearance crankshaft	0.15 -0.45	0.80
Main bearing clearance	0.258 - 0.361	0.390
Big end bearing clearance (0 version)	0.186 - 0.283	0.310
(A version)	0.165 - 0.262	0.290
Camshaft :		
Camshaft bearing clearance (0 version)	0.205 - 0.303	0.330
Camshaft bearing clearance (A version)	0.167- 0.249	0.280
Camshaft “0” bearing clearance	0.205 - 0.314	0.350
Camshaft trust bearing axial clearance	0.15 - 0.45	0.70
Cylinder head (cold engine) :		
Inlet valves	0.7	
Exhaust valves	0.8	
Rocker arm ; bore / shaft	0.030 - 0.094	0.11
Yoke / pin	0.24 - 0.078	0.10
Valve stem clearance	0.130 - 0.181	0.28
Governor drive;		
Backlash driving gear	0.12 - 0.18	0.25
Nozzle :		
Needle lift	0.5 -0.6	0.8
HP fuel pump adjustment :		
Distance fuel pump push rod / pedestal top surface	0.90 - 1.1	1.2
Piston :		
Axial clearance top ring groove		0.35
Axial clearance second ring groove		0.35
Axial clearance third ring groove		0.20
Axial clearance piston / small end	0.4- 0.7	0.8
Clearance gudgeon pin / piston	0.045 - 0.085	0.11

Tightening torques and jack pressures

Connection	L-engine [Nm]	V -engine [Nm]
Oil pump		
Lubricating oil pump	80	195
Gearwheel on shaft	65	75
Cooling water pump HT/LT		
Cooling water pump on cover	195	
Gear wheel on shaft	15 (0-version) 17 (A-version)	
Suction house	43	
Impeller on shaft	15	
Sea water pump		
Impeller nut	62	
Cover / housing	43	
Gear wheel	50	
Seal holder	14	
Control system components		
Governor drive housing	175	
Governor gear wheel on shaft	10	
Governor	80	
Adapter	80 (0-version) 46 (A-version)	
Engine block with bearings		
Main bearing stud, mounting	200	
Main bearing cap, tightening -first step -second step -third step Elongation	tool nr. 9612ZT903 200 bar measure size ‘X’ 900 bar 900 bar measure size ‘Y’ ‘Y’ - ‘X’ = 1.4 - 1.7 mm	
Side stud, mounting	0 Nm 180° back	
Side stud (short), tightening -first step -second step -third step Elongation	tool nr. 9612ZT902 100 bar measure size ‘X’ 450 bar 450 bar measure size ‘Y’ ‘Y’ - ‘X’ = 0.9 - 1.1 mm	
Side stud (long), tightening -first step -second step - third step Elongation	tool nr. 9612ZT902 100 bar measure size ‘X’ 450 bar 450 bar measure size ‘Y’ ‘Y’ - ‘X’ = 1,35 - 1.60 mm	

Note: For tightening sequence studs, see Instruction manual

Connection	L-engine	V -engine
	[Nm]	[Nm]
Crankshaft		
Counter weight stud, mounting	100	
Counter weight , tightening		
Counter weight tool	14083TD900	14016TD900
-first step	100 bar	100 bar
-second step	520 bar	770 bar
-third step	520 bar	770 bar
Elongation	0.50 ±0.1 mm	0.70 ±0.1 mm
Crankshaft gear		
Split gearwheel on crankshaft	270	
Split gearwheel	540	
Vibration damper		
Vibration damper	2400	4300
Gear wheel on damper	195	
Extension piece	195	--
Flywheel		
Flywheel	2400	4300
Toothed ring on flywheel	80	
Connection rod		
Big end stud, mounting	100	
Big end bearing cap, tightening*) -first step -second step -third step Elongation	**tool nr 9612ZT944** 380 bar !! measure size 'X' 970 bar !! 970 bar !! measure size 'Y' 'Y'-'X' = 0.7 - 0.9 mm	
Big end bearing cap, tightening*) -first step -second step -third step Elongation	**tool nr 9612ZT905** 300 bar !! measure size 'X' 760 bar !! 760 bar !! measure size 'Y' 'Y'-'X' = 0.7-0.9 mm	

*) **Note:** Tool number 9612ZT944 has a diameter of 96mm.
Tool number 9612ZT905 has a diameter of 114mm.

Caution: Take good care for the correct pressure in relation with the used hydraulic jacks!

Connection	L-engine	V -engine
	[nm]	[nm]
Multiduct connection		
Multiduct to cylinder head	200	
Multiduct to exhaust manifold	200	
Multiduct to engine block	79	
Roller holder casing		
Roller holder casing	46	
Cylinder head		
Cylinder head stud, mounting	200	
Cylinder head, tightening -first step -second step -third step Elongation	tool nr. 9612ZT904 300 bar measure size 'X' 725 bar 725 bar measure size 'Y' 'Y' - 'X' = 1.15 - 1.30 mm	
Rocker arm mechanism		
Rocker arm bracket	385	
Locking nut (on yoke)	120	
Locking nut (on rocker arm)	220	
Intermediate gear shaft		
shaft cover	46	
Intermediate gear wheel	650 (0 - version)	560 (A - version)
Camshaft/camshaft gearwheel		
Camshaft section to journal		
-first step	40	
-second step (final setting)	330 (0 - version)	135 (A - version)
Thrust ring to journal	80	
Journal to camshaft gear wheel	195	
Governor drive		
Governor drive shaft nut	100	
Locking bolt	10	

Connection	L-engine	V -engine
	[Nm]	[Nm]
Fuel injector mounted in cylinder head		
Nut for clamping piece	30	
Stud for clamping piece	10	
HP connecting pipe	120	
HP fuel line union	140	
Fuel injector		
Nozzle (use loctite 767 on thread) cap nut	750...800	
Locking (adjusting) screw	70...90	
Locking adj. screw 1501ZT945	50...70	
End plug	20...22	
Fuel pump		
HP fuel pump	140	
Fuel pump support	46	
Exhaust bellows tightening V-clamping rings		
Step 1 : tighten bolts	20	
Step 2 : loosen bolts	1.5 turn	
Step 3 : tighten bolts	9 - 12	
Intermediate gearwheel		
Bolts in gearwheel	560	
Bolts for shaft end cover	46	
Lub.oil unit		
Bolts - mounting on eng. block	195	660
Turbocharger bracket on engine block		
Flywheel side (0 version)	195	
Vibration damper side (0 version)	385	
A version	390	
V - engine		660

Loctite

Loctite overview

Thread locking		
Loctite 243	4496136	fine thread (< M36)
Loctite 262	4496139	coarse thread (>M36)
Loctite 290	4496124	exhaust valve seat
Thread sealing		
Loctite 542	4496119	fine thread (< M20, G½)
Loctite 515	4496130	coarse thread > M20, G½)
Flange seal/gasket		
Loctite 515	4496130	sealing small clearance (anaerobe glue)
Loctite 5910	4496155	large clearance (silicone. oil- and fuel resistant
Loctite 5399	4496157	Large clearance. temp. < 350º C (Less oil resistant then 5910)
Cylindrical bonding		
Loctite 648	4496108	Bonding shaft/bore connection (< 175º C)
Glue		
Loctite 307	4496151	Metal / metal
Loctite 401	4496166	Metal / rubber / plastic

Loctite application

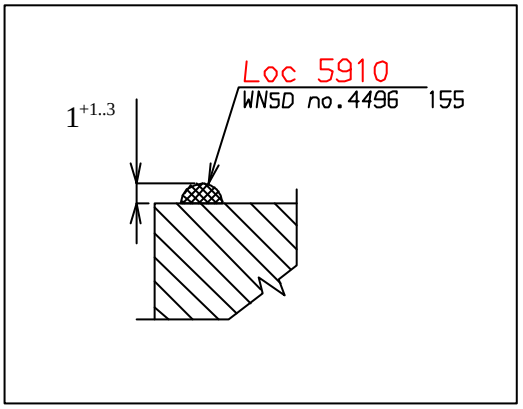
For sealing of several parts on the W26 engine use Loctite type 5910 or as on drawing is specified

Mounting instructions :

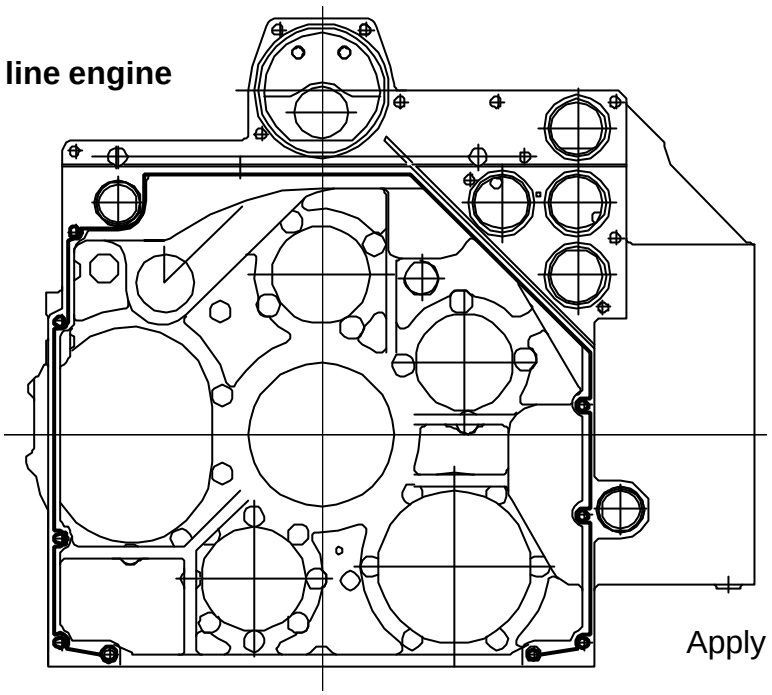
- Get the correct equipment and parts to mount this part.
- First try to assemble the parts whit out the Loctite, this is for the purpose to check if everything is right and if there are no obstructions.
- Clean both faces several times with cleaner NA90 or equal.
- If necessary “glue” the O-rings with silicone grease in the available groove.
- Put the Loctite, type and pattern, on according to the drawing.

NOTE :
The maximum time between applying the Loctite and fastening the parts is **10 min!!!**

- Final check, if there is no Loctite in the leakage groove.

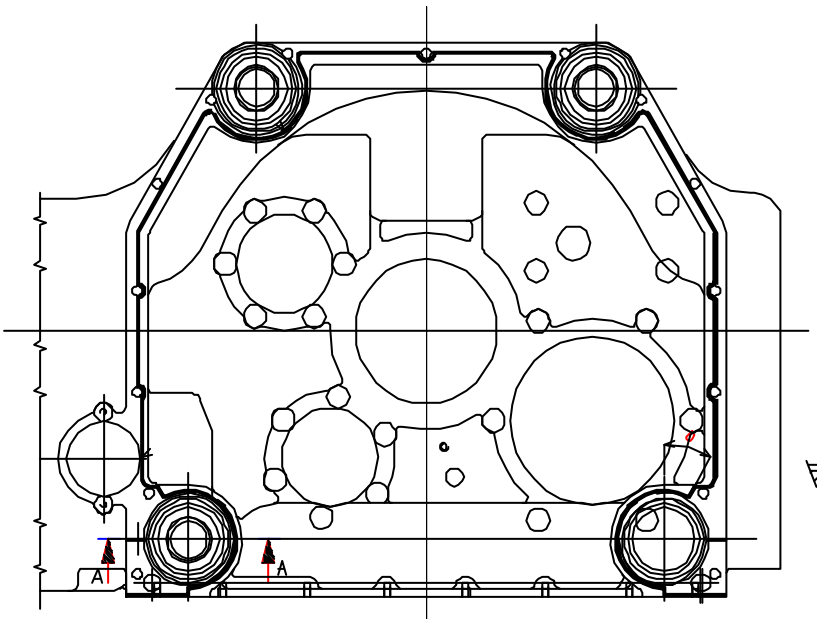


Pump cover line engine

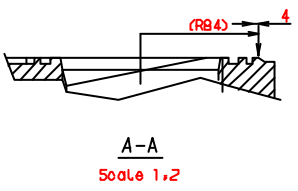


Apply Loctite 5910

Pump cover V-engine

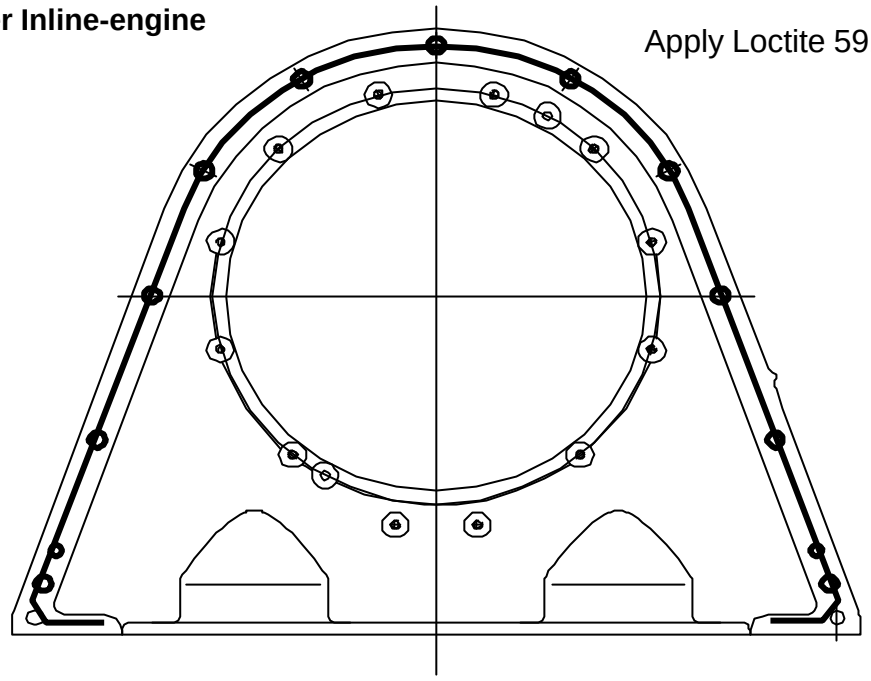


Apply Loctite 5910



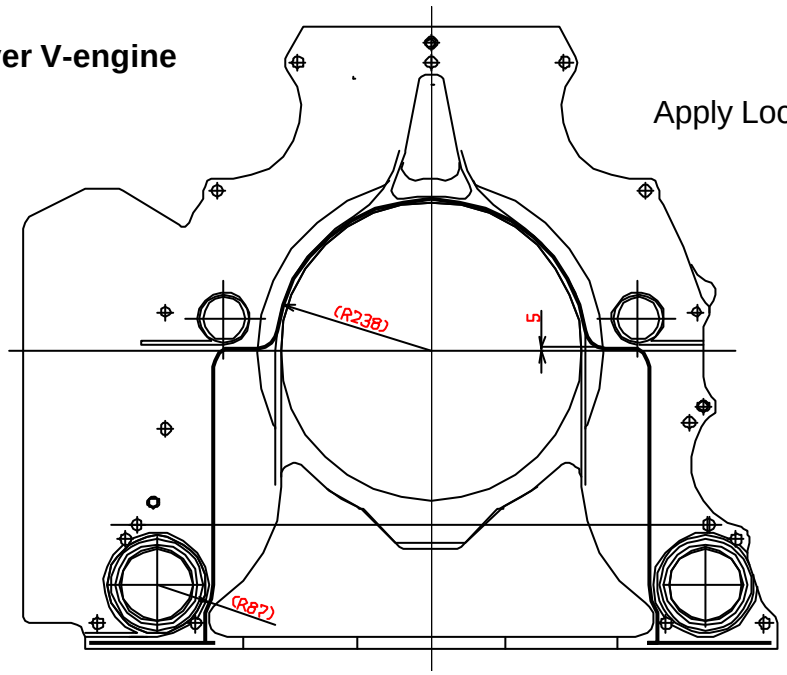
End cover Inline-engine

Apply Loctite 5910

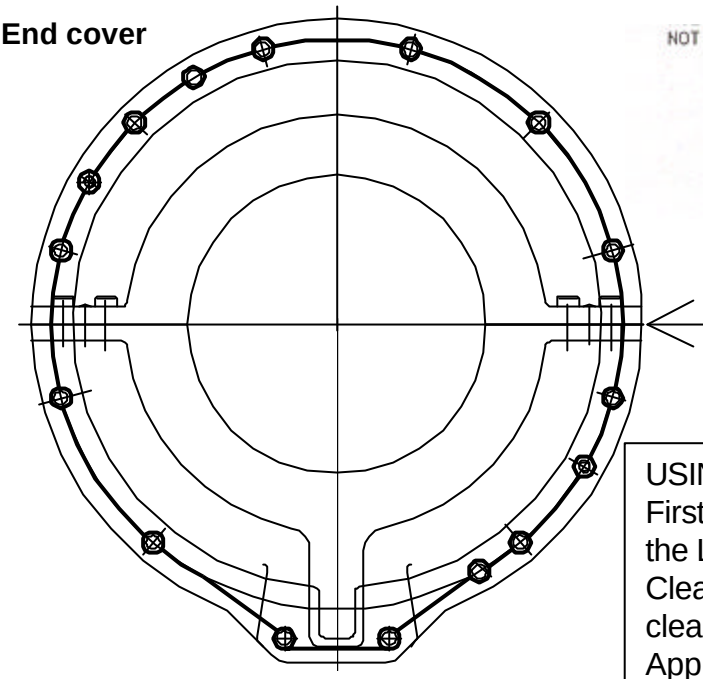


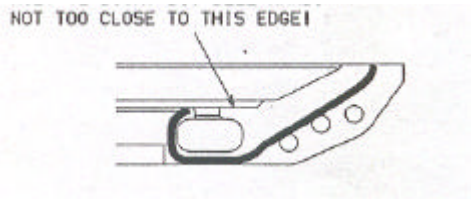
End cover V-engine

Apply Loctite 5910



End cover



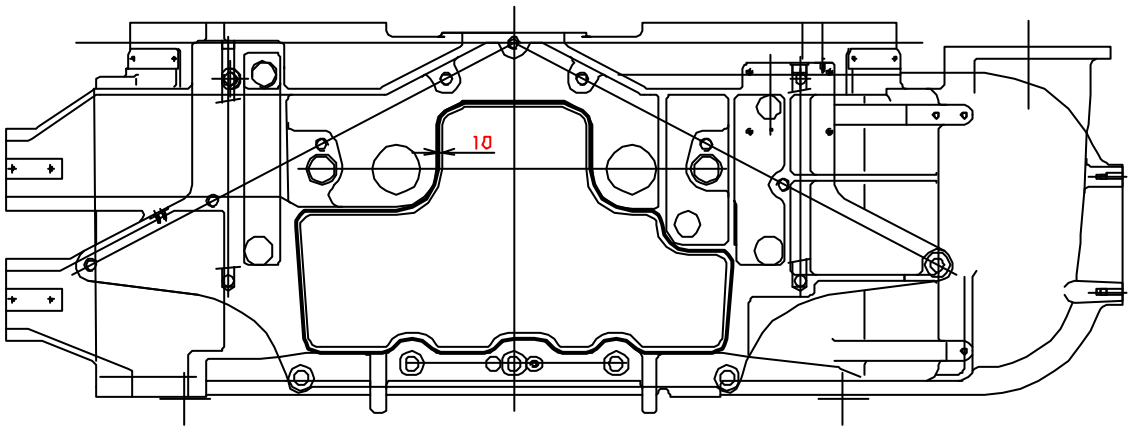


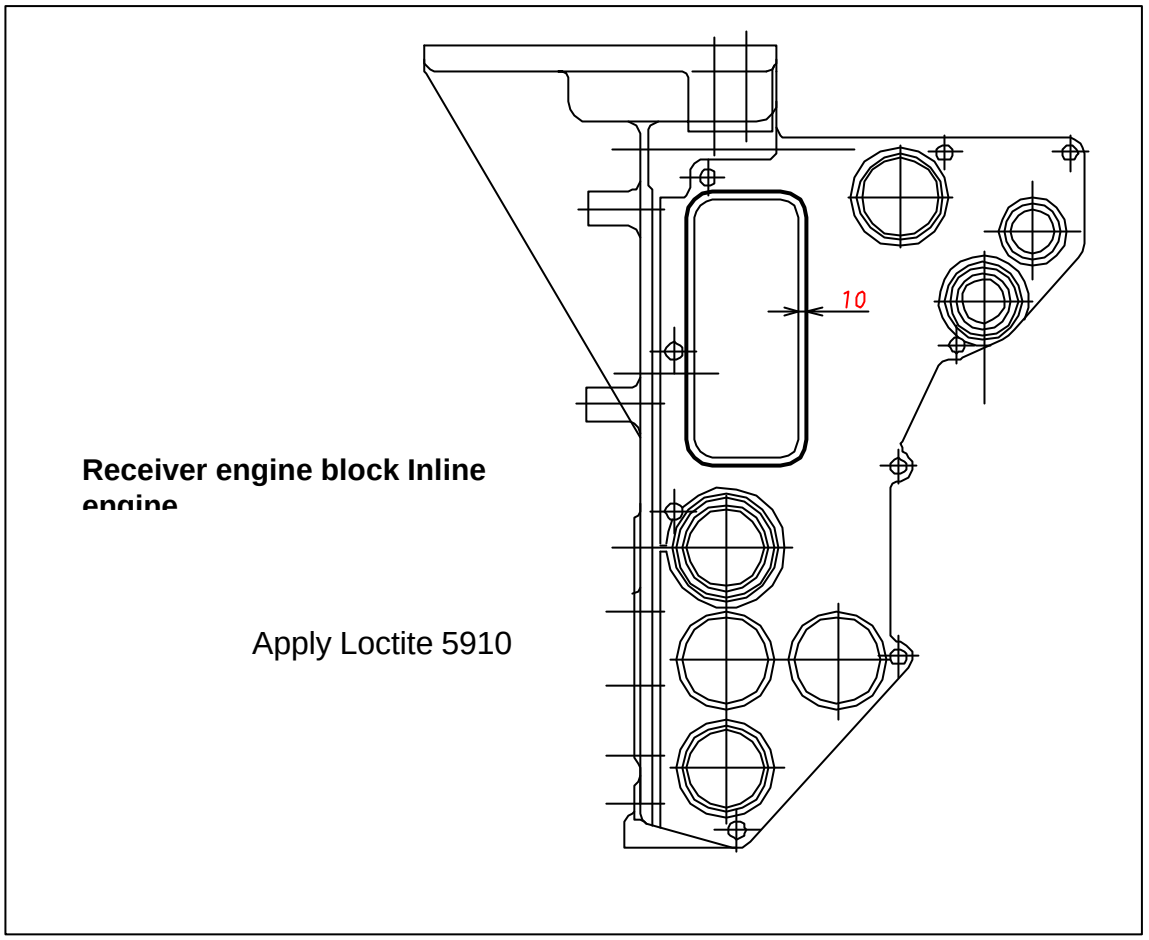
Apply Loctite 515

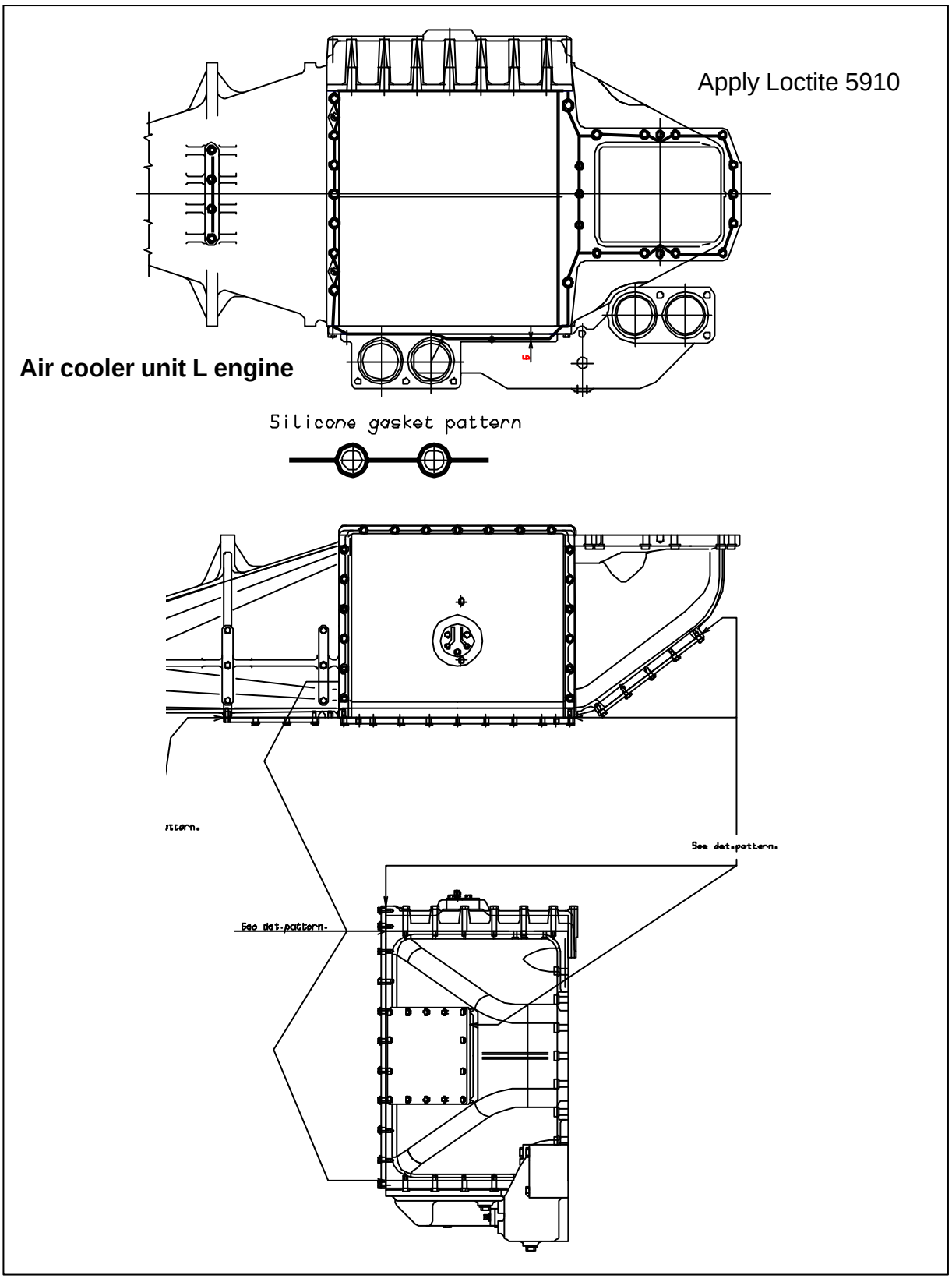
USING INSTRUCTION LOCTITE 515
First try to assemble the parts without the Loctite
Clean both faces several times with cleaner NA90 or equal.
Apply Loctite according drawing.
After assembly min.24 hour curing time.

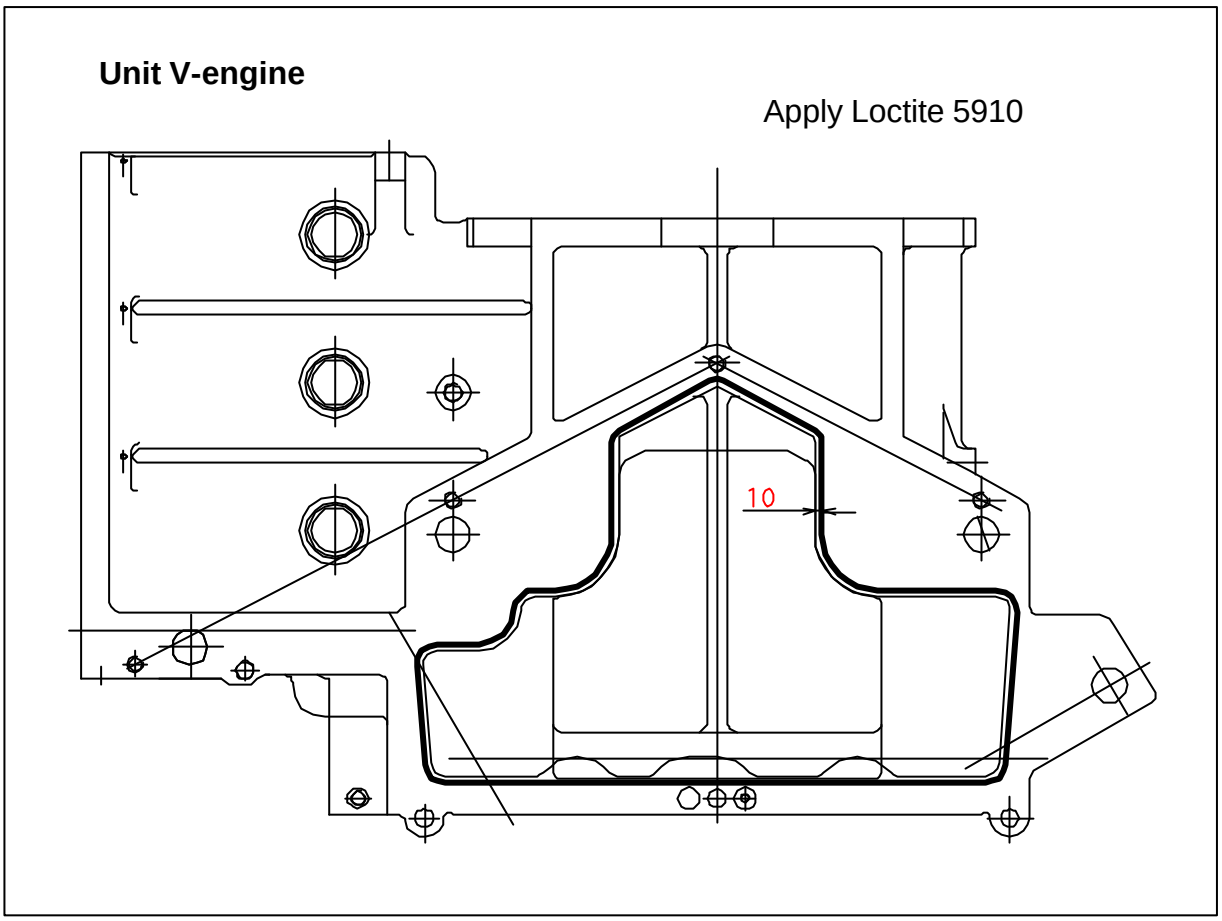
Receiver engine block V-engine

Apply Loctite 5910




10
Receiver engine block Inline engine
Apply Loctite 5910


Apply Loctite 5910
Air cooler unit L engine
Silicone gasket pattern
See dat.pattern.
See dat.pattern.


Unit V-engine
Apply Loctite 5910
10

Maintenance schedule

Maintenance intervals for W26 MDO/LFO

Intervals [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			Sp	D	W	0.5	1	2	4	8	12	24	36	48	60	72	96
1000		***General***															
	1000-001	Check on leakage's at the engine. Check on fixation of piping and cables.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-002	Record performance data in engine log sheet.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-003	Check the fluid levels.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-005	Check the engine on bolt connections.	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-006	Carry out a test run.	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐
	1000-007	Carry out a running-in program. Taking down readings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	1000-009	Test start process of the engine. Engine in standby position.	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-014	Carry out a load performance test.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
1101		***Crankcase***															
	1101-001	Visual inspection of crankcase.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
1102		***Main bearing(s)***															
	1102-002	Inspection of 1 main bearing.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
	1102-005	Renew main bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐
1111		***Crankshaft***															
	1111-001	Check crankshaft deflections and axial bearing clearances.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1111-006	Inspection of 1 crankpin.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐	☐
	1111-007	Inspection of crankpins.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒	☒
	1111-008	Inspection of 1 main journal.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒	☒
	1111-009	Inspection of main journals.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐	☐
	1111-010	Renew crankshaft-sealing.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒	☒
	1111-011	Inspection of 1 crankpin, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1111-014	Renew crankshaft-sealing of PTO-shaft.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒	☒
1302		***Cylinder liner(s)***															
	1302-001	Endosc. inspection of cylinder liners.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☐	☒	☐	☒	☐	☐	☐
	1302-012	Inspection of 1 cylinder liner, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	302-013	Renew cylinder liner(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐
	1302-018	Insp./overhaul cylinder liners and renew the anti-polishing rings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☐	☐	☐
1400		***Piston(s) & connecting rod(s)***															
	1400-004	Inspection of gudgeon-pins and gudgeon-bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☒	☐	☐
	1400-007	Inspection of 1 gudgeon-pin and -bearing, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1400-009	Renew gudgeon-pins and gudgeon-bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	
1401		***Connecting rod(s)***															
	1401-004	Renew crankpin bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒	
	1401-010	Insp./overhaul connecting rods.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒	
	1401-014	Inspection of 1 connecting rod, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1401-017	Inspection of 1 crankpin bearing, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1421		***Piston(s)***															
	1421-010	Insp./overhaul pistons, renew piston rings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☐	☐	
	1421-011	Insp./overhaul 1 piston incl. piston-rings, after the first 4000 running	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	1421-012	Renew piston(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	
1501		***Injector(s)***															
	1501-005	Insp./overhaul and test injector holders complete.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1501-008	Renew the injector-nozzles.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1501-009	Renew inner parts of injector holder.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
1503		***Safety valve(s)***															
	1503-004	Inspection of safety valves.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒	

Intervals MDO/LFO [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			Sp	D	W	0.5	1	2	4	8	12	24	36	48	60	72	96
1504		***In / exhaust valve(s)***															
	1504-001	Check valve clearances.	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1504-002	Endosc. inspection of all valves cq seats.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☐	☒	☐	☒	☐	☐
	1504-003	Check valve clearances in new and overhauled engine, after the first 100 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1504-005	Renew inlet valves.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
	1504-006	Renew exhaust valves.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1504-010	Insp./overhaul inlet valves.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☒	☐
1511		***Cylinder head(s)***															
	1511-008	Insp./overhaul cylinder heads.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1511-012	Function check of valve rotators.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1511-013	Insp./clean valve rotators.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	1511-014	Renew valve rotators.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1511-015	Inspection of 1 cylinder head, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1511-016	Renew safety valves.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
1530		***Rocker-arms assembly***															
	1530-007	Insp./overhaul rocker-arms assembly.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
1531		***Pushrod(s)***															
	1531-001	Check push rod pivots.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
1620		***Gear train***															
	1620-010	Inspect gear pump drive.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1620-011	Inspect gear camshaft drive.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1620-014	Inspect gear pump drive, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1620-015	Inspect gear camshaft drive, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2100		***Camshaft(s) with cam followers***															
	2100-002	Check fuel injection timing.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	2100-004	Renew camshaft-bearings and inspect journals.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
	2100-014	Inspection of the cams.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	2100-016	Inspection of 1 camshaft-bearing and journal.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☒	☐
	2100-018	Inspection of 1 inlet- and exhaust-cam follower.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	2100-019	Inspection of inlet- and exhaust-cam followers.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	2100-020	Inspection of 1 fuel-cam follower and pedestal.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	2100-021	Inspection of fuel-cam followers and pedestals.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
2106		***Fuel injection pump(s)***															
	2106-005	Insp./clean fuel injection pumps.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	2106-007	Renew inner elements and calibrate the HP fuel pumps.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	2106-010	Check leak fuel quantity of the fuels ystem.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	2106-011	Insp./clean 1 fuel injection pump, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2107		***Control air system***															
	2107-002	Drain starting air vessels and air treatment unit(s), check system on leakage, oxidation. and water.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
2301		***Fuel rack mechanism***															
	2301-001	Check and lubricate the control mechanism.	☐	☐	☒	☒	☒	☒	☒	☒	☒	☐	☒	☐	☒	☐	☐
	2301-006	Insp./overhaul control mechanism.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
3001		***Hydraulic governor(s)***															
	3001-002	Refresh lubricating oil in governor.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	3001-005	Insp./overhaul governor.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
3005		***Governor drive***															
	3005-004	Insp./overhaul governor drive.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
4005		***Turning device(s)***															
	4005-002	Check operation of turning device and start-interlock device.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	4005-004	Refresh lub.oil of turning device.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
5101		***Lubricating oil pump(s)***															
	5101-006	Insp./overhaul lub.oil pump(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
5301		***Lubricating oil cooler(s)***															
	5301-007	Insp./overhaul lub.oil cooler-stack.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒

Intervals MDO/LFO [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			Sp	D	W	0.5	1	2	4	8	12	24	36	48	60	72	96
5302		***Air cooler(s)***															
	5302-008	Insp./overhaul air coolers-stack.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
5402		***Fresh cooling water pump(s)***															
	5402-006	Insp./overhaul HT-coolingwater pump.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	5402-008	Insp./overhaul LT-coolingwater pump.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
5415		***Raw coolingwater pump(s)***															
	5415-003	Inspection/overhaul of raw c.w. pump and replacement of seals and ball bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
5611		***Lubricating oil filter***															
	5611-001	Renew lub.oil filter elements.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	5611-002	Clean built-on centrifugal by-pass lub.oil filter and renew insert	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	5611-007	Renew all seals at the build-on centrifugal by-pass lub.oil filter.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
6102		***Air inlet line(s)***															
	6102-006	Check drain of charge air receiver	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
6104		***Exhaust gas piping***															
	6104-004	Inspection of exhaust-lines, exp. bellows, covers, insulation etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐
	6104-006	Renew exhaust expansion bellows.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
6108		***Air intake filter(s)***															
	6108-003	Renew air filter material of turbocharger(s)/silencer(s).	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	6108-004	Insp./clean air filter(s)/silencer(s).	☐	☐	☒	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐
6120		***Turbocharger(s)***															
	6120-004	Clean turbocharger(s) at compr. side by means of water-injections.	☐	☒	☒	☒	☒	☒	☒	☐	☒	☐	☒	☐	☒	☐	☐
	6120-008	Renew compressor wheel of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
	6120-009	Insp./overhaul turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☒	☒
	6120-012	Insp./clean entire turbocharger, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	6120-014	Check balance the rotor-shaft of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	6120-015	Renew bearings of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☒	☒
	6120-021	Renew turbine wheel of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
6201		***LP fuel line(s)***															
	6201-003	Renew O-rings in supply- and discharge-lines.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
6203		***HP fuel line(s)***															
	6203-005	Inspection of H.P.fuel-lines on cavitation and conical sealing.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	6203-006	Renew HP-fuel-lines.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
6206		***Fuel filter***															
	6206-002	Renew fuel filter-element.	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	6206-004	Check pressure difference indicator of fuel-filter.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
6303		***Main lub. oil system***															
	6303-001	Check lub.oil by sampling and according formula; refresh if necessary.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
6404		***Cool water system***															
	6404-001	Check de-aeration of the c.w.system.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	6404-003	Check Ph-value, chloride contents and additive concentration.	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	6404-005	Clean and check the c.w.system of the cyl.block for corrosion and	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
8203		***Safety / alarm / stopping devices***															
	8203-013	Check on functioning of oilmistdetector.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8203-016	Check alarm and safety systems/devices.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8203-017	Check measuring devices on proper working.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8203-018	Calibrate measuring devices.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
8502		***Starting motor(s)***															
	8502-001	Inspect starting air motor and performance test of automatic lubricating device.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
	8502-002	Insp./overhaul starting air motor.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐
8703		***Engine foundation***															
	8703-001	Check alignment between engine and driven machinery.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8703-002	Check foundation bolts, chocks and mounting elements.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8703-003	Check elastic engine mounting elements.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8703-006	Check foundation bolts, chocks and mounting elements, each 2 month during first year.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Intervals MDO/LFO [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			Sp	D	W	0.5	1	2	4	8	12	24	36	48	60	72	96
9004		***Thermostats***															
	9004-005	Insp./overhaul c.w.thermostats.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
	9004-006	Insp./overhaul oil-thermostats.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
	9004-008	Renew c.w.- and oil-thermostats.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐
9203		***Elastic coupling***															
	9203-001	Inspection of the elastic elements of flexible coupling.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☐	☒	☒	☐
	9203-002	Inspection of the elastic elements of flexible coupling, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	9203-004	Renew elastic elements of flexible coupling.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
9205		***Vibration damper(s)***															
	9205-001	Sample visc.fluid of vibr.damper; first sample after 12000 hrs, afterwards acc. advise.	☒	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐
	9205-006	Renew vibr.damper.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐

Maintenance intervals for W26 HFO

Intervals [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			Sp	D	W	0.5	1	2	4	8	12	24	36	48	60	72	96
1000		***General***															
	1000-001	Check on leakage's at the engine. Check on fixation of piping and cables.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-002	Record performance data in engine log sheet.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-003	Check the fluid levels.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-005	Check the engine on bolt connections.	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-006	Carry out a test run.	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☐	☐	☐	☐
	1000-007	Carry out a running-in program. Taking down readings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	1000-009	Test start process of the engine. Engine in standby position.	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1000-014	Carry out a load performance test.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
1101		***Crankcase***															
	1101-001	Visual inspection of crankcase.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
1102		***Main bearing(s)***															
	1102-002	Inspection of 1 main bearing.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	1102-005	Renew main bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
1111		***Crankshaft***															
	1111-001	Check crankshaft deflections and axial bearing clearances.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1111-007	Inspection of crankpins.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	1111-008	Inspection of 1 main journal.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	1111-009	Inspection of main journals.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1111-010	Renew crankshaft-sealing.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1111-011	Inspection of 1 crankpin, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1111-014	Renew crankshaft-sealing of PTO-shaft.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
1302		***Cylinder liner(s)***															
	1302-001	Endosc. inspection of cylinder liners.	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☐	☐	☐	☐
	1302-012	Inspection of 1 cylinder liner, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1302-013	Renew cylinder liner(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐
	1302-018	Insp./overhaul cylinder liners and renew the anti-polishing rings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
1400		***Piston(s) & connecting rod(s)***															
	1400-004	Inspection of gudgeon-pins and gudgeon-bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☐	☒	☒	☐
	1400-007	Inspection of 1 gudgeon-pin and -bearing, after the first 4000 running	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1400-009	Renew gudgeon-pins and gudgeon-bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐
1401		***Connecting rod(s)***															
	1401-004	Renew crankpin bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	1401-010	Insp./overhaul connecting rods.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	1401-014	Inspection of 1 connecting rod, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1401-017	Inspection of 1 crankpin bearing, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1421		***Piston(s)***															
	1421-010	Insp./overhaul pistons, renew piston rings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☐	☒	☒	☐
	1421-011	Insp./overhaul 1 piston incl. piston-rings, after the first 4000 running	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1421-012	Renew piston(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒

Intervals HFO [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			D		0.5		2		8		24		48		72	
			Sp	W		1		4		12		36		60		96
1501		Injector(s)														
	1501-005	Insp./overhaul and test injector holders complete.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	1501-008	Renew the injector-nozzles.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	1501-009	Renew inner parts of injector holder.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒
1503		Safety valve(s)														
	1503-004	Inspection of safety valves.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
1504		In / exhaust valve(s)														
	1504-001	Check valve clearances.	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1504-002	Endosc. inspection of all valves cq seats.	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☐	☐	☐
	1504-003	Check valve clearances in new and overhauled engine, after the first 100 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1504-005	Renew inlet valves.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐
	1504-006	Renew exhaust valves.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1504-008	Insp./overhaul exhaust valves.	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	1504-010	Insp./overhaul inlet valves.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
1511		Cylinder head(s)														
	1511-008	Insp./overhaul cylinder heads.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	1511-012	Function check of valve rotators.	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	1511-013	Insp./clean valve rotators.	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	1511-014	Renew valve rotators.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1511-015	Inspection of 1 cylinder head, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1511-016	Renew safety valves.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
1530		Rocker-arms assembly														
	1530-007	Insp./overhaul rocker-arms assembly.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
1531		Pushrod(s)														
	1531-001	Check push rod pivots.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
1620		Gear train														
	1620-010	Inspect gear pump drive.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1620-011	Inspect gear camshaft drive.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	1620-014	Inspect gear pump drive, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1620-015	Inspect gear camshaft drive, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2100		Camshaft(s) with cam followers														
	2100-002	Check fuel injection timing.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	2100-004	Renew camshaft-bearings and inspect journals.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
	2100-014	Inspection of the cams.	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	2100-016	Inspection of 1 camshaft-bearing and journal.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☒	☐
	2100-018	Inspection of 1 inlet- and exhaust-cam follower.	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	2100-019	Inspection of inlet- and exhaust-cam followers.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	2100-020	Inspection of 1 fuel-cam follower and pedestal.	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐
	2100-021	Inspection of fuel-cam followers and pedestals.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
2106		Fuel injection pump(s)														
	2106-005	Insp./clean fuel injection pumps.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	2106-007	Renew inner elements and calibrate the HP fuel pumps.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	2106-010	Check leak fuel quantity of the fuel system.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	2106-011	Insp./clean 1 fuel injection pump, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2107		Control air system														
	2107-002	Drain starting air vessels and air treatment unit(s), check system on leakage, oxide. and water.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
2301		Fuel rack mechanism														
	2301-001	Check and lubricate the control mechanism.	☐	☐	☒	☒	☒	☒	☒	☒	☐	☒	☐	☒	☐	☐
	2301-006	Insp./overhaul control mechanism.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
3001		Hydraulic governor(s)														
	3001-002	Refresh lubricating oil in governor.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	3001-005	Insp./overhaul governor.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
3005		Governor drive														
	3005-004	Insp./overhaul governor drive.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
4005		Turning device(s)														
	4005-002	Check operation of turning device and start-interlock device.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	4005-004	Refresh lub.oil of turning device.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
5101		Lubricating oil pump(s)														
	5101-006	Insp./overhaul lub.oil pump(s).	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒

Intervals HFO [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			D		0.5		2		8		24		48		72	
			Sp	W		1		4		12		36		60		96
5301		***Lubricating oil cooler(s)***														
	5301-007	Insp./overhaul lub.oil cooler-stack.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
5302		***Air cooler(s)***														
	5302-008	Insp./overhaul air coolers-stack.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	5302-009	Inspection of fresh-water side of the air cooler-stack, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5402		***Fresh coolingwater pump(s)***														
	5402-006	Insp./overhaul HT-cooling water pump.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	5402-008	Insp./overhaul LT-cooling water pump.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
5415		***Raw coolingwater pump(s)***														
	5415-003	Inspection/overhaul of raw c.w. pump and replacement of seals and ball bearings.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
5611		***Lubricating oil filter***														
	5611-001	Renew lub.oil filter elements.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	5611-002	Clean built-on centrifugal by-pass lub.oil filter and renew insert	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	5611-007	Renew all seals at the build-on centrifugal by-pass lub.oil filter.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
6102		***Air inlet line(s)***														
	6102-006	Check drain of charge air receiver	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
6104		***Exhaust gas piping***														
	6104-004	Inspection of exhaust-lines, exp. bellows, covers, insulation etc.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☐	☒	☒	☐
	6104-006	Renew exhaust expansion bellows.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
6108		***Air intake filter(s)***														
	6108-003	Renew air filter material of turbocharger(s)/silencer(s).	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	6108-004	Insp./clean air filter(s)/silencer(s).	☐	☐	☒	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐
6120		***Turbocharger(s)***														
	6120-004	Clean turbocharger(s) at compr. side by means of water-injections.	☐	☒	☒	☒	☒	☒	☒	☐	☒	☐	☒	☐	☒	☐	☐
	6120-008	Renew compressor wheel of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
	6120-009	Insp./overhaul turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☒	☒
	6120-011	Clean turbocharger(s) at turb. side, by means of water injection; at least once per week.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	6120-012	Insp./clean entire turbocharger, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	6120-014	Check balance the rotor-shaft of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒	
	6120-015	Renew bearings of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☒	☒	
	6120-021	Renew turbine wheel of the turbocharger(s).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	
6201		***LP fuel line(s)***														
	6201-003	Renew O-rings in supply- and discharge-lines.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
6203		***HP fuel line(s)***														
	6203-005	Inspection of H.P.fuel-lines on cavitation and conical sealing.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒
	6203-006	Renew HP-fuel-lines.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
6206		***Fuel filter***														
	6206-002	Renew fuel filter-element.	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	6206-004	Check pressure difference indicator of fuel-filter.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
6303		***Main lub. oil system***														
	6303-001	Check lub.oil by sampling and according formula; refresh if necessary.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
6404		***Cool water system***														
	6404-001	Check de-aeration of the c.w.system.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
	6404-003	Check Ph-value, chloride contents and additive concentration.	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	6404-005	Clean and check the c.w.system of the cyl.block for corrosion and	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☒
	6404-007	Inspection of cooling water spaces.	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☒	☐	☐	
8203		***Safety / alarm / stopping devices***														
	8203-013	Check on functioning of oilmistdetector.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8203-016	Check alarm and safety systems/devices.	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8203-017	Check measuring devices on proper working.	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	8203-018	Calibrate measuring devices.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
8502		***Starting motor(s)***														
	8502-001	Inspect starting air motor and performance test of automatic lubricating device.	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒	
	8502-002	Insp./overhaul starting air motor.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐	

Intervals HFO [*1000 hrs]: (Sp = Special, D= daily, W = Weekly)

			D		0.5		2		8		24		48		72	
			Sp	W		1		4		12		36		60		96
8703		***Engine foundation***														
	8703-001	Check alignment between engine and driven machinery.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	8703-002	Check foundation bolts, chocks and mounting elements.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	8703-003	Check elastic engine mounting elements.	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒
	8703-006	Check foundation bolts, chocks and mounting elements, each 2 month during first year.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9004		***Thermostats***														
	9004-005	Insp./overhaul c.w.thermostats.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
	9004-006	Insp./overhaul oil-thermostats.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☒	☒	☐	☒
	9004-008	Renew c.w.- and oil-thermostats.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐
9203		***Elastic coupling***														
	9203-001	Inspection of the elastic elements of flexible coupling.	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☐	☒	☒	☐
	9203-002	Inspection of the elastic elements of flexible coupling, after the first 4000 running hours.	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	9203-004	Renew elastic elements of flexible coupling.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒
9205		***Vibration damper(s)***														
	9205-001	Sample visc.fluid of vibr.damper; first sample after 12000 hrs, afterwards acc. advise.	☒	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐
	9205-006	Renew vibr.damper.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐

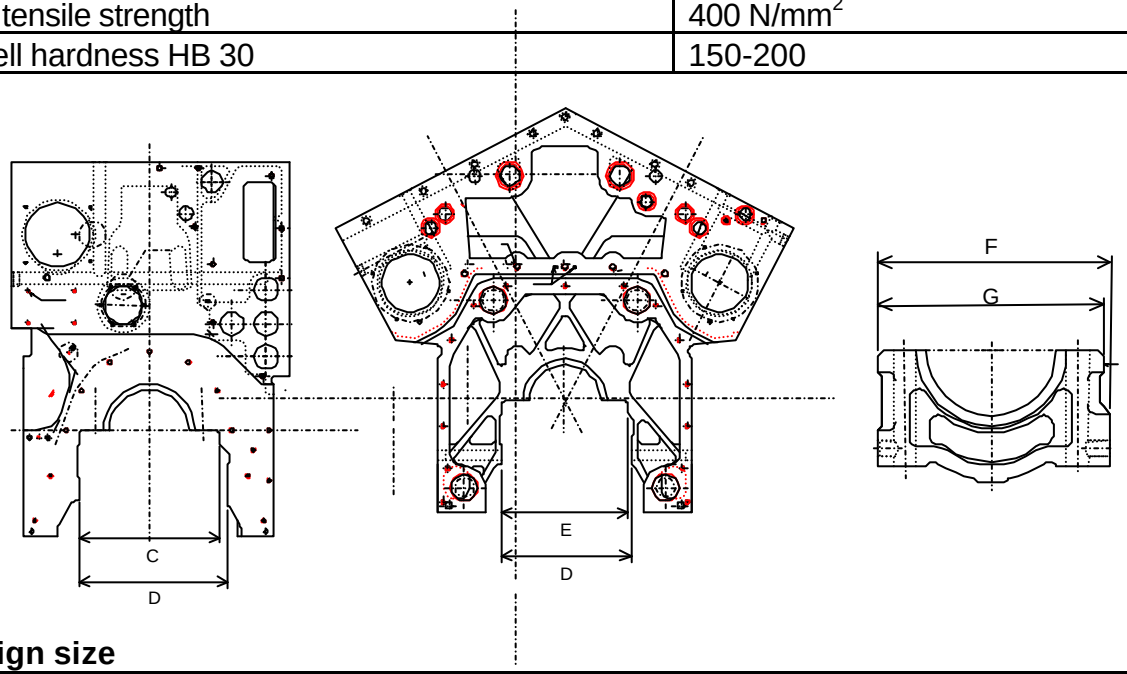
2.5 ENGINE BLOCK / CYLINDER LINER

Engine block

Material: GGG40

Mechanical material properties

Min. tensile strength	400 N/mm^2
Brinell hardness HB 30	150-200



Design size

Engine	D [mm]	E [mm]	F [mm]	G [mm]
26 L + 26V	553.000 553.070	523.000 523.044	552.934 552.978	522.934 522.978
No go				522.920

Main bearing cap

Material : GGG50

Mechanical material properties

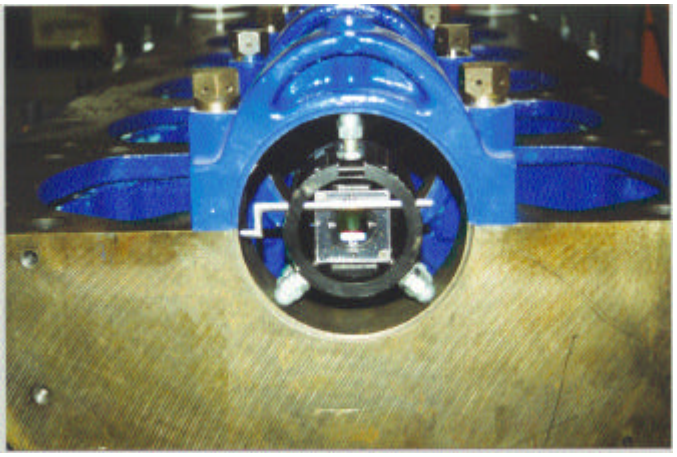
Min. tensile strength	500 N/mm^2
Brinell hardness HB 30	170-220 ; max 230

In case of a main bearing damage or a bearing in poor condition, check always dimension F and G (see table above) of the main bearing cap and the crankshaft deflections. In case of deviations check also the adjacent bearings / bearing caps (make a measurement protocol) and check the engine /gearbox/generator foundation and alignment. In case of unallowable deviations of the main bearing cap, the bearing cap should be renewed and the engine should be line-bored.

Guideline for laser line-bore measurements

Required measuring equipment

Laser transmitter (for example transmitter : Fixtur Digilaser FL11 or Damalini Easy Laser D75)+ *special designed bracket* (not shown)



Laser detector (for example Digilaser D11 or Easy Laser D5) +. ***Machine Support line-bore bracket***

Display box *for signal read out* :consisting of laser signal convertor + cables (for example Digilaser display box incl. **Adcom** or Easy Laser display box).

Laser transmitter *for flatness check* (for example Digilaser FL100 or Easy Laser D22).

Notes:

- The used laser detector should match with the display box.
- The resolution of the Adcom should be set on 0,01 mm.
- Use the following filter settings for the Diglaser Adcom or Easy laser:
  Engine shorter then 3000 mm – 6 seconds.
  Engine length larger than 3000mm - 12 seconds.
- Enter the real distance between the centre of the main bearing pockets (±5 mm) into the Adcom. (for W26 distance = 390 mm)
- X+ side of the detector should match the 2x2 legs bottom side of the bracket.
- Before measuring, switch on the laser transmitter. Allow the equipment to acclimatise to site temperature with a minimum of 15 minutes. Make sure that the lens of transmitter and detector are and stay clean.
- Wait 5 seconds before every measurement after placing the detector bracket and in case the Adcom is used the log scale on the computer should be below 60% of the scale.

Preparation:

1) Make a measurement protocol of the (new) bearing caps (size F;G)
   (See Measurement record, mr26/1301/02)
2) Make a protocol of the engine block bearing caps rebate width D; E
   (See Measurement record, mr26/1301/02)
3) Mount all main bearing caps (renewed if necessary) without bearing shells according the procedure as mentioned in the engine manual.
4) Make a measurement protocol (a,b,c; a1,b1,c1) of all main-bores.
   (See Measurement record, mr26/1301/01)
5) Place the engine-block feet on six points (the engine block should be supported in the middle) in one horizontal plane preferable on adjustable chocks (e.g. vibracons; size ≥ SM 16) or by means of jack bolts.
6) Check the flatness of the horizontal plane of the engine-block feet by laser on six points (use for this a magnetic bracket on a cleaned surface), so there is no twist or bending in the engine block. A tolerance of ± 0.05 mm is allowed.

Checking the (main bearing) line bore:

7) Clean all the main bearing pockets with a cloth from dirt ,oil etc.
   Note: use no degreasing agent like thinner!
8) **Eliminate or remove as far as possible any vibrations, moving air and heat sources near the measuring site as these will disturb the measurements.**
9) Record all applicable data like: date, temperature, relation engine bearing pocket no. / measurement no. , direction of + for x / y , position eng. block, measurement before / after machining, damaged bearing pocket no, line-bored bearing pockets no's, and the oversize of bearing pocket(s), serial no's of the used measuring equipment.
   (see mr26/1301/01, mr26/1301/02, mr26/1301/03)
10) Mount the laser transmitter preferable rigidly to the engine block (on a rigid bracket) between 250 and 1000 mm distance of the first bearing pocket. (This to prevent reflection of the laser)

11) Adjust the laser detector bracket with the help of a measuring tape in the centre of the first and last pocket.
12) Fix the bracket to the right diameter of the bore (tolerance ± 1 mm)
13) Put the laser detector in the first pocket (seen from laser transmitter) with the bracket 2x2 legs down. The pointer should point to the split line of the bearing bore. Set the display box or Adcom to zero.
14) Turn the laser detector bracket upside down. The pointer should point to the split line of the bearing bore. Divide the readings on the display box or Adcom by two.
15) Adjust the laser transmitter bracket in radial position till the reading on the display box is zero in X and Y direction.
16) Turn the laser detector bracket in the starting position (2x2 legs of bracket down) and check if the reading on the display box or Adcom is still zero or very near (± 0.02 mm).
17) Put the laser detector bracket in the last pocket (seen from laser transmitter) and adjust the angle of the laser beam by using the micrometer screws on the laser transmitter.
    Check the stability of the laser transmitter by slightly pushing it. Depending on the distance between the laser transmitter and laser detector it should not move more then approx. 0.1mm, and it should return afterwards to zero.
18) Repeat step 13 -17 until the laser beam has reached an accuracy of ± 0.03 mm or better to the centre of the bore.
19) Check the line bore of the engine block, start in the last pocket (seen from laser transmitter).
    Position the laser detector bracket (make sure the laser detector bracket is in an upright position, the pointer should point to the split line of the bearing bore)
    Work to the first pocket and check each pocket by checking the reading on the display box.
    Note : if the laser detector bracket is mis-positioned, the reading on the display box will be larger then ± 0.1 mm.
    In that case take out the laser detector and re-position it.
    Work quickly but accurate (< 1 min. per position)
20) Rename the measured bearing numbers.
    Note : W26 pocket 0 is the first pocket on flywheel side.
21) Print out the line-bore report.
22) Repeat step 19 - 21.
23) Compare the two reports. A difference of 0.01 mm in 40% of all readings is allowable for engines shorter then 5000 mm. For larger engines this accuracy could be 0.02 mm if the measurement is done in field conditions. If there are more readings out of tolerance, repeat step 19 - 21.
    If there is again a difference larger then the tolerance, recheck all the equipment for failures and repeat the measurement one more time.
24) Determine the resultant of the measured X and Y value. (see mr26/1301/03)
    Determine the eccentricity of the main bearing line-bore over groups of three bores at a time. {(resultant left bore + right bore) / 2 – resultant middle bore}
    Note : the circular run-out is two times the eccentricity. (see mr26/1301/03)
    Compare the circular run-out with the no-go figure.

25) If necessary line bore one or more bores, check (if possible) after pre-machining and before final machining the new bore position by laser, see tolerances below.
Note ; When measuring an oversized bearing pocket a correction should be calculated because of the fact that the detector bracket legs (2x2) are positioned under an angle, or otherwise the detector bracket should be turned before the measurement over 180 degrees, so that the vertical movement can be measured directly.
26) Check after line-boring the line bore again by laser and make protocol.
(see mr26/1301/03) Note ; see note at point 25.
27) Make a measurement protocol (a,b,c; a1,b1,c1) of the line bored pocket(s) (without and with bearing). (See Measurement record mr26/1301/01)
28) Check crankshaft deflections and alignment before and after tightening the foundation bolts, and make protocols (see mr26/1301/01 and mr26/1111/01)
29) Check during running-in all bearing temperatures (after max. 5 min and after full load), and do a visual bearing / crankcase inspection, (see also chapter 2.3)
30) Check after running-in the paper element of the lub.oil filters on wear / bearing / dirt particles, and renew the lub.oil filters.

Note :

Technical Service WNSNL-S has developed a calculation program to judge the results before and after the line bore job.
It is recommended to send the results of the laser line bore measurements together with measurements of all pockets to the Technical Service for approval and advice.

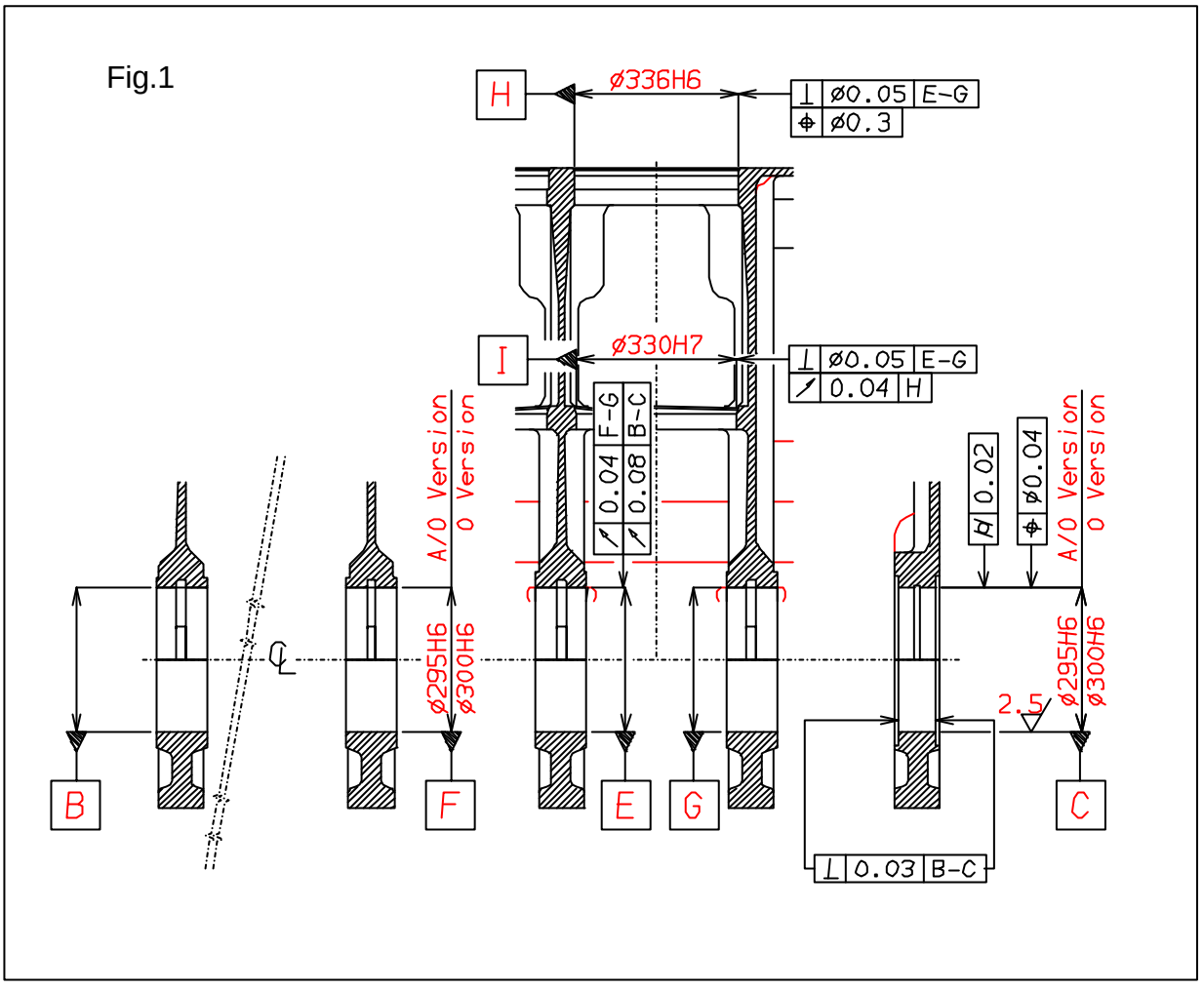
Main bearing bore tolerances:

(see also figure 1)

Main bearing bore (A / 0- version) : 295.000 - 295.032 mm.
Main bearing bore (0 - version) : 300.000 - 300.032 mm.
Positional tolerance of bore : 0.04 mm
(on theoretically exact position)
Bore cylindricity tolerance : 0.02 mm
Circular run-out tolerance :
- of bore compared to adjacent bores : 0.04 mm
- of bore compared to first / last bore : 0.08 mm

Perpendicularity tolerance of
cylinder liner bore to adjacent bores : 0.05 mm

Fig.1



Cylinder liner contact surface, tolerances and repair instructions

(see fig.2)	Flatness tolerance	: 0.015 mm
	Perpendicularity tolerance I - H	: 0.025 mm
	Recess for contact surface design	: 0.8 - 1.2 mm
	Recess for contact surface max.	: min. measured value (within design tolerance) + 0.2 mm.

(if necessary glue a 3 mm thick ring with Loctite 638, after machining contact surface on recess design value (1 mm) + 3 mm,

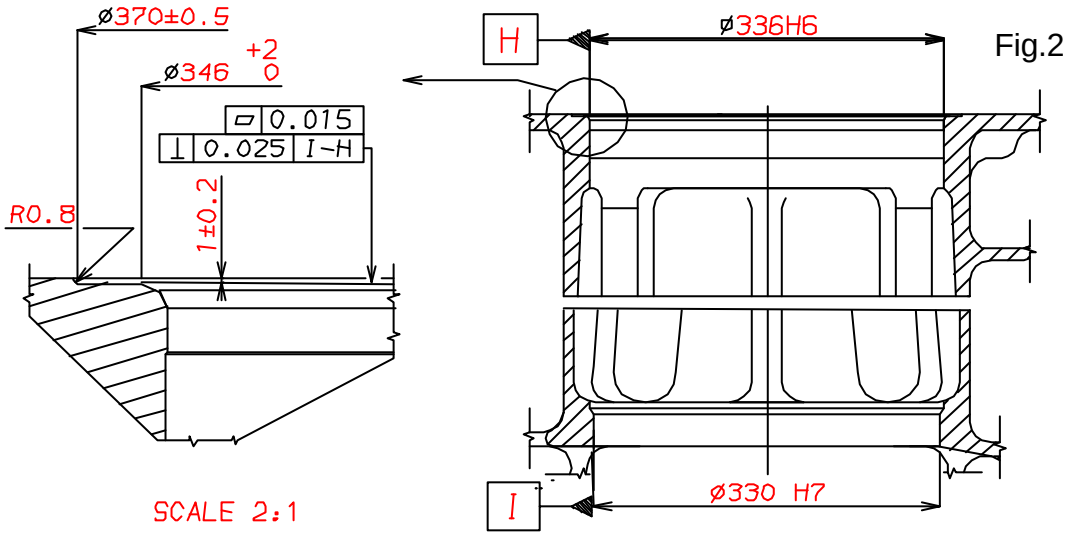
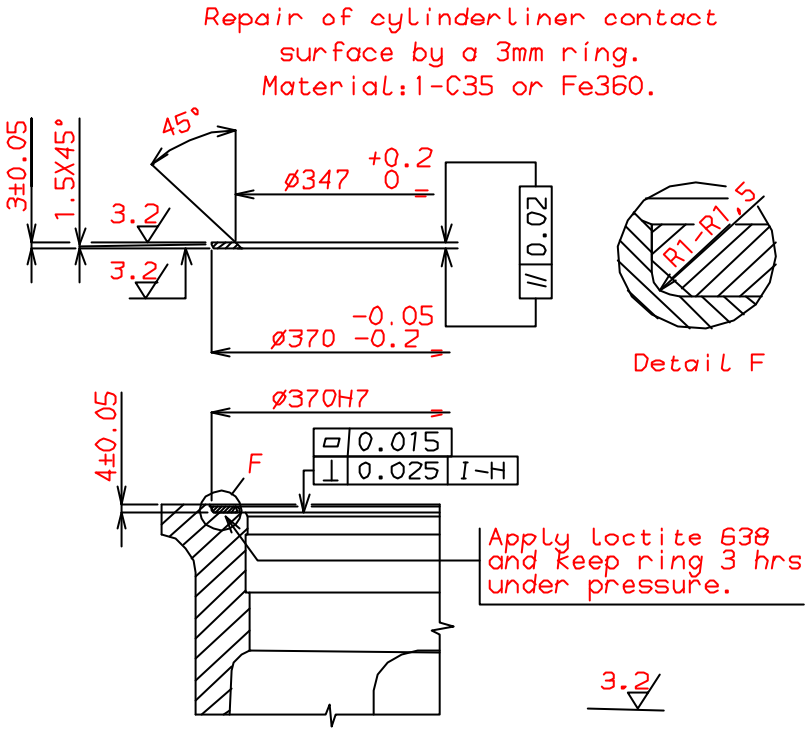


Fig.2



Cylinder liner reconditioning

1 Material ;
Material: GG 30 (Centrifugally cast)

2 Honing quality criteria;
2.1 Uniformity of the honing appearance
The overall appearance of the cylinder wall should be clear, uniform and clean.
2.2 Formation of honing scores.
Cut edges clean and sharp, with scores uniform.
2.3 Orientation of honing scores
Uniform cutting during the upward and downward strokes.
2.4 Honing profile
Sharply cut, edges not turned down and smeared over, see fig 3.

3 Hone machining:

Whenever new piston rings are mounted, the cylinder liner must be honed by means of " plateau honing "

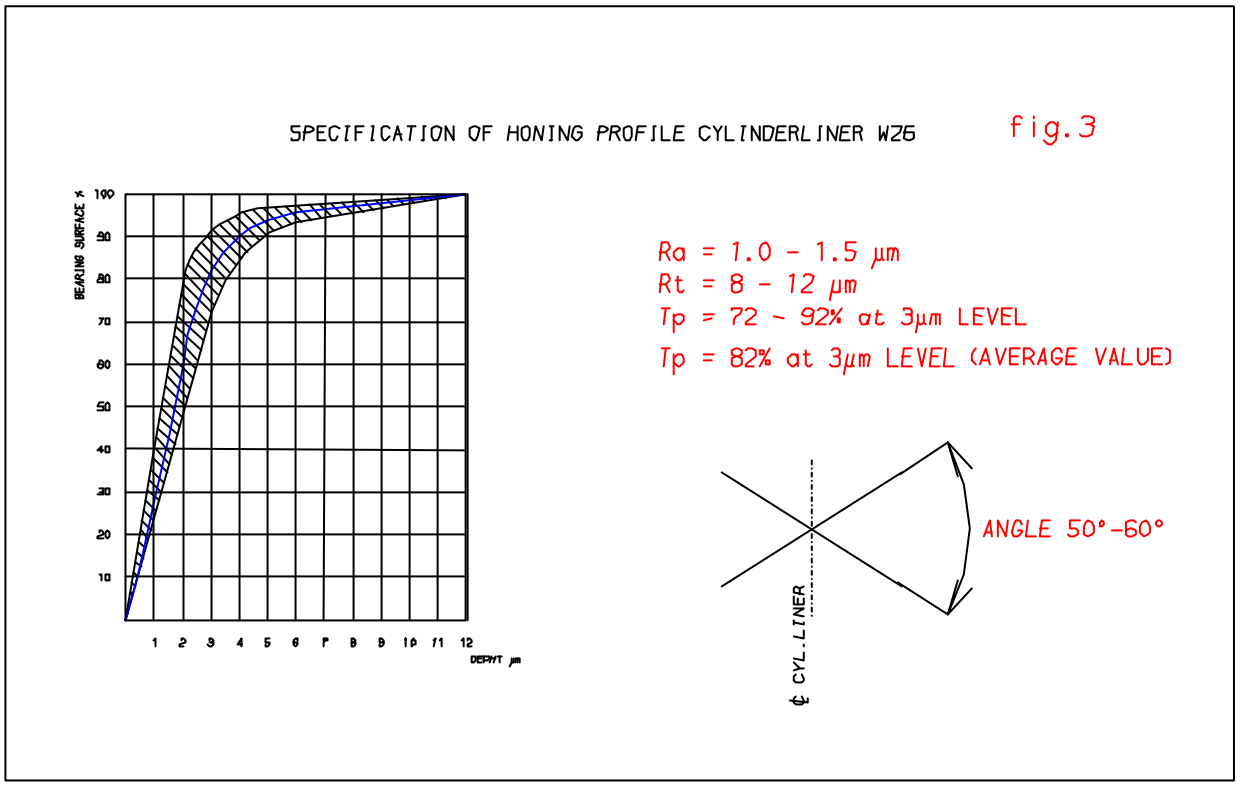
- If the machining is done in the engine block, honing debris / coolant must be prevented from falling into the sump.
- Use a fair amount of clean gas oil as coolant, and to flush away the grains.
- During honing the stones should not leave the liner surface for more than max. 2 - 3 cm length.
- Clean hone stones regularly (every 2 - 3 minutes) by rubbing another hone stone over the running surface of the hone stone to prevent smearing of the honing profile.
- The up- and down speed in combination with the rotation speed of the honing machine determines the honing groove cross angle.
- The coarseness of the stone in combination with the contact pressure against the liner wall and the duration of hone machining determines the amount of material that is removed and the roughness of the hone groove created.
- Use ceramic hones with a coarseness of 100 to roughen the surface.
  (in case of scoring marks, removal of ovulate etc. diamond stones can be used
- for pre-machining) .**When roughening, try to remove as little material as possible.**
  Therefore a "divergent shaped" liner is allowed (see no-go sizes). In the upper region of the liner extra machining has to be carried out, as the liner is mainly worn in this region.

Therefore hone after each full stroke alternately, the top part of the liner bore (over a height of approx. 20 cm)

- Check the honing groove cross angle during honing and **stop to hone as soon as the liner surface is machined clean.**
  The overall appearance of the cylinder wall should be clear and uniform.
- Use ceramic hones with a coarseness of 400 to finish the surface.
  The sharp tops will be removed from the coarse grooves made before and the so called "plateau honing " will be created.

Note : The longer you machine the smoother the liner surface becomes.
Check the roughness of the upper part of the liner (on different places) by means of a perthometer and check also the honing groove cross angle during honing regularly.

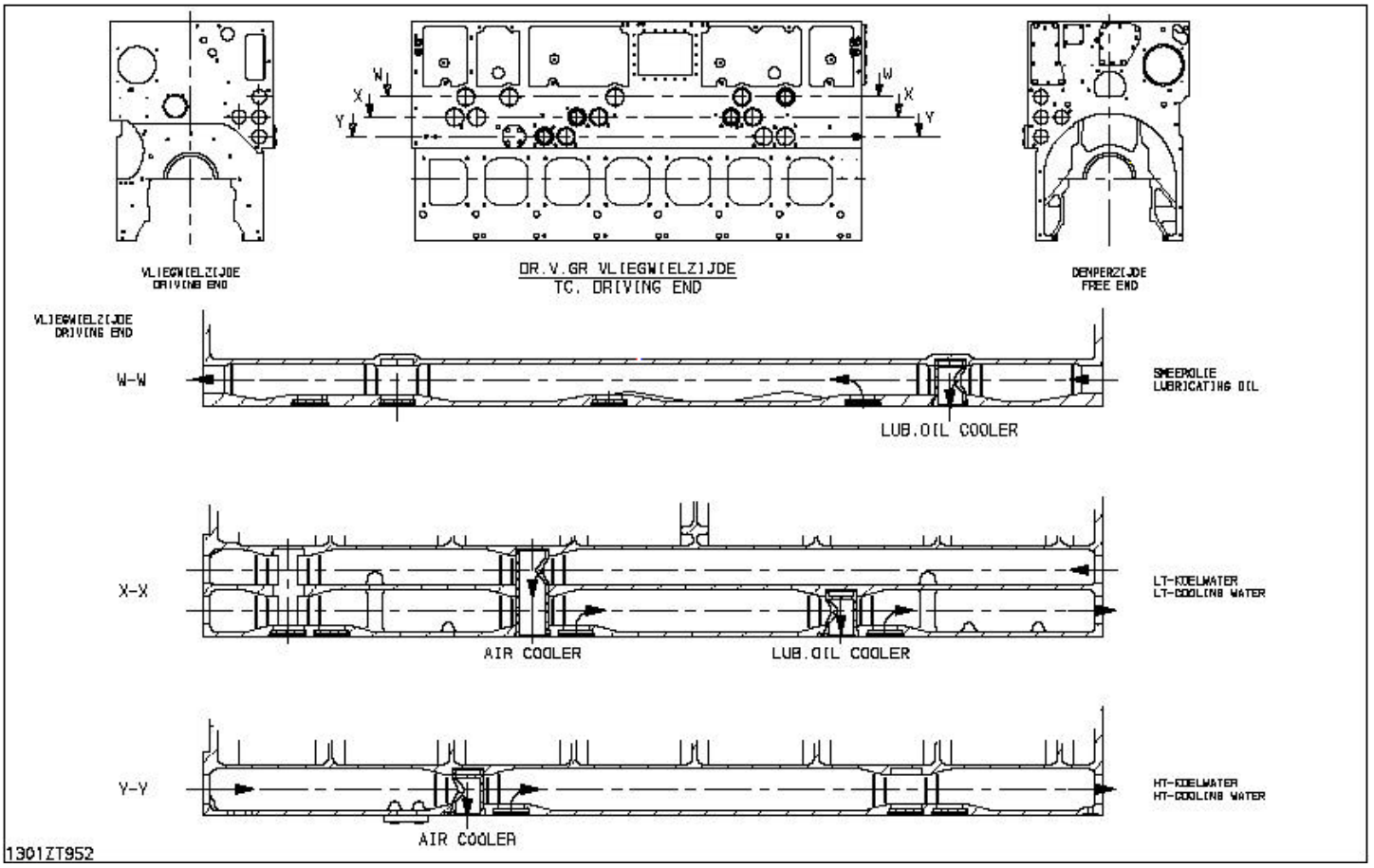
Stop the finishing as soon the honing profile is within specification (see fig. 3).
- Make a cyl. liner measurement protocol and attach the measured roughness profile. Compare the liner measurements with no-go dimensions.



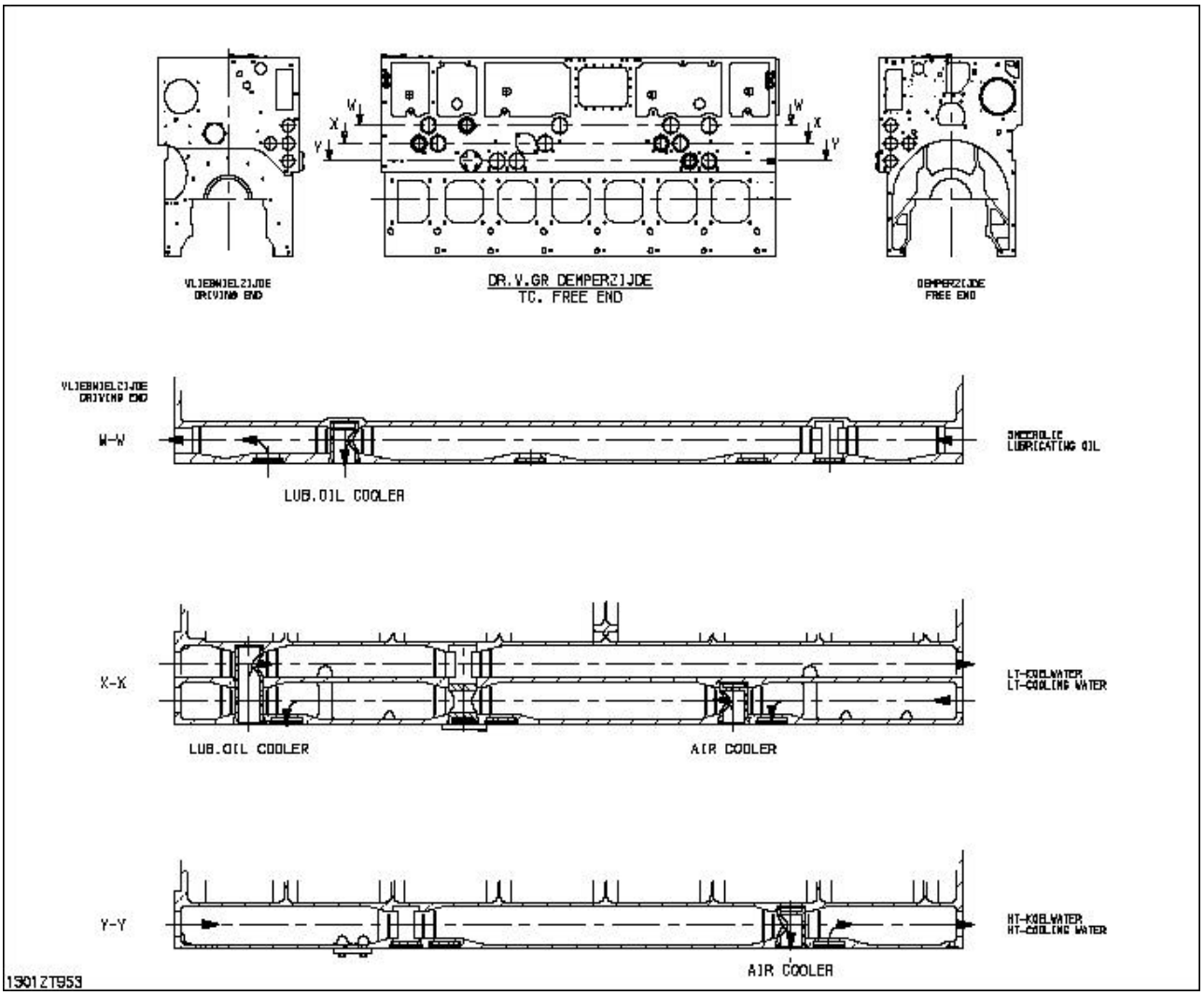
Note :
- After honing is completed, clean the bore carefully with e.g. gas oil by using a suitable brush, then dry the liner with e.g. a cloth.

Lubricate the liner bore with engine oil for corrosion prevention.

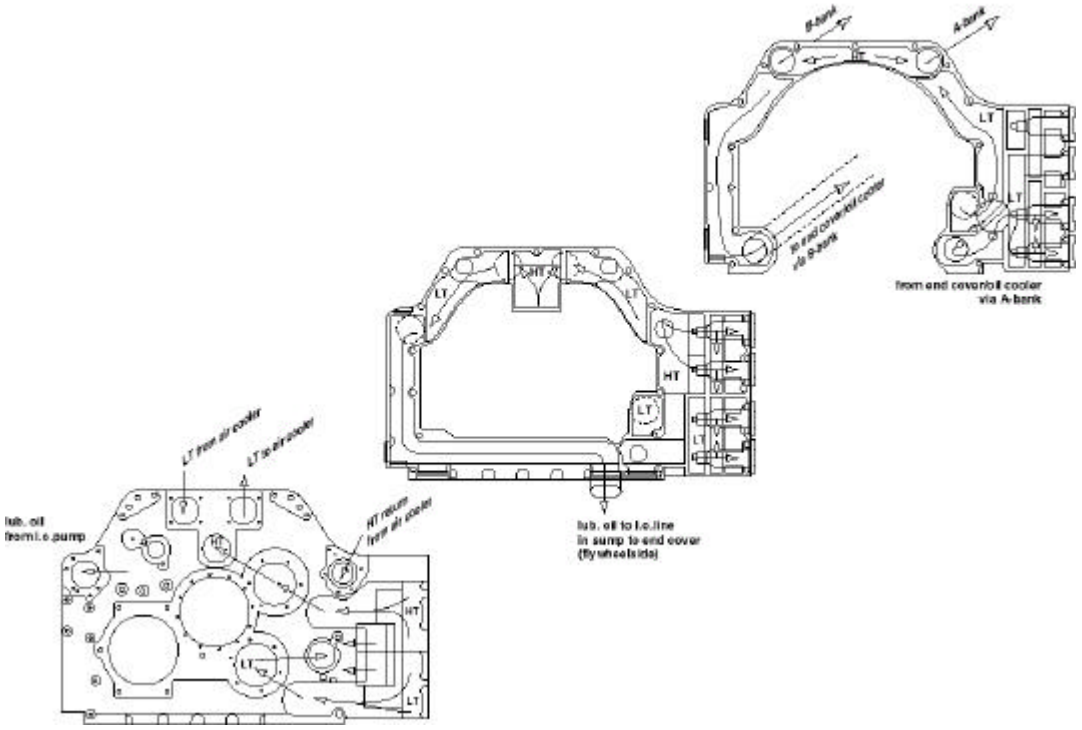
Lub.oil - ht/ lt cooling water; t.c. driving end



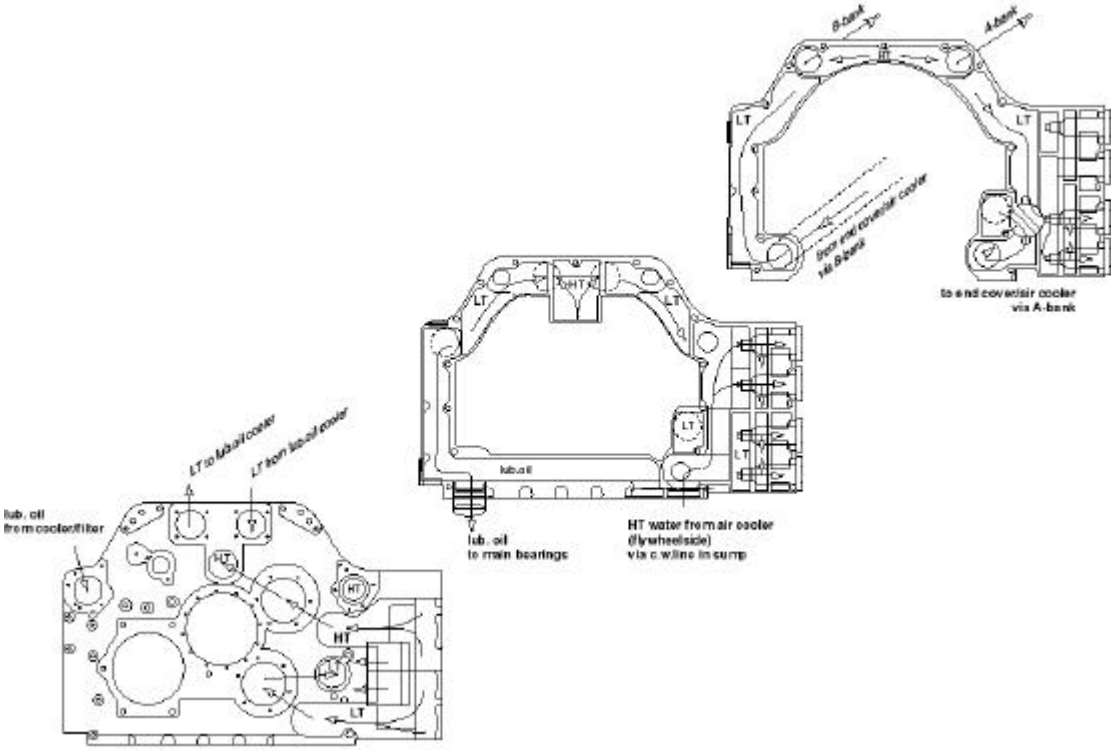
Lub.oil - ht/ lt cooling water; t.c. free end



Lub.oil - ht/ lt cooling water

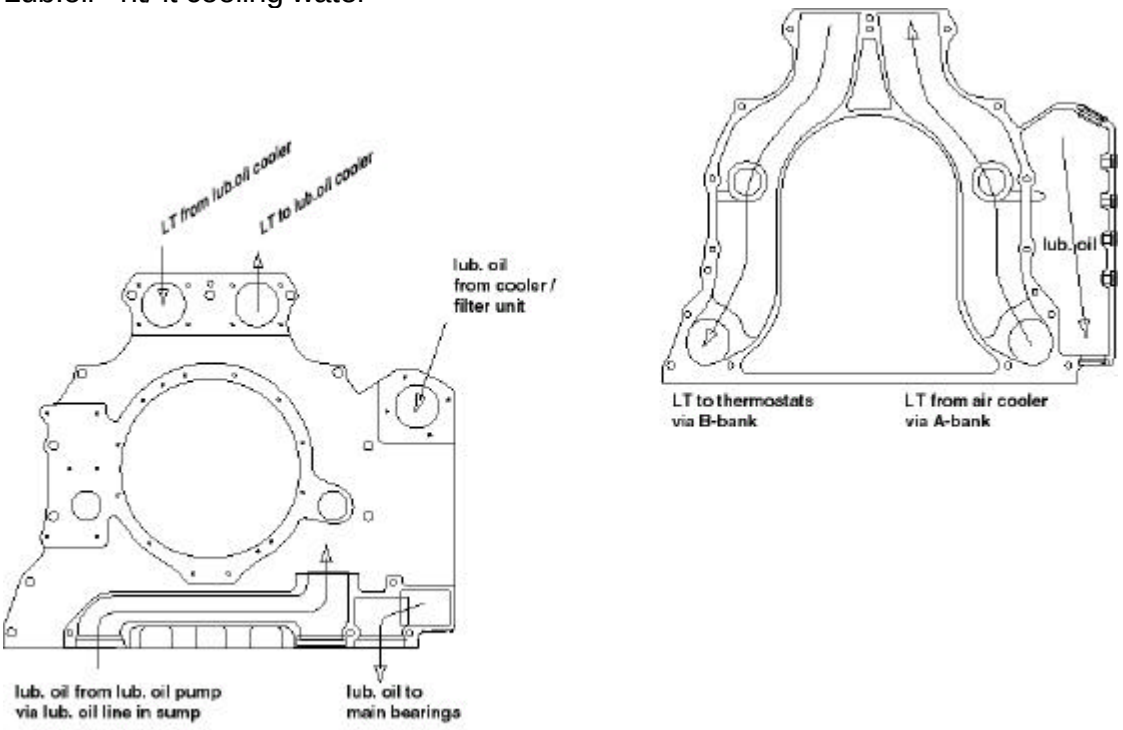


W26 Pump cover DPP

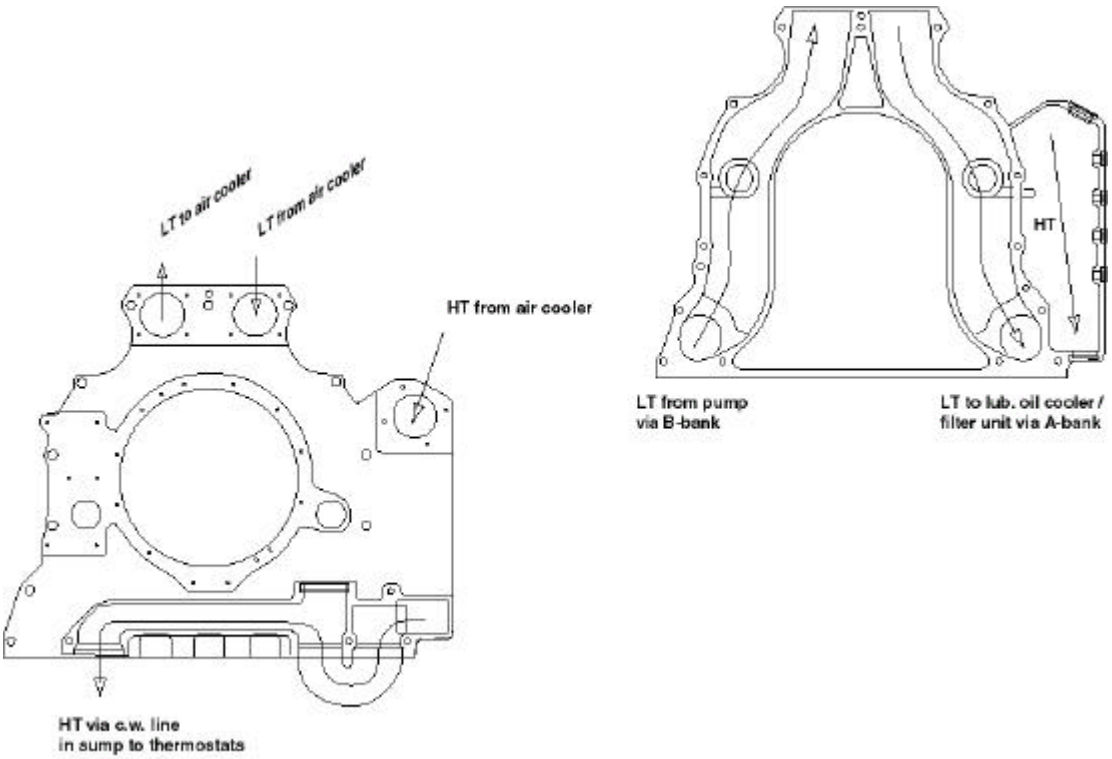


W26 Pump cover Marine

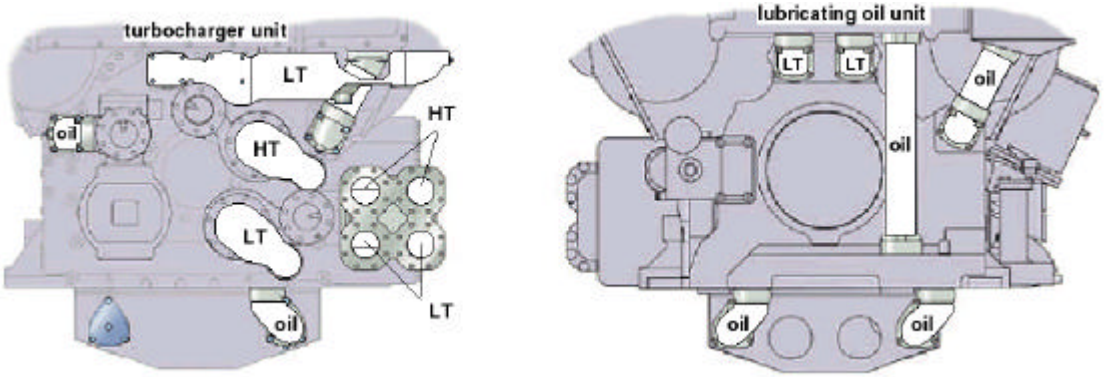
Lub.oil - ht/ lt cooling water



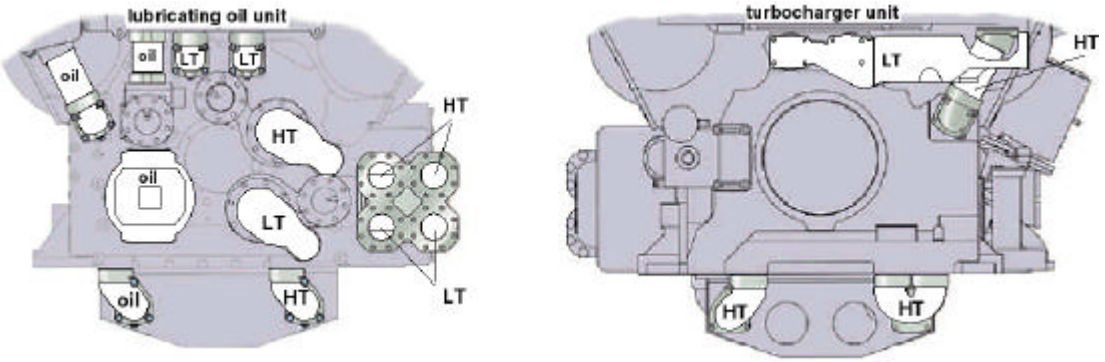
W26 End cover DPP



W26 End cover Marine



W26 Connecting Pieces DPP



W26 Connecting Pieces Marine

Main bearings

Main bearings overview

						inner diam.	outer diam.	
	MAIN BEARINGS					280	300	
MAIN BEARING (AlSn20)		MAIN BEARING- 0 (AlSn20)		undersize (mm)		axle	housing	oversize (mm)
upper/lower	partnumber		partnumber	-2	-1	std	std	+1
upper	1111ZT125		1111ZT111			replaced		
lower	1111ZT110		1111ZT112			by		
upper	1111ZT130		1111ZT132			bial		
lower	1111ZT131		1111ZT133			bearings		
MAIN BEARING (BIAL)		MAIN BEARING- 0 (BIAL)		undersize (mm)		axle	housing	oversize (mm)
upper/lower	partnumber		partnumber	-2	-1	std	std	+1
upper	1111ZT150		1111ZT152					
lower	1111ZT151		1111ZT153					
upper	1111ZT501		1111ZT507					
lower	1111ZT502		1111ZT508					
upper	1111ZT503		1111ZT509					
lower	1111ZT504		1111ZT510					
upper	1111ZT505		1111ZT512					
lower	1111ZT506		1111ZT512					
						inner diam.	outer diam.	
	MAIN BEARINGS					280	295	
MAIN BEARING (BIAL)		MAIN BEARING- 0 (BIAL)		undersize (mm)		axle	housing	oversize (mm)
upper/lower	partnumber		partnumber	-2	-1	std	std	+1
upper	1111ZT140		1111ZT142					
lower	1111ZT141		1111ZT143					
upper	1111ZT513		1111ZT519					
lower	1111ZT514		1111ZT520					
upper	1111ZT515		1111ZT521					
lower	1111ZT516		1111ZT522					
upper	1111ZT517		1111ZT523					
lower	1111ZT518		1111ZT524					
	AXIAL / THRUST RINGS							
	partnumber							
upper/lower	1111ZT113							

2.6 PISTON/CONNECTING ROD

Piston

General

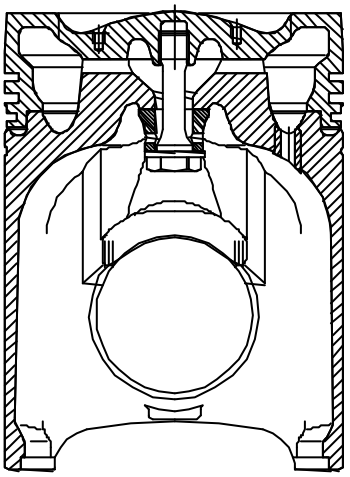
Material of piston skirt: cast iron M-5 70.
Material of piston crown: 42 CrMo 4 V

Removal of piston crown

Remove piston crown only for cleaning purposes in case of bearing damage. Use special tool.

Tightening of piston crown

1) Lubricate thread and contact surface of bolt head with Molykote G-n plus.
1) Tighten bolt with 250 Nm.
2) Loosen bolt.
3) Tighten bolt with 80 Nm.
4) Turn bolt 70° + 5° further.



Check :

Check the torque with 250 Nm, the bolt should not turn further !

Note : *Replace bolt if the total length exceeds 107.0 mm.*

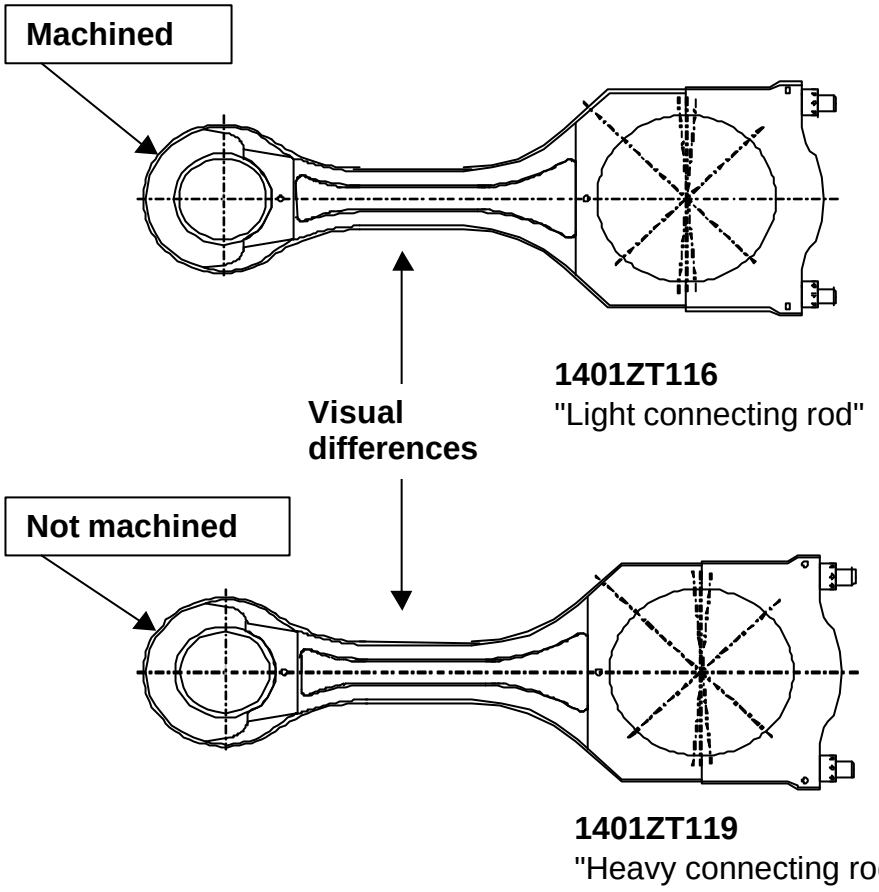
Connecting rod

Connecting rod complete

Material: 42CrMo4

Summary of applied connecting rods	
Material number	Remarks
1401ZT116	-
1401ZT119	3.5 Kg heavier than 1401ZT116

The 'light' (1401ZT116) and the "heavy' (1401ZT119) connecting rods are interchangeable according to the table.
The visual differences are shown in the pictures below.



1401ZT116
"Light connecting rod"

1401ZT119
"Heavy connecting rod"

Weight connecting rod 1401ZT119 = weight connecting rod 1401ZT116 +3.5 [kg].

Changeability of connecting rods

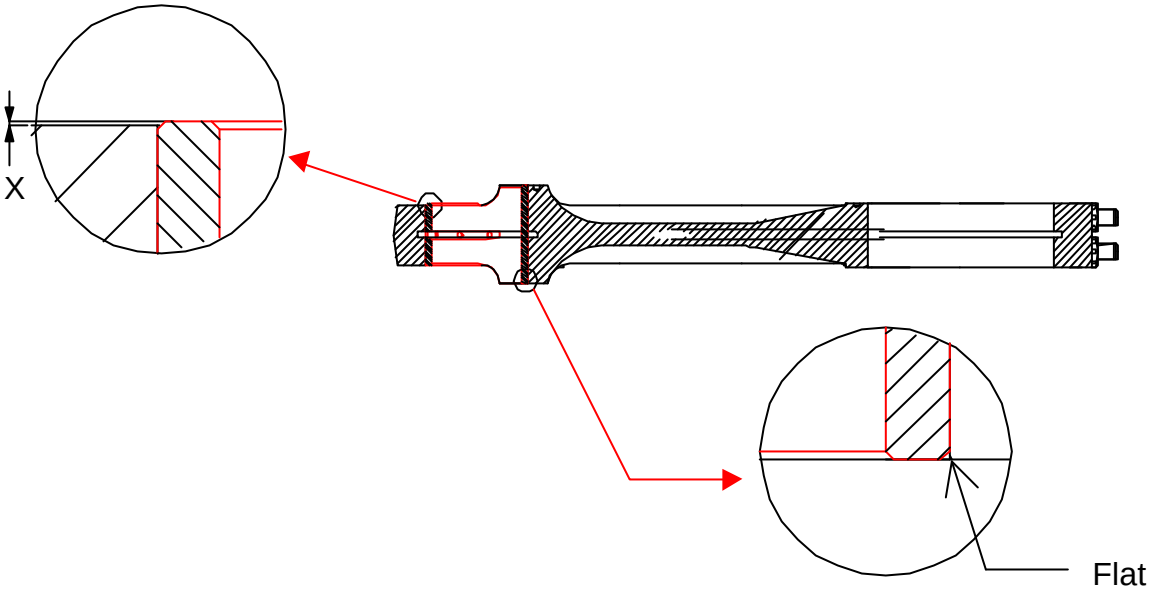
The exchange of only 1 (one) connecting rod		
Engine version	**Arrangement**	
	Flexible mounted	**Fixed[1] mounted**
6L	Allowed	Allowed
8L	Allowed	Allowed
9L	Not allowed	Allowed
12V	Allowed	Allowed
16V	Allowed	Allowed
18V	Not allowed	Allowed
The change of 2 or more connecting rods, only after consultation of the Technical Service department.		

[1] Also applies for flexible arrangement of the fundation plate.

Assembly of small end bearing

Cool the gudgeon-pin bearing bush in liquid nitrogen before fitting

Adjustment dimension X = min 0,25 mm

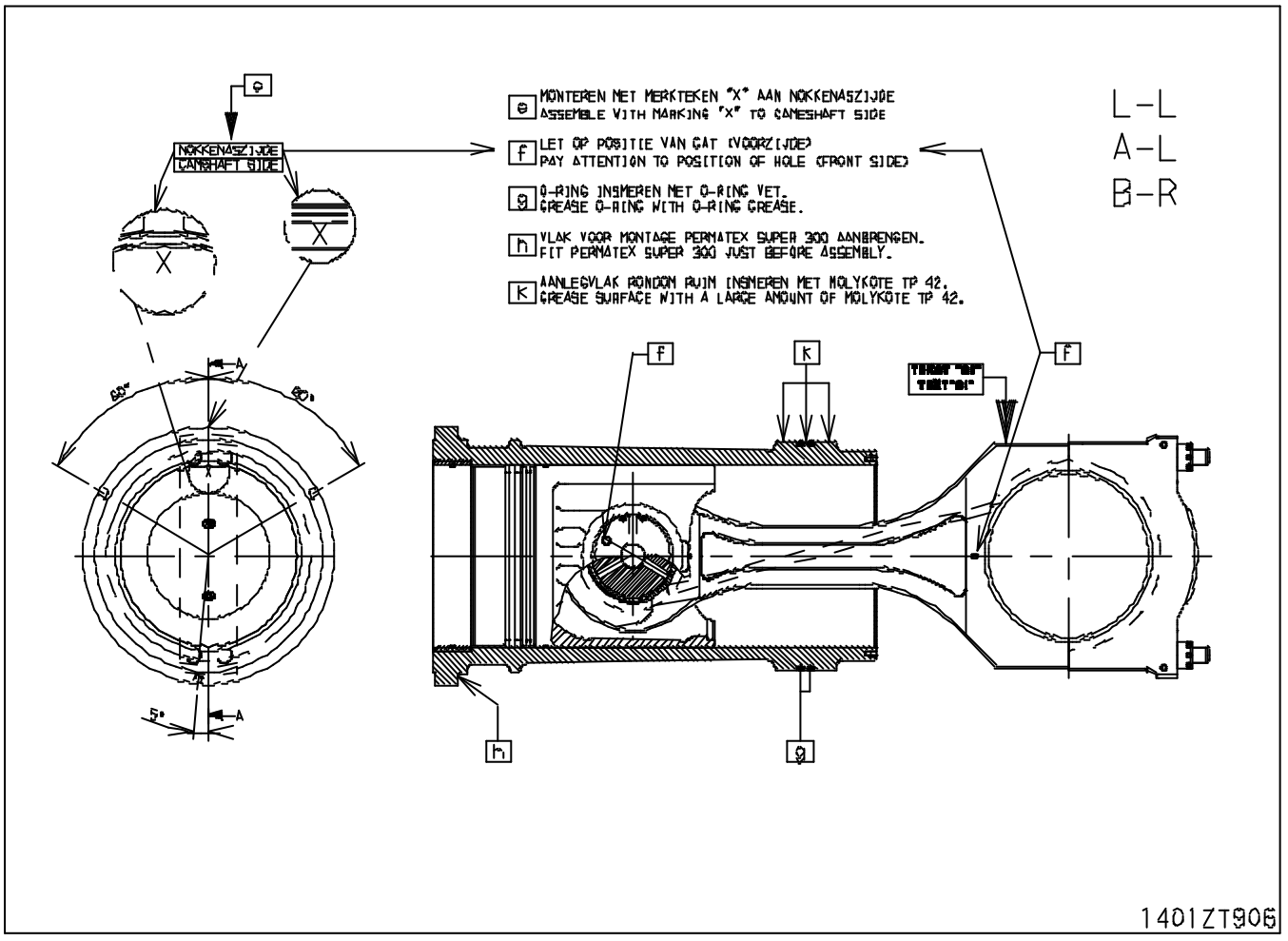


Summary of connecting rod bearings

		CONNECTING ROD				inner diam.	outer diam.	
			BEARINGS W26 (AlSn20)			235	247	
				undersize (mm)		axle	housing	
upper/lower	partnumber			-2	-1	std	std	
upper	1401ZT114					replaced		
lower	1401ZT115					by		
upper	1401ZT117					bial		
lower	1401ZT118					bearings		
		CONNECTING ROD				inner diam.	outer diam.	
			BEARINGS W26 (BIAL)			235	247	
				undersize (mm)		axle	housing	
upper/lower	partnumber			-2	-1	std	std	
upper	1401ZT120							
lower	1401ZT121							
upper	1401ZT123							Latest version
lower	1401ZT124							Latest version
upper	1401ZT501							
lower	1401ZT502							
upper	1401ZT503							
lower	1401ZT504							
		CONNECTING ROD				inner diam.	outer diam.	
			Small-end					
bearing -	partnumber					std	std	
bush	1401ZT106							

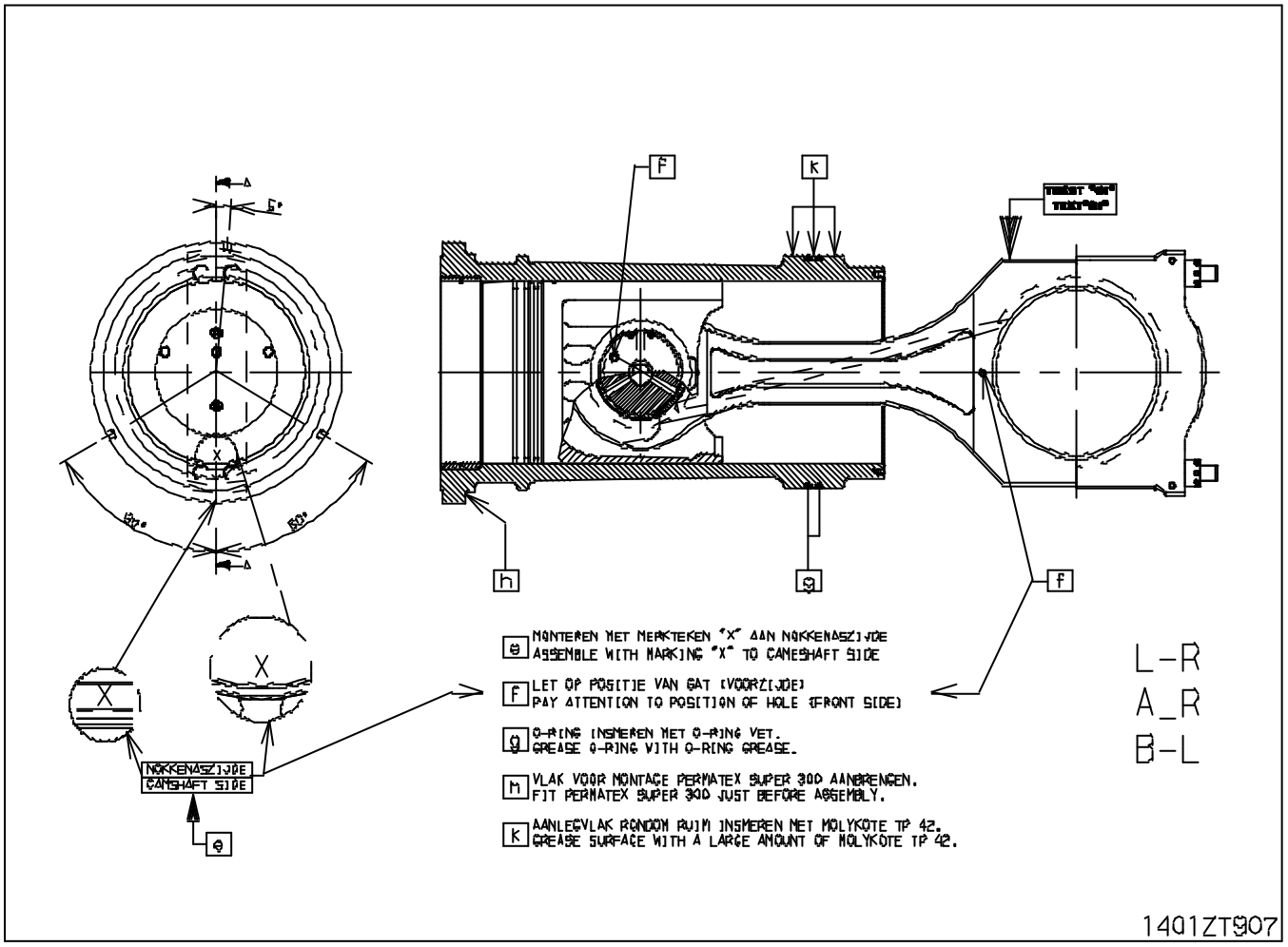
Driving unit, Assembly

Application		Rotating direction
Line engine		counter clockwise
Vee engine	A - Bank	counter clockwise
	B - Bank	clockwise



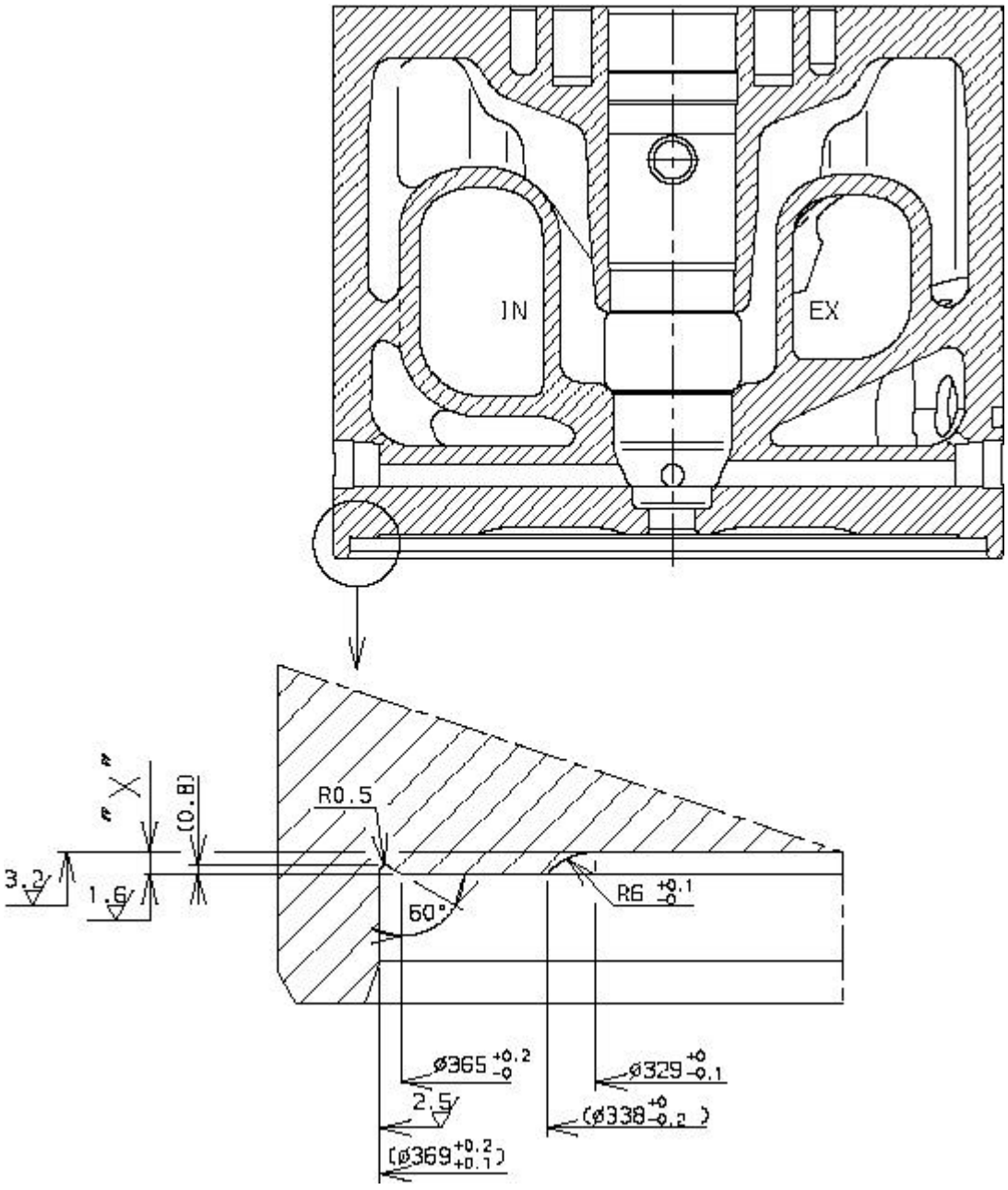
Driving unit, assemby (continuation)

Application		Rotating direction
Line engine		clockwise
Vee engine	A - Bank	clockwise
	B - Bank	counter clockwise



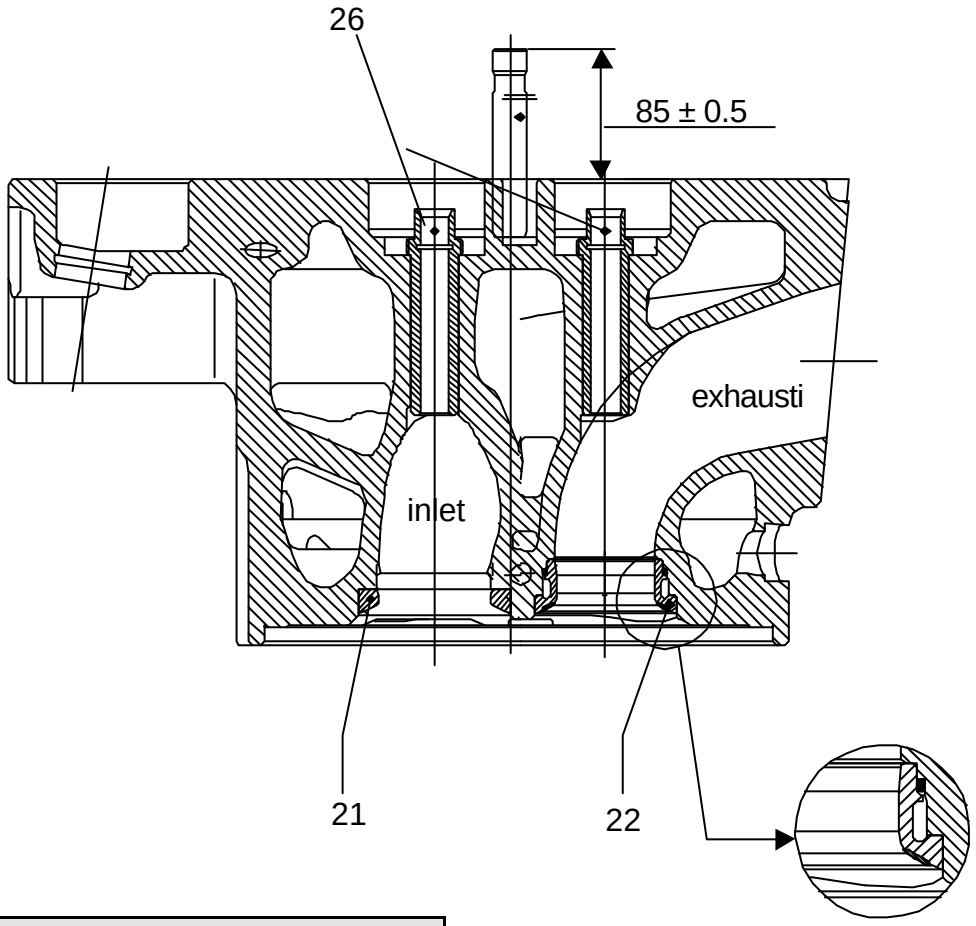
2.7 CYLINDERHEAD Reconditioning

Gas sealing



Dimension	Design value.(mm)		No go value.(mm)
	Minimum	Maximum	
"x"	2.0	2.1	1.8

Valve seats and valve guides



Item	Description
21	Inlet valve seat
22	Exhaust valve seat
26	Inlet and exhaust valve guides

Fitting of valve seats/valve guides/yoke pins/injector bush

Note: Wear always full face protection and special working gloves to avoid burns when working with fluid nitrogen or deeply frozen parts!

General:

1) Preheat the cylinder head for ca. 25 min on 90°C ± 10°C before fitting valve seats / valve guides / yoke pins / injector bush.

Valve guides:

2) Cool the valve guide down to -150°C.
3) Fit the valve guide in the cylinder head.

Yoke pins:

2) Cool the yoke pin down to -150°C.
3) Fit the yoke pin in the cylinder head.
4) Check the free length of fitted yoke pins (85 ± 0.5 mm).

Exhaust valve seats:

2) Cool in a freezer the exhaust valve seat down to -50°C.
3) Lubricate O-ring 1501ZT237 with O-ring grease (Parker Super-O-Lube), and place the O-ring in cylinder head.
4) Smear Loctite 290 on the outer rim of the exhaust valve seat, and fit the valve seat in the cylinder head with tool 14020TD900.

Note: Check always the cylinder head on water leakage after fitting the exhaust valve seats by 7 bar water pressure during 15 min. (use tool 14030TD900).

Inlet valve seats:

2) Cool the inlet valve seat down to -150°C.
3) Fit the inlet valve seat in the cylinder head with tool 14020TD900.

Injector bush:

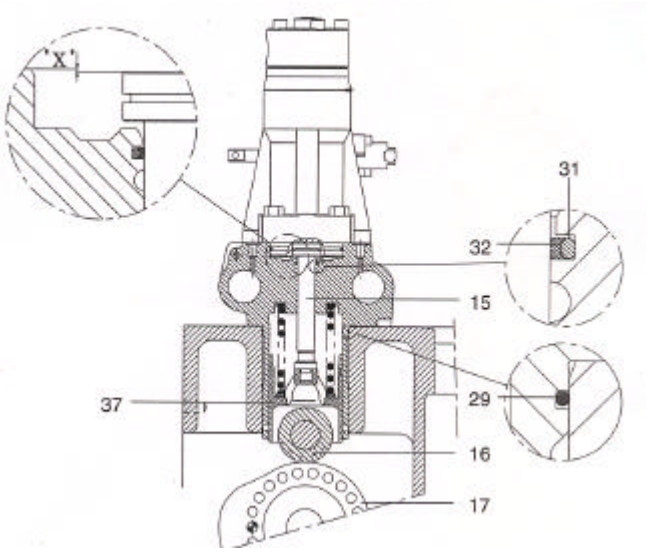
2) Cool in a freezer the injector bush down to -50°C.
3) Smear Loctite 290 on the outer rims Φ 72mm and Φ 48mm of the injector bush, and fit the injector bush in the cylinder head with tool 14020TD900.

Note: Check always the cylinder head on water leakage after fitting the injector bush by 7 bar water pressure during 15 min. (use tool 14030TD900)

2.8 CAMSHAFT

Timing, Procedure for timing inspection

Fuel cam:



- Turn roll on base circle of cam.
- Check if size "X" is 1 ± 0.1 mm
- Place a dial gauge on top of the fuel tappet and adjust gauge to 0 mm.
- Bar the engine in rotation direction of until the dial gauge reads 4.5 mm.
- Read the position on the flywheel and compare with value in table (tolerance ± 0.25°).
- If necessary adjust camshaft gearwheel .

Exhaust cam

- Turn roll on base circle of cam.
- Adjust valve clearance to 0 mm.
- Place a dial gauge on the valve and adjust gauge to 0 mm.
- Bar the engine in rotation direction of until the dial gauge reads 5.6 mm.
- Read the position on the flywheel and compare with value in table (tolerance ± 1°)

Inlet cam

- Turn roll on base circle of cam.
- Adjust valve clearance to 0 mm.
- Place a dial gauge on the valve and adjust gauge to 0 mm.
- Bar the engine in rotation direction of until the dial gauge reads 4.1 mm.
- Read the position on the flywheel and compare with value in table (tolerance ± 1°)

Camshaft piece 0-version, 2103ZT127/128

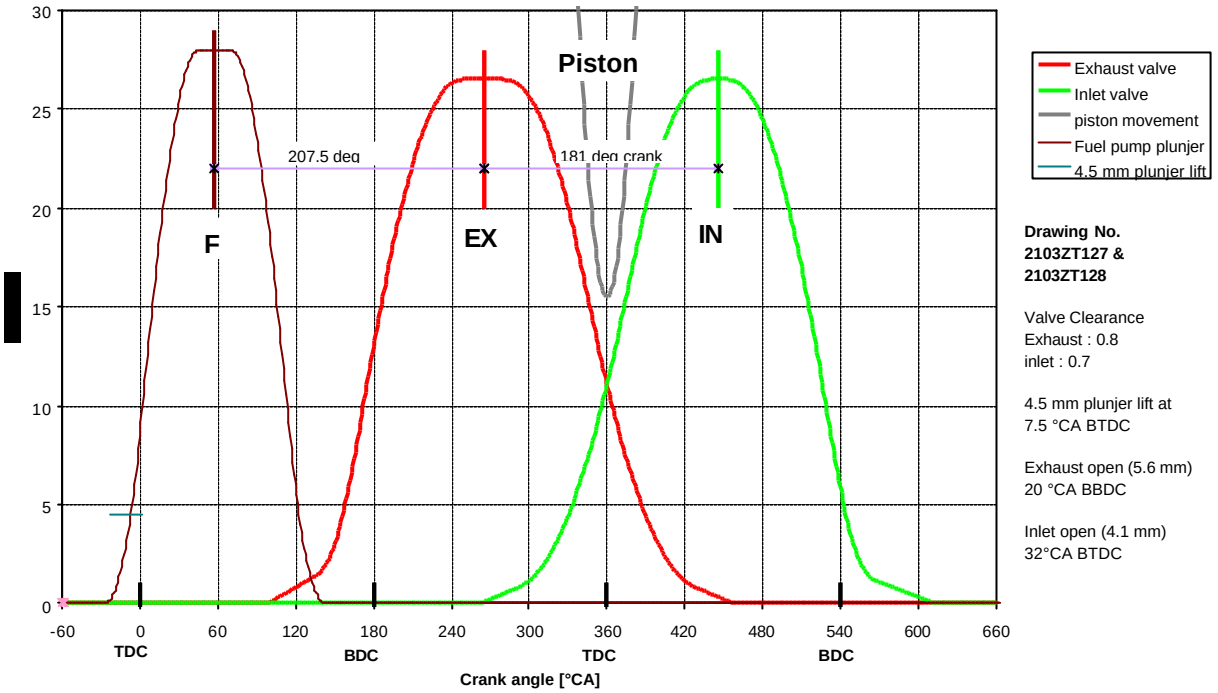
Injection timing 4.5 mm plunjer lift [°CA]	Exhaust at 5.6 mm valve lift open [°CA] BBDC	close [°CA] ATDC	Inlet at 4.1 mm valve lift open [°CA] BTDC	close [°CA] BTDC
9	21,5	21,9	33,5	4,3
8,5	21	22,4	33	4,8
8	20,5	22,9	32,5	5,3
7,5	20	23,4	32	5,8
7	19,5	23,9	31,5	6,3
6,5	19	24,4	31	6,8
6	18,5	24,9	30,5	7,3
5,5	18	25,4	30	7,8

Camshaft piece 0-version, 2103ZT141/142

Injection timing 4.5 mm plunjer lift [°CA]	Exhaust at 5.6 mm valve lift open [°CA] BBDC	close [°CA] ATDC	Inlet at 4.1 mm valve lift open [°CA] BTDC	close [°CA] BTDC
13,5	23,5	19,9	31,5	6,3
13	23	20,4	31	6,8
12,5	22,5	20,9	30,5	7,3
12	22	21,4	30	7,8
11,5	21,5	21,9	29,5	8,3
11	21	22,4	29	8,8
10,5	20,5	22,9	28,5	9,3
10	20	23,4	28	9,8

Camshaft piece A-version, 2103ZT150/151

Injection timing 4.5 mm plunjer lift [°CA]	Exhaust at 5.6 mm valve lift open [°CA] BBDC	close [°CA] ATDC	Inlet at 4.1 mm valve lift open [°CA] BTDC	close [°CA] BTDC
13,9	23	20,5	31	6,8
13,4	22,5	20,9	30,5	7,3
12,9	22	21,4	30	7,8
12,4	21,5	21,9	29,5	8,3
11,9	21	22,4	29	8,8
11,4	20,5	22,9	28,5	9,3
10,9	20	23,4	28	9,8
10,4	19,5	23,9	27,5	10,3



Drawing No.
2103ZT127 &
2103ZT128

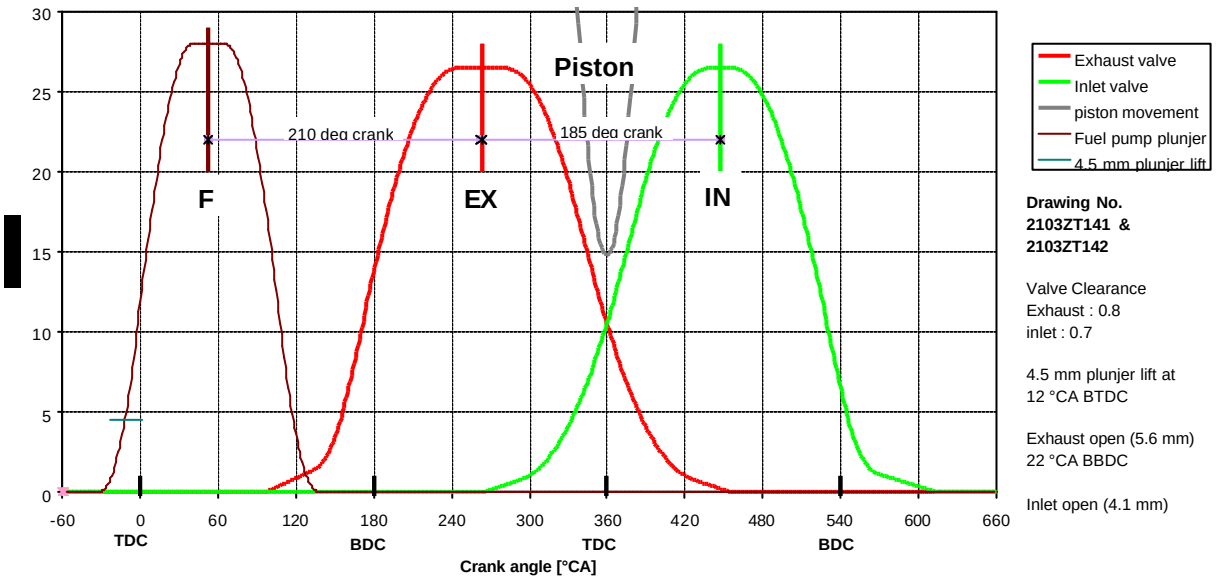
Valve Clearance
Exhaust : 0.8
inlet : 0.7

4.5 mm plunjer lift at
7.5 °CA BTDC

Exhaust open (5.6 mm)
20 °CA BBDC

Inlet open (4.1 mm)
32°CA BTDC

0 - version (Camshaft pieces 2103ZT127/128)



Drawing No.
2103ZT141 &
2103ZT142

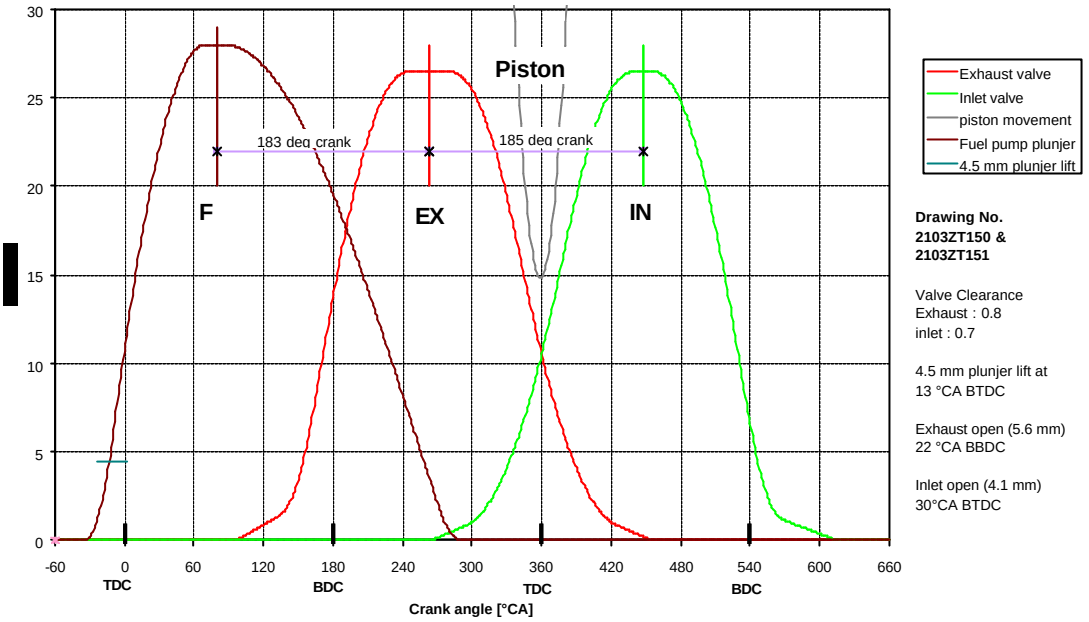
Valve Clearance
Exhaust : 0.8
inlet : 0.7

4.5 mm plunjer lift at
12 °CA BTDC

Exhaust open (5.6 mm)
22 °CA BBDC

Inlet open (4.1 mm)

0 - version (Camshaft pieces 2103ZT141/142)



A - version (Camshaft pieces 2103ZT150/151)

Valve clearance

Valve clearance for engine in cold condition :

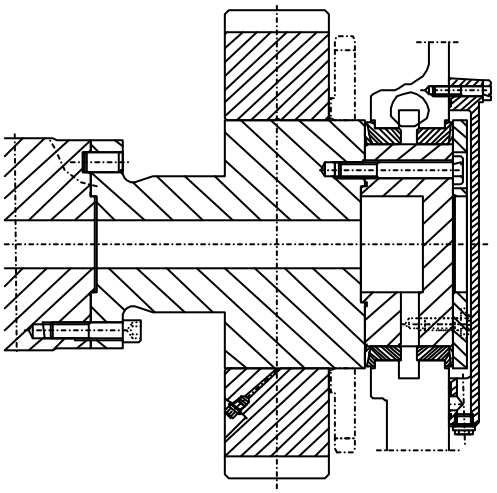
Valve clearance	0-version	A-version
inlet valves	0.7 mm	0.75 mm
exhaust valves	0.8 mm	0.75 mm

Mounting and dismounting gearwheel camshaft

Mod / FT / Advice no		Ref.	TN 2103Z001
Installation - type - no	All W26 engines		
Concerns	Mounting and dismounting gearwheel camshaft		

Subject:
Mounting and dismounting procedure with the help of hydraulic tools.

Background:
Field experience has shown that there might be some difficulties with regard to the use of hydraulic tools and its hydraulic oil.
When there is used hydraulic oil with a higher viscosity in stead of a more common lower viscosity, parts like for instance the camshaft gearwheel may not be tightens as they should be after the present-day mount procedure.
In some cases there is found oil under pressure behind the plug that causes distortion of the gearwheel with regard to the camshaft.
The cause should be found in the combination of the viscosity of the used hydraulic oil with the press surface and the time between using the hydraulic tool and mounting the plug.
The purpose of the plug is to prevent pollution into the connection of the hydraulic tool.



Connection hydraulic tool

Action:
Turn the camshaft in such a way that the connection of the hydraulic tool is in the lowest position.
Wait for at least 10 minutes before mounting the plug.

Piston in relation of camshaft pieces 0-version

Mod / FT / Advice no	970811.52	Ref.	TN1421Z001
Installation - type - no	W26		
Concerns	**Piston and camshaft pieces 0 - version**		

Subject:

Differences of the pistons 1421ZT114/115 and 1421ZT116, camshaft pieces 2103ZT127/128 and 2103ZT141/142 and the use in according with each other.

Background

To prevent damage in case injection timing has to be changed or pistons and/or camshaft have to be replaced.
The given allowed fuel injection timing guarantees a free space between the piston crown and valves of 2 [mm].

Piston

Piston 1421ZT116 is a modification of piston 1421ZT114/115. In the table below the changes are given.

Differences	
Compression ratio	15.8 instead of 13.5
Distance piston crown and axis gudgeon pin	234.2 instead of 233.5
Piston skirt	Tolerance changed
Piston crown	Tolerance changed
Combustion room	Shape changed

Attention! *In an engine only one type of piston is allowed!*
For engines (0-version) with camshaft pieces 2103ZT127/128 and an injection timing > 9.5 °, only piston 1421ZT114 should be used.

Camshaft

Camshaft pieces 2103ZT141/142 are a modification of the camshaft pieces 2103ZT127/128.

Camshaft pieces	Fuel Injection	Exhaust valve		Inlet valve	
		Open	Close	Open	Close
	before TDC	before BDC	after TDC	before TDC	before BDC
2103ZT127/128	7.5°±3.5°	13.1°	12.0°	12.0°	5.8°
2103ZT141/142	12°±4°	15.1°	10.0°	10.0°	3.8°

Fuel injection at 4.5 [mm] plunger lift; valve timing at 8 [mm] valve lift

Application of Piston and Camshaft pieces

The “old” and “new” pistons and “old” and “new” camshaft pieces are interchangeable.
The possibilities and restrictions are give in the table below.

Allowed fuel injection Timing (before TDC)		
Camshaft pieces	2103ZT127/128	2103ZT141/142
Piston 1421ZT114/115	4°-11°	6°-18°
Piston 1421ZT116	5.5°-9.5°	8°-16°

Note: *Changing of fuel injection time only after consultation and permission of the Technical Service Department!*

3.0 SPECIAL TOOLS

CONTENTS OF SPECIAL TOOLS BOX 1 (figure 1 - 3)			
01	**HYDRAULIC HOSE**	**12**	**FUEL INJECTOR TEST UNIT**
	2x 9612DT381		1x 9612ZT934
02	**TORQUE SPANNER (260-800Nm)**	**13**	**T-BAR WRENCH 8mm**
	1x 9612ZT230		1x 9612SW510
03	**SOCKET FOR NOZZLE TIP**	**14**	**PIPE KEY FOR INJECTOR**
	1x 9612DT259		1x 9612SW186
04	**WRENCH FOR INJECTOR**	**15**	**TAP M8 FOR PISTON**
	1x 9612ZT187		1x 9612ZT195
05	**HYDRAULIC HANDPUMP**	**16**	**SPLINE TOOL**
	1x 9612ZT955		1x 9612ZT332
06	**JACKS FOR CYL. HEAD**	**17**	**CIRCLIP PLIER**
	2x 9612ZT904		1x 9612ZT250
07	**POL. RING FOR CYL. HEAD / LINER**	**18**	**SENSOR FOR VALVE CLEARANCE**
	1x 9612ZT950		2x 9612ZT251
08	**HOLDER FOR FUEL INJECTOR**	**19**	**WRENCH 1¼" FOR HP-FUELLINES**
	1x 9612ZT978		1x 9612ZT331
09	**COMPRESSING TOOL FOR VALVES**	**20**	**WRENCH 24 mm**
	1x 9612ZT919		1x 9612ZT333
10	**JACKS FOR CYL. HEAD**	**21**	**SOCKET SPANNER FOR FUELCONN.**
	2x 9612ZT901		1x 9612ZT255
11	**FORCE MULTIPLIER**		
	1x 9612DT260		

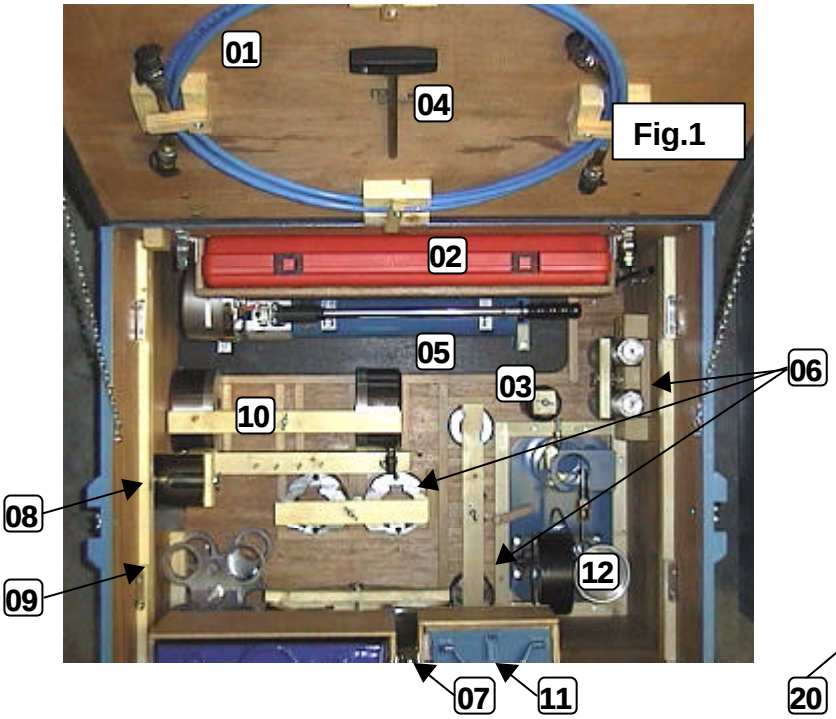


Fig.1

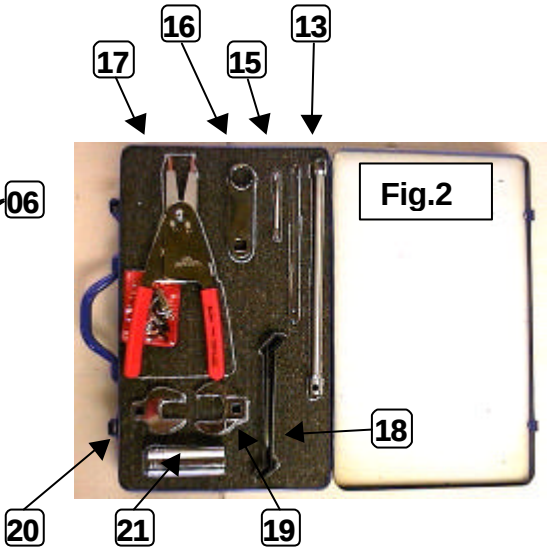
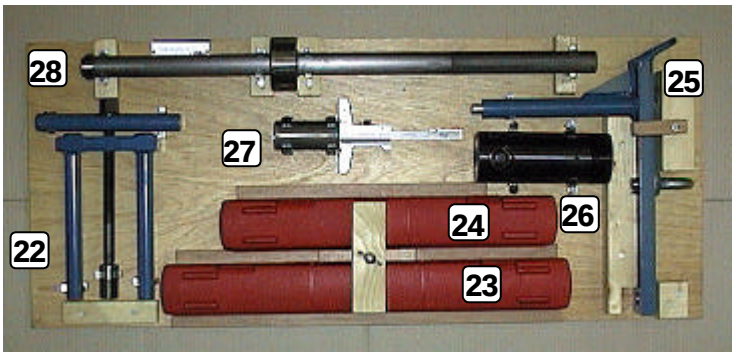


Fig.2

CONTENTS OF SPECIAL TOOLS BOX 1 (CONTINUATION) (figure 3)			
22	**EXTRACTOR FUEL INJECTOR**	**26**	**HYDRAULIC JACK**
	1x 9612ZT931		1x 9612ZT913
23	**TORQUE SPANNER (50-340Nm)**	**27**	**DEPTH GAUGE FOR CON.ROD**
	1x 9612ZT231		1x 9612ZT940
24	**TORQUE SPANNER (22-140Nm)**	**28**	**FINGER DRILL FOR INJECTOR BUSH**
	1x 9612ZT330		1x 9612ZT962
25	**LIFTING TOOL CYLINDER HEAD**		
	1x 9612ZT927		

Fig.3



CONTENTS OF SPECIAL TOOLS BOX 2 (figure 4 & 5)			
01	**PNEUMATIC / HYDRAULIC PUMP**	**10**	**MOUNTING TOOL FOR CYL.UNIT**
	1x 9612ZT380		1x 9612ZT911
02	**MOUNTING UNIT FOR CYL.UNIT**	**11**	**PULL FRAME CYLINDER LINER**
	1x 9612ZT445		1x 9612ZT912
03	**AIR TOOL TO LOWER MAINB.CAP**	**12**	**STUDREMOVER CYLINDER HEAD**
	1x 9612ZT334		1x 9612ZT935
04	**TROLLEY FOR MAIN BEARING**	**13**	**PISTON SUPPORT**
	1x 9612ZT906		1x 9612ZT938
05	**JACK COMPLETE FOR MAINB.**	**14**	**DRIVER MAIN BEARING SHELL**
	2x 9612ZT902		1x 9612ZT910
06	**JACK COMPLETE FOR MAINB.**	**15**	**PROTECTION PIPE FOR CYL.UNIT**
	2x 9612ZT903		8x 9612ZT911
07	**JACK CONNECTING ROD**	**16**	**DEPTH GAUGE CYL.HEAD / MAINB.**
	2x 9612ZT944		1x 9612ZT941
08	**LOCKING STRIP FOR CYL.UNIT**	**17**	**PISTON RING PLIER**
	1x 9612ZT113 (part of 9612zt911)		1x 9612ZT185
09	**PISTON RING TOOL**		
	1x 9612ZT917		

Fig.4

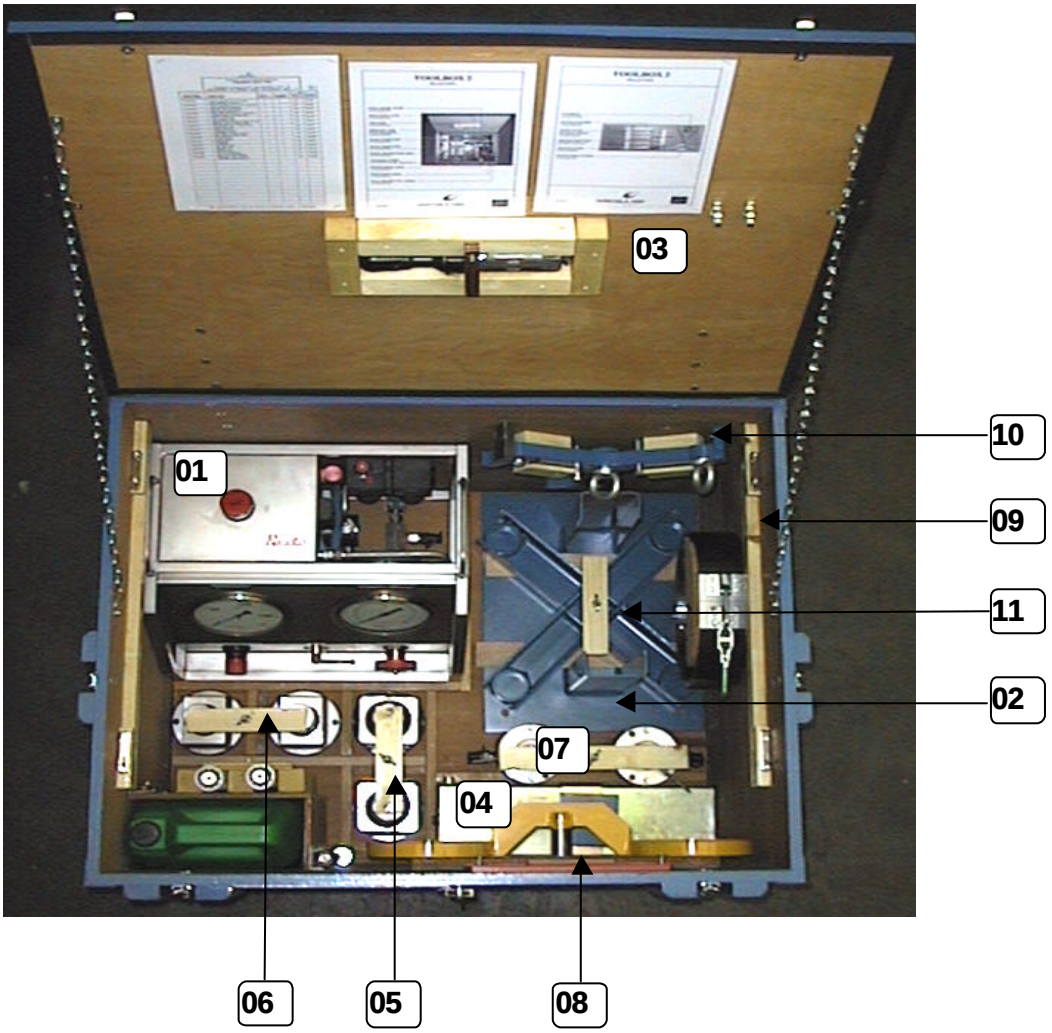
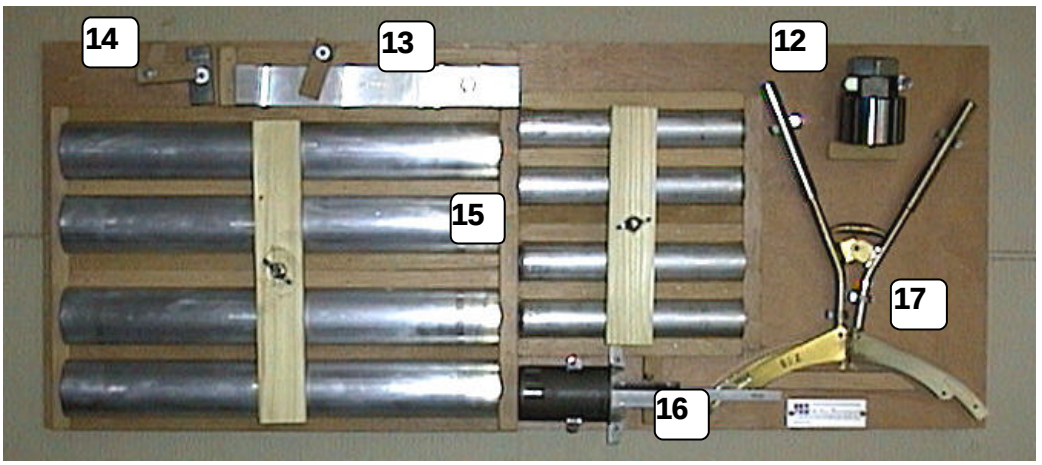


Fig.5



CONTENTS OF SPECIAL TOOLS BOX 3 (figure 6 & 7)			
01	**PROTECTOR JOURNAL CRANKPIN**	**09**	**CROW BAR**
	9x 9612ZT970		1x 9612ZT376
02	**PIPE CYL.HEAD STUDS**	**10**	**POLISHING RING LINER / BLOCK**
	4x 9612ZT256		1x 9612ZT951
03	**HYDRAULIC HOSE**	**11**	**TOOL SUP.RING INL.VALVESPRING**
	4x 9612ZT373		1x 9612ZT947
04	**TOOL FOR WASHER F.PUMP PEDES.**	**12**	**HYDR. DISTRIB. BLOCK**
	1x 9612ZT953		1x 9612ZT918
05	**SPARE SET MISC. RINGS**	**13**	**HANDLE FOR BIG END B.CAP**
	2x 9612ZT975		1x FOR 9612ZT952
06	**DISC FOR LINER**	**14**	**DISM.TOOL APR**
	9x 9612ZT247		1x 9612ZT915
07	**FRAME AND JACKS FOR CYL.HEAD**	**15**	**TOOL SUP.RING EXH.VALVESPRING**
	1x 9612ZT942		1x 9612ZT956
08	**DIS./ASS.TOOL CON.RODCAP**	**16**	**STUD REMOVER CON.ROD**
	1x 9612ZT929 / 952		1x 962ZT936

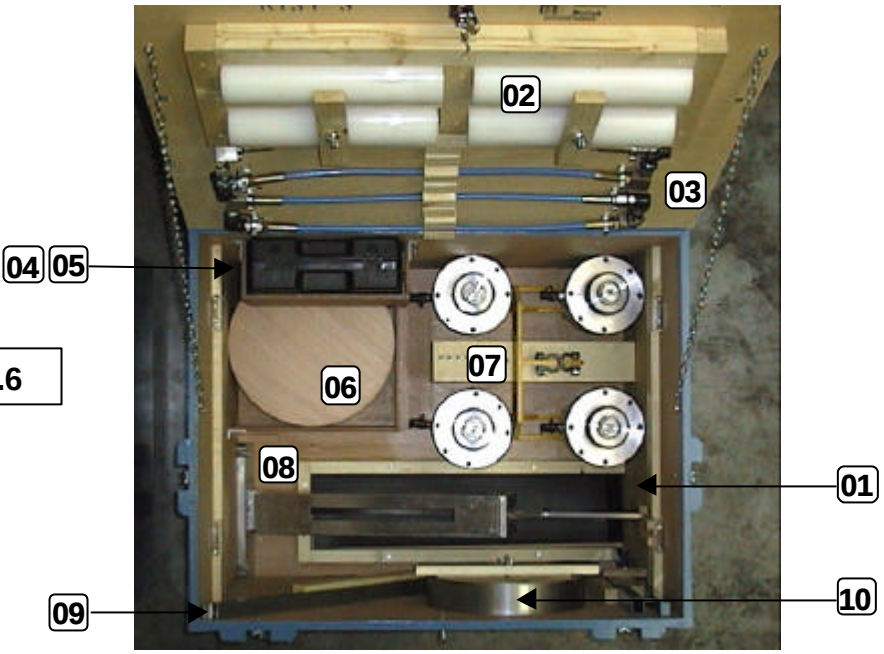


Fig.6

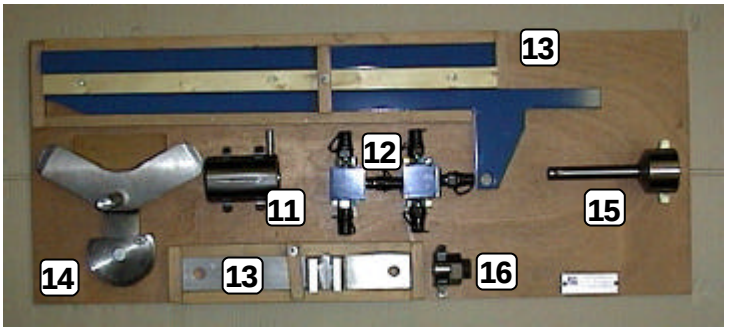


Fig.7

CONTENTS OF SPECIAL TOOLS BOX 4 (figure 8, 9 & 10)			
01	**DIS/ASSEMBLY VALVE GUIDE**	**14**	**TOOL INJECTOR BUSH**
	1x 9612ZT909		1x 9612ZT946
02	**DIS/ASSEMBLY BRACK.-FUELPUMP**	**15**	**SECURE TOOL CAMSHAFT**
	1x 9612ZT960		1x 9612ZT930
03	**EXTRACTOR INJECTOR BUSH**	**16**	**POS. TOOL AXIAL BEARING**
	1x 9612ZT932		1x 9612ZT948
04	**TOOL FOR VALVE SEAT**	**17**	**DIS/ASSEMBLY FUELPUMP**
	1x 9612ZT945		1x 9612ZT971
05	**HOIST.TOOL STARTMOTOR**	**18**	**PIN CAMSHAFT BEARING**
	1x 9612ZT981		1x 9612ZT194
06	**VALVE SEAT REFAC.SET**	**19**	**HOLDER YOKEPIN**
	1x 66760 900		1x 9612ZT234
07	**LOCKING RING ROLLER HOLDERS**	**20**	**PIN HP FUELPUMP**
	18x 9612ZT924 & 9x 9612ZT925		1x 9612ZT225
08	**FORCE MULTIPLIER 6200 Nm**	**21**	**HOLDER CAMSH.GEAR-JOURNAL**
	1x 9612ZT979		1x 9612ZT982
09	**HOLDER VALVE GUIDE**	**22**	**RATCHETING BOX 17/19**
	1x 9612ZT233		1x 9612ZT232
10	**DEPTH GAUGE PUSHROD**	**23**	**KEY FOR VIBRATION DAMPER**
	1x 9612ZT974		1x 9612ZT497
11	**LIFT.TOOL BRACKET-FUELPUMP**	**24**	**DISASS. INTERMEDIATE GEAR**
	1x 9612ZT961		1x 9612ZT980
12	**TOOL CAMSHAFT BEARING**	**25**	**HOISTING TOOL PISTON**
	1x 9612ZT914		1x 9612ZT916
13	**CAL. TOOL FOR W26 HP FUEL PUMP**	**26**	**PULLING TOOL FUEL PIPE**
	1x 66762 900		1x 9612ZT439

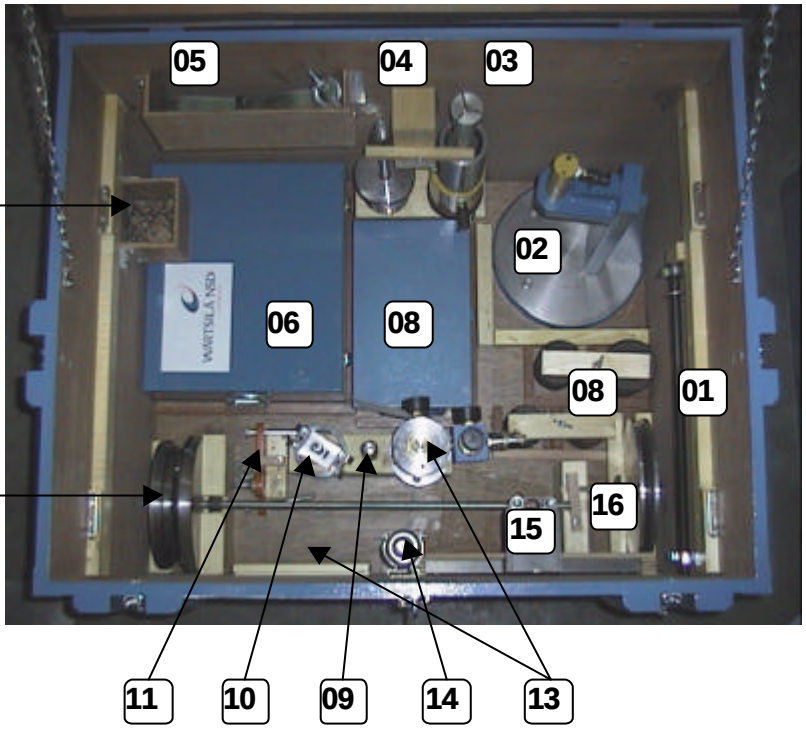
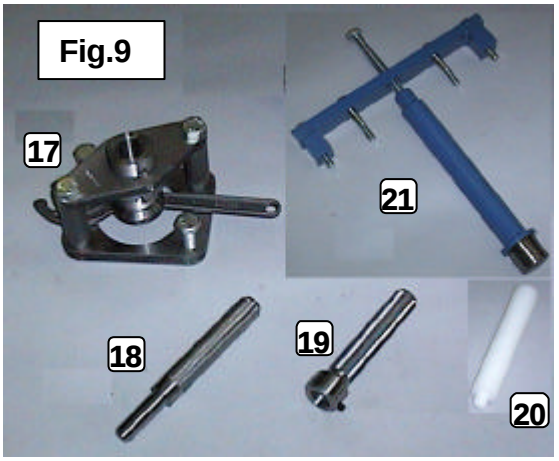
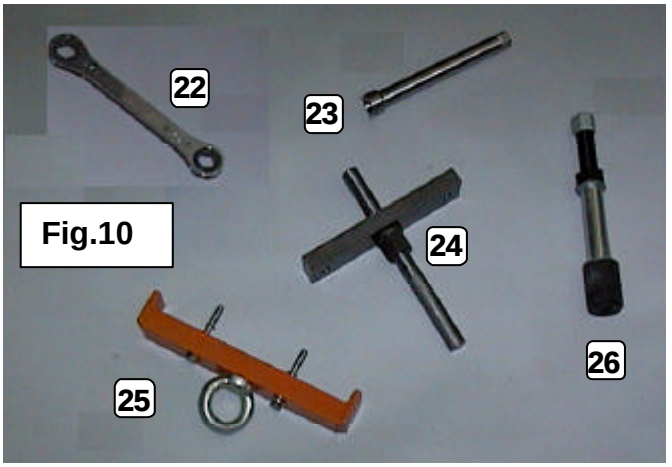


Fig.8





CONTENTS OF SPECIAL TOOLS (separate parts, figure 11 - 14)			
01	**TILTING YOKE**	**03**	**TRANSPORT CASE DRIVING-UNIT**
	1x 9612ZT954		9x 9612ZT973
02	**TILTING BLOCK FOR CYL.HEAD**	**04**	**MOUNTING TOOLS DRIVING-UNIT**
	1x 9612ZT958		9x 9612ZT911

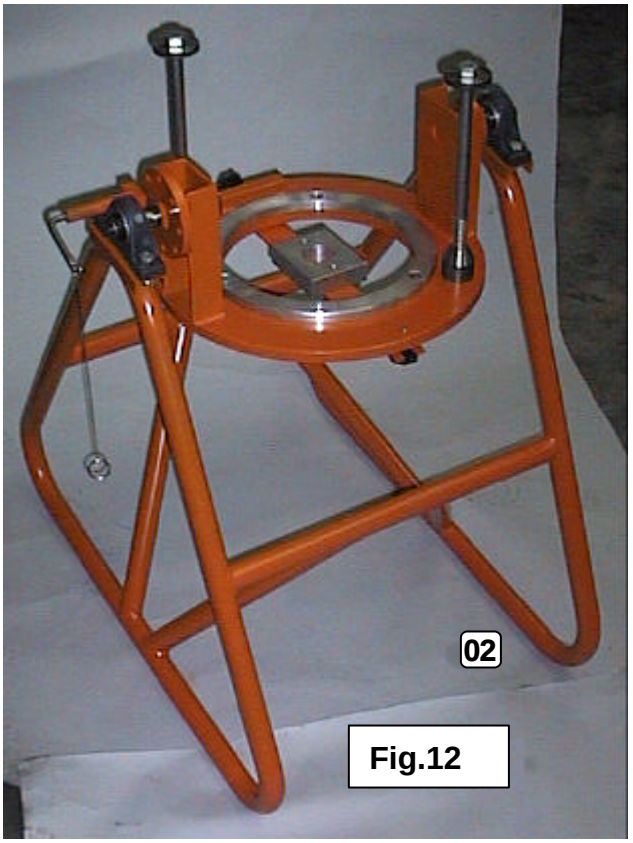


Fig.13

03

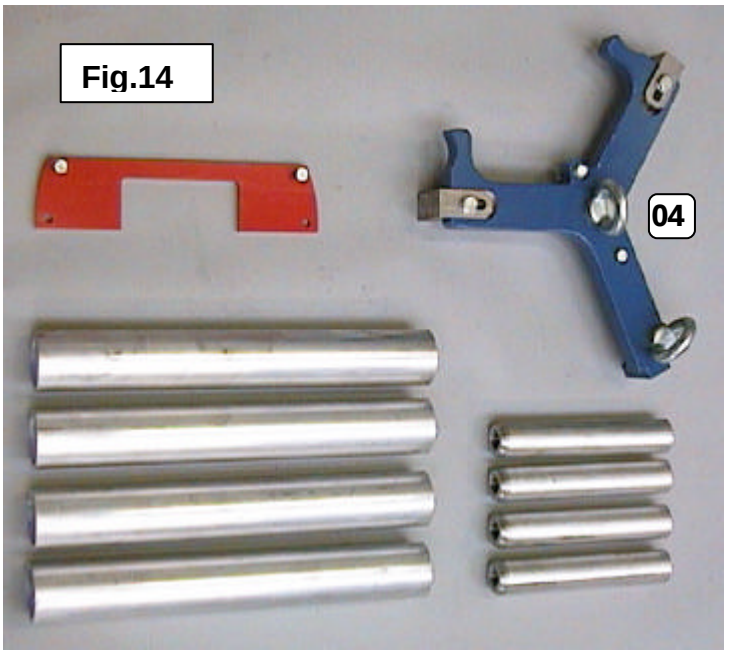


Fig.14

04

CONTENTS OF SPECIAL TOOLS (without pictures)			
01	**TOOL CAMSHAFT-SEGMENT**	**06**	**TOOL PUMPCOVER**
	1x 9612ZT921 / 933		1x 9612ZT907 / 926 (incl. 248)
02	**TOOL CAMSHAFT-JOURNAL**	**07**	**TOOL INTERMED.GEAR-WHEEL**
	1x 9612ZT908 / 957		1x 9612ZT966 / 965
03	**TOOL AIR-COOLER**	**08**	**TOOL CAMSHAFT GEAR-WHEEL**
	1x 9612ZT949 / 928		1x 9612ZT968 / 967
04	**TOOL LUBOIL-COOLER**	**09**	**TOOL FOR ZT966, 968**
	1x 9612ZT920 / 922		1x 9612ZT964 / 963
05	**HOISTINGTOOL PUMPS**	**10**	**DUMMY COUNTERWEIGHT**
	1x 9612ZT937 / 939		1x 9612ZT856

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1000 General	**Wärtsilä 26**	WNSNL-S	10-05-2000	04	mr26/1000/01	1(2

Installation (ship): _____ Engine type: _____ Engine No.: _____

Fuel type: _____

Operating Data Record

	= wecs reading

General				
Date				
Time	hr.			
Runninghrs.	hr.			
Load	kW			
Rack	mm			
Pitch	%			
Governor	%			
Actuator				
RPM engine	rpm			
Outdoor temp.	°C			
Atmospheric	mm			
Humidity	%			
Temp.LT water	°C			

Exhaust gas temperature

		A-bank		B-bank		A-bank		B-bank		A-bank		B-bank	
		t 1	t 2	t 1	t 2	t 1	t 2	t 1	t 2	t 1	t 2	t 1	t 2
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9												
	Mean												
Exh.temp. turbo inlet 1													
Exh.temp. turbo inlet 2													
Exh.temp. turbo inlet 3													
Exh.temp. after turbo													
RPM turbo	rpm												
Back pressure	mm												

Main bearing temp

		°C	°C	°C
	0			
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			

Wärtsilä NSD Nederland B.V.
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8000 GB Zwolle

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8017 JE Zwolle
The Netherlands

Telephone: +31 38 425 32 53
Telefax +31 38 422 35 38

Charge air				
Pressure	bar			
Aspirated air	°C			
Temp.after	°C			
Temp. receiver	°C			
∂ p - filter	mm			
Lub. oil				
Temperature	°C			
Pressure	bar			
P before filter	bar			
∂ p - filter	bar			
Crankcase	mm			
Fuel				
Pressure	bar			
Temp. before	°C			
Viscosity	cSt			
Temp. after	°C			
HT coolingwater				
Suction press.	bar			
Temp. inlet	°C			
Pressure be-	bar			
Temp. before	°C			
Temp.outlet	°C			
LT coolingwater				
Suction	bar			
Temp. inlet	°C			
Pressure	bar			
Temp. before	°C			
Temp. outlet	°C			

Fuel rack and Combustion pressure

		A-bank		B-bank		A-bank		B-bank		A-bank		B-bank	
		Rack	p cyl	Rack	p cyl	Rack	p cyl	Rack	p cyl	Rack	p cyl	Rack	p cyl
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9												
	Mean												
Smoke level	RB												
Fuel con-	kg/h												
Leak oil	kg/h												

Date of measurement: _____ Place: _____ Name: _____

Wärtsilä NSD Nederland B.V.
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8017 JE Zwolle
The Netherlands

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Telefax +31 38 422 35 38

Installation (ship): _____ Engine type: _____ Engine No.: _____

Fuel viscosity (cSt): _____ Temperature (°C): _____ Running hours: _____

DETERMINATION OF SMOKE LEVEL

Complete measurement record includes also measurement record mr26/1000/01

Allowed visible smoke level 3.25

Fuel rack [mm]	RPM	Smoke Level				Back pressure [mm H_2O]
		1	2	3	Mean	

round off 1 decimal

Fuel rack measured at cylinder no.	

Place measurement probe above Turbocharger in [mm]	

General
1500 up to 2000 [mm] above the turbocharger, in the exhaust gases pipe there has to be a connection for the measurement probe. During the measurement period, the measurement probe has be to in the middle of the exhaust gases pipe.

Take a sample
After a load change a stabilisation time is necessary:
30 minutes by increase of load
15 minutes by decrease of load

1. Place the measurement probe and connect the Smokemeter sampling pump..
2. Press the bellow to initiate a sample, without a paper insert. After every sample; operate the tensioning lever and cock the pump plunger by pressing of the cocking knob. Repeat for 5 times.
3. Tensioning lever and cock the pump plunger by pressing of the cocking knob. Insert the paper disc.
4. Press the bellow to initiate a sample. After every sample; operate the tensioning lever and cock the pump plunger by pressing of the cocking knob. Exhaust gasses can blow out behind the paper insert. **Do not remove the paper insert**. Repeat for 10 times.
5. After 10 samples operate the tensioning lever and remove the paper insert.
6. Repeat point 3 up to 5 for 3 times.

Analyse a sample
1. Place the blackened paper insert on the 10 clean white paper inserts.
2. Pressed the measuring head firmly and vertically onto the darkened surface.
3. Depress the push-button until the measured blacking number appears in the display.
4. Note result.

Special Tools

Smokemeter Sampling Pump	BOSCH ETD 020.00
Diesel Smoke Evaluator	BOSCH ETD 020.50
Paper inserts	**1.680.009.004**

For complete instruction read TN1000Z001

Date of measurement: _____ Place: _____ Name: _____

WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

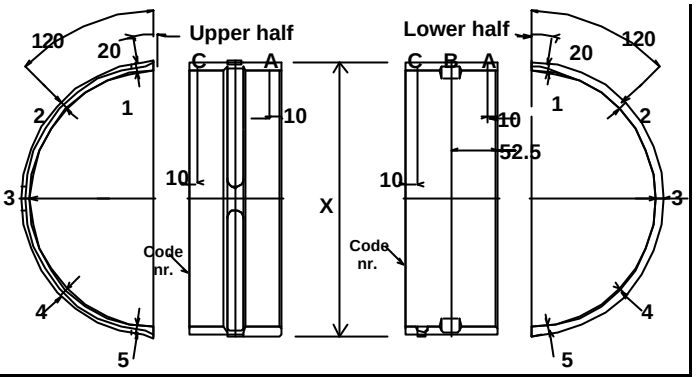
Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1102 Main bearing	**Wärtsilä 26**	WNSNL-S	10-05-2000	04	mr26/1102/01	1(1)

Installation (ship): Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:

Main bearing shell



Bearings: 1111ZT150-151
Main bearing shell nominal thickness : 9.870-9.890 [mm]
Free spread X : 301-303 [mm]
Bearings: 1111ZT140-141
Main bearing shell nominal thickness : 7.375-7.395 [mm]
Free spread X : 296-298 [mm]

Wear limit: thickness = 9.865 [mm] (1111ZT150-151)
Wear limit: thickness = 7.360 [mm] (1111ZT140-141)
To be measured with a ball-shaped micrometer

			Bearing number										
			0	1	2	3	4	5	6	7	8	9	
Upper Half	**A**	1											
		2											
		3											
		4											
		5											
	C	1											
		2											
		3											
		4											
		5											
Free spread		X											
Manufact. nr.													
Material nr.													
Bearing running hours													
Remarks													
Lower Half	**A**	1											
		2											
		3											
		4											
		5											
	B	1											
		2											
		3											
		4											
		5											
	C	1											
		2											
		3											
		4											
		5											
Free spread		X											
Manufact. nr.													
Material nr.													
Bearing running hours													
Remarks													

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1111 Crankshaft	**Wärtsilä 26**	WNSNL-S	10-05-2000	04	mr26/1111/01	1(1)

Installation (ship): _____ Engine type: _____ Engine No.: _____

Fuel viscosity (cSt): _____ Temperature (°C): _____ Running hours: _____

CRANKSHAFT ALIGNMENT

ENGINE CONNECTED TO:

- Alternator ☐
- Gear ☐
- Other ☐

- Free end PTO ☐

ENGINE INSTALLED ON:

- Steel chocks ☐
- Chockfast ☐
- Rubber cushions ☐

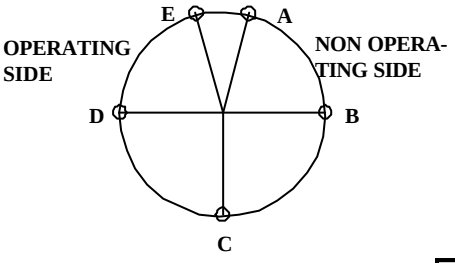
CLUTCH:

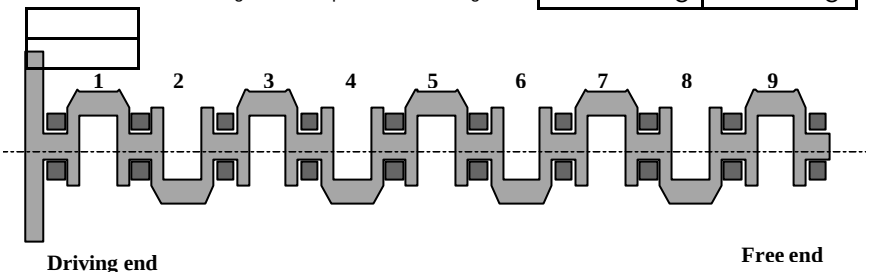
- Engaged ☐
- Disengaged ☐

ENGINE CONDITION:

	Engine cold	Engine warm
Engine running continuously bef. indicating	h	h
Time between stop en indicating	h	min
Ambient temperature	°C	°C
Lubricating oil temperature before engine	°C	°C
HT cooling water temperature after engine	°C	°C

DIAL OPERATING POSITION
as seen from the flywheel end



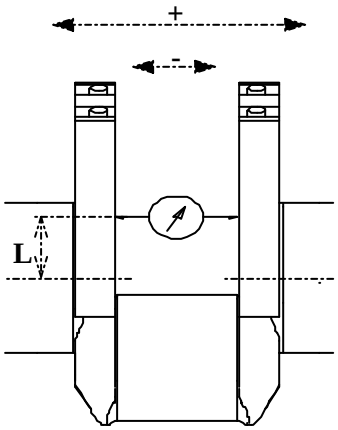


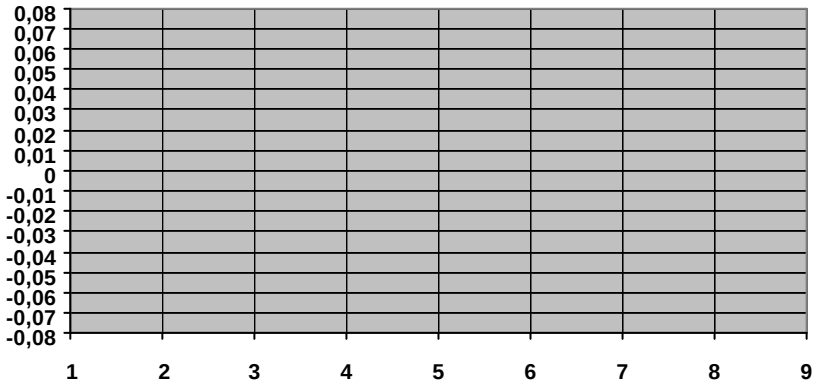
	Cylinder number								
	1	2	3	4	5	6	7	8	9
A	0	0	0	0	0	0	0	0	0
B									
C									
D									
E									

All readings in 1/100 [mm], don't neglect to fill all information!

Turn the crankshaft in the normal running direction.

☐ Crankshaft not turned in normal running direction





For references see manual 2.6.1

L=115 [mm] for L- and L=155 [mm] V-engines.

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

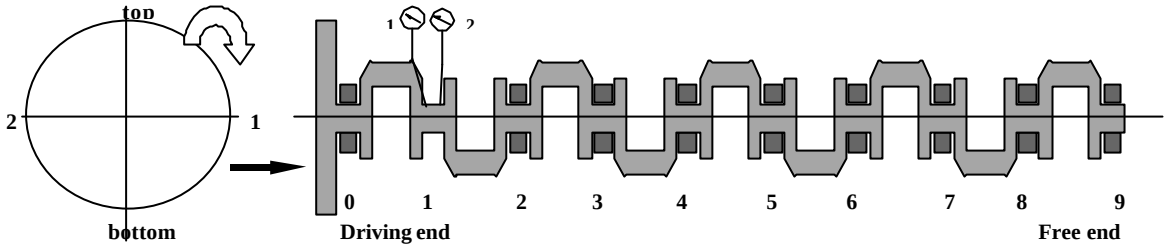
Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1111 Crankshaft	**Wärtsilä 26**	WNSNL-S	10-05-2000	03	mr26/1111/02	1(1)

Installation (ship): _____ Engine type: _____ Engine No.: _____

Fuel viscosity (cSt): _____ Temperature (°C): _____ Running hours: _____

CRANKSHAFT OSCILLATION

Part no. crankshaft:		Serial no. Crankshaft	
Hours crankshaft			



NOTE: Measurements carried out in engine after removal of:

-Piston and connecting rod cyl.no(s):

-Counter weight no.(s):

- Main bearing cap(s) no(s) removed :

- Flywheel / vibration damper mounted : ☐ yes

☐ no

Measurements of journal oscillation related to top position of crankno. 1 (x 0.01 mm)

Journal No.	Dial Gauge	Position of crank				Additional information
		Top	1	Bottom	2	
0	1	0				
	2	0				
1	1	0				
	2	0				
2	1	0				
	2	0				
3	1	0				
	2	0				
4	1	0				
	2	0				
5	1	0				
	2	0				
6	1	0				
	2	0				
7	1	0				
	2	0				
8	1	0				
	2	0				
9	1	0				
	2	0				

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1111 Crankshaft	**Wärtsilä 26**	WNSNL-S	10-05-2000	03	mr26/1111/03	1(1)

Installation (ship): _____ Engine type: _____ Engine No.: _____

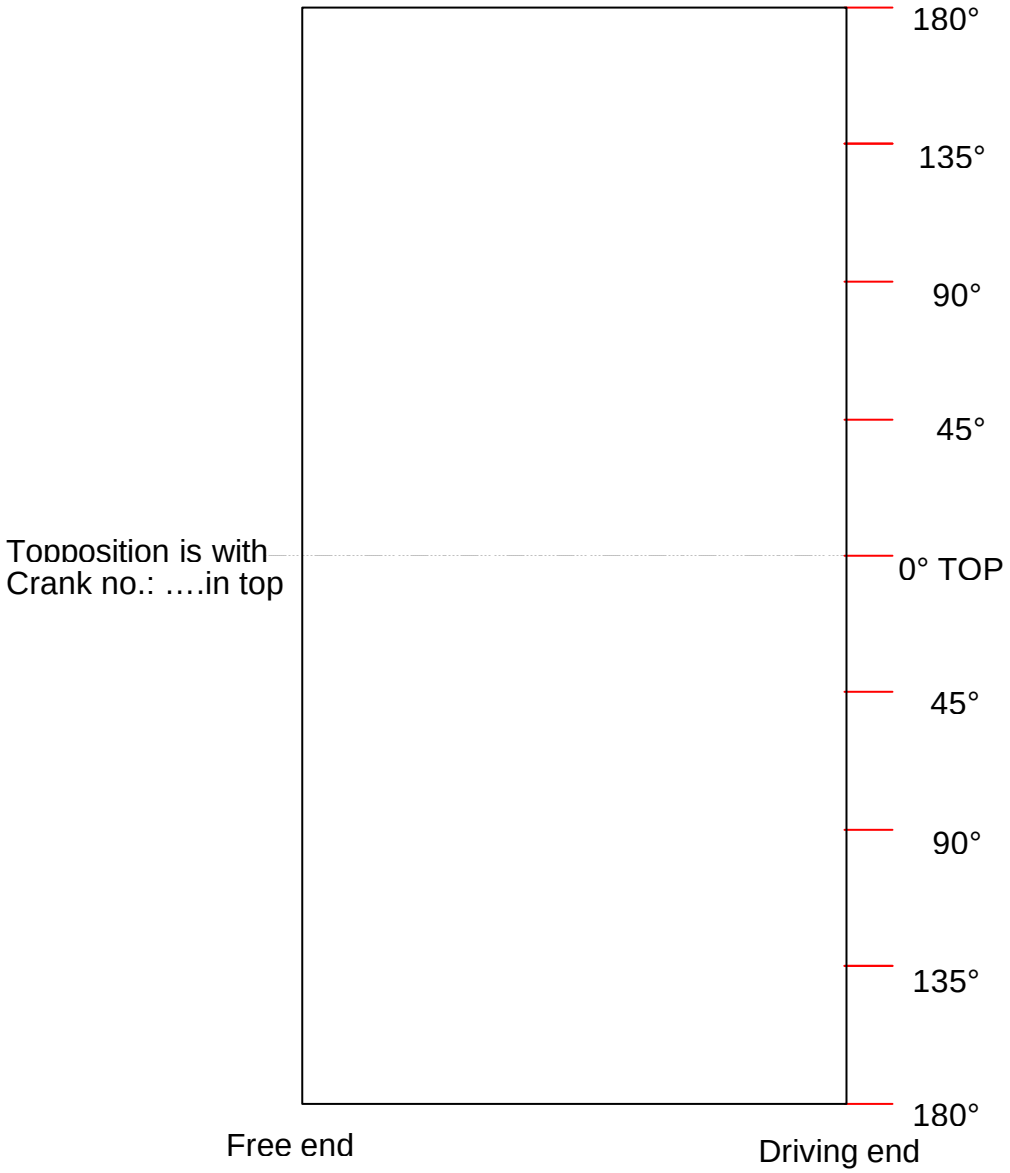
Fuel viscosity (cSt): _____ Running hours: _____ Temperature (°C): _____

CRANKSHAFT JOURNAL SURFACE CONDITION

Part no. crankshaft:		Serial no, crankshaft		
Crankshaft hrs.		Original hardness of crankshaft		HB

Remarks: Surface damages or discolorations and hardnesses to be sketched or noted.

JOURNAL SURFACE No.: _____



Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engine

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1302 Cylinder liner	**Wärtsilä 26**	WNSNL-S	12-05-2000	03	mr26/1302/01	1(1)

Installation (ship): Engine type: Engine No:

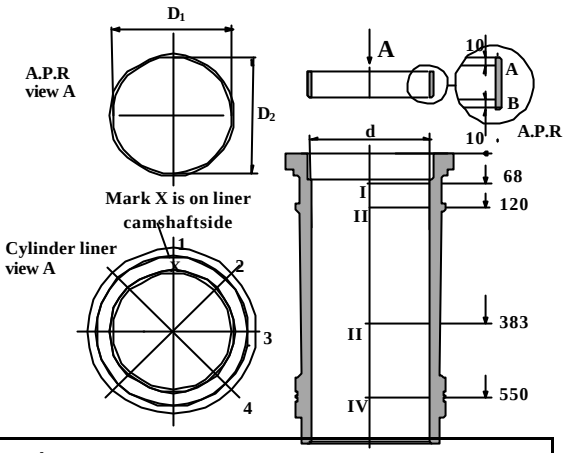
Unit, DG-set No.: Temperature (°C): Engine running hours:

Cylinder liner, diameter d

Measured: ☐ Mounted
☐ Free Temperature (°C): _____

Diameter = 260.000 – 260.052 [mm]
Wear limits: **I** = 260.60 [mm], **II** = 260.40 [mm], **III** = 260.23 [mm]
Ovality = 0.2 [mm] (Difference between d_{max} and d_{min} measured on any level).

Reference diameter (or **IV/3**): _____



Antipolishing ring, diameter D

Thickness = 6.50 – 6.45 [mm], Wear limit = 6.35 [mm]
Measure with a ball-shaped micrometer on level A and level B.
A.P.R. step= $(D_{smallest}-d_i)/2$

Bank		**Cylinder number**								
		1	2	3	4	5	6	7	8	9
Cylinder liner, diameter d (in 1/100 [mm])										
I	1									
	2									
	3									
	4									
II	1									
	2									
	3									
	4									
III Only after honing	1									
	2									
	3									
	4									
IV Only after honing	1									
	2									
	3									
	4									
Manufact nr.										
Material nr.										
Running hours										
Remarks										
Antipolishing ring, diameter D (in 1/100 [mm])										
Level A	1									
	2									
Level B	1									
	2									
A.P.R. step	A									
	B									
Manufact nr.										
Material nr.										
Running hours										
Remarks										

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1400 Piston(s) & Conecting rod(s)	**Wärtsilä 26**	WNSNL-S	10-05-2000	04	mr26/1400/01	1(1)

Installation (ship): Engine type: Engine No:

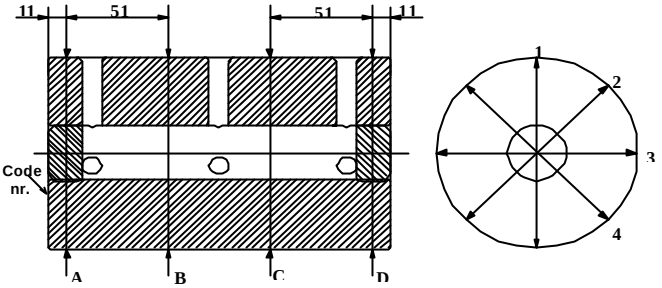
Unit, DG-set No.: Temperature (°C): Engine running hours:

GUDGEON PIN

Gudgeon pin diameter: 119.985-120.000 [mm]

Wear limit: 119.980 [mm]

Reference diameter: 120 [mm]



Bank		Cylinder number								
–		1	2	3	4	5	6	7	8	9
Gudgeon pin , diameter d (deviation in 100/mm)										
A	1									
	2									
	3									
	4									
B	1									
	2									
	3									
	4									
C	1									
	2									
	3									
	4									
D	1									
	2									
	3									
	4									
Material nr.										
Manufact nr.										
Remarks										

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1401 Connecting rod	**Wärtsilä 26**	WNSNL–S	23-06-2000	04	mr26/1401/01	1(1)

Installation (ship): Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:

Connecting rod

Big end bearing bore

Connecting rod nut must be tightened before measuring.
Hydraulic pressure when tightening: See manual.

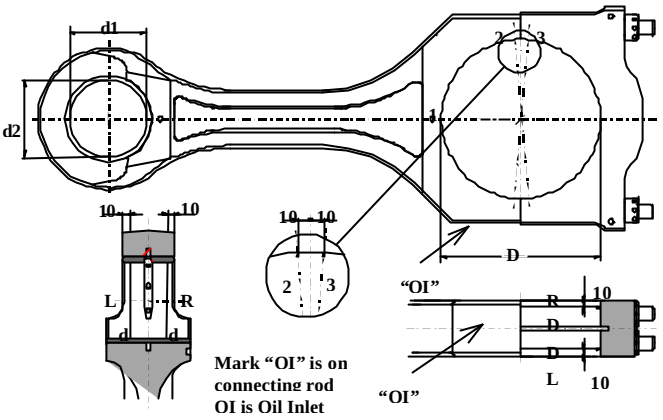
Diameter without shells: D = 247.000-247.029 [mm].
Allowed min. diameter: 246.97 [mm].
Allowed max. diameter: 247.05 [mm].
No go : D2 or D3 < D1.

Component Temperature (°C):

Small end bearing bore

Diameter: 120.085-120.150 [mm] (bearing mounted).
Diameter: 134.950-134.975 [mm] (bearing not mounted).

Straightness conrod : Difference (left / right) in distance big end / small end steelbore : max 0.04 [mm].



Bank		Cylinder number								
		1	2	3	4	5	6	7	8	9
Big end bearing bore (deviations in 1/100 [mm])										
D1	L									
	R									
D2	L									
	R									
D3	L									
	R									
Max. deviation										
Hydr.press. of tight.										
Material nr.										
Manufact. nr.										
Running hours										
Remarks										
Gudgeon pin bearing bush mounted / not mounted *										* Delete what is not applicable
d1	L									
	R									
d2	L									
	R									
Straightness conrod										
Remarks										

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

Service, WNSNL Engines

MEASUREMENT RECORD

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1401 Connecting rod	**Wärtsilä 26**	WNSNL-S	12-05-2000	04	mr26/1401/02	1(1)

Installation (ship): Engine type: Engine No:

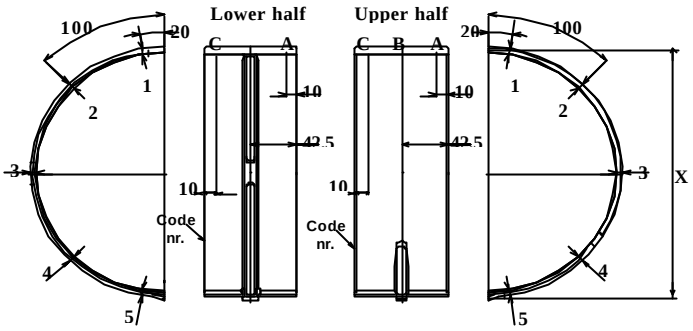
Unit, DG-set No.: Temperature (°C): Engine running hours:

Big end bearing shell

Bearing shell thickness: 5.905-5.925 [mm]

Wear limit: 5.890 [mm]

Free spread X: 250-252 [mm]



Bank			Cylinder number								
			1	2	3	4	5	6	7	8	9
UpperHalf	A	1									
		2									
		3									
		4									
		5									
	B	1									
		2									
		3									
		4									
		5									
	C	1									
		2									
		3									
		4									
		5									
Free spread		X									
Manufact. nr.											
Material nr.											
Bearing running hours											
Remarks											
Lower Half	A	1									
		2									
		3									
		4									
		5									
	C	1									
		2									
		3									
		4									
		5									
Free spread		X									
Manufact. nr.											
Material nr.											
Bearing running hours											
Remarks											

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1421 Piston	**Wärtsilä 26**	WNSNL–S	25-04-2000	04	mr26/1421/01	1(1)

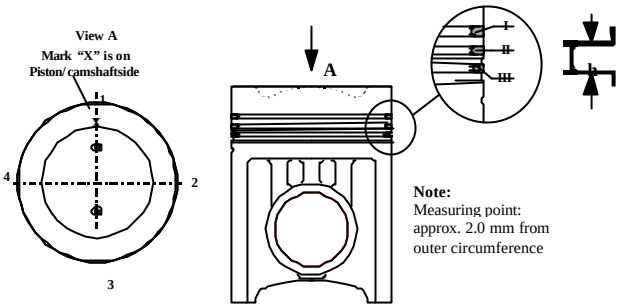
Installation (ship): Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:

Piston ring groove height

Temperature (°C): _____

Piston	Height [mm] 1421ZT114	1421ZT116	Wear limit [mm]
Groove I	7.21-7.23	7.16-7.18	7.35
Groove II	7.16-7.18	7.16-7.18	7.35
Groove III	7.04-7.06	7.04-7.06	7.15



			Cylinder number								
			1	2	3	4	5	6	7	8	9
A-BANK	I	1									
		2									
		3									
		4									
	II	1									
		2									
		3									
		4									
	III	1									
		2									
		3									
		4									
Running hours											
Remarks:											
B-BANK	I	1									
		2									
		3									
		4									
	II	1									
		2									
		3									
		4									
	III	1									
		2									
		3									
		4									
Running hours											
Remarks:											

WÄRTSILÄ NSD CORPORATION

Service, WNSNL Engines

MEASUREMENT RECORD

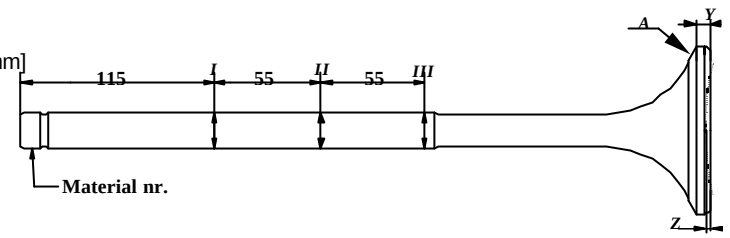
Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1504 In-/exhaustvalve(s) 1(1)	**Wärtsilä 26**	WNSNL	12-05-2000	04	mr26/1504/01	

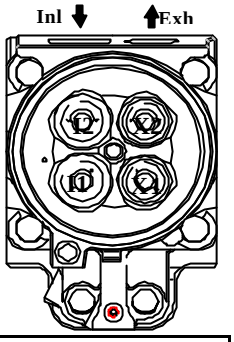
Installation (ship): Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:

VALVES

Diameter valve stem: 19.979-20.000 [mm]
Wear limit: *I* and *II* : 19.95 [mm]
III: 19.90 [mm]
Oscillation A≤0.06 [mm]
Burn-off area: max. Z= 1 [mm]
min. Y= 7 [mm]
Reference diameter: 20.00 [mm]





Bank			Cylinder number								
			1	2	3	4	5	6	7	8	9
Inlet	Material nr.										
	I1	*I*									
		II									
		III									
		Y									
		Z									
		A									
	Material nr.										
	I2	*I*									
		II									
		III									
		Y									
		Z									
		A									
Exh.	Material nr.										
	X1	*I*									
		II									
		III									
		Y									
		Z									
		A									
	Material nr.										
	X2	*I*									
		II									
		III									
		Y									
		Z									
		A									
Remarks:											

Date of measurement: _____ Place: _____ Name: _____

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Service, WNSNL Engines

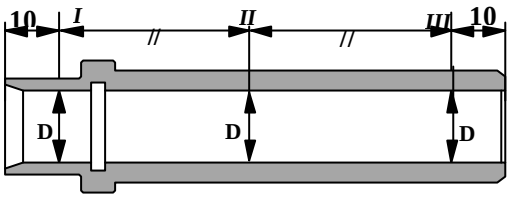
MEASUREMENT RECORD

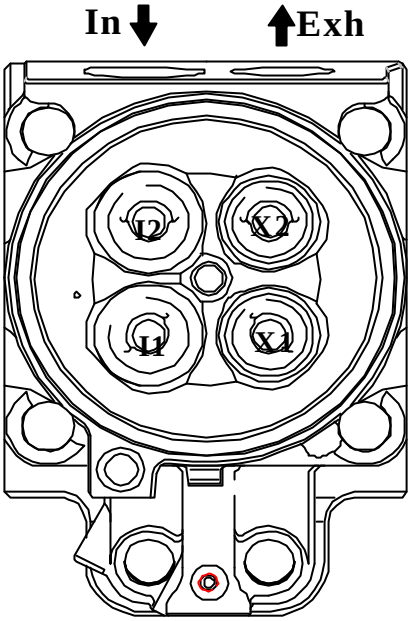
Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1504 In-/exhaustvalve(s) 1(1)	**Wärtsilä 26**	WNSNL-S	16-05-2000	03	mr26/1504/02	

Installation (ship): Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:

VALVE GUIDES





Valve guide diameter: 20.13-20.16 [mm]

Wear limit: 20.25 [mm]

Reference diameter: 20.00 [mm]

Max. Clearance with valves= 0.35 [mm]

Bank			Cylinder number								
			1	2	3	4	5	6	7	8	9
Inlet	I1	I									
		II									
		III									
	I2	I									
		II									
		III									
Exh.	X1	I									
		II									
		III									
	X2	I									
		II									
		III									
Manufact. nr.:											
Material nr.:											
Remarks:											

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

Service, WNSNL Engines

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
9203 Elastic coupling	**Wärtsilä 26**	WNSNL-S	12-05-2000	03	mr26/9203/01	1(1)

Installation (ship): _____ Engine type: _____ Engine No.: _____

Fuel viscosity (cSt): _____ Temperature (°C): _____ Running hours: _____

ALIGNMENT OF FLEXIBLE COUPLING

COUPLING TYPE: _____

CONNECTED; From: _____ To: _____

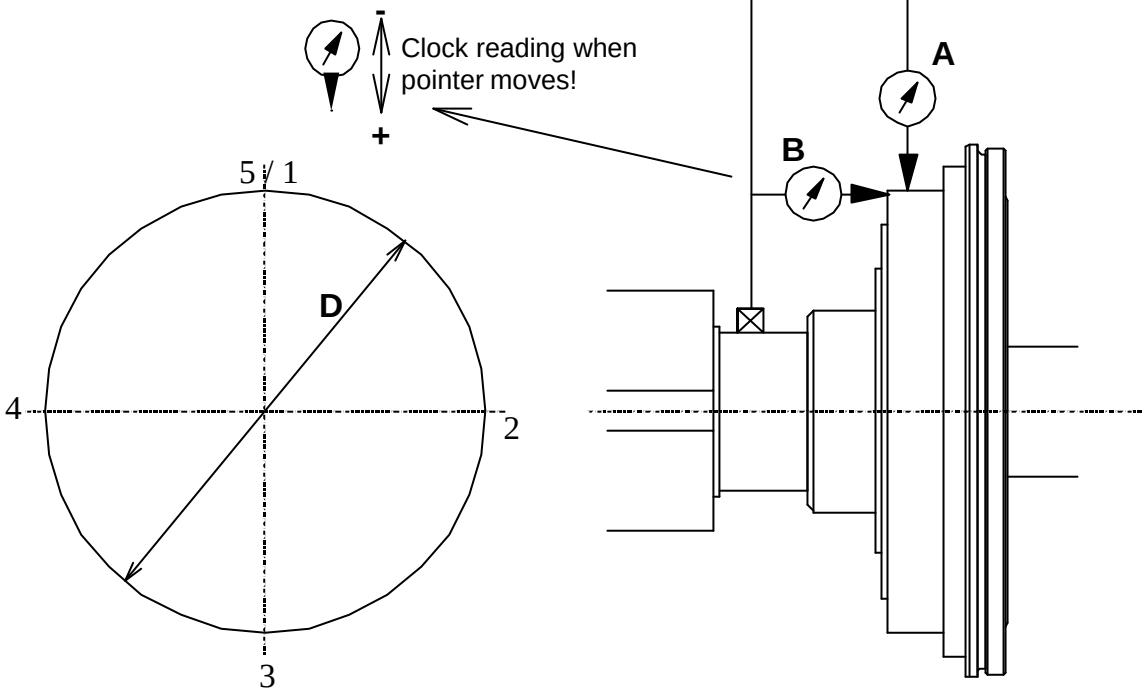
Limits given by coupling manufacturer; Axial (1/100 mm) _____ D [mm]= _____ Radial distance (1/100 mm) _____

Ambient Temp: _____ Foundation Temp: _____

GEARBOX TYPE:
- Twin in Single Out ☐
- Single in Single Out ☐

ALTERNATOR:
- Single Bearing ☐
- Double Bearing ☐

CLUTCH:
- Engaged ☐
- Disengaged ☐



REMARKS:(Specialle regarding ship loading and sun conditions)

SHIP UNLOADED ☐

SHIP LOADED ☐

ENG.NOS.	Radial Indicator/Position (INDICATOR A)						Axial Indicator/Position (INDICATOR B)					
	1	2	3	4	5		1	2	3	4	5	

Readings in 1/100 [mm]

Date of measurement: _____ Place: _____ Name: _____

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

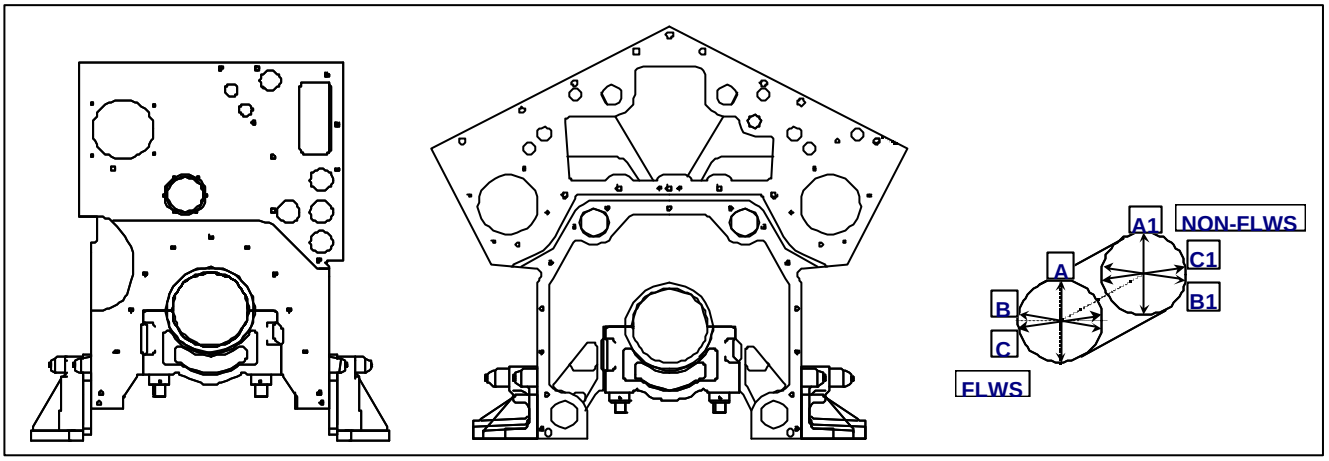
Service, Wärtsilä NSD Nederland B.V. mr26-1301-01.doc

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1301 Main bearings	**Wärtsilä 26**	WNSNL–S	29.03.2000	01	mr26/1301/01	1(1)

Installation / ship: Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:

Main bearing bores



FLWS = Flywheel side

Main bearing caps must be tightened according engine manual before bore measuring.

Temperature (°C):							
Design diameters [mm]:	**Excl. shells** [1]	295H6 $^{+0.032}_{+0}$		**No go** [1]	295 $^{+0.032}_{-0.010}$		
	Excl. shells [1]	300H6 $^{+0.032}_{+0}$		**No go** [1]	300 $^{+0.032}_{-0.010}$		
	Incl. shells	280 $^{+0.329}_{+0.258}$					
Criteria [mm]:	A1 – B1 = 0.01		A – B = 0.01	-0.02 ≤ A - A1 = 0.02		-0.02 ≤ C - C1 =	
	A1 – C1 = 0.01		A – C = 0.01	-0.02 ≤ B - B1 = 0.02			

[1] Dependable on type of mainbearing.

Main bearing bore (deviation to nominal size * 0.01 mm)

Nominal bore measurement: with mainbearing shells ☐ 280 or without mainbearing shells ☐ 295 / ☐ 300. [2]

	Cylinder number										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
A											
A1											
B											
B1											
C											
C1											
REMARKS:											

[2] Mark type of measurement.

Date of	**Place:**	**Name:**

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WÄRTSILÄ NSD CORPORATION

MEASUREMENT RECORD

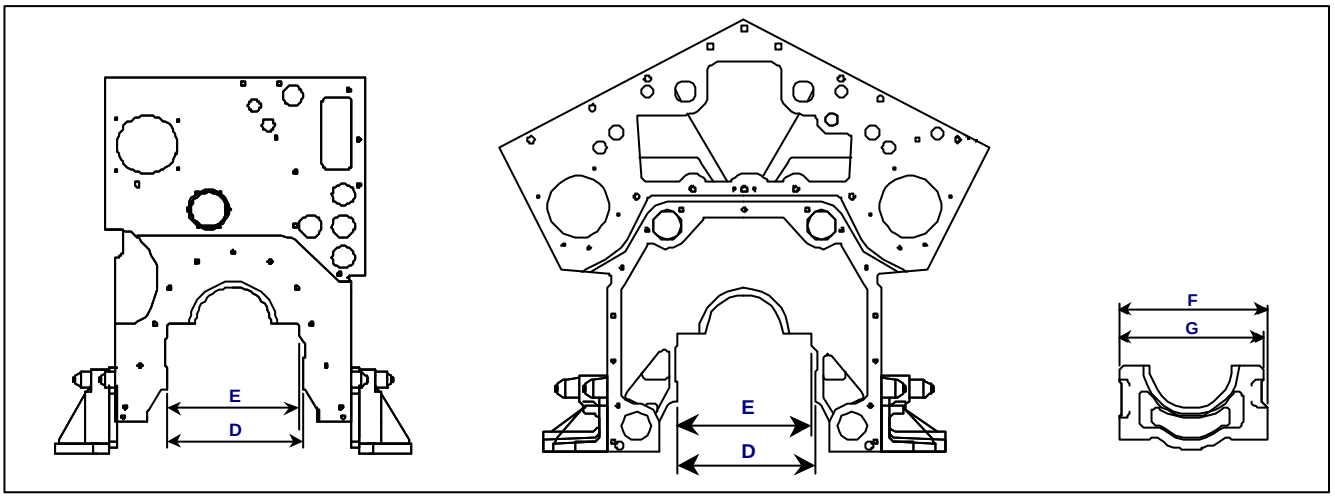
Service, Wärtsilä NSD Nederland B.V. mr26-1301-02.doc

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1301 Main bearings	**Wärtsilä 26**	WNSNL–S	24.01.2000	01	mr26/1301/02	1(1)

Installation / ship: Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:

Engine block / main bearing cap



All main bearing caps must be untightened before measuring.

Temperature (°C):				
Design measurements [mm]:	**D**	**E**	**F**	**G (no go = 522.920)**
	553H7 $^{+0.070}_{+0}$	523H6 $^{+0.044}_{+0}$	553g6 $^{-0.066}_{-0.022}$	523g6 $^{-0.066}_{-0.022}$

Cylinderblock / Main bearing cap (deviation to nominal size * 0.01 mm)											
	Cylinder number										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
D [1]											
D1 [2]											
E [1]											
E1 [2]											
F [1]											
F1 [2]											
G [1]											
G1 [2]											
REMARKS:											

[1] Flywheel side [2] Non flywheel side

Date of	**Place:**	**Name:**

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WÄRTSILÄ NSD CORPORATION

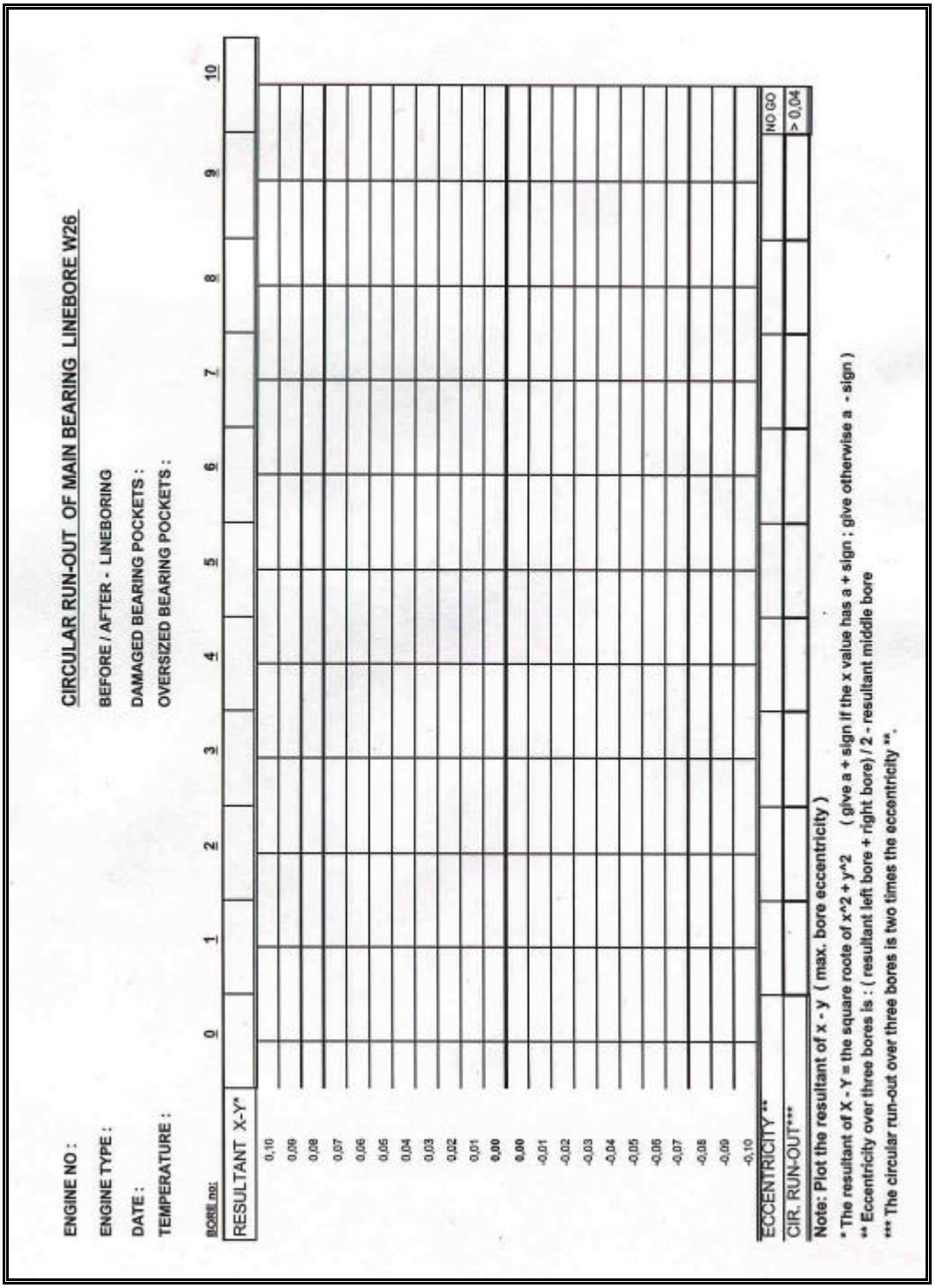
MEASUREMENT RECORD

Service, Wärtsilä NSD Nederland B.V. mr26-1301-03.doc

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
1301 Main bearings	**Wärtsilä 26**	WNSNL–S	24.01.2000	01	mr26/1301/03	1(1)

Installation / ship: Engine type: Engine No:

Unit, DG-set No.: Temperature (°C): Engine running hours:



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