General

4-stroke direct injected, turbocharged and aftercooled diesel engine

Number of cylinders		6
No of valves		24
Displacement, total	litres in³	12,78 779,7
Firing order		1-5-3-6-2-4
Rotational direction, viewed from the front		Clockwise
Bore	mm in	131 5,16
Stroke	mm in	158 6,22
Compression ratio		18,5:1
Compression pressure at 240 rpm	MPa psi	
Max. static forward inclination:	°	5
Max. static backward inclination:	°	10
Max. intermittent forward inclination while running:	°	35
Max. intermittent backward inclination while running:	°	35
Max. intermittent side inclination while running:	°	35
Idling speed	rpm	550 - 800
Rated speed R1	rpm	1800
Propeller selection range R1	rpm	1770 - 1870
Dry weight engine BT	kg lb	1520 3351

Performance	**Rating**	**rpm**	**600**	**800**	**1000**	**1200**	**1400**	**1500**	**1600**	**1800**	**1900**	**2000**
Crankshaft power 1), 5)	1	kW	82	145	181	208	214	214	214	214	165	
		hp	112	197	246	283	291	291	291	291	224	
Propeller shaft power 1) (At full load)	1	kW	76	136	171	197	202	202	202	202	155	
With drive ZF 335 AE		hp	103	185	232	267	275	275	275	275	211	
Propellershaft power at prop. load x^3	1	kW	7	18	35	60	95	117	142	202		
With drive ZF 335 AE		hp	10	24	47	82	130	159	193	275		
Torque at crankshaft 2)	1	Nm	1305	1731	1728	1655	1460	1362	1277	1135	829,3	
		lbf ft	963	1277	1275	1221	1077	1005	942	837	612	
Mean piston speed		m/s	3,2	4,2	5,3	6,3	7,4	7,9	8,4	9,5	10,0	10,5
		ft/s	10,4	13,8	17,3	20,7	24,2	25,9	27,6	31,1	32,8	34,6
Effective mean pressure 2)	1	MPa	1,28	1,70	1,70	1,63	1,44	1,34	1,26	1,12	0,82	
		psi	186,2	246,9	246,5	236,1	208,2	194,3	182,2	161,9	118,3	
Max combustion pressure 2)	1	MPa	10,9	13,6	12,7	12,1	12,1	12,1	12	12,3	10,6	
		psi	1581	1973	1842	1755	1755	1755	1740	1784	1537	

Lubricating system

Specific lubricating oil consumption.	g/kWh	0,06
Max. oil volume including filters for all allowed installation inclinations:	litres US gal	49 12,94
Max. oil volume excluding filters for all allowed installation inclinations:	litres US gal	44 11,62
Min. oil volume excluding filters for all allowed installation inclinations:	litres US gal	35 9,25

Fuel system	Rating	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Specific fuel consumption 2)	1	g/kWh	244,8	219	201,7	198,7	197,9	199,1	201,7	207,5	229,1	
		lb/hph	0,396	0,355	0,327	0,322	0,321	0,323	0,327	0,336	0,371	
Fuel consumption at Test cycle?	1	g/kWh	209,8									
		lb/hph	0,34									
Fuel consumption at prop. load x [3]	1	l/h	3,4	6,3	10,7	17,3	25,9	31,2	37,5	52,8		
		US gal/h	0,9	1,7	2,8	4,6	6,9	8,3	9,9	14,0		
Fuel consumption at full load	1	l/h	24,0	38,0	43,7	49,5	50,7	51,0	51,7	53,1	45,2	
		US gal/h	6,3	10,0	11,5	13,1	13,4	13,5	13,6	14,0	11,9	

Intake and exhaust system	Rating	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Specific exhaust heating effect in percent of crankshaft power	1	%	42	38	42	49	55	57	61	67	91	
Exhaust temperature at the exhaust pipe connecting flange after the turbo charger.	1	°C	613	629	576	537	495	484	465	451	363	
		°F	1135	1164	1069	999	923	903	869	844	685	
Permitted back pressure in the exhaust line at rated speed. (Installed back pressure)		kPa							Max	12		
		psi								1,7		
		kPa							Min	0		
		psi								0,0		

Intake and exhaust system	Rating	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Engine air consumption at 25°C / 77°F atmospheric pressure 100kPA and relative humidity 30%.	1	m³/min	4,8	7,9	10,9	14,7	17,0	17,9	19,1	20,9	17,4	
		cu.ft./min	170,6	279,7	385,9	520,2	600	632,5	674,8	738,3	612,9	
Charge air pressure Inlet manifold	1	kPa	35	77	98	121	126	127	130	133	83	
		psi	5,0	11,1	14,3	17,6	18,3	18,4	18,8	19,2	12,0	
Exhaust gas flow	1	m³/min	3,0	4,9	6,6	8,6	9,7	10,1	10,6	11,4	8,8	
		cu.ft./min	106	172,7	232,6	305	341,8	356,2	374,1	400,9	310,3	

Cooling system	Rating	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Radiated heat in kW (per engine)	1	kW	3	3,6	4,2	4,6	4,7	4,7	4,7	4,7	4,1	
Heat rejection to charge air cooler in percent of crankshaft power.	1	%	4,5	6,9	9,0	12,4	13,7	14,8	16,3	18,3	16,3	
Coolant heat rejection to HE, incl. engine oil cooler and excl. charge air cooler, in percent of crankshaft power.	1	%	111,4	76,5	65,0	58,9	56,3	57,6	57,5	61,7	76,3	
Coolant flow with fully open thermostat and std cooling system		l/min	120	192	246	306	360	384	408	450		
		cu.ft./min	4,2	6,8	8,7	10,8	12,7	13,6	14,4	15,9		
Coolant volume engine, including heat exchanger and charge air cooler		litres	51									
		US gal.	13,47									
Max. additional coolant for cabin heater etc. with std. Expansion tank		litres	16									
		US gal.	4,23									
Maximum coolant flow to cabin heater etc.		l/min	42									
		cu.ft./min	1,48									
Thermostat, start open at		°C	82									
		°F	180									
Thermostat, fully open at		°C	92									
		°F	198									

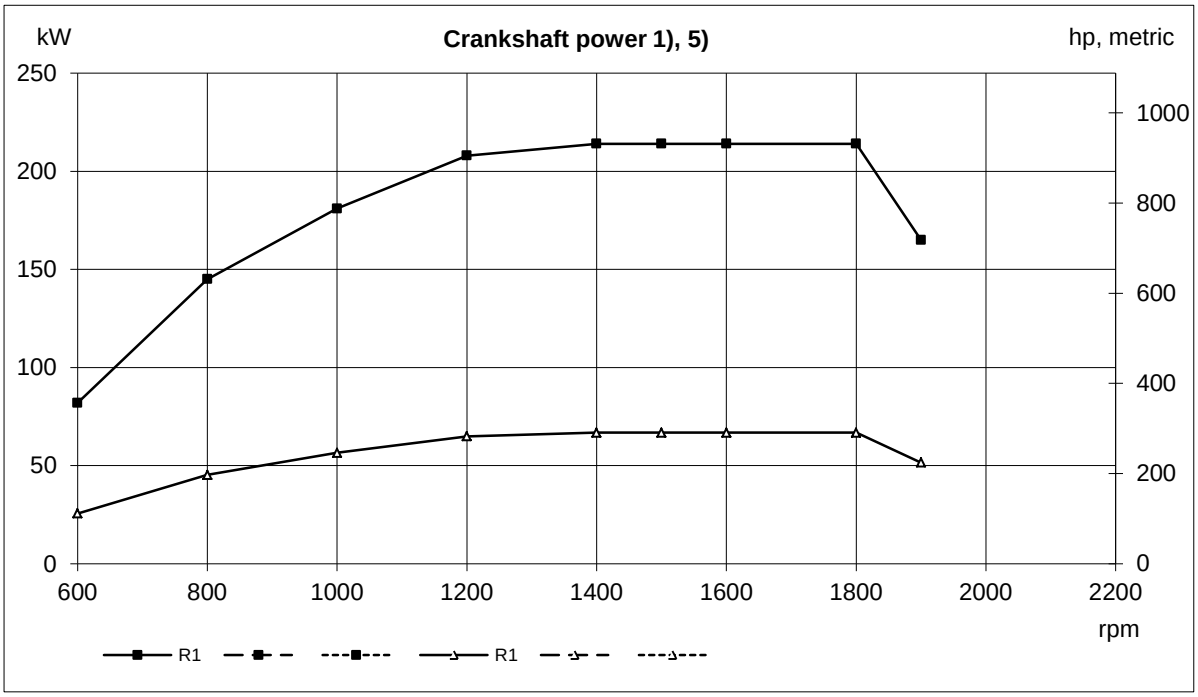
Raw water circuit	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Nominal raw water design flow	l/min	161	216	273	320	368	392	414	456		
	cu.ft/min	5,7	7,6	9,6	11,3	13,0	13,8	14,6	16,1		
Nominal raw water pump pressure head at design flow. (measured before and after pump)	kPa	19	30	49	66	84	95	107	131		
	psi	2,8	4,4	7,1	9,6	12,2	13,8	15,5	19,0		
Maximum raw water pump suction head	kPa	-30									
	psi	-4,4									
Maximum raw water temperature entering heat exchanger	°C	38									
	°F	100									

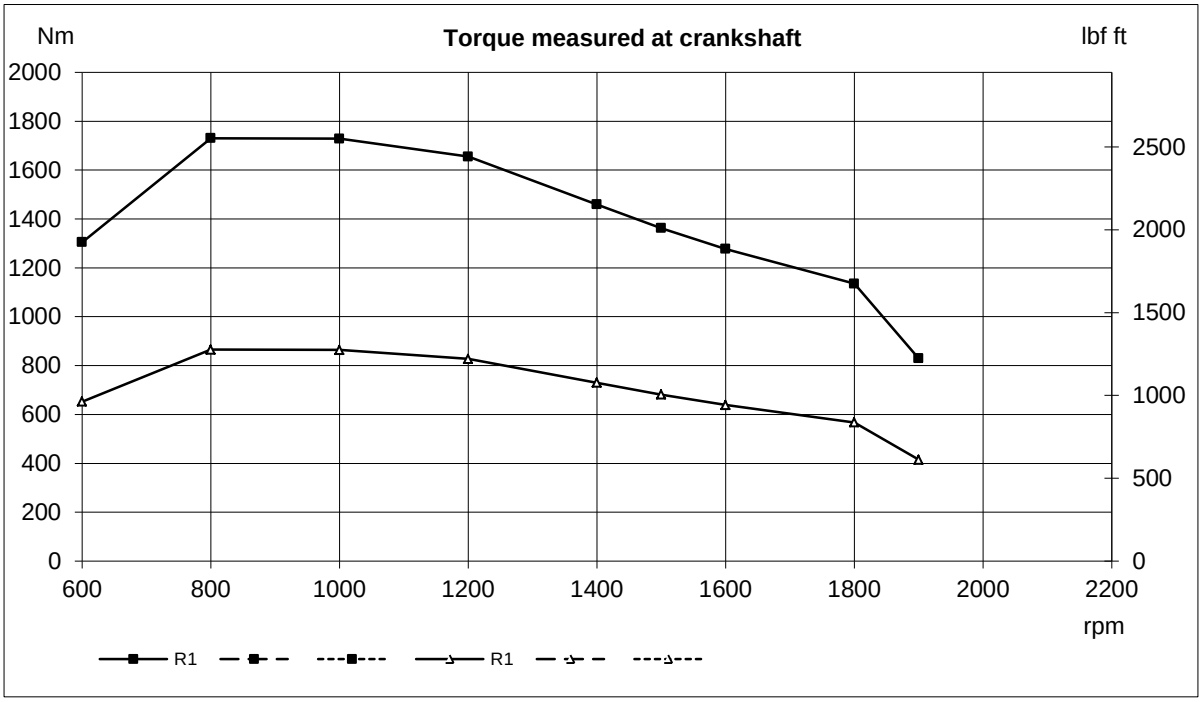
2 circuit keel cooling system, LT	Rating	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Maximum temperature to charge air cooler from external LT-cooling system circuit	1	°C								45		
		°F								113		
Coolant flow through keel cooler, LT-cooling system circuit	1	l/min	33	45	58	70	81	85	90	96		
		cu.ft./min	1,2	1,6	2,0	2,5	2,9	3,0	3,2	3,4		
Pressure drop in external LT-cooling system circuit, including piping		kPa				85	-					
		psi				12,3	-					
Coolant volume charge air cooler		litres	5									
		US gal.	1,32									

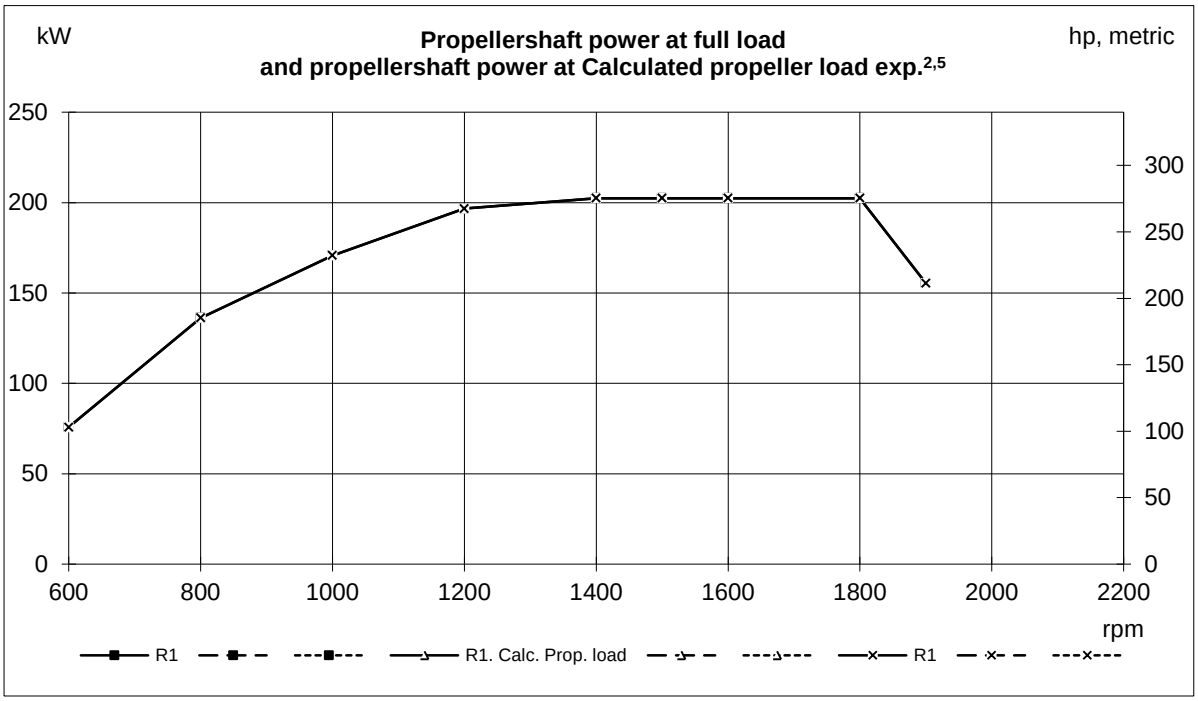
2 circuit keel cooling system, HT	Rating	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Design point for keel cooler, engine outlet temperature	1	°C								86		
		°F								187		
Maximum temperature to engine from external HT-cooling system circuit	1	°C								70		
		°F								158		
Coolant flow through keel cooler, HT-cooling system circuit at design point	1	l/min								99		
		cu.ft./min								3,5		
Maximun coolant flow through keel cooler, HT-cooling system circuit	1	l/min								260		
		cu.ft./min								9,2		
Pressure drop in external HT-cooling system circuit, including piping		kPa				85	-					
		psi				12,3	-					
Coolant volume engine, excl. heat exchangers		litres	28									
		US gal.	7,40									

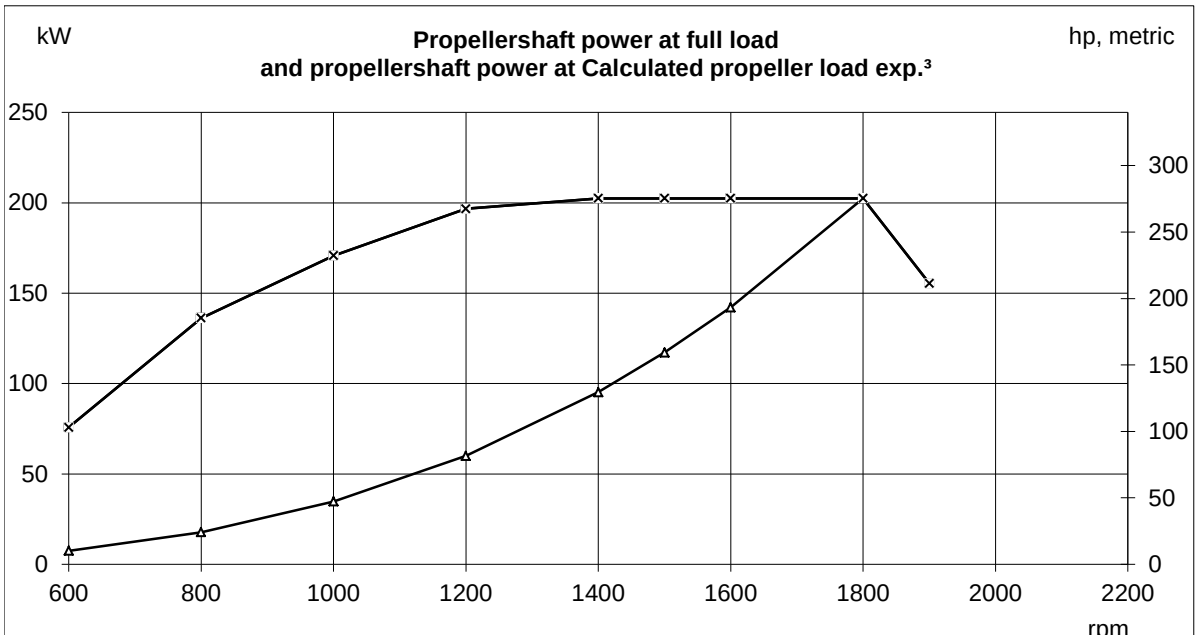
Emissions	Rating	rpm	600	800	1000	1200	1400	1500	1600	1800	1900	2000
Smoke at prop. load x³	1	*BSU	4,1	1,6	0,6	0,2	0,1	0,1	0,2	0,2	0,1	
Noise at prop. load x³. 4)	1	dBA	100,1	104,1	107,2	109,2	111		111,8	113		

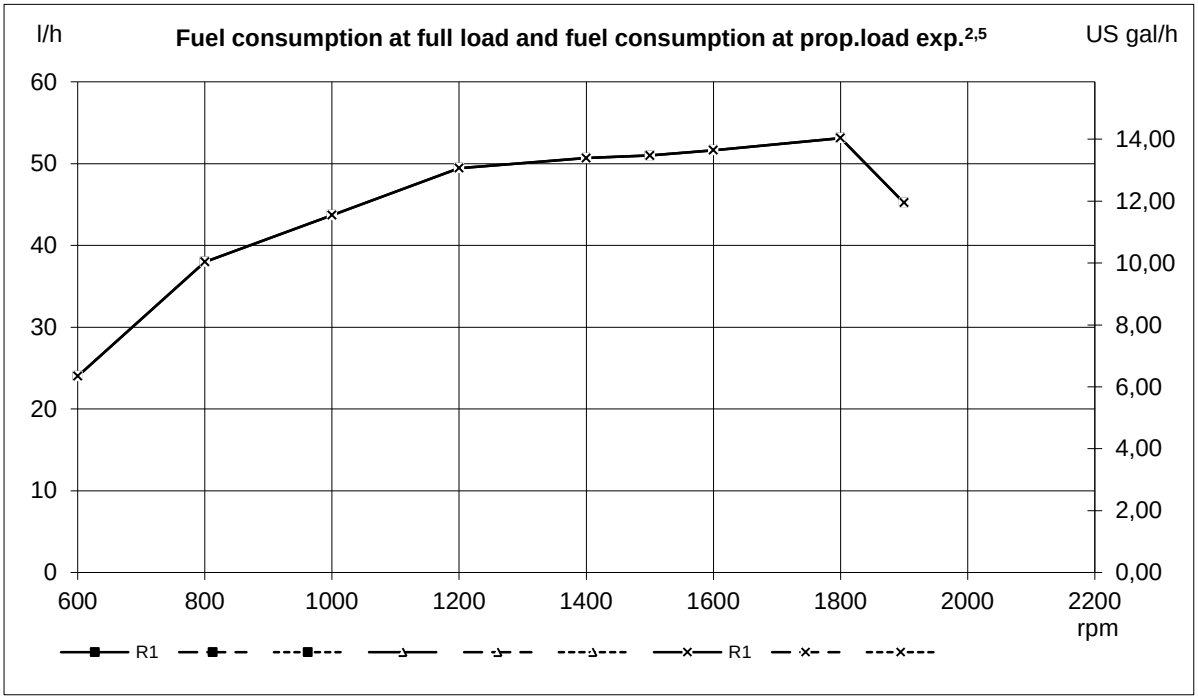
***NB.!** BSU are calculated values. Measured values are acc. to ISO 10054 in FSN units

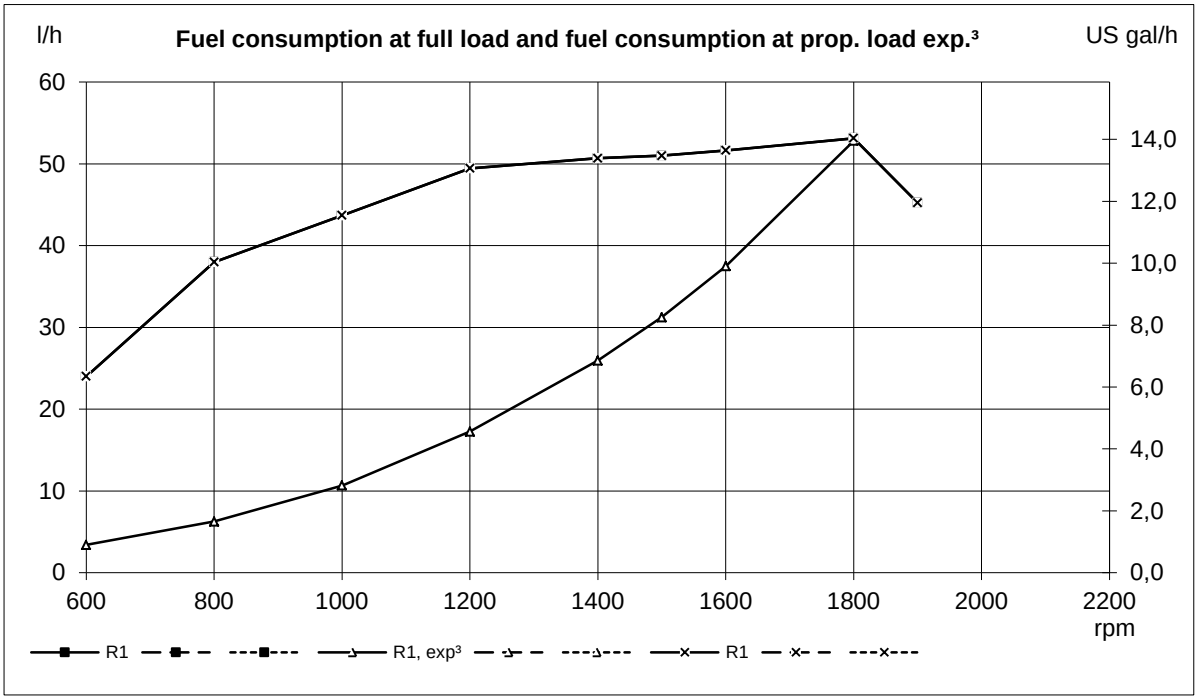

kW
Crankshaft power 1), 5)
hp, metric
250
200
150
100
50
0
1000
800
600
400
200
0
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
R1
R1

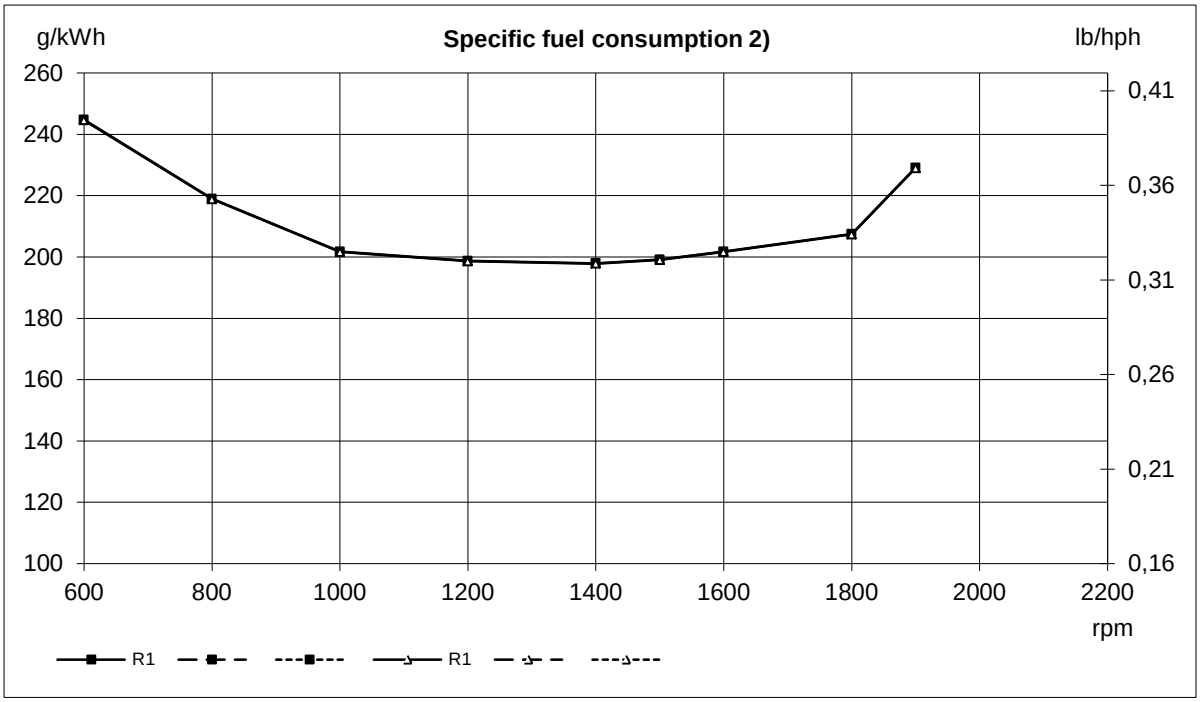

Nm
Torque measured at crankshaft
lbf ft
2000
1800
1600
1400
1200
1000
800
600
400
200
0
2500
2000
1500
1000
500
0
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
R1
R1

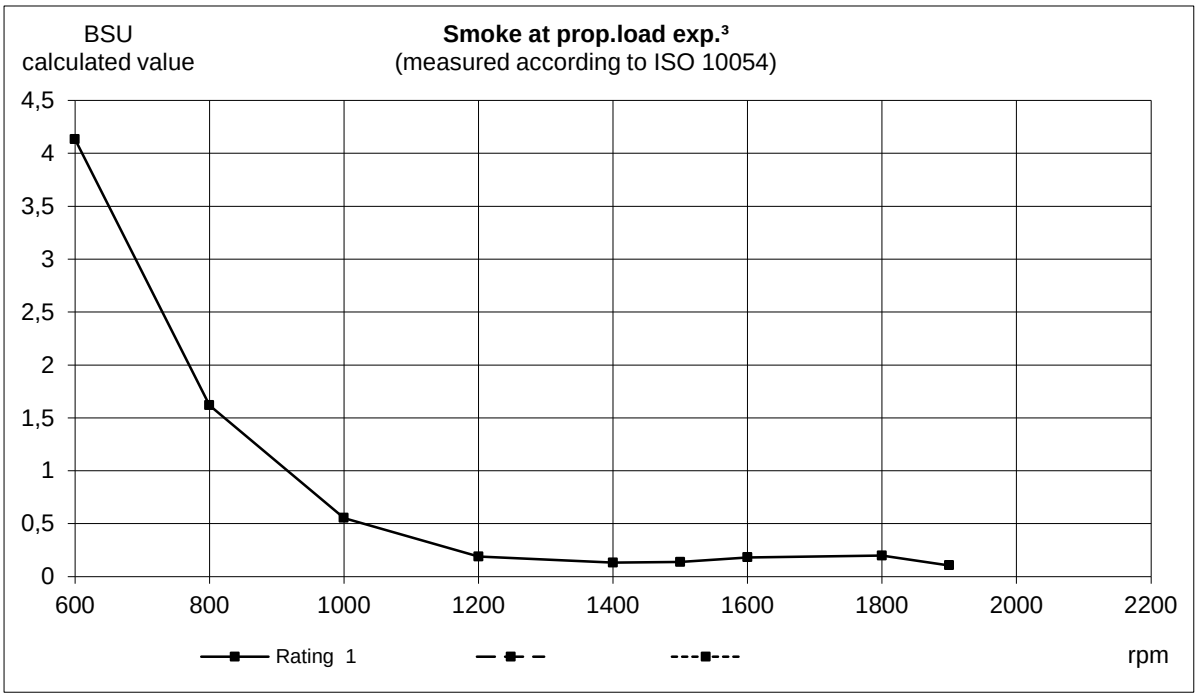

kW
Propellershaft power at full load
and propellershaft power at Calculated propeller load exp.2,5
hp, metric
250
200
150
100
50
0
300
250
200
150
100
50
0
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
R1
R1. Calc. Prop. load
R1

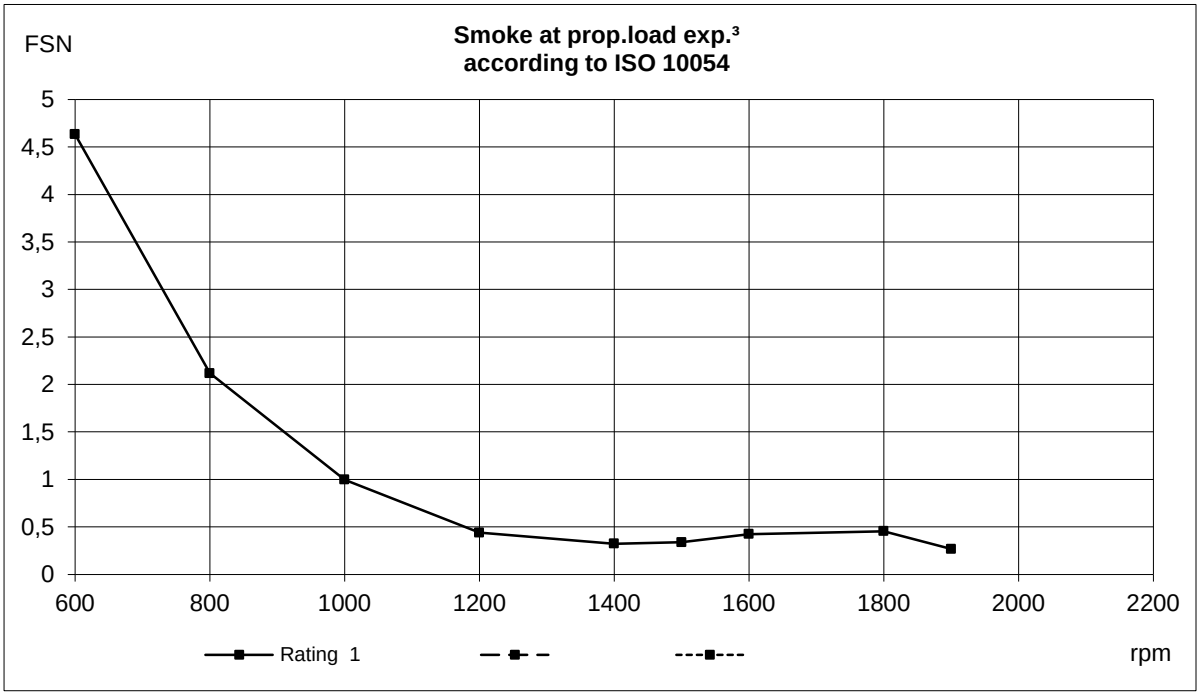

kW
Propellershaft power at full load
and propellershaft power at Calculated propeller load exp.3
hp, metric
250
200
150
100
50
0
300
250
200
150
100
50
0
600
800
1000
1200
1400
1600
1800
2000
2200
rpm

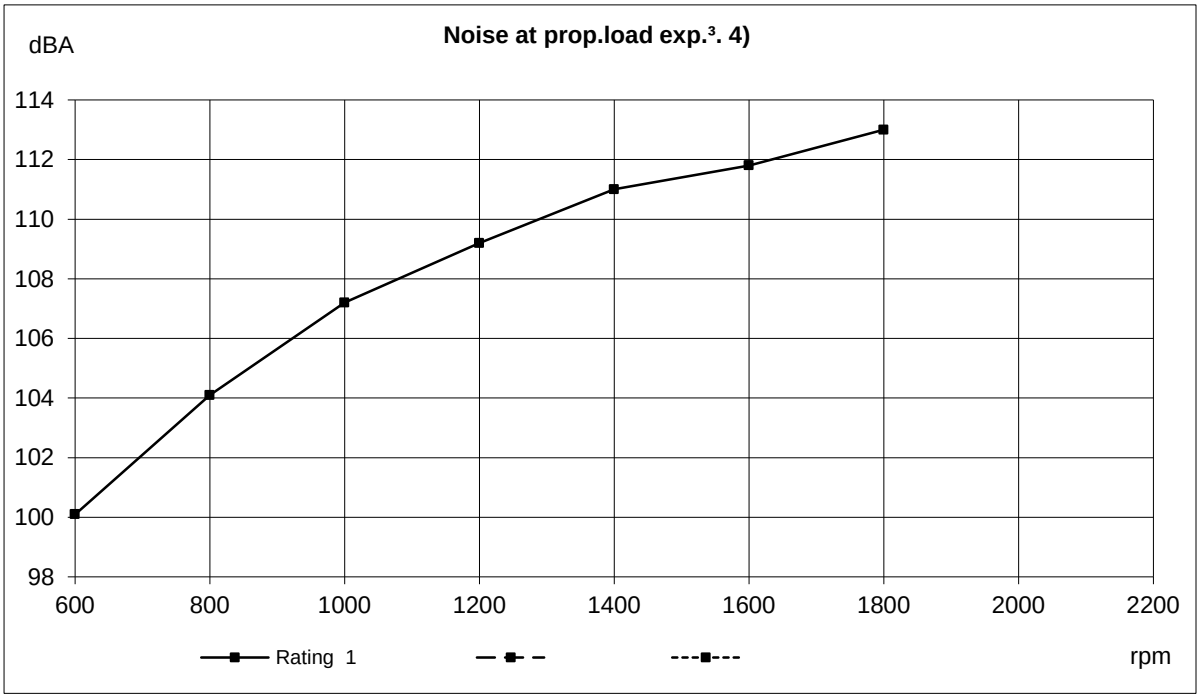

l/h
Fuel consumption at full load and fuel consumption at prop.load exp.2,5
US gal/h
60
50
40
30
20
10
0
14,00
12,00
10,00
8,00
6,00
4,00
2,00
0,00
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
R1
R1


l/h
Fuel consumption at full load and fuel consumption at prop. load exp.3
US gal/h
60
50
40
30
20
10
0
14,0
12,0
10,0
8,0
6,0
4,0
2,0
0,0
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
R1
R1, exp3
R1


g/kWh
Specific fuel consumption 2)
lb/hph
260
240
220
200
180
160
140
120
100
0,41
0,36
0,31
0,26
0,21
0,16
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
R1
R1


BSU
calculated value
Smoke at prop.load exp.³
(measured according to ISO 10054)
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
600
800
1000
1200
1400
1600
1800
2000
2200
Rating 1
rpm


FSN
Smoke at prop.load exp.³
according to ISO 10054
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
600
800
1000
1200
1400
1600
1800
2000
2200
Rating 1
rpm


Noise at prop.load exp.³. 4)
dBA
114
112
110
108
106
104
102
100
98
600
800
1000
1200
1400
1600
1800
2000
2200
Rating 1
rpm

Sensors Control and Monitoring System							Switches Engine Shutdown System	
Sensors	**Signal**	**Unit**	**Range**	**Warning Initial Delay / Warning Delay**	**Warning Level**	**Derating Level**	**Shutdown Initial Delay / Shutdown Delay**	**Shutdown Level (Tolerance)**
Charge air pressure	0,5-4,5 V	kPa	50 - 400 (150-500	30 sec from start / 5 sec	300 (400 abs.)	310 (410 abs.) *	NA	NA
Charge air temperaure	50-0 kΩ	°C	-40 - 130	30 sec from start / 5 sec	80	90 (soft 3)	NA	NA
Coolant level switch	Digital		ON/OFF	30 sec from start / 5 sec	Low (ON / Closed)	NA	NA	NA
Coolant temperature	50-0 kΩ	°C	-40 - 140	30 sec from start / 5 sec	98	101 (soft 1)	4 sec from start/ 1 sec	105 (±2°C) SDU Ch. S1
Engine speed cam	Frequency	rpm		Instant	Lost signal	NA	NA	NA
Engine speed crank	Frequency	rpm		Instant	Lost signal	NA	NA	NA
Eng. overspeed SDU 1800+15%	Frequency	rpm / Hz	153	Instant	Lost signal	NA	Instant	2070 / 5279 Hz (-1 to 0%)
Eng. overspeed SDU 1900+15%	Frequency	rpm / Hz	153	Instant	Lost signal	NA	Instant	2185 / 5572 Hz (-1 to 0%)
Exhaust gas temperature	PT200	°C	0 - 850	30 sec from start / 5 sec	650	665 (soft 4)	NA	NA
Oil level sensor	Digital		ON/OFF	30 sec from start / 5 sec	Low level	NA	NA	NA
Oil temperature	50-0 kΩ	°C	-40 - 140	30 sec from start / 5 sec	125	128 (soft 2)	NA	NA
Piston cooling switch	Digital	kPa	ON/OFF	Above 1000 rpm instant	120 ±20	120 (70%)	NA	NA
Reversing gear temperature	NA	°C	NA	NA	NA	NA	NA	NA
Water In fuel switch	Digital		ON/OFF	All the time	Water in fuel	NA	NA	NA

NA = Not applicable

** Yes, 50% of engine prot. map.*

Sensors (rpm dependent)	Signal	Unit	Range	Initial Delay /	Warning Level / Derating Level / Shutdown Level					Switches
Coolant pressure	0,5-4,5 V	kPa	0-300		**600 rpm**	**1000 rpm**	**1500 rpm**	**1800 rpm**	**1900 rpm**	
Warning Level		kPa		30 sec from start / 4 sec	5	30	55	80	90	
Derating Level (50% remain trq.)		kPa		10% trq. decr. per sec	NA	20	45	70	80	
Shutdown Level (Shutdown Unit Channel S4)	Digital	kPa	ON/OFF	4 sec from start / 1 sec	NA	NA	NA	25 (-10/+20)	25 (-10/+20)	Shutdown Unit Setting S4:1150 rpm±2% 2933 Hz ±2% 153 pulses / revolution
Fuel pressure	0,5-4,5 V	kPa	0-700		**600 rpm**	**1000 rpm**	**1500 rpm**	**1800 rpm**	**1900 rpm**	
Warning Level		kPa		30 sec from start / 5 sec	180	240	270	270	270	
Derating Level		kPa		NA	NA	NA	NA	NA	NA	
Oil pressure	0,5-4,5 V	kPa	0-700		**600 rpm**	**1000 rpm**	**1500 rpm**	**1800 rpm**	**1900 rpm**	
Warning Level		kPa		30 sec from start / 3 sec	135	200	265	265	265	
Derating Level (30% remain trq.)		kPa		10% trq. decr. per sec	105	170	235	235	235	
Shutdown Level (Shutdown Unit Channel S3)	Digital	kPa	ON/OFF	4 sec from start / 1 sec	120 ±20	120 ±20	120 ±20	120 ±20	120 ±20	Shutdown Unit Setting S2,S3: 850 rpm ±2% 2180 Hz ±2% 153 pulses / revolution
Seawater pressure	0,5-4,5 V	kPa	0-300		**600 rpm**	**1000 rpm**	**1500 rpm**	**1800 rpm**	**1900 rpm**	Only HE
Warning Level		kPa		30 sec from start / 8 sec	5	15	40	40	40	
Derating Level		kPa		NA	NA	NA	NA	NA	NA	
Reversing Gear pressure					**600 rpm**	**1000 rpm**	**1500 rpm**	**1800 rpm**	**1900 rpm**	
Warning Level	NA	kPa	NA	NA	NA	NA	NA	NA	NA	
Derating Level	NA	kPa	NA	NA	NA	NA	NA	NA	NA	
Shutdown Level (Shutdown Unit Channel S2)	Digital	kPa	ON/OFF	4 sec from start / 1 sec	NA	400 ±20	400 ±20	400 ±20	400 ±20	Shutdown Unit Setting S2,S3: 850 rpm ±2% 2180 Hz ±2% 153 pulses / revolution
Charge air pressure	0,5-4,5 V	kPa	50 - 600 ± 4		**600 rpm**	**1000 rpm**	**1500 rpm**	**1800 rpm**	**1900 rpm**	
Warning Level (Relative pressure)		kPa		30 sec from start / 2 sec	310	310	300	255	245	
Derating Level (Relative pressure)		kPa		Instant	330	330	320	275	265	0-50% @ 1200-1800rpm
Shutdown Level	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Warning = Yellow Lamp active

Derating = Red Lamp active

Remarks

	Speed / °C	101°C	103°C	106°C
Soft 1) Soft derate Coolant temp				
Remaining torque in %	600	100%	100%	100%
	1200	100%	91%	82%
	1800	100%	83%	66%

	Speed / °C	128°C	130°C	135°C
Soft 2) Soft derate Oil temp				
Remaining torque in %	600	100%	100%	100%
	1200	100%	91%	74%
	1800	100%	83%	52%

	Speed / °C	90°C	95°C	105°C
Soft 3) Soft derate Charge Air Temp				
Remaining torque in %	600	100%	100%	100%
	1200	100%	82%	74%
	1800	100%	66%	52%

	Speed / °C	665°C	675°C	680°C	685°C
Soft 4) Soft derate Exhaust Temp					
Remaining torque in %	600	100%	100%	100%	100%
	1200	100%	96%	93%	89%
	1800	100%	93%	86%	80%