General

4-stroke direct injected, turbocharged and aftercooled diesel engine

Number of cylinders		6
No of valves		24
Displacement, total	litres in³	10,84 661,3
Firing order		1-5-3-6-2-4
Rotational direction, viewed from the front		Clockwise
Bore	mm in	123 4,84
Stroke	mm in	152 5,98
Compression ratio		16,5:1
Compression pressure at 240 rpm	MPa psi	
Max. static forward inclination:	°	0
Max. static backward inclination:	°	7
Max. intermittent forward inclination while running:	°	10
Max. intermittent backward inclination while running:	°	17
Max. intermittent side inclination while running:	°	30
Idling speed	rpm	600 (+50)
Rated speed R	rpm	2500
Rated speed Crankshaft power 1), 5) R4	rpm	2400
Propeller selection range R	rpm	2500-2550
Propeller selection range Crankshaft power 1), 5)	rpm	2400-2450
Dry weight engine BT	kg lb	1145 2524

Performance	**Rating**	**rpm**	**700**	**900**	**1100**	**1300**	**1600**	**1900**	**2100**	**2300**	**2400**	**2500**
Crankshaft power 1), 5)	4	kW	71	120	180	300	360	430	457	459	459	
		hp	97	163	245	408	490	585	622	625	625	
Propeller shaft power 1) (At full load)	4	kW	69	116	175	291	349	417	443	445	445	
With reverse gear		hp	94	158	237	396	475	567	603	606	606	
Propellershaft power at prop. load x2,5	4	kW	20	38	63	96	162	248	319	400	445	
With drive Reverse gear		hp	28	52	86	131	220	338	434	544	606	
Propellershaft power at prop. load x3	4	kW	11	23	43	71	132	221	298	392	445	
With drive Reverse gear		hp	15	32	58	96	179	300	406	533	606	
Torque at crankshaft 2)	4	Nm	968,6	1273	1563	2204	2149	2161	2078	1906	1826	
		lbf ft	714	939	1153	1625	1585	1594	1533	1406	1347	
Mean piston speed		m/s	3,5	4,6	5,6	6,6	8,1	9,6	10,6	11,7	12,2	12,7
		ft/s	11,6	15,0	18,3	21,6	26,6	31,6	34,9	38,2	39,9	41,6
Effective mean pressure 2)	4	MPa	1,12	1,48	1,81	2,56	2,49	2,51	2,41	2,21	2,12	
		psi	162,9	214,1	262,8	370,6	361,4	363,5	349,5	320,5	307,2	
Max combustion pressure 2)	4	MPa	11,1	13,2	17	19,1	18,6	19,6	19,3	17,9	17,7	
		psi	1610	1914	2466	2770	2698	2843	2799	2596	2567	

Lubricating system

Specific lubricating oil consumption.	g/kWh	0,1
Max. oil volume including filters for all allowed installation inclinations:	litres US gal	30 7,93
Max. oil volume excluding filters for all allowed installation inclinations:	litres US gal	25 6,60
Min. oil volume excluding filters for all allowed installation inclinations:	litres US gal	21 5,55

1) ISO 3046, fuel temp 40°C
ISO 8665 (=SAE J 1228=ICOMIA 28-83)
2) At power according to 1).
3) If reverse gear is used, 4% in heat rejection will be added for its oil cooler.
4) ACC. To ISO 3744
5) At installed back pressure

Fuel system	Rating	rpm	700	900	1100	1300	1600	1900	2100	2300	2400	2500
Specific fuel consumption 2)	4	g/kWh	247	239	247	214	198	200	206	216	219	
		lb/hph	0,4	0,387	0,4	0,347	0,321	0,324	0,334	0,35	0,355	
Fuel consumption, Test cycle E5		g/kWh	223									
		lb/hph	0,36									
Fuel consumption, Test cycle E5	4	g/kWh	222									
		lb/hph	0,36									
Fuel consumption at prop. load x [2,5]	4	l/h	6,4	11,1	17,7	25,9	42,8	65,1	83,2	108,7	120,7	
		US gal/h	1,7	2,9	4,7	6,9	11,3	17,2	22,0	28,7	31,9	
Fuel consumption at full load	4	l/h	21,0	34,3	53,2	76,8	85,3	102,9	112,7	118,6	120,3	
		US gal/h	5,5	9,1	14,1	20,3	22,5	27,2	29,8	31,3	31,8	

Intake and exhaust system	Rating	rpm	700	900	1100	1300	1600	1900	2100	2300	2400	2500
Specific exhaust heating effect in percent of crankshaft power		%										
	4		75	69	65	64	70	79	83	87	88	
Exhaust temperature at the exhaust pipe connecting flange after the turbo charger.	4	°C	528	635	704	611	493	464	472	478	476	
		°F	982	1175	1299	1132	919	867	882	892	889	
Permitted back pressure in the exhaust line at rated speed. (Installed back pressure)		kPa							Max		15	
		psi									2,2	
		kPa							Min			
		psi										
Engine air consumption at 25°C / 77°F atmospheric pressure 100kPA and relative humidity 30%.	4	m³/min	4,2	6,7	9,7	15,2	21,3	27,9	31,1	34	34,9	
		cu.ft./min	148,3	236,6	342,6	536,8	752,2	985,3	1098	1201	1232	
Charge air pressure Inlet manifold	4	kPa	22	49	78	138	177	212	218	219	218	
		psi	3,2	7,1	11,3	20,0	25,7	30,7	31,6	31,8	31,6	
Exhaust gas flow	4	m³/min	12	23	33	49	57	77	81	83	85	
		cu.ft./min	423,8	812,2	1165	1730	2013	2719	2860	2931	3002	

Cooling system	Rating	rpm	700	900	1100	1300	1600	1900	2100	2300	2400	2500
Radiated heat in percent of crankshaft power.	4	%	5,1	4,3	3,4	2,4	1,3	1,1	1,1	1,1	1,1	
Heat rejection to charge air cooler in percent of crankshaft power.	4	%	4	6	8	12	16	19	21	23	23	
Coolant heat rejection to HE, incl. engine oil cooler and excl. charge air cooler, in percent of crankshaft power.	4	%	168	134	104	80	48	39	41	47	49	
Coolant flow with fully open thermostat and std cooling system		l/min	249	342	400	477	591	693	742	750	738	733
		cu.ft./min	8,8	12,1	14,1	16,8	20,9	24,5	26,2	26,5	26,1	25,9
Max. permissible temperature on coolant in engine outlet		°C	98									
		°F	208									
Coolant volume engine, including heat exchanger and charge air cooler		litres	46									
		US gal.	12,15									
Max. additional coolant for cabin heater etc. with std. Expansion tank		litres	40									
		US gal.	10,57									
Maximum coolant flow to cabin heater etc.		l/min	76									
		cu.ft./min	2,68									
Thermostat, start open at		°C	76									
		°F	169									
Thermostat, fully open at		°C	86									
		°F	187									

Raw water circuit	rpm	700	900	1100	1300	1600	1900	2100	2300	2400	2500
Nominal raw water design flow	l/min	91	99	121	141	174	204	227	249	258	266
	cu.ft/min	3,2	3,5	4,3	5,0	6,1	7,2	8,0	8,8	9,1	9,4
Maximum raw water pump suction head	kPa	-10									
	psi	-1,5									
Maximum raw water temperature entering heat exchanger	°C	32									
	°F	90									

1) ISO 3046, fuel temp 40°C
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2) At power according to 1).
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4) ACC. To ISO 3744
5) At installed back pressure

2 circuit keel cooling system, LT	Rating	rpm	700	900	1100	1300	1600	1900	2100	2300	2400	2500
Maximum temperature to charge air cooler from external LT-cooling system circuit	4	°C °F									32 90	
Coolant flow through keel cooler, LT-cooling system circuit	4	l/min cu.ft./min									255 9,0	
Pressure drop in external LT-cooling system circuit, including piping		kPa psi						50 7,3				
Coolant volume charge air cooler		litres US gal.						5 1,32				

2 circuit keel cooling system, HT	Rating	rpm	700	900	1100	1300	1600	1900	2100	2300	2400	2500
Design point for keel cooler, engine outlet temperature	4	°C °F									85 185	
Maximum temperature to engine from external HT-cooling system circuit	4	°C °F									65 149	
Coolant flow through keel cooler, HT-cooling system circuit at design point	4	l/min cu.ft./min									209 7,4	
Maximun coolant flow through keel cooler, HT-cooling system circuit	4	l/min cu.ft./min									231 8,2	
Pressure drop in external HT-cooling system circuit, including piping		kPa psi						70 10,2				
Coolant volume engine, excl. heat exchangers		litres US gal.						33 8,72				

Emissions	Rating	rpm	700	900	1100	1300	1600	1900	2100	2300	2400	2500
Smoke at prop. load $x^{2,5}$	4	*BSU	0,0	0,1	0,3	0,4	0,5	0,2	0,2	0,4	0,4	
Noise at prop. load $x^{2,5}$. 4)	4	dBA	103	106	109	110,3	111,1	113,8	115,3	116,9	117,8	

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

1) ISO 3046, fuel temp 40°C
   ISO 8665 (=SAE J 1228=ICOMIA 28-83)
2) At power according to 1).
3) If reverse gear is used, 4% in heat rejection will be added for its oil cooler.
4) ACC. To ISO 3744
5) At installed back pressure

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 ± 4.2kPa	30 sec from start / 2 sec	270 kPa (relative)	280 kPa*	NA	NA
Charge air temperaure	50-0 kΩ	°C	-40 - 130 ± 4%	30 sec from start / 2 sec	75°C	80°C (soft 3)	NA	NA
Coolant level switch	Digital		ON / OFF	30 sec from start / 100 sec	Low level / Lost signal	NA	NA	NA
Coolant temperature	50-0 kΩ	°C	-40 - 140 ± 1.5°C	30 sec from start / 2 sec	98°C	101°C (soft 1)	4 sec from start / 1 sec	105 (± 2°C) SDU Ch. S1
Engine speed cam	Frequency	rpm		Instant	Lost signal	Lost signal**	NA	NA
Engine speed crank	Frequency	rpm		Instant	Lost signal	Lost signal**	NA	NA
Eng. overspeed SDU 2250 +15%	Frequency	rpm / Hz	54 puls./rev.	Instant	Lost signal	NA	Instant	2588 / 2329 Hz (-1 to 0%)
Eng. overspeed SDU 2400+15%	Frequency	rpm / Hz	54 puls./rev.	Instant	Lost signal	NA	Instant	2760 / 2484 Hz (-1 to 0%)
Eng. overspeed SDU 2450+15%	Frequency	rpm / Hz	54 puls./rev.	Instant	Lost signal	NA	Instant	2818 / 2536 Hz (-1 to 0%)
Exhaust gas dry temperature	PT200	°C	-40 - 750 ± 2.5%	30 sec from start / 5 sec	Fault Limit table 1	655°C (soft 4)	NA	NA
Exhaust gas wet temperature	PT200	°C	-40 - 750 ± 2.5%	30 sec from start / 5 sec	200°C	NA	NA	NA
Oil level switch	Digital		ON / OFF	30 sec from start / 5 sec	Low level / Lost signal	NA	NA	NA
Oil temperature	50-0 kΩ	°C	-40 - 140 ± 3.5%	30 sec from start / 2 sec	120°C	122°C (soft 2)	NA	NA
Water in fuel switch	Digital		ON / OFF	All the time	Water in fuel	NA	NA	NA
Gear oil pressure (EVC)	0.5-4.5 V	kPa	0-3000 ± 3%	60 sec from start / 7 sec	700 kPa	NA	NA	NA
Gear oil temperature (EVC)	50-0 kΩ	°C	-40 - 140 ± 2.5%	NA (IB) 2s (IPS)	95°C Lost signal during slip	NA	NA	NA
Gear oil pressure (SDU) (Shutdown Unit Channel S2)	Digital	kPa	ON / OFF	NA	NA	NA	11 sec ± 20% from start / 1 sec	400 ± 20 Shutdown Unit Setting S2.S3: 510 rpm ± 2% 459 Hz ± 2% 54 pulses / revolution

NA = Not applicable
* 50% remaining torque from 1500 rpm
** 80% remaining torque
Run detection S4 should be set to same value as S2, S3

Sensors (rpm dependent)	Signal	Unit	Range	Initial Delay / Delay	Warning Level / Derating Level / Shutdown Level rpm Map					Notes
					0 rpm	600 rpm	1000 rpm	1500 rpm	2300 / 2400 rpm	
Coolant pressure	0.5-4.5 V	kPa	0-300 ± 3%							
Warning Level		kPa		30 sec from start / 2 sec	NA	3	20	50	70	
Derating Level		kPa		Instant after warning	NA	NA	10	40	60	50% remain torque >1500 rpm
Shutdown Level (Shutdown Unit Channel S4)	NA	kPa	NA	NA	NA	NA	NA	NA	NA	Run detection S4 = S2, S3
Fuel pressure	0.5-4.5 V	kPa	0-700 ±1.5%							
Warning Level		kPa		30 sec from start / 2 sec	NA	125	200	260	270	
Derating Level		kPa		NA	NA	NA	NA	NA	NA	
Oil pressure	0.5-4.5 V	kPa	0-700 ±1.5%							
Warning Level		kPa		30 sec from start / 1 sec	NA	136	280	320	330	
Derating Level		kPa		Instant after warning	NA	80	260	300	310	30% remain torque > 1500 rpm
Shutdown Level (Shutdown Unit Channel S3)	Digital	kPa	ON/OFF	11 sec ±20% from start / 1 sec	NA	120 ± 20	120 ± 20	120 ± 20	120 ± 20	Shutdown Unit Setting S2.S3: 510 rpm ± 2% 459 Hz ± 2% 54 pulses / revolution
Piston cooling pressure	0.5-4.5 V	kPa	0-700 ±1.5%							
Warning Level		kPa		30 sec from start / 4 sec	NA	NA	75	230	250	
Derating Level		kPa		Instant after warning	NA	NA	65	220	240	30% remain torque > 1500 rpm
Seawater pressure	0.5-4.5 V	kPa	0-300 ± 3%							
Warning Level		kPa		30 sec from start / 5 sec	NA	1	8	17	30	
Derating Level		kPa		Instant after warning	NA	NA	NA	7	20	Derate active >1500 rpm

Warning = Yellow Lamp active
Derating = Red Lamp active

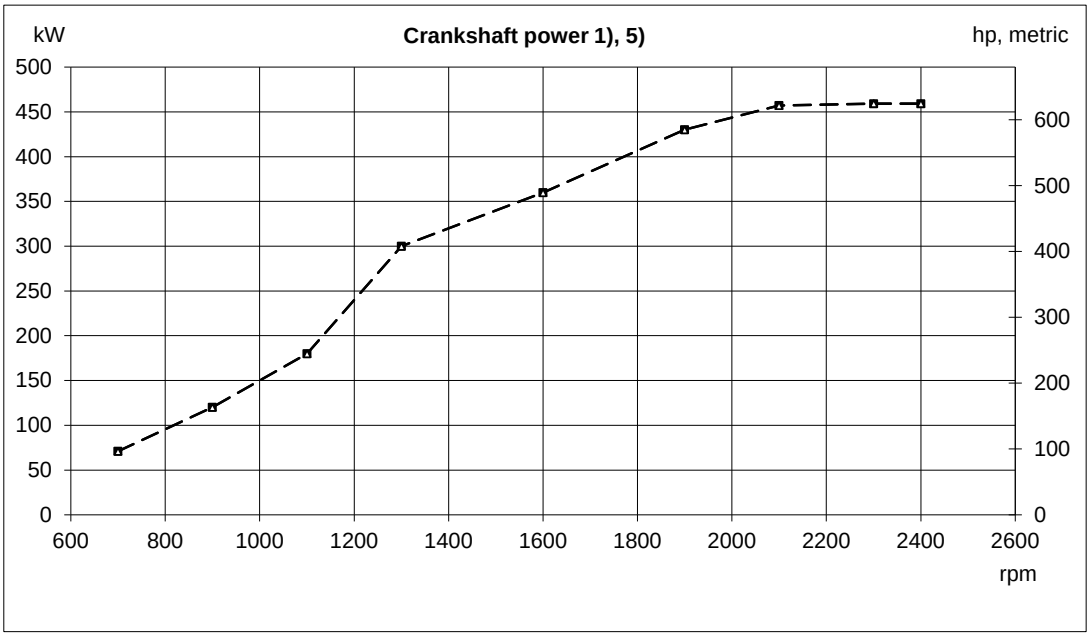
	Speed / °C	101°C	103°C	106°C
Soft 1) Soft derate Coolant Temp.	**600**	100%*	100%*	100%*
Remaining torque in %	**1000**	100%*	100%*	100%*
	1500 ->	100%*	75%	50%

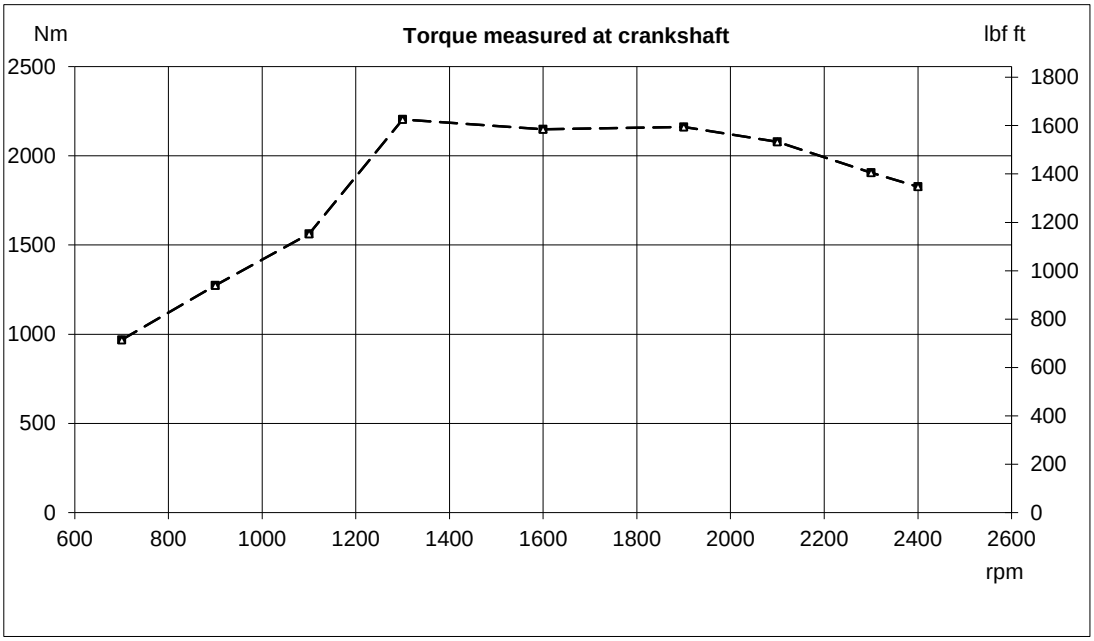
	Speed / °C	122°C	124°C	126°C
Soft 2) Soft derate Oil Temp.	**600**	100%*	100%*	100%*
Remaining torque in %	**1000**	100%*	100%*	100%*
	1500 ->	100%*	50%	30%

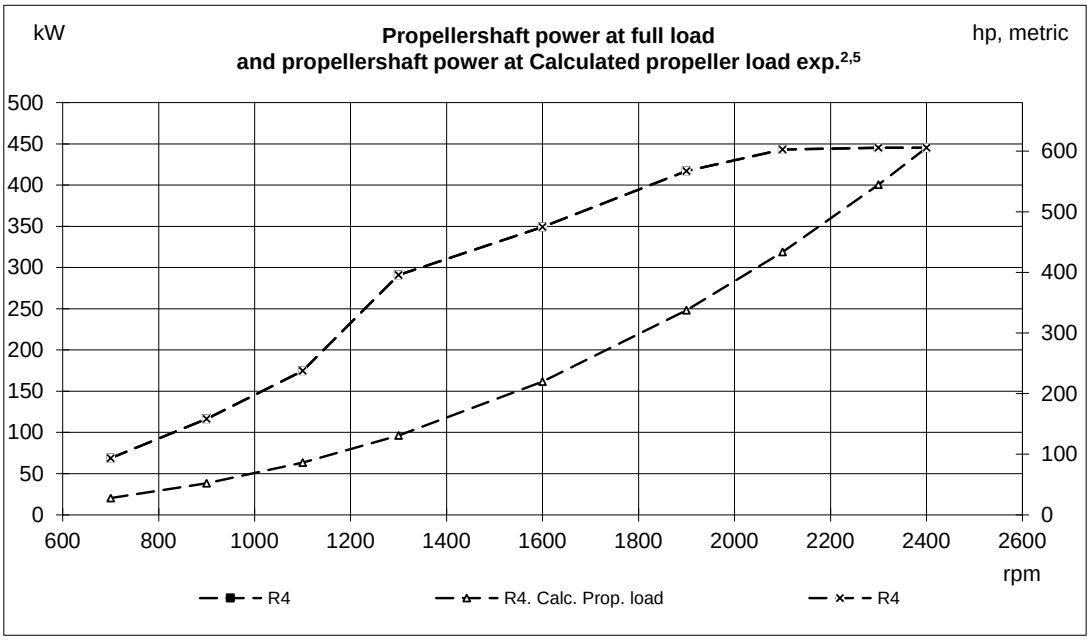
	Speed / °C	80°C	85°C	90°C
Soft 3) Soft derate Charge Air Temp.	**600**	100%*	100%*	100%*
Remaining torque in %	**1000**	100%*	100%*	100%*
	1500 ->	100%*	50%	30%

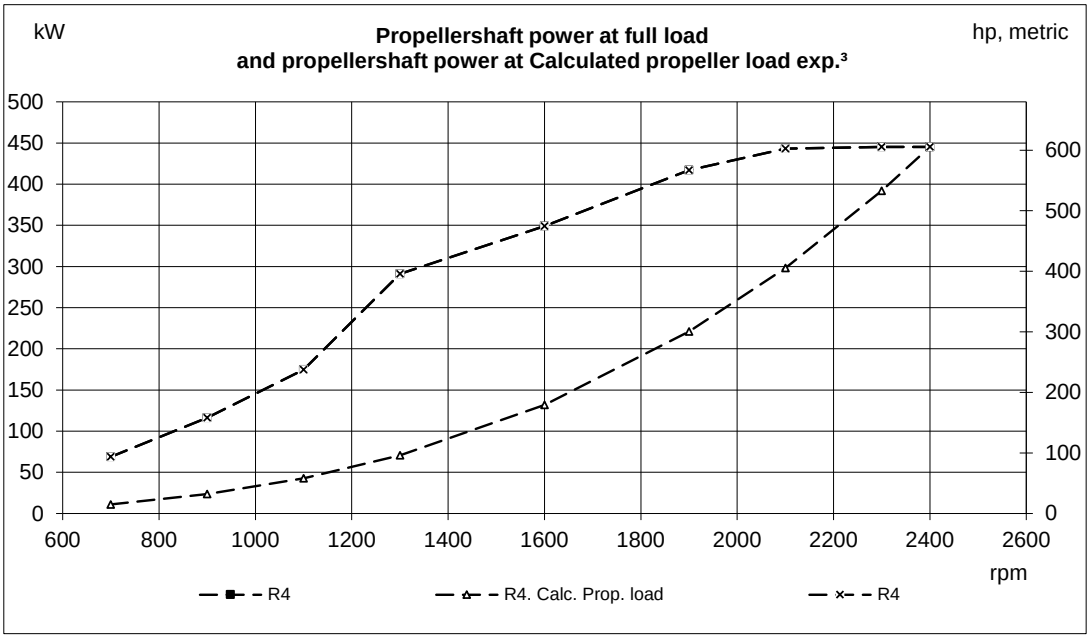
	Speed / °C	655°C	665°C	670°C	675°C
Soft 4) Soft derate Exhaust Temp.	**600**	100%*	100%*	100%*	100%*
Remaining torque in %	**1000**	100%*	100%*	100%*	100%*
	1500 ->	100%*	60%	20%	10%

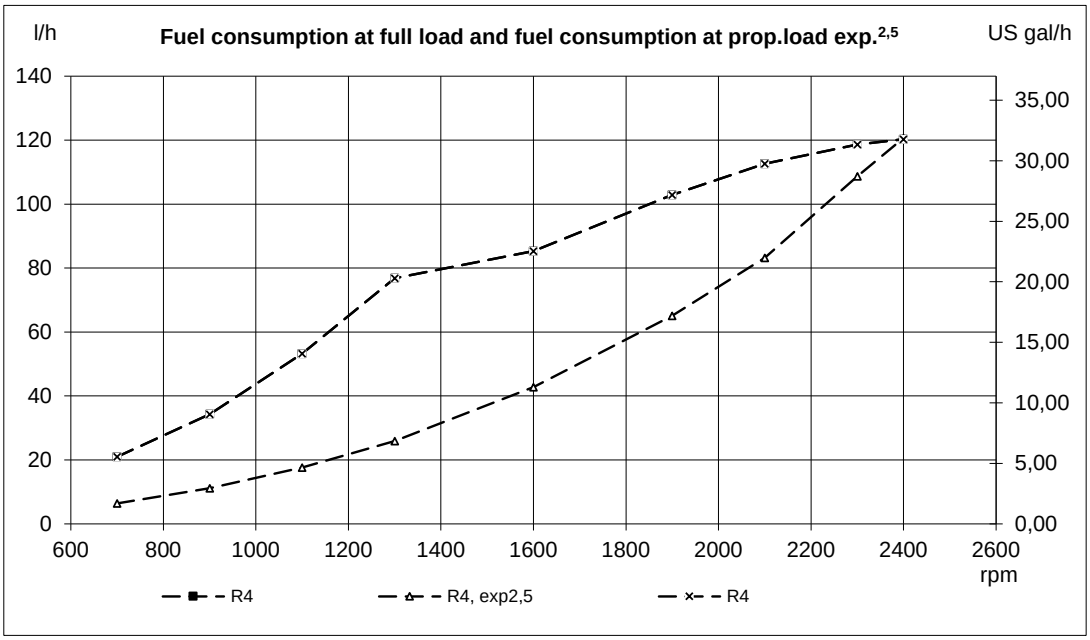
* = Alarm but no derate

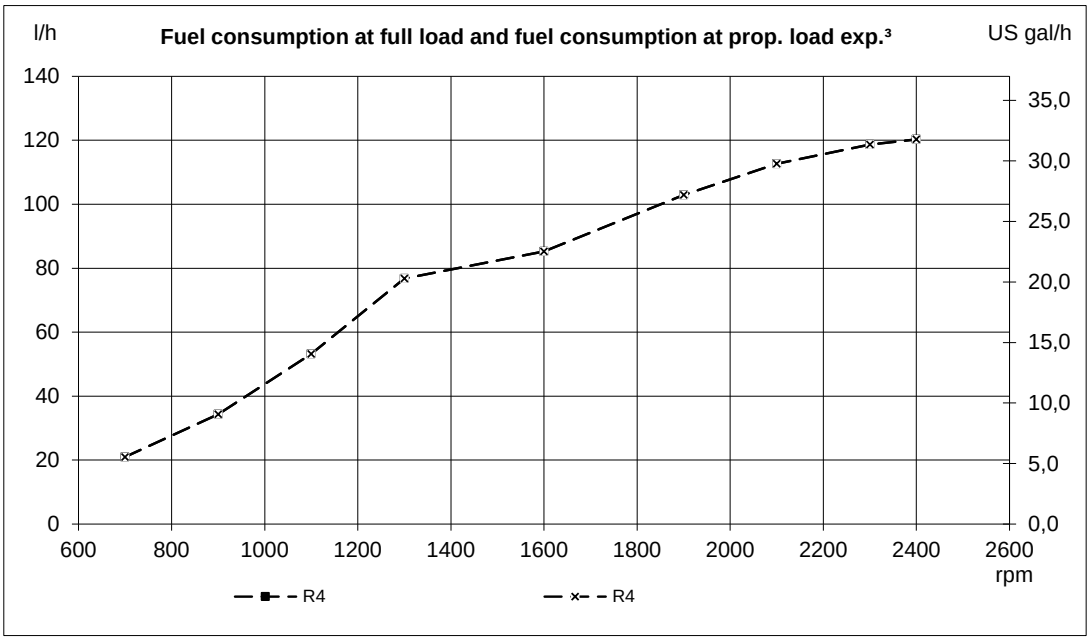

kW
Crankshaft power 1), 5)
hp, metric
500
450
400
350
300
250
200
150
100
50
0
600
500
400
300
200
100
0
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
rpm

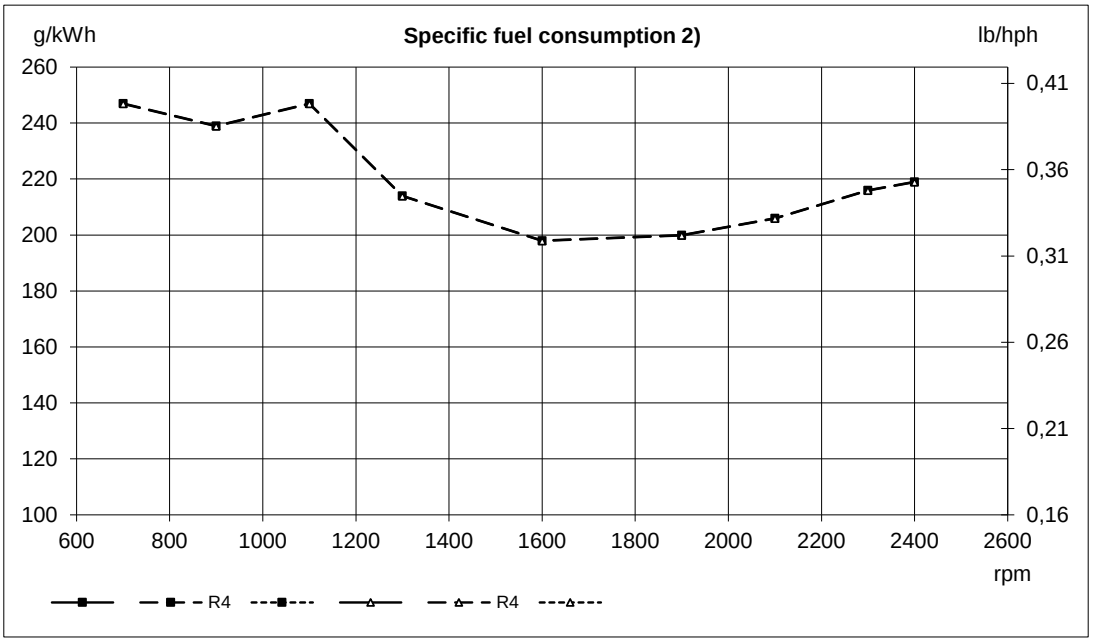

Nm
Torque measured at crankshaft
lbf ft
2500
2000
1500
1000
500
0
1800
1600
1400
1200
1000
800
600
400
200
0
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
rpm

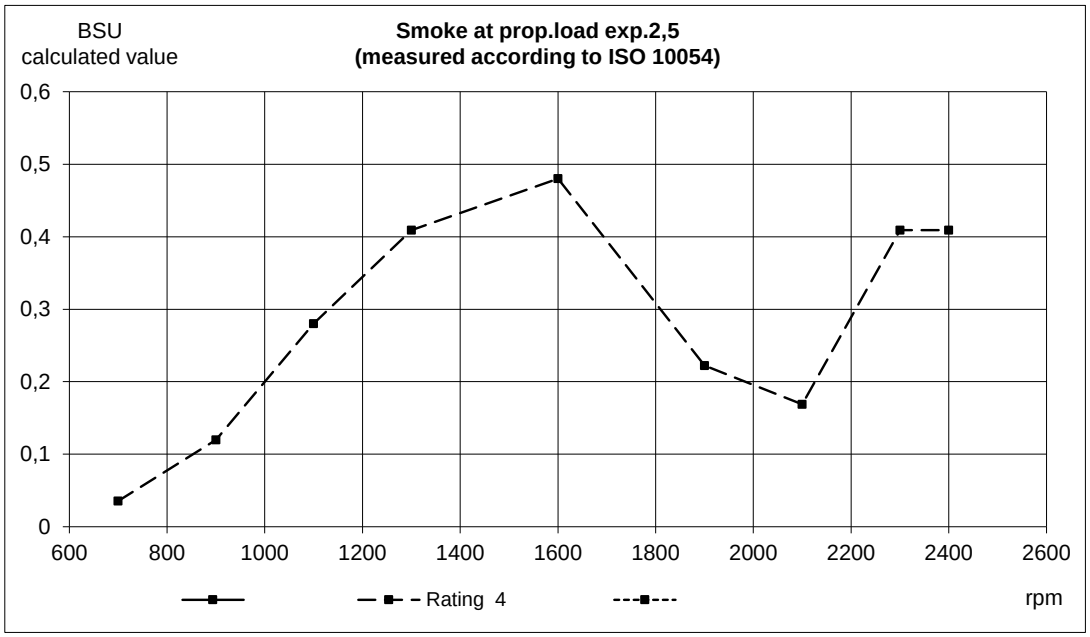

kW
Propellershaft power at full load
and propellershaft power at Calculated propeller load exp.2,5
hp, metric
500
450
400
350
300
250
200
150
100
50
0
600
500
400
300
200
100
0
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
rpm
R4
R4. Calc. Prop. load
R4

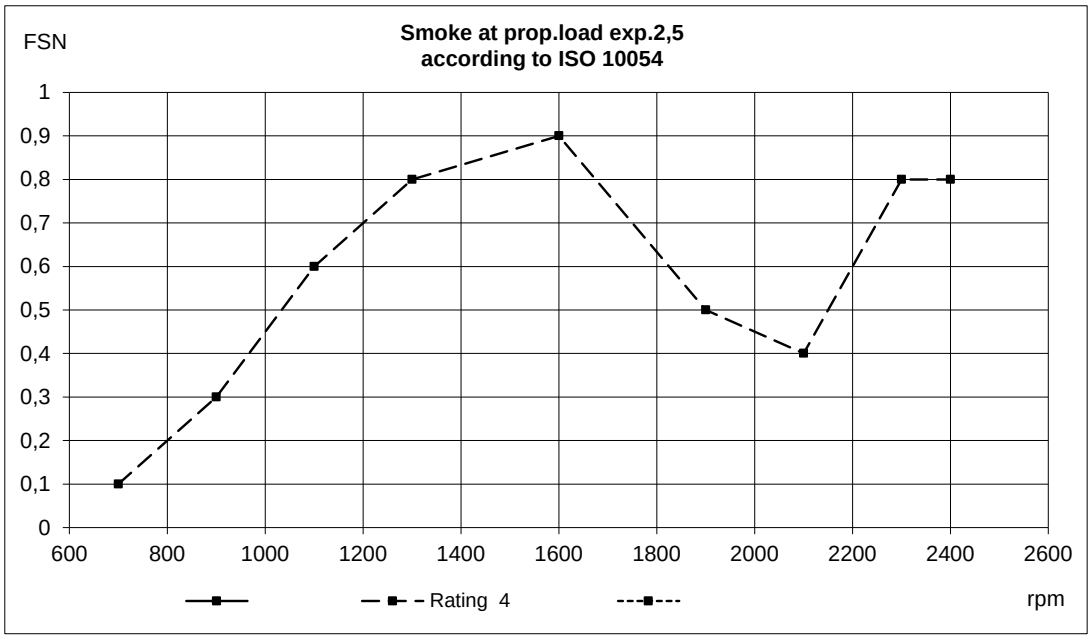

kW
Propellershaft power at full load
and propellershaft power at Calculated propeller load exp.3
hp, metric
500
450
400
350
300
250
200
150
100
50
0
600
500
400
300
200
100
0
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
rpm
R4
R4. Calc. Prop. load
R4

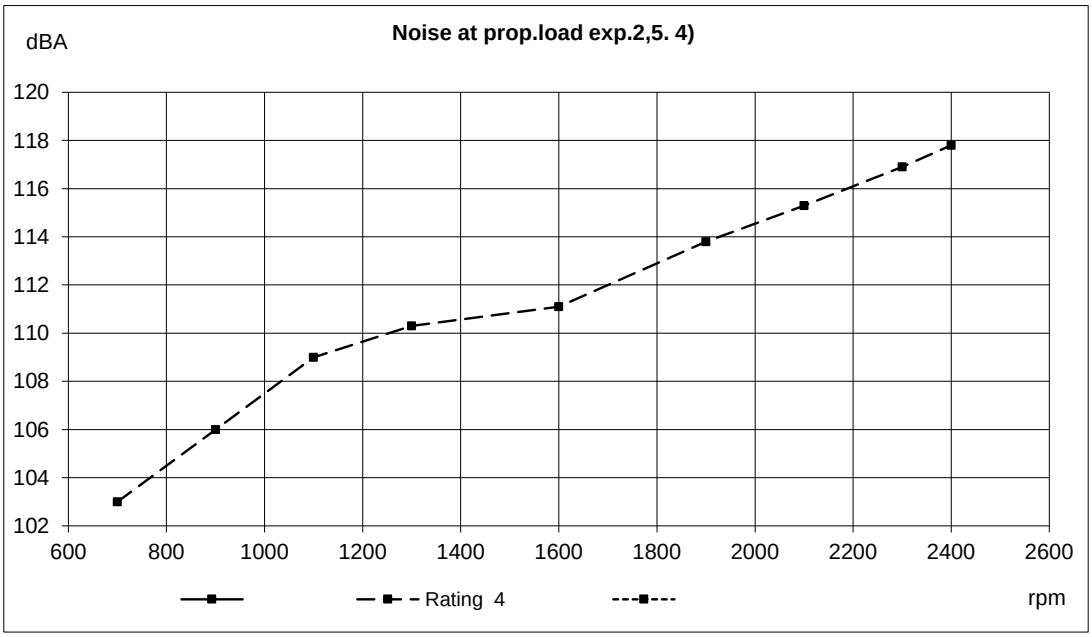

l/h
Fuel consumption at full load and fuel consumption at prop.load exp.2,5
US gal/h
140
120
100
80
60
40
20
0
35,00
30,00
25,00
20,00
15,00
10,00
5,00
0,00
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
rpm
R4
R4, exp2,5
R4


l/h
Fuel consumption at full load and fuel consumption at prop. load exp.3
US gal/h
140
120
100
80
60
40
20
0
35,0
30,0
25,0
20,0
15,0
10,0
5,0
0,0
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
rpm
R4
R4


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
2400
2600
rpm
R4
R4


BSU
calculated value
Smoke at prop.load exp.2,5
(measured according to ISO 10054)
0,6
0,5
0,4
0,3
0,2
0,1
0
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
Rating 4
rpm


FSN
Smoke at prop.load exp.2,5
according to ISO 10054
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
Rating 4
rpm


Noise at prop.load exp.2,5. 4)
dBA
120
118
116
114
112
110
108
106
104
102
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
Rating 4
rpm