General

In-line four stroke diesel engine with direct injection. Rotation direction, anti-clockwise viewed towards flywheel. Turbocharged

4/6/2009			6
Displacement, total		litre in^3	16.12 983.9
Firing order			1-5-3-6-2-4
Bore		mm in	144 5.67
Stroke		mm in	165 6.50
Compression ratio			17.5:1
Dry weight	Engine only, excluding cooling system	kg lb	1750 3858
	Genset, see dimension drawing	kg lb	

			r/min			1500		
Performance			**load**	**25%**	**50%**	**75%**	**100%**	**110%**
Power setting 450 kW		without fan	kW hp	113 153	225 306	338 459	450 612	495 673
		with fan	kW hp				433 589	
Power setting 495 kW		without fan	kW hp					
		with fan	kW hp					
Torque at:	Power setting 450 kW		Nm lbft	716 528	1432 1056	2149 1585	2865 2113	3151 2324
	Power setting 495 kW		Nm lbft					
Mean piston speed			m/s ft/sec			8.3 27.1		
Effective mean pressure at:	Power setting 450 kW		MPa psi	0.6	1.1	1.7	2.2	2.5
Effective mean pressure at:	Power setting 495 kW		MPa psi					
Max combustion pressure at:	Power setting 450 kW		MPa psi	8.7	10.7	13.1	15.8	17.6
Max combustion pressure at:	Power setting 495 kW		MPa psi					
Total mass moment of inertia, J (mR^2) Engine only			kgm^2 $lbft^2$			4.70698 111.7		
Degree of irregularity at:	Power setting 450 kW			1;353	1;131	1;71	1;48	1;43
	Power setting 495 kW							
Friction Power			kW hp	42 57	42 57	42 57	42 57	42 57

Performance			r/min load	1800 25%	 50%	 75%	 100%	 110%
Power setting 500 kW		without fan	kW hp	125 170	250 340	375 510	500 680	550 748
		with fan	kW hp				470 639	
Power setting 550 kW		without fan	kW hp					
		with fan	kW hp					
Torque at:	Power setting 500 kW		Nm lbft	663 489	1326 978	1989 1467	2653 1956	2918 2152
	Power setting 550 kW		Nm lbft					
Mean piston speed			m/s ft/sec			9.9 32.6		
Effective mean pressure at:	Power setting 500 kW		MPa psi	0.5	1.0	1.6	2.1	2.3
Effective mean pressure at:	Power setting 550 kW		MPa psi					
Max combustion pressure at:	Power setting 500 kW		MPa psi	8.9	11.2	13.9	16.6	18.2
Max combustion pressure at:	Power setting 550 kW		MPa psi					
Total mass moment of inertia, J (mR^2) Engine only			kgm^2 $lbft^2$			4.70698 111.7		
Degree of irregularity at:	Power setting 500 kW			1;295	1;264	1;134	1;88	1;79
	Power setting 550 kW							
Friction Power			kW hp	59 80.24	59 80.24	59 80.24	59 80.24	59 80.24

Engine noise emission

Test Standards: ISO 3744-1981 (E) sound power (without fan, intake and exhaust noise)
Tolerans ± 0.75 dB(A)

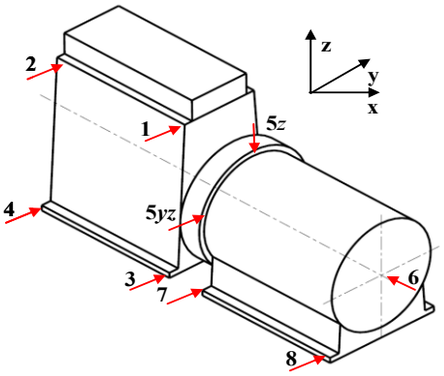
		r/min load	1500 25%	 50%	 75%	 100%	 110%
Measured sound power Lw	No load	dB(A)			113.3		
	Power setting 450 kW	dB(A)	114.1	114.8	114.8	115.4	115.8
	Power setting 495 kW	dB(A)					
Calculated sound pressure Lp at 1 m	No load	dB(A)					
	Power setting 450 kW	dB(A)					
	Power setting 495 kW	dB(A)					
		r/min			**1800**		
Measured sound power Lw	No load	dB(A)			116.7		
	Power setting 500 kW	dB(A)	117.2	117.7	117.8	118.4	118.3
	Power setting 550 kW	dB(A)					
Calculated sound pressure Lp at 1 m	No load	dB(A)					
	Power setting 500 kW	dB(A)					
	Power setting 550 kW	dB(A)					

Unsilenced exhaust noise

Data calculated as sound pressure Lp. Assumed microphone distance 1 m	r/min load	25%	50%	1500 75%	100%	110%
Power setting 450 kW	dB(A)	109	112	114	115	116
Power setting 495 kW	dB(A)					
	r/min			1800		
Power setting 500 kW	dB(A)	113	116	118	119	120
Power setting 550 kW	dB(A)					

Vibrations (vibration velocity)

Declared vibration levels according to ISO 8528-9 at 100% Power outtake



r/min **1500**

RMS Velocity (2 - 1000 Hz) Measurement direction for D16MG-RC / HCM534F			
Measuring position	Axial [x] mm/s	Transverse [y] mm/s	Vertical [z] mm/s
1	12.6	14.8	13.2
2	12.4	17.7	34.3
3	12.3	14.4	13.1
4	6.6	14.1	13.0
5	8.1	18.6	16.2
6	7.9	16.7	10.7
7	8.2	23.7	20.9
8	8.3	21.3	23.7
r/min		**1800**	
1	18.1	22.2	20.1
2	16.8	26.4	30.7
3	14.8	19.3	12.5
4	6.7	18.3	13.7
5	10.5	18.3	20.3
6	12.5	17.6	14.0
7	14.4	22.2	18.4
8	14.8	18.9	21.1

r/min **1500**

RMS Velocity (2 - 1000 Hz) Measurement direction for D16MG-RC / HCM534E			
Measuring position	Axial [x] mm/s	Transverse [y] mm/s	Vertical [z] mm/s
1	12.3	27.2	12.3
2	13.7	24.6	26.3
3	13.1	20.7	14.7
4	6.0	12.5	12.8
5	8.5	9.0	14.1
6	7.7	16.7	10.7
7	7.5	22.0	22.3
8	7.5	20.4	23.1
r/min		**1800**	
1	14.7	41.2	21.4
2	16.5	24.6	27.0
3	15.0	23.2	16.8
4	8.1	15.6	12.9
5	15.9	9.5	11.5
6	13.5	17.1	19.5
7	8.9	13.9	15.1
8	9.1	14.1	19.1

Test conditions for load acceptance data

Warm engine.	**Generator**	**Modell**	**Type of AVR**
	Stamford	HCM 534 F	MX-341
	Voltage drop		

Load acceptance performance can vary due to actual alternator inertia, voltage regulator, type of load and local ambient conditions.

Single step load performance at 1500 rpm

Load (%)	Speed diff (%)		Recovery time (s)		Remaining load	Speed diff (%)		Recovery time (s)	
	Nominal	110% power	Nominal	110% power	(%)	Nomi-nal	110% power	Nomi-nal	110% power
0-20	1.9	1.9	1.3	1.4	20-100	17.1	18.5	3.4	3.7
0-40	4.1	4.6	1.5	1.6	40-100	8.1	8.7	2.8	2.4
0-50	5.1	5.1	1.6	1.6	50-100	6.1	6.3	1.8	1.7
0-60	5.9	7.5	2.6	2.7	60-100	4.6	5.0	1.7	1.6
0-70	10.0		2.9		70-100	3.7		1.7	
0-65		10.0		4.0	65-100		4.5		1.6
100-0	8.6	8.5	3.2	3.2					

Single step load performance at 1800 rpm

Load (%)	Speed diff %		Recovery time (s)		Remaining load	Speed diff (%)		Recovery time (s)	
	Nominal	110% power	Nominal	110% power	(%)	Nomi-nal	110% power	Nomi-nal	110% power
0-20	1.2	1.4	1.5	1.2	20-100	10.6	10.4	2.4	2.5
0-40	2.9	3.2	1.4	1.2	40-100	5.7	6.2	1.9	1.1
0-60	4.1	4.6	1.4	1.4	60-100	3.5	3.4	1.5	1.5
0-70	5.2	7.4	1.3	2.3	70-100	3.0	3.3	1.4	1.4
0-86	10.0		1.9		86-100	1.5		1.3	
0-78		10.0		1.9	78-100		2.1		1.4
100-0	6.6	6.5	1.6	1.2					

Cold start performance		**r/min**	**1500**	**1800**
Time from start to no load speed at ambient temperature:	20°C	s	5.8	6.7
	5 °C	s	6.0	7.1
Time from start to stay within 0.5% of no load speed at ambient temperature:	20°C	s	5.8	6.7
	5 °C	s	6.0	7.1

Block heater type	**Make**	**Power kW**	**Engaged hours**	**Cooling water temp engine block**
Ext/therm.contr.	Volvo Penta	2	12	32°C 90°F

Lubrication system			load	25%	50%	75%	100%	110%
Lubricating oil consumption	Power setting 450 kW		liter/h US gal/h				0.10 0.026	0.11 0.029
	Power setting 495 kW		liter/h US gal/h					
			r/min			1800		
	Power setting 500 kW		liter/h US gal/h				0.11 0.026	0.12 0.029
	Power setting 550 kW		liter/h US gal/h					
Oil system capacity including filters			liter US gal	55 14.5				
Oil sump capacity:		max	liter US gal	49 12.9				
		min	liter US gal	39 10.3				
Oil change intervals/ specifications: (Fuel quality dependent)	VDS-2. ACEA: E3, E5. API: CG-4, CH4		h	400				
	VDS. ACEA: E2. API: CF, CF-4		h	500				
			h					
			h					
Engine angularity limits, static (ref. classification rules, roll and pitch simultaneously)		front up	°	10				
		front down	°	10				
		side tilt	°	22.5				
Engine angularity limits, dynamic (ref. classification rules, roll and pitch simultaneously)		front up	°	10				
		front down	°	10				
		side tilt	°	22.5				

Lubrication system		r/min	1500	1800
Oil pressure at rated speed		kPa psi	300-500 43,5-72,5	
Oil pressure shut down switch setting		kPa psi	200 29.0	
Lubrication oil temperature in oil sump:	max	°C °F	128 262	
Oil filter micron size		µ	40	

* See also general section in the sales guide

Fuel system		r/min load	1500 25%	 50%	 75%	 100%	 110%
Specific fuel consumption with: (Power setting without fan)	Power setting 450 kW	g/kWh lb/hph	229 0.371	208 0.337	203 0.329	206 0.334	202 0.327
	Power setting 495 kW	g/kWh lb/hph					
		r/min			**1800**		
	Power setting 500 kW	g/kWh lb/hph	241 0.391	212 0.344	209 0.339	213 0.345	209 0.339
	Power setting 550 kW	g/kWh lb/hph					
Fuel to conform to		ASTM-D975-No. 1 and 2-D, JIS KK 2204, EN 590 MDO-DMX and MDO-DMA (ISO8217)					
		r/min			**1500**		
System return flow	Power setting 450 kW	liter/h US gal/h	47 12.4	47 12.4	47 12.4	47 12.4	47 12.4
	Power setting 495 kW	liter/h US gal/h					
		r/min			**1800**		
	Power setting 500 kW	liter/h US gal/h	51.0 13.5	51.0 13.5	51.0 13.5	51.0 13.5	51.0 13.5
	Power setting 550 kW	liter/h US gal/h					
		r/min			**1500**		
System supply flow	Power setting 450 kW	liter/h US gal/h	78 20.6	103 27.2	129 34.1	158 41.7	166 43.9
	Power setting 495 kW	liter/h US gal/h					
		r/min			**1800**		
	Power setting 500 kW	liter/h US gal/h	87 23.0	115 30.4	145 38.3	178 47.0	188 49.7
	Power setting 550 kW	liter/h US gal/h					
		r/min			**1500**		
Normal fuel pressure (after filter)	Power setting 450 kW	kPa psi	455 66.0	449 65.1	445 64.5	438 63.5	437 63.4
	Power setting 495 kW	kPa psi					
		r/min			**1800**		
	Power setting 500 kW	kPa psi	478 69.3	475 68.9	472 68.5	466 67.6	466 67.6
	Power setting 550 kW	kPa psi					

Fuel system

Fuel supply line max restriction	kPa psi	10.0
Fuel supply max pressure head (day tank, from CL)	m feet	2.0 6.6
Fuel supply line max suction head (from CL)	kPa psi	2.0 6.6
Fuel return line max restriction	kPa psi	20.0 2.9
Maximum allowable inlet fuel temp	°C °F	60 140

Fuel system		**r/min** **load**	**25%**	**50%**	**1500** **75%**	**100%**	**110%**
Fuel temp rise over engine	Power setting 450 kW	°C °F	27 81	27 81	27 81	27 81	27 81
	Power setting 495 kW	°C °F					
		r/min			**1800**		
	Power setting 500 kW	°C °F	32 90	32 90	32 90	32 90	32 90
	Power setting 550 kW	°C °F					
Prefilter / Water separator micron size		µ	10.000				
Fuel filter micron size		µ	2.000				

	r/min	**1500**	**1800**
Governor type/make, standard		Electronic/Volvo EMS II	Electronic/Volvo EMS II
Injection pump type/make		Unit injector	Unit injector
Injection timing std.	°B.T.D.C		
Injection timing	°B.T.D.C		

Intake system		**r/min** **load**	**25%**	**50%**	**1500** **75%**	**100%**	**110%**
Air consumption at: (+25°C and 100kPa)	Power setting 450 kW	m^3/min cfm	15.23 538	20.52 725	26.95 952	32.92 1162	34.03 1202
	Power setting 495 kW	m^3/min cfm					
		r/min			**1800**		
	Power setting 500 kW	m^3/min cfm	19.82 700	26.90 950	34.68 1225	40.57 1433	41.37 1461
	Power setting 550 kW	m^3/min cfm					
Max allowable air intake restriction including piping		kPa psi	3 0.4				
Air filter type			Paper cartridge				
Air filter cleaning efficiency		%	98				

Exhaust system		r/min load	25%	50%	1500 75%	100%	110%
Heat rejection to exhaust at:	Power setting 450 kW	kW BTU/min				306 17379	336 19119
	Power setting 495 kW	kW BTU/min					
		r/min			**1800**		
	Power setting 500 kW	kW BTU/min				378 21496	404 22975
	Power setting 550 kW	kW BTU/min					
		r/min			**1500**		
Exhaust gas temperature after turbine at:	Power setting 450 kW	°C °F				443 829	457 855
	Power setting 495 kW	°C °F					
		r/min			**1800**		
	Power setting 500 kW	°C °F				430 806	447 837
	Power setting 550 kW	°C °F					
Max allowable back pressure in exhaust line		kPa psi	15 2.2				

Exhaust system		r/min load	25%	50%	1500 75%	100%	110%
Exhaust gas flow at: (temp and pressure after turbine at the corresponding power setting)	Power setting 450 kW	m^3/min cfm				76 2681	81 2848
	Power setting 495 kW	m^3/min cfm					
		r/min			**1800**		
	Power setting 500 kW	m^3/min cfm				85 3009	89 3135
	Power setting 550 kW	m^3/min cfm					

Cooling system		**r/min load**	**1500 25%**	**50%**	**75%**	**100%**	**110%**
Heat rejection radiation from engine to sorrounding at:	Power setting 450 kW	kW BTU/min				16 910	21 1194
	Power setting 495 kW	kW BTU/min					
		r/min			**1800**		
	Power setting 500 kW	kW BTU/min				18 1024	23 1308
	Power setting 550 kW	kW BTU/min					
		r/min			**1500**		
Heat rejection to coolant at:	Power setting 450 kW	kW BTU/min				315 17914	324 18426
	Power setting 495 kW	kW BTU/min					
		r/min			**1800**		
	Power setting 500 kW	kW BTU/min				381 21667	409 23259
	Power setting 550 kW	kW BTU/min					

Coolant (40% coolant / 60% water)	Volvo Penta coolant "ready mix" or Volvo Penta coolant mixed with clean fresh water		
Radiator cooling system type	Closed circuit		
Standard radiator core area		m² foot²	1.68 18.08
Fan diameter		mm in	965 38.0

		r/min	**1500**	**1800**
Fan power consumption			fan Ø 965	fan Ø 965
		kW hp	17 23	30 41
Fan drive ratio	fan ø 965		1,04:1	
Coolant capacity:	engine	liter US gal	38 10.04	
	std radiator with hoses	liter US gal	95 25.10	
Coolant pump	drive/ratio		0	

	r/min	**1500**	**1800**
Coolant flow engine radiator (at fully open thermostat)	l/min US gal/min	285 75.29	345 91.14
Coolant flow CAC-radiator (at fully open thermostat)	l/min US gal/min	47 12.42	51 13.47
Nominal coolant pressure with standard system	kPa psi		
Maximum external coolant system restriction, including piping	kPa psi		

Thermostat	start to open	°C °F	82 180
	fully open	°C °F	92 198
Maximum static pressure head (expansion tank height + pressure cap setting)		kPa psi	100 14.5
Minimum static pressure head (expansion tank height + pressure cap setting)		kPa psi	70 10.2
Standard pressure cap setting		kPa psi	75 10.9
Maximum top tank temperature		°C °F	103 217

Charge air cooler system		r/min load	25%	50%	1500 75%	100%	110%
Cooling power	Power setting 450 kW	kW				88	100
		BTU/min				5004	5687
	Power setting 495 kW	kW					
		BTU/min					
		r/min			**1800**		
	Power setting 500 kW	kW				121	131
		BTU/min				6881	7450
	Power setting 550 kW	kW					
		BTU/min					
		r/min			**1500**		
Charge air mass flow	Power setting 450 kW	kg/s				0.64	0.68
	Power setting 495 kW	kg/s					
		r/min			**1800**		
	Power setting 500 kW	kg/s				0.76	0.79
	Power setting 550 kW	kg/s					
		r/min			**1500**		
Charge air inlet temp. Charge air temp after turbo compressor)	Power setting 450 kW	°C				190	202
		°F				374	396
	Power setting 495 kW	°C					
		°F					
		r/min			**1800**		
	Power setting 500 kW	°C				215	225
		°F				419	437
	Power setting 550 kW	°C					
		°F					
		r/min			**1500**		
Charge air outlet temp. (Charge air temp after charge air cooler)	Power setting 450 kW	°C				54	56
		°F				129	133
	Power setting 495 kW	°C					
		°F					
		r/min			**1800**		
	Power setting 500 kW	°C				58	61
		°F				136	142
	Power setting 550 kW	°C					
		°F					

Maximum pressure drop over charge air cooler, incl. piping		kPa	6
		psi	0.87
		r/min	**1500**
Charge air pressure	Power setting 450 kW	kPa	214
		psi	31.04
	Power setting 495 kW	kPa	235
		psi	34.08
		r/min	**1800**
	Power setting 500 kW	kPa	223
		psi	32.34
	Power setting 550 kW	kPa	232
		psi	33.65

Standard charge air cooler core area	m²	0.04
	foot²	0.43

Cooling performance

Cooling air flow and external restriction at different radiator air temperatures based on 103°C TTT and 40% antifreeze. Valid at 1 atm. (radiator and cooling fan, see optional equipment)

Engine speed rpm	Air on temp °C	Nominal POWER		110% power POWER	
		Air flow m^3/s	External restriction Pa	Air flow m^3/s	External restriction
1500	35	x	x	6.6	960
	40	6.6	940	7.6	850
	45	7.6	800	8.4	700
	50	8.9	635	9.7	541
	55	11	381	12	253
	58	x	x	13	0
	60	13	0		
1800	35	9	1223	10	1110
	40	10	1083	11	940
	45	11	895	12	730
	50	13	650	14	430
	55	15	282	16	0
	58	16	0		

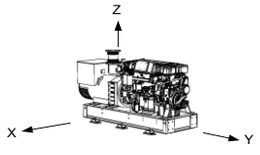
Note! Calculated values >0 Pa

Engine management system

Functionality	**Alternatives**	**Default setting**
Governor mode	Isochronous/Droop Switchable during operation	Droop
Governor droop	0-5%	0.0
Governor response	P, I and D part via VODIA	
Idle speed	600-1200rpm	900rpm
Fine speed adjustment	N/A	+-120rpm
Stop function	Energized to run/stop	Energized to stop

Engine protection			Alarm level	
Parameter		Unit	Setting range	Default setting
Oil temp		°C	N/A	125
Oil pressure	Low idle	kPa	N/A	190.0
	1500 rpm	kPa	N/A	250.0
	1800 rpm	kPa	N/A	250.0
Oil level			N/A	Low level
Piston cooling pressure >1000 rpm		kPa	N/A	150+/-20
Coolant temp		°C	95-103	98
Coolant level			N/A	Low level
Fuel feed pressure	Low idle	kPa	N/A	70
	>1400 rpm		N/A	200
Water in fuel			N/A	N/A
Crank case pressure		kPa	N/A	Inc.pressure
Charge air temp		°C	N/A	80
Charge air pressure		kPa	N/A	400
Engine speed		rpm	100-120% of rated speed	120%

Note complete sensor list available

Electrical system			r/min	1500 and 1800
Voltage and type			24V / insulated from earth	
Alternator:	make/output		Amp	Bosch 20849349/35-80A
	tacho output		Hz/alt. Rev	6
	drive ratio			4
Starter motor			make	Melco
			type	24V/7kW
			kW	7kW
Starter motor solenoid,	pull current		Amp	2.3
	hold current		Amp	N/A
Number of teeth on:	flywheel			153
	starter motor			12
Inrush current at +20°C \ +5°C			Amp	2000 \ 2100
Cranking current at +20°C \ +5°C			Amp	375 \ 390
Crank engine speed at 20°C \ +5°C			rpm	165 \ 140
Starter motor battery capacity:		max	Ah	2x220 700A DIN
		min at +5°C	Ah	2x180 600A DIN
Max. g-force 		x	m/s²	N/A
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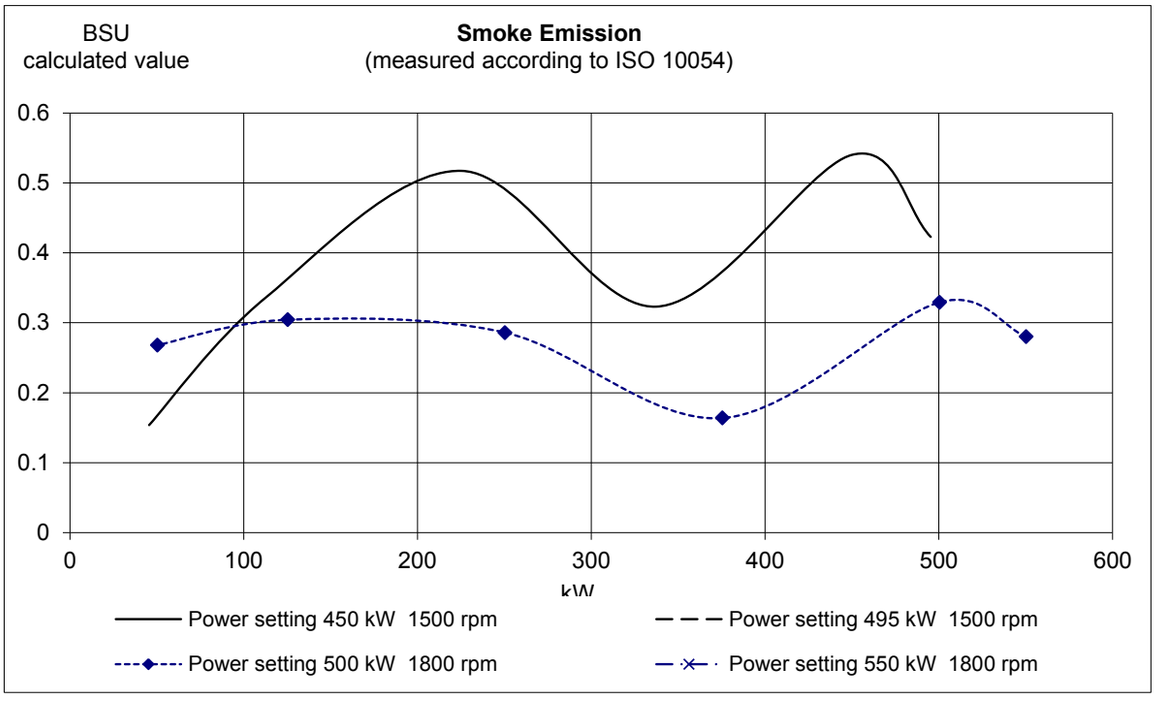
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calculated value
Smoke Emission
(measured according to ISO 10054)
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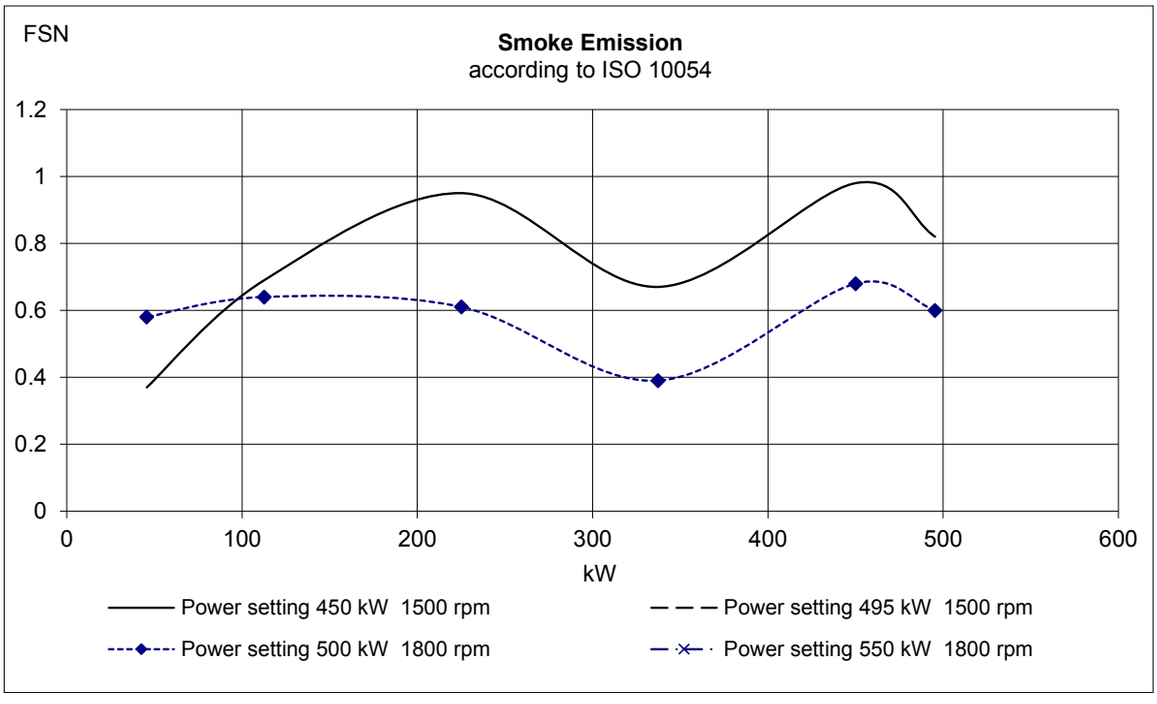
0.5
0.4
0.3
0.2
0.1
0
0
100
200
300
400
500
600
kW
Power setting 450 kW 1500 rpm
Power setting 495 kW 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 550 kW 1800 rpm


FSN
Smoke Emission
according to ISO 10054
1.2
1
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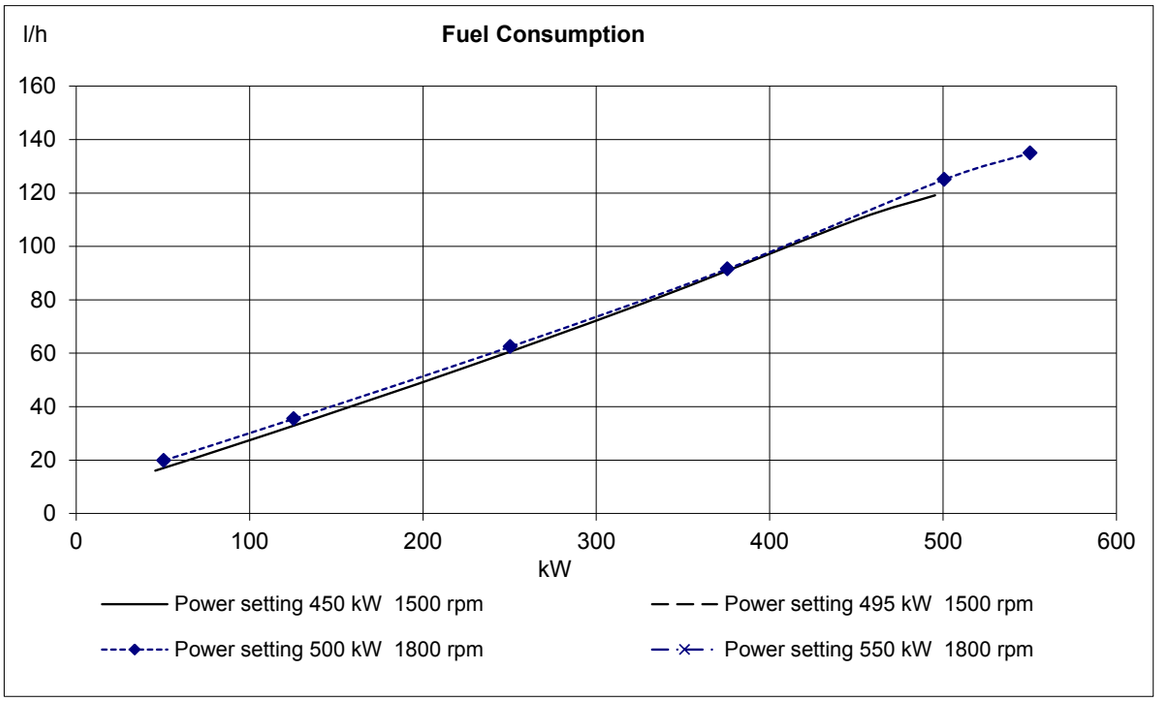
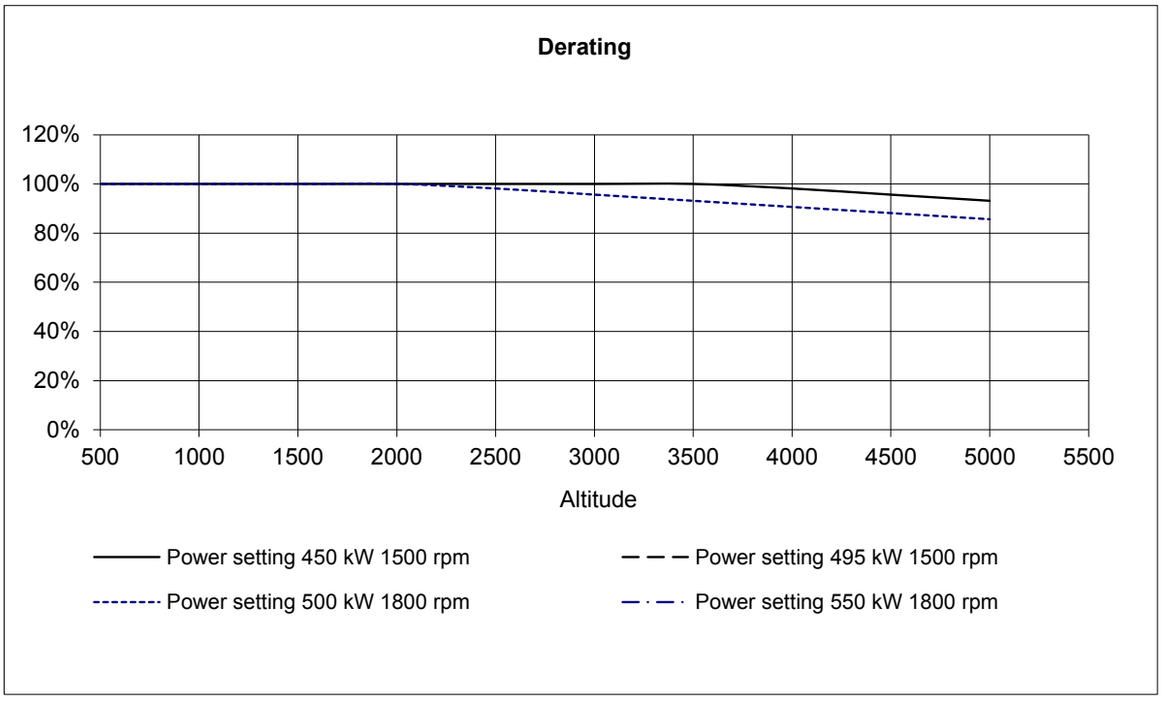
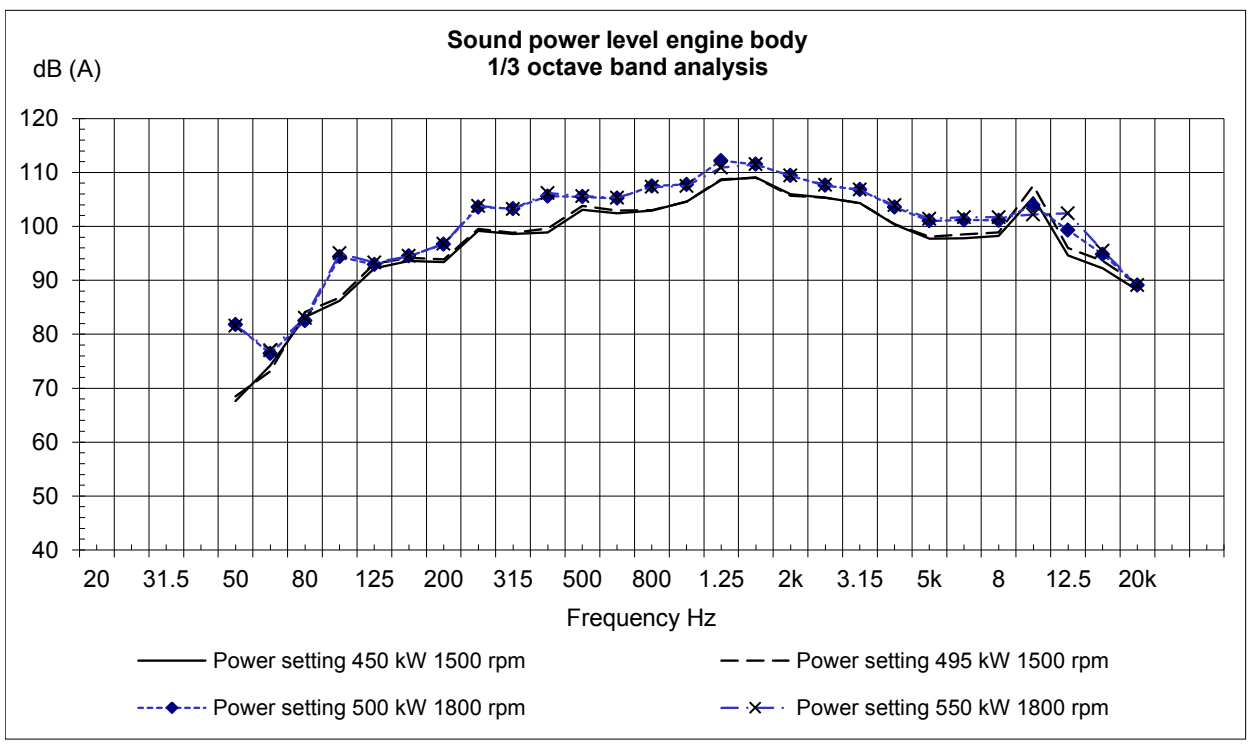
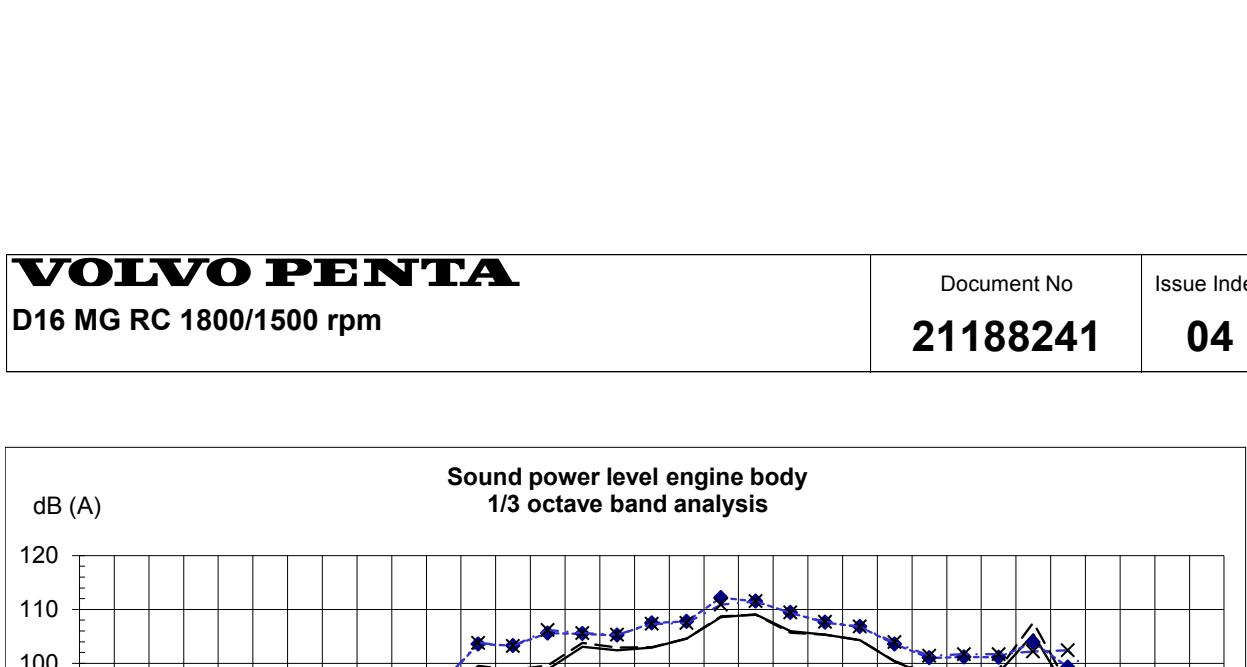
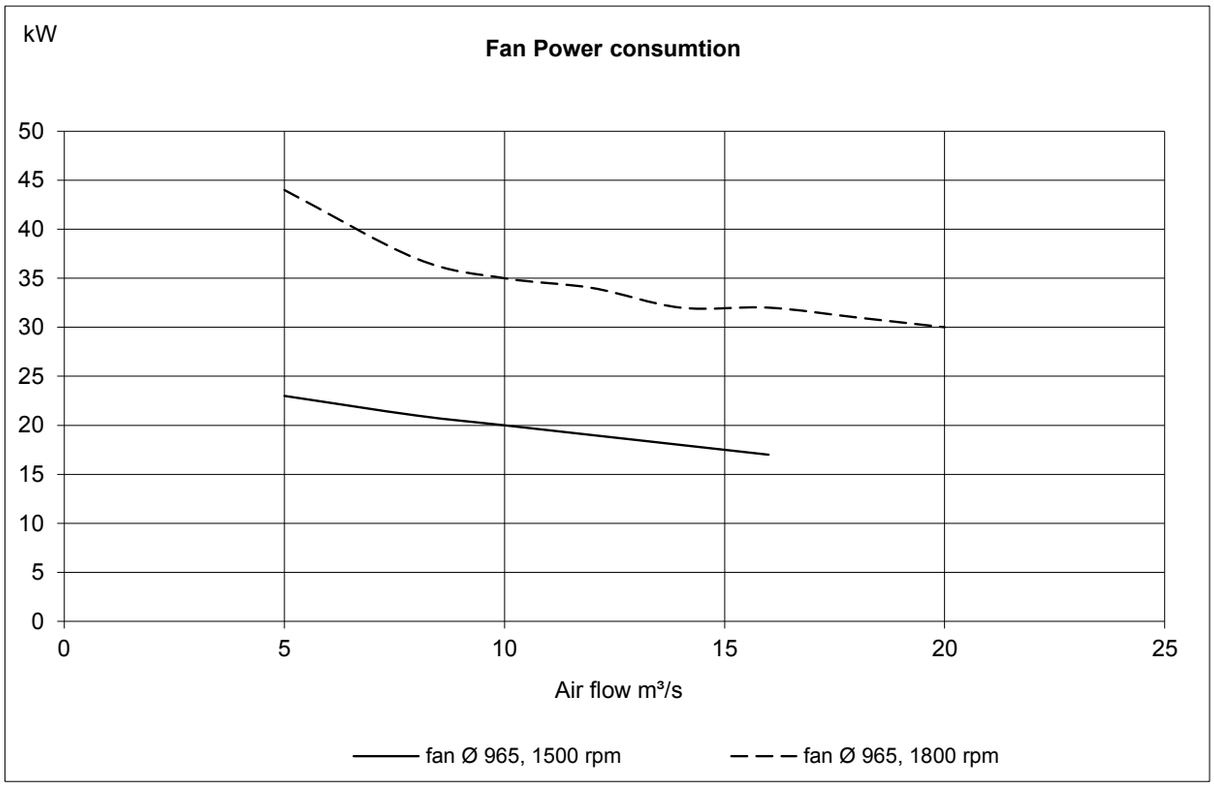
0.6
0.4
0.2
0
0
100
200
300
400
500
600
kW
Power setting 450 kW 1500 rpm
Power setting 495 kW 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 550 kW 1800 rpm

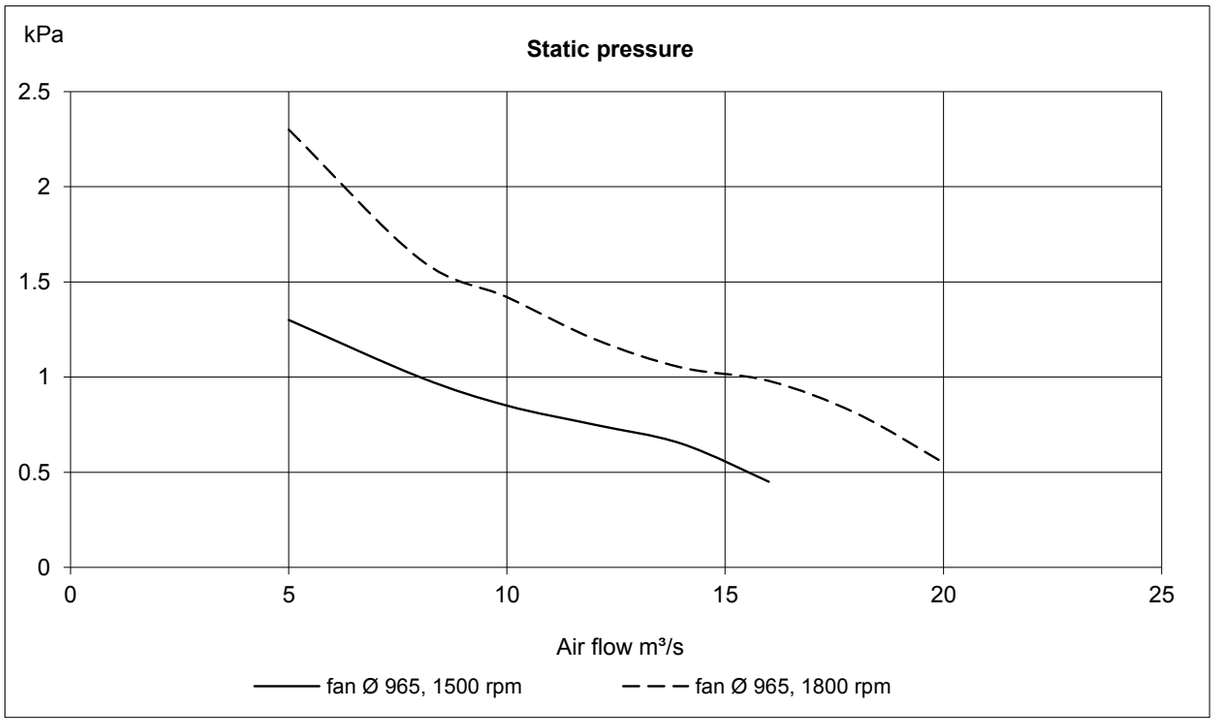

Fuel Consumption
l/h
160
140
120
100
80
60
40
20
0
0
100
200
300
400
500
600
kW
Power setting 450 kW 1500 rpm
Power setting 495 kW 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 550 kW 1800 rpm


Derating
120%
100%
80%
60%
40%
20%
0%
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
Altitude
Power setting 450 kW 1500 rpm
Power setting 495 kW 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 550 kW 1800 rpm


Sound power level engine body
1/3 octave band analysis
dB (A)
120
110
100
90
80
70
60
50
40
20
31.5
50
80
125
200
315
500
800
1.25
2k
3.15
5k
8
12.5
20k
Frequency Hz
Power setting 450 kW 1500 rpm
Power setting 495 kW 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 550 kW 1800 rpm


Exhaust sound power level
1/3 octave band analysis
dB (A)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
20
31.5
50
80
125
200
315
500
800
1.25
2k
3.15
5k
8
12.5
20k
Frequency Hz
Power setting 450 kW 1500 rpm
Power setting 495 kW 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 550 kW 1800 rpm


kW
Fan Power consumtion
50
45
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
Air flow m³/s
fan Ø 965, 1500 rpm
fan Ø 965, 1800 rpm


kPa
Static pressure
2.5
2
1.5
1
0.5
0
0
5
10
15
20
25
Air flow m³/s
fan Ø 965, 1500 rpm
fan Ø 965, 1800 rpm