VOLVO PENTA D16 MG 1800/1500 rpm	Document No 21188254	Issue Index 03

Base on water temp 38°C/100°F

General

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

Number of cylinders			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	

Performance		**r/min** **load**	**1500** **25%**	**50%**	**75%**	**100%**	**110%**
Power setting 450 kW		kW hp	113 153	225 306	338 459	450 612	495 673
Torque at:	Power setting 450 kW	Nm lbft	716 528	1432 1056	2149 1585	2865 2113	3151 2324
Mean piston speed		m/s ft/sec			8,3 27,1		
Effective mean pressure at:	Power setting 450 kW	MPa psi	0,6 81	1,1 162	1,7 243	2,2 324	2,5 356
Max combustion pressure at:	Power setting 450 kW	MPa psi	8,7 1262	10,7 1552	13,1 1900	15,8 2292	17,6 2553
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						
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		kW hp	125 170	250 340	375 510	500 680	550 748
Torque at:	Power setting 500 kW	Nm lbft	663 489	1326 978	1989 1467	2653 1956	2918 2152
Mean piston speed		m/s ft/sec			9,9 32,6		
Effective mean pressure at:	Power setting 500 kW	MPa psi	0,5 75	1,0 150	1,6 225	2,1 300	2,3 330
Max combustion pressure at:	Power setting 500 kW	MPa psi	8,9 1291	11,2 1624	13,9 2016	16,6 2408	18,2 2640
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
Friction Power		kW hp	59 80,24	59 80,24	59 80,24	59 80,24	59 80,24

VOLVO PENTA D16 MG 1800/1500 rpm	Document No 21188254	Issue Index 03

Engine noise emission

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

		r/min load			1500 75%		
			25%	**50%**		**100%**	**110%**
Measured sound power Lw	No load	dB(A)			111,1		
	Power setting 450 kW	dB(A)	112,9	114,4	114,9	115,9	116,4
		r/min			**1800**		
Measured sound power Lw	No load	dB(A)			113		
	Power setting 500 kW	dB(A)	113,8	115,4	116	116,5	116,7

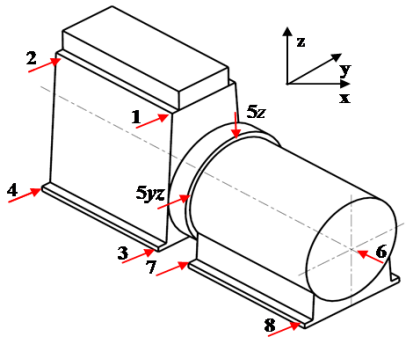
Unsilenced exhaust noise

Data calculated as sound pressure Lp.
Assumed microphone distance 1 m

	r/min load			1500 75%		
		25%	**50%**		**100%**	**110%**
Power setting 450 kW	dB(A)	109	112	114	115	116
	r/min			**1800**		
Power setting 500 kW	dB(A)	113	116	118	119	120

Vibrations (vibration velocity)

Declared vibration levels according to ISO 8528-9



r/min	**1500**		
	RMS Velocity (10 - 1000Hz) Measurement direction		
Measuring position	Axial [x] mm/s	Transverse [y] mm/s	Vertical [z] mm/s
1	8,3	12	8
2	7,3	14	12
3	7,1	12	9,7
4	7,5	10	13
5	8,5	20	12
6	7,1	13	8,9
7	7,7	15	16
8	8,1	16	16
r/min	**1800**		
1	10	13	14
2	8,7	26	25
3	8,1	15	13
4	6,5	25	25
5	6,4	27	15
6	9,0	19	15
7	7,9	17	23
8	8,7	20	24

Test conditions for load acceptance data

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

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	2,9	3,3	0,9	0,9	20-100	22,5	29,4	4,5	8,0
0-40	5,1	5,5	1,1	2,2	40-100	9,9	11,2	2,7	4,1
0-50	7,4	9,3	2,3	2,5	50-100	6,8	7,5	2,4	3,3
0-60	11,4	15,1	2,7	3,3	60-100	5,0	5,5	2,1	2,9
0-x	10,0		2,5		x-100	5,2		2,2	
0-x		10,0		2,5	x-100		7,3		3,9
100-0	7,1	10,0	1,2	1,6					

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	2,2	2,5	0,9	1,1	20-100	12,2	16,0	2,4	7,0
0-40	3,6	4,2	1,2	1,2	40-100	5,9	6,8	1,2	6,0
0-60	6,9	8,6	1,9	1,6	60-100	3,6	4,2	1,3	2,2
0-70	9,2	12,3	1,8	2,6	70-100	2,9	3,0	1,2	1,7
0-x	10,0		1,9		x-100	2,8		1,1	
0-x		10,0		2,0	x-100		3,6		1,9
100-0	8,1	8,3	2,0	2,0					

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./Thermostat-ctrl	Volvo Penta	2	12	32°C 90°F

Lubrication system		**r/min load**	**25%**	**50%**	**1500 75%**	**100%**	**110%**
Lubricating oil consumption	Power setting 450 kW	liter/h				0,100	0,110
		US gal/h				0,026	0,029
		r/min			**1800**		
	Power setting 500 kW	liter/h				0,110	0,120
		US gal/h				0,029	0,032

Oil system capacity including filters		liter	55
		US gal	14,5
Oil sump capacity:	max	liter	49
		US gal	12,9
	min	liter	39
		US gal	10,3
Oil change intervals/ specifications: (Fuel quality dependant)	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	°	15
	front down	°	15
	side tilt	°	22,5

Lubrication system		**r/min**	**1500**	**1800**
Oil pressure at rated speed		kPa	425	440
		psi	62	64
Oil pressure shut down switch setting		kPa	200	200
		psi	29	29
Lubrication oil temperature in oil sump:	max	°C	128	
		°F	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 450 kW	g/kWh	229	208	203	206	202
		lb/hph	0,371	0,337	0,329	0,334	0,327
		r/min			**1800**		
	Power setting 500 kW	g/kWh	241	212	209	213	209
		lb/hph	0,391	0,344	0,339	0,345	0,339
Fuel to conform to		ASTM-D975-No. 1 and 2-D, JIS KK 2204, EN 590 DMX and MDO-DMA (ISO8271)					
		r/min			**1500**		
System return flow	Power setting 450 kW	liter/h	47	47	47	47	47
		US gal/h	12,4	12,4	12,4	12,4	12,4
		r/min			**1800**		
	Power setting 500 kW	liter/h	51	51	51	51	51
		US gal/h	13,5	13,5	13,5	13,5	13,5
		r/min			**1500**		
System supply flow	Power setting 450 kW	liter/h	78	103	129	158	166
		US gal/h	20,6	27,2	34,1	41,7	43,9
		r/min			**1800**		
	Power setting 500 kW	liter/h	87	115	145	178	188
		US gal/h	23,0	30,4	38,3	47,0	49,7
		r/min			**1500**		
Normal fuel pressure (after filter)	Power setting 450 kW	kPa	455	449	445	438	437
		psi	66,0	65,1	64,5	63,5	63,4
		r/min			**1800**		
	Power setting 500 kW	kPa	478	475	472	466	466
		psi	69,3	68,9	68,5	67,6	67,6

Fuel system

Fuel supply line max restriction	kPa	10
	psi	1,5
Fuel supply max pressure head (day tank, from CL)	m	2
	feet	6,6
Fuel supply line max suction head (from CL)	kPa	2
	psi	0,3
Fuel return line max restriction	kPa	20
	psi	2,9
Maximum allowable inlet fuel temp	°C	60
	°F	140

Fuel system		r/min load	1500 25%	50%	75%	100%	110%
Fuel temp rise over engine	Power setting 450 kW	°C	27	27	27	27	27
		°F	81	81	81	81	81
		r/min			**1800**		
	Power setting 500 kW	°C	32	32	32	32	32
		°F	90	90	90	90	90
Prefilter / Water separator micron size		µ	10				
Fuel filter micron size		µ	2				
		r/min	**1500**		**1800**		
Governor type/make, standard		Electronic/Volvo EMSII			Electronic/Volvo EMSII		
Injection pump type/make		Unit injector			Unit injector		
Injection timing std.		°B.T.D.C					
Injection timing		°B.T.D.C					

VOLVO PENTA D16 MG 1800/1500 rpm	Document No 21188254	Issue Index 03

Intake system		r/min load	1500 25%	50%	75%	100%	110%
Air consumption at: (+25°C and 100kPa)	Power setting 450 kW	m^3/min	15,23	20,52	26,95	32,92	34,03
		cfm	538	725	952	1163	1202
		r/min			1800		
	Power setting 500 kW	m^3/min	19,82	26,9	34,68	40,57	41,37
		cfm	700	950	1225	1433	1461
Max allowable air intake restriction including piping		kPa	3				
		psi	0,4				
Air filter type		Paper cartridge					
Air filter cleaning efficiency		%	98				

Exhaust system		r/min load	1500 25%	50%	75%	100%	110%
Heat rejection to exhaust at:	Power setting 450 kW	kW	93	167	241	327	349
		BTU/min	5289	9497	13705	18596	19847
		r/min			1800		
	Power setting 500 kW	kW	108	183	262	361	388
		BTU/min	6142	10407	14900	20530	22065

Exhaust system		r/min load	1500 25%	50%	75%	100%	110%
Exhaust gas temperature after turbine at:	Power setting 450 kW	°C	309	394	434	474	485
		°F	588	741	813	885	905
		r/min			1800		
	Power setting 500 kW	°C	280	340	373	426	444
		°F	536	644	703	799	831
Max allowable back pressure in exhaust line		kPa	15				
		psi	2,2				
		r/min			1500		
Exhaust gas flow at: (temp and pressure after turbine at the corresponding power setting)	Power setting 450 kW	m^3/min	29,72	44,42	58,3	73,73	77
		cfm	1050	1569	2059	2604	2719
		r/min			1800		
	Power setting 500 kW	m^3/min	36,5	54,17	70,83	86,75	90,9
		cfm	1289	1913	2501	3064	3210

Cooling system, HT circuit, heat rejection		r/min load	1500 25%	50%	75%	100%	110%
Heat rejection radiation from engine to surrounding at:	Power setting 450 kW	kW	1	5	10	16	21
		BTU/min	57	284	569	910	1194
		r/min			1800		
	Power setting 500 kW	kW	3	7	12	18	23
		BTU/min	171	398	682	1024	1308

Cooling system, HT circuit, heat rejection		r/min	1500				
Heat rejection to coolant at: (HT)	Power setting 450 kW	kW	73	115	176	239	256
		BTU/min	4151	6540	10009	13592	14558
		r/min			1800		
	Power setting 500 kW	kW	94	139	204	279	294
		BTU/min	5346	7905	11601	15866	16719

Cooling system, HT circuit, other data

Coolant volume in engine with std. expansion tank		liter US gal	38 10,04		Note! Expansion tank size to be calculated. Recomended. 15% of total coolant volume
Max. additional coolant in HT system with std. expansion tank		liter US gal	6 1,59		
Coolant pump	drive/ratio		1;1,906		
		r/min	**1500**	**1800**	
Coolant flow with fully open thermostat		l/min US gal/min	373 98,54	460 121,52	
Nominal coolant pressure with standard system		kPa psi	75,0 10,9	75,0 10,9	
Maximum external coolant system restriction, including piping		kPa psi	50 7,3	50 7,3	
Thermostat	start to open	°C °F	86 187		
	fully open	°C °F	96 205		
Design point for box cooler, engine outlet temperature		°C °F	92 198		
Coolant flow at design point		l/min US gal/min	139,80 36,93	160,20 42,32	
Maximum static pressure head (expansion tank height + pressure cap setting)		kPa psi	100 14,5		
Standard pressure cap setting		kPa psi	75 10,9		
Maximum temperature entering engine		°C °F	64 147		
Coolant (40% coolant / 60% water)	Volvo Penta coolant together with clean fresh water				

Cooling system, LT circuit, heat rejection		**r/min** **load**	**25%**	**50%**	**1500** **75%**	**100%**	**110%**
Heat rejection to coolant at: (LT)	Power setting 450 kW	kW BTU/min	12 682	28 1592	51 2900	80 4550	87 4948
		r/min			**1800**		
	Power setting 500 kW	kW BTU/min	20 1137	44 2502	78 4436	115 6540	123 6995

Cooling system, LT, other data

Coolant volume in engine charge air cooler circuit		liter US gal	5 1,32		Note! Expansion tank size to be calculated. Recomended. 15% of total coolant volume
Max. additional coolant in LT system with std. expansion tank		liter US gal	-		
Maximum static pressure head (expansion tank height + pressure cap setting)		kPa psi	100 14,5		
Standard pressure cap setting		kPa psi	75 10,9		
LT circuit pump	drive/ratio		1;1,131		
		r/min	**1500**	**1800**	
Nominal LT water design flow		l/min US gal/min	78,0 20,61	84,0 22,19	
Nominal LT water pump pressure head at design flow		kPa psi	N/A	N/A	
Maximum LT waterpump suction head		kPa psi	N/A	N/A	
Maximum additional pressure drop LT water circuit		kPa psi	50 7,3	50 7,3	
Maximum allowed LT water circuit pressure before Heat Exchanger (External pump system)		kPa psi	10 1,5	10 1,5	
Maximum temperature entering charge air cooler		°C °F	48 118		
Coolant (40% coolant / 60%water)	Volvo Penta coolant together with clean fresh water				

Charge air cooler system		r/min load	25%	50%	1500 75%	100%	110%
Cooling power	Power setting 450 kW	kW	12	28	51	80	87
		BTU/min	682	1592	2900	4550	4948
		r/min			**1800**		
	Power setting 500 kW	kW	20	44	78	115	123
		BTU/min	1137	2502	4436	6540	6995
		r/min			**1500**		
Charge air mass flow	Power setting 450 kW	kg/s	0,303	0,403	0,519	0,633	0,655
		r/min			**1800**		
	Power setting 500 kW	kg/s	0,396	0,53	0,677	0,794	0,812
		r/min			**1500**		
Charge air inlet temp.	Power setting 450 kW	°C	66	103	143	181	189
Charge air temp after turbo compressor)		°F	151	217	289	358	372
	Power setting						
		r/min			**1800**		
	Power setting 500 kW	°C	79	120	163	203	212
		°F	174	248	325	397	414

Charge air cooler system		r/min load	25%	50%	1500 75%	100%	110%
Charge air outlet temp.	Power setting 450 kW	°C	27	35	45	55	57
(Charge air temp after charge air cooler)		°F	81	95	113	131	135
		r/min			**1800**		
	Power setting 500 kW	°C	29	37	49	59	62
		°F	84	99	120	138	144
		r/min		**1500**			
Charge air pressure	Power setting 450 kW	kPa		225			
		psi		32,63			
		r/min		**1800**			
	Power setting 500 kW	kPa		241			
		psi		34,95			
Standard charge air cooler core area		m²		0,04			
		foot²		0,43			

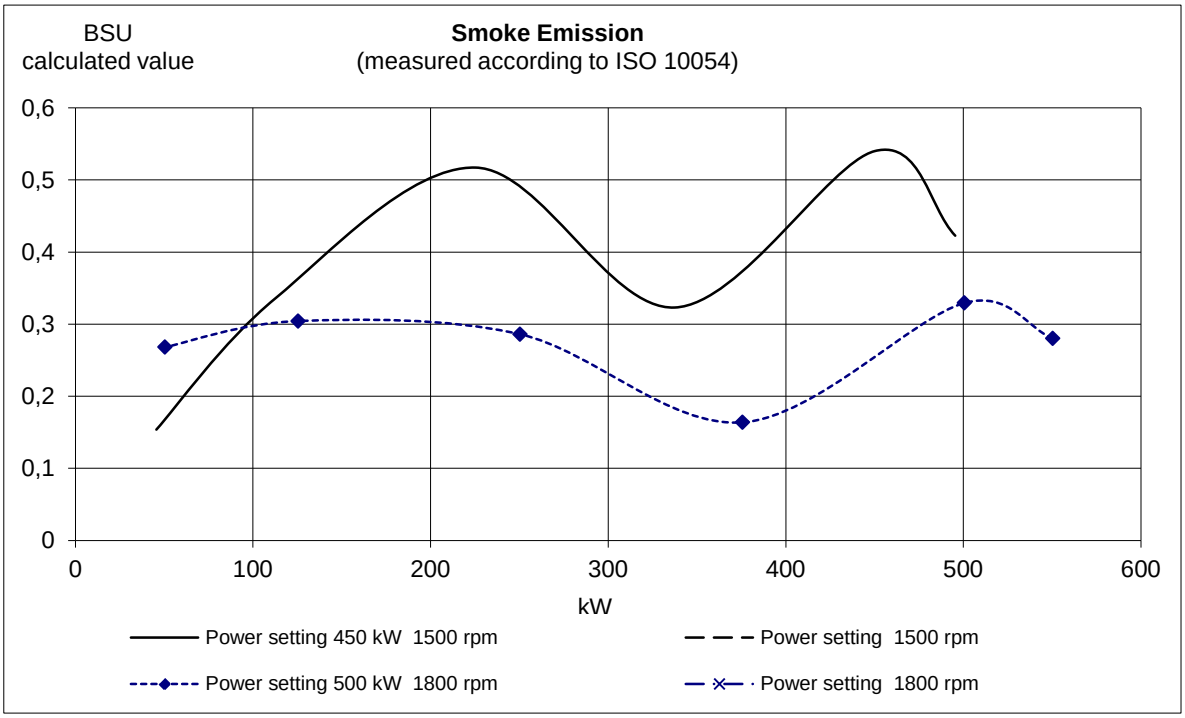
Engine management system

Functionality	Alternatives	Default setting
Governor mode	Isochronous/Droop Switchable during operation	Droop
Governor droop	0-5%	0,0
Governor response	P, I and D 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	Water in fuel
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		A	Bosch 20849349/35-80A
	tacho output		Hz/alt. Rev	6
	drive ratio			4
Starter motor			make	Melco
			type	24V/7kW
			kW	7/kW
Starter motor solenoid,	pull current		A	2,3
	hold current		A	N/A
Number of teeth on:	flywheel			153
	starter motor			12
Inrush current at +20°C \ 5°C			A	2000 \ 2100
Cranking current at +20°C \ 5°C			A	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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Smoke Emission
(measured according to ISO 10054)
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0,2
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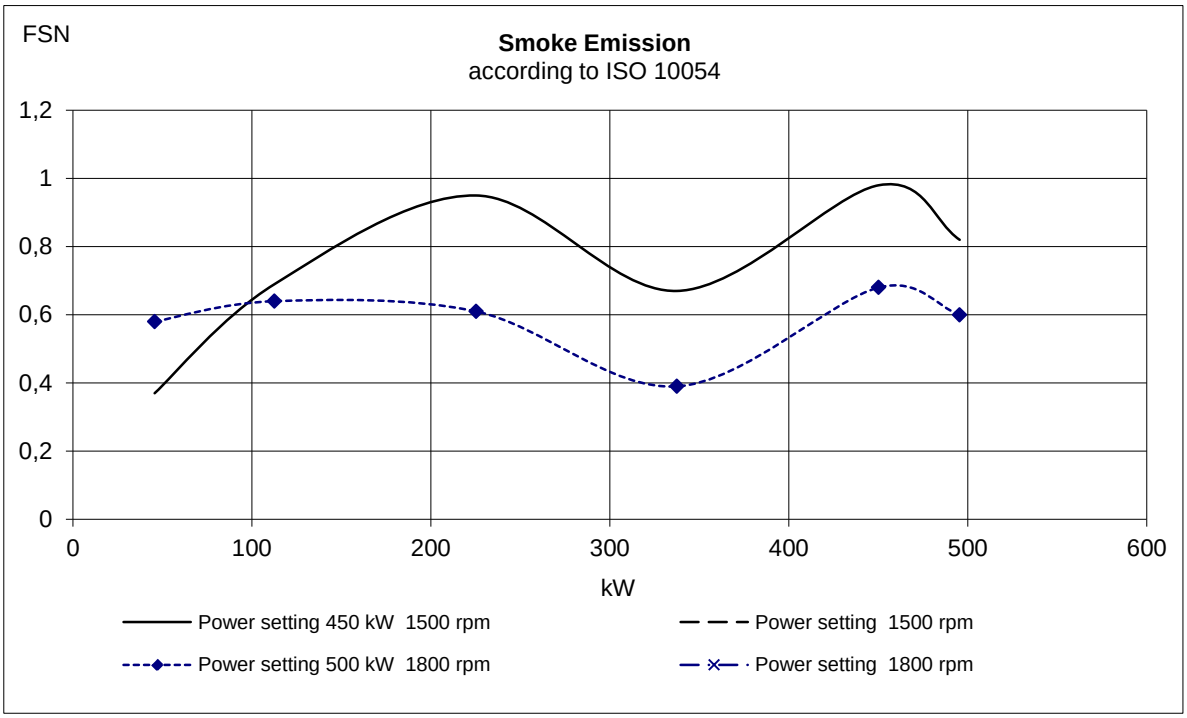
200
300
400
500
600
kW
Power setting 450 kW 1500 rpm
Power setting 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 1800 rpm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Smoke Emission
according to ISO 10054
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0
0
100
200
300
400
500
600
kW
Power setting 450 kW 1500 rpm
Power setting 1500 rpm
Power setting 500 kW 1800 rpm
Power setting 1800 rpm

VOLVO PENTA D16 MG 1800/1500 rpm	Document No 21188254	Issue Index 03