VOLVO PENTA **TAD1650VE-B**	Document No **22539051**	Issue Index **05**

Important

This Technical Data Sheet and the corresponding Installation Instructions provide important information to ensure the installed engine will operate according to the design specification in the Volvo Penta application for certification.

Requirements marked with ⚠ are considered as critical for exhaust emissions compliance according to the design specification in the Volvo Penta application for certification.

Failing to follow and meet these instructions and requirements when installing a certified engine in a piece of nonroad equipment for use in the United States violates U.S. federal law (40 CFR 1068.105(b)), subject to fines or other penalities as described in the Clean Air Act.

General

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

Number of cylinders			6
Displacement, total		liters in^3	16,12 984
Firing order			1-5-3-6-2-4
Bore		mm in	144 5,67
Stroke		mm in	165 6,50
Compression ratio			17,0:1
Wet weight	Engine only (Estimated) (excl after treatment comp.)	kg lb	1395 3075
	Power pac	kg lb	1840 4057

Performance				**rpm**	**1200**	**1500**	**1800**	**1900**
IFN Power 405 kW		without fan		kW hp	340 462	405 551	405 551	405 551
		with fan 890 mm		kW hp	See diagram for fan power consumption			
Torque at:		IFN Power		Nm lbf ft	2703 1994	2577 1901	2148 1584	2035 1500
Max torque at engine speed		rpm	1260 rpm	Nm lbf ft	2757 2033			
Power tolerance				%	±2			
Mean piston speed				m/s ft/sec	6,6 21,7	8,3 27,1	9,9 32,5	10,5 34,3
Effective mean pressure at:		IFN Power		MPa psi	2,11 306	2,01 291	1,67 243	1,59 230
Max combustion pressure at:		IFN Power		MPa psi				
Total mass moment of inertia, J (mR^2) (not including flywheel)				kgm^2 $lbft^2$	1,43 33,9			
Friction Power				kW hp	26 35	39 53	55 75	61 83
Derating see Technical Diagrams								

Engine brake performance (only engines with VCB)		rpm	1200	1500	1800	1900
Brake power:	without fan	kW hp	N/A	N/A	N/A	N/A
Brake torque:	without fan	Nm lbf ft	N/A	N/A	N/A	N/A
Engine speed range for VCB activation:		rpm	N/A			
Min engine speed with VCB still active:		rpm	N/A			
Min oil temperature for VCB activation:		°C	N/A			

Cold start performance

*Cold start limit temperature	without starting aid	°C °F	-10 14	
	with manifold heater 3.5 kW	°C °F	-25 -13	
	with manifold heater 3.5 kW and block heater	°C °F	-30 -22	
*Specify oil and fuel quality	T>-15°C Oil VDS4/VDS3 15W/40 T<-15°C Oil VDS4/VDS3 5W/40			
Heater type	Make	Power kW	Engaged hours (-30°C)	Cooling water temp engine block
Self circulating	Volvo 21578298	2	12	1°C 34°F

* See also general section in the sales guide

Lubrication system

Lubricating oil consumption (average)			Vol%	0,03
Oil system capacity including filters			liter US gal	48 12,68
Oil sump capacity: (both variants)		Max	liter US gal	42 11,10
		Min	liter US gal	32 8,45
Oil change intervals/specifications	VDS3		h	500*
	VDS4		h	500*
Engine angularity limits: Standard sump / optional aluminium sump		front up	°	11 / 30
		front down	°	11 / 30
		side tilt	°	11 / 30
Oil pressure at rated speed			kPa psi	300 - 650 44 - 94

Oil change intervals vary depending on oil grade, sulfur content of the fuel and running conditions. Oil sample analyses is recommended to determine application specific oil change interval.

Lubrication system

Lubrication oil temperature in sump:	max	°C °F	130 266
Oil filter filtration efficiency (in accordance with ISO 4548-12)	99%	µ	38
	50%	µ	14

Fuel system

System supply flow at max. Speed		liter/h US gal/h	135 35,7
Fuel supply line max. restriction (measured at fuel inlet connection)		kPa psi	10 1,5
Fuel supply line max. pressure, during engine stand still (meassured at fuel inlet connection)		kPa psi	16,5 2,4
Fuel supply line min. pressure, during engine stand still (meassured at fuel inlet connection)		kPa psi	-125 -18,1
System return flow at max. Speed		liter/h US gal/h	30,0 7,9
Fuel return line max. restriction (measured at fuel return connection)		kPa psi	20 2,9
Max. allowable inlet fuel temp		°C	60
Prefilter / Water separator micron size		µ	10
Fuel filter filtration efficiency	96%	µ	6
	75%	µ	4
Engine Control System, standard		Volvo/EMS2.3	
Specific UREA consumption in Nonroad Transient Cycle (NRTC)		Vol%	N/A
Fuel to conform to			Fuel corresponding to EN590 or ASTM D 975 (No 1-D, No 2-D) or JIS KK2204

Intake and exhaust system		**rpm**	**1200**	**1500**	**1800**	**1900**
Charge air consumption at: (+25°C and 100kPa)	IFN Power	m³/min cfm	20,6 727	27,4 968	31,5 1112	31,1 1098
⚠ **See front page for important information** Max allowable air intake restriction including piping		kPa psi	5 0,7			
Heat rejection to exhaust at:	IFN Power	kW BTU/min	243 13819	314 17857	330 18767	382 21724
Exhaust gas temperature after turbine at:	IFN Power	°C °F	537 999	528 982	491 916	516 961
⚠ **See front page for important information** Max allowable back pressure in exhaust line (after turbine) Pipe dimension Ø: 125 mm		kPa psi	10 1,5	12 1,7	14 2,0	15 2,2
Exhaust gas flow at: (temp and pressure after turbine at the corresponding power setting) ⚠ ⚠	IFN Power	m³/min cfm	57,0 2013	71,3 2518	75,6 2670	81,5 2878

Cooling system				rpm	1200	1500	1800	1900
Heat rejection radiation from engine at:		IFN Power		kW	10	10	10	11
				BTU/min	569	569	569	626
Heat rejection to coolant at:		IFN Power		kW	145	172	180	204
				BTU/min	8246	9781	10209	11601
Coolant				Yellow Volvo Coolant Solution (VCS)				
Radiator cooling system type					Closed circuit			
Standard radiator core area		IFN Power		m²	1,42			
				foot²	15,28			
HD radiator core area				m²	0,87			
				foot²	9,36			
Fan diameter	890 mm	IFN Power		mm	890			
				in	35,04			
Fan power consumption	890 mm			kW	See diagram for actual fan drive ratio power.			
				hp				
Fan drive ratio	fan Ø890				See diagram for cooling performance			
Coolant capacity:	Engine			liter	24			
				US gal	6,3			
	STD. 1,42m² radiator with hoses Pusher syst. Core thickness 63mm			liter	37			
				US gal	9,8			
	STD. 1,42m² radiator with hoses Puller syst. Core thickness 41mm			liter	30			
				US gal	7,9			
	HD 0,87m² radiator with hoses			liter	32			
				US gal	8,5			
Coolant pump				drive/ratio	belt/1,77:1 cw			
Coolant flow with standard system				l/s	4,7	5,8	7	7,3
				US gal/s	1,2	1,5	1,8	1,9
Minimum coolant flow				l/s	4,3	5,4	6,6	6,9
				US gal/s	1,1	1,4	1,7	1,8
Maximum outer circuit restriction incl. piping				kPa	70,0			
				psi	10,2			
Thermostat:		start to open		°C	82			
				°F	180			
		fully open		°C	92			
				°F	198			
Maximum static pressure head (expansion tank height + pressure cap setting)				kPa	100			
				psi	14,5			
Minimum static pressure head (expansion tank height + pressure cap setting)				kPa	70			
				psi	10,2			
Standard pressure cap setting				kPa	75			
				psi	10,9			
Maximum top tank temperature				°C	107			
				°F	225			
Recommended Draw down capacity. The difference between min coolant level in the expansion tank and the lowest level where the engine's coolant system still are functioning				liter	2			
				US gal	0,5			

Charge air cooler system		rpm	1200	1500	1800	1900
Heat rejection to charge air cooler	IFN Power	kW	51	71	81	77
		BTU/min	2900	4038	4606	4379
Charge air mass flow	IFN Power	kg/s	0,4	0,54	0,61	0,61
Charge air inlet temp.	IFN Power	°C	164	178	183	175
(Charge air temp after turbo compressor)		°F	327	352	361	347
⚠ **See front page for important information** Max allowable Charge air outlet temp. (Charge air temp after charge air cooler at 25°C ambient)		°C	40	47	50	50
		°F	104	117	122	122
⚠ **See front page for important information** Maximum pressure drop over charge air cooler incl. piping		kPa	12			
		psi	1,74			
Charge air pressure		kPa	178	204	205	189
(Relative, after charge air cooler)		psi	25,82	29,59	29,73	27,41
Standard charge air cooler core area		m²	0,76			
		foot²	8,18			

Cooling performance: STD cooling package 1,42m² radiator and suction 890mm fan

Cooling air flow and maximum additional external restriction at different radiator air temperatures based on 107°C TTT and 40% coolant. Valid at 1 atm.

Fix fan drive ratio 1:0,97

Engine speed	Engine power	Air on temp		Air flow		External restriction	
rpm	kW hp	°C	°F	kg/s	lb/s	Pa	psi
1900	405	64	147	12,1	26,6	0	
	551	62	144	11,4	25,0	150	0,022
		61	142	10,7	23,6	300	0,044
		59	139	10,0	22,1	450	0,065

Cooling performance: STD cooling package 1,42m² radiator and suction 890mm electronically controlled visco fan

Cooling air flow and maximum additional external restriction at different radiator air temperatures based on 107°C TTT and 40% coolant. Valid at 1 atm.

Visco fan drive, ratio 1:0,88

Engine speed	Engine power	Air on temp		Air flow		External restriction	
rpm	kW hp	°C	°F	kg/s	lb/s	Pa	psi
1900	405	59	139	10,5	23,3	0	
	551	57	135	9,8	21,5	150	0,022
		55	132	9,0	19,9	300	0,044
		53	127	8,2	18,1	450	0,065

Cooling performance: STD cooling package 1,42 m² radiator and pusher 890mm fan

Cooling air flow and maximum additional external restriction at different radiator air temperatures based on 107°C TTT and 40% coolant. Valid at 1 atm.

Fix fan drive ratio 1:1,13

Engine speed	Engine power	Air on temp		Air flow		External restriction	
rpm	kW hp	°C	°F	m^3/s	ft^3/s	Pa	psi
1900	405	69	156	10,0	353,1	450	0,065
	551	70	158	10,5	371,9	300	0,044
		71	159	11,1	392,3	150	0,022
		71	160	11,7	413,5	0	

Fix fan drive ratio 1:1,04

Engine speed	Engine power	Air on temp		Air flow		External restriction	
rpm	kW hp	°C	°F	m^3/s	ft^3/s	Pa	psi
1900	405	67	153	9,1	321,7	450	0,065
	551	68	155	9,6	338,3	300	0,044
		69	157	10,2	358,4	150	0,022
		70	158	10,7	377,2	0	

Fix fan drive ratio 1:0,97

Engine speed	Engine power	Air on temp		Air flow		External restriction	
rpm	kW hp	°C	°F	m^3/s	ft^3/s	Pa	psi
1900	405	65	150	8,4	297,7	450	0,065
	551	67	152	8,8	312,2	300	0,044
		68	154	9,4	331,3	150	0,022
		69	155	9,8	346,8	0	

Fix fan drive ratio 1:0,88

Engine speed	Engine power	Air on temp		Air flow		External restriction	
rpm	kW hp	°C	°F	m^3/s	ft^3/s	Pa	psi
1900	405	63	145	7,6	269,5	450	0,065
	551	64	147	8,0	281,5	300	0,044
		65	149	8,5	298,8	150	0,022
		66	151	8,8	310,4	0	

Cooling performance: STD cooling package 1,42m² radiator and pusher 890mm electronically controlled visco fan
Cooling air flow and maximum additional external restriction at different radiator air temperatures based on 107°C TTT and 40% coolant. Valid at 1 atm.

Visco fan drive, pully ratio 1:0,88

Engine speed	Engine power	Air on temp		Air flow		External restriction	
	kW						
rpm	hp	°C	°F	m^3/s	ft^3/s	Pa	psi
1900	405	62	144	7,5	263,1	450	0,065
	551	63	146	7,8	274,4	300	0,044
		65	148	8,2	290,6	150	0,022
		65	150	8,5	300,9	0	

Cooling performance, HD cooling package with 890mm fan and fan drive ratio 1:0,97
Cooling air flow and external restriction at different radiator air temperatures based on 107°C TTT and 40% antifreeze (radiator and cooling fan, see optional equipment)

Engine speed	External	PRIME POWER		STANDBY POWER	
rpm	restrictio n	Air mass flow kg/s	Air on temp C°	Air mass flow kg/s	Air on temp C°
1500	0		72		70
	100		69		67
	200		67		64
	300		63		61
	400		61		57
1800	0		73		70
	100		70		68
	200		69		66
	300		68		65
	400		66		63

Engine management system

Functionality	Alternatives			Default setting
Governor mode		Isochronous		
Governor droop		0		
Governor response		Adjustable PI-constants		1
Idle speed		600-900		700
Stop function		Ignition off stop engine		
Preheating function		On/Off		
Lamp test		On/Off		

Engine sensors and switch settings			Warning level (Yellow lamp)		Engine protection (Red lamp)	
Parameter		**Unit**	**Setting range**	**Default setting**	**Level**	**Action. Default/Alternative**
Oil temp		°C	125-130	125	130	Soft derate VE / Shut down, Powerpack
Oil pressure	Low idle	kPa	N/A	50	25	Shut down, ON/OFF*
	Rated speed	kPa	N/A	300	275	Shut down, ON/OFF*
Oil level						
Piston cooling pressure >1000 rpm		kPa				
Coolant temp		°C	105-107	105	107	Soft derate VE / Shut down, Powerpack
Coolant level			See cooling system	On		
Fuel feed pressure	1200rpm	kPa		100		
Water in fuel			Alarm When Closed			
Crank case pressure		kPa	N/A	Rapid Pres inc	Rapid Pres inc	Shut down, ON/OFF*
Air filter pressure drop				5		
Altitude, above sea		m				Automatic derating, see section derating
Charge air temp		°C	N/A	80	85	Soft derate VE / Shut down, Powerpack
Charge air pressure		kPa	N/A	Demand value +35kPa	Demand value +40kPa	Soft derate VE / Shut down, Powerpack
Engine speed		rpm	100-120% of rated speed	120% of rated speed	Alarm level	Alarm only

* Off means no shut down, alarm only

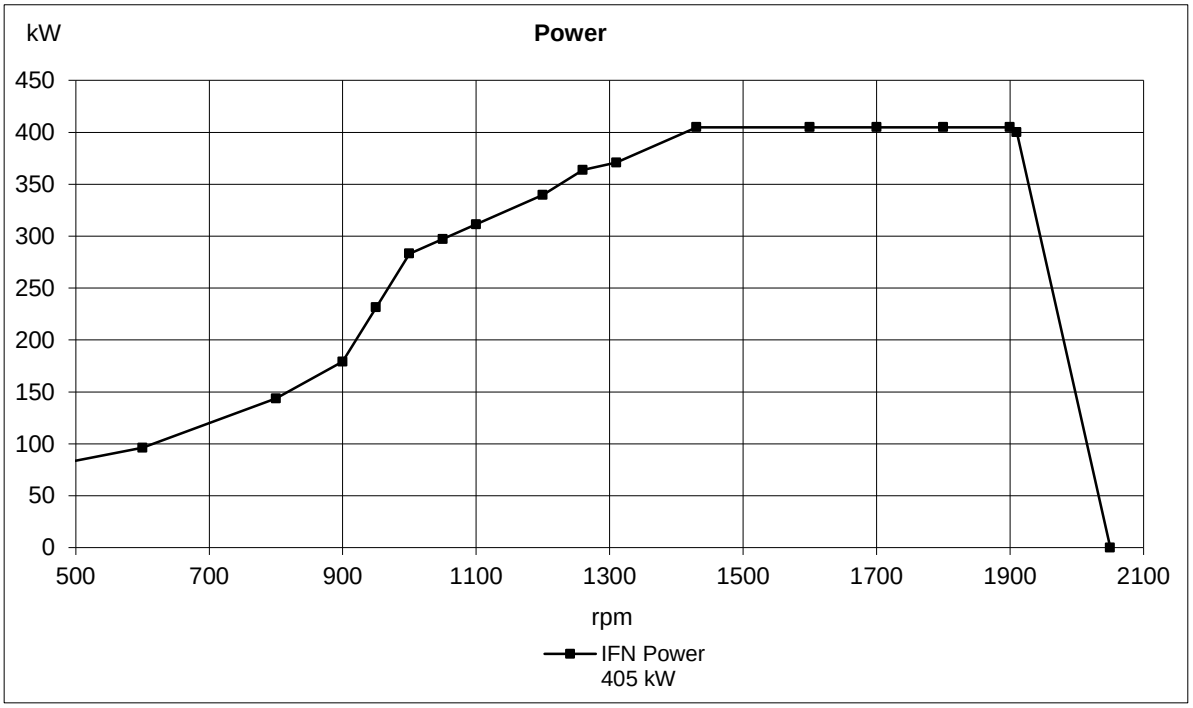
Parameter	Warning	Alarm	Derated 0% to engine protection map	Derated 100% to engine protection map	Forced idle after sec	Forced shut down after 2 sec
Coolant temp	105°C	107°C	107°C	108°C	N/A	Powerpack
Oil temp	125°C	130°C	130°C	132°C	N/A	Powerpack
Low oil pressure	Warning map value	Alarm map value	N/A	N/A	N/A	Alarm map value
High charge air temp	80°C	85°C	85°C	86°C	N/A	Powerpack
High charge air pressure	Warning map value	Alarm map value	Alarm map value	Alarm map value	N/A	Powerpack

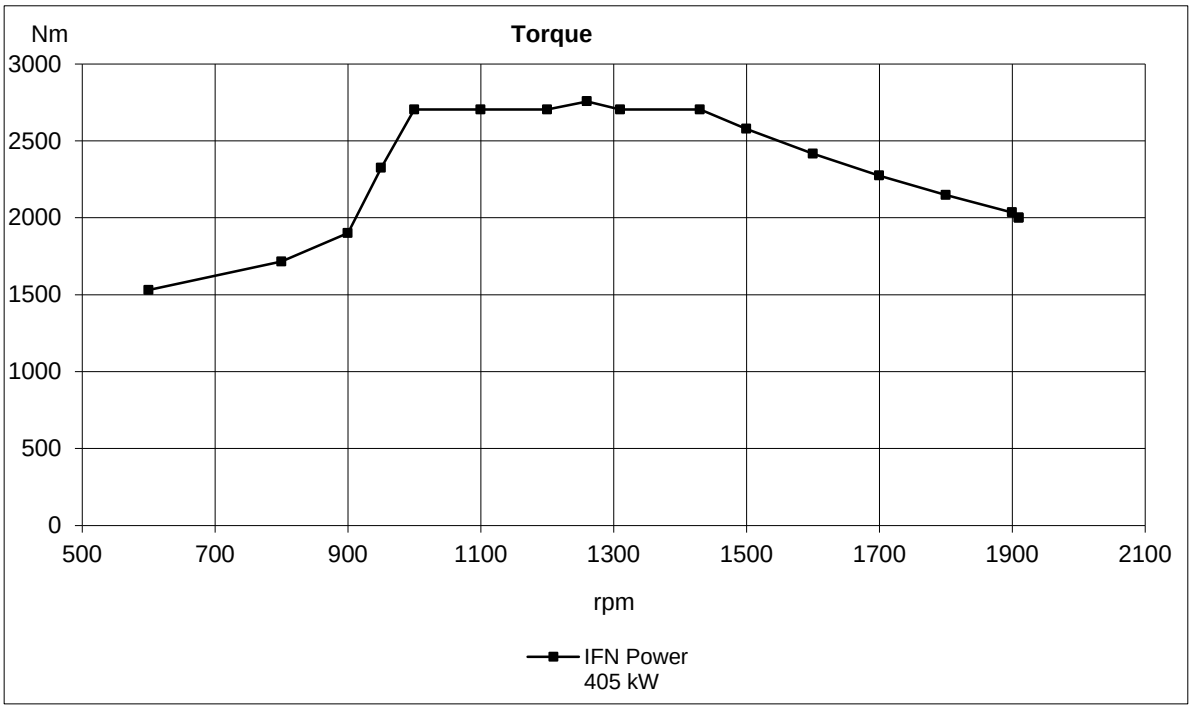
Electrical system

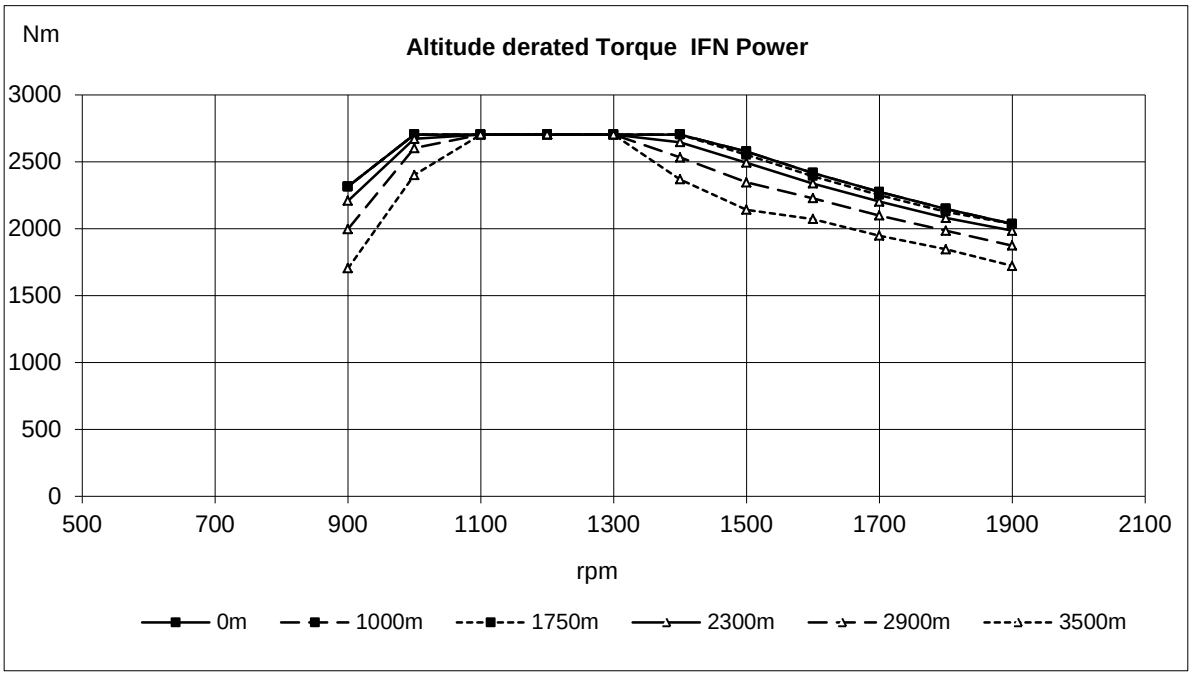
Voltage and type					24V		
Alternator:	make				Bosch		
Alternator:	output	A			110/150		
	tacho output	Hz/alternator rev.			6		
	drive ratio				3,9:1		
Starter motor:		make			Melco		
		type			105P70		
		output	kW		7		
			hp		9,5		
Number of teeth on:		flywheel			153		
		starter motor			12		
Max wiring resistance main circuit			mΩ		2		
Cranking current at +20°C			A		280		
Crank engine speed at 20°C			rpm		150		
Starter motor battery capacity		max	Ah/A		2x225		
		min at +5°C	Ah/A				
Inlet manifold heater (at 20 V)			kW		3.5		
Power relay for the manifold heater			A		1		
Conditions:	**Temperature**		**°C**		**25**	**0**	**-15**
(4 mΩ main circuit resistance@	**Battery**		**Ah / CCA**		**235 / 1300**	**145 / 1050**	**145 / 1050**
Crank speed			rpm		171	118	98
Crank current			A		290	400	480
Starter input power during crank			kW		6,2	7,5	7,7
Battery power during crank			kW		6,5	8,1	8,5
Min battery @ 0°C			Ah / CCA		140/800		

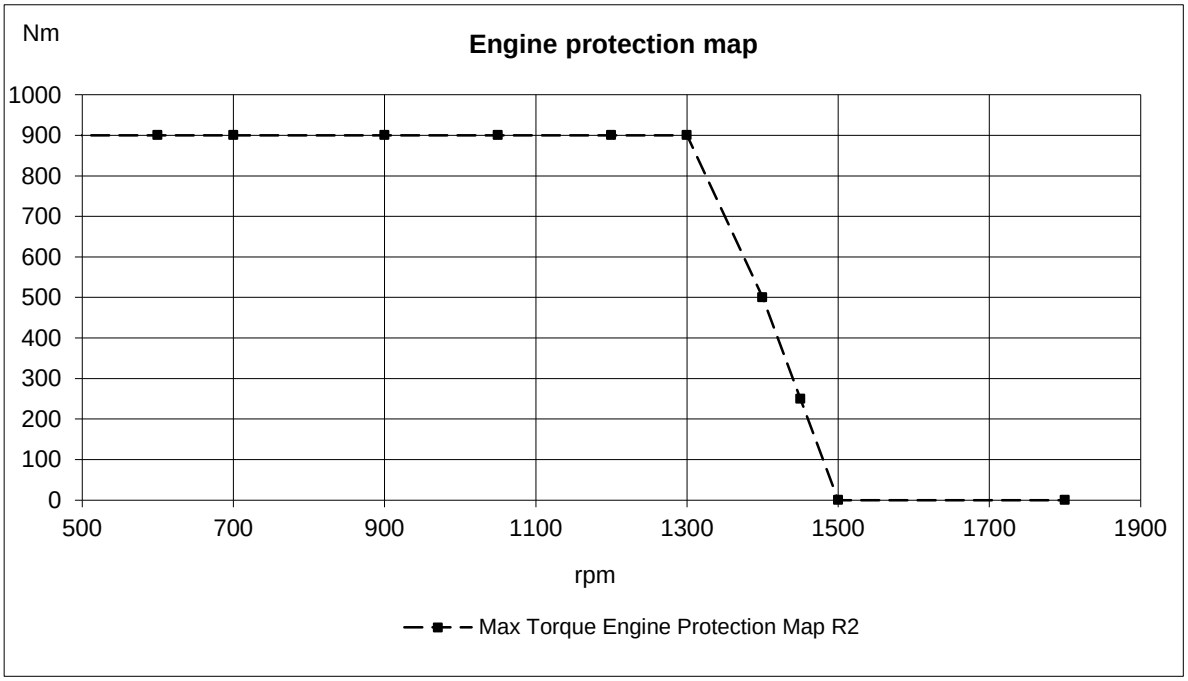
Power take off			rpm	1200	1500	1800	1900
Front end in line with crank shaft max:*			Nm	2703	2577	2148	2035
(with a total added mass moment of inertia, J (mR2)≤0,05 kgm²)			lbf ft	1993	1901	1584	1501
Front end belt pulley load. Direction of load viewed from flywheel side:	max left		kW	26	33	40	
			hp	35	45	54	
	max down		kW	60	75	90	
			hp	82	102	122	
	max right		kW	26	33	40	
			hp	35	45	54	
Timing gear at servo pump PTO max:*			Nm	100			
			lbf ft	74			
Speed ratio direction of rotation viewed from flywheel side				1,75:1/ccw			
Timing gear at compressor PTO max:*			Nm	300			
			lbf ft	221			
Speed ratio direction of rotation viewed from flywheel side				1,31:1/ccw			
Max allowed bending moment in flywheel housing			Nm	15000			
			lbf ft	11063			
Max. rear main bearing load			N	5000			
			lbf	1124,0			

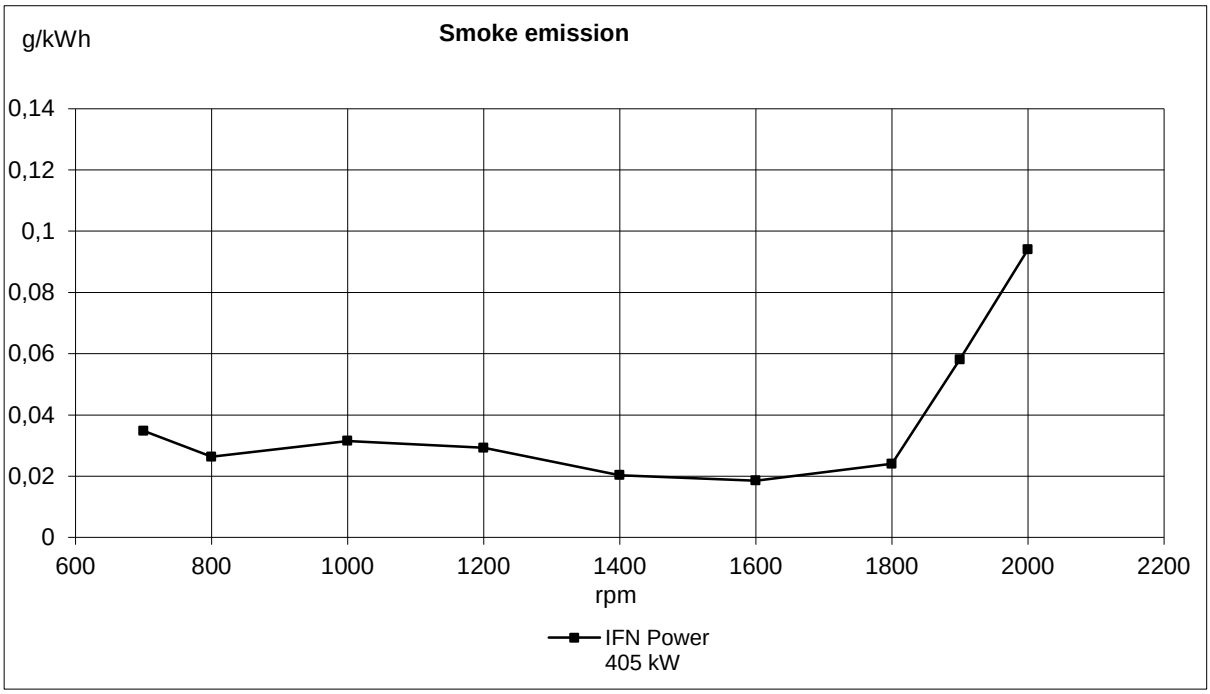
**** Maximum allowed torque at individual PTO´s.***
If more then one PTO output is used simultaniusly, calculations needs to be performed to determine available maximum.
Available torque depends on application inertia.

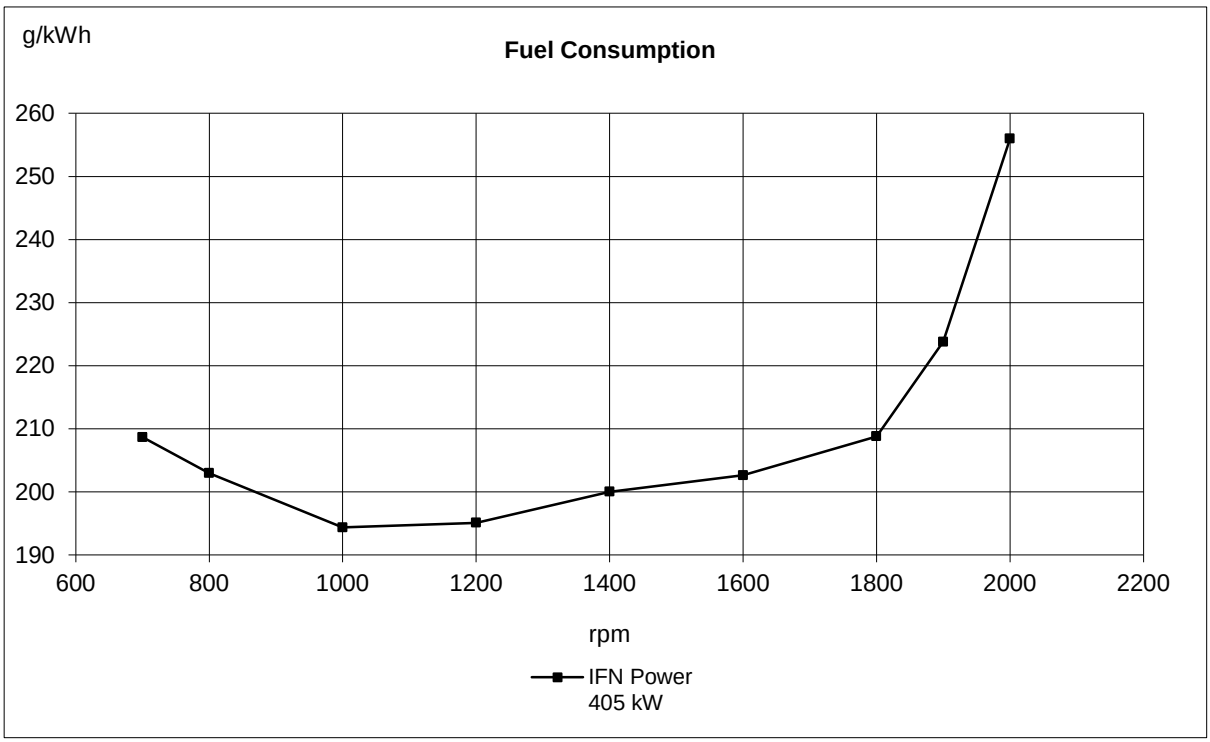

kW
Power
450
400
350
300
250
200
150
100
50
0
500
700
900
1100
1300
1500
1700
1900
2100
rpm
IFN Power
405 kW

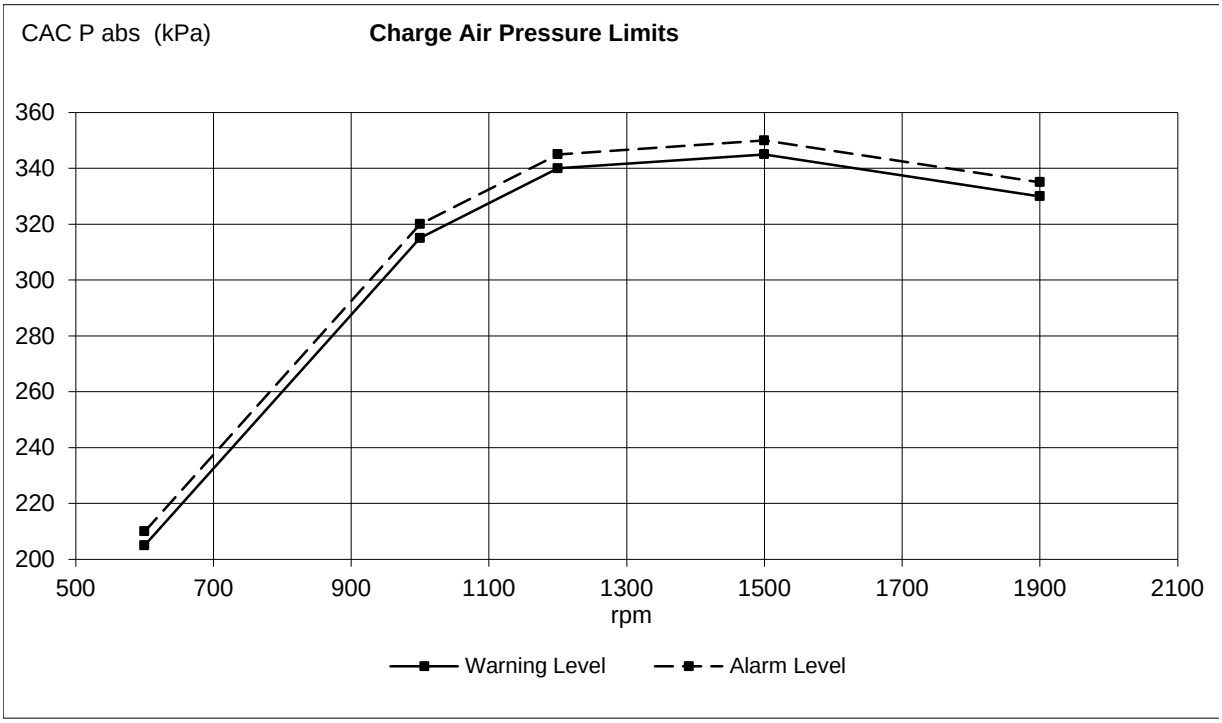

Nm
Torque
3000
2500
2000
1500
1000
500
0
500
700
900
1100
1300
1500
1700
1900
2100
rpm
IFN Power
405 kW

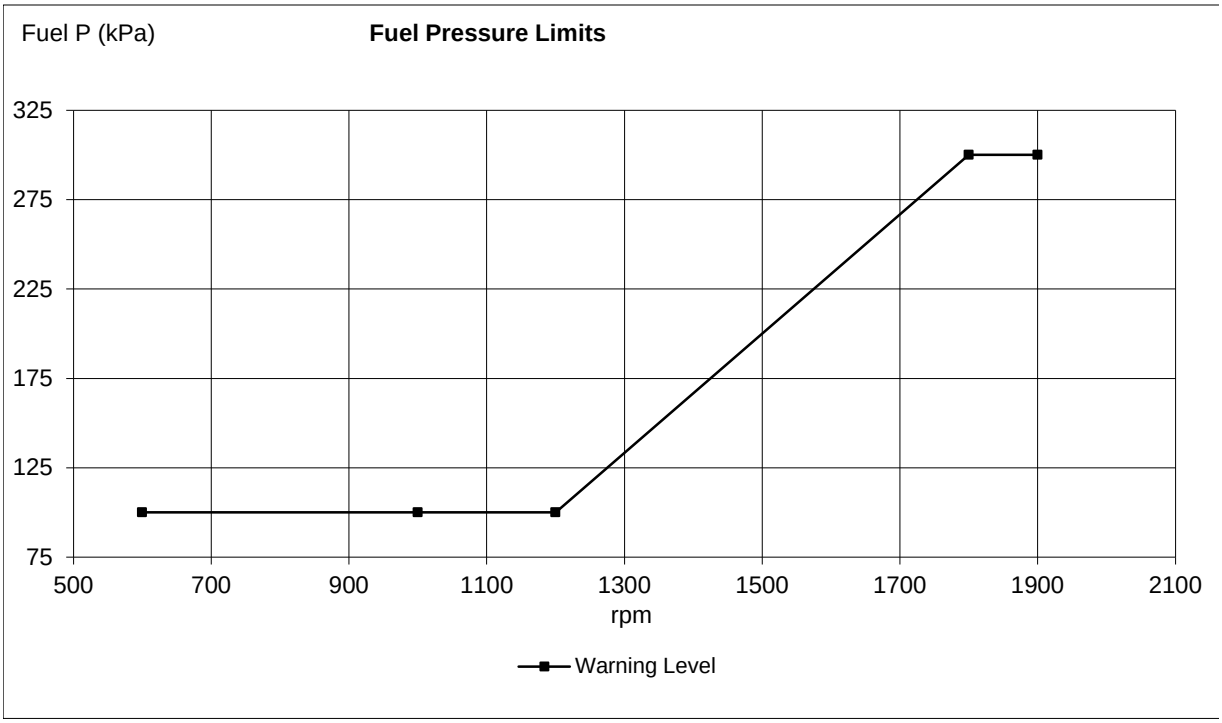

Nm
Altitude derated Torque IFN Power
3000
2500
2000
1500
1000
500
0
500
700
900
1100
1300
1500
1700
1900
2100
rpm
0m
1000m
1750m
2300m
2900m
3500m

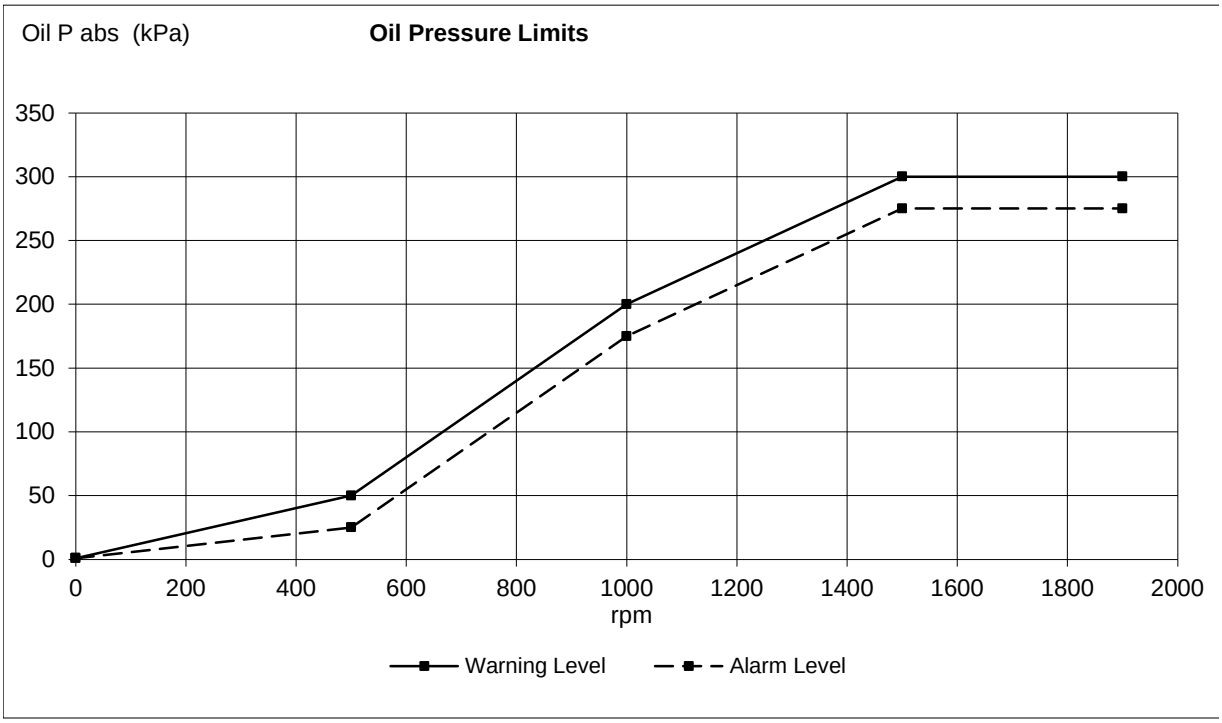

Nm
Engine protection map
1000
900
800
700
600
500
400
300
200
100
0
500
700
900
1100
1300
1500
1700
1900
rpm
Max Torque Engine Protection Map R2

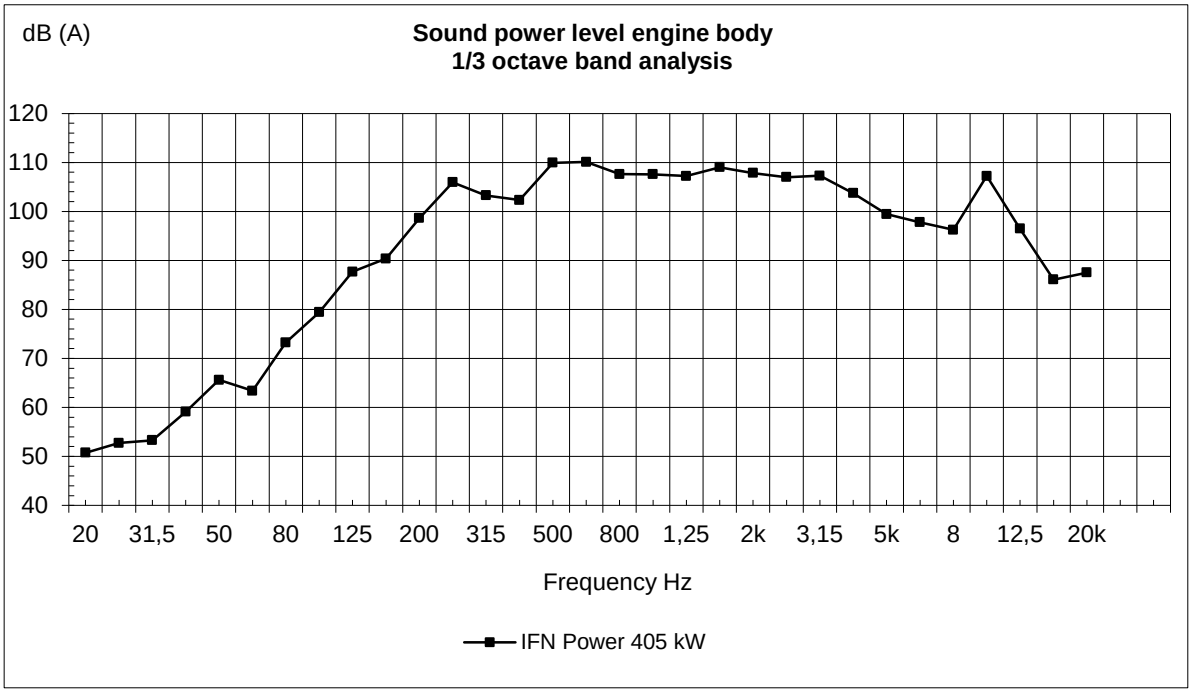

Smoke emission
g/kWh
0,14
0,12
0,1
0,08
0,06
0,04
0,02
0
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
IFN Power
405 kW

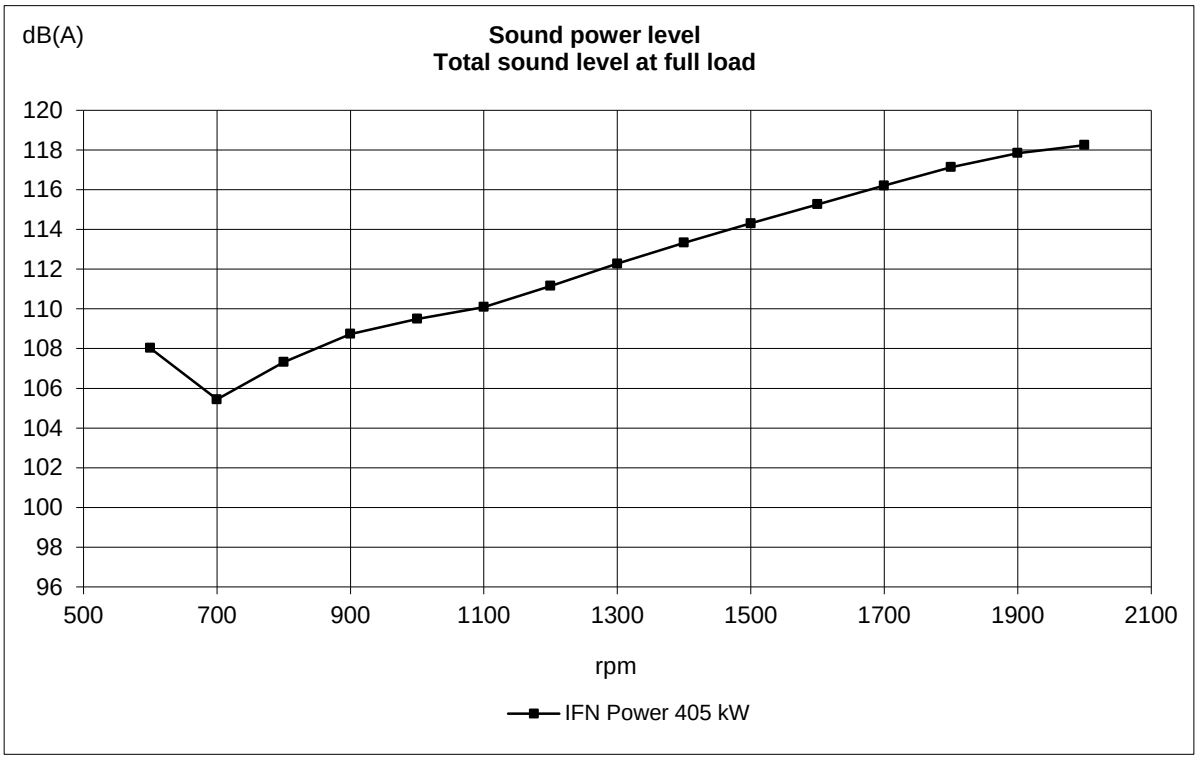

g/kWh
Fuel Consumption
260
250
240
230
220
210
200
190
600
800
1000
1200
1400
1600
1800
2000
2200
rpm
IFN Power
405 kW

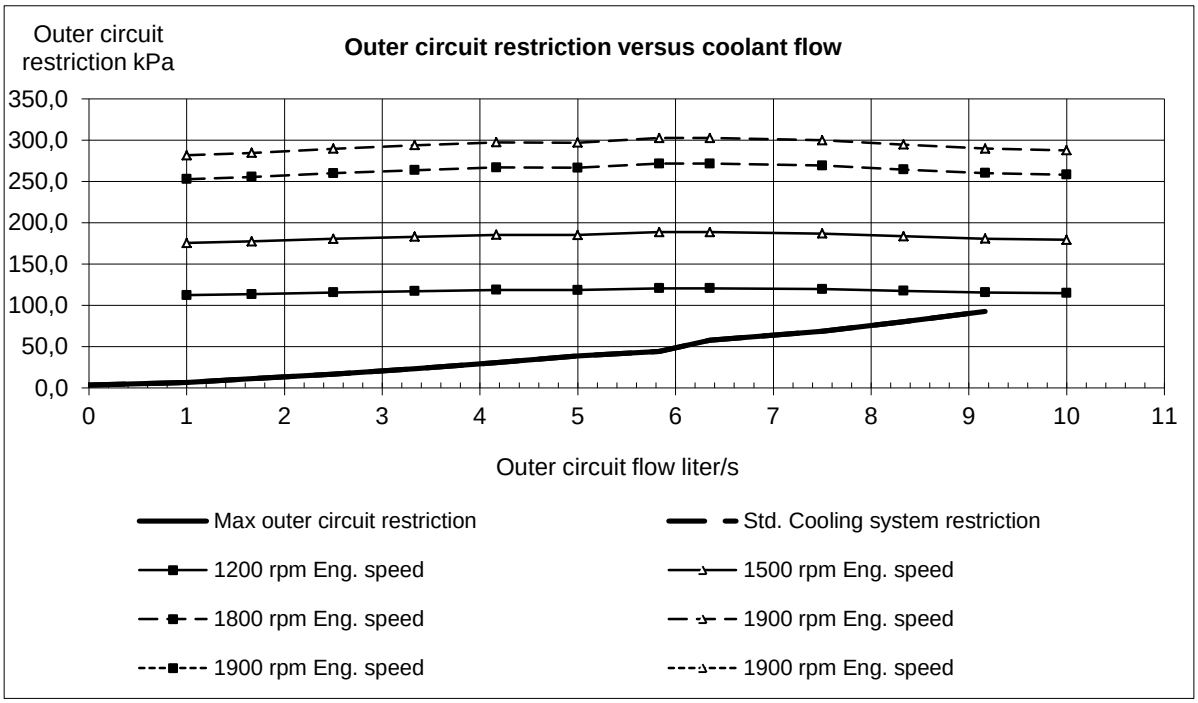

CAC P abs (kPa)
Charge Air Pressure Limits
360
340
320
300
280
260
240
220
200
500
700
900
1100
1300
1500
1700
1900
2100
rpm
Warning Level
Alarm Level


Fuel P (kPa)
Fuel Pressure Limits
325
275
225
175
125
75
500
700
900
1100
1300
1500
1700
1900
2100
rpm
Warning Level

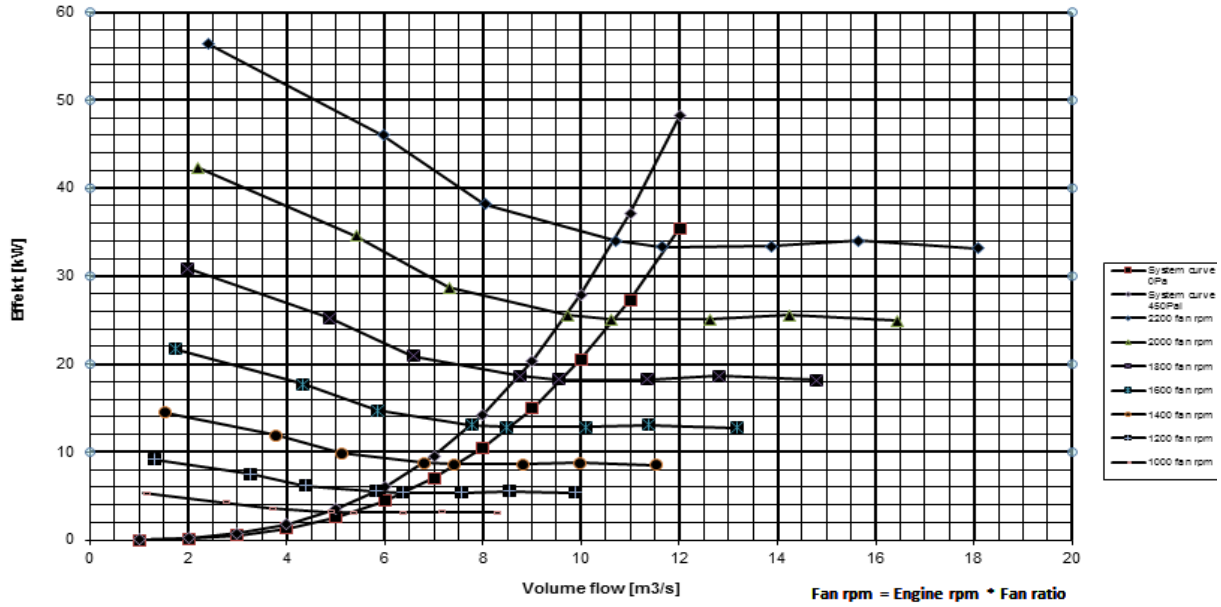

Oil P abs (kPa)
Oil Pressure Limits
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
rpm
Warning Level
Alarm Level


dB (A)
Sound power level engine body
1/3 octave band analysis
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
IFN Power 405 kW

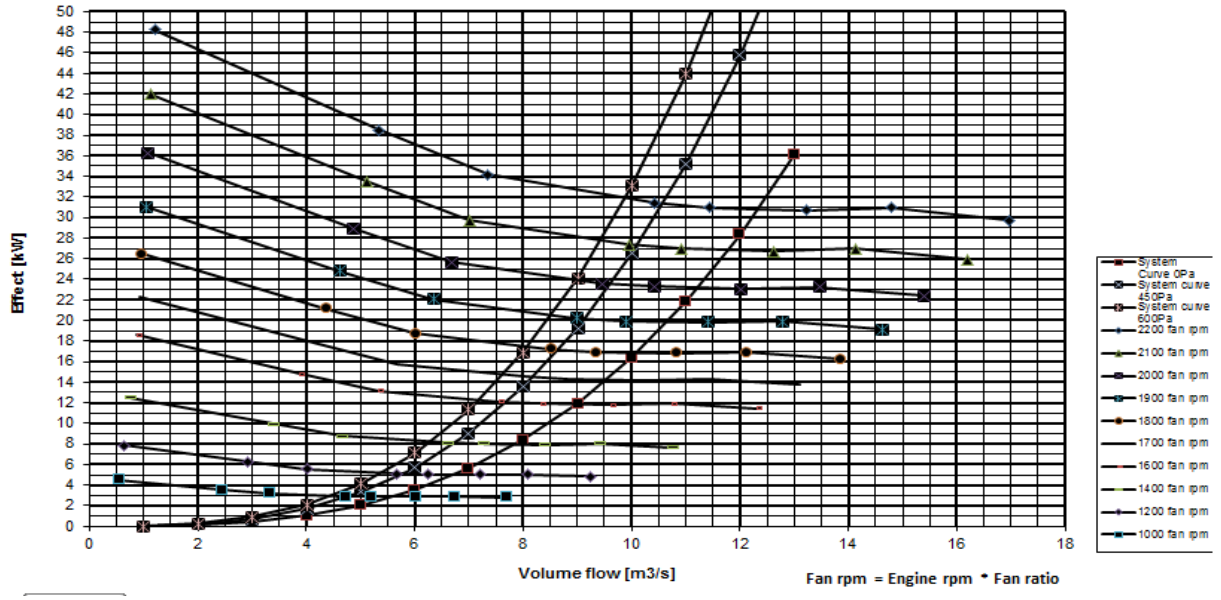

dB(A)
Sound power level
Total sound level at full load
120
118
116
114
112
110
108
106
104
102
100
98
96
500
700
900
1100
1300
1500
1700
1900
2100
rpm
IFN Power 405 kW


Outer circuit restriction kPa
Outer circuit restriction versus coolant flow
350,0
300,0
250,0
200,0
150,0
100,0
50,0
0,0
0
1
2
3
4
5
6
7
8
9
10
11
Outer circuit flow liter/s
Max outer circuit restriction
Std. Cooling system restriction
1200 rpm Eng. speed
1500 rpm Eng. speed
1800 rpm Eng. speed
1900 rpm Eng. speed
1900 rpm Eng. speed
1900 rpm Eng. speed

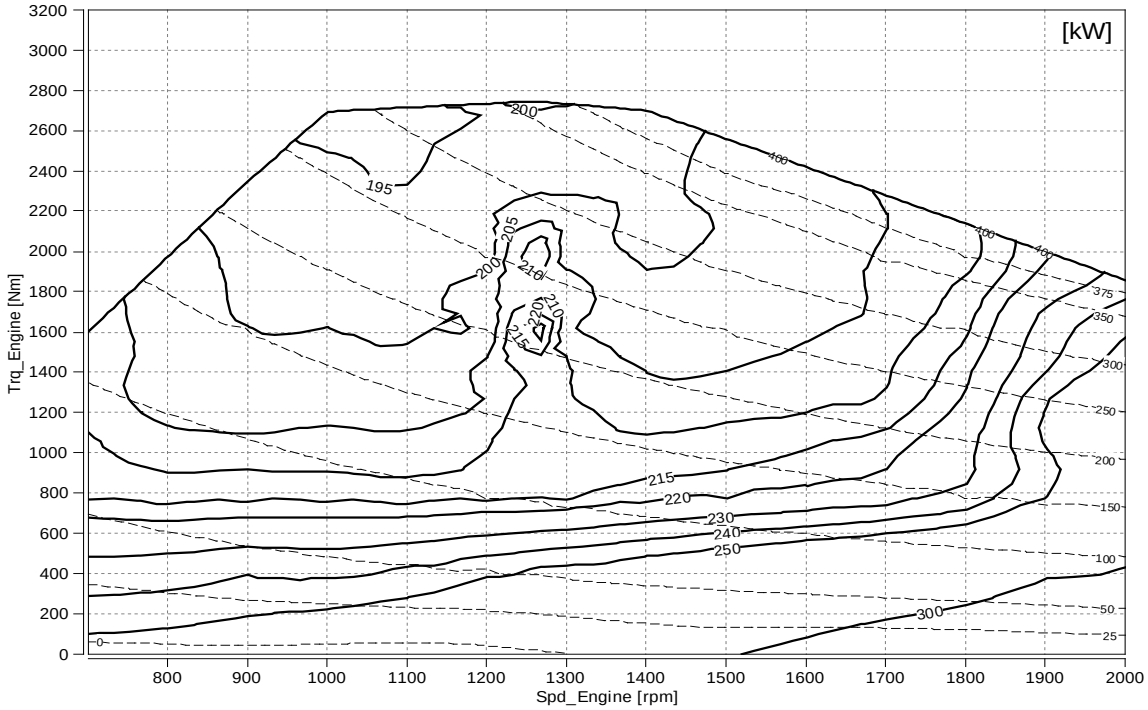
Fan power 890mm Pusher fan



Fan power 890mm Puller fan



BSFC [g/kWh]



Fuel consumption [l/h]