

Notice of Compliance



Revised MARPOL Annex VI & NO_x Technical Code 2008

Engine Family D13-MH/MG

AB Volvo Penta

This is to State

That above-mentioned engine family has been established under the requirements of Technical Code 2008 on Control of Emission of Nitrogen Oxides from Marine Diesel Engines showing that all engines covered by the engine family comply with the emission limits of Regulation 13.4 of Revised MARPOL Annex VI.

This is to Note

1. That every member engine of the above-mentioned engine family shall be subject to pre-certification in accordance with the procedure established to the parent engine to verify that the member engine, as designed, equipped and adjusted, complies with the applicable regulation 13.4 of Revised Annex VI of the Convention; and
2. That this Notice of Compliance does not replace the EIAPP Certificate to be issued for each individual engine.

Specification of the Engine Family

Engine manufacturer	:	AB Volvo Penta			
Engine type(s)	:	according to supplement			
GL approval no.	:	30356-11 HH			
Date of primary issue	:	2011-08-24			
No. of cylinders	:	6			
Power at speed	:	according to supplement			
Test cycle(s)	:	D2	E2	E3	C1
NO _x emission limit Tier II	:	7.8 g/kWh	7.8 g/kWh	7.8 g/kWh	7.8 g/kWh
Actual NO _x emission value	:	6.9 g/kWh	6.9 g/kWh	6.8 g/kWh	7.1 g/kWh

Specification of the Parent Engine

Parent engine type	:	D2/E2: D13B-F MG (FE); C1/E3: D13B-E MH (FE)
Parent engine no.	:	13-277912

This is to Confirm

1. That the above-mentioned parent engine representing the above-mentioned engine family as specified in the document 'Technical File' has been approved in accordance with all requirements as applicable. The engine family will always be represented by the parent engine, its approved Technical File and the family documentation; and
2. That the selection of the parent engine has been carried out on the basis of tests and engineering judgement in accordance with the applicable chapter of the NO_x Technical Code 2008 providing that the parent engine incorporates those features and/or characteristics which most adversely affect the NO_x emission level and result in the highest NO_x emission level among all of the engines in the family; and
3. That adequate arrangements have been made by the engine manufacturer to ensure effective control of the conformity of production for all member engines within the family.



Germanischer Lloyd

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Hans-Jürgen Rein

Manga Higgen

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Engine Family D13-MH/MG

AB Volvo Penta

Supplement to the Notice of Compliance

Specification of the Engine Family, continue

Engine	Rated Power [kW]	Rated Speed [rpm]	Application
D13B-E MH (FE) / D13B-N MH (FE)	441	1900	E2/E3/C1
D13B-E MH (FE) / D13B-N MH (FE)	404	1900	E2/E3/C1
D13B-E MH (FE) / D13B-N MH (FE)	368	1800	E2/E3/C1
D13B-E MH (FE) / D13B-N MH (FE)	331	1800	E2/E3/C1
D13B-E MH (FE) / D13B-N MH (FE)	294	1800	E2/E3/C1
D13B-E MH (FE) / D13B-N MH (FE)	214	1800	E3
D13B-E MH / D13B-N MH	441	1900	E2/E3/C1
D13B-E MH / D13B-N MH	404	1900	E2/E3/C1
D13B-E MH / D13B-N MH	368	1800	E2/E3/C1
D13B-E MH / D13B-N MH	331	1800	E2/E3/C1
D13B-E MH / D13B-N MH	294	1800	E2/E3/C1
D13B-E MG (FE) / D13B-F MG (FE)	400	1800	E2/D2
D13B-E MG (FE) / D13B-F MG (FE)	360	1800	E2/D2
D13B-E MG (FE) / D13B-F MG (FE)	360	1500	E2/D2
D13B-E MG (FE) / D13B-F MG (FE)	300	1500	E2/D2
D13B-E MG / D13B-F MG	400	1800	E2/D2
D13B-E MG / D13B-F MG	360	1800	E2/D2
D13B-E MG / D13B-F MG	360	1500	E2/D2
D13B-E MG / D13B-F MG	300	1500	E2/D2



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VOLVO PENTA

Technical File

D13-MH-MG*GL*E3E2C1D2

According to Revised MARPOL Annex VI and NOx Technical Code 2008

Manufacturer:	AB Volvo Penta
Engine Family:	D13-MH/MG
GL family approval no.	30356-11 HH
Engine Type:	E3, C1: D13B-E MH (FE) D2, E2: D13B-F MG (FE)
Engine Serial no.:	13-277912
Date of Manufacture:	2011-05-27
Rated Power:	E3, C1: 441 kW D2, E2: 360 kW
Rated Speed:	E3, C1: 1900rpm D2, E2: 1500rpm

Contents

1. Components, setting and operating values of the engine which influence NOx emissions
2. On board verification procedure
3. Test report of parent engine, E3, E2, C1, D2-cycle
4. Specification of spare parts



GLAPP0018389162

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1. Components, setting and operating values of the engine that influence NOx emissions

Common components within the engine type D13B-E MH / D13B-N MH / D13B-F MG/ D13B-E MG, D13B-E MH (FE) / D13B-N MH (FE) / D13B-F MG (FE) / D13B-E MG (FE)			
	ID-no. on component	Volvo Penta part No.	Remarks
Piston	21105177	21105177	
Engine Electronic Control Unit	20959036 21631327	20959036 21631327	
Cylinder Head	21315476 22008243	21315476 22008243	
Camshaft	21154172	21154172	
Turbo Charger	21343027 22316747	21343027 22316747	
Unit Injector	21379939	21379939	
Charge Air Cooler	3889640 21922701	3889640 21922701	Keel & heat exchanger cooled engine
Charge Air Cooler	21146123 40005102	21146123 40005102	Radiator cooled engine

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Setting specific components engine type D13B-E MH (FE) / D13B-N MH (FE)			
Power	kW	441	404
Speed	rpm	1900	1900
Application(s)		E3, E2, C1	E3, E2, C1
Dataset, part no.		21770807 22125672 22418811	21889821 22125665 22418806
Setting specific components engine type D13B-E MH (FE) / D13B-N MH (FE)			
Power	kW	331	294
Speed	rpm	1800	1800
Application(s)		E3, E2, C1	E3
Dataset, part no.		21889819 22125658 22418802	21889818 22125649 22418799
Setting specific components engine type D13B-E MH / D13B-N MH			
Power	kW	441	404
Speed	rpm	1900	1900
Application(s)		E3, E2, C1	E3, E2, C1
Dataset, part no.		21752103 22125670 22418810	21752099 22125662 22418805
Setting specific components engine type D13B-E MH / D13B-N MH			
Power	kW	331	294
Speed	rpm	1800	1800
Application(s)		E3, E2, C1	E3, E2, C1
Dataset, part no.		21752097 22125654 22418801	21752096 22125648 22418795
Setting specific components engine type D13B-E MG (FE) / D13B-F MG (FE)			
Power	kW	400	360
Speed	rpm	1800	1500
Application(s)		E2, D2	E2, D2
Dataset, part no.		21770801 22125684	21770801 22125684
Setting specific components engine type D13B-E MG (FE) / D13B-F MG (FE)			
Power	kW	300	
Speed	rpm	1500	
Application(s)		E2, D2	
Dataset, part no.		21889856 22125681	
Setting specific components engine type D13B-E MG / D13B-F MG			
Power	kW	400	360
Speed	rpm	1800	1500
Application(s)		E2, D2	E2, D2
Dataset, part no.		21752476 22125683	21752476 22125683
Setting specific components engine type D13B-E MG / D13B-F MG			
Power	kW	300	
Speed	rpm	1500	
Application(s)		E2, D2	
Dataset, part no.		21752475 22125680	

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Settings	
Maximum sea water temp., if applicable	32°C
Maximum sea water temp., if applicable (HE)	32°C
Maximum charge air temp., if applicable	50°C
Maximum fresh water temp. from Keel Cooler, if applicable	38°C
Low / high temp. cooling system set points	NA/90°C
Maximum inlet depression	-3 kPa
Maximum exhaust back pressure	12 kPa (MH)
Maximum exhaust back pressure	10 kPa (MG)
Fuel oil specification	According to operator's manual
Fuel oil temp.	40°C
Lubricating oil specification	According to operator's manual

Please see section 3 "Test report of parent engine" for design details of the engine family.

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2. On board verification procedure

Component	Procedure / location of ID-nos.	Remarks
Cylinder head	Check ID-no on machined surface (rear exhaust side). Inspection is recommended at overhaul when the engine is dismantled.	See Figure 1
Piston	Check ID-no on piston crown. Inspection is recommended at overhaul when cylinder head is removed.	
Turbocharger	Check ID-no on metal plate on compressor house. There is a waste-gate that is controlled by the software.	
Unit injector	Check ID-no on injector body. Inspection is recommended at overhaul when the engine is dismantled and the injector unit is visible.	
Electronic control unit and data set	ID no. for the Electronic Control Unit is positioned on the rear side of the ECU. It is not visible without dismantling. The data set can be checked by using a diagnostic tool at a service shop.	
Charge air cooler	Check ID no. on label. The ID-no is located on the charge air cooler, on the side of the cooler.	
Charge air cooler for engine type (RC)	Check ID no. on label. The ID-no is located on the upper side of the complete cooling system.	
Compression ratio	Determined by the correct piston and cylinder head combination. Inspection is recommended at overhaul when cylinder head is removed.	
Camshaft	The ID-no. is located at the front end of the camshaft. Inspection is recommended at overhaul when valve cover is removed and the camshaft is visible.	

! **Important!** The ID-numbers that can not be controlled unless the engine is taken apart shall only be checked at regular overhaul when the engine is taken out of service and dismantled for maintenance. Check only if considerable doubt of the correctness of the ID-no exist.

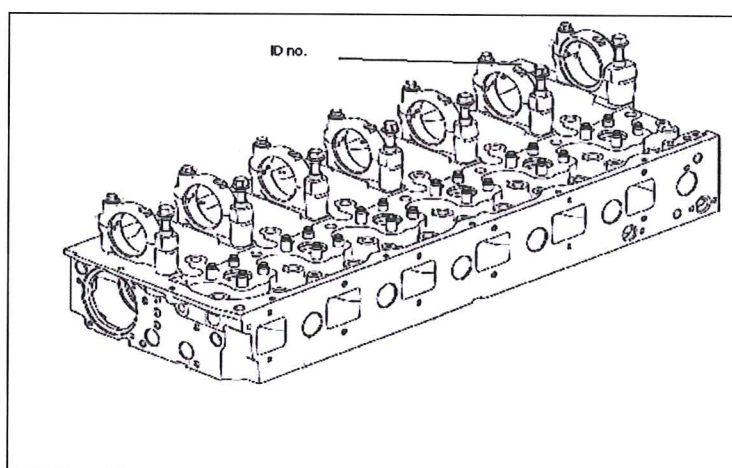


Figure 1

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3. Test report of parent engine E3 & C1 cycle

Emission Test Report E3 & C1					
Engine Information					
Manufacturer	AB Volvo Penta				
Engine type	D13B-E MH (FE)				
Family identification	D13-MH/MG				
Serial number	13-277912				
Rated speed	1900		rpm		
Rated power	441		kW		
Intermediate speed	1425		rpm		
Maximum torque at intermediate speed	2404		Nm		
Maximum fuel at rated power, parent engine	264 mg/str				
Static injection timing	N/A				
Electronic injection control	no:		yes: X		
Variable injection timing	no:		yes: X		
Variable turbocharger geometry	no: X		yes:		
Bore	131		mm		
Stroke	158		mm		
Nominal compression ratio	16.7:1				
Mean effective pressure, at rated power	2,17		MPa		
Maximum cylinder pressure, at rated power	NA				
Cylinder number and configuration	Number: 6		V:		In-line: X
Auxiliaries	None				
Specified Ambient Conditions					
Maximum inlet cooling water temperature	32 °C				
Maximum charge air temperature, if applicable	50°C				
Cooling system spec. intermediate cooler	no:		yes: X		
Cooling system spec. charge air stages	Single stage				
Low/high temperature cooling system set points	90		°C		
Maximum inlet depression	-3		kPa		
Maximum exhaust back pressure	12		kPa		
Fuel oil specification	RF-03-A-84 (acc. to ISO 8217, ISO-F-DMA)				
Fuel oil temperature	40		°C		
Lubricating oil specification	VDS3 SAE 15W-40				
Application / Intended for					
Customer	N/A				
Final application/installation, Ship	N/A				
Final application/installation, Engine	Main: X		Aux: X		
Emissions Test Results					
Cycle			NOx (g/kWh)		Test number
C1			7,09		22005618
E3			6,83		22005619
Date/time	2011-06-21				
Test site/bench	Volvo Penta Testcell Nr 22				
Surveyor	Germanischer Lloyd, Volker Pawils				
Date and Place of report	2011-05-21 Volvo Penta Gothenburg				
Signature					

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Test report of parent engine D2 & E2 cycle

Emission Test Report D2 & E2			
Engine Information			
Manufacturer	AB Volvo Penta		
Engine type	D13B-F MG (FE)		
Family identification	D13-MH/MG		
Serial number	13-277912		
Rated speed	1500	rpm	
Rated power	360	kW	
Intermediate speed	N/A	rpm	
Maximum torque at intermediate speed	N/A	Nm	
Maximum fuel at rated power, parent engine	258	mg/str	
Static injection timing	N/A		
Electronic injection control	no:	yes: X	
Variable injection timing	no:	yes: X	
Variable turbocharger geometry	no: X	yes:	
Bore	131	mm	
Stroke	158	mm	
Nominal compression ratio	16.7:1		
Mean effective pressure, at rated power	2,26	MPa	
Maximum cylinder pressure, at rated power	NA		
Cylinder number and configuration	Number: 6	V:	In-line: X
Auxiliaries	None		
Specified Ambient Conditions			
Maximum inlet cooling water temperature	32	°C	
Maximum charge air temperature, if applicable	50	°C	
Cooling system spec. intermediate cooler	no:	yes: X	
Cooling system spec. charge air stages	Single stage		
Low/high temperature cooling system set points	90	°C	
Maximum inlet depression	-3	kPa	
Maximum exhaust back pressure	10	kPa	
Fuel oil specification	RF-03-A-84 (acc. to ISO 8217, ISO-F-DMA)		
Fuel oil temperature	40	°C	
Lubricating oil specification	VDS3 SAE 15W-40		
Application / Intended for			
Customer	N/A		
Final application/installation, Ship	N/A		
Final application/installation, Engine	Main: X	Aux: X	
Emissions Test Results			
Cycle		NOx (g/kWh)	Test number
D2		6,86	22005617
E2		6,88	22005617
Date/time	2011-06-21		
Test site/bench	Volvo Penta Testcell Nr 22		
Surveyor	Germanischer Lloyd, Volker Pawils		
Date and Place of report	Volvo Penta Gothenburg		
Signature			

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Common Features Within the Engine Family	
Family identification	D13-MH/MG
Electronic injection control	Yes
Variable injection timing	Yes
Variable turbocharger geometry	No
Bore	131 mm
Stroke	158 mm
Nominal compression ratio	16.7:1
Cylinder number and configuration	6, in-line
Combustion cycle	4-stroke, compression ignition
Cooling medium	40/60 glycol/water
Method of aspiration	Pressure charged
Fuel type to be used on board	Distillate fuel
Combustion chamber	Open chamber
Valve and porting configuration	2 inlet valves Ø = 42 mm (closes after BDC) 2 exhaust valves Ø = 40 mm All valves are located in the cylinderhead
Fuel system type	Direct injection, electronic unit injectors
Auxiliaries	None
Miscellaneous features	
Exhaust gas recirculation	No
Water injection / emulsion	No
Air injection	No
Charge air cooling system	Water to air / air to air
Exhaust aftertreatment	No
Exhaust aftertreatment type	N/A
Dual fuel	No
Engine Family Information (selection of parent engine for test bed test)	
Family identification	D13-MH/MG
Method of pressure charging	Turbo charger with waste gate, pulsating pressure
Charge air cooling system	Water to air
Criteria of the Selection (specify)	Maximum NOx cycle emission (g/kWh)

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Engine type	D13B-E MH (FE) D13B-N MH (FE)	D13B-E MH D13B-N MH	D13B-E MH D13B-N MH	D13B-E MH D13B-N MH	D13B-E MH D13B-N MH
Number of cylinder	6	6	6	6	6
Max. rated power per cyl. (kW)	73,5	73,5	67,3	61,3	55,1
Rated speed	1900	1900	1900	1800	1800
Injection timing (range)	variable	variable	variable	variable	variable
Max. fuel parent engine	264				
Selected parent engine	C1 E3				
Application(s)	E3, E2, C1	E3, E2, C1	E3, E2, C1	E3, E2, C1	E3, E2, C1
Engine type	D13B-E MH D13B-N MH	D13B-E MH (FE) D13B-N MH (FE)	D13B-E MH (FE) D13B-N MH (FE)	D13B-E MH (FE) D13B-N MH (FE)	D13B-E MH (FE) D13B-N MH (FE)
Number of cylinder	6	6	6	6	6
Max. rated power per cyl. (kW)	49,0	67,3	61,3	55,1	49
Rated speed	1800	1900	1800	1800	1800
Injection timing (range)	variable	variable	variable	variable	variable
Max. fuel parent engine					
Selected parent engine					
Application(s)	E3, E2, C1	E3, E2, C1	E3, E2, C1	E3, E2, C1	E3, E2, C1
Engine type	D13B-E MH (FE) D13B-N MH (FE)	D13B-E MG (FE) D13B-F MG (FE)	D13B-E MG (FE) D13B-F MG (FE)	D13B-E MG D13B-F MG	D13B-E MG D13B-F MG
Number of cylinder	6	6	6	6	6
Max. rated power per cyl. (kW)	35,7	66,7	60	66,7	60
Rated speed	1800	1800	1500	1800	1500
Injection timing (range)	variable	variable	variable	variable	variable
Max. fuel parent engine			258		
Selected parent engine			E2 D2		
Application(s)	E3	E2, D2	E2, D2	E2, D2	E2, D2
Engine type	D13B-E MG D13B-F MG	D13B-E MG D13B-F MG	D13B-E MG (FE) D13B-F MG (FE)	D13B-E MG (FE) D13B-F MG (FE)	
Number of cylinder	6	6	6	6	
Max. rated power per cyl. (kW)	60	50	60	50	
Rated speed	1800	1500	1800	1500	
Injection timing (range)	variable	variable	variable	variable	
Max. fuel parent engine					
Selected parent engine					
Application(s)	E2, D2	E2, D2	E2, D2	E2, D2	

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Emission Test Report E3/E2/D2/C1 cycle

Exhaust Pipe					
Diameter	150 mm				
Length	10 m				
Insulation	no: yes: X				
Probe location	5,5 m				
Remark					
Measurement Equipment					
	Manufacturer	Model	Measurement ranges	Span gas conc.	Calibration Deviation
Analyser					
NO Analyser	Horiba	CLA-757	0-2000	1974	< ±2% or 0.3% of full scale
NOx Analyser	Horiba	CLA-757	0-2000 ppm	1974	< ±2% or 0.3% of full scale
CO Analyser	Horiba	AIA-721A	0-3000 ppm	2982	< ±2% or 0.3% of full scale
CO ₂ Analyser	Horiba	AIA-722	0-15 %	14.76	< ±2% or 0.3% of full scale
O ₂ Analyser	Horiba	MPA-720	25 %	24.66	< ±2% or 0.3% of full scale
HC Analyser	Horiba	FIA-726D	0-300 ppm	292.6	< ±2% or 0.3% of full scale
Speed	Siemens	1SR9 407	0 - 2835 rpm		<± 2% of reading or ± 1% of engines maximum value
Torque	Siemens	1SR9 407	0 - 5600 Nm		< ± 2% of reading or ± 1% of engines maximum value
Power, if applicable			calculated		
Fuel flow	AWL 734 Double	Xact-2000	1 - 350 lit/h		< ± 2%
Air flow	Sensyflow	2*8'	167-6683 m³/h		< ± 2% of reading or ± 1% of engines maximum value
Exhaust flow			calculated		
Temperatures					
Coolant	Pentronic	type-K	0 - 100 °C		< ± 1,5 K absolute
Exhaust gas	Pentronic	type-K	0 - 700 °C		< ± 2,5 % absolute
Inlet air	Pentronic	type-PT100	0 - 100 °C		< ± 1,5 °C absolute
Intercooled air	Pentronic	type-K	0 - 100 °C		< ± 1,5 K absolute
Fuel	Pentronic	type-K	0 - 100 °C		< ± 1,5 K absolute
Pressures					
Exhaust gas	WIKA		-10 - 45 kPa		< ± 0,2 kPa Absolute
Inlet manifold	WIKA		-10 - 0 kPa		< 5%
Atmospheric	Druck Ltd.		0 - 1,6 bar		< ± 0,1 kPa Absolute
Vapour pressure					
Intake air			calculated		
Humidity					
Intake air	Michell Instruments	DEWMET TDH	0 - 100 %		< ±1% of point
Fuel Characteristics					
Fuel type	RF-03-A-84 (acc. to ISO 8217, ISO-F-DMA)				
Fuel Properties			Fuel Elemental Analysis		
Density, at 15 °C	ISO 12185	0,8408	kg/l	Carbon	86,5 % mass
Viscosity, at 40 °C	ISO 3104	2,653	mm²/s	Hydrogen	13,4 % mass
Water	ISO 12937	43	mg/kg	Nitrogen	39,8 % mass
				Oxygen	< 0,1 % mass
				Sulphur	0,12 % mass
				LHV/Hu	42,83 MJ/kg

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Emission test report of parent engine, D2-cycle

D2-cycle Emission Test Report

Mode		1	2	3	4	5
Power/Torque	%	100	75	50	25	10
Speed	%	100	100	100	100	100
Time at beginning of mode						
Ambient Data						
Atmospheric pressure	kPa	100,39	100,39	100,41	100,41	100,41
Intake air temperature	°C	25	25,2	25	25,1	25,1
Intake air humidity	g/kg	9,3	8,9	8,9	8,9	9
Rel. Hum	%	47,45	44,88	45,68	46,28	47,31
Air temp at rel. h sensor	°C	24,7	24,9	24,6	24,5	24,2
Atmospheric factor (f _a)		1,001	1,002	1,001	1,001	1,001
Gaseous Emission Data						
NOx concentration dry/wet ppm		795	814	638	481	263
CO concentration dry/wet ppm		131	157	145	85	116
CO ₂ concentration dry/wet %		8,41	7,54	6,71	5,29	3,47
O ₂ concentration dry/wet %		9,04	10,22	11,37	13,33	15,86
HC concentration dry/wet ppm		29	35	44	57	91
NOx humidity correction factor		0,98	0,98	0,98	0,98	0,98
Dry/wet correction factor		0,92	0,93	0,94	0,95	0,96
NOx mass flow g/h		2345	1934	1178	623	279
CO mass flow g/h		221	215	156	65	74
CO ₂ mass flow kg/h		224,7	163,8	114,3	64,0	34,9
O ₂ mass flow kg/h		173,9	160,2	139,6	116,1	115,1
HC mass flow g/h		26	26	25	23	30
NOx specific g/kWh		6,5	7,15	6,54	6,91	7,69
CO specific g/kWh		0,61	0,79	0,87	0,72	2,03
CO ₂ specific g/kWh		617,3	601,5	629,3	703,7	953,9
HC specific g/kWh		0,07	0,1	0,14	0,25	0,82
Engine Data						
Speed	rpm	1500	1500	1500	1500	1500
Auxiliary power kW		0	0	0	0	0
Dynamometer setting kW		360	270	180	90	36
Power kW		361	270	180	90	36
Mean effective pressure MPa		2,26	1,69	1,13	0,56	0,23
Fuel rack	mm	--	--	--	--	--
Uncorrected specific fuel consumption g/kWh		193	192	199	223	303
Fuel flow kg/h		70	52	36	20	11
Air flow kg/s		0,506	0,41	0,32	0,226	0,187
Exhaust flow (gexhw) kg/s		0,525	0,425	0,33	0,232	0,19
Exhaust temperature °C		414	376	351	290	216
Exhaust back pressure kPa		9,9	6,4	3,8	1,8	1,2
Charge air coolant in °C		41	39	36	34	33
Charge air coolant out °C		69	60	52	45	44
Charge air temp °C		47	44	40	40	45
Charge air ref temp °C		47	44	40	40	45
Inlet depression kPa		-3	-1,9	-1	-0,3	-0,1
Charge air pressure kPa		236	175	112	50	25
Fuel oil temp °C		40	40	40	40	40

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Emission test report of parent engine, E2-cycle

E2-cycle Emission Test Report

Mode		1	2	3	4
Power/Torque	%	100	75	50	25
Speed	%	100	100	100	100
Time at beginning of mode					
Ambient Data					
Atmospheric pressure	kPa	100,39	100,39	100,41	100,41
Intake air temperature	°C	25	25,2	25	25,1
Intake air humidity	g/kg	9,3	8,9	8,9	8,9
Rel. Hum		47,45	44,88	45,68	46,28
Air temp at rel. h sensor	°C	24,7	24,9	24,6	24,5
Atmospheric factor (f _a)		1,001	1,002	1,001	1,001
Gaseous Emission Data					
NOx concentration dry/wet	ppm	795	814	638	481
CO concentration dry/wet	ppm	131	157	145	85
CO ₂ concentration dry/wet-%		8,41	7,54	6,71	5,29
O ₂ concentration dry/wet	%	9,04	10,22	11,37	13,33
HC concentration dry/wet	ppm	29	35	44	57
NOx humidity correction factor		0,98	0,98	0,98	0,98
Dry/wet correction factor		0,92	0,93	0,94	0,95
NOx mass flow	g/h	2345	1934	1178	623
CO mass flow	g/h	221	215	156	65
CO ₂ mass flow	kg/h	224,7	163,8	114,3	64,0
O ₂ mass flow	kg/h	173,9	160,2	139,6	116,1
HC mass flow	g/h	26	26	25	23
NOx specific	g/kWh	6,5	7,15	6,54	6,91
CO specific	g/kWh	0,61	0,79	0,87	0,72
CO ₂ specific	g/kWh	617,3	601,5	629,3	703,7
HC specific	g/kWh	0,07	0,1	0,14	0,25
Engine Data					
Speed	rpm	1500	1500	1500	1500
Auxiliary power	kW	0	0	0	0
Dynamometer setting	kW	360	270	180	90
Power	kW	361	270	180	90
Mean effective pressure	MPa	2,26	1,69	1,13	0,56
Fuel rack	mm	--	--	--	--
Uncorrected specific fuel consumption	g/kWh	193	192	199	223
Fuel flow	kg/h	70	52	36	20
Air flow	kg/s	0,506	0,41	0,32	0,226
Exhaust flow (gexhw)	kg/s	0,525	0,425	0,33	0,232
Exhaust temperature	°C	414	376	351	290
Exhaust back pressure	kPa	9,9	6,4	3,8	1,8
Charge air coolant in	°C	41	39	36	34
Charge air coolant out	°C	69	60	52	45
Charge air temp	°C	47	44	40	40
Charge air ref temp	°C	47	44	40	40
Inlet depression	kPa	-3	-1,9	-1	-0,3
Charge air pressure	kPa	236	175	112	50
Fuel oil temp	°C	40	40	40	40

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Emission test report of parent engine, E3-cycle

E3-Cycle Emission Test Report

Mode		1	2	3	4
Power/Torque	%	100	75	50	25
Speed	%	100	91	80	63
Time at beginning of mode		-	-	-	-
Ambient Data					
Atmospheric pressure	kPa	100,46	100,46	100,46	100,46
Intake air temperature	°C	24,8	25,2	25	25,3
Intake air humidity	g/kg	9	8,7	9,1	9
Rel. Hum	%	45,71	43,21	46,92	47,29
Air temp at rel. h sensor	°C	24,8	25,1	24,6	24,3
Atmospheric factor (f _a)		0,999	1,00	1,00	1,00
Gaseous Emission Data					
NOx concentration dry/wet	ppm	951	739	679	606
CO concentration dry/wet	ppm	542	123	144	155
CO ₂ concentration dry/wet	%	9,95	7,44	6,92	6,97
O ₂ concentration dry/wet	%	6,85	10,28	10,99	10,92
HC concentration dry/wet	ppm	21	35	39	48
NOx humidity corr.factor		0,98	0,98	0,98	0,98
Dry/wet correction factor		0,91	0,93	0,93	0,93
NOx mass flow	g/h	3073	2262	1471	685
CO mass flow	g/h	991	218	181	102
CO ₂ mass flow	kg/h	287,8	209,3	137,6	72,3
O ₂ mass flow	kg/h	143	208,5	157,5	81,7
HC mass flow	g/h	21	33	26	17
NOx specific	g/kWh	6,99	6,83	6,66	6,2
CO specific	g/kWh	2,26	0,66	0,82	0,92
CO ₂ specific	g/kWh	650,2	627	618,1	649,5
HC specific	g/kWh	0,05	0,1	0,12	0,15
Engine Data					
Speed	rpm	1900	1729	1520	1197
Auxiliary power	kW	0	0	0	0
Dynamometer setting	kW	441	331	221	110
Power	kW	439	331	221	111
Mean effective pressure	MPa	2,17	1,8	1,36	0,87
Fuel rack	mm	--	--	--	--
Uncorrected specific fuel consumption	g/kWh	206	197	195	207
Fuel flow	kg/h	90	65	43	23
Air flow	kg/s	0,552	0,531	0,375	0,195
Exhaust flow (gexhw)	kg/s	0,578	0,549	0,386	0,202
Exhaust temperature	°C	527	374	354	371
Exhaust back pressure	kPa	11,8	8,6	4,3	1,4
Charge air coolant in	°C	43	41	37	33
Charge air coolant out	°C	68	68	55	45
Charge air temp	°C	49	46	41	40
Charge air ref temp	°C	49	46	41	40
Inlet depression	kPa	-3	-2,7	-1,2	-0,1
Charge air pressure	kPa	208	214	143	56
Fuel oil temp	°C	40	40	40	40

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Emission test report of parent engine, C1-cycle

C1-cycle Emission Test Report

Mode		1	2	3	4	5	6	7	8
Power/Torque	%	100	75	50	10	100	75	50	0
Speed	%	100	100	100	100	Intermediate			Idle
Time at beginning of mode									
Ambient Data									
Atmospheric pressure	kPa	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4
Intake air temperature	°C	24,9	25	25,1	25,1	25,1	24,9	25,2	25,4
Intake air humidity	g/kg	8,7	8,9	8,9	8,9	8,6	8,9	9	8,9
Rel. hum.	%	43,87	44,71	45,4	46,59	44,03	46,16	46,49	48,59
Air temp at rel. h sensor	°C	24,9	25,1	24,8	24,3	24,7	24,5	24,6	23,7
Atmospheric factor (f _a)		1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Gaseous Emission Data									
NOx concentration dry/wet	ppm	973	697	574	180	984	840	653	184
CO concentration dry/wet	ppm	516	130	75	126	142	171	172	51
CO ₂ concentration dry/wet	%	9,96	7,32	5,89	3,39	8,52	7,77	6,97	1,25
O ₂ concentration dry/wet	%	6,85	10,47	12,42	15,9	8,84	9,88	10,97	18,89
HC concentration dry/wet	ppm	21	38	48	88	33	35	43	110
NOx humidity correction factor		0,98	0,98	0,98	0,98	0,98	0,98	0,98	0,98
Dry/wet correction factor		0,91	0,93	0,94	0,96	0,92	0,93	0,93	0,98
NOx mass flow	g/h	3126	2235	15,38	276	2771	1930	1158	65
CO mass flow	g/h	942	241	118	115	231	227	177	11
CO ₂ mass flow	kg/h	287,4	215,1	146,6	49,2	218,6	162,9	113,4	4,3
O ₂ mass flow	kg/h	142,7	221,8	222,8	166,5	163,6	149,4	128,6	46,6
HC mass flow	g/h	21	37	40	42	28	25	23	12
NOx specific	g/kWh	7,1	6,75	6,97	6,19	7,71	7,16	6,45	--
CO specific	g/kWh	2,14	0,73	0,54	2,59	0,64	0,84	0,98	--
CO ₂ specific	g/kWh	648,7	644,3	659	1097,2	603,6	600,2	626,8	--
HC specific	g/kWh	0,05	0,11	0,18	0,93	0,08	0,09	0,13	--
Engine Data									
Speed	rpm	1900	1900	1900	1900	1425	1425	1425	600
Auxiliary power	kW	0	0	0	0	0	0	0	0
Dynamometer setting	kW	441	3301	221	44	359	180	90	0
Power	kW	440	331	221	44,5	359	269	180	0,2
Mean effective pressure	MPa	2,17	1,64	1,09	0,22	2,37	1,78	1,18	0
Fuel rack	mm	--	--	--	--	--	--	--	--
Uncorrected specific fuel consumption	g/kWh	206	204	208	349	189	191	198	--
Fuel flow	kg/h	90	67	46	16	68	51	36	1
Air flow	kg/s	0,551	0,555	0,466	0,269	0,487	0,397	0,306	0,063
Exhaust flow (g _{exhw})	kg/s	0,576	0,573	0,479	0,274	0,505	0,411	0,316	0,063
Exhaust temperature	°C	529	374	305	219	409	386	367	124
Exhaust back pressure	kPa	11,8	9,8	6,1	2	7,8	5,2	3,1	0,1
Charge air Coolant temp. in	°C	44	42	38	34	42	39	36	41
Charge air Coolant temp. out	°C	69	70	60	47	68	60	51	58
Charge air temp	°C	50	48	43	41	47	43	40	60
Charge air temp ref temp	°C	50	48	43	41	47	43	40	60
Inlet depression	kPa	-3	-3	-2	-0,4	-2,1	-1,3	-0,6	0
Charge air pressure	kPa	208	208	155	47	238	176	110	2
Fuel oil temp	°C	40	40	40	40	40	40	40	40

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4. Specification of spare parts

Ship owners or persons responsible for ships required to undergo an engine parameter check method shall maintain on board a record book of engine parameters for recording of all the changes made relative to an engine's components and settings.

If any adjustments or modifications are made to any engine after its delivery from Volvo Penta, a full record of such adjustments or modifications shall be recorded in the engine's record book of engine parameters.

Any changes or modifications of the approved parameters and components of this engine that are not allowed by Volvo Penta may result in that the engine no longer complies with the approved specification. Volvo Penta has no responsibility for compliance if parts and components are used other than those authorized by Volvo Penta.