

# Notice of Compliance



Revised MARPOL Annex VI & NO<sub>x</sub> Technical Code 2008

## Engine Family D9-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.	:	11323-10 HH
Date of primary issue	:	2010-07-20
No. of cylinders	:	according to supplement
Power at speed	:	according to supplement
Test cycle(s)	:	E2                      D2
NO <sub>x</sub> emission limit Tier II	:	7.8 g/kWh              7.8 g/kWh
Actual NO <sub>x</sub> emission value	:	6.3 g/kWh              6.9 g/kWh

#### Specification of the Parent Engine

Parent engine type	:	D9A2A MG
Parent engine no.	:	13672

#### 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<sub>x</sub> Technical Code 2008 providing that the parent engine incorporates those features and/or characteristics which most adversely affect the NO<sub>x</sub> emission level and result in the highest NO<sub>x</sub> 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

Issued at Hamburg, 2010-07-20 / Rev. 0

Hans-J. Rein

Volker Pawils

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Revised MARPOL Annex VI & NO<sub>x</sub> Technical Code 2008

## Engine Family D9-MG

### AB Volvo Penta

#### Supplement to the Notice of Compliance

Specification of the Engine Group / Family, continue

Engine	Number of Cylinder	Rated Power [kW]	Rated Speed [rpm]
D9A2A MG	6	239	1500
D9A2A MG	6	265	1800



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# VOLVO PENTA

## Technical File

### D9-MG\*GL\*D2E2

According to Revised MARPOL Annex VI and NOx Technical Code 2008

Manufacturer:	AB Volvo Penta
Engine Family:	D9-MG
GL family approval no.	11323-10 HH
Engine Type:	D9A2A MG
Engine Serial no.:	13672
Date of Manufacture:	2004
Rated Power:	239 kW
Rated Speed:	1500 rpm

#### 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
4. Specification of spare parts.



# VOLVO PENTA

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

Common components for Engine Types D9A2A MG			
	ID-no. on component	Volvo Penta part No.	Remarks
Cylinder Head	20574285 21418339 21576287	20574285 21418339 21576287	
Camshaft	20451775	20451775	
Piston	20485939	20485939	
Turbo Charger	03836017 3842677	3836017 3842677	
Charge Air Cooler	3818558 888294 40005102 3827870	3818558 888295 40005102 3827870	
Unit Injector	3586247 21586294	3586247 21586294	
Injector nozzle	N/A	N/A	
Engine Electronic Control Unit	24425461 20797156 20814594 21695319	24425461 20797156 20814594 21695319	
<b>Specific Setting</b>			
Engine type	D9A2A MG		
Power kW	239	265	
Speed rpm	1500	1800	
Application(s)	D2, E2	D2, E2	
Dataset 1, part no.	3840911 20731392 20949772 21205936 22099455	3840911 20731392 20949772 21205936 22099455	

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Settings	
Maximum sea water temp., if applicable	38 °C
Maximum charge air temp., if applicable	45 °C
Maximum fresh water temp. from Keel Cooler, if applicable	38 °C
Low / high temp. cooling system set points	N/A / 98 °C
Maximum inlet depression	3 kPa
Maximum exhaust back pressure	15 kPa
Fuel oil specification	According to operator's manual
Fuel oil temp.	40 °C
Lubricating oil specification	According to operator's manual

# VOLVO PENTA

## 2. On board verification procedure

Component	Procedure / location of ID-numbers	Remarks
Cylinder head	Check ID-no on machined surface (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.	See Figure 3
Turbocharger	Check ID-no on metal plate on compressor house.	Waste gate. Opening pressure 2,39 bar at stroke 2,87 mm.
Unit injector	Check ID-no on injector body. Inspection is recommended at overhaul when the engine is dismantled and the injector unit is visible.	
Injector nozzle	N/A	See ID-no on Unit Injector.
Electronic control unit and data set	Check ID-no. on label. The data set can be checked by using a diagnostic tool at a service shop.	
Charge air cooler	The ID-no is located at the front side of the charge air cooler. The ID-no is included in the tooling. Inspection is recommended at overhaul when charge air cooler is dismantled.	
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 rear end of the camshaft. Inspection is recommended at overhaul when valve cover is removed and the camshaft is visible.	See Figure 2



**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-number exist.

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# VOLVO PENTA

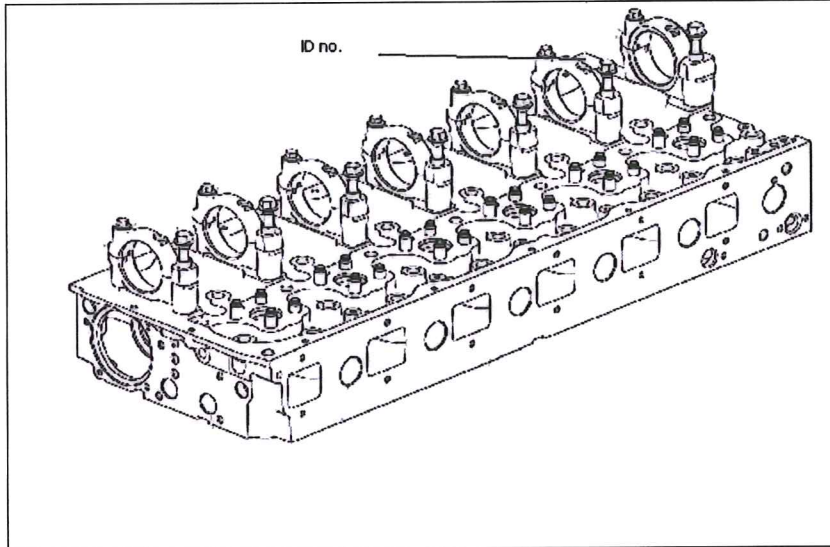


Figure 1

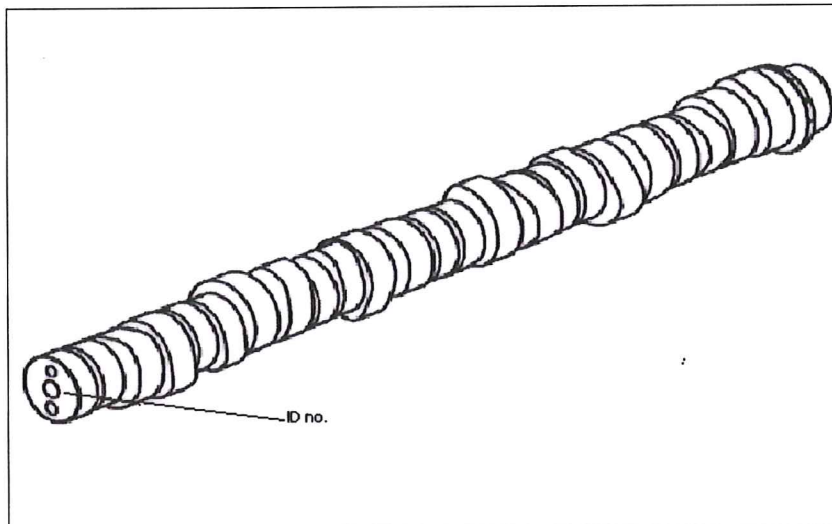


Figure 2

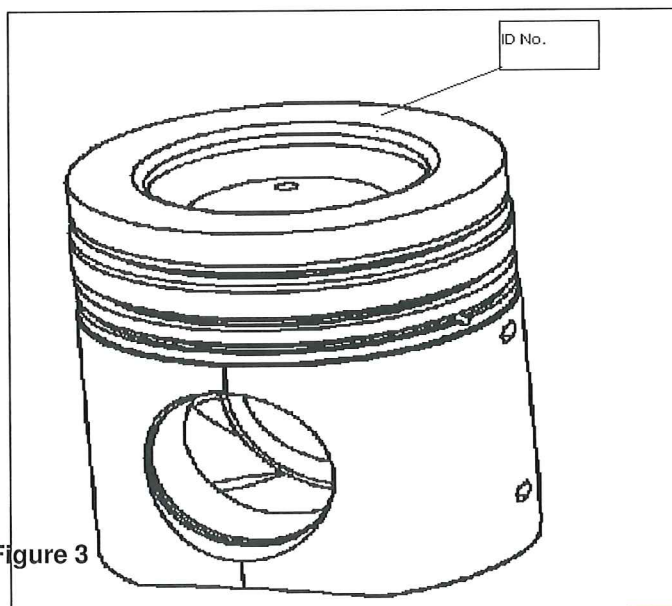


Figure 3

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# VOLVO PENTA

## 3. Test report of parent engine

D2/E2 Emission Test Report

Sheet 1 of 4

Engine Information		
Manufacturer	AB Volvo Penta	
Engine type	D9A2A MG	
Family identification	D9-MG	
Serial number	13672	
Rated speed	1500 rpm	
Rated power	239 kW	
Intermediate speed	N/A	
Maximum torque at intermediate speed	N/A	
Static injection timing	N/A	
Electronic injection control	no:      yes: X	
Variable injection timing	no:      yes: X	
Variable turbocharger geometry	no: X    yes:	
Bore	120 mm	
Stroke	138 mm	
Nominal compression ratio	20,2:1	
Mean effective pressure, at rated power	2,05 MPa	
Maximum cylinder pressure, at rated power	N/A	
Cylinder number and configuration	Number: 6      V:      In-line: X	
Auxiliaries	None	
Specified Ambient Conditions		
Maximum inlet cooling water temperature	38 °C	
Maximum charge air temperature, if applicable	45 °C	
Cooling system spec. intermediate cooler	no:      yes: X	
Cooling system spec. charge air stages	Single stage	
Low/high temperature cooling system set points	98 °C	
Maximum inlet depression	3 kPa	
Maximum exhaust back pressure	15 kPa	
Fuel oil specification	RF-03-A-84 according to ISO-F-DMA	
Fuel oil temperature	40 °C	
Lubricating oil specification	VDS2 SAE 15W-40	
Emissions Test Results		
Cycle	NOx (g/kWh)	Test number
D2	6,94	25002338
E2	6,35	25002338
Date/time	2004-12-13	
Test site/bench	Volvo Penta Test Cell 25	
Surveyor	Volker Pawils, Germanischer Lloyd	
Date and Place of report	2004-12-13, Volvo Penta Gothenburg	
Signature		

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# VOLVO PENTA

Common Features Within the Engine Family		Sheet 2 of 4	
Family identification	D9-MG		
Electronic injection control	Yes		
Variable injection timing	Yes		
Variable turbocharger geometry	No		
Bore	120 mm		
Stroke	138 mm		
Nominal compression ratio	20,2:1		
Cylinder configuration	6, in-line		
Combustion cycle	4-stroke, compression ignition		
Cooling medium	50/50 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 = 38 mm (closes after BDC) 2 exhaust valves Ø = 38 mm All valves are located in the cylinder head		
Fuel system type	Direct injection, electronic unit injectors		
Auxiliaries	None		
Miscellaneous features			
Exhaust gas recirculation	No		
Water injection / emulsion	No		
Air injection	No		
Charge cooling system	Single stage, water to air		
Exhaust after treatment	No		
Exhaust after treatment type	N/A		
Dual fuel	No		
Engine Family Information (selection of parent engine for test bed test)			
Family identification	D9-MG		
Method of pressure charging	Turbo charger		
Charge air cooling system	Single stage, water to air		
Criteria of the Selection (specify)	Maximum NOx cycle emission (g/kWh)		
Engine	D9A2A MG		
Number of cylinder	6	6	
Max. rated power per cyl.	39,8 kW	44,2 kW	
Rated speed	1500 rpm	1800 rpm	
Injection timing (range)	variable	variable	
Max. fuel parent engine	180 mg/str.		
Selected parent engine	X		
Application(s)	D2/E2	D2/E2	

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D2/E2 cycle Emission test report

Sheet 3 of 4

Exhaust Pipe					
Diameter	150 mm				
Length	7 m				
Insulation		no:	yes: X		
Probe location	2 m				
Remark					
Measurement Equipment					
	Manufacturer	Model	Measurement ranges	Calibration	
				Span gas conc.	Deviation
Analyser					
NOx Analyser	Horiba	CLA-755A	0-1000 ppm	964	< ±2% or 0.3% of full scale
CO Analyser	Horiba	AIA-721A	0-300 ppm	284	< ±2% or 0.3% of full scale
			0-1000 ppm	950,2	< ±2% or 0.3% of full scale
CO <sub>2</sub> Analyser	Horiba	AIA-722	0-15 %	14,26	< ±2% or 0.3% of full scale
O <sub>2</sub> Analyser	Horiba	MPA-720	25 %	23,8	< ±2% or 0.3% of full scale
HC Analyser	Horiba	FIA-725A	0-100 ppm	93,8	< ±2% or 0.3% of full scale
			0-500 ppm	479,4	< ±2% or 0.3% of full scale
Speed	Schenck	D1200	0 - 7500 rpm		<± 2% of reading or ± 1% of engines maximum value
Torque	Schenck	D1200	0 - 5500 Nm		< ± 2% of reading or ± 1% of engines maximum value
Power, if applicable			calculated		
Fuel flow	ASE	Xact-2000	1 - 350 lit/h		< ± 2%
Air flow	Westwind	6"	167-2548 m <sup>3</sup> /h		< ± 2% of reading or ± 1% of engines maximum value
Exhaust flow			calculated		
Temperatures					
Coolant	Heraeus	type-K	0 - 150 °C		< ± 2K absolute
Exhaust gas	Heraeus	type-K	0 - 800 °C		< ± 1 % absolute
Inlet air	Pentronic	type-PT100	0 - 100 °C		< ± 2 °C absolute
Intercooled air	Heraeus	type-K	0 - 150 °C		< ± 2K absolute
Fuel	Heraeus	type-K	0 - 150 °C		< ± 2K 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	General Eastern	DEW-10-0A2	0 - 100 %		< ±1% of point
Fuel Characteristics					
Fuel type	RF-03-A-84 according to ISO-F-DMA				
Fuel Properties			Fuel Elemental Analysis		
Density, at 15 °C	ISO 12185	0,8425	kg/l	Carbon	86,52 % mass
Viscosity, at 15 °C	ISO 3104	4,73	mm <sup>2</sup> /s	Hydrogen	13,4 % mass
Water		25	mg/kg	Nitrogen	0,000039 % mass
				Oxygen	< 0,1 % mass
				Sulphur	0,11 % mass
				LHV/Hu	42,81 MJ/kg

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## Emission test report of parent engine, D2/E2-cycle

D2/E2-cycle Emission Test Report

Sheet 4 of 4

Mode		1	2	3	4	5
Power/Torque	%	100	75	50	25	10
Speed	%	100	100	100	100	100
Time at beginning of mode		0,2	0,37	0,53	0,7	0,88
<b>Ambient Data</b>						
Atmospheric pressure	kPa	102,5	102,5	102,5	102,5	102,5
Intake air temperature	°C	26	26	26	26	26
Intake air humidity	g/kg	7,4	7,4	7,4	7,4	7,4
Rel. Hum	%	44,7	44,6	44,5	43,6	43,6
Air temp at rel. h sensor	°C	22,4	22,3	22,4	22,8	22,8
Atmospheric factor (f <sub>a</sub> )		0,99	0,99	0,99	0,99	0,99
<b>Gaseous Emission Data</b>						
NOx concentration dry/wet	ppm	882	890	824	609	338
CO concentration dry/wet	ppm	394	355	215	138	112
CO <sub>2</sub> concentration dry/wet	%	10,02	8,99	7,66	5,50	3,33
O <sub>2</sub> concentration dry/wet	%	7,09	8,49	10,3	13,22	16,19
HC concentration dry/wet	ppm	60	60	74	106	134
NOx humidity correction factor		0,97	0,96	0,96	0,97	0,96
Dry/wet correction factor		0,92	0,92	0,93	0,95	0,97
NOx mass flow	g/h	1349	1137	848	494	242
CO mass flow	g/h	380	286	140	71	51
CO <sub>2</sub> mass flow	kg/h	152,0	114,0	78,2	44,2	23,6
O <sub>2</sub> mass flow	kg/h	78,1	78,2	76,4	77,2	83,4
HC mass flow	g/h	31	26	26	28	31
NOx specific	g/kWh	5,6	6,4	7,1	8,3	11,4
CO specific	g/kWh	1,6	1,6	1,2	1,2	2,4
CO <sub>2</sub> specific	g/kWh	635	639	658	742	1112
HC specific	g/kWh	0,1	0,2	0,2	0,5	1,5
<b>Engine Data</b>						
Speed	rpm	1500	1500	1500	1500	1500
Auxiliary power kW		0	0	0	0	0
Dynamometer setting	kW	239	178	119	60	21
Power	kW	239,4	178,3	119,0	59,6	21,2
Mean effective pressure	MPa	2,05	1,52	1,02	0,51	0,18
Fuel rack	mm	-	-	-	-	-
Uncorrected specific fuel consumption	g/kWh	203	204	210	239	360
Fuel flow	kg/h	49	36	25	14	8
Air flow	kg/h	1048	871	698	544	475
Exhaust flow (gexhw)	kg/h	1094	907	724	558	482
Exhaust temperature	°C	455	414	362	277	191
Exhaust back pressure	kPa	14,6	9,2	5,5	3,1	2,1
Charge air coolant out	°C	53	49	45	42	40
Charge air coolant in	°C	38	38	38	38	38
Charge air temp	°C	43	41	39	38	37
Charge air ref temp	°C	43	41	39	38	37
Inlet depression	kPa	-3,4	-1,9	-0,8	-0,1	0
Charge air pressure	kPa	153	110	68	31	15
Fuel oil temp	°C	40	40	40	40	40

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# **VOLVO PENTA**

## **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.