
Technical File

Engine Model: MD706LX (4.2L 320) - MD706LH (4.2L 300) - MD706LS (4.2L 270) – MD706LB (4.2L 250)

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Engine Model: MD706LX (4.2L 320) - MD706LH (4.2L 300) - MD706LS (4.2L 270) – MD706LB (4.2L 250)

1 Components, settings and operating values of the engine which influence its NO_x emissions

Components:

Injector
Turbocharger
Charge Air Cooler
Electronic Control Module

Settings:

Injection timing
Injection duration
Injection pressure
Status of turbocharging

Engine operating values:

Please see Appendix A.

2 Full range of allowable adjustments or alternatives for the components of the engine

Adjustments:

No adjustments are allowed to the emission relevant settings.

Alternatives for the components:

Use only those component part numbers specified on the part number summary or equivalent as specified by VM MOTORI S.P.A. at the time of rebuild or repair.

3 Full record of the engine performance, including rated speed and rated power.

Please see Appendix A.

4 On-Board NO_x verification procedures

To complete an engine parameter check, the following items must be verified by the surveyor:

- a. parameter "injection timing" and "fueling rate calibration"
confirm calibration by connecting the appropriate diagnostic device to the ECM
- b. parameter "injection nozzle"
verify injector part number
- c. parameter "turbocharger type and build"
verify turbocharger part number
- d. parameter "charge air cooler"
verify charge air cooler part number
- e. parameter "valve lash"
verify valve lash settings per service manual procedure

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Engine Model: MD706LX (4.2L 320) - MD706LH (4.2L 300) - MD706LS (4.2L 270) – MD706LB (4.2L 250)

5 Copy of the Parent Engine Test Report.

Please see Appendix B.

6 Designation and restrictions for an engine which is a member of an engine group or engine family.

Designation: These engines are for use in recreational marine propulsion applications only.

Restriction: Must be installed in accordance with VM MOTORI Pilot Installation Description (PID) and Sea Trial Requirements.

7 Specifications of spare parts/components which, when used in the engine, according to those specifications, will result in continued compliance of the engine with the NO_x emission limits

Identification numbers which should be checked within the scope of the On-Board NO_x verification procedures (section 4) are shown below.

No. of Cyl.	Engine Code	Engine Rating (kW)	Component Type	Identification number
6	A	235 @3900 [MD706LX]	Injection Pump	LV 1977
			Injector	15062046F
			Injector	15062043F
		221 @3800 [MD706LH]	Turbocharger	35242100F
			Electronic Control Module	*
			Charge Air Cooler	11212028F
		199 @3800 [MD706LS]	Coolant Temperature Sensor	45962029F
			Air Pressure Sensor	45962066F
			Air Temperature Sensor	45962066F
		184 @3800 [MD706LB]	Rotational Speed Sensor	45962050F
			Throttle Position Sensor	43002012F

* ECU:

- Ref.13002336 = MD706LX (4.2L 320)
- Ref.13002255 = MD706LH (4.2L 300)
- Ref.13002335 = MD706LS (4.2L 270)
- Ref.13002337 = MD706LB (4.2L 250)

EIAPP Certificate (if applicable)

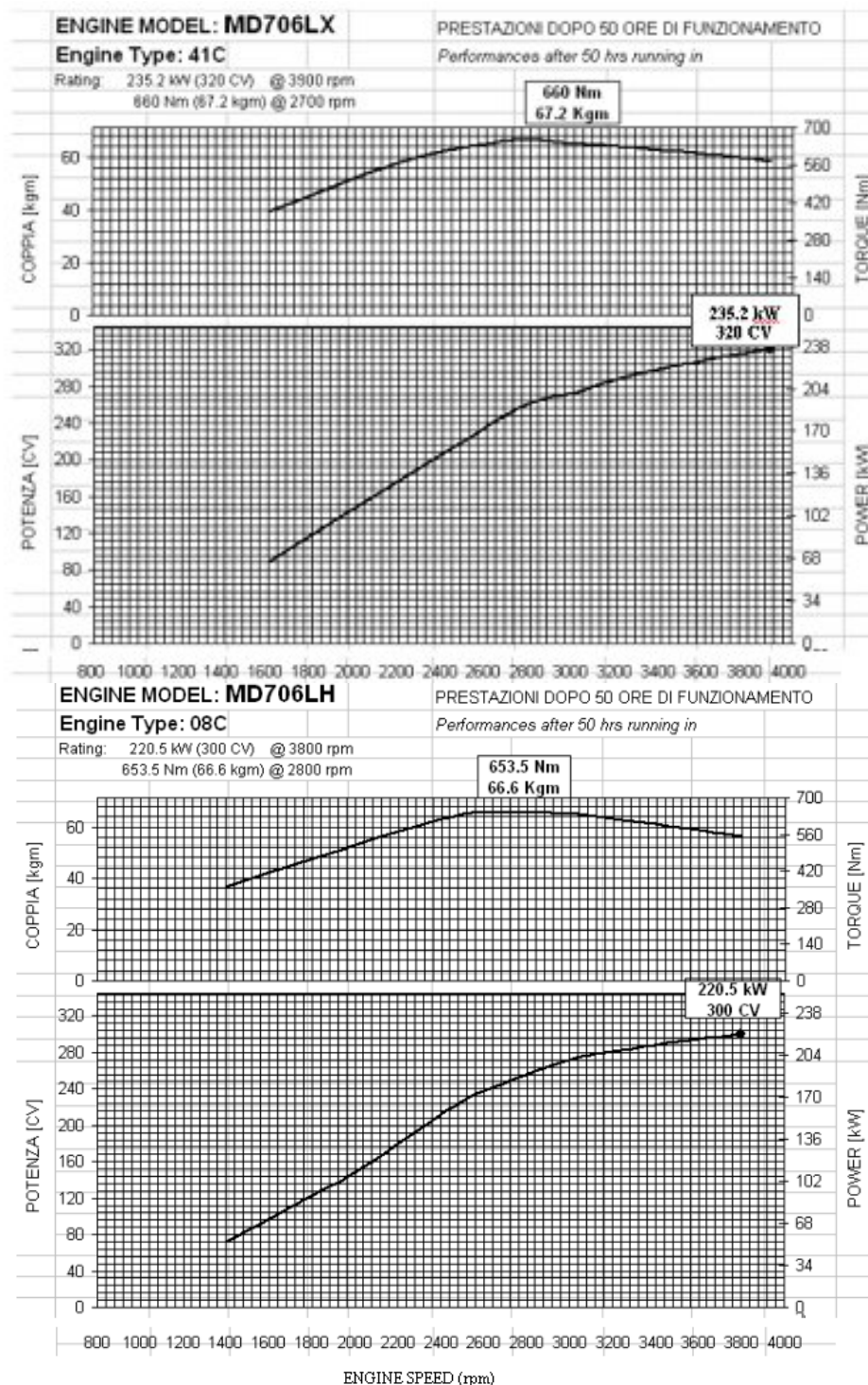
Please see Appendix C.

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Engine Model: MD706LX (4.2L 320) - MD706LH (4.2L 300) - MD706LS (4.2L 270) – MD706LB (4.2L 250)

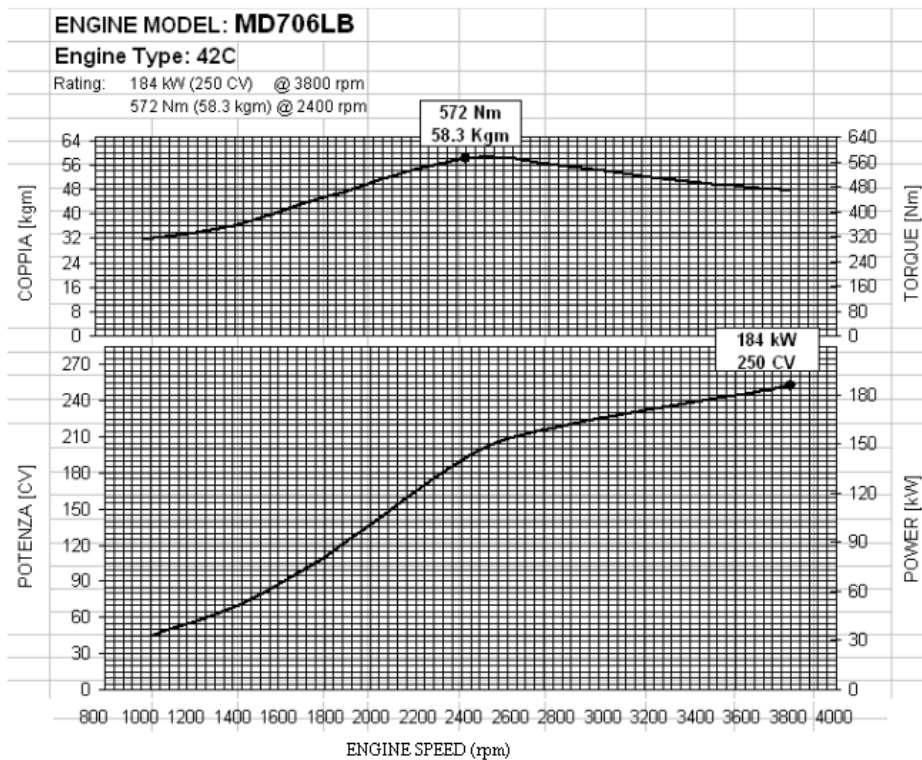
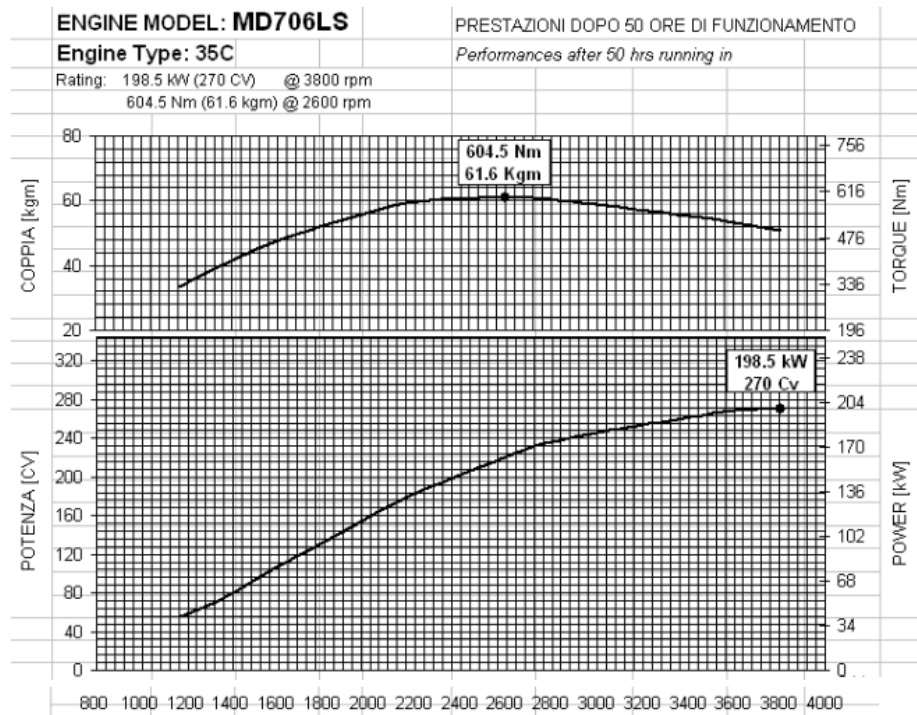
Appendix A

Please see attached specification sheets for specific engine rating.



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Engine Model: MD706LX (4.2L 320) - MD706LH (4.2L 300) - MD706LS (4.2L 270) – MD706LB (4.2L 250)



Technical File

Engine Model: MD706LX (4.2L 320) - MD706LH (4.2L 300) - MD706LS (4.2L 270) – MD706LB (4.2L 250)

Engine:

Manufacturer	VM Motori S.p.A.		
Engine type	MD706LX		
Family or group identification	5V5X04.2K1A		
Serial number	01P-01942		
Rated speed	3900 RPM		
Rated power	235 kW		
Intermediate speed	2700 RPM		
Maximum torque at intermediate speed	660 Nm (487 lbs.ft)		
Static injection timing	Crank TDC / pump @ 1.68 mm (.066 in) lift		
Electronic injection control	No:	yes: X	
Variable injection timing	No: X	yes:	
Variable turbocharger geometry	No: X	yes:	
Bore	94.1 mm (3.705 in)		
Stroke	100.1 mm (3.941 in)		
Nominal compression ratio	17.5 ^{±.5} : 1		
Cylinder number and configuration	Number: 6	V:	In-line: X
Auxiliaries	Tested in onboard configuration per 1.3.1.4		
Specified ambient conditions:			
Maximum seawater temperature	38 °C (100°F)		
Maximum charge air temperature, if applicable	Engine air not to exceed air temperature outside engine compartment by more than 17°C (63 °F).		
Cooling system spec. intermediate cooler	Operating temperature range 80°- 85° C (176-185 ° F)		
Cooling system spec. charge air stages	Same temperature of incoming sea water		
Low/high temperature Cooling system set points	Thermostat fully closed 65°C (149 °F), fully open @ 84°C (183 °F)		
Maximum inlet depression	Not Adjustable		
Maximum exhaust backpressure	250-+20 mbar		
Fuel oil specification	Grade 2-D diesel fuel		
Fuel oil temperature	Minimum -5°C (23 °F), Maximum 50°C (122 °F) at fuel filter		
Lubricating oil specification	SAE 10W - 40		
Application/Intended for:			
Customer	Pleasure craft (planning hull)		
Final application/installation, ship	N/A		
Final application/installation, engine	Main: X	Aux:	

Emissions test results:	
Cycle	ISO 8178-4 E3
NO _x (g/KW-hr)	7.868 (average of the three tests performed)

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Engine Model: MD706LX (4.2L 320) - MD706LH (4.2L 300) - MD706LS (4.2L 270) – MD706LB (4.2L 250)

Date(s)	September 02,2004			
Test number(s)	3910A, 3910B, 3910C			
Engine family information/Group information (common specifications)				
Combustion cycle	Four stroke			
Cooling medium	Water - Water			
Cylinder configuration	In line			
Method of aspiration	Turbocharged with Intercooler			
Fuel type to be used on board	Grade 2D diesel fuel			
Combustion chamber	Ref.VM 10252084F (complete)			
Valve port configuration	2 valve per cylinder (1 exh – 1 inlet)			
Valve port size and number	Ø 37.8 mm (inlet) – Ø 35 mm (exh.)			
Fuel system type	Mechanic Electronically Controlled			
Miscellaneous features:				
Exhaust gas recirculation	N/A			
Water injection/emulsion	N/A			
Air injection	N/A			
Charge cooling system	Yes			
Exhaust after-treatment	N/A			
Exhaust after-treatment type	N/A			
Duale fuel	N/A			
Engine family/group information (selection of parent engine for test-bed test)				
Family/group identification	MD706LX	MD706LH	MD706LS	MD706LB
Method of pressure charging	Turbocharger + Intercooler			
Charge air cooling system	Air / Water			
Criteria of the selection (specify)	Max Rated Power per Cylinder / Fuel Rate			
Number of cylinder	6	6	6	6
Max. rated power per cylinder (KW)	39.2	36.8	33,2	30,6
Rated speed	3900	3800	3800	3800
Injection timing (range in mm)	1.45 ^{±0,25}	1.45 ^{±0,25}	1.45 ^{±0,25}	1.45 ^{±0,25}
Max. fuel parent engine	72.6 liters per hour at 3900 rpm			
Selected parent engine	MD706LX			
Application	Main Engine Pleasure Craft			

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Engine Model: MD706LX (4.2L 320) – MD706LH (4.2L 300) – MD706LS (4.2L 270) MD706LB (4.2L 250)

Test Cell Information

Exhaust pipe					
Diameter	7.62 cm (3 in) ID dry exhaust and 10.16 cm (4 in) OD of water jacketed exhaust				
Length	Determined by the boat builder				
Insulation	Water jacketed up to the exhaust elbow				
Probe location	Exhaust elbow				
Measurement equipment					
	Manufacturer	Model	Measurement ranges	Calibration	
				Span gas conc.	Deviation
Analyzer					
NO _x analyzer	Horiba	CLA 220	1	29 ppm	2 %
			2	97.6 ppm	2 %
			3	289 ppm	2 %
			4	970 ppm	2 %
			5	2870 ppm	2 %
CO analyzer	Horiba	AIA 220	1	0.1%	2 %
			2	0.5%	2 %
			3	1.0%	2 %
			4	3.0%	2 %
CO ₂ analyzer	Horiba	AIA 220	1	0.9%	2 %
			2	4.25%	2 %
			3	9.03%	2 %
			4	18.0%	2 %
O ₂ analyzer	Horiba	MPA 220	1	4.49%	2 %
			2	8.88%	2 %
			3	22.34%	2 %
HC analyzer	Horiba	FMA 236	1	9.1 ppm	2 %
			2	278 ppm.	2 %
			3	90.2 ppm	2 %
			4	266.4 ppm	2 %
Speed	Digalog		100-10,000 min ⁻¹		1 min ⁻¹ per 10,000
Torque	Omega		0-1356 Nm		± 1.4 Nm
Fuel flow	AVL	Mod. 730	0-40 lbs.min.		Flow: ± .10% Density: ± .0005 %
Temperatures					
temperatures	Omega	E-type	0-1000 °C		± 1 °C
Pressures					
Pressures	Sensotec	Type A-5	-103-689 kPa		± .689 kPa
Humidity					
Intake air			5-98 %		+ 1 %

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**Engine Model: MD706LX (4.2L 320) – MD706LH (4.2L 300) –
MD706LS (4.2L 270) MD706LB (4.2L 250)**

Fuel Characteristics

Fuel Characteristics		
Fuel type:	No. 2 fuel oil - low sulfur	
Fuel properties:	ASTM test method:	Specifications:
Gravity, API	D287	32-37
Sulfur %	D2622	.03-.05
Cetane Number	D613	42.0-50.0
Flash point, °C	D93	55 min.
Viscosity, 40 °C	D445	2.0-3.2

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Engine Model: MD706LX (4.2L 320) – MD706LH (4.2L 300) – MD706LS (4.2L 270) MD706LB (4.2L 250)

Ambient and Gaseous Data (reference test No.3910A)

Mode		1	2	3	4	5
Power/Torque	%	100	75	50	25	
Speed	%	100	91	80	63	

Ambient Data

Atmospheric pressure	kPa	102	102	102	102	
Intake air temperature	°C	25	25	25	25	
Intake air humidity	(RH %)	40	39	40	38	
Atmospheric factor (fa)		.982	.983	.984	.987	

Gaseous Emissions Data:

NOx	concentration dry	ppm	970.0	960.0	775.2	700.6	
CO	concentration dry	ppm	345.0	80.0	85.0	160.0	
CO2	concentration dry	%	14.0	12.0	11.0	8.5	
O2	concentration dry	%	8.6	11.8	12.0	13.5	
HC	concentration wet	ppm	16.0	11.0	20.0	30.0	
NOx humidity correction factor			.9496	.9377	.9392	.9415	
Fuel specification factor (FFH)			1.89				
Dry/wet correction factor			0.93	0.93	0.93	0.94	
NOx	mass flow	g/h	1746	1445	817	400	
CO	mass flow	g/h	398	78	58	59	
HC	mass flow	g/h	10.10	5.78	7.33	5.93	
NOx	specific	g/kWh	7.945				

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Engine Model: MD706LX (4.2L 320) – MD706LH (4.2L 300) – MD706LS (4.2L 270) MD706LB (4.2L 250)

Engine Test Data

MD706LX (Parent Engine) (reference test No.3910A)

Mode		1	2	3	4	5
Power/Torque	%	100	75	50	25	
Speed	%	100	91	80	63	
Engine Data						
Speed	rpm	3800	3460	3040	2395	
Auxiliary power	kW	---	---	---	---	
Dynamometer setting	kW	---	---	---	---	
Power	kW	229	172.5	114.8	55.8	
Fuel rack	mm ³ /H	Not adj.-	Not adj.-	Not adj.	Not adj.	
Specific fuel consumption	g/kWh	225.5				
Fuel flow	kg/h	51.8	37.3	25.4	13.0	
Air flow (wet)	kg/h	1265	1060	740	400	
Exhaust flow (gexhw)	kg/h	1323	1097	765	412	
Exhaust temperature	°C	450	330	300	235	
Exhaust back pressure	mbar	265	165	78	25	
Cylinder Coolant temperature out	°C	80	78	77	71	
Cylinder Coolant temperature in	°C	20	20	20	20	
Cylinder Coolant pressure	bar	---	---	---	---	
Temperature intercooled air	°C	49	44	36	28	
Lubricant temperature in	°C	101	99	99	98	
Lubricant pressure	bar	4.1	4.2	4.3	4.3	
Charge air pressure (abs.)	bar	---	---	---	---	
Inlet depression	mbar	47	35	17	6	

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**Engine Model: MD706LX (4.2L 320) – MD706LH (4.2L 300) –
MD706LS (4.2L 270) MD706LB (4.2L 250)**

Appendix C

Please see attached EIAPP or Statement of Voluntary Compliance (as applicable)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
STATEMENT OF COMPLIANCE
WITH REGULATION 13 OF ANNEX OF THE INTERNATIONAL
CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS

Manufacturer: **VM MOTORI S.P.A.**
Marine Diesel Engine Family: **5V5XM04.2K1A**
Certificate Number: **V5X-IMO-05-02**
Date Issued: **DEC 21 2004**



Merrylin Zaw-Mon, Director
Certification and Compliance Division
Office of Transportation and Air Quality

This is to certify that the manufacturer of the above mentioned marine diesel engine has provided information to the U.S. Environmental Protection Agency that demonstrates:

1. this engine has been tested in accordance with the requirements of the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines, and,
2. the engine, its components, adjustable features, and Technical File, prior to the engine's installation and/or service on board a ship, fully comply with the applicable regulation 13 of Annex VI of the Convention

This Statement of Compliance is valid until Annex VI of Regulation 13 of the Convention is ratified and the requirements become effective and applicable to this engine.

Issued at U.S. Environmental Protection Agency, Office of Transportation and Air Quality,
Washington, DC

MD706 LH/LS/LI

**Supplement to the Statement of Compliance with Regulation 13 of Annex VI of the
International Convention on the Prevention of Pollution from Ships**

1. Particulars of the engine

1.1 Name & address of manufacturer:

**VM Motori SPA
Via Ferrarese 29
Cento (FE) Italy 44042**

1.2 Place of engine build:

**VM Motori SPA
Via Ferrarese 29
Cento (FE) Italy 44042**

1.3 Date of engine build:

7/30/2004

1.4 Place of pre-certification survey:

**VM Motori SPA
Via Ferrarese 29
Cento (FE) Italy 44042**

1.5 Date of pre-certification survey:

03/12/2001

1.6 Engine family:

5v5xm04.2k1a

1.7 Models:

MD706LH/706LS/706LI

1.8 Test cycle:

E3 General cycle (propulsion engine, fixed-pitch prop)

1.9 Rated Power(kW) & Speed(RPM):

220 3800

1.10 Engine certificate number:

v5x-IMO-05-02

1.11 Test fuel:

No. 2 Fuel Oil-low sulfur

1.12 NOx reducing device?:

No

1.13 Applicable NOx Emission Limit(g/kW-hr):

9.8

1.14 Engine NOx Emission Value(g/kW-hr):

6.72

2 Particulars of the Technical File:

2.1 Technical File number:

VM MOTORI SPA

2.2 NOx verification number:

PLEASE SEE IMO TECHNICAL

This is to certify that this record is correct in all respects. Issued at U.S. Environmental Protection Agency,
Office of Transportation and Air Quality Washington, DC

Merrylin Zaw-Mon, Director
Certification and Compliance Division
Office of Transportation and Air Quality

Date of Issue