INTERNATIONAL MARITIME ORGANIZATION (IMO)

Technical File

and

Copy of United States

Environmental Protection Agency

(EPA) Statement of Compliance

MARINE DIESEL ENGINES

Base Engine MR504L

Mercury Diesel Models:

2.0L 115 (Inboard)

2.0L 130, 150, 170 (Inboard)

MCM 2.0L 130 EO, 150 EO, 170 EO (Sterndrive)

IMPORTANT: To comply with regulations this document must remain with the engine at all times.

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VM Motori Technical File

ID Number: MR504LS3-IMO-MY14

VM MOTORI S.p.A.

TECHNICAL FILE

(ID Number: MR504LS3-IMO-MY14)

According to Revised MARPOL Annex VI and

NOx Technical Code 2008

Manufacturer:	VM Motori S.p.A.
Engine Type:	MR504LS3
Engine Serial No.:	01P-04704
Year of Engine Build:	2013
Model Year:	2014
Rated Power:	96.94 kW
Rated Speed:	4000 rpm
Application:	MARINE ENGINE CYCLE E3

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

Components:

- Injector
- Turbocharger
- Charge Air Cooler
- Electronic Control Module

Settings:

- Injection timing
- Injection duration
- Injection pressure
- Status of turbocharging

Engine operating values: Please refer to individual engine specifications

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.

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VM MOTORI S.p.A.

4. Onboard NOx verification procedures (ID Number: MR504LS3-IMO-MY14-OBNOX)

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

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 Installation Guidelines.

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 NOx emission limits.
Identification numbers which should be checked within

No. of Cyl.	Engine Code	Engine Rating (kW @ rpm)	Component Type	Identification number
4	53D	96.94 @4000 [MR504LB3] 130 HP	Injection Pump Injector Turbocharger Charge Air Cooler Electronic Control Module Speed Sensor Phase Sensor Coolant Temperature Sensor Fuel Temperature Sensor Air Pressure and Temperature Sensor Pressure Sensor	35022103F 15062057F 35242129H 31042001F 13002750F 45962087F 45962086F 45962053F 45962084F 45962082F 45962079F
4	52D	85.76 @4000 [MR504LS3] 115 HP	Injection Pump Injector Turbocharger Charge Air Cooler Electronic Control Module Speed Sensor Phase Sensor Coolant Temperature Sensor Fuel Temperature Sensor Air Pressure Sensor Temperature Pressure Sensor	35022103F 15062057F 35242129H 31042001F 13002749F 45962087F 45962086F 45962053F 45962084F 45962082F 45962079F

8. EIAPP Certificate/Statement of Voluntary Compliance (as applicable)

Please see Appendix C.

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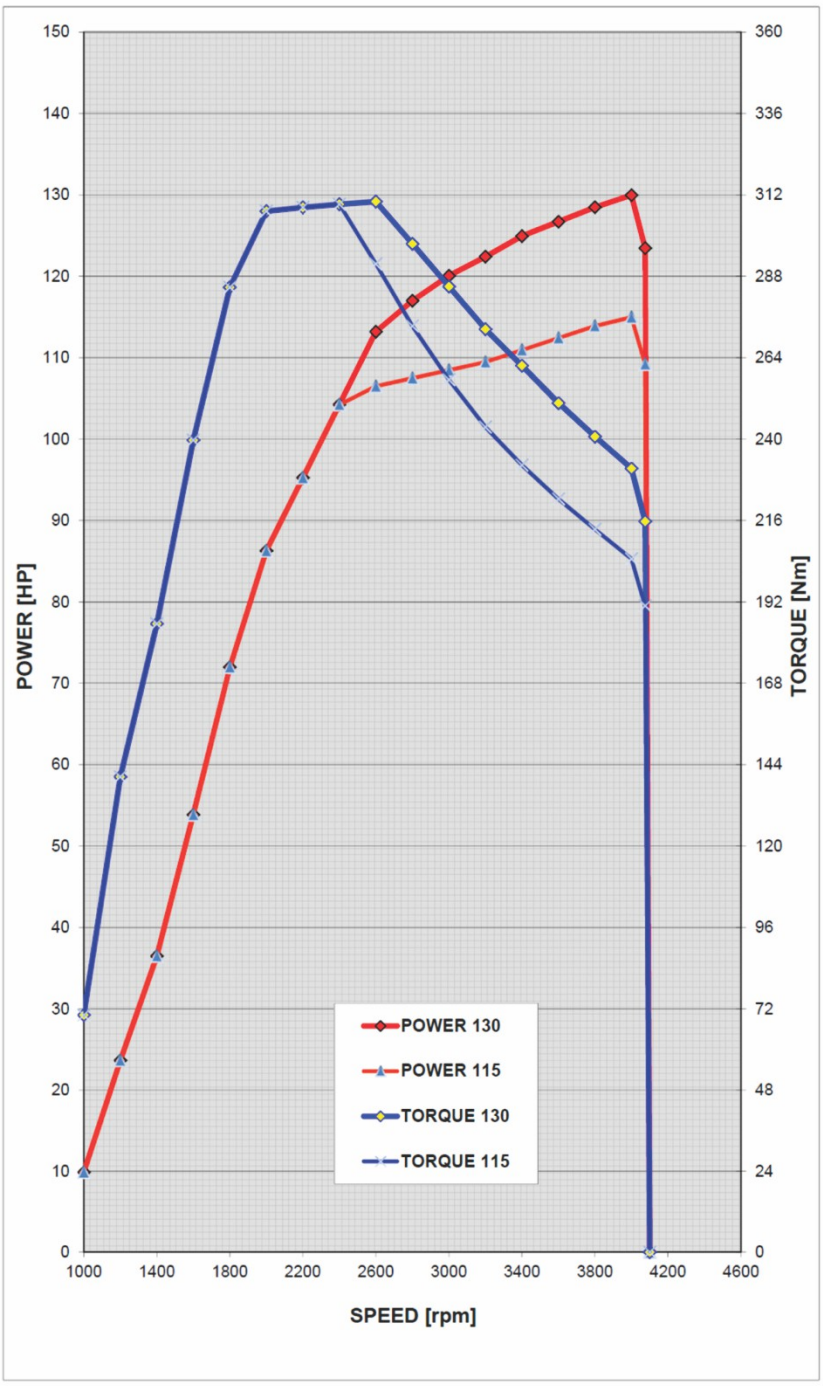
Appendix A - Power and Torque Curves

VM MOTORI S.p.A.

APPENDIX A
Power and Torque Curves



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Appendix B - Parent Engine Test Report

Sheet 1 of 4

VM MOTORI S.p.A.

APPENDIX B
Parent Engine Test Report

Emissions Test Report No.: 13ep01238	**Engine Information**	**Sheet 1/4**
Engine		
Manufacturer	VM Motori S.p.A. plant	
Engine type	MR504LS3	
Family identification	EV5XW02.0K4Z (EV5XN02.0K4Z)	
Serial number	01P-04704	
Rated speed	4000	rpm
Rated power	96,94	kW
Intermediate speed	N/A	rpm
Max torque at intermediate speed	N/A	Nm
Static injection timing	N/A	deg CA BTDC
Electr. injection control	yes	
Variable injection timing	yes	
Variable turbocharger geom.	no	
Bore	83 (3.27 in)	mm
Stroke	92 (3.62 in)	mm
Nominal compression ratio	17.5: 1	
Mean effective pressure, at rated power	1460	kPa
Maximum cylinder pressure, at rated power	132.6	kPa
Cylinder number and configuration	Number: 4 V: In-line: X	
Auxiliaries	no	
Specified ambient conditions		
Max. Seawater temperature	38 (100.4 F)	°C
Max. Charge air temperature, if applicable	50 (122 F)	°C
Cooling system spec., intermediate cooler	Operating temperature range 88°- 93°	°C
Cooling system spec., charge air stages	1 - Same temperature of incoming sea water	
Low/high temp. cooling system set points	Thermostat fully closed 80°C (176 °F), fully open @ 94°C (201.2 °F)	°C
Maximum inlet depression	-2,5	kPa
Maximum exhaust backpressure	14.5	kPa
Oil lubricating specification	SAE 10W40 ACEA E6	
Fuel oil specification	2-D type ULS diesel fuel	
Fuel oil temperature	30	°C
Application/ intended for		
Customer	Pleasure craft	
Final application/ installation, Ship	N/A	
Final application/ installation, Engine	Main: **X** Aux:	
Emissions test results		
Cycle	E3	
NOx	4.73	g/kWh
Test identification	13ep01238	
Date	03.22.2013	
Test site/bench	VM Motori S.p.A – Cento (FE) / E13	Bench

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Sheet 2 of 4

VM MOTORI S.p.A.

Emissions Test Report No. 13ep01238	**Engine Family/Group Inform.**	**Sheet 2/4**
Engine family/group information (common specifications)		
Combustion cycle	Diesel 4-stroke	
Cooling medium	Seawater/Ethylene glycol - water	
Cylinder configuration	In line	
Method of air aspiration	Pressure charged	
Fuel type to be used onboard	2-D type ULS diesel fuel	
Combustion chamber	Open chamber - Ref.VM 10252103F (complete)	
Valve port configuration	4 valves per cylinder (2 exh – 2 inlet)	
Valve port size and number	2X Ø 28.6 mm (inlet) – 2X Ø 24.4 mm (exh.)	
Fuel system type	Common Rail	
Miscellaneous features		
Exhaust gas recirculation	no	
Water injection/emulsion	no	
Air injection	no	
Charge cooling system	yes	
Exhaust after treatment	no	
Exhaust after treatment type	N/A	
Dual fuel	no	
Engine family/group information (selection of parent engine for testbed test)		
Family/group identification	EV5XW02.0K4Z	
Method of pressure charging	Turbocharger + Intercooler	
Charge air cooling system	Air/Water	
Parent Engine, criteria of selection	Highest NOx emission (g/kWh)	
Engine Types	According to Chapter 1	
	53D	52D
Parent Engine	**X**	
Number of cylinder	**4**	4
Max rated power per cylinder (kW)	**96,94**	85,76
Rated Speed	**4000**	4000
Injection timing (range)	4-17.5	
Max fuel parent engine	25 kg/h @4000 rpm	
Selected parent engine	MR504LS3	
Application	Main Engine Pressure Craft	

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Sheet 3 of 4

VM MOTORI S.p.A.

Emissions Test Report No. 13ep01238	**Test Cell Information**	**Sheet 3/4**
Exhaust pipe		
Diameter	47.8 (1.88 in.)	mm
Length	Determined by the boat builder	
Insulation	Water jacketed up to the exhaust elbow	
Probe location	N/A	
Remark		

Measurement equipment					
Analyser	Manufacturer	Model	Measurement ranges	Calibration	
				Span gas conc.	Deviation
NOx Analyser	HORIBA	CLA720	0÷1000 [ppm]	901 [ppm]	<2 %
CO Analyser	HORIBA	AIA721	0÷300 [ppm]	264 [ppm]	<2 %
CO^2 Analyser	HORIBA	AIA722	0÷ 20 [%]	17.97 [%]	<2 %
O^2 Analyser	HORIBA	MPA720	0÷25 [%]	22.574 [%]	<2 %
HC Analyser	HORIBA	FIA721	0÷1000 [ppmC1]	900.9 [ppmC1]	<2 %
Speed	RS/TSI	11091-054	0÷5000 rpm	1000÷3000 rpm	+/- 3rpm
Torque	INTERFACE	-	0÷5000 N	0÷730 Nm	+/- 1 Nm
Power, if appl.	-	-	-		
Fuel flow	AVL	733	0÷160 kg/h	90 g	+/- 0.1g
Air flow	-	-	-		
Exhaust flow	-	-	-		
Temperatures		**Temperatures**			
Coolant	ITALCOPPIE	TRM	-50÷+500 °C	0÷200 °C	+/-0.5 °C (read Value)
Lubricant	ITALCOPPIE	TRM	-50÷+500 °C	0÷200 °C	+/-0.5 °C
Exhaust gas	TERMICS	NT-MI-002	0÷1200 °C	0÷800 °C	+/- 0.5 %
Inlet air	ITALCOPPIE	TRM	-50÷+500 °C	0÷200 °C	+/- 0.5 %
Intercooled air	ITALCOPPIE	TRM	-50÷+500 °C	0÷200 °C	+/- 0.5 %
Fuel	ITALCOPPIE	TRM	-50÷+500 °C	0÷200 °C	+/- 0.5 %
Pressures					
Exhaust gas	DRUCK	PTX1000	0÷1 bar g	0÷1 bar g	+/- 1 % F.S.
Inlet manifold	DRUCK	PTX1000	0÷2 bar g	0÷2 bar g	+/- 1 % F.S.
Atmospheric	DRUCK	PTX1000	800÷1200 mbar Abs	980÷1040	+/- 1 mbar
Vapour pressure					
Intake air	-	-	-		-
Humidity					
Intake air	ROTRONIC	Hygroclip-S	0÷100 % Urel	35 - 80 %	+/- 1%

Fuel Characteristicsident					
Fuel type	2-D type ULS diesel fuel				
Fuel properties			**Fuel elemental analysis**		
Density ISO 3675	846.7	kg/m^3	Carbon	86.77	%mass
Viscosity ISO 3104	2.630	mm^2/s	Hydrogen	13.23	%mass
Cetan N° ISO	48.9		Nitrogen	-	%mass
			Oxygen	-	%mass
			Sulphur	10.4	mg/kg
			LHV / Hu	42.949	MJ/kg

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Sheet 4 of 4

VM MOTORI S.p.A.

Emissions Test Report No. 13ep01238		Ambient and Gaseous Emissions Data						Sheet 4/4	
Mode		1	2	3	4	5	6	7	8
Power / Torque	%	100	75	50	25				
Speed	%	100	91	80	63				
Time at beginning of mode		11:19	11:30	11:43	11:54				
Ambient data									
Atmospheric pressure	kPa	102	102	102	103				
Intake air temp.	°C	24.5	24.9	24.9	24				
Intake air humidity rel.	%	56.9	57	58.1	62.2				
Atmospheric factor (fa)	-	1.00	1.00	1.00	1.00				
Gaseous emissions data									
NOx conc. wet	ppm	643	472.6	351.3	237.3				
CO conc. dry	ppm	225.6	121.6	137.2	156.6				
CO^2 conc. dry	%	11.25	8.82	6.70	5.05				
O^2 conc. dry	%	6.23	9.41	12.27	14.52				
HC conc. wet	ppm	40.6	87.6	106.8	119.6				
NOx hum. corr. factor		1.004	1.003	1.000	1.010				
Fuel spec. factor (FFH)									
Dry/wet corr .factor		0.890	0.909	0.926	0.940				
NOx mass flow	g/h	493.3	337.0	219.2	101.0				
CO mass flow	g/h	105.5	52.6	52.1	40.5				
CO^2 mass flow	g/h								
O^2 mass flow	g/h								
HC mass flow	g/h	10.59	20.66	21.72	16.35				
SO^2 mass flow	g/h								
NOx spec.	g/kWh	5.09	4.64	4.53	4.17				
Engine data									
Speed	rpm	4001	3640	3200	2520				
Auxiliary power	kW	-	-	-	-				
Dynamometer setting	kW	-	-	-	-				
Power	kW	97.5	72.7	48.4	24.2				
Mean eff. pressure	bar	14.69	12.04	9.12	5.79				
Fuel rack	mm	-	-	-	-				
Uncorrected spec. fuel	g/kW	251.73							
Fuel flow	kg/h	24.62	17.73	11.74	6.14				
Air flow	kg/h	519.4	474.9	412.8	279.1				
Exhaust flow (gexhw)	kg/h	544	493	425	285				
Exhaust temp.	°C	540.1	424.6	317.1	230.2				
Exhaust back pressure	mbar	145	103	73	25				
Cyl. coolant temperature	°C	83.9	83.6	83.4	83.2				
Cyl. coolant temperature in	°C	24.3	24.3	24.2	24.1				
Cyl. coolant pressure	bar	-	-	-	-				
Temperature intercooled air	°C	43.9	41.9	39.5	36				
Charge air pressure	bar	2.15	2.12	2.06	1.74				
Lubricant temp.	°C	82.4	82.1	82	81.9				
Lubricant pressure	bar	5.5	5.8	5.8	5.5				
Inlet depression	mbar	-9	-7	-5	-2				
Charge air reference	°C	43.9	41.9	39.5	36.0				

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EPA Certificate Number: V5X-IMO-14-01

CERTIFICATE OF CONFORMITY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TRANSPORTATION AND AIR QUALITY
WASHINGTON, DC 20460

CERTIFICATE OF CONFORMITY
2014 MODEL YEAR

Manufacturer:	**VM MOTORI S.P.A.**
Engine Family:	**EV5XN02.0K4Z**
Certificate Number:	**V5X-MCI-14-01**
Intended Service:	**PROPULSION**
Intended Service Fuel:	**DISTILLATE DIESEL [1065.703(B)]**
FELs:	NOx: **N/A** THC+NOx: **N/A** PM: **N/A**
Effective Date:	**8/9/2013**
Date Issued:	**8/9/2013**

Byron J. Bunker, Director
Compliance Division
Office of Transportation and Air Quality

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. § 7547) and 40 CFR Part 1042, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following marine engines, by engine family, more fully described in the documentation required by 40 CFR Part 1042 and produced in the stated model year.

This certificate of conformity covers only those new marine compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 1042 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1042.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR Part 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1042. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void ab initio for other reasons specified in 40 CFR Part 1042.

This certificate does not cover marine engines sold, offered for sale, introduced, or delivered for introduction into commerce in the U.S. prior to the effective date of the certificate.

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ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Page 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TRANSPORTATION AND AIR QUALITY
ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Manufacturer:	**VM MOTORI S.P.A.**
Engine Family:	**EV5XW02.0K4Z**
Certificate Number:	**V5X-IMO-14-01**
Date Issued:	**8/9/2013**

Byron J. Bunker, Director
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 to MARPOL 73/78

This certificate is valid for the life of the engine subject to surveys in accordance with regulation 5 of Annex VI to MARPOL 73/78, installed in ships under the authority of this Government.

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

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Page 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TRANSPORTATION AND AIR QUALITY
ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Page 2

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

Byron J. Bunker, Director
Compliance Division
Office of Transportation and Air Quality

1. Particulars of the engine

1.1 Name & address of manufacter:

VM Motori S.p.A.
Via Ferrarese, 29
44042 CENTO (FE) - ITALY

1.2 Place of engine build:

VM Motori S.p.A.
Via Ferrarese, 29
44042 CENTO (FE) - ITALY

1.3 Date of engine build:

01/08/2013

1.4 Place of pre-certification survey:

VM Motori S.p.A.
Via Ferrarese, 29
44042 CENTO (FE) - ITALY

1.5 Date of pre-certification survey:

03/22/2013

1.6 Engine family:

EV5XW02.0K4Z

1.7 Models:

53D - MR504LS3,
52D - MR504LB3

1.8 Test cycle:

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

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

96.9 4000

1.10 Engine certificate number:

V5X-IMO-14-01

1.11 Test fuel:

Distillate Diesel [1065.703(b)]

1.12 NOx reducing device?:

No

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

7.7

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

4.7

2 Particulars of the Technical File:

2.1 Technical File number:

MR504LS3-IMO-MY14

2.2 NOx verification number:

MR504LS3-IMO-MY14-OBNOX

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VM Motori Technical File

ID Number: MR504LX3-IMO-MY15

VM MOTORI S.p.A.

TECHNICAL FILE

(ID Number: MR504LX3-IMO-MY15)

According to Revised MARPOL Annex VI and NOx Technical Code 2008

Manufacturer :	VM Motori S.p.A.
Engine Type:	MR504LX3
Engine Serial No.:	01P-04965
Year of Engine Build:	2013
Requested Certification for Model Year	2015
Rated Power:	126.8kW
Rated Speed:	4000 rpm
Application:	MARINE ENGINE CYCLE E3

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

Components:

- Injector
- Turbocharger (VGT) with Electronic Actuator
- Charge Air Cooler
- Electronic Control Module

Settings:

- Injection timing
- Injection duration
- Injection pressure
- Status of turbocharging

Engine operating values: Please refer to individual engine specifications

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. Onboard NOx verification procedures (ID Number: MR504LX3-IMO-MY15-OBNOX)

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

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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

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 Installation Guidelines.

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 NOx emission limits.
Identification numbers which should be checked within

No. of Cyl.	Engine Code	Engine Rating (kW @ rpm)	Component Type	Identification number
4	55D	126.8 @4000 [MR504LX3] 170 HP	Injection Pump Injector Turbocharger Charge Air Cooler Electronic Control Module Speed Sensor Phase Sensor Coolant Temperature Sensor Fuel Temperature Sensor Air Pressure and Temperature Sensor Pressure Sensor	35022103F 15062057F 35242173F 31042003F 13002752F 45962115F 45962116F 45962053F 45962084F 45962082F 45962079F
4	54D	111.8 @4000 [MR504LH3] 150 HP	Injection Pump Injector Turbocharger Charge Air Cooler Electronic Control Module Speed Sensor Phase Sensor Coolant Temperature Sensor Fuel Temperature Sensor Air Pressure Sensor Temperature Pressure Sensor	35022103F 15062057F 35242173F 31042003F 13002751F 45962115F 45962116F 45962053F 45962084F 45962082F 45962079F

8. EIAPP Certificate/Statement of Voluntary Compliance (as applicable)

Please see Appendix C.

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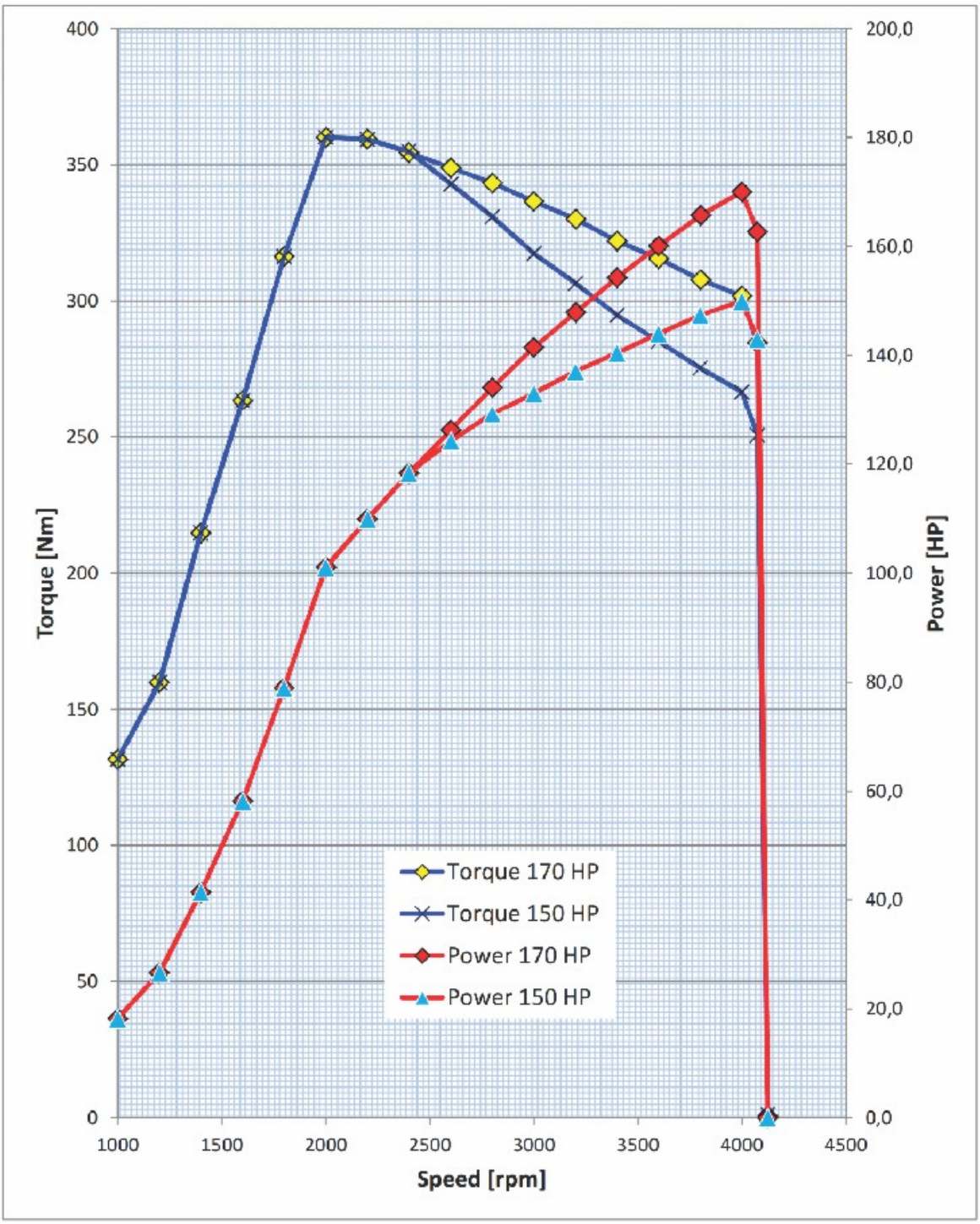
Appendix A - Power and Torque Curves

VM MOTORI S.p.A.

APPENDIX A
Power and Torque Curves



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Appendix B - Parent Engine Test Report

Sheet 1 of 4

VM MOTORI S.p.A.

APPENDIX B
Parent Engine Test Report

Emissions Test Report No. : M-164.48.107.00	Engine Information	Sheet 1/4
Engine		
Manufacturer	VM Motori S.p.A. plant	
Engine type	MR504LX3	
Family identification	FV5XW02.0K4V (EPA family: FV5XN02.0K4V)	
Serial number	01P-04965	
Rated speed	4000	rpm
Rated power	126.8	kW
Intermediate speed	2000	rpm
Max torque at intermediate speed	360	Nm
Static injection timing	N/A	deg CA BTDC
Electr. injection control	yes	
Variable injection timing	yes	
Variable turbocharger geom.	yes	
Bore	83 (3.27 in)	mm
Stroke	92 (3.62 in)	mm
Nominal compression ratio	17.5: 1	
Mean effective pressure, at rated power	1920	kPa
Maximum cylinder pressure, at rated power	15000	kPa
Cylinder number and configuration	Number: 4 V: In-line: X	
Auxiliaries	no	
Specified ambient conditions		
Max. Seawater temperature	25	°C
Max. Charge air temperature, if applicable	45	°C
Cooling system spec., intermediate cooler	Operating temperature range 88°-	°C
Cooling system spec., charge air stages	1 - Same temperature of incoming seawater	
Low / high temp. cooling system set points	Thermostat fully closed 80°C (176 °F), fully open @ 94°C (201.2 °F)	°C
Maximum inlet depression	+6.3	kPa
Maximum exhaust backpressure	25.0	kPa
Oil lubricating specification	First filling: SAE 10W40 ACEA B4 Following: SAE 5W30 ACEA C3	
Fuel oil specification	2-D type LS diesel fuel	
Fuel oil temperature	30	°C
Application / intended for		
Customer	Pleasure craft	
Final application/ installation, Ship	N/A	
Final application/ installation, Engine	Main: **X** Aux:	
Emissions test results		
Cycle	E3	
NOx	4.42	g/kWh
Test identification	131108201	
Surveior	TÜV NORD, B. Kleffner	
Date	08.11.2013	
Date and Place of report	09.12.2013, Essen	
Test site / bench	TÜV NORD Mobilität GmbH & Co. KG – Essen Bench 2 - MPS2	
Signature	see Test Report, M-164.48.107.00	

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Sheet 2 of 4

VM MOTORI S.p.A.

Emissions Test Report No. M-164.48.107.00	**Engine Family / Group Inform.**	**Sheet 2/4**
Engine family / group information (common specifications)		
Combustion cycle	Diesel 4-stroke	
Cooling medium	Seawater/Ethylene glycol - water	
Cylinder configuration	In line	
Method of air aspiration	Pressure charged	
Fuel type to be used onboard	Distillate 2-D type ULS diesel fuel	
Combustion chamber	Open chamber - Ref.VM 10252103F (complete)	
Valve port configuration	4 valves per cylinder (2 exh – 2 inlet)	
Valve port size and number	2X Ø 28.6 mm (inlet) – 2X Ø 24.4 mm (exh.)	
Fuel system type	Common Rail	
Miscellaneous features		
Exhaust gas recirculation	no	
Water injection / emulsion	no	
Air injection	no	
Charge cooling system	yes	
Exhaust after treatment	no	
Exhaust after treatment type	N/A	
Dual fuel	no	
Engine family / group information (selection of parent engine for test-bed test)		
Family/group identification	FV5XW02.0K4V	
Method of pressure charging	Turbocharger + Intercooler	
Charge air cooling system	Air / Water	
Parent Engine, criteria of selection	Highest NOx emission (g/kWh)	
Engine Types	According to Chapter 1	
	55D	54D
Parent Engine	**X**	
Number of cylinder	**4**	4
Max rated power per cylinder (kW)	**31.7**	27.98
Rated Speed	**4000**	4000
Injection timing (range)	0.5-16	
Max fuel parent engine	28.55 kg/h @4000rpm	
Selected parent engine	MR504LX3 / 55D	
Application	Main Engine Pressure Craft	
Test cycle	E3	

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Sheet 3 of 4

VM MOTORI S.p.A.

Emissions Test Report No. M-164.48.107.00	**Test Cell Information**	**Sheet 3/4**

Exhaust pipe		
Diameter	80	mm
Length	3	
Insulation	no	
Probe location	Inside exhaust pipe at 1.5 m after turbocharger	

Measurement equipment					
Analyser	Manufacturer	Model	Measurement ranges	Calibration	
				Span gas conc.	Deviation
NOx Analyser	Pierburg	CLD i60 HH SLQ	0÷10000 [ppm]	846.6 [ppm]	<2 %
CO Analyser	Pierburg	IRD4000	0÷5000 [ppm]	496.3 [ppm]	<2 %
CO_2 Analyser	Pierburg	IRD4000	0÷25 [%]	4.799 [%]	<2 %
O_2 Analyser	Pierburg	IRD4000	0÷20 [%]	16.000 [%]	<2 %
HC Analyser	Pierburg	FID4000HHD	0÷10000 [ppmC1]	116.8 [ppmC1]	<2 %
Speed	Siemens (HBM)	T36FN	0÷4500 rpm		<0.5%
Torque	Siemens (HBM)	T36FN	0÷3000 N		<1%
Power, if appl.	-	-	-		
Fuel flow	AVL	FUEL EXACT MFM 600	0÷150 kg/h		<0.5%
Air flow	ABB Alzenau	Sensyflow FMT700-	0÷2.400 kg/h		<1%
Exhaust flow	-	-	-		
Temperatures		**Temperatures**			
Charge air coolant	MTB Sensor Technik	NiCrNi type	0÷1200 °C		<2°C
Lubricant	MTB Sensor Technik	NiCrNi type	0÷1200 °C		<2°C
Exhaust gas	MTB Sensor Technik	NiCrNi type	0÷1200 °C		<2°C
Inlet air	MTB Sensor Technik	NiCrNi type	0÷1200 °C		<2°C
Intercooled air	MTB Sensor Technik	PT100	0÷50 °C		<1°C
Fuel	MTB Sensor Technik	PT100	0÷50 °C		<1°C
Pressures					
Exhaust gas	WIKA	TL 0592	0 ÷ 60 kPa		<1%
Inlet manifold	WIKA	TL 0492	-25 ÷ 0 kPa		<1%
Atmospheric	WIKA	P10	80 ÷ 120 kPa		<1%
Vapour pressure					
Intake air	-	-	-		-
Humidity					
Intake air	Driesen + Kern	HMP13	0÷100 % Urel		<1%

Fuel Characteristicsident					
Fuel type	2-D type LS diesel fuel				
Fuel properties			**Fuel elemental analysis**		
Density ISO 3675	842.9	kg/m^3	Carbon	86.77	%mass
Viscosity ISO 3104	2.334	mm^2/s	Hydrogen	13.23	%mass
Cetan N° ISO	48.7		Nitrogen	-	%mass
			Oxygen	-	%mass
			Sulphur	350	mg/kg
			LHV / Hu	42.942	MJ/kg

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Sheet 4 of 4

VM MOTORI S.p.A.

Emissions Test Report No. M-164.48.105.00		**Ambient and Gaseous Emissions Data**							**Sheet 4/4**
Mode		1	2	3	4	5	6	7	8
Power / Torque	%	100	75	50	25				
Speed	%	100	91	80	63				
Time at beginning of mode		8:43	8:53	9:03	9:13				
Ambient data									
Atmospheric pressure	kPa	99.76	99.75	99.75	99.75				
Intake air temp.	°C	21.7	20.9	21.3	21				
Intake air humidity	g/kg	7.43	7.42	7.36	7.41				
Relative intake air humidity (RH)	%	45.4	47.5	46.2	46.8				
Air temperature at RH sensor	°C	21.7	20.9	21.3	21.1				
Atmospheric factor (fa)	-	0.982	0.977	0.980	0.980				
Gaseous emissions data									
NOx conc. ~~dry~~/wet	Ppm	604.8	528.9	413.9	308.1				
CO conc. dry	Ppm	166.4	106.7	115.2	179.2				
CO_2 conc. dry	%	10.8	9.1	7.4	7.4				
O_2 conc. dry/~~wet~~	%	6.7	8.9	11.0	11.0				
HC conc. wet	ppmC	14.7	25.0	34.0	44.4				
NOx hum. corr. Factor k_{hd}	-	0.950	0.949	0.948	0.949				
Dry/wet corr .factor k_{wr}	-	0.902	0.914	0.927	0.927				
NOx mass flow	kg/h	0.580	0.428	0.269	0.106				
CO mass flow	kg/h	0.092	0.051	0.045	0.037				
CO_2 mass flow	kg/h	94.11	67.55	44.81	23.63				
O_2 mass flow	kg/h	47.15	52.49	52.25	27.62				
HC mass flow	kg/h	0.013	0.019	0.021	0.015				
NOx spec.	g/kWh	4.59	4.48	4.24	3.35				
Engine data									
Speed	rpm	4000	3640	3200	2520				
Auxiliary power	kW	-	-	-	-				
Dynamometer setting	kW	126.3	95.5	63.5	31.6				
Power	kW	126.3	95.5	63.5	31.6				
Mean eff. pressure	KPa	1863.2	1539.5	1168.4	748.6				
Fuel rack	Mm	71.8	57.2	43.4	29.1				
Uncorrected spec. fuel	g/kWh	226.1	216.7	217.3	230.3				
Fuel flow	kg/h	28.5	20.7	13.8	7.3				
Air flow	kg/h	607.3	516.0	418.3	221.0				
Exhaust flow (gexhw)	kg/h	635.9	536.7	432.1	228.3				
Exhaust temp.	°C	500.7	411.9	330.8	333.0				
Exhaust back pressure	kPa	25.8	16.7	9.4	2.6				
Charge air coolant temperature in	°C	22.8	22.8	22.8	22.8				
Charge air coolant temperature out	°C	-	-	-	-				
Charge air temperature	°C	44.4	40.0	36.9	34.4				
Charge air reference temperature	°C	45.0	40.0	37.0	35.0				
Cyl. coolant pressure	bar	-	-	-	-				
Charge air pressure	kPa	157.2	135.7	113.3	41.1				
Lubricant temp.	°C	125.0	117.1	109.2	99.0				

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EPA Certificate Number: V5X-IMO-15-01

CERTIFICATE OF CONFORMITY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TRANSPORTATION AND AIR QUALITY
WASHINGTON, DC 20460

CERTIFICATE OF CONFORMITY
2015 MODEL YEAR

Manufacturer:	**VM MOTORI S.P.A.**
Engine Family:	**FV5XN02.0K4V**
Certificate Number:	**V5X-MCI-15-01**
Intended Service:	**PROPULSION**
Intended Service Fuel:	**DISTILLATE DIESEL [1065.703(B)]**
FELs:	NOx: **N/A** THC+NOx: **N/A** PM: **N/A**
Effective Date:	**2/26/2014**
Date Issued:	**2/26/2014**

Byron J. Bunker, Director
Compliance Division
Office of Transportation and Air Quality

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. § 7547) and 40 CFR Part 1042, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following marine engines, by engine family, more fully described in the documentation required by 40 CFR Part 1042 and produced in the stated model year.

This certificate of conformity covers only those new marine compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 1042 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1042.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR Part 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1042. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void ab initio for other reasons specified in 40 CFR Part 1042.

This certificate does not cover marine engines sold, offered for sale, introduced, or delivered for introduction into commerce in the U.S. prior to the effective date of the certificate.

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ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TRANSPORTATION AND AIR QUALITY
ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Manufacturer:	**VM MOTORI S.P.A.**
Engine Family:	**FV5XW02.0K4V**
Certificate Number:	**V5X-IMO-15-01**
Date Issued:	**2/26/2014**

Byron J. Bunker, Director
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 to MARPOL 73/78

This certificate is valid for the life of the engine subject to surveys in accordance with regulation 5 of Annex VI to MARPOL 73/78, installed in ships under the authority of this Government.

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

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Page 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TRANSPORTATION AND AIR QUALITY
ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Page 2

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

Byron J. Bunker, Director
Compliance Division
Office of Transportation and Air Quality

1. Particulars of the engine

1.1 Name & address of manufacter:

VM Motori S.p.A.
Via Ferrarese, 29
44042 CENTO (FE) - ITALY

1.2 Place of engine build:

VM Motori S.p.A.
Via Ferrarese, 29
44042 CENTO (FE) - ITALY

1.3 Date of engine build:

10/02/2013

1.4 Place of pre-certification survey:

VM Motori S.p.A.
Via Ferrarese, 29
44042 CENTO (FE) - ITALY

1.5 Date of pre-certification survey:

11/08/2013

1.6 Engine family:

FV5XW02.0K4V

1.7 Models:

54D - MR504LH3, 55D - MR504LX3

1.8 Test cycle:

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

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

127 4000

1.10 Engine certificate number:

V5X-IMO-15-01

1.11 Test fuel:

Distillate Diesel [1065.703(b)]

1.12 NOx reducing device?:

No

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

7.7

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

4.4

2 Particulars of the Technical File:

2.1 Technical File number:

MR504LX3-IMO-MY15

2.2 NOx verification number:

MR504LX3-IMO-MY15-OBNOX

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Products of Mercury Marine
W6250 Pioneer Road
Fond du Lac, WI 54936-1939