MERCURY
MerCruiser

INTERNATIONAL MARITIME ORGANIZATION (IMO)
Technical File
and
Copy of United States Environmental Protection Agency (EPA) Statement of Compliance

MARINE DIESEL ENGINES
D4.2L DI
(Mercury MerCruiser D4.2L D-Tronic Model)

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

Printed in U.S.A.

90-862793 OCTOBER 2000

IMO Technical File for MerCruiser D4.2L DI

In accordance with the IMO Annex VI NOx Technical Code concerning the exhaust gas emissions of marine engines

Trade mark	Mercury MerCruiser
Engine Type	Inline 6 Cylinder
Commercial Description	D4.2L DI D4.2L DI D-Tronic

Communication Addresses

MerCruiser
3003 N. Perkins Road
Stillwater, Oklahoma USA 74075-2299
405-743-6566
International Phone Number
001-405-743-6566

90-862793 OCTOBER 2000

INDEX

General Information

1. Description of the engines

1.1.	Brand name	:	Mercury MerCruiser
1.2.	Engine type	:	Inline 6 Cylinder
1.3.	Fuel	:	Diesel
1.4.	Working principle	:	4-stroke
	Ignition system	:	Compression
	Combustion system	:	Direct Injection
1.5.	Bore	:	94.1 mm (3.705 in)
1.6.	Stroke	:	100.1 mm (3.941 in)
1.7.	Displacement	:	4177 cc (255 ci)
1.8.	Number of cylinders	:	6
1.9.	Firing order	:	1-5-3-6-2-4
1.10.	Location of the manufacturer's plate, engine number	:	On top of air plenum housing, aft end of engine

2. Cooling system

2.1.	Fresh-water cooling	:	Yes
2.2.	Diagram of the cooling system	:	See ANNEX 1 Illustration 1.
2.3.	Type of fluid cooling	:	50/50 antifreeze and water
2.1.4.	Cooling pump		
	Type	:	Impeller
	Speed	:	6300 min^{-1} at rated engine speed

3. Allowable temperatures

3.1.	Liquid cooling	:	107 ^{o}C max. (225 °F)
3.2.	Radiator/ Heat exchanger	:	107 ^{0}C max. (225 °F)
3.4.	Fuel temperature		
	-Maximum	:	50 ^{o}C (122 °F)
	-Minimum	:	-5 ^{o}C (23 °F)
3.5.	Lubricant	:	135 ^{o}C max. (275 °F)

4. Air-Intake system

4.1.	Air intake filter		
	Type	:	Foam Filter

5. Turbocharger, charge air cooling

5.1 Diagram of the turbocharger system : See ANNEX 1 Illustration 2

6. Fuel System

6.1. Diagram of the complete system : See ANNEX 1 Illustration 3

6.2. Feed pump : Cam actuated diaphragm pump

6.3. Fuel filter : Water separating paper element

6.4. Idle speed : 650 min^{-1} $\pm$ 25 min^{-1} in Forward gear

6.5. Start of overspeed control under load : n = 3850 min^{-1}

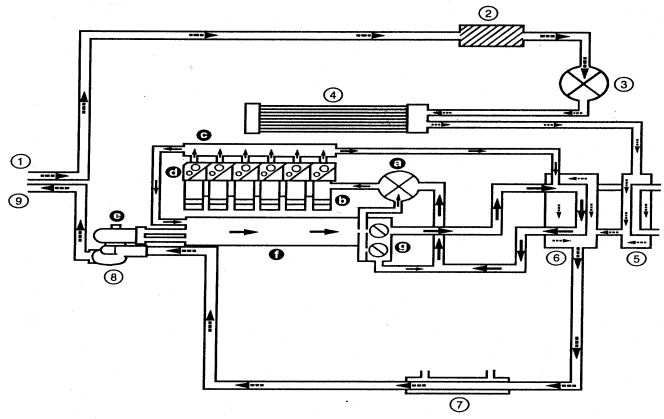
6.6. End of overspeed control without load : n = 4200 min^{-1} $\pm$ 50 min^{-1}

6.7. Governor -Type : Electronic (integrated inside injection pump)

7. Valves

		Exhaust	Intake
7.1. Valve stroke	:	10.66 mm (.420 in)	10.25 mm (.404 in)
Opening angle (ATDC)	:	114°	334°
Closing angle (BTDC)	:	36°	238°
		Open/closed angles @ 1.27 mm (.050 in) lift	
7.2. Adjusting clearance	:	N/A (Hydraulic)	

COOLING SYSTEM (Illustration 1)



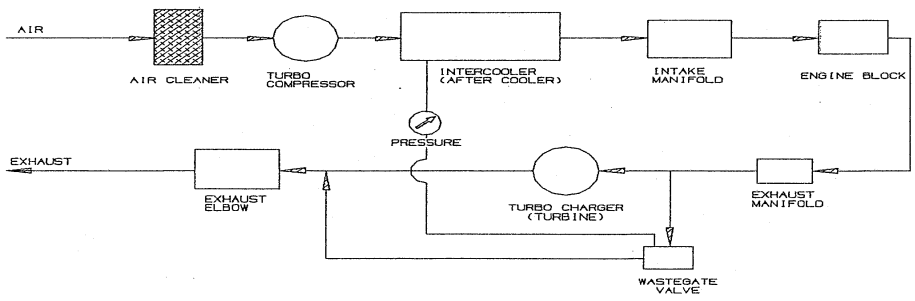
SEAWATER COOLING CIRCUIT (RAW WATER)
1 - Seawater Inlet (Thru Drive)
2 - Seawater Strainer
3 - Seawater Pump
4 - Intercooler
5 - Engine Oil Cooler
6 - Heat Exchanger (Seawater Circuit)
7 - Power Steering Fluid Cooler
8 - Exhaust Pipe Water Jacket
9 - Seawater Outlet (Exhaust)

CLOSED COOLING CIRCUIT (COOLANT)
a - Circulating Pump - Closed Coolant
b - Engine Block - Upper Section of Liners
c - Water Manifold
d - Cylinder Heads
e - Turbocharger
f - Exhaust Manifold
g - Thermostat

Six Cylinder MCM Engine Shown (Five Cylinder Similar)

TURBOCHARGER (Illustration 2)

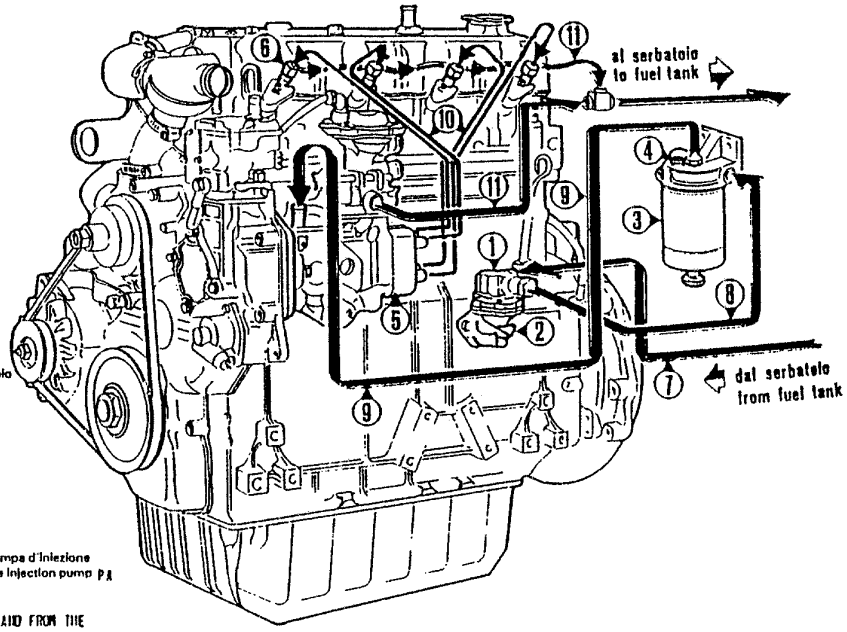
Air enters the air cleaner where it is compressed by the turbo compressor pump. From there it is forced into the intercooler where it maintains a boost pressure of 1,200 mbar (17 psi). It then enters the intake manifold and is compressed into the combustion chamber and exits as exhaust gas. In the event that the boost pressure is too high, the wastegate pressure valve opens, allowing excess exhaust to by-pass the turbocharger. This regulates the boost pressure if the boost pressure is acceptable; the exhaust passes through the turbocharger and out through the exhaust elbow.



FUEL INJECTION SYSTEM (Illustration 3)

SCHEMA CIRCUITO DELL'ALIMENTAZIONE-motori serie HR.H-HT

FEEDING CIRCUIT DIAGRAM HR.H-HT-engines series



EQUIPAGGIAMENTO BOSCH - BOSCH EQUIPMENT

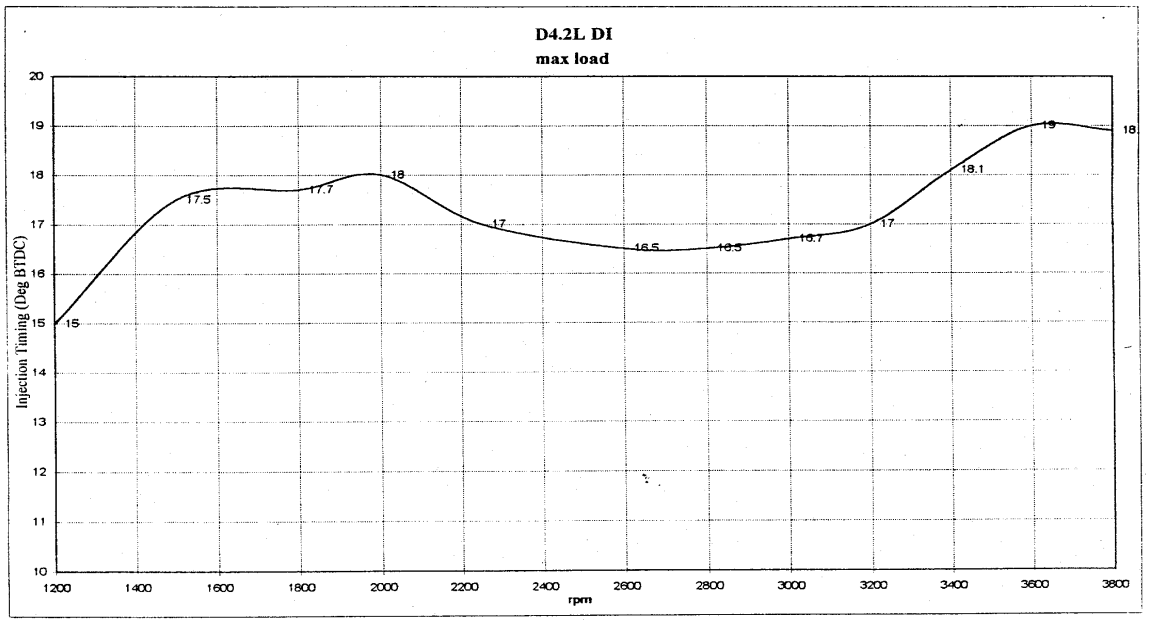
1. Pompa alimentazione
Feeding pump
2. Leva innesco a mano
Hand primer levee
3. Filtro carburante
Fuel filter
4. Vite di spurgo
Drain screw
5. Pompa d'iniezione
Injection pump
6. Iniettore
Injector
7. Tubo arrivo carburante alla pompa alimentazione dal serbatoio
Fuel line end from the fuel tank to the feeding pump
8. Tubo mandata carburante al filtro
Fuel delivery fine to the filter
9. Tubo mandata carburante alla pompa d'iniezione
Fuel delivery fine to the injection pump
10. Tubi mandata carburante agli iniettori
Fuel delivery line to the injectors
11. Tubi recupero carburante in eccesso dagli iniettori e dalla pompa d'iniezione
Exceeding recovery fuel lines from the injectors and from the injection pump P.A
12. D'INIEZIONE
EXCEEDING RECOVERY FUEL LINES FROM THE INJECTORS AND FROM THE INJECTION PUMP

Checklist for Engine Parameter Check Method

This parameter checklist is to be used to demonstrate compliance with NO_x emission limits on board ship.

1. Injection Timing

1.1 Static Timing	:	Crank at TDC / pump @ 1.75 mm (.069 in) lift
1.2 Injection quantity at full Load and speed	:	50.19 liters per hour (13.25 gallons per hour) at 3800 rpm
1.3 Dynamic timing	:	See chart below



2. Injection Nozzle

2.1 Brand	:	Bosch
2.2 Type	:	Multi-Orifice, Hole-Type Nozzle
2.3 Part Number	:	Bosch Part Number Number One Cylinder 0 432 193 698 Number Two through Six Cylinder 0 432 193 699

3. Injection Pump

3.1 Brand	:	Bosch
3.2 Type	:	Distributor Type VE
3.3 Part Number	:	Bosch Code: VE 4/12 E 1900 LV 1857 L718

4. Fuel Cam

4.1 Part Number : Only available with Injection Pump
Bosch Code: VE 4/12 E 1900 LV
1857 L718

4.2 Specify Shape : Rotating disk fuel cam on roller bearing

5. Injection Pressure

5.1 Common Rail : Not Applicable

5.2 Feed Pump Pressure : 13.8-34.5 kPa (2-5 psi)

5.3 Injection Pump Pressure : 27,000 kPa (3,916 psi)

6. Combustion Chamber

6.1 Piston:

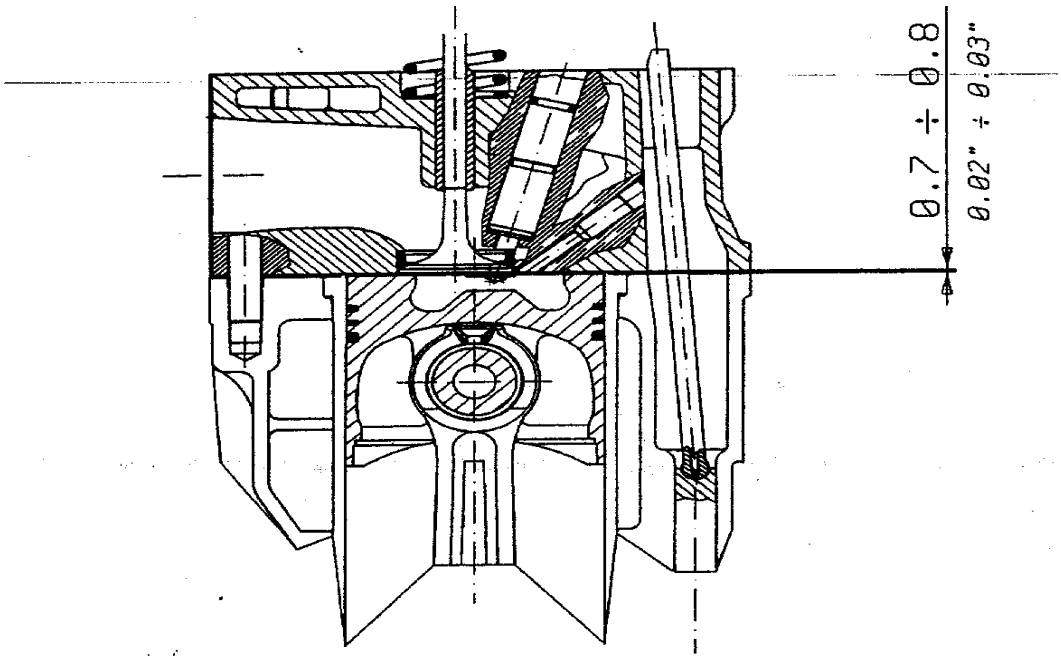
6.1.1 Brand : Hondial

6.1.2 Part Number : VM Part Number 20252049F

6.2 Cylinder Head

6.2.1 Brand : VM part

6.2.2 Part Number : VM Part Number 10352051F



7. Compression Ratio

7.1 Compression ratio : 17 $\pm$ .5: 1

8. Turbocharger Type and Build

8.1 Brand	:	KKK
8.2 Type	:	Exhaust Driven Turbine
8.3 Part number	:	K 26 2967 MxA 8.72
8.4 Wastegate		
8.4.1 Brand	:	KKK
8.4.2 Type	:	Boost Pressure actuated
8.4.3 Part Number	:	KKK Part Number 5806 110 1101
8.5 Maximum boost pressure	:	124 kPa (18 psi)
8.6 Minimum boost pressure	:	100 kPa (15 psi)

9. Charge Air Cooler or Charge Air Preheater

9.1 Charge Air Preheater	:	N/A
9.2 Charge Air Cooler:		
9.2.1 Brand	:	Forcellini
9.2.2 Type	:	Water-cooled heat exchanger
9.2.3 Part Number	:	VM Part Number 11212025F

10. Valve Timing

10.1 Only for four stroke engines with inlet valve closure before BDC	:	N/A
11. Water Injection	:	N/A
12. Emulsified Fuel	:	N/A
13. Exhaust Gas Recirculation	:	N/A
14. Selective Catalytic Reduction	:	N/A

Engine	
Manufacturer	Mercury MerCruiser
Engine type	D4.2L D-Tronic
Family or group identification	D4.2L DI
Serial number	K290258
Rated speed	3800 RPM
Rated power	186 kW (250 HP)
Intermediate speed	2575 RPM
Maximum torque at intermediate speed	549 N m (405 lbs.ft)
Static injection timing	Crank TDC / pump @ 1.75 mm (.069 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 $\pm$ .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	10. 3 kPa (1.50 psi)
Fuel oil specification	Grade 2-D diesel fuel, meeting standards ASTM D975 or DIN 51601, Minimum cetane rating of 45.
Fuel oil temperature	Minimum -5°C (23 °F), Maximum 50°C (122 °F) at fuel filter
Lubricating oil specification	Mercury Precision Parts 4-Cycle Marine Engine Oil 25W-40
Application/Intended for:	
Customer	Pleasure craft (planing 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)	6.77 (average of the three tests performed)
Date(s)	2/16/00, 2/16/00, 2/17/00
Test number(s)	1766, 1767, 1768
Engine family information/Group information (common specifications)	
Combustion cycle	**Only engine in family** (ref. parameter check list)
Cooling medium	
Cylinder configuration	
Method of aspiration	
Fuel type to be used on board	
Combustion chamber	
Valve port configuration	
Valve port size and number	
Fuel system type	
Miscellaneous features:	
Exhaust gas recirculation	**N/A**
Water injection/emulsion	**N/A**
Air injection	**N/A**
Charge cooling system	Yes, ref. Annex 1, Illustrations 1
Exhaust after-treatment	**N/A**
Exhaust after-treatment type	**N/A**
Dual fuel	**N/A**
Engine family/group information (selection of parent engine for test-bed test)	
Family/group identification	**Only engine in family** (ref. parameter check list)
Method of pressure charging	
Charge air cooling system	
Criteria of the selection (specify)	
Number of cylinder	
Max. rated power per cylinder	
Rated speed	
Injection timing (range)	
Max. fuel parent engine	
Selected parent engine	
Application	

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	Pierburg	CLD PM-2000	1	**N/A**	2 %
			2	98.3	2 %
			3	967.	2 %
			4	4750	2 %
CO analyzer	Pierburg	BINOS 2000	1	.464	2 %
			2	1.77	2 %
			3	9.59	2 %
			4	**N/A**	2 %
CO_2 analyzer	Pierburg	BINOS 2000	1	**N/A**	2 %
			2	**N/A**	2 %
			3	**N/A**	2 %
			4	15.19	2 %
O_2 analyzer	Pierburg	Oxymat 2000	1	**N/A**	2 %
			2	4.98	2 %
			3	**N/A**	2 %
			4	**N/A**	2 %
HC analyzer	Pierburg	FID PM-2000	1	**N/A**	2 %
			2	294.	2 %
			3	881.	2 %
			4	9110.	2 %
Speed	Digalog		100-10,000 min^{-1}		1 min^{-1} per 10,000
Torque	Omega		0-1356 Nm		$\pm$ 1.4 Nm
Fuel flow	Micromotion	CMF 010	0-40 lbs.min.		Flow: $\pm$ .10% Density: $\pm$ .0005 %
Temperatures					
temperatures	Omega	E-type	0-1000 °C		$\pm$ 1 °C
Pressures					
Pressures	Sensotec	Type A-5	-103-689 kPa		$\pm$ .689 kPa
Humidity					
Intake air			5-98 %		$\pm$ 1 %

Fuel Characteristics		
Fuel type:	No. 2 fuel oil - low sulfur	
Fuel properties:	**ASTM test method:**	**Specifications:**
Gravity, API @ 60 °F	D1298	30.7 min.
Sulfur, Wt %	D4294	.047 min.
Cetane index	D976	41.0 min.
Flash point, °F, PM @ origin	D93	140 min.
Viscosity, CST @ 104 °F	D445	1.9 - 3.4

				Ambient data			
Test	**Mode**	Power %	Speed %	Atmospheric pressure (kPa)	Intake air temperature (°C)	Intake air Humidity (RH %)	Atmospheric factor (*f*a)
1766	**1**	100 %	100 %	98.8	24	16	.999
1766	**2**	75 %	91 %	98.8	24	15	.996
1766	**3**	50 %	80 %	98.7	23	15	.993
1766	**4**	25 %	63 %	98.7	23	15	.991
1767	**1**	100 %	100 %	98.7	24	15	.999
1767	**2**	75 %	91 %	98.7	24	15	.998
1767	**3**	50 %	80 %	98.7	23	15	.993
1767	**4**	25 %	63 %	98.7	23	15	.990
1768	**1**	100 %	100 %	97.7	23	35	1.001
1768	**2**	75 %	91 %	97.7	23	35	.999
1768	**3**	50 %	80 %	97.7	23	35	.998
1768	**4**	25 %	63 %	97.7	22	36	.993

		Gaseous emissions data									
Test	**Mode**	NO_x concentration wet (% FS)		CO concentration dry (% FS)		CO_2 concentration dry (% FS)		O_2 concentration dry (% FS)		HC concentration wet (% FS)	
1766	**1**	Rg 4	19.92	Rg 1	10.43	Rg 4	54.30	Rg 4	24.50	Rg 2	5.11
1766	**2**	Rg 4	13.97	Rg 1	2.08	Rg 4	43.68	Rg 4	35.64	Rg 2	5.88
1766	**3**	Rg 3	44.00	Rg 1	1.77	Rg 4	31.91	Rg 4	47.82	Rg 2	5.46
1766	**4**	Rg 3	50.31	Rg 1	3.19	Rg 4	27.78	Rg 4	51.99	Rg 2	10.19
1767	**1**	Rg 4	19.61	Rg 1	11.03	Rg 4	54.51	Rg 4	23.73	Rg 2	3.9
1767	**2**	Rg 4	14.19	Rg 1	2.07	Rg 4	43.44	Rg 4	35.49	Rg 2	5.25
1767	**3**	Rg 3	43.88	Rg 1	1.88	Rg 4	31.64	Rg 4	47.75	Rg 2	5.16
1767	**4**	Rg 3	49.03	Rg 1	3.35	Rg 4	27.59	Rg 4	51.88	Rg 2	9.73
1768	**1**	Rg 3	90.30	Rg 1	11.93	Rg 4	54.94	Rg 4	23.71	Rg 2	3.44
1768	**2**	Rg 3	62.64	Rg 1	1.95	Rg 4	43.97	Rg 4	35.57	Rg 2	4.95
1768	**3**	Rg 3	41.28	Rg 1	1.71	Rg 4	32.10	Rg 4	48.16	Rg 2	4.87
1768	**4**	Rg 3	45.18	Rg 1	3.36	Rg 4	27.87	Rg 4	52.61	Rg 2	10.14

Gaseous emissions data

Test	Mode	NO_x humidity correction factor	Fuel specification factor (FFH)	NO_x mass flow (g/hr)		CO mass flow (g/hr)		HC mass flow (g/hr)		NO_x specific (g/kW-hr)
1766	**1**	.80	1.86	Rg 4	1516	Rg 1	438	Rg 2	2.35	7.01
1766	**2**	.79		Rg 4	942	Rg 1	79	Rg 2	2.40	
1766	**3**	.79		Rg 3	471	Rg 1	54	Rg 2	1.77	
1766	**4**	.79		Rg 3	286	Rg 1	53	Rg 2	1.75	
1767	**1**	.80	1.86	Rg 4	1489	Rg 1	462	Rg 2	1.79	5.58
1767	**2**	.79		Rg 4	950	Rg 1	78	Rg 2	2.13	
1767	**3**	.79		Rg 3	467	Rg 1	57	Rg 2	1.66	
1767	**4**	.79		Rg 3	286	Rg 1	56	Rg 2	1.71	
1768	**1**	.89	1.86	Rg 4	1365	Rg 1	497	Rg 2	1.57	5.50
1768	**2**	.87		Rg 4	833	Rg 1	73	Rg 2	1.99	
1768	**3**	.87		Rg 3	433	Rg 1	52	Rg 2	1.55	
1768	**4**	.87		Rg 3	265	Rg 1	57	Rg 2	1.80	

Gaseous emissions data | **Engine data**

Test	Mode	Specific fuel (g/KW-hr)	Speed (min^{-1})	Power (kW)	Fuel flow (kg/hr)	Exhaust back pressure (mbar)	Coolant in (°C)
1766	**1**	235.81	3794	186	45.54	200	14
1766	**2**		3465	141	32.95	165	13
1766	**3**		3045	85	19.26	124	13
1766	**4**		2389	43	9.11	83	13
1767	**1**	235.18	3780	185	45.60	200	14
1767	**2**		3458	140	32.55	165	13
1767	**3**		3043	84	19.24	124	13
1767	**4**		2401	43	9.26	83	13
1768	**1**	235.81	3803	186	45.73	200	14
1768	**2**		3453	140	32.68	165	13
1768	**3**		3048	84	19.24	124	13
1768	**4**		2398	43	9.42	83	13

Engine data

Test	Mode	Coolant out (°C)	Intercooler air temperature (°C)	Lubricant temperature (°C)	Lubricant pressure (bar)	Fuel rack (mm)	
1766	**1**	78	54	81	3.92	Not adj.	
1766	**2**	73	53	83	4.30	Not adj.	
1766	**3**	72	48	91	4.44	Not adj.	
1766	**4**	72	38	94	4.28	Not adj.	
1767	**1**	78	56	82	3.91	Not adj.	
1767	**2**	73	54	89	4.37	Not adj.	
1767	**3**	72	46	92	4.44	Not adj.	
1767	**4**	72	37	94	4.29	Not adj.	
1768	**1**	77	52	80	3.92	Not adj.	
1768	**2**	73	51	83	4.33	Not adj.	
1768	**3**	70	46	91	4.45	Not adj.	
1768	**4**	72	34	94	4.31	Not adj.	

Engine data

Test	Mode						
1766	**1**						
1766	**2**						
1766	**3**						
1766	**4**						
1767	**1**						
1767	**2**						
1767	**3**						
1767	**4**						
1768	**1**						
1768	**2**						
1768	**3**						
1768	**4**						

United States Environmental Protection Agency
Statement of Compliance
With Regulation 13 of Annex VI of the International Convention for the Prevention of Pollution from Ships

Engine Manufacturer	EPA Engine Family Name	Model number	Serial number	Test Cycle(s)	Rated Power (kW) and Speed (RPM)	Statement of Compliance number
Mercury MerCruiser	YM9XM04.2DIX	D4.2L DI		E3	186@3800	M9X-IMO-00-04

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, D.C.

Gregory A. Green, Director
Certification and Compliance Division
Office of Transportation and Air Quality

09-19-00
Date of Issue

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 and address of manufacturer .....

1.2 Place of engine build: **Mercury MerCruiser, 3003 N. Perkins RD Stillwater, OK 74075**

1.3 Date of engine build .....

1.4 Place of pre-certification survey **Mercury MerCruiser,300 N. Perkins RD Stillwater, OK 74075**

1.5 Date of pre-certification survey **2/17/2000** .....

1.6 Engine type and model number .....

1.7 Engine serial number .....
.....

1.8 If applicable, the engine is a parent engine ~~or a member engine~~ of the following engine family ~~or engine group~~ **YM9XM04.2DIX** .....
.....

1.9 Test cycle(s) (see chapter 3 of the NO_x Technical Code) **E3** .....

1.10 Rated Power (kW) and Speed (RPM) **186@3800** .....

1.11 Engine approval number **M9X-IMO-00-04** .....

1.12 Specification(s) of test fuel **No. 2 fuel oil - low sulfur (see page 13 of technical file)**

1.13 NO_x reducing device designated approval number (if installed) **NA** .....

1.14 Applicable NO_x Emission Limit (g/kWh) (regulation 13 of Annex VI) **9.8** .....

1.15 Engine's actual NO_x Emission Value (g/kWh) **6.77 (average of three tests, 7.02 highest)**

2 Particulars of the Technical File

2.1 Technical File identification/approval number **D4.2L DI/M9X-IMO-00-04** .....

2.2 Technical File approval date **See approval date below** . . . . . .

3 Specifications for the On-board NO_x Verification Procedures for the Engine Parameter Survey

3.1 On-board NO_x verification procedures identification/approval number **D4.2L DI/M9X-IMO-00-04**

3.2 On-board NO_x verification procedures approval date **See approval date below**

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, D.C.

Gregory A. Green, Director
Certification and Compliance Division
Office of Transportation and Air Quality

09-19-00
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