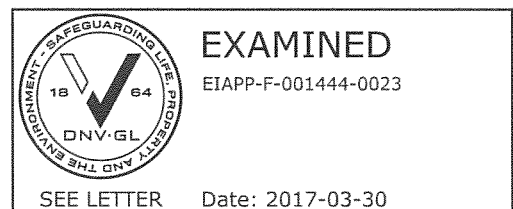


Technical file

IMO certification

According to Annex VI of REVISED MARPOL 73/78
"Regulations for the Prevention of Air Pollution from Ships"
and "NOx Technical Code 2008"

Mitsubishi Turbocharger and Engine Europe B.V.
March 2017

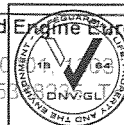


i. A. J. J. J.

Family Member : 58C
Engine type : Mitsubishi S6A3-MPTAW
Power / Rate : 221 kW @ 1530 rpm
Engine S/N : 37571

Contents

1. ENGINE GENERAL INFORMATION
2. PRINCIPAL PARTICULARS OF PARENT ENGINE
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5. DESIGNATION AND RESTRICTION FOR ENGINE FAMILY
6. PROCEDURE FOR DEMONSTRATING COMPLIANCE WITH NO_x EMISSION LIMITS ON BOARD
7. PARENT ENGINE TEST REPORT AND NO_x TEST REPORT
8. EIAPP CERTIFICATE



1. ENGINE GENERAL INFORMATION

- 1.1 Make (name of undertaking): Mitsubishi Heavy Industries, Ltd.
- 1.2 Type and commercial description of the parent engine and (if applicable) of the engines within the family/group: S6A3-MPTAW, Family 58C, see overview in chapter 3 "Principal particulars of engine types within the family"
- 1.3 Purpose for which the engine will be used: Propeller-law-operated main and auxiliary engines or constant-speed operated engines for main propulsion
- 1.4 Name and address of manufacturer: Mitsubishi Heavy Industries, Ltd.
General Machinery & Special Vehicle Headquarters
3000 Tana, Sagamihara
Kanagawa 229-1193
Japan
- 1.5 Name and address of manufacturer's representative (if any): Mitsubishi Turbocharger and Engine Europe BV
Damsluisweg 2
1332 EC Almere
The Netherlands
- 1.6 Location, coding and method of affixing of the engine identification number: The engine model name and engine serial number are stamped on the engine name plate riveted to the left side⁽¹⁾ of engine crankcase.
- 1.7 Address(es) of assembly plant(s): Mitsubishi Turbocharger and Engine Europe BV
Damsluisweg 2
1332 EC Almere
The Netherlands
- MHI Equipment Alsace S.A.S (MEA)
1, rue de la Fonderie-68100
Mulhouse
France

⁽¹⁾ – when face the engine flywheel end.



MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.
2. PRINCIPAL PARTICULARS OF PARENT ENGINE

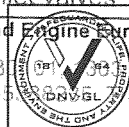
2	Description of the engine	Unit
2.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
2.02	Manufacturer's engine code: Mitsubishi S6A3-MPTAW; #35602	
2.03	Rated power kW at rated speed: 360 kW @ 1840 rpm	
2.04	Engine Family 58C	
2.05	Cycle: four stroke	
2.06	Bore: 150	mm
2.07	Stroke: 175	mm
2.08	Number and layout of cylinders: 6 cylinders In-line	
2.09	Engine displacement: 18.56	dm ³
2.10	Volumetric compression ratio 14.5: 1	
2.11	Combustion system description direct injection, open chamber	
2.12	Mean effective pressure: 12.7	bar
2.13	Maximum cylinder pressure: 132.0	bar
2.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
2.15.	Cooling system	
2.15.1	Cooling medium: water/Glycol	
2.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
2.15.3	Max.charge air temperature: 55	°C
2.16	Turbocharger: 1 unit	
2.16.1	Make: Mitsubishi	
2.16.2	Type: TD10L2-45VRC	
2.17	Intercooler: yes	
2.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
2.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
2.20	Injection system	
2.20.1	Fuel injection pump: 1 unit	
2.20.2	Make(s): ☐ ZEXEL ☐	
2.20.3	Type(s): NP-PE 6P130/	
2.20.4	Injection timing: 25° bTDC	
2.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
2.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
2.20.7	Make(s): ☐ ZEXEL ☐	
2.20.8	Type(s): NP-DLLA158SM268	
2.20.9	Opening pressure: 29.9 ~ 30.7	MPa
2.21	VALVE TIMING ⁽¹⁾	
2.21.1	Intake opens: 11° bTDC	
2.21.2	Intake closes: 21° aBDC	
2.21.3	Exhaust opens: 21° bBDC	
2.21.4	Exhaust closes: 11° aTDC	
2.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves

Mitsubishi Turbocharger and Engine Europe B.V.

Approval No EIAPP-F-001441-0023

Damsluisweg 2, 1332 EC Almere, P.O. Box 3000, 1332 EC Almere, The Netherlands
 Telephone: +31-(0)36-5388311 Telefax: +31-(0)36-5388311
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3. PRINCIPAL PARTICULARS OF ENGINE TYPES WITHIN THE FAMILY

3.1 Specifications of engines within Family 58C

	1	2	3
Engine type	S6A3-MPTAW-3	S6A3-Y2MPTK-3	S6A3-MPTAW*
Number of cylinders	6	6	6
Rated speed (min ⁻¹)	1840	1840	1840
Rated net power (kW)	360	360	360
Fuel injection timing (° bTDC)	20	20	25
Piston displacement (in % of parent engine)	100	100	N/A

	4	5	6 ^{REV 02}
Engine type	S6A3-MPTAW	S6A3-MPTAW	S6A3-MPTAW-99
Number of cylinders	6	6	6
Rated speed (min ⁻¹)	1530	1564	1800
Rated net power (kW)	221	221	385
Fuel injection timing (° bTDC)	20	20	20
Piston displacement (in % of parent engine)	100	100	100

	7 ^{REV 03}	8 ^{REV 04}	9 ^{REV 04}
Engine type	S6A3-MPTAW	S6A3-MPTAW-97	S6A3-MPTAW-98
Number of cylinders	6	6	6
Rated speed (min ⁻¹)	1840	1564	1530
Rated net power (kW)	360	221	221
Fuel injection timing (° bTDC)	20	20	20
Piston displacement (in % of parent engine)	100	100	100

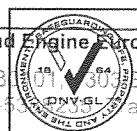
* - Parent engine



3.2. ESSENTIAL CHARACTERISTICS OF ENGINE TYPES WITHIN THE FAMILY

3	Description of the engine	Unit
3.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
3.02	Manufacturer's engine code: Mitsubishi S6A3-MPTAW-3	
3.03	Rated power kW at rated speed: 360 kW @ 1840 rpm	
3.04	Engine Family 58C	
3.05	Cycle: four stroke	
3.06	Bore: 150	mm
3.07	Stroke: 175	mm
3.08	Number and layout of cylinders: 6 cylinders In-line	
3.09	Engine displacement: 18.56	dm ³
3.10	Volumetric compression ratio 14.5: 1	
3.11	Combustion system description direct injection, open chamber	
3.12	Mean effective pressure: 12.7	bar
3.13	Maximum cylinder pressure: 132.0	bar
3.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
3.15.	Cooling system	
3.15.1	Cooling medium: water/Glycol	
3.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
3.15.3	Max.charge air temperature: 55	°C
3.16	Turbocharger: 1 unit	
3.16.1	Make: Mitsubishi	
3.16.2	Type: TD10L2-45VRC	
3.17	Intercooler: yes	
3.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
3.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
3.20	Injection system	
3.20.1	Fuel injection pump: 1 unit	
3.20.2	Make(s): ☐ ZEXEL ☐	
3.20.3	Type(s): NP-PE 6P130/	
3.20.4	Injection timing: 20° bTDC	
3.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
3.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
3.20.7	Make(s): ☐ ZEXEL ☐	
3.20.8	Type(s): NP-DLLA158SM268	
3.20.9	Opening pressure: 29.9 ~ 30.7	MPa
3.21	VALVE TIMING ⁽¹⁾	
3.21.1	Intake opens: 11° bTDC	
3.21.2	Intake closes: 21° aBDC	
3.21.3	Exhaust opens: 21° bBDC	
3.21.4	Exhaust closes: 11° aTDC	
3.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves



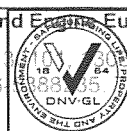
3	Description of the engine	Unit
3.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
3.02	Manufacturer's engine code: Mitsubishi S6A3-Y2MPTK-3	
3.03	Rated power kW at rated speed: 360 kW @ 1840 rpm	
3.04	Engine Family 58C	
3.05	Cycle: four stroke	
3.06	Bore: 150	mm
3.07	Stroke: 175	mm
3.08	Number and layout of cylinders: 6 cylinders In-line	
3.09	Engine displacement: 18.56	dm ³
3.10	Volumetric compression ratio 14.5: 1	
3.11	Combustion system description direct injection, open chamber	
3.12	Mean effective pressure: 12.7	bar
3.13	Maximum cylinder pressure: 132.0	bar
3.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
3.15.	Cooling system	
3.15.1	Cooling medium: water/Glycol	
3.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
3.15.3	Max.charge air temperature: 55	°C
3.16	Turbocharger: 1 unit	
3.16.1	Make: Mitsubishi	
3.16.2	Type: TD10L2-45VRC	
3.17	Intercooler: yes	
3.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
3.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
3.20	Injection system	
3.20.1	Fuel injection pump: 1 unit	
3.20.2	Make(s): ☐ ZEXEL ☐	
3.20.3	Type(s): NP-PE 6P130/	
3.20.4	Injection timing: 20° bTDC	
3.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
3.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
3.20.7	Make(s): ☐ ZEXEL ☐	
3.20.8	Type(s): NP-DLLA158SM268	
3.20.9	Opening pressure: 29.9 ~ 30.7	MPa
3.21	VALVE TIMING ⁽¹⁾	
3.21.1	Intake opens: 11° bTDC	
3.21.2	Intake closes: 21° aBDC	
3.21.3	Exhaust opens: 21° bBDC	
3.21.4	Exhaust closes: 11° aTDC	
3.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves

⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves

3	Description of the engine	Unit
3.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
3.02	Manufacturer's engine code: Mitsubishi S6A3-MPTAW	
3.03	Rated power kW at rated speed: 221 kW @ 1564 rpm	
3.04	Engine Family 58C	
3.05	Cycle: four stroke	
3.06	Bore: 150	mm
3.07	Stroke: 175	mm
3.08	Number and layout of cylinders: 6 cylinders In-line	
3.09	Engine displacement: 18.56	dm ³
3.10	Volumetric compression ratio 14.5: 1	
3.11	Combustion system description direct injection, open chamber	
3.12	Mean effective pressure: 9.32	bar
3.13	Maximum cylinder pressure: 132.0	bar
3.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
3.15	Cooling system	
3.15.1	Cooling medium: water/Glycol	
3.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
3.15.3	Max.charge air temperature: 55	°C
3.16	Turbocharger: 1 unit	
3.16.1	Make: Mitsubishi	
3.16.2	Type: TD10L2-45VRC	
3.17	Intercooler: yes	
3.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
3.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
3.20	Injection system	
3.20.1	Fuel injection pump: 1 unit	
3.20.2	Make(s): ☐ ZEXEL ☐	
3.20.3	Type(s): NP-PE 6P130/	
3.20.4	Injection timing: 20° bTDC	
3.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
3.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
3.20.7	Make(s): ☐ ZEXEL ☐	
3.20.8	Type(s): NP-DLLA158SM268	
3.20.9	Opening pressure: 29.9 ~ 30.7	MPa
3.21	VALVE TIMING⁽¹⁾	
3.21.1	Intake opens: 11° bTDC	
3.21.2	Intake closes: 21° aBDC	
3.21.3	Exhaust opens: 21° bBDC	
3.21.4	Exhaust closes: 11° aTDC	
3.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

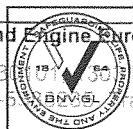
⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves



MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

3	Description of the engine	Unit
3.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
3.02	Manufacturer's engine code: Mitsubishi S6A3-MPTAW-99	
3.03	Rated power kW at rated speed: 385 kW @ 1800 rpm	
3.04	Engine Family 58C	
3.05	Cycle: four stroke	
3.06	Bore: 150	mm
3.07	Stroke: 175	mm
3.08	Number and layout of cylinders: 6 cylinders In-line	
3.09	Engine displacement: 18.56	dm ³
3.10	Volumetric compression ratio 14.5: 1	
3.11	Combustion system description direct injection, open chamber	
3.12	Mean effective pressure: 13.8	bar
3.13	Maximum cylinder pressure: 132.0	bar
3.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
3.15.	Cooling system	
3.15.1	Cooling medium: water/Glycol	
3.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
3.15.3	Max.charge air temperature: 60	°C
3.16	Turbocharger: 1 unit	
3.16.1	Make: Mitsubishi	
3.16.2	Type: TD10L2-45VRC	
3.17	Intercooler: yes	
3.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
3.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
3.20	Injection system	
3.20.1	Fuel injection pump: 1 unit	
3.20.2	Make(s): ☐ ZEXEL ☐	
3.20.3	Type(s): NP-PE 6P130/	
3.20.4	Injection timing: 20° bTDC	
3.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
3.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
3.20.7	Make(s): ☐ ZEXEL ☐	
3.20.8	Type(s): NP-DLLA158SM268	
3.20.9	Opening pressure: 29.9 ~ 30.7	MPa
3.21	VALVE TIMING ⁽¹⁾	
3.21.1	Intake opens: 11° bTDC	
3.21.2	Intake closes: 21° aBDC	
3.21.3	Exhaust opens: 21° bBDC	
3.21.4	Exhaust closes: 11° aTDC	
3.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves



3	Description of the engine	Unit
3.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
3.02	Manufacturer's engine code: Mitsubishi S6A3-MPTAW	
3.03	Rated power kW at rated speed: 360 kW @ 1840 rpm	
3.04	Engine Family 58C	
3.05	Cycle: four stroke	
3.06	Bore: 150	mm
3.07	Stroke: 175	mm
3.08	Number and layout of cylinders: 6 cylinders In-line	
3.09	Engine displacement: 18.56	dm ³
3.10	Volumetric compression ratio 14.5: 1	
3.11	Combustion system description direct injection, open chamber	
3.12	Mean effective pressure: 12.7	bar
3.13	Maximum cylinder pressure: 132.0	bar
3.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
3.15	Cooling system	
3.15.1	Cooling medium: water/Glycol	
3.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
3.15.3	Max.charge air temperature: 55	°C
3.16	Turbocharger: 1 unit	
3.16.1	Make: Mitsubishi	
3.16.2	Type: TD10L2-45VRC	
3.17	Intercooler: yes	
3.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
3.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
3.20	Injection system	
3.20.1	Fuel injection pump: 1 unit	
3.20.2	Make(s): ☐ ZEXEL ☐	
3.20.3	Type(s): NP-PE 6P130/	
3.20.4	Injection timing: 20° bTDC	
3.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
3.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
3.20.7	Make(s): ☐ ZEXEL ☐	
3.20.8	Type(s): NP-DLLA158SM268	
3.20.9	Opening pressure: 29.9 ~ 30.7	MPa
3.21	VALVE TIMING ⁽¹⁾	
3.21.1	Intake opens: 11° bTDC	
3.21.2	Intake closes: 21° aBDC	
3.21.3	Exhaust opens: 21° bBDC	
3.21.4	Exhaust closes: 11° aTDC	
3.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves

MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

3	Description of the engine	Unit
3.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
3.02	Manufacturer's engine code: Mitsubishi S6A3-MPTAW-97	
3.03	Rated power kW at rated speed: 221 kW @ 1564 rpm	
3.04	Engine Family 58C	
3.05	Cycle: four stroke	
3.06	Bore: 150	mm
3.07	Stroke: 175	mm
3.08	Number and layout of cylinders: 6 cylinders In-line	
3.09	Engine displacement: 18.56	dm ³
3.10	Volumetric compression ratio 14.5: 1	
3.11	Combustion system description direct injection, open chamber	
3.12	Mean effective pressure: 9.13	bar
3.13	Maximum cylinder pressure: 132.0	bar
3.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
3.15.	Cooling system	
3.15.1	Cooling medium: water/Glycol	
3.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
3.15.3	Max.charge air temperature: 55	°C
3.16	Turbocharger: 1 unit	
3.16.1	Make: Mitsubishi	
3.16.2	Type: TD10L-36F-28	
3.17	Intercooler: yes	
3.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
3.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
3.20	Injection system	
3.20.1	Fuel injection pump: 1 unit	
3.20.2	Make(s): ☐ ZEXEL ☐	
3.20.3	Type(s): NP-PE 6P130/	
3.20.4	Injection timing: 20° bTDC	
3.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
3.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
3.20.7	Make(s): ☐ ZEXEL ☐	
3.20.8	Type(s): NP-DLLA158SM268	
3.20.9	Opening pressure: 29.9 ~ 30.7	MPa
3.21	VALVE TIMING ⁽¹⁾	
3.21.1	Intake opens: 11° bTDC	
3.21.2	Intake closes: 21° aBDC	
3.21.3	Exhaust opens: 21° bBDC	
3.21.4	Exhaust closes: 11° aTDC	
3.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves



3	Description of the engine	Unit
3.01	Manufacturer: Mitsubishi Heavy Industries, Ltd.	
3.02	Manufacturer's engine code: Mitsubishi S6A3-MPTAW-98	
3.03	Rated power kW at rated speed: 221 kW @ 1530 rpm	
3.04	Engine Family 58C	
3.05	Cycle: four stroke	
3.06	Bore: 150	mm
3.07	Stroke: 175	mm
3.08	Number and layout of cylinders: 6 cylinders In-line	
3.09	Engine displacement: 18.56	dm ³
3.10	Volumetric compression ratio 14.5: 1	
3.11	Combustion system description direct injection, open chamber	
3.12	Mean effective pressure: 9.33	bar
3.13	Maximum cylinder pressure: 132.0	bar
3.14	Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): 650	°C
3.15.	Cooling system	
3.15.1	Cooling medium: water/Glycol	
3.15.2	Liquid cooling: maximum temperature at outlet: 95	°C
3.15.3	Max.charge air temperature: 55	°C
3.16	Turbocharger: 1 unit	
3.16.1	Make: Mitsubishi	
3.16.2	Type: TD10L-36F-28	
3.17	Intercooler: yes	
3.18	Intake system: maximum allowable intake depression at rated engine speed and at 100% load: 3.92	kPa
3.19	Exhaust system: maximum allowable exhaust backpressure at rated engine speed and at 100% load: 4.41	kPa
3.20	Injection system	
3.20.1	Fuel injection pump: 1 unit	
3.20.2	Make(s): ☐ ZEXEL ☐	
3.20.3	Type(s): NP-PE 6P130/	
3.20.4	Injection timing: 20° bTDC	
3.20.5	Injection timing adjustment: see chapter 6 "Procedure for demonstrating compliance with NOx emission limits on board"	
3.20.6	Fuel Injector(s): 8 holes - Ø 0.26 mm-158°	
3.20.7	Make(s): ☐ ZEXEL ☐	
3.20.8	Type(s): NP-DLLA158SM268	
3.20.9	Opening pressure: 29.9 ~ 30.7	MPa
3.21	VALVE TIMING ⁽¹⁾	
3.21.1	Intake opens: 11° bTDC	
3.21.2	Intake closes: 21° aBDC	
3.21.3	Exhaust opens: 21° bBDC	
3.21.4	Exhaust closes: 11° aTDC	
3.21.5	Operational valve clearance (cold engine): Intake valve: 0.4 mm Exhaust valve: 0.5 mm	

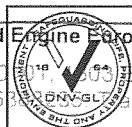
⁽¹⁾ - With 2 mm clearance added to the exhaust and inlet valves



MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.
4. IMO COMPONENT IDENTIFICATION&SETTING

Engine Family : 58C
 Engine type : Mitsubishi S6A3-MPTAW
 Parent Engine Serial Number : 35602 (parent)
 Rated power : 360kW @ 1840rpm

Parameter	IMO ID / setting	Illustration	Drawing	1 S6A3 -MPTAW-3 (member) 35602@1840rpm	2 S6A3 -MPTAW-3 (member) 35602@1840rpm	3 S6A3 -MPTAW (parent) 35602@1840rpm	4 S6A3 -MPTAW (member) 22160@1840rpm	5 S6A3 -MPTAW (member) 22160@1840rpm	6 S6A3 -MPTAW-30 (member) 35602@1840rpm	7 S6A3 -MPTAW (member) 35602@1840rpm	8 S6A3 -MPTAW-37 (member) 22160@1840rpm	9 S6A3 -MPTAW-38 (member) 22160@1840rpm
1 Fuel injection timing (° BTDC)	25	see section 5.1.		✓	✓	✓	✓	✓	✓	✓	✓	✓
	25	see section 5.1.				✓						
2 Injection nozzle assy	1Z-40-5136	58C21	35A81-11530	✓	✓	✓	✓	✓	✓	✓	✓	✓
3 Injection nozzle tip	NP-DLLA158SH255	58C22	33B51-00010	✓	✓	✓	✓	✓	✓	✓	✓	✓
4 Injection nozzle specification	8 holes - Φ 0.25mm	-	33B51-00610	✓	✓	✓	✓	✓	✓	✓	✓	✓
5 Injection nozzle operating pressure	28.3 - 30.7 MPa	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
6 Injection pump	35A25	58C23	35A85-11330	✓	✓	✓	✓	✓	✓	✓	✓	✓
7 Fuel pump camshaft	controlled by PM of injection pump											
8 Max. mechanical rack position limit	See test record for actual position											
9 Piston	35100 or 35101	58C24	45A85-17000	✓	✓	✓	✓	✓	✓	✓	✓	✓
10 Cylinder head assy	35501	58C25	591-4900	✓	✓	✓	✓	✓	✓	✓	✓	✓
11 Cylinder liner	35A07	58C26	591-4112	✓	✓	✓	✓	✓	✓	✓	✓	✓
12 Rod, connecting	32510	58C27	45A85-19000	✓	✓	✓	✓	✓	✓	✓	✓	✓
13 Turbo-charger (model and assy)	1 pcs x TD10L2-4519C 49181	58C28	49181-02540	✓	✓	✓	✓	✓	✓	✓		
	1 pcs x TD10L3-36F-25 49181	58C28	49181-03852								✓	✓
14 Charge air cooler assy	35A30	58C29	45A85-30000	✓	✓	✓	✓	✓	✓	✓	✓	✓
15 Charge air cooler type	Intercooler	-	-	-	-	-	-	-	-	-	-	-
16 Camshaft	specified by valve timing	-	-	-	-	-	-	-	-	-	-	-
17 Valve timing												
Inlet valve open	BTDC 11°			✓	✓	✓	✓	✓	✓	✓	✓	✓
Inlet valve close	ABDC 21°	see section 5.1.		✓	✓	✓	✓	✓	✓	✓	✓	✓
Exh. valve open	BBDC 21°			✓	✓	✓	✓	✓	✓	✓	✓	✓
Exh. valve close	BTDC 11°			✓	✓	✓	✓	✓	✓	✓	✓	✓



5. DESIGNATION AND RESTRICTION FOR ENGINE FAMILY

The engine family is defined by S6A3-MPTAW with the following speed and output range.

(Propeller-law-operated main and propeller-law-operated auxiliary engines E3 test cycle or constant-speed operated engines for main propulsion E2 test cycle)

NOx emission limit calculated according: $44.n^{(-0.23)}$ g/kWh

Rated speed:	1840 rpm
Output range:	360 kW
NOx limit:	7.8 g/kWh

6. PROCEDURE FOR DEMONSTRATING COMPLIANCE WITH NOx EMISSION LIMITS ON BOARD

For verification of NOx emission onboard a vessel, the "Engine parameter check" procedure is applied.

Engine parameter check

To check compliance with the applicable emission limits the following procedures should be applied:

- The engine record book should be checked on major deviations in engine parameters and changes or modifications made to the engine.
- The following components and settings that influence exhaust emissions must be verified:
 - Injection timing;
 - Injection nozzles;
 - Injection nozzle tip;
 - Injection nozzle pressure;
 - Injection pump;
 - Camshaft;
 - Fuel rack position;
 - Piston,
 - Cylinder head;
 - Cylinder liner;
 - Connecting rod;
 - Turbocharger;
 - Charge air cooler.
- The fuel rack setting should be checked for deviation from the "as-built" setting for this is the only adjustable parameter with influence on NOx emission.
- The actual engine operating parameters should be checked using the Engine test record.

2017-03-30



Approval No EIAPP-F-001444-0023

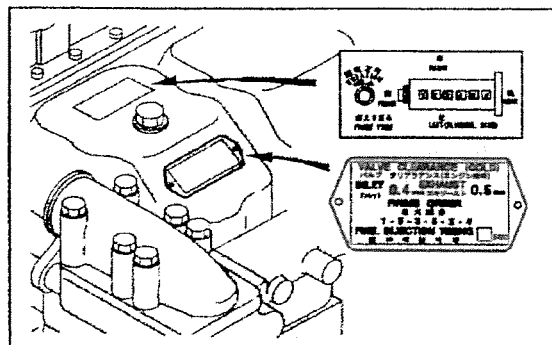
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6.1. Inspection and adjustment of fuel injection timing.

1.3 Inspection and Adjustment of Fuel Injection Timing

(1) Injection timing and its indication location

Since the fuel injection timing varies depending on the engine output, rated speed and other specifications, be sure to check the caution plate on the No. 1 rocker cover.

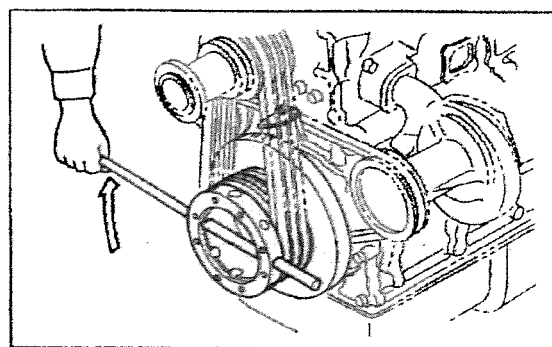


Fuel injection timing and indication

(2) Checking No. 1 cylinder top dead center in compression stroke

- (a) Using a turning bar, rotate the crank pulley in the normal direction (clockwise when viewed from the front of the engine).

Name of basic tool	Part No.
Turning bar	37491-03100

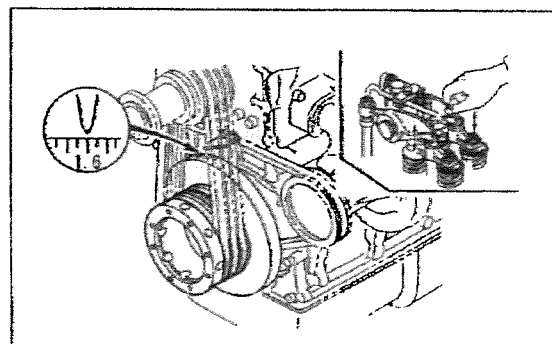


Turning the engine

- (b) Stop turning when the stamped No. 1, 6 on the damper aligns with the pointer.
- (c) Move the rocker arms for the No. 1 cylinder up and down to make sure the pushrods are not pushing the inlet and exhaust valves off their seats.

⚠ CAUTION

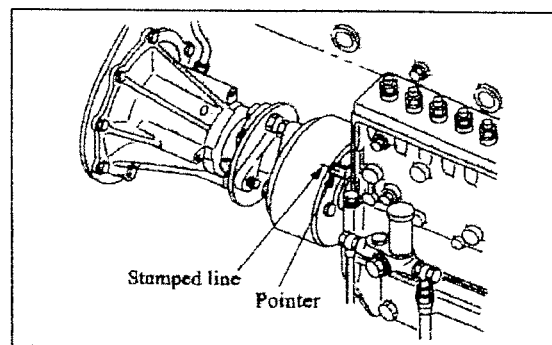
Conduct the above check to make sure the piston in the No. 1 cylinder is at the top dead center, not the piston in the No. 6 cylinder.



Checking top dead center of No. 1 cylinder piston in compression stroke

(3) Inspection of fuel injection timing

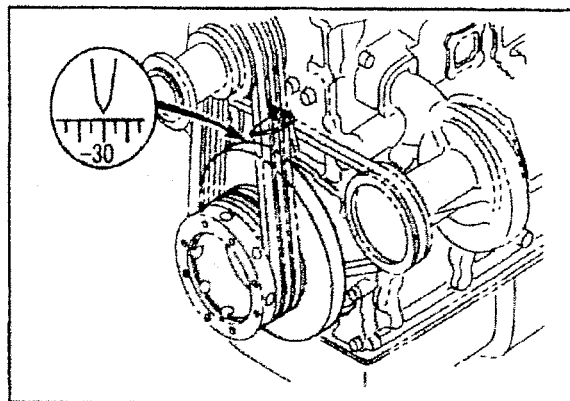
- (a) Turn the crankshaft about 60° in the reverse direction, then turn it in the normal direction a little at a time to align the stamped line on the pump drive coupling with the pointer on the pump case end face.



Inspection of fuel injection timing - I

INSPECTION, ADJUSTMENT, BREAK-IN OPERATION AND PERFORMANCE TESTS

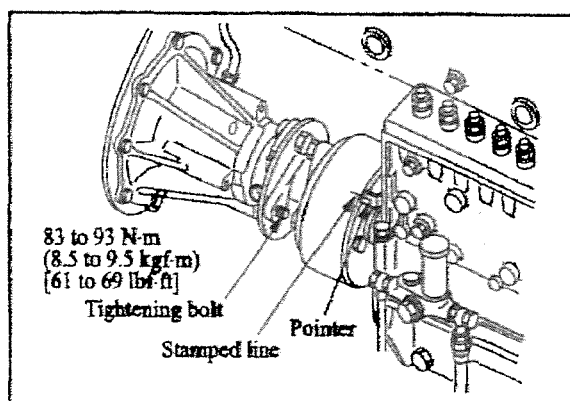
- (b) Read the injection mark (degree) on the circumference of the damper indicated by the pointer on the engine. The indicated angle is the injection timing of the engine. The negative (-) mark on the angle scale and BTDC indicate "Before Top Dead Center."



Inspection of fuel injection timing -2

(4) Adjustment of fuel injection timing

- (a) Make sure the injection timing mark for No. 1 cylinder on the damper is aligned with the pointer on the engine.
- (b) Loosen the two bolts for the fuel injection pump drive coupling, and move the fuel injection pump shaft until the stamped line on the coupling aligns with the pointer on the pump case end face, then tighten one bolt to the specified torque. Crank the engine, and tighten the other bolt.
- (c) Double-check the fuel injection timing by cranking the engine again.

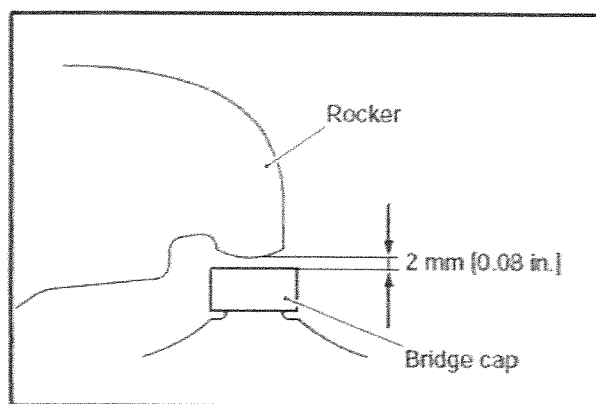


Adjustment of fuel injection timing

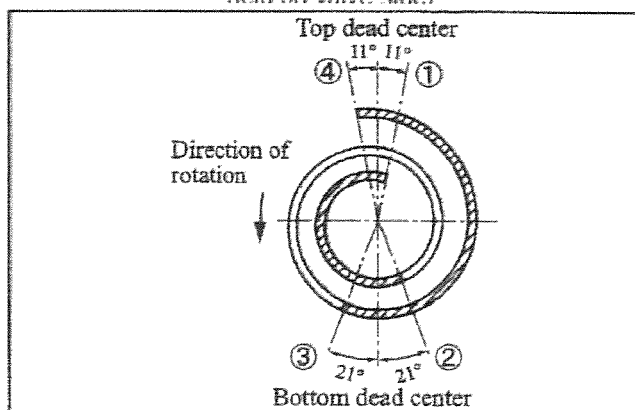
6.2. Valve timing inspection

The valve timing will be set in the specified range if each gear is assembled according to the matching marks. For verification, however, inspect the valve timing as follow:

- (1) Make sure that the No.1 piston is at the top dead center on compression stroke.
- (2) Using a 2 mm thickness gauge, adjust the valve clearance of both inlet and exhaust valves of the cylinder No.1 to 2 mm.
- (3) With 0.05 mm thickness gauge inserted between the bridge cap and the rocker. Rotate the crankshaft slowly to determine the position where the thickness gauge becomes hard to move (the valve is closed) and the position where the thickness gauge becomes easy to move (valve is closed). This will be valve timing with 2 mm clearance. Check to see if these positions agree with angular positions shown on the valve timing diagram



Valve clearance (with 2 mm [0.08 in.] clearance held on valve side)

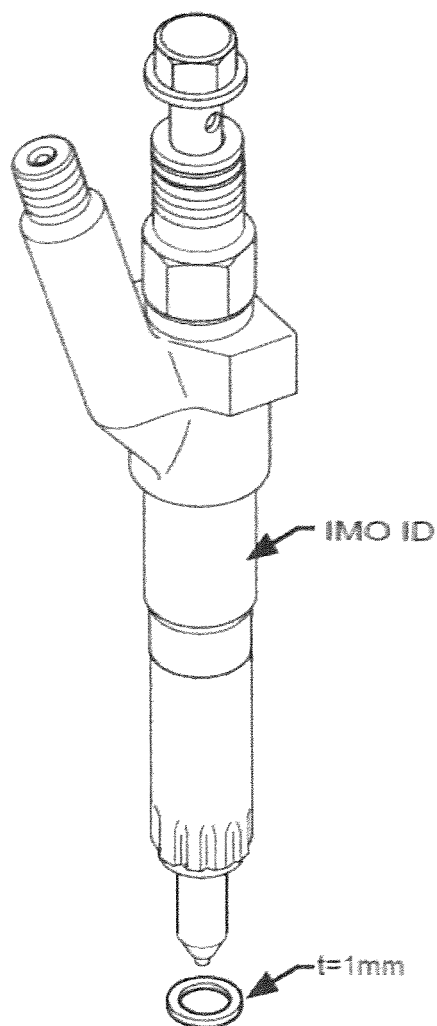


Valve timing (crank angle)

(with 2mm [0.008 in.] clearance on valve side, cold)

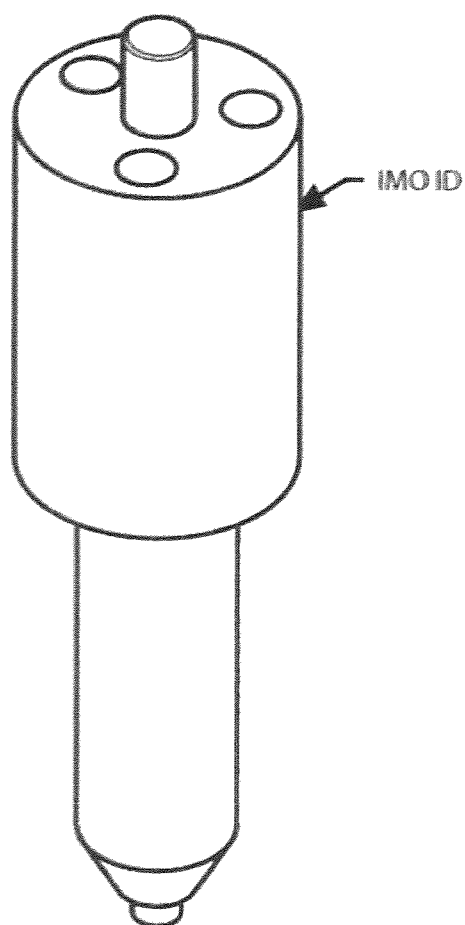
6.3. Location of IMO ID Numbers

**INJECTION NOZZLE ASSY
LOCATION OF IMO ID NUMBER**

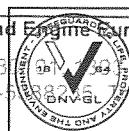


58C01

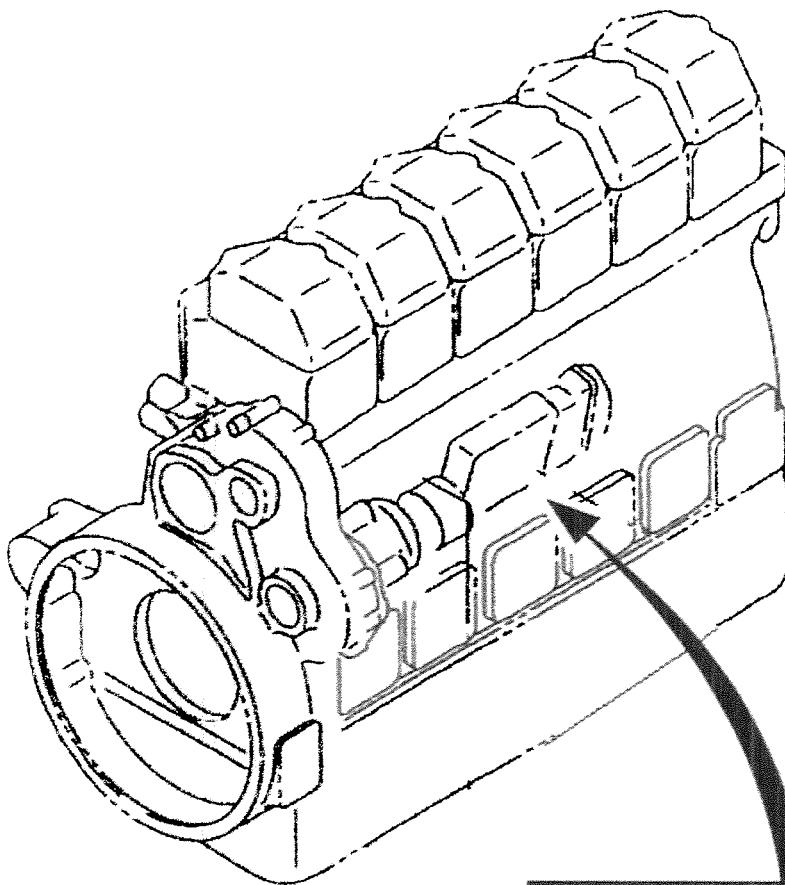
INJECTION NOZZLE TIP
LOCATION OF IMO ID NUMBER



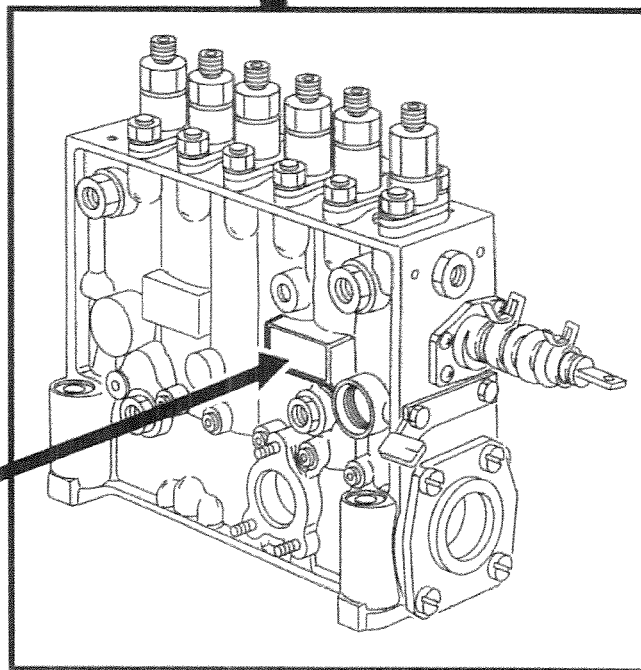
58C02



INJECTION PUMPS
LOCATION OF IMO ID NUMBER

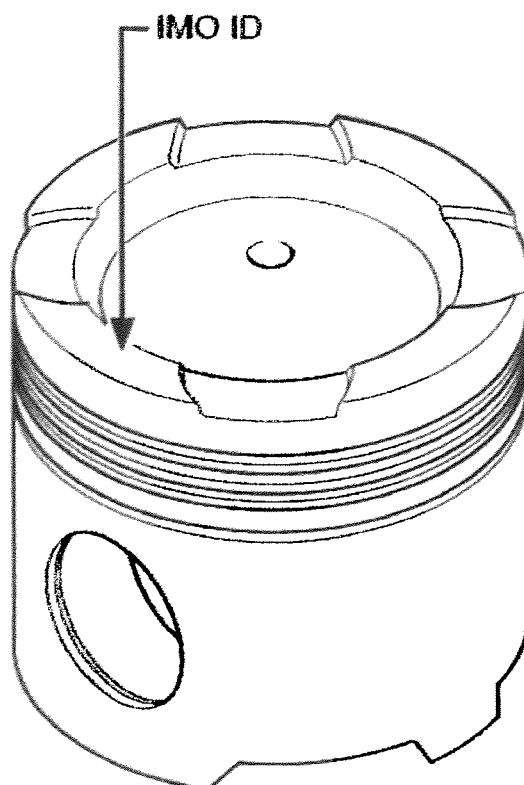


IMO ID

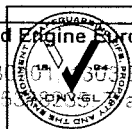


58C03

PISTON
LOCATION OF IMO ID NUMBER

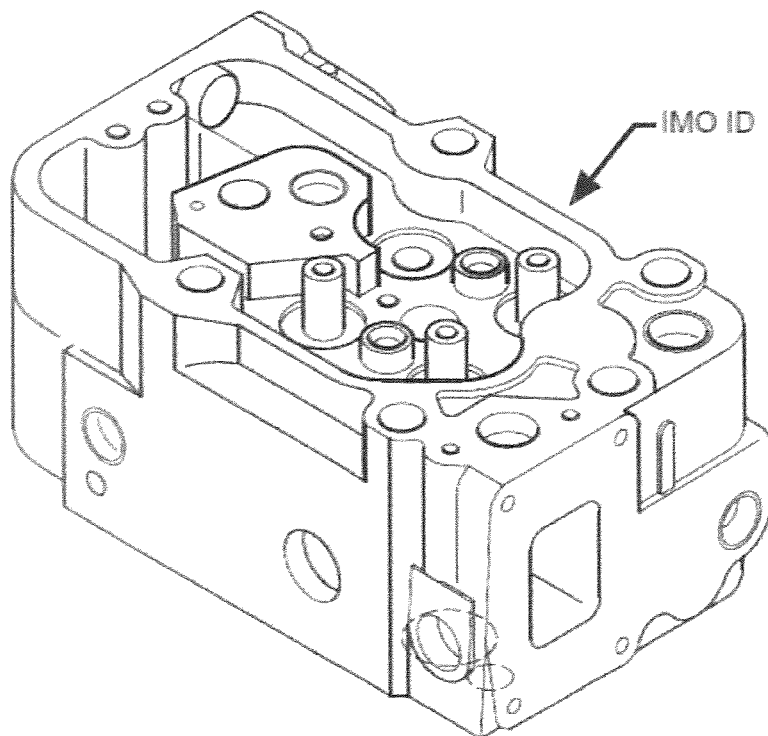


58C04





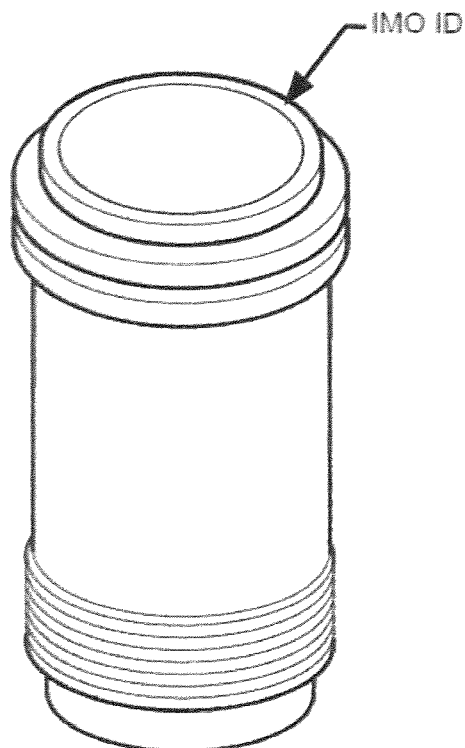
CYLINDER HEAD
LOCATION OF IMO ID NUMBER



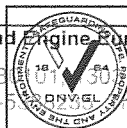
58C05



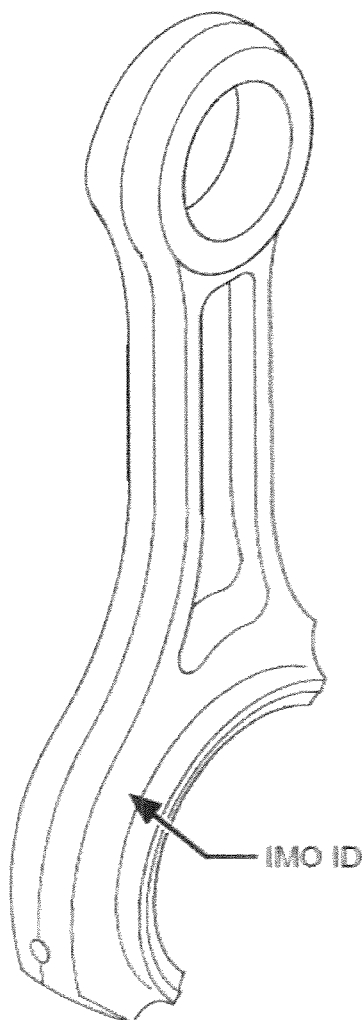
CYLINDER LINER
LOCATION OF IMO ID NUMBER



58C06

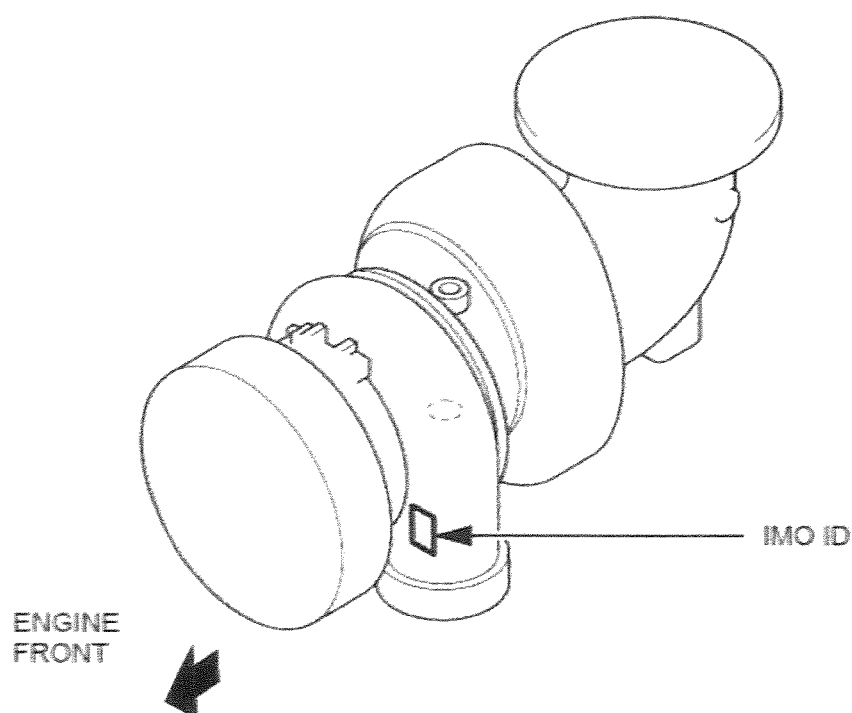


CONNECTING ROD
LOCATION OF IMO ID NUMBER



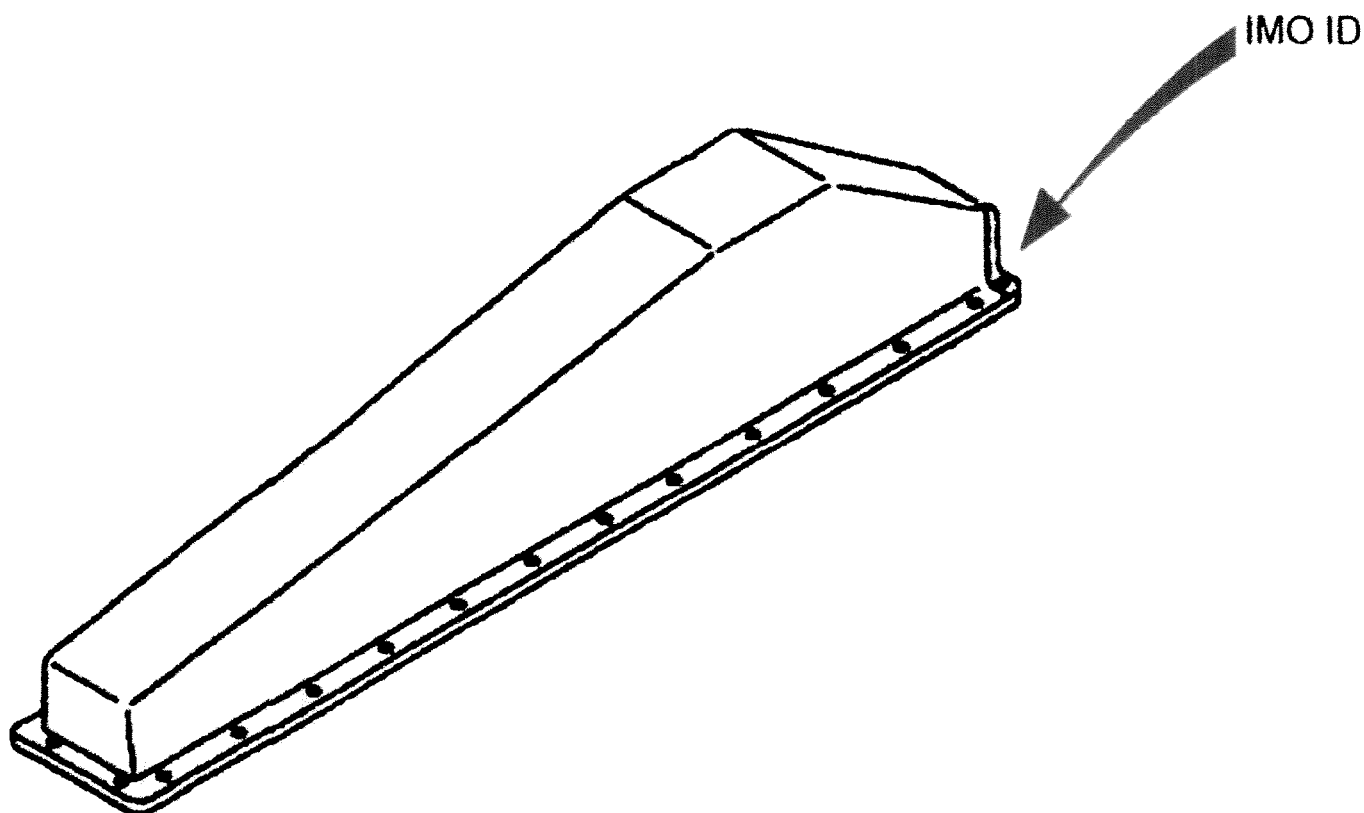
58C07

TURBOCHARGER ASSY LOCATION OF IMO ID NUMBER



58C08

CHARGE AIR COOLER ASSY
LOCATION OF IMO ID NUMBER



58C09



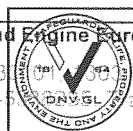
7. PARENT ENGINE TEST REPORT AND TEST DATA

7.1. E3 TEST CYCLE

Section 1 - Parent engine test report

Emission test report no.	EZ/09/2656-44	Engine information	Sheet 1/5
--------------------------	---------------	--------------------	-----------

Engine			
Manufacturer	Mitsubishi Heavy Industries, Ltd		
Engine type	S6A3-MPTAW		
Engine family or engine group identification	58C		
Serial number	35602		
Rated speed		1840	rpm
Rated power		360	kW
Intermediate speed			rpm
Maximum torque at intermediate speed			Nm
Static injection timing		25 deg	CA BTDC
Electronic injection control		no:	-yes:
Variable injection timing			N/A
Variable turbocharger geometry			N/A
Bore		150	mm
Stroke		175	mm
Nominal compression ratio		14.5:1	
Mean effective pressure, at rated power		1270	kPa
Maximum cylinder pressure, at rated power		13200	kPa
Cylinder number and configuration		Number: 6	In-line:
Auxiliaries			
Specified ambient conditions			
Maximum seawater temperature		25	°C
Maximum charge air temperature, if applicable		55	°C
Cooling system spec. intermediate cooler		No:	Yes:
Cooling system spec. charge air stages			single stage
Low/high temperature cooling system set points		55 / 95	°C
Maximum inlet depression		3.92	kPa
Maximum exhaust back pressure		4.41	kPa
Fuel oil specification		DMX ISO 8217	
Fuel oil temperature		25	°C
Emissions test results:			
Cycle		E3	
NO _x		7.0	g/kWh
Test identification			
Date/time		16-09-2011	
Test site/bench		Bench C	
Test number		1	
Surveyor		Marco de Vente	
Date and Place of report		Almere	
Signature			



Emission test report no. **EZ/09/2656-44**

Engine family information

Sheet
2/5

Engine family/engine group information (common specifications)	
Combustion cycle	2-stroke cycle/4 stroke cycle
Cooling medium	air/water
Cylinder configuration	Required to be written, only if the exhaust cleaning devices are applied
Method of aspiration	natural-aspired/pressure charged
Fuel type to be used on board	distillate/distillate or heavy fuel/dual
Combustion chamber	Open chamber/divided chamber
Valve port configuration	Cylinder head/cylinder wall
Valve port size and number	Inlet $\Phi 48$ mm/ 2 pcs; Outlet $\Phi 45$ mm/ 2 pcs
Fuel system type	mechanical control fuel injectors

Miscellaneous features:	
Exhaust gas recirculation	no / yes
Water injection/emulsion	no / yes
Air injection	no / yes
Charge cooling system	no / yes
Exhaust after-treatment	no / yes
Exhaust after-treatment type	
Dual fuel	no / yes

Engine family/engine group information (selection of parent engine for test bed test)				
Family /group Identification	58C			
Method of pressure charging	Pulsating system			
Charge air cooling system	With intercooler			
Criteria of the Selection (specify)	Highest NOx emission value			
Number of cylinder				6
Max.rated power per cylinder				60.0
Rated speed				1840
Injection timing (range)				25
Selected parent engine				Parent
Test cycle(s)				E3



Emission test report no. EZ/09/2656-44

Test cell information

Sheet
3/5

Exhaust Pipe						
Diameter	250 mm					
Length	8 m					
Insulation	no: yes:					
Probe location	8 m from the exit of the exhaust gas system					
Measurement equipment						
	Manufacturer	Model	Measurement ranges	Calibration		
				Span gas conc.	Deviation of calibration	
Analyzer						
NOx analyzer		Horiba	PG250	ppm	936	%
CO analyzer		Horiba	PG250	ppm	904	%
CO2 analyzer		Horiba	PG250	%	17.92	%
O2 analyzer		Horiba	PG250	%	20.72	%
HC analyzer		Ratfisch	RS55T	ppm	85.8	%
Speed	HORIBA	D900	rpm			0.09%
Torque	HORIBA	D900	Nm			0.03%
Power, if applicable			kW			%
Fuel flow	KRAL	BEM 500	0-700 l/hr			1.00%
Air flow	-	-				%
Exhaust flow	-	-				%
Temperatures						
Charge air cooler inlet	Thermokoppel	Type K	0-200 °C			3.2 °C
Exhaust gas		Type K	°C			°C
Inlet air	Testo	645	°C			°C
Charge air	Thermokoppel	Type K	0-200 °C			2.6 °C
Fuel	Thermokoppel	Type K	0-200 °C			2.6 °C
Pressures						
Exhaust gas	Testo	511	0-20 kPa			kP
Charge air	DANFOSS	mbs33m	0-100 kPa			2.0 kPa
Atmospheric	Luft	2039	kPa			kPa
Vapour pressure						
Intake air	Luft	2039	kPa			kPa
Humidity						
Intake air	Testo	645	%			%

Fuel Characteristics

Fuel type				
Fuel properties:			Fuel elemental analysis	
Density	ISO 3675	kg/m ³	Carbon	% m/m
Viscosity	ISO 3104	mm ² /s	Hydrogen	% m/m
Water	ISO 3733	%V/V	Nitrogen	% m/m
			Oxygen	% m/m
			Sulphur	% m/m
			LHV/Hu	MJ/kg

Emission test report no.

EZ/09/2656-44

Ambient and gaseous emission data

Mode		1	2	3	4
Power/Torque	%	100	75	50	25
Speed	%	100	91	80	63
Time at beginning of mode		10:30	10:48	11:08	11:28
Ambient data					
Atmospheric pressure	kPa	102.1	102.1	102.1	102.1
Intake air temperature	°C	23	23	23	24
Intake air humidity	g/kg	7.83	7.93	7.74	7.81
Relative humidity (RH) of intake air*	%	45	44	43	43
Air temperature at RH sensor*	°C	23	24	24	24
Dry bulb temperature of intake air*	°C				
Wet bulb temperature of intake air*	°C				
Test condition parameter	f_a	0.98	0.98	0.98	0.98
Gaseous Emissions Data:					
NO _x concentration dry	ppm	508	574	671	725
CO concentration	ppm	44	49	67	113
CO ₂ concentration	%	5.4	5.2	5.2	4.7
O ₂ concentration dry	%	13.1	13.4	13.5	14.1
HC concentration	ppmC	84	87	81	90
NO _x humidity correction factor, k_{hd}		0.962	0.962	0.961	0.963
Dry/wet correction factor, k_{wr}					
NO _x mass flow	kg/h	2.261	1.924	1.519	0.995
CO mass flow	kg/h	0.1198	0.1008	0.0922	0.0945
CO ₂ mass flow	kg/h	229.9	166.7	112.7	61.7
O ₂ mass flow	kg/h	405.6	312.5	212.7	134.7
HC mass flow	kg/h	0.1300	0.1014	0.0638	0.0430
NO _x specific	g/kWh	6.04	6.86	8.11	10.65
Exhaust gas flow m_0^3/h		2167	1632	1103	669

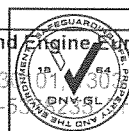
* As applicable

MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.
Emission test report no. **EZ/09/2656-44**

Engine test data

Mode		1	2	3	4
Power (kW)/Torque(Nm)	%	100	75	50	25
Speed	%	100	91	80	63
Time at beginning of mode		10:30	10:48	11:08	11:28
Engine Data					
Speed	rpm	1840	1674	1472	1159
Auxiliary power	kW				
Dynamometer setting	kW	360	270	180	90
Power	kW	360	270	180	90
Mean effective pressure	kPa	1270	520	347	173
Fuel rack set. (stopper bolt length)	mm	22.3	20.1	18.5	16.7
Uncorrected spec. fuel consumption	g/kWh				
Fuel flow	kg/h or m ³ /h*	0.0936	0.0678	0.0452	0.0252
Air flow	kg/h				
Exhaust flow (q _{mew})	kg/h	2858	2151	1453	880
Exhaust temperature	°C	339	323	321	288
Exhaust back pressure	kPa	4.33	2.66	1.12	0.32
Charge air coolant temperature in	°C	32	32	32	32
Charge air coolant temperature out	°C	40	36	32	30
Charge air temperature	°C	45	38	36	34
Charge air reference temperature	°C				
Charge air pressure	kPa	176	121	62	20
Fuel oil temperature	°C	17	17	17	18

* As applicable





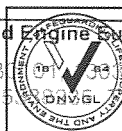
Parent engine test data						
Parent engine						
Model/type		S6A3-MPTAW				
Nominated rated power		kW	360			
Nominated rated speed		rpm	1840			
Parent engine test fuel oil						
Reference fuel designation			SR-3938.01.A01			
ISO 8217:2005 grade (DM or RM)						
Carbon		% m/m	85.5			
Hydrogen		% m/m	13.4			
		% m/m				
Nitrogen		% m/m	0.1			
Oxygen		% m/m	1			
Water		% V/V				
Measured data (parent engine)						
Power/torque		%	100	75	50	25
Speed		%	100	91	80	63
Mode point			1	2	3	3
Engine performance						
Power		kW	360	270	180	90
Speed		rpm	1840	1674.4	1472	1159.2
Fuel flow		kg/h or m³/h*	0.0936	0.0678	0.0452	0.0252
Intake air flow (wet/dry)		kg/h				
Exhaust gas flow		kg/h	2857.67	2150.64	1452.65	879.52
Intake air temperature		°C	23.2	22.8	23.2	23.7
Charge air temperature		°C	45	38	36	34
Charge air reference temperature		°C				
Charge air pressure		kPa	176	121	62	20
Weighting factor			0.20	0.50	0.15	0.15



MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Ambient conditions					
Atmospheric pressure	kPa	102.1	102.1	102.1	102.1
Relative humidity (RH) of intake air	%	45.2	43.6	43.3	42.9
Air temperature at RH sensor*	°C	23.1	23.9	23.6	23.9
Dry bulb temperature of intake air*	°C				
Wet bulb temperature of intake air*	°C				
Absolute humidity of intake air*	g/kg	8	8	8	8
Emission concentrations					
NOx dry	ppm	508	574	671	725
CO ₂	%	5.4	5.2	5.2	4.7
O ₂ dry	%	13.1	13.4 ^{REV.02}	13.5 ^{REV.02}	14.1 ^{REV.02}
CO	ppm	44	49	67	113
HC	ppmC	84	87	81	90
Calculated data (parent engine)					
Intake air humidity	g/kg	7.83	7.93	7.74	7.81
Charge air humidity	g/kg	23	19	23	28
Test condition parameter, f_a		0.98	0.98	0.98	0.98
Dry/wet correction factor, k_{wr}					
NOx humidity correction factor, k_{hd}		0.962	0.962	0.961	0.963
Exhaust gas flow rate	kg/h	2857.67512	2150.64683	1452.65237	879.524672
NOx emission flow rate	kg/h	2.261	1.924	1.519	0.995
Weighting factor		0.2	0.5	0.15	0.15
NOx specific)	g/kWh	6.04	6.86	8.11	10.65
Test cycle		E3			
Emission value	g/kWh	7.0			

* As applicable



7.2. E2 TEST CYCLE

Section 1 - Parent engine test report

Emission test report no.		EZ/09/2656-44	Engine information
Engine			
Manufacturer	Mitsubishi Heavy Industries, Ltd		
Engine type	S6A3-MPTAW		
Engine family or engine group identification	58C		
Serial number	35602		
Rated speed	1840 rpm		
Rated power	360 kW		
Intermediate speed	rpm		
Maximum torque at intermediate speed	Nm		
Static injection timing	25 deg CA BTDC		
Electronic injection control	no: -yes:		
Variable injection timing	N/A		
Variable turbocharger geometry	N/A		
Bore	150 mm		
Stroke	175 mm		
Nominal compression ratio	14.5:1		
Mean effective pressure, at rated power	1270 kPa		
Maximum cylinder pressure, at rated power	13200 kPa		
Cylinder number and configuration	Number: 6 In-line:		
Auxiliaries			
Specified ambient conditions			
Maximum seawater temperature	25 °C		
Maximum charge air temperature, if applicable	55 °C		
Cooling system spec. intermediate cooler	No: Yes:		
Cooling system spec. charge air stages	single stage		
Low/high temperature cooling system set points	55 / 95 °C		
Maximum inlet depression	3.92 kPa		
Maximum exhaust back pressure	4.41 kPa		
Fuel oil specification	DMX ISO 8217		
Fuel oil temperature	25 °C		
Emissions test results:			
Cycle	E2		
NO _x	5.9 g/kWh		
Test identification			
Date/time	16-09-2011/ 11:20		
Test site/bench	Bench C		
Test number	1		
Surveyor	Marco de Vente		
Date and Place of report	Almere		
Signature			

MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Emission test report no. EZ/09/2656-44

Engine family information

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Engine family/engine group information (common specifications)	
Combustion cycle	2-stroke cycle/4 stroke cycle
Cooling medium	air/water
Cylinder configuration	Required to be written, only if the exhaust cleaning devices are applied
Method of aspiration	natural aspired/pressure charged
Fuel type to be used on board	distillate/distillate or heavy fuel/dual
Combustion chamber	Open chamber/divided chamber
Valve port configuration	Cylinder head/cylinder wall
Valve port size and number	Inlet $\Phi 48$ mm/ 2 pcs; Outlet $\Phi 45$ mm/ 2 pcs
Fuel system type	mechanical control fuel injectors

Miscellaneous features:	
Exhaust gas recirculation	no / yes
Water injection/emulsion	no / yes
Air injection	no / yes
Charge cooling system	no / yes
Exhaust after-treatment	no / yes
Exhaust after-treatment type	
Dual fuel	no / yes

Engine family/engine group information (selection of parent engine for test bed test)			
Family /group Identification	58C		
Method of pressure charging	Pulsating system		
Charge air cooling system	With intercooler		
Criteria of the Selection (specify)	Highest NOx emission value		
Number of cylinder			6
Max.rated power per cylinder			60.00
Rated speed			1840
Injection timing (range)			25
Selected parent engine			Parent
Test cycle(s)			E2



Emission test report no. EZ/09/2656-44

Test cell information

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Exhaust Pipe						
Diameter	250 mm					
Length	8 m					
Insulation	no: yes:					
Probe location	8 m from the exit of the exhaust gas system					
Measurement equipment						
	Manufacturer	Model	Measurement ranges	Calibration		
				Span gas conc.	Deviation of calibration	
Analyzer						
NOx analyzer	Horiba	PG250	ppm	936	%	
CO analyzer	Horiba	PG250	ppm	904	%	
CO2 analyzer	Horiba	PG250	%	17.92	%	
O2 analyzer	Horiba	PG250	%	20.72	%	
HC analyzer	Ratfish	RS55T	ppm	85.8	%	
Speed	HORIBA	D900	rpm		0.09%	
Torque	HORIBA	D900	Nm		0.03%	
Power, if applicable			kW		%	
Fuel flow	KRAL	BEM 500	0-700 l/hr		1.00%	
Air flow	-	-			%	
Exhaust flow	-	-			%	
Temperatures						
Charge air cooler inlet	Thermokoppel	Type K	0-200 °C		3.2 °C	
Exhaust gas		Type K	°C		°C	
Inlet air	Testo	645	°C		°C	
Charge air	Thermokoppel	Type K	0-200 °C		2.6 °C	
Fuel	Thermokoppel	Type K	0-200 °C		2.6 °C	
Pressures						
Exhaust gas	Testo	511	0-20 kPa		kPa	
Charge air	DANFOSS	mbs33m	0-100 kPa		2.0 kPa	
Atmospheric	Luft	2039	kPa		kPa	
Vapour pressure						
Intake air	Luft	2039	kPa		kPa	
Humidity						
Intake air	Testo	645	%		%	

Fuel Characteristics

Fuel type				
Fuel properties:			Fuel elemental analysis	
Density	ISO 3675	kg/m³	Carbon	% m/m
Viscosity	ISO 3104	mm²/s	Hydrogen	% m/m
Water	ISO 3733	%V/V	Nitrogen	% m/m
			Oxygen	% m/m
			Sulphur	% m/m
			LHV/Hu	MJ/kg

MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Emission test report no.

EZ/09/2656-44

Ambient and gaseous emission data

Mode		1	2	3	4
Power/Torque	%	100	75	50	25
Speed	%	100	100	100	100
Time at beginning of mode		12:20	12:40	13:00	13:20
Ambient data					
Atmospheric pressure	kPa	102.1	102.0	102.0	102.0
Intake air temperature	°C	25	26	26	26
Intake air humidity	g/kg	8.00	7.99	8.20	8.30
Relative humidity (RH) of intake air*	%	42	39	41	41
Air temperature at RH sensor*	°C	25	26	26	26
Dry bulb temperature of intake air*	°C				
Wet bulb temperature of intake air*	°C				
Test condition parameter	f_a	0.99	0.99	0.99	0.99
Gaseous Emissions Data:					
NO _x concentration dry	ppm	495	436	352	232
CO concentration	ppm	42	42	55	91
CO ₂ concentration	%	5.8	5.2	4.5	3.5
O ₂ concentration dry	%	13.0	13.8	14.8	16.1
HC concentration	ppmC	45	51	57	57
NO _x humidity correction factor, k_{hd}		0.967	0.971	0.972	0.973
Dry/wet correction factor, k_{wr}					
NO _x mass flow	kg/h	2.182	1.625	1.072	0.550
CO mass flow	kg/h	0.1122	0.0944	0.1011	0.1306
CO ₂ mass flow	kg/h	243.2	184.9	129.9	79.7
O ₂ mass flow	kg/h	398.7	357.9	313.7	265.5
HC mass flow	kg/h	0.0690	0.0661	0.0604	0.0470
NO _x specific	g/kWh	5.86	5.84	5.79	5.95
Exhaust gas flow	m ³ /h	2147	1815	1484	1154

* As applicable



Emission test report no. **EZ/09/2656-44**

Engine test data

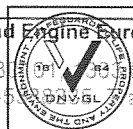
Mode		1	2	3	4
Power (kW)/Torque(Nm)	%	100	75	50	25
Speed	%	100	100	100	100
Time at beginning of mode		12:20	12:40	13:00	13:20
Engine Data					
Speed	rpm	1840	1840	1840	1840
Auxiliary power	kW				
Dynamometer setting	kW	360	270	180	90
Power	kW	360	270	180	90
Mean effective pressure	kPa	1270	520	347	173
Fuel rack set. (stopper bolt length)	mm	22.3	22	21.2	21
Uncorrected spec. fuel consumption	g/kWh				
Fuel flow	kg/h or m ³ /h*	0.0939	0.0714	0.0502	0.0308
Air flow	kg/h				
Exhaust flow (q _{mew})	kg/h	2831	2389	1948	1511
Exhaust temperature	°C	341	310	282	242
Exhaust back pressure	kPa	4.32	2.94	1.82	1.13
Charge air coolant temperature in	°C	32	32	32	32
Charge air coolant temperature out	°C	40	36	33	32
Charge air temperature	°C	45	40	37	36
Charge air reference temperature	°C				
Charge air pressure	kPa	177	123	76	46
Fuel oil temperature	°C	17	18	18	19

* As applicable

MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Parent engine test data					
Parent engine					
Model/type		S6A3-MPTAW			
Nominated rated power		kW	360		
Nominated rated speed		rpm	1840		
Parent engine test fuel oil					
Reference fuel designation		SR-3938.01.A01			
ISO 8217:2005 grade (DM or RM)					
Carbon	% m/m	85.5			
Hydrogen	% m/m	13.4			
	% m/m				
Nitrogen	% m/m	0.1			
Oxygen	% m/m	1			
Water	% V/V				
Measured data (parent engine)					
Power/torque	%	100	75	50	25
Speed	%	100	100	100	100
Mode point		1	2	3	3
Engine performance					
Power	kW	360	270	180	90
Speed	rpm	1840	1840	1840	1840
Fuel flow	kg/h or m³ /h*	0.0939	0.0714	0.0502	0.0308
Intake air flow (wet/dry)	kg/h				
Exhaust gas flow	kg/h	2831.47	2389.19	1948.13	1510.78
Intake air temperature	°C	24.5	26	25.5	25.5
Charge air temperature	°C	45	40	37	36
Charge air reference temperature	°C				
Charge air pressure	kPa	177	123	76	46
Weighting factor		0.20	0.50	0.15	0.15

* As applicable



Ambient conditions					
Atmospheric pressure	kPa	102.1	102.0	102.0	102.0
Relative humidity (RH) of intake air	%	42.4	38.9	40.9	40.9
Air temperature at RH sensor*	°C	24.5	25.9	25.5	25.7
Dry bulb temperature of intake air*	°C				
Wet bulb temperature of intake air*	°C				
Absolute humidity of intake air*	g/kg	8	8	8	8
Emission concentrations					
NOx dry	ppm	495	436	352	232
CO ₂	%	5.8	5.2	4.5	3.5
O ₂ dry	%	13.0	13.8 ^{REV.02}	14.8 ^{REV.02}	16.1 ^{REV.02}
CO	ppm	42	42	55	91
HC	ppmC	45	51	57	57
Calculated data (parent engine)					
Intake air humidity	g/kg	8.00	7.99	8.20	8.30
Charge air humidity	g/kg	22	21	23	26
Test condition parameter, f_a		0.99	0.99	0.99	0.99
Dry/wet correction factor, k_{wr}					
NOx humidity correction factor, k_{hd}		0.967	0.971	0.972	0.973
Exhaust gas flow rate	kg/h	2831.47	2389.19	1948.13	1510.78
NOx emission flow rate	kg/h	2.182	1.625	1.072	0.550
Weighting factor		0.2	0.5	0.15	0.15
NOx specific)	g/kWh	5.86	5.84	5.79	5.95
Test cycle			E2		
Emission value	g/kWh	5.9			

* As applicable

8. EIAPP CERTIFICATE

APPENDICES

1. TEST RECORDS
2. IMO COMPONENT&IDENTIFICATION SETTINGS CHECK SHEET
3. DETAILED DRAWINGS OF IMO COMPONENTS
4. TEST BENCH CALIBRATION REPORT
5. EMISSION REPORT

