The Technical File

Engine type: **7RT-flex50B**
Builder: H.Cegielski – Poznan S.A.
Eng. No.: 02

Content Page

Particulars of the engine

Name and address of manufacturer	H.Cegielski – Poznań SA Ul. 28 Czerwca 1956r no. 223/229 60-965 Poznań. Poland
Place of engine build	Poznań - Poland
Date of engine build	October 2007
Place of pre-certification survey	H.Cegielski – Poznań SA Ul. 28 Czerwca 1956r no. 223/229 60-965 Poznań. Poland
Date of pre-certification survey	2007-10-11
Engine type and model number	**Wärtsilä 7RT-flex50B**
Engine serial number	02

The engine is ☐ an individual engine, ☐ a parent engine or ☒ a member engine of the following engine family ☐ or engine group ☒
H.Cegielski – 7RT-flex50B engines group

Test cycle(s) (see chapter 3 of the NO_X Technical Code)	**E3**
Rated Power (kW) and Speed (RPM)	**11620 kW x 124 rpm**
Engine approval number	.....
Specification(s) of test fuel	**Marine Diesel Oil**

NO_X reducing device designated approval number (if installed)

Applicable NO_X Emission Limit (Regulation 13 of Annex VI)	**17.0 g/kWh**
Engine's NO_X Emission Value	**14,5 g/kWh**

for member engines only:
based and corrected according following formula and values:

- $NO_{X,\ Member} = NO_{X,\ Parent} \times ((p_{firing,\ Member} - p_{firing,\ Parent}) / 100 + 1) = 14,4 g/kWh$
- $NO_{X,\ Parent} = 14,5\ g/kWh$
- $p_{firing,\ Parent} = 160,4\ bar$
- $p_{firing,\ Member} = 160,0\ bar$

List of NO_X relevant components and settings

The following list summarizes all components and settings, which must be respected to comply with the Annex VI to Marpol 73/78 of the IMO.

Item	Component or Setting	Cyl.	Check-value	Wärtsilä ID No.
Engine control hardware	Flex Control Module	1-12	Supplier Type	Wärtsilä FCM-20
	Software package		ID-number	LN-BG9801
Engine control software	IMO relevant parameters (rail pressure, injection timing, exhaust valve timing)		IMO CRC VALUE [3] --- IMO DATA LENGTH [3]	0xD650 --- 428
Injection system	Injection nozzle	1-12	ID-number	LN-BG2205
	Injection control block	1-12	ID-number	LN-BG5500
	Crank angle sensor	1	TDC position	0°CA
	Firing pressure		at 100% load [2]	max. 160,5 barG
			at 75% load [2]	max. 119,3 barG
Combustion chamber	Piston head	1-12	ID-number	LN-BG3000
	Piston rod	1-12	ID-number	LN-BG3200
	Cylinder cover	1-12	ID-number	LN-BG2700
	Cylinder liner	1-12	ID-number	LN-BG2100
	Compression ratio	1-12	Piston Protrusion	68 mm
	Housing of partition device	1-12	ID-number	LN-BG5600
	Exhaust valve upper housing	1-12	ID-number	LN-BG2705
	Exhaust valve housing	1-12	ID-number	LN-BG2710
Turbocharger system	Turbocharger		Number, Type Specification	see page C.7
	Auxiliary blower		Number, Type Specification	see page C.7
Scavenge air cool. system	Scavenge air cooler (SAC)		ID-number	LN-BG6022
	Water temp. controller before SAC		Check of setting temperature	29°C [1]
	Layout of cooling system		Correct layout	see page C.8

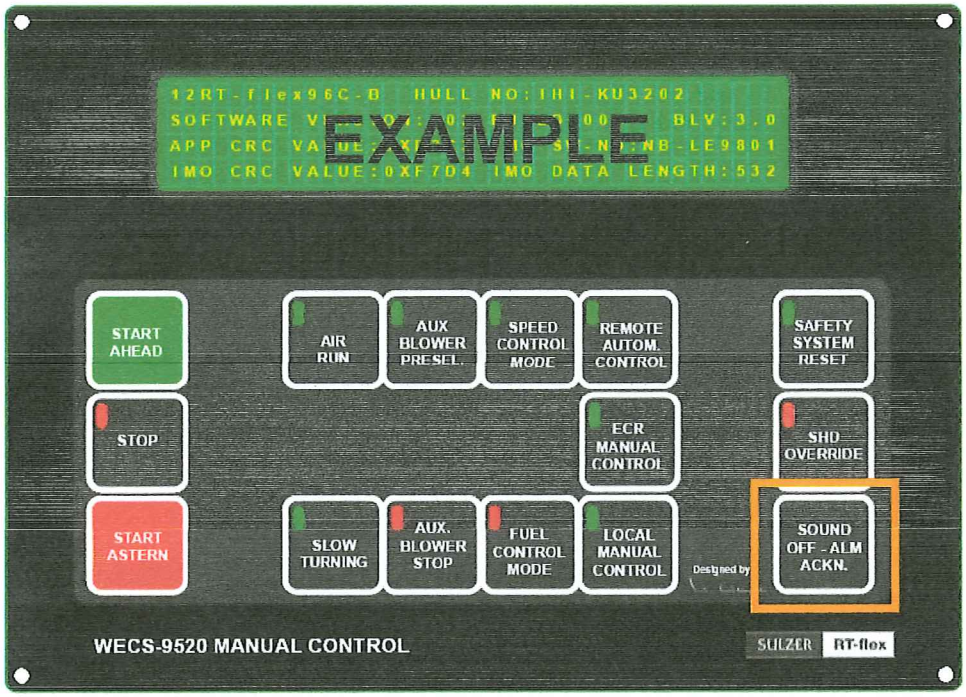
1) The setting of the temperature controller for the scavenge air cooling water at scavenge air cooler inlet should be min. 29°C based on sea water temperature 25°C, but not higher than 32°C in case of sea water cooling systems and not higher than 36°C for fresh water cooling systems at tropical conditions.

2) Average of all cylinders measured during official shop test at 100% and 75% (ISO corrected) load.

3) 'IMO CRC VALUE' and 'IMO DATA LENGTH' has to be filled in at the shop test of the engine. Both are displayed on the WECS-9520 Manual Control. See page B.2

Engine control system parameters

IMO relevant WECS parameters ('IMO SW-NO', 'IMO CRC VALUE' and 'IMO DATA LENGTH') can be checked on the WECS-9520 Manual Control. A display similar to the example below appears after pressing the button "**SOUND OFF – ALM ACKN.**" (marked in orange) for approximate *3 seconds*.



Engine documentation at shop test:

1. "IMO CRC Value" and "IMO DATA LENGTH" must be filled into the list on page B.1.

2. The engine parameters at 100%, 75%, 50% and 25% load must be documented in the shop test protocol with print-screens of the window "IMO" from FlexView.

Parameter 'FQS' and 'Inj. begin offset' settings

The following parameters are adjustable and must be in the following range:

	min.	*max.*	
FQS	-1	1	[°CA]
Inj. begin offset cylinder 1-n	-0.5	0.5	[°CA]

Please note, the average of 'Inj. begin offset' may not exceed ±0.2°CA!

On board verification procedure

The procedure described here is intended to provide an easy and reliable check of the engine in order to confirm its compliance with Annex VI to Marpol 73/78. This list should be used for initial, periodical and intermediate surveys after installation of the engine in the ship.

Reference Values

All ID-numbers, settings and dimensions mentioned in the following verification procedure are defined in the "List of NO_X relevant components and settings" and "Engine control system parameters".
The exact position of the ID-numbers on the specific components is indicated in the appendix to this chapter.

Verification procedure

1. Check nameplate of the engine.

Engine control system parameters (refer to page B.2)

2. Check the IMO relevant parameters ('IMO SW-NO', 'IMO CRC VALUE' and 'IMO DATA LENGTH') on the WECS-9520 Manual Control.
3. Crank angle control is available via remote control system (RCS) on board. Staff on board has authority to show respective indications on the control panel.

Firing pressure, FQS-limit and injection begin offset

4. Check firing pressure (average from all cylinders) from indicator diagrams taken at 85%-100% load and/or 75% load. The firing pressure(s) must not exceed the required value as indicated in the 'List of NO_X relevant components and settings' page B.1.

   Note: The actual pressure or the previously taken pressures (by Maihak indicators, for example) by the crew during FQS adjustment must be at or lower than the value indicated in the 'List of NO_X relevant components and settings'. In case the FQS adjustment cannot be performed at 100% load, other loads (as 75% load) can be taken on condition the reference value for the firing pressure is known. Please note that below 85% load the VIT is acting in a reduced way and influence of ambient conditions are not corrected automatically to the full extent.

5. Check the FQS-limitation on the OPI (Operator Interface) panel of the Propulsion Control system.
   → The FQS is adjustable within the range of ±1°CA.
6. Access to injection begin offsets is via remote control system (RCS) on board. Staff on board has authority to show respective values.
   → the average over all cylinder offsets must not exceed ±0.2°CA.

Engine components (refer to page B.1, C.4)

7. Check supplier and type of engine control hardware.
8. Check ID-numbers of the injection nozzles of each cylinder of the engine. (Dismantling as described in the maintenance manual).
9. Check ID numbers of the injection control unit (control block) for each cylinder
10. Check ID-number of the piston head for each cylinder. The crankshaft has to be turned until the number just below the piston rings can be seen trough the liner scavenging ports (exhaust side).
11. Check ID-number of the piston rod for each cylinder.
12. Check ID-number of the cylinder cover for each cylinder.
13. Check ID-number of the cylinder liner for each cylinder.
14. Check the shim thickness at each cylinder. The shims are placed in between piston rod and crosshead – just near the marking place of the piston rod (arrow 13 in the overview picture on appendix page C.4). The shim thickness is measured in millimetres.
15. Check ID-numbers of exhaust valve unit (cylinder of partition device, exhaust valve upper housing and exhaust valve housing) for each cylinder.

Check of turbocharger and aux. blower (refer to page B.1, C.4 and C.7)

16. Check the number and the correct specification of the turbocharger(s) on the nameplate.
17. Check number and correct specification of auxiliary blower(s) on the nameplate.

Check of scavenge air cooling system (refer to page B.1, C.8 and C.9)

18. Check ID-number of the scavenge air cooler.
19. Check the correct setting of the temperature controller of the cooling water system (page B.1) and the resulting scavenge air temperature (page C.9).
    Deviations to the reference conditions as mentioned on page C.9 can be corrected as follow:
    - An increase of the coolant temperature before SAC about 1°C causes an increase of the scavenge air temperature of approximately 1°C.
    - Increasing the air temperature before blower has no major (0.03°C per 1°C) influence to the scavenge air temperature.
20. Check layout of cooling system and compare with required layout as attached.

According to paragraph 2.3.12 in the NO_X Technical Code to ANNEX VI to Marpol 73/78 this verification procedure may be abbreviated by the administration by reducing the number of cylinders inspected. Differences in injection timing, combustion chamber design and compression ratio from cylinder to cylinder would lead to unbalanced function of the engine. Therefore an unequal adjustment of these parameters is unlikely.

***Note*:**
Sensors and gauges used in connection with on board adjustments and verifications must be applied, serviced and calibrated according to manufacturer's guidelines and Annex VI requirements (NO_X Technical Code Appendix 4).

Particulars of the engine

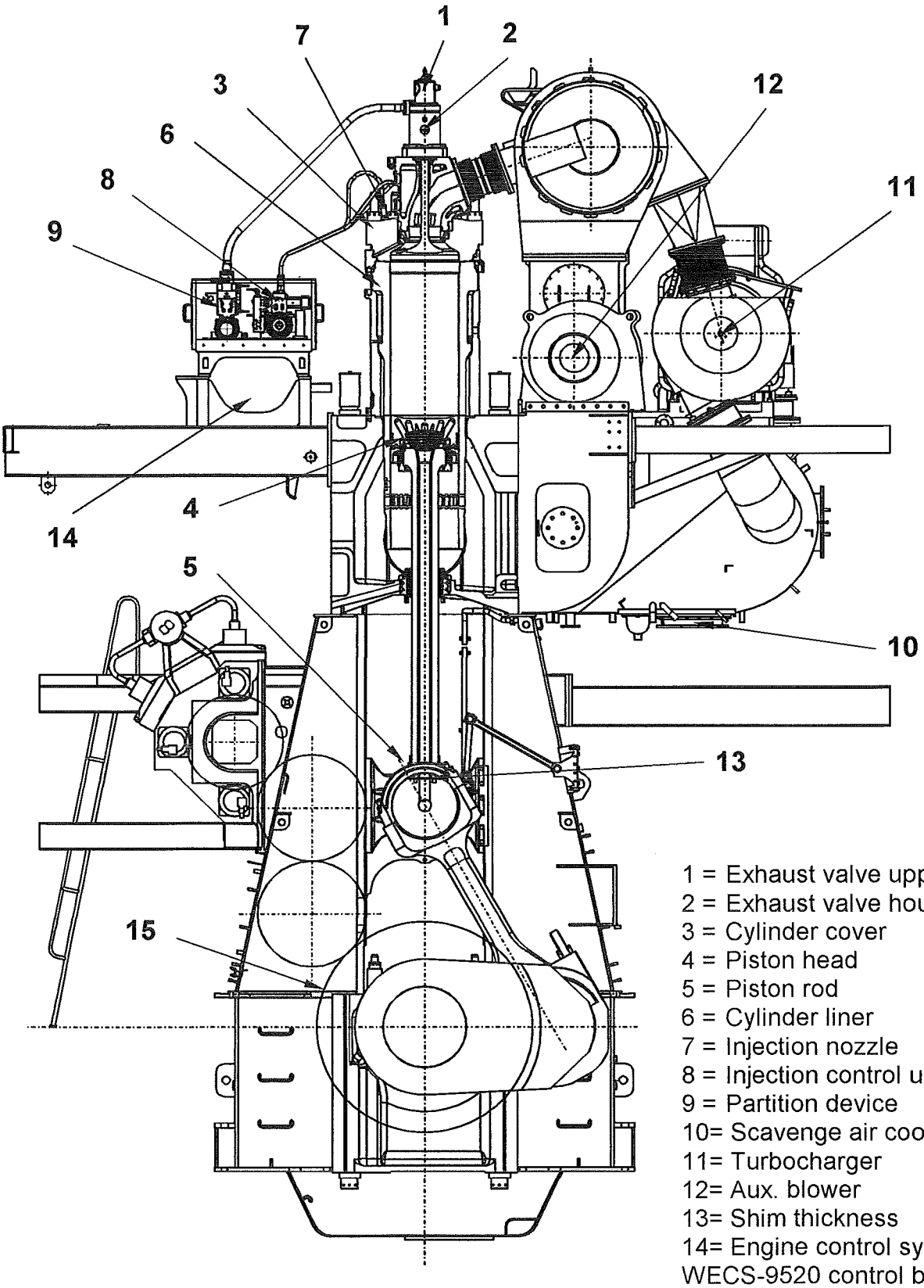
Engine type and model number: 7RTFIex50B
Engine Serial number: 02
EIAPP approval number: .....

Identification/Approval number: .....

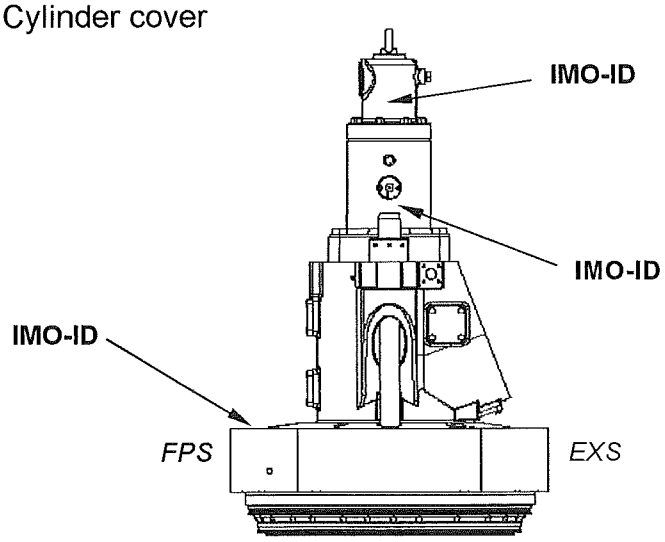
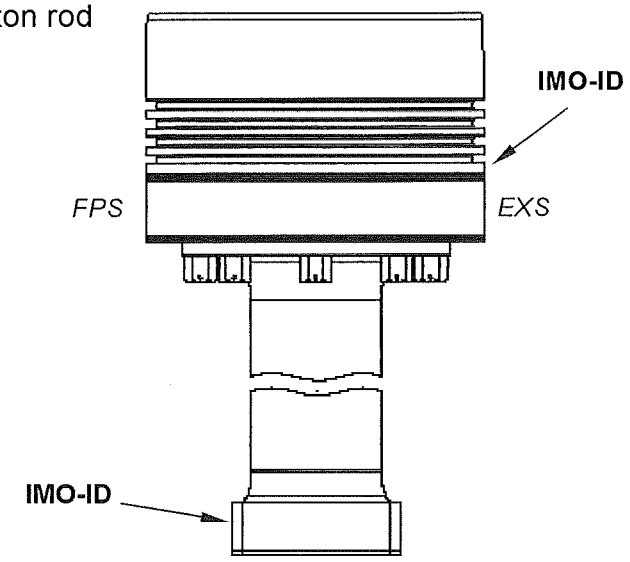
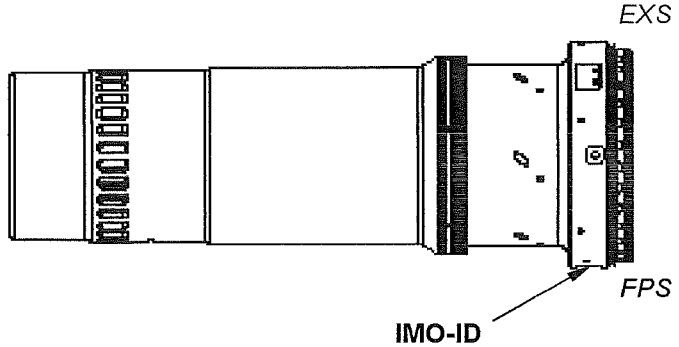
Approval date: .....

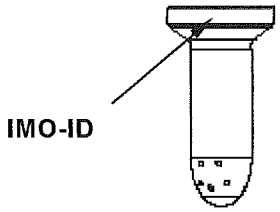
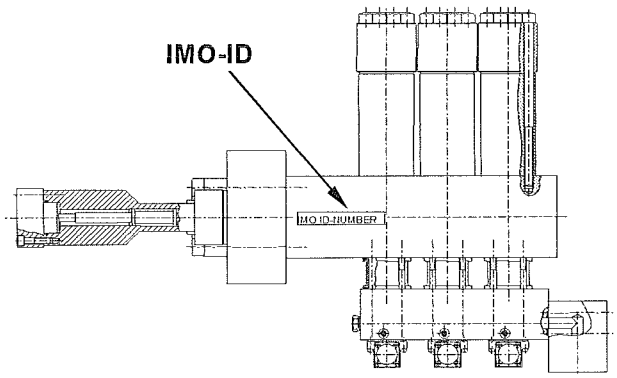
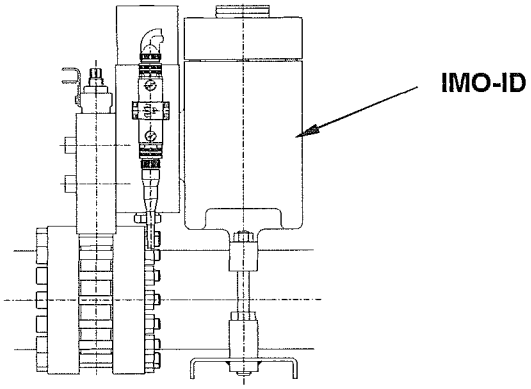
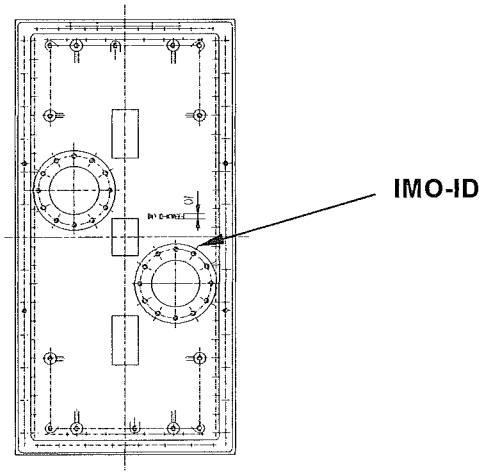
Appendixes to On Board Verification Procedure

Position of ID-numbers

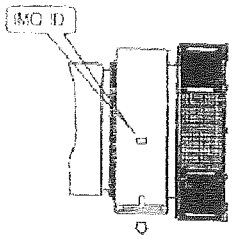
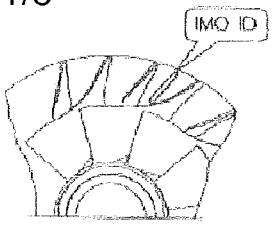
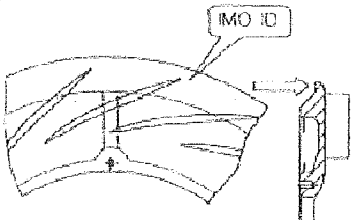
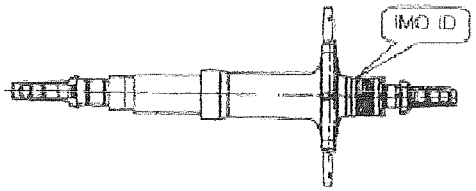
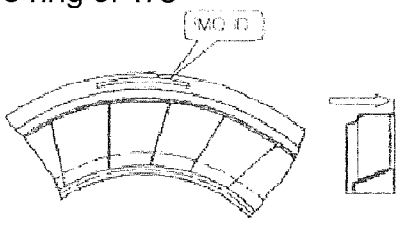
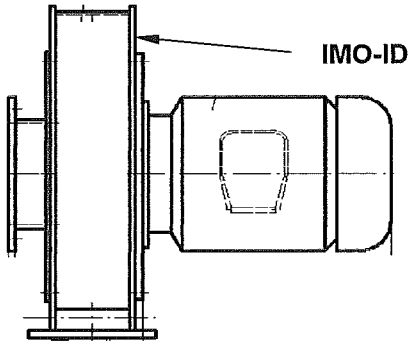


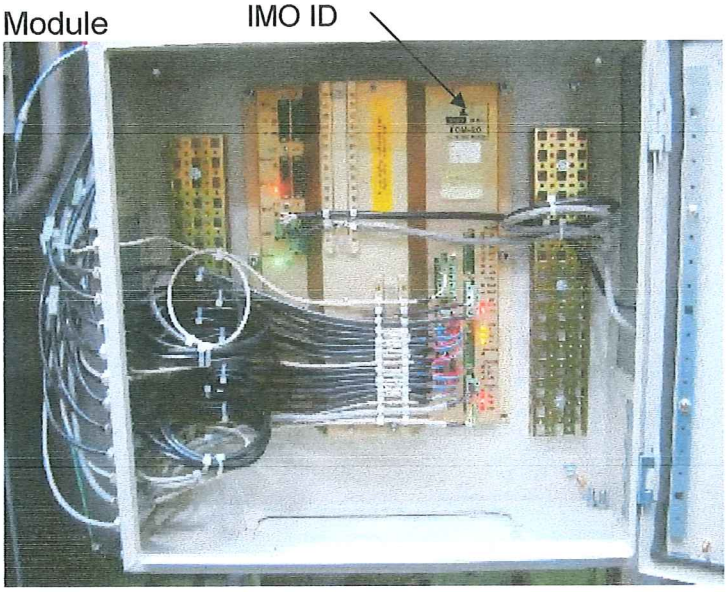
1 = Exhaust valve upper housing
2 = Exhaust valve housing
3 = Cylinder cover
4 = Piston head
5 = Piston rod
6 = Cylinder liner
7 = Injection nozzle
8 = Injection control unit
9 = Partition device
10= Scavenge air cooler
11= Turbocharger
12= Aux. blower
13= Shim thickness
14= Engine control system; WECS-9520 control box with FCM-20 inside
15= Crank angle

No.	Location of IMO-ID No.	Wärtsilä ID No.	Manufacturer ID No.
1-3	Exhaust valve upper housing Exhaust valve housing Cylinder cover 	LN-BG2705 LN-BG2710 LN-BG-2700	W2.R049.27.7003 W2.R049.27.0014 W2.R049.27.6500
4,5	Piston head Piston rod 	LN-BG3000 LN-BG3200	W2.R049.34.6500 W2.R049.34.6502
6	Cylinder Liner 	LN-BG2100	W2.R049.21.6501

No.	Location of IMO-ID No.	Wärtsilä ID No.	Manufacturer ID No.
7	Injection nozzle 	LN-BG2205	W2.R049.27.6507
8	Injection control unit 	LN-BG5500	W2.R049.55.6510
9	Cylinder of partition device 	LN-BG5600	W2.R049.56.7000
10	Scavenge air cooler 	LN-BG6022	

Specification of turbocharger and aux. blower

No.	Location of IMO-ID No.	Serial No. respectively specification
11	Turbocharger 	TPL77-B12 no. HT480842
	Compressor wheel of T/C 	CT75
	Diffuser ring of T/C 	CA15, CT75
	Turbine rotor of T/C 	TF20, TT40
	Turbine nozzle ring of T/C 	TA25, TT40
12	Aux. blower 	DM40-7 no.0975

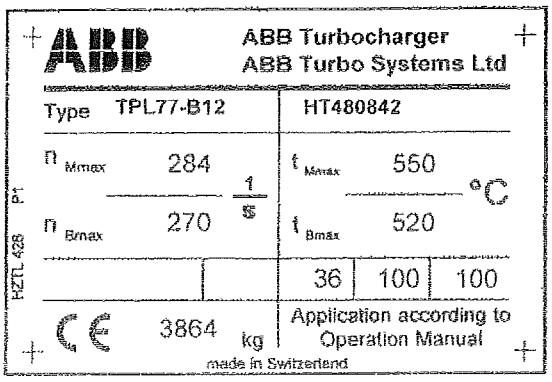
No.	Location of IMO-ID No.	Wärtsilä ID No.	Manufacturer ID No.
14	FCM-Module 	FCM-20	FCM-20

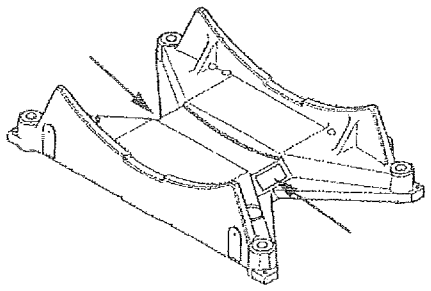
Technical File
for ABB Turbocharger on Engine with IMO-NOx-Certification

Type of Turbocharger: TPL77-B12

Serial-No.: HT480842

General instruction about identification of the turbocharger's air- and gasflow components.
Turbocharger Type, Serial-No. and operating limits are indicated on the rating plate.
The rating plate is positioned on the turbocharger foot.





The designation of the turbocharger type consists of 3 letters an 2 digits for the size and 1 letter and 2 digits for the compressor type, e.g. TPL69-A10.

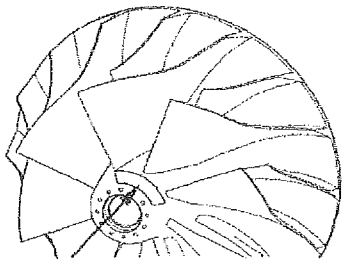
The traceability to the specification is given by the Serial-No., e.g. HT421524.

The thermo-dynamical characteristics (charge air pressure and air mass flow) of the turbocharger for this specific application will be specificed by the following components:

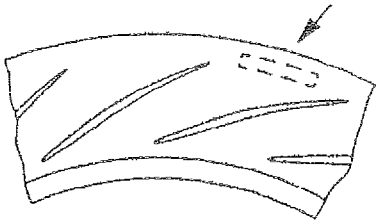
Component	Serial-No.	Position of Code
	HT480842	

Each component is marked with 2 letter and 2 digit codes indicating the specific feature.

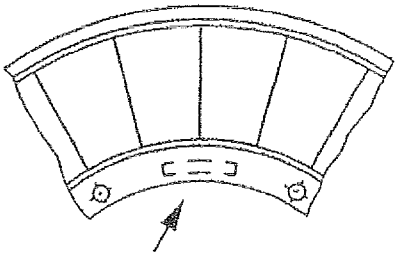
1. Compressor wheel, — Code: CT75



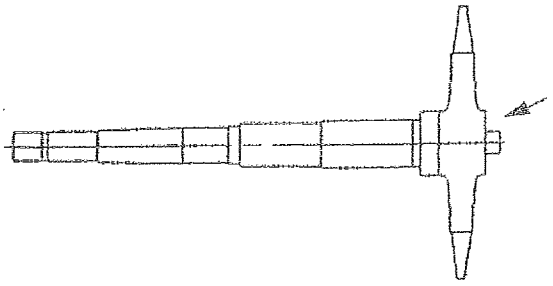
2. Diffusor, — Code: CA15, CT75



3. Nozzle ring, — Code: TA25, TT40



4. Turbine shaft, — Code: TF20, TT40



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Date: 2007-07-26

ABB Turbo Systems Ltd
Turbocharger Center

Required layout of scavenge air cooling system

(Drawing of fresh or sea water cooling system applied on board of the ship; the drawing calculated by Wärtsilä Switzerland Ltd.'s "winGTD" can be included).

WÄRTSILÄ **RT-flex** — General Technical Data

7RT-flex50-B

11620,0 kW 100,0% R1
124,0 rpm 100,0% R1

IMO emission compliant

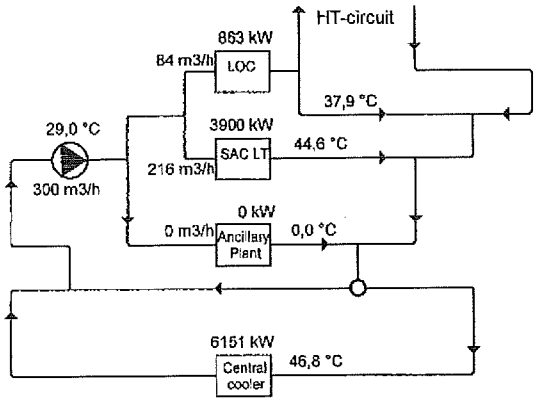
Project:
Yard / Plant:
Owner:
Created: 2007-03-20 /...
Printed: 2007-03-20

FW cooled / single-stage SAC (service conditions)

Design conditions		Service conditions	
Air temperature before blower	45,0 °C	Air temperature before blower	25,0 °C
Engine room ambient air temp.	45,0 °C	Engine room ambient air temp.	25,0 °C
Coolant temperature before SAC	36,0 °C	Coolant temperature before SAC	29,0 °C
Barometric pressure	1000,0 mbar	Barometric pressure	1000,0 mbar
Cylinder water outlet temperature	85,0 °C	Cylinder water outlet temperature	85,0 °C
Oil temperature before engine	45,0 °C	Oil temperature before engine	45,0 °C
Exhaust gas back pressure	300,0 mm WG	Exhaust gas back pressure	300,0 mm WG

Fresh water cooled / single-stage SAC - 1 x TPL77B12 (ABB) / 1 x SAC65F

Main cooling FW
Service conditions



System data at 100 %Rx (11620,0 kW)

Reference temperature of scavenge air

(Printout of scavenge air system at reference conditions calculated by Wärtsilä Switzerland Ltd.'s "winGTD")

WÄRTSILÄ **RT-flex** — General Technical Data

7RT-flex50-B

11620,0 kW 100,0% R1
124,0 rpm 100,0% R1
IMO emission compliant

Project:
Yard / Plant:
Owner:
Created: 2007-03-20 /...
Printed: 2007-03-20

Scavenge air system (service conditions)

Design conditions			Service conditions		
Air temperature before blower	45,0	°C	Air temperature before blower	25,0	°C
Engine room ambient air temp.	45,0	°C	Engine room ambient air temp.	25,0	°C
Coolant temperature before SAC	36,0	°C	Coolant temperature before SAC	29,0	°C
Barometric pressure	1000,0	mbar	Barometric pressure	1000,0	mbar
Cylinder water outlet temperature	85,0	°C	Cylinder water outlet temperature	85,0	°C
Oil temperature before engine	45,0	°C	Oil temperature before engine	45,0	°C
Exhaust gas back pressure	300,0	mm WG	Exhaust gas back pressure	300,0	mm WG

Fresh water cooled / single-stage SAC - 1 x TPL77B12 (ABB) / 1 x SAC65F

Service conditions

Power %CMCR	Power kW	after TC °C	after SAC °C	Mass flow kg/h	Pressure bar g
110,0	12782,0	210,7	42,1	96121	3,24
100,0	**11620,0**	**197,9**	**40,5**	**90520**	**2,95**
95,0	11039,0	190,1	39,5	86877	2,77
90,0	10458,0	181,5	38,5	82723	2,58
85,0	9877,0	173,2	37,5	78917	2,39
80,0	9296,0	165,9	36,8	75576	2,23
75,0	8715,0	158,6	36,0	71986	2,07
70,0	8134,0	150,0	35,0	67675	1,90
60,0	6972,0	131,8	33,5	58077	1,52
50,0	5810,0	110,5	31,9	47700	1,13

Turbocharger (ABB type)	Scavenge air cooler
1 x TPL77B12	**1 x SAC65F** internal specific.

Wärtsilä Switzerland Ltd
CH-8401 Winterthur
Switzerland

winGTD 2.9 / 2006-03

WÄRTSILÄ

At **25%** load the coolant temperature of water before scavenge air cooler has to be taken for reference scavenge air temperature (**29°C for fresh water** respectively **25°C for sea water** cooling)

Guideline for Component Replacements

If any of the components listed under "List of NO_X relevant components and settings" has to be changed during operation, the replacing component should be identical to the old one.
The guarantee to receive the correct component can only be achieved by ordering the new components from the engine manufacturer or Wärtsilä Switzerland Ltd. and the Network Companies.

Proceeding for the replacement

1. Order the component indicating the ID-numbers specified in this Technical File from the engine manufacturer or Wärtsilä Switzerland Ltd..
2. Substitute the old component by the new one.
3. Record the substitution including component specification, date of replacement and component supplier in the "Engine's Record Book of engine parameters", which must be kept on board of the ship.

"FQS" and "Injection Begin Offset" settings
After replacement of engine components check firing pressure (average from all cylinders) and adjust accordingly. The parameter "FQS" and "Injection Begin Offsets" must be set in that way to reach **same or lower firing pressure** as noted in the "List of NO_X relevant component and settings" page B.1. In the case the adjustment cannot be performed at 100% load, other loads, as 75% load, can be taken on condition the reference value for the firing pressure is known.

Special requirements:

'IMO CRC VALUE' and 'IMO CRC DATA' have to be checked monthly. The values must be included in the Engine Record Book.

'FQS' and 'Injection Offset' have to be checked at least once per month – or after changes to one of the parameters – together with the firing pressure (Verification procedure item 3, page C.1) and have to be included in the Engine Record Book.

NO_X Emission Analysis

5 Measurement results

Mode	-	1	2	3	4
Start Time	hh:mm	17:29	19:30	19:51	20:22
Power	%	100	75	50	25
Speed	%	100	91	80	63
Engine test data					
Power [3]	kW	11628	8720	5815	2953
Speed [3]	rpm	124	113	99	78
Fuel consumption [3]	kg/h	2099.0	1543.0	1043.0	539.0
Uncorr. specific fuel consumption	g/kWh	181	177	179	183
Charge air temperature [3]	°C	40	37	34	33
Charge air ref.temperature [2]	°C	40	37	34	33
Charge air pressure [3]	bar	3.0	2.2	1.1	0.3
Ambient and gaseous emission					
Exhaust gas temp. at samp. point	°C	271	248	277	316
Barometric pressure of intake air	mbar	998	999	999	999
Temperature of intake air	°C	30.0	29.6	33.8	30.7
Humidity of intake air	%	35.0	37.6	30.2	34.9
Atmospheric factor (fa)	-	1.030	1.028	1.050	1.034
NOx (dry)	ppm	1087	1106	1371	1737
CO (dry)	ppm	66	71	53	29
HC (wet)	ppm	107	98	105	100
CO2 (dry)	%	5.04	4.52	4.63	5.14
O2 (dry)	%	14.10	14.80	14.61	13.90
Correction factors					
NO_x humidity corr. factor (K_{HDIES})	-	0.997	1.004	1.017	1.005
Fuel specific factor (F_{FH})	-	1.897	1.901	1.900	1.896
Dry to wet correction factor ($K_{w,r}$)	-	0.940	0.943	0.942	0.938
Calculated gas mass flow					
NO_x	kg/h	147.83	124.18	102.85	59.99
CO	kg/h	5.48	4.86	2.36	0.61
HC	kg/h	4.67	3.51	2.49	1.10
CO_2	kg/h	6578	4834	3269	1691
O_2	kg/h	13390	11516	7500	3325
Exhaust mass flow [1]	kg/h	91341	74591	49250	23048
Calculated specific emission					
NO_x without K_{HDIES} correction	g/kWh	12.75	14.18	17.38	20.21
NO_x	g/kWh	12.71	14.24	17.69	20.31
CO	g/kWh	0.47	0.56	0.41	0.20
HC	g/kWh	0.40	0.40	0.43	0.37
CO_2	g/kWh	566	554	562	573
O_2	g/kWh	1152	1321	1290	1126

1) Calculation of the exhaust gas mass flow: Universal carbon balance, Method 2
2) Given by the manufacturer.
3) Taken from manufactures test report.

5.1 Specific emissions

The engine's weighted emission value for nitrogen oxides according to the IMO NO_X Technical Code [1] was calculated as follows:

$$NO_x\text{-}emission\ value = \frac{\sum_{i=1}^{n} NOx_i \cdot WF_i}{\sum_{i=1}^{n} P_i \cdot WF_i}$$

NOx	Nitrogen value [g/h]
P	power [kW]
WF	weighting factor
i	operating point

The total weighted NO_X emission, as measured and calculated in accordance to the procedures in IMO NO_X Technical Code [1] was 14.5 g/kWh for test cycle E3.

6 Literature

[1] *IMO, Annex VI of MARPOL 73/78*
Regulations for the Prevention of Air Pollution from Ships and NO_X Technical Code
Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines
London, 1998

Test Report

WÄRTSILÄ

Performance data

WÄRTSILÄ RT-flex

Installation:	Engine type:	Lic.:	Eng. no.:	Hull no. :	Sheet:
EPI24331	7RT-flex50-B	HCP	2	EPI24331	1 / 26

Shipyard:	Class:	Nom. Power at CMCR:	Nom revolution:	Stroke :	Mean. eff. press.:	Optim.:
NA	CCS	11620 kW	124 rpm	2050 mm	19.97 bar	IMO

Shoptest

Brake type : RFA16S

Brake factor k : 1,471 Pe = k x brake force x rpm

Fuel properties: Net. spec. energy: **42 560** kJ / kg; Spec. grav.: **881** kg/m³ at 30 °C; Viscosity: **26.1** cSt at 40 °C

Sulphur content: **0.3** %; Water content: **0.01** %; Ash content: **0.001** %

General data	Date / Time		*		2007.10.11		14:20		2007.10.11		14:50	
	Loading theor. / Reading No.		*	%	25.0		1		50.0		2	
	Calculated load in % of CMCR / Mean eff. pressure			% / bar	25.4		8.06		50.55		12.69	
	Engine speed theor. / Engine power theor			rpm / kW	78.11		2 905		98.41		5 810	
	Engine speed meas. / speed in % of CMCR		*	rpm / %	78.1		63.0		98.6		80.0	
	Engine power meas. / calculated by WECS		*	kW / %	2 953		26.0		5 874		51	
	Fuel Command / scaled in % of CMCR	WECS	*	%	29.2		41.7		45.1		64.5	
	Brake force / Brake torque			t / kNm	25.7				40.5			
	IT_A / IT_B / IT_C / IT_D	WECS		∠°	-2.0	3.0	-1.5	-0.5	-2.5	2.1	-1.2	-1.6
	Inj. begin / Inj. std. angle / FQS / IT_DEL	WECS		∠°	0.8	1.3	0.0	0.0	-0.3	1.3	0.0	0.0
	p scav / % of CMCR / pscav at CMCR	WECS		bar / % /	0.28		32.00	3.03	0.94		48.00	3.03
	Injection time / Injection begin deadtime	WECS		ms	12.3		12.4		18.4		11.7	
	Quantity piston return / Inject	WECS		mA	3.9		8.6		3.9		11.2	
	Exhaust valve opening / closing angle	WECS		∠°	128.3		228.6		124.8		228.6	
	Exhaust valve opening / closing deadtime	WECS		ms	22.0		83.0		23.8		79.1	
	Control oil pressure / Pump in operation	WECS		bar / #	-		-		-		-	
	Servo oil pressure / pressure setpoint	WECS		bar	108		108		125		114	
	Fuel rail pressure / pres. control actuator %	WECS		bar / %	601		32		651		43	
	VIT / Kind of air suction		*		on		ER		on		ER	
Scavenge air	Aux. Blower / Waste gate				ON				OFF			
	No. of nozzles in operation	WECS		#	2				2			
	Barom. press. / Rel. humidity / Ambient temp.		*	bar / % / °C	1.020	30	24.0		1.020	30	24.0	
	Pressure drop across air cooler 1 / 2			mmWG	60				130			
	Pressure drop across air filter 1 / 2			mmWG	0				10			
	Scavenge air pressure (column / Manometer)			mmHG / bar	210		0.28		720		0.96	
	Scavenge air pressure (local Manometer / ISO)			bar	0.26		0.27		0.95		0.98	
	Pressure after blower 1 / 2			mmHG / bar	180		0.24		705		0.94	
	Temp. before blower 1 / 2		*	°C	30				30			
	Temp. after blower 1 / 2			°C	62				98			
	Temp. after air cooler 1 / 2		*	°C	32				30			
	Temp. after air cooler (Mean)			°C	32.0				30.0			
Exhaust gas	Pressure / Temp. in exhaust gas manifold			mmWG / °C	-		-		-		-	
	Exhaust back pressure / before exhaust boiler			mmWG / °C	-		-		-		-	
	Pressure before turbine 1 / 2			mm HG / bar	150		0.20		540		0.72	
	Pressure after turbine 1 / 2			mmWG	0				40			
	Temp. before turbine 1 / 2		*	°C	370				405			
	Temp. before turbine (Mean / ISO)			°C	370.0		365.5		405.0		401.4	
	Temp. after turbine 1 / 2		*	°C	340				330			
	Temp. after turbine (Mean / ISO)			°C	340.0		333.5		330.0		324.0	
	Temp. after cylinder	Mean		°C	306				351			
		1 / 2 / 3 / 4		°C	315	300	300	295	355	345	350	340
		5 / 6 / 7 / -		°C	305	310	315		360	350	355	
	Turboblower speed 1 / 2		*	rpm	5 770				10 461			
	Turboblower efficiency 1 / 2			%	63.26				65.61			
	Pressure ratios: blower / turbine 1 / 2											
	Air consumtion per blower 1 / 2			kg/h / m³/s								
	Spec. air consumtion 1 / 2			kg/kW h								
Cylinder press.	Compression- / Combustion pressure	Mean		bar	52.0		82.1		80.4		114.1	
		ISO		bar	52.5		82.7		81.5		115.2	
		1	*	bar	51.0		82.0		80.0		115.0	
		2	*	bar	51.0		82.0		80.0		114.0	
		3	*	bar	52.0		82.0		80.0		114.0	
		4	*	bar	53.0		82.0		80.0		113.0	
		5	*	bar	53.0		83.0		82.0		115.0	
		6	*	bar	52.0		82.0		81.0		114.0	
		7	*	bar	52.0		82.0		80.0		114.0	
	Ignition ratio / Pcomb-Pcomp				1.58		30.14		1.42		33.71	
	Pcomp/pscav				41.42		41.42		41.34		41.34	
Systems	Air press.: Control air / Valve air spring			bar	6.6		6.7		6.6		6.7	
	Lub. oil press.: Bearing / Crosshead			bar	5.4		5.4		5.3		5.3	
	Geislinger / Elba			bar	-		-		-		-	
	DYNEX inlet / Boll&Kirch flushing interva			bar / min	5.20				5.00			
	T/C lub oil inlet 1 / 2			bar	2.1				1.6			
	Axial detuner driving end / free enc			bar	5.1		5.3		5.0		5.2	
	Water press.: Cylinder			bar	3.7				3.7			
	Air cooler stage I 1 / 2			bar	2.0				2.0			
	Lub. oil temp.: Engine inlet / Thrust bearing			°C	40		40		40		40	
	T/C. inlet temp 1 / 2			°C	40				40			
	T/C outlet temp 1 / 2			°C	43				50			
	Piston inlet / outlet Mear			°C	40		56		40		58	
	Outlet	1 / 2 / 3 / 4		°C	56	58	57	57	57	60	58	58
		5 / 6 / 7 / -		°C	55	55	56		57	57	58	
	Water temp.: Cylinder inlet / outlet Mear			°C	77		82		76		83	
	Outlet	1 / 2 / 3 / 4		°C	82	82	82	82	83	83	83	83
		5 / 6 / 7 / -		°C	82	82	82		83	82	82	
	Air cooler inlet stage I 1 / 2			°C	20				26			
	Air cooler outlet stage I 1 / 2			°C	21				32			
	Fuel : Press. before / after engine			bar	10.0		9.0		9.5		8.5	
	Consumption absol. / spec.		*	kg/h / gr/kWh	534		181.0		1039		176.8	
	Spec. consumption ISO (42707 kJ/kg)			gr/kWh	180.0				176.0			
	Temp. / Viscosity before engine			°C / cSt	59.0				59.0			
	Cyl. lub. oil : Pump speed factor / Frequency output			- / Hz	1.00		16.0		1.00		32.0	
	E-Motor rpm / Lub. shaft rpm			rpm	464		15.5		928		31.0	
	Setting: Upper / lower level			Pos / Pos	5	100			5	100		
	Consumption absol. / spec.			kg/h / gr/kWh	4.87		1.65		9.74		1.66	
	OMD Percentage of alarm level (Supply Unit)			%								
	OMD Percentage of alarm level (Crankcase)			%								

WÄRTSILÄ

Performance data

WÄRTSILÄ RT-flex

Installation:		Engine type:	Lic.:	Eng. no.:	Hull no. :	Sheet:
EPI24331		**7RT-flex50-B**	**HCP**	**2**	**EPI24331**	**2 / 26**
Shipyard:	**Class:**	*Nom. Power at CMCR:*	*Nom revolution:*	*Stroke :*	*Mean. eff. press.:*	*Optim.:*
NA	**CCS**	**11620 kW**	**124 rpm**	**2050 mm**	**19.97 bar**	**IMO**

Shoptest

Brake type : RFA16S

Brake factor k : 1,471 Pe = k x brake force x rpm

Fuel properties: Net. spec. energy: **42 560** kJ / kg; Spec. grav.: **881** kg/m³ at: 30 °C; Viscosity: **26.1** cSt at: 40 °C

Sulphur content: **0.3** %; Water content: **0.01** %; Ash content: **0.001** %

General data	Date / Time		*		2007.10.11		15:20		2007.10.11		15:50	
	Loading theor. / Reading No.		*	%	75.0		3		90.0		4	
	Calculated load in % of CMCR / Mean eff. pressure			% / bar	75		16.45		91.0		18.8	
	Engine speed theor. / Engine power theor			rpm / kW	112.66		8 715		119.71		10 458	
	Engine speed meas. / speed in % of CMCR		*	rpm / %	112.9		91.0		119.7		97.0	
	Engine power meas. / calculated by WECS		*	kW / %	8 719		75.0		10 565		87	
	Fuel Command / scaled in % of CMCR	WECS	*	%	57.5		82.0		63.8		90.8	
	Brake force / Brake torque			t / kNm	52.5				60.0			
	IT_A / IT_B / IT_C / IT_D	WECS		∠°	-2.6	0.9	-0.9	-2.6	-2.7	0.4	0.0	-2.3
	Inj. begin / Inj. std. angle / FQS / IT_DEL	WECS		∠°	-1.3	1.3	0.0	0.0	-1.0	1.3	0.0	0.0
	p scav / % of CMCR / pscav at CMCR	WECS		bar / %	1.98		74.00	3.03	2.40		84.00	3.03
	Injection time / Injection begin deadtime	WECS		ms	22.4		10.9		22.3		10.4	
	Quantity piston return / Inject	WECS		mA	3.9		13.7		3.9		14.3	
	Exhaust valve opening / closing angle	WECS		∠°	124.8		251.6		123.7		251.6	
	Exhaust valve opening / closing deadtime	WECS		ms	21.8		78.0		21.2		78.3	
	Control oil pressure / Pump in operation	WECS		bar / #	-		-		-		-	
	Servo oil pressure / pressure setpoint	WECS		bar	150		150		163		164	
	Fuel rail pressure / pres. control actuator %	WECS		bar / %	718		51		900		59	
	VIT / Kind of air suction		*		on		ER		on		ER	
Scavenge air	Aux. Blower / Waste gate				OFF				OFF			
	No. of nozzles in operation	WECS		#	2				2			
	Barom. press. / Rel. humidity / Ambient temp.		*	bar / % / °C	1.020	30	24.0		1.020	30	24.0	
	Pressure drop across air cooler 1 / 2			mmWG	180				210			
	Pressure drop across air filter 1 / 2			mmWG	40				50			
	Scavenge air pressure (column / Manometer)			mmHG / bar	1650		2.20		1890		2.52	
	Scavenge air pressure (local Manometer / ISO)			bar	1.97		2.04		2.48		2.58	
	Pressure after blower 1 / 2			mmHG / bar	1500		2.00		1875		2.50	
	Temp. before blower 1 / 2		*	°C	34				34			
	Temp. after blower 1 / 2			°C	132				152			
	Temp. after air cooler 1 / 2		*	°C	34				37			
	Temp. after air cooler (Mean)			°C	34.0				37.0			
Exhaust gas	Pressure / Temp. in exhaust gas manifold			mmWG / °C	-		-		-		-	
	Exhaust back pressure / before exhaust boiler			mmWG / °C	-		-		-		-	
	Pressure before turbine 1 / 2			mm HG / bar	1185		1.58		1500		2.00	
	Pressure after turbine 1 / 2			mmWG	100				170			
	Temp. before turbine 1 / 2		*	°C	415				440			
	Temp. before turbine (Mean / ISO)			°C	415.0		405.8		440.0		431.1	
	Temp. after turbine 1 / 2		*	°C	290				290			
	Temp. after turbine (Mean / ISO)			°C	290.0		278.6		290.0		278.2	
	Temp. after cylinder	Mean		°C	354				376			
		1 / 2 / 3 / 4		°C	360	350	350	345	380	375	375	370
		5 / 6 / 7 / -		°C	350	365	355		380	380	370	
	Turboblower speed 1 / 2		*	rpm	13 830				15 013			
	Turboblower efficiency 1 / 2			%	68.69				68.79			
	Pressure ratios: blower / turbine 1 / 2											
	Air consumtion per blower 1 / 2			kg/h / m³/s								
	Spec. air consumtion 1 / 2			kg/kW h								
Cylinder press.	Compression- / Combustion pressure	Mean		bar	106.4		143.3		126.3		159.7	
		ISO		bar	108.9		145.5		130.0		160.8	
		1	*	bar	107.0		144.0		127.0		160.0	
		2	*	bar	105.0		144.0		127.0		160.0	
		3	*	bar	107.0		144.0		126.0		160.0	
		4	*	bar	105.0		142.0		125.0		159.0	
		5	*	bar	107.0		142.0		127.0		160.0	
		6	*	bar	107.0		144.0		125.0		159.0	
		7	*	bar	107.0		143.0		127.0		160.0	
	Ignition ratio / Pcomb-Pcomp				1.35		36.86		1.26		33.43	
	Pcomp/pscav				35.94		35.94		36.37		36.37	
Systems	Air press.:	Control air / Valve air spring		bar	6.6		6.7		6.6		6.7	
	Lub. oil press.:	Bearing / Crosshead		bar	5.2		5.2		5.1		5.1	
		Geislinger / Elba		bar	-		-		-		-	
		DYNEX inlet / Boll&Kirch flushing interva		bar / min	4.80				4.70			
		T/C lub oil inlet 1 / 2		bar	2.1				2.2			
		Axial detuner driving end / free enc		bar	4.9		5.2		4.8		5.0	
	Water press.:	Cylinder		bar	3.7				3.7			
		Air cooler stage I 1 / 2		bar	2.0				2.0			
	Lub. oil temp.:	Engine inlet / Thrust bearing		°C	40		41		40		41	
		T/C. inlet temp 1 / 2		°C	40				40			
		T/C outlet temp 1 / 2		°C	62				68			
		Piston inlet / outlet Mear		°C	40		60		40		62	
		Outlet	1 / 2 / 3 / 4	°C	59	61	61	60	61	63	62	62
			5 / 6 / 7 / -	°C	59	59	60		61	61	62	
	Water temp.:	Cylinder inlet / outlet Mear		°C	75		84		74		84	
		Outlet	1 / 2 / 3 / 4	°C	84	83	84	84	84	83	84	84
			5 / 6 / 7 / -	°C	84	83	83		84	84	83	
		Air cooler inlet stage I 1 / 2		°C	28				28			
		Air cooler outlet stage I 1 / 2		°C	39				43			
	Fuel :	Press. before / after engine		bar	9.5		8.5		9.0		8.0	
		Consumption absol. / spec.	*	kg/h / gr/kWh	1522		174.6		1856		175.7	
		Spec. consumption ISO (42707 kJ/kg)		gr/kWh	173.4				175.0			
		Temp. / Viscosity before engine		°C / cSt	55.0				55.0			
	Cyl. lub. oil :	Pump speed factor / Frequency output		- / Hz	1.00		47.0		1.00		57.0	
		E-Motor rpm / Lub. shaft rpm		rpm	1363		45.6		1653		55.3	
		Setting: Upper / lower level		Pos / Pos	5	100			5	100		
		Consumption absol. / spec.		kg/h / gr/kWh	14.30		1.64		17.35		1.64	
	OMD	Percentage of alarm level (Supply Unit)		%								
	OMD	Percentage of alarm level (Crankcase)		%								

WÄRTSILÄ

Performance data

WÄRTSILÄ RT-flex

Installation:	Engine type:	Lic.:	Eng. no.:	Hull no. :	Sheet:
EPI24331	7RT-flex50-B	HCP	2	EPI24331	3 / 26

Shipyard:	Class:	Nom. Power at CMCR:	Nom revolution:	Stroke :	Mean. eff. press.:	Optim.:
NA	CCS	11620 kW	124 rpm	2050 mm	19.97 bar	IMO

Shoptest

Brake type : RFA16S

Brake factor k : 1,471 Pe = k x brake force x rpm

Fuel properties: Net. spec. energy: **42 560** kJ / kg; Sulphur content: **0.3** %

Spec. grav.: **881** kg/m³ at: 30 °C; Water content: **0.01** %

Viscosity: **26.1** cSt at: 40 °C; Ash content: **0.001** %

General data	Date / Time		*		11.10.07		16:30		11.10.07		17:00	
	Loading theor. / Reading No.		*	%	100.0		5		100.0		6	
	Calculated load in % of CMCR / Mean eff. pressure			% / bar	100.62		20.09		100.46		20.06	
	Engine speed theor. / Engine power theor			rpm / kW	123.99		11 620		123.99		11 620	
	Engine speed meas. / speed in % of CMCR		*	rpm / %	124.0		100.0		124.0		100.0	
	Engine power meas. / calculated by WECS		*	kW / %	11 692		101.0		11 674		101	
	Fuel Command / scaled in % of CMCR	WECS	*	%	71.0		101.4		71.0		101.4	
	Brake force / Brake torque			t / kNm	64.1				64.0			
	IT_A / IT_B / IT_C / IT_D	WECS		∠°	-0.8	0.1	0.0	-0.7	-0.8	0.1	0.0	-0.7
	Inj. begin / Inj. std. angle / FQS / IT_DEL	WECS		∠°	0.6	1.3	0.0	0.0	0.6	1.3	0.0	0.0
	p scav / % of CMCR / pscav at CMCR	WECS		bar / %	2.88		96.00	3.03	2.88		96.00	3.03
	Injection time / Injection begin deadtime	WECS		ms	24.3		10.0		24.3		10.0	
	Quantity piston return / Inject	WECS		mA	3.9		15.1		3.9		15.1	
	Exhaust valve opening / closing angle	WECS		∠°	123.1		251.6		123.1		251.6	
	Exhaust valve opening / closing deadtime	WECS		ms	20.4		75.2		20.4		75.2	
	Control oil pressure / Pump in operatior	WECS		bar / #	-		-		-		-	
	Servo oil pressure / pressure setpoint	WECS		bar	180		180		180		180	
	Fuel rail pressure / pres. control actuator %	WECS		bar / %	903		62		903		62	
	VIT / Kind of air suction		*		on		ER		on		ER	
Scavenge air	Aux. Blower / Waste gate				off				off			
	No. of nozzles in operatior	WECS		#	2				2			
	Barom. press. / Rel. humidity / Ambient temp.		*	bar / % / °C	1.020	30	24.0		1.020	30	24.0	
	Pressure drop across air cooler 1 / 2			mmWG	225				220			
	Pressure drop across air filter 1 / 2			mmWG	60				60			
	Scavenge air pressure (column / Manometer)			mmHG / bar	2190		2.92		2175		2.90	
	Scavenge air pressure (local Manometer / ISO)			bar	2.88		3.00		2.88		3.00	
	Pressure after blower 1 / 2			mmHG / bar	2175		2.90		2160		2.88	
	Temp. before blower 1 / 2		*	°C	35				35			
	Temp. after blower 1 / 2			°C	160				158			
	Temp. after air cooler 1 / 2		*	°C	40				40			
	Temp. after air cooler (Mean)			°C	40.0				40.0			
Exhaust gas	Pressure / Temp. in exhaust gas manifold			mmWG / °C	-				-			
	Exhaust back pressure / before exhaust boiler			mmWG / °C	-				-			
	Pressure before turbine 1 / 2			mm HG / bar	1770		2.36		1770		2.36	
	Pressure after turbine 1 / 2			mmWG	280				280			
	Temp. before turbine 1 / 2		*	°C	470				470			
	Temp. before turbine (Mean / ISO)			°C	470.0		459.4		470.0		459.3	
	Temp. after turbine 1 / 2		*	°C	310				315			
	Temp. after turbine (Mean / ISO)			°C	310.0		296.5		315.0		301.5	
	Temp. after cylinder	Mean		°C	412				411			
		1 / 2 / 3 / 4		°C	415	405	415	410	415	405	415	410
		5 / 6 / 7 / -		°C	415	410	415		415	410	410	
	Turboblower speed 1 / 2		*	rpm	15 880				15 910			
	Turboblower efficiency 1 / 2			%	67.75				67.75			
	Pressure ratios: blower / turbine 1 / 2											
	Air consumtion per blower 1 / 2			kg/h / m³/s								
	Spec. air consumtion 1 / 2			kg/kW h								
Cylinder press.	Compression- / Combustion pressure	Mean		bar	139.9		160.0		140.3		159.6	
		ISO		bar	144.3		160.9		144.8		160.5	
		1	*	bar	140.0		160.0		140.0		159.0	
		2	*	bar	141.0		160.0		141.0		160.0	
		3	*	bar	140.0		160.0		140.0		160.0	
		4	*	bar	140.0		160.0		140.0		160.0	
		5	*	bar	139.0		160.0		141.0		160.0	
		6	*	bar	139.0		160.0		140.0		159.0	
		7	*	bar	140.0		160.0		140.0		159.0	
	Ignition ratio / Pcomb-Pcomp				1.14		20.14		1.14		19.29	
	Pcomp/pscav				36.12		36.12		36.23		36.23	
Systems	Air press.:	Control air / Valve air spring		bar	6.6		6.7		6.6		6.7	
	Lub. oil press.:	Bearing / Crosshead		bar	5.0		5.0		5.0		5.0	
		Geislinger / Elba		bar	-		-		-		-	
		DYNEX inlet / Boll&Kirch flushing interva		bar / min	4.60				4.50			
		T/C lub oil inlet 1 / 2		bar	2.1				2.1			
		Axial detuner driving end / free enc		bar	4.7		5.0		4.7		5.0	
	Water press.:	Cylinder		bar	3.7				3.7			
		Air cooler stage I 1 / 2		bar	2.0				2.0			
	Lub. oil temp.:	Engine inlet / Thrust bearing		°C	40		42		40		42	
		T/C. inlet temp 1 / 2		°C	40				40			
		T/C outlet temp 1 / 2		°C	73				73			
		Piston inlet / outlet Mear		°C	40		63		40		63	
		Outlet	1 / 2 / 3 / 4	°C	62	64	64	63	62	64	64	63
			5 / 6 / 7 / -	°C	61	62	63		62	62	63	
	Water temp.:	Cylinder inlet / outlet Mear		°C	72		83		72		84	
		Outlet	1 / 2 / 3 / 4	°C	84	82	84	84	84	83	84	84
			5 / 6 / 7 / -	°C	83	83	83		84	84	84	
		Air cooler inlet stage I 1 / 2		°C	28				29			
		Air cooler outlet stage I 1 / 2		°C	47				47			
	Fuel :	Press. before / after engine		bar	9.5		8.5		9.5		8.5	
		Consumption absol. / spec.	*	kg/h / gr/kWh	2087		178.5		2080		178.2	
		Spec. consumption ISO (42707 kJ/kg)		gr/kWh	177.7				177.4			
		Temp. / Viscosity before engine		°C / cSt	54.0				54.0			
	Cyl. lub. oil :	Pump speed factor / Frequency output		- / Hz	1.00		63.0		1.00		63.0	
		E-Motor rpm / Lub. shaft rpm		rpm	1827		61.1		1827		61.1	
		Setting: Upper / lower level		Pos / Pos	5	100			5	100		
		Consumption absol. / spec.		kg/h / gr/kWh	19.17		1.64		19.17		1.64	
	OMD	Percentage of alarm level (Supply Unit)		%								
	OMD	Percentage of alarm level (Crankcase)		%								

WÄRTSILÄ

Performance data

WÄRTSILÄ RT-flex

Installation:	Engine type:	Lic.:	Eng. no.:	Hull no. :	Sheet:
EPI24331	**7RT-flex50-B**	**HCP**	**2**	**EPI24331**	**4 / 26**

Shipyard:	Class:	Nom. Power at CMCR:	Nom revolution:	Stroke :	Mean. eff. press.:	Optim.:
NA	**CCS**	**11620 kW**	**124 rpm**	**2050 mm**	**19.97 bar**	**IMO**

Shoptest

Brake type : RFA16S

Brake factor k : 1,471 Pe = k x brake force x rpm

Fuel properties: Net. spec. energy: **42 560** kJ / kg Sulphur content: **0.3** %

Spec. grav.: **881** kg/m³ at: 30 °C Water content: **0.01** %

Viscosity: **26.1** cSt at: 40 °C Ash content: **0.001** %

General data	Date / Time		*		11.10.07		17:30		11.10.07		18:20	
	Loading theor. / Reading No.		*	%	100.0		7		110.0		8	
	Calculated load in % of CMCR / Mean eff. pressure			% / bar	100.39		20.03		110.19		21.31	
	Engine speed theor. / Engine power theor			rpm / kW	123.99		11 620		128.0		12 782	
	Engine speed meas. / speed in % of CMCR		*	rpm / %	124.1				128.0		104.0	
	Engine power meas. / calculated by WECS		*	kW / %	11 665		101.0		12 804		117	
	Fuel Command / scaled in % of CMCR	WECS	*	%	71.0		104.4		78.4		112.4	
	Brake force / Brake torque			t / kNm	63.9				68.0			
	IT_A / IT_B / IT_C / IT_D	WECS		∠°	-0.8	0.1	0.0	-0.7	0.6	-0.4	0.0	0.2
	Inj. begin / Inj. std. angle / FQS / IT_DEL	WECS		∠°	0.6	1.3	0.0	0.0	1.7	1.3	0.0	0.0
	p scav / % of CMCR / pscav at CMCR	WECS		bar / %	2.88		96.00	3.03	3.38		109.00	30.30
	Injection time / Injection begin deadtime	WECS		ms	24.3		10.0		27.1		9.9	
	Quantity piston return / Inject	WECS		mA	3.9		15.1		3.9		16.0	
	Exhaust valve opening / closing angle	WECS		∠°	123.1		251.6		122.3		251.6	
	Exhaust valve opening / closing deadtime	WECS		ms	20.4		75.2		27.3		76.6	
	Control oil pressure / Pump in operation	WECS		bar / #	-		-		-		-	
	Servo oil pressure / pressure setpoint	WECS		bar	180		180		181		180	
	Fuel rail pressure / pres. control actuator %	WECS		bar / %	903		62		902		65	
	VIT / Kind of air suction		*		on		ER		on		ER	
Scavenge air	Aux. Blower / Waste gate				off				off			
	No. of nozzles in operation	WECS		#	2				2			
	Barom. press. / Rel. humidity / Ambient temp.		*	bar / % / °C	1.020	30	24.0		1.020	30	24.0	
	Pressure drop across air cooler 1 / 2			mmWG	230				215			
	Pressure drop across air filter 1 / 2			mmWG	60				70			
	Scavenge air pressure (column / Manometer)			mmHG / bar	2190		2.92		2505		3.34	
	Scavenge air pressure (local Manometer / ISO)			bar	2.89		3.01		3.55		3.65	
	Pressure after blower 1 / 2			mmHG / bar	2160		2.88		2505		3.34	
	Temp. before blower 1 / 2		*	°C	35				37			
	Temp. after blower 1 / 2			°C	160				170			
	Temp. after air cooler 1 / 2		*	°C	40				45			
	Temp. after air cooler (Mean)			°C	40.0				45.0			
Exhaust gas	Pressure / Temp. in exhaust gas manifold			mmWG / °C	-		-		-		-	
	Exhaust back pressure / before exhaust boiler			mmWG / °C	-		-		-		-	
	Pressure before turbine 1 / 2			mm HG / bar	1770		2.36		2025		2.70	
	Pressure after turbine 1 / 2			mmWG	280				300			
	Temp. before turbine 1 / 2		*	°C	470				510			
	Temp. before turbine (Mean / ISO)			°C	470.0		459.3		510.0		493.1	
	Temp. after turbine 1 / 2		*	°C	310				350			
	Temp. after turbine (Mean / ISO)			°C	310.0		296.5		350.0		332.0	
	Temp. after cylinder	Mean		°C	411				476			
		1 / 2 / 3 / 4		°C	415	405	415	405	485	465	475	465
		5 / 6 / 7 / -		°C	415	410	415		475	475	490	
	Turboblower speed 1 / 2		*	rpm	15 929				16 800			
	Turboblower efficiency 1 / 2			%	67.91				69.45			
	Pressure ratios: blower / turbine 1 / 2											
	Air consumtion per blower 1 / 2			kg/h / m³/s								
	Spec. air consumtion 1 / 2			kg/kW h								
Cylinder press.	Compression- / Combustion pressure	Mean		bar	139.4		160.0		150.6		158.1	
		ISO		bar	143.9		160.9		154.0		161.7	
		1	*	bar	140.0		160.0		150.0		158.0	
		2	*	bar	138.0		160.0		150.0		158.0	
		3	*	bar	139.0		160.0		150.0		158.0	
		4	*	bar	140.0		160.0		150.0		158.0	
		5	*	bar	139.0		160.0		152.0		158.0	
		6	*	bar	140.0		160.0		152.0		158.0	
		7	*	bar	140.0		160.0		150.0		159.0	
	Ignition ratio / Pcomb-Pcomp				1.15		20.57		1.05		7.57	
	Pcomp/pscav				35.92		35.92		33.17		33.17	
Systems	Air press.:	Control air / Valve air spring		bar	6.6		6.7		6.6		6.7	
	Lub. oil press.:	Bearing / Crosshead		bar	5.0		5.0		4.9		4.9	
		Geislinger / Elba		bar								
		DYNEX inlet / Boll&Kirch flushing interva		bar / min	4.50				4.50			
		T/C lub oil inlet 1 / 2		bar	2.1				2.0			
		Axial detuner driving end / free enc		bar	4.7		5.0		4.6		4.9	
	Water press.:	Cylinder		bar	3.7							
		Air cooler stage I 1 / 2		bar	2.0							
	Lub. oil temp.:	Engine inlet / Thrust bearing		°C	40		42		40		42	
		T/C. inlet temp 1 / 2		°C	40				40			
		T/C outlet temp 1 / 2		°C	73				78			
		Piston inlet / outlet Mear		°C	40		63		40		65	
		Outlet	1 / 2 / 3 / 4	°C	62	64	64	63	64	66	66	65
			5 / 6 / 7 / -	°C	61	62	63		64	64	65	
	Water temp.:	Cylinder inlet / outlet Mear		°C	72		82		72		84	
		Outlet	1 / 2 / 3 / 4	°C	83	82	83	83	84	83	84	84
			5 / 6 / 7 / -	°C	82	82	82		84	84	84	
		Air cooler inlet stage I 1 / 2		°C	29				32			
		Air cooler outlet stage I 1 / 2		°C	47				52			
	Fuel :	Press. before / after engine		bar	9.5		8.5		10.0		9.0	
		Consumption absol. / spec.	*	kg/h / gr/kWh	2078		178.1		2334		182.3	
		Spec. consumption ISO (42707 kJ/kg)		gr/kWh	177.3				180.1			
		Temp. / Viscosity before engine		°C / cSt	54.0				55.0			
	Cyl. lub. oil :	Pump speed factor / Frequency output		- / Hz	1.00		63.0		1.00		69.0	
		E-Motor rpm / Lub. shaft rpm		rpm	1827		61.1		2001		66.9	
		Setting: Upper / lower level		Pos / Pos	5	100			5	100		
		Consumption absol. / spec.		kg/h / gr/kWh	19.17		1.64		21.00		1.64	
	OMD	Percentage of alarm level (Supply Unit)		%								
	OMD	Percentage of alarm level (Crankcase)		%								

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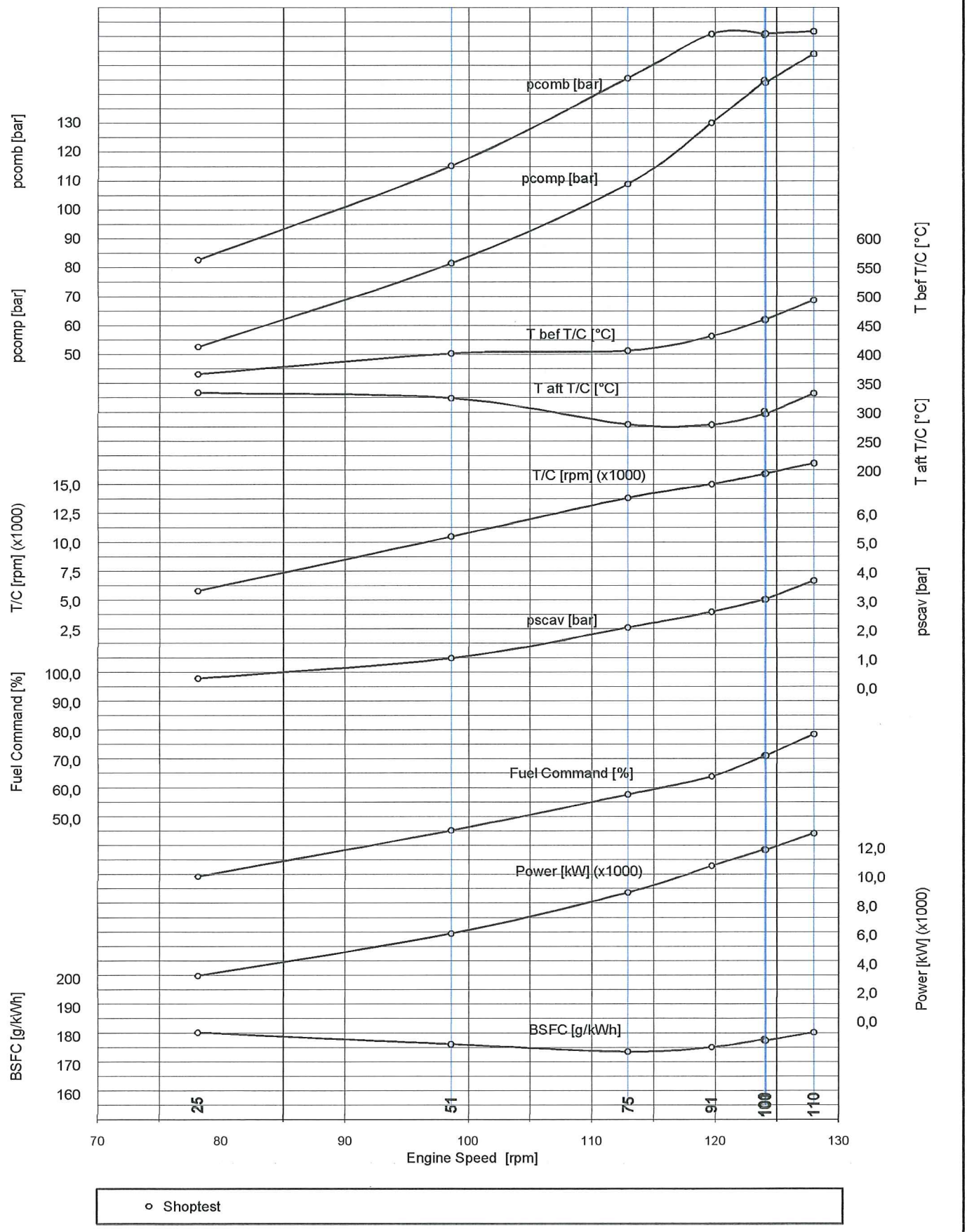
Performance data curves

WÄRTSILÄ RT-flex

Installation:		Engine type:	Stroke:	Lic.:	Eng No.:	Sheet:
EPI24331		7RT-flex50-B	2050	HCP	2	5 / 26
Shipyard:	**Class:**	**Nom. power:**	**Nom. rpm:**	**Mep:**	**Hull No.:**	**Optim. at:**
NA	CCS	11620 kW	124 rpm	19.97 bar	EPI24331	IMO

v5



Power by FC x rpm

WÄRTSILÄ RT-flex

Installation:		Engine type:	Lic.:	Eng. no.:	Hull no. :	Sheet:
EPI24331		7RT-flex50-B	HCP	2	EPI24331	8 / 26
Shipyard:	**Classification:**	**Nom. Power at CMCR:**	**Nom revolution:**	**Stroke :**	**Mean. eff. press.:**	**Optim.:**
NA	CCS	11620 kW	124 rpm	2050 mm	19.97 bar	IMO

Shoptest

Fuel Command	%	29.20	45.10	57.50	63.80	71.00	71.00	71.00	78.40
Speed	rpm	78.1	98.6	112.9	119.7	124.0	124.0	124.1	128.0
Power	kW	2953	5874	8719	10565	11692	11674	11665	12804
FCxrpm		2280.5	4446.9	6491.8	7636.9	8804.0	8804.0	8811.1	10035.2

Analysis:					
	Water:	0.01 %	Net spec. energy	42120	kJ/kg
	Ash:	0.00 %	Spec. gravity	887.00	kg/m3
	Sulphur:	0.63 %	at:	30	°C

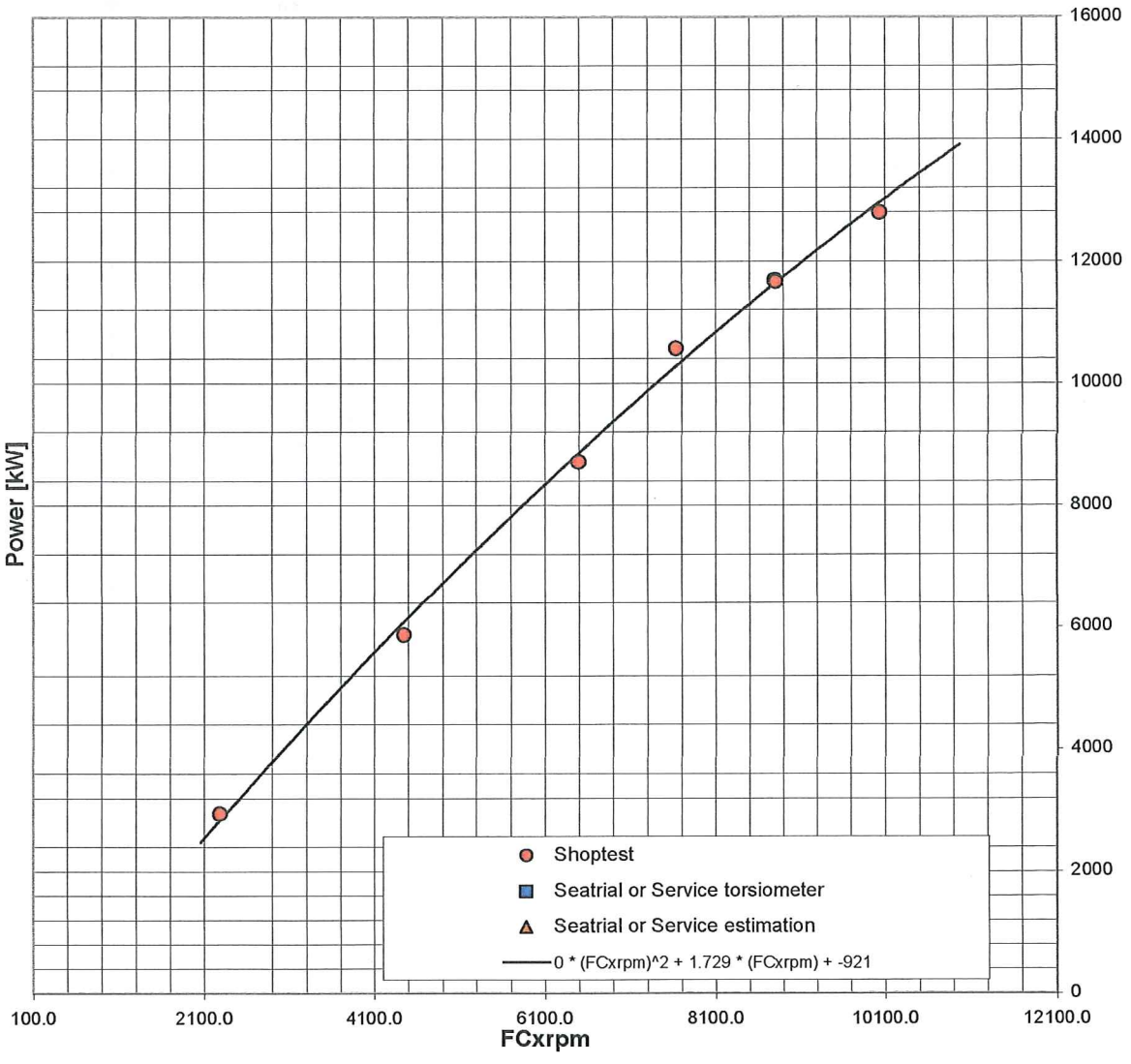
Temp.fuel bef. engine:		°C
Spec grav. bef. engine:	906.14	kg/m3
LCV bef. Engine:	42 120	kJ/kg

Seatrial or Service

Fuel Command	%								
Speed	rpm								
FCxrpm		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Power FCxrpm	kW								
Power toros.	kW								
Power Δ	kW								
Temp.bef.eng.	°C								
Spec.grav.bef.	kg/m3								
LCV	kJ/kg	0	0	0	0	0	0	0	0
Fuel correction factor									

1 kcal/kg = 4.147 kJ/kg

Analysis:					
	Water:	0.00 %	Net spec. energy	0	kJ/kg
	Ash:	0.00 %	Spec. gravity	0.00	kg/m3
	Sulphur:	0.00 %	at:	0	°C



Report of checking of IMO markings for 7RTFlex50B no. 02 engine

Item	Component or Setting	Cyl.	Check-value	IMO -ID
Engine control hardware	Flex Control Module	1-7	Supplier Type	FCH-20
	Software package		ID-number	LN-BE 9801
Engine control software	IMO relevant parameters (rail pressure, injection timing, exhaust valve timing)		IMO CRC VALUE [3] --- IMO DATA LENGTH [3]	0x D650 --- 428
Injection system	Injection nozzle	1-7	ID-number	LN-BG-2205
	Injection control block	1-7	ID-number	LN-BG 5700
Combustion chamber	Piston head	1-7	ID-number	LN-BG 3000
	Piston rod	1-7	ID-number	LN-BG 3200
	Cylinder cover	1-7	ID-number	LN-BG 2700
	Cylinder liner	1-7	ID-number	LN-BG 2100
	Housing of partition device	1-7	ID-number	LN-BG 5600
	Exhaust valve upper housing	1-7	ID-number	LN-BG 2705
	Exhaust valve housing	1-7	ID-number	LN-BG 2710
Turbocharger system	Turbocharger		Type TPL77-B12	No. HTD480842
	Auxiliary blower		Type DM60-7	No. 0975
Scavenge air cool. system	Scavenge air cooler (SAC)		ID-number	LN.BG 6022

Signatures:

Jacek Migdal

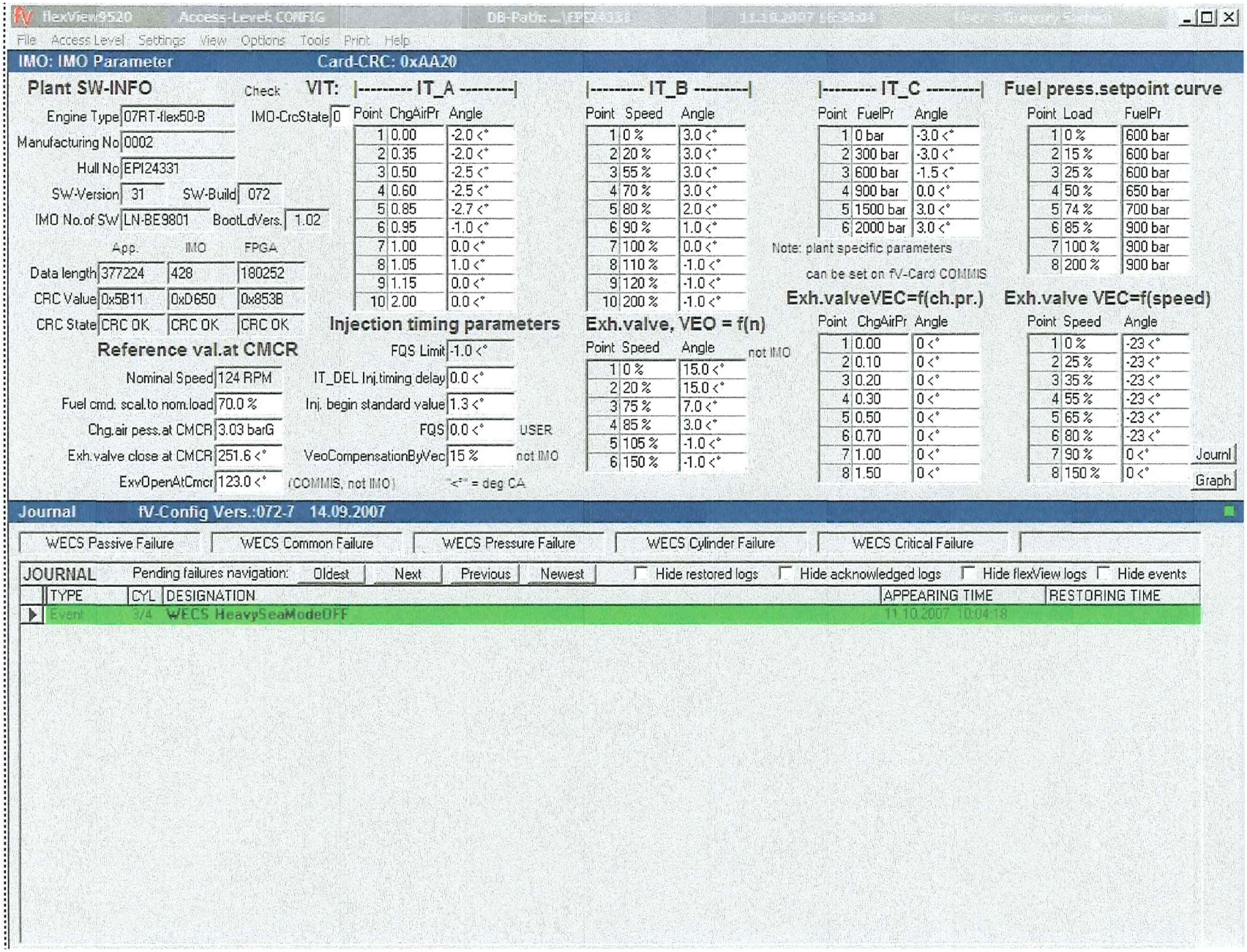
Confirmed by CCS.

Surveyor: Zhan, Yu

Oct. 12, 2007.

Zhan Yu

中国船级社 E2 01 CHINA CLASSIFICATION SOCIETY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File Access Level Settings View Options Tools Print Help
IMO: IMO Parameter Card-CRC: 0xAA20
Plant SW-INFO
Engine Type 07RT-flex50-B
Manufacturing No 0002
Hull No EPI24331
SW-Version 31 SW-Build 072
IMO No.of SW LN-BE9801 BootLdVers. 1.02
App. IMO FPGA
Data length 377224 428 180252
CRC Value 0x5B11 0xD650 0x853B
CRC State CRC OK CRC OK CRC OK
Check VIT: IMO-CrcState 0
|--------- IT_A ---------|
Point ChgAirPr Angle
1 0.00 -2.0 <°
2 0.35 -2.0 <°
3 0.50 -2.5 <°
4 0.60 -2.5 <°
5 0.85 -2.7 <°
6 0.95 -1.0 <°
7 1.00 0.0 <°
8 1.05 1.0 <°
9 1.15 0.0 <°
10 2.00 0.0 <°
|--------- IT_B ---------|
Point Speed Angle
1 0 % 3.0 <°
2 20 % 3.0 <°
3 55 % 3.0 <°
4 70 % 3.0 <°
5 80 % 2.0 <°
6 90 % 1.0 <°
7 100 % 0.0 <°
8 110 % -1.0 <°
9 120 % -1.0 <°
10 200 % -1.0 <°
|--------- IT_C ---------|
Point FuelPr Angle
1 0 bar -3.0 <°
2 300 bar -3.0 <°
3 600 bar -1.5 <°
4 900 bar 0.0 <°
5 1500 bar 3.0 <°
6 2000 bar 3.0 <°
Note: plant specific parameters
can be set on fV-Card COMMIS
Fuel press.setpoint curve
Point Load FuelPr
1 0 % 600 bar
2 15 % 600 bar
3 25 % 600 bar
4 50 % 650 bar
5 74 % 700 bar
6 85 % 900 bar
7 100 % 900 bar
8 200 % 900 bar
Injection timing parameters
FQS Limit -1.0 <°
IT_DEL Inj.timing delay 0.0 <°
Inj. begin standard value 1.3 <°
FQS 0.0 <° USER
VeoCompensationByVec 15 % not IMO
Reference val.at CMCR
Nominal Speed 124 RPM
Fuel cmd. scal.to nom.load 70.0 %
Chg.air pess.at CMCR 3.03 barG
Exh.valve close at CMCR 251.6 <°
ExvOpenAtCmcr 123.0 <° (COMMIS, not IMO)
"<°" = deg CA
Exh.valve, VEO = f(n) not IMO
Point Speed Angle
1 0 % 15.0 <°
2 20 % 15.0 <°
3 75 % 7.0 <°
4 85 % 3.0 <°
5 105 % -1.0 <°
6 150 % -1.0 <°
Exh.valveVEC=f(ch.pr.)
Point ChgAirPr Angle
1 0.00 0 <°
2 0.10 0 <°
3 0.20 0 <°
4 0.30 0 <°
5 0.50 0 <°
6 0.70 0 <°
7 1.00 0 <°
8 1.50 0 <°
Exh.valve VEC=f(speed)
Point Speed Angle
1 0 % -23 <°
2 25 % -23 <°
3 35 % -23 <°
4 55 % -23 <°
5 65 % -23 <°
6 80 % -23 <°
7 90 % 0 <°
8 150 % 0 <°
Journl
Graph
Journal fV-Config Vers.:072-7 14.09.2007
WECS Passive Failure
WECS Common Failure
WECS Pressure Failure
WECS Cylinder Failure
WECS Critical Failure
JOURNAL Pending failures navigation: Oldest Next Previous Newest
Hide restored logs Hide acknowledged logs Hide flexView logs Hide events
TYPE CYL DESIGNATION APPEARING TIME RESTORING TIME
Event 3/4 WECS HeavySeaModeOFF 11.10.2007 10:04:18

Group Concept

(For information of the Administration or the Classification Society acting on behalf of the Ship's Flag State only – not necessarily to be included in the Technical File)

Idea of the group concept is the need for emission measurements only for the first engine, the so-called "parent engine". All the following engines declared as members of the group can be adjusted and certified according to the procedures described in this page and according to the "List of NO_X relevant components and settings".

Concept for identical engines

Identical engines means: Same cylinder number, same rating, and identical equipment.

Conditions for an engine to be member of the group

1. Conformity of production.

   The engine manufacturer must show "conformity of production" in the production process. This includes ISO900x certificates or other quality insuring systems, which should guarantee, that the required component conformance is given.

2. Identical Components.

   All components listed in the "List of NO_X relevant components and settings" must have the same design and same specification as specified in the list. If this is not the case the engine manufacturer has to show that the modified or exchanged components behave in the same way.

3. Same settings.

   All settings and measured values according to the "List of NO_X relevant components and settings" should be identical, except 'IMO CRC VALUE'.
   The exception is the setting of the injection timing. Due to engine manufacturing tolerances different injection begins from engine to engine may result to the same combustion process and therefore same NO_X production. The main parameter influencing the NO_X production is the resulting maximum firing pressure at 100% load. The other loads are then adjusted automatically by adjusting the VIT injection management system identically as for the parent engine.

Procedure for certification of engines being *group members* after the parent engine

1. Check engine according to " List of NOX relevant components and settings" (page B.1).
2. Due to manufacturing tolerances each engine, injection equipment and turbocharger behaves slightly different. Thus, the WECS-9520 parameters valid for the specific engine at ISO conditions might differ for the individual engines of the group. By adjusting these parameters for each engine the same behaviour at different ambient conditions is guaranteed.
   The tuning that compensates the described tolerances is reflected in an individual 'IMO CRC VALUE' for each engine, while the 'IMO CRC LENGTH' remains constant.

   Note: The tuning parameters influencing the 'IMO CRC VALUE' cannot be accessed by the user after engine tuning.

   Note: Member engines are adjusted such, that they reach **same or lower firing pressures** as the parent engine!

   If the average firing pressure at 100% load during official shop test of a group member exceeds the official emission measurement of the parent engine (max. 2 bar), then the NO_X emission value of the member engine has to be corrected according to following formula:

   $$NO_{X,\,Member} = NO_{X,\,Parent} \times ((p_{firing,\,Member} - p_{firing,\,Parent}) / 100 + 1)$$

   Note: The according to above formula calculated NOx emission value for member engines still has to be below the applicable NO_X emission limit. This correction may only be applied for a maximum deviation of 2 bar firing pressure at 100% load within member and parent engine. For higher deviations, the 'Injection begin standard value' of respective member engines must be readjusted and the measurement of the firing pressure repeated.
   The above calculated $NO_{X,\,Member}$-value has to be noted on page A.1., "Particulars of the engine", under "Engine's NO_X Emission Value".

3. Setting of water temperature at scavenge air cooler inlet:
   Generally for Wärtsilä RT-flex engines the reference value for the water temperature is 25°C for seawater systems (open circuit) resp. 29°C for freshwater systems (closed circuits).