3 Engine Test Protocol

This chapter contains a copy of the factory Test Protocol signed by the receiver of the engine end EIAPP Authority.

WÄRTSILÄ

TEST PROTOCOL

Project:	LANGSTEN 189
Number:	21306
Type:	W8L32
Date(s):	23.11.2001
Class. Soc.	DNV

WÄRTSILÄ

Test protocol no	21306
Report	RA_056
Version	1.0.0.0
Printed	23.11.2001

Installation Data

ENGINE DATA

Customer:	LANGSTEN SLIP & BÅTBYGGERI A/S
Type:	W8L32
Manufacturing number:	21306
Nominal output [kW]:	3680
Nominal speed [rpm]:	750
Rotation direction:	counter-clockwise

INSTALLATION

Type:	Main Engine
Name:	LANGSTEN 189
Number	8243

LOADING: Alternator

Type:	LSA 58U12
Manufacturer:	LEROY SOMER
Number:	160937-1
Current [A]:	427,8
Voltage [V]:	11000
Output [kVA]:	8150
Frequency [Hz]:	50

FUEL

Quality	Density at [kg / l]	Temp. [C°]	Viscosity at [mm2 / s]	Temp. [C°]	Lower Heating value
MDF	0,84	15	2,9	40	43,07

LUBRICATING OIL

Quality: Shell Argina T 40

WÄRTSILÄ

Test protocol no	21306
Report	RA_057
Version	1.0.0.1
Printed	23.11.2001

Test Program for LANGSTEN 189

Test Bed 1

Order number: 8243

Engine number: 21306

Engine type: W8L32

Test run date(s): 23.11.2001

Time: Start	Stop	Dur. [min]	Speed [rpm]	Shaft load [%]		Engine power [kW]	η	Load power [kW]	Fuel	Oper. data	Notices
12:35	12:40	5	750	0					MDF		Verification of HT-water and OIL stops.
12:40	13:00	20	750	0	25				MDF		
13:00	13:20	20	750	25		920	94,3	868	MDF	X	
13:20	13:25	5	750	0					MDF		
13:25	13:45	20	750	0	50				MDF		
13:45	14:05	20	750	50		1840	96,2	1770	MDF	X	
14:05	14:10	5	750	0					MDF		
14:10	14:30	20	750	0	75				MDF		
14:30	14:50	20	750	75		2760	97,3	2685	MDF	X	
14:50	14:55	5	750	0					MDF		
14:55	15:30	35	750	0	100				MDF		
15:30	16:30	60	750	100		3680	97,6	3592	MDF	X	
16:30	17:00	30	750	110		4048	97,6	3951	MDF	X	
17:00	18:00	60	710	85		3128	97,4	3047	MDF	X	
18:00	18:30	30	681	75		2760	97,3	2685	MDF	X	
18:30	19:00	30	595	50		1840	96,2	1770	MDF	X	
19:00	19:30	30	595	25		920	94,3	868	MDF	X	

Check of overspeed devices

WÄRTSILÄ

Test Protocol No.	21306
Report	RA_058
Version	1.0.0.0
Printed	23.11.2001

Operation Data

Mode									
Loadpoint: Power/ Torque		25	50	75	100	110	85	75	50
Time		13:10	13:55	14:40	15:40	16:40	17:25	18:25	18:55
Fuel		MDF	MDF	MDF	MDF	MDF	MDF	MDF	MDF
Ambient Data									
Total barometric pressure	hPa	1009	1009	1010	1011	1012	1012	1013	1013
Temperature of intake air	°C	22,0	23,0	25,0	27,4	28,0	26,6	27,1	27,1
Relative humidity of intake air	%	13,8	13,0	11,4	9,2	9,0	9,0	8,3	8,3
Alternator Data									
Alternator efficiency		94,3	96,2	97,3	97,6	97,6	97,4	97,3	96,2
Alternator output	kW	868	1770	2685	3592	3951	3047	2685	1770
Alternator voltage, nominal	V	11000	11000	11000	11000	11000	11000	11000	11000
Alternator current, nominal	A	427.8	427.8	427.8	427.8	427.8	427.8	427.8	427.8
Engine Data									
Power	kW	920	1840	2760	3680	4048	3128	2760	1840
Speed	rpm	750	750	750	750	750	710	681	595
Load indicator position		3,3	5,0	6,3	8,0	8,7	7,2	6,6	5,5
Fuel rack position, A-bank	mm	16,0	26,5	35,0	45,0	49,5	40,0	36,0	29,0
Turbocharger speed, A-bank	rpm	11355	16938	20392	23191	24192	21326	19940	15435
Exh. gas temp, cylinder A1	°C	271	321	342	391	418	374	366	375
Exh. gas temp, cylinder A2	°C	302	330	353	407	436	381	370	392
Exh. gas temp, cylinder A3	°C	278	326	351	398	422	373	369	390
Exh. gas temp, cylinder A4	°C	273	314	335	391	419	365	357	374
Exh. gas temp, cylinder A5	°C	276	323	356	412	444	386	373	389
Exh. gas temp, cylinder A6	°C	283	314	350	404	433	378	365	374
Exh. gas temp, cylinder A7	°C	286	316	343	398	419	368	356	365
Exh. gas temp, cylinder A8	°C	330	336	358	407	439	376	369	381
Mean value	°C	287	323	349	401	429	375	366	380
Main bearing temp, bearing 0	°C	81	82	83	84	83	83	0	79
Main bearing temp, bearing 1	°C	79	82	84	87	87	85	83	79
Main bearing temp, bearing 2	°C	78	82	85	88	89	86	84	79
Main bearing temp, bearing 3	°C	78	82	86	89	89	87	85	79
Main bearing temp, bearing 4	°C	78	82	85	88	89	87	85	80
Main bearing temp, bearing 5	°C	81	84	86	89	90	87	86	80
Main bearing temp, bearing 6	°C	80	83	87	90	91	88	86	81
Main bearing temp, bearing 7	°C	81	84	87	90	91	88	86	80
Main bearing temp, bearing 8	°C	80	83	86	90	91	88	86	80
Main bearing temp, bearing 9	°C	81	83	85	87	87	85	84	79
Mean value	°C	80	83	85	88	89	86	77	80
Exh. gas temp. bef. TC, A-bank	°C	372	420	439	482	514	462	460	500
Exh. gas temp. aft. TC, A-bank	°C	315	329	316	328	347	326	341	414
Charge air temp. in air receiver	°C	33	36	42	49	52	45	41	35
HT-water temp. bef. engine	°C	90	91	93	93	90	91	84	84
HT-water temp. aft. engine	°C	92	94	96	98	95	97	91	89
LT-water temp. bef. CAC	°C	33	33	33	33	33	33	33	33
LT-water temp. aft. CAC	°C	34	37	42	47	49	43	41	36
LT-water temp. bef. LOC	°C	34	37	42	47	49	43	41	36
LT-water temp. aft. LOC	°C	37	42	47	53	55	49	46	40
Lub. oil temp. bef. LOC	°C	69	72	75	79	80	77	76	72
Lub. oil temp. aft. LOC	°C	59	60	62	64	64	62	62	60
Fuel oil temperature	°C	43	46	32	35	39	41	39	37
Firing pressure, cylinder A1	bar			157	183		166	160	
Firing pressure, cylinder A2	bar			159	188		171	163	
Firing pressure, cylinder A3	bar			159	187		171	163	
Firing pressure, cylinder A4	bar			158	184		169	162	
Firing pressure, cylinder A5	bar			160	187		172	163	
Firing pressure, cylinder A6	bar			161	188		174	165	
Firing pressure, cylinder A7	bar			158	185		171	161	
Firing pressure, cylinder A8	bar			158	184		172	164	

WÄRTSILÄ

Test Protocol No.	21306
Report	RA_058
Version	1.0.0.0
Printed	23.11.2001

Operation Data

Mode									
Loadpoint: Power/ Torque		25	50	75	100	110	85	75	50
Time		13:10	13:55	14:40	15:40	16:40	17:25	18:25	18:55
Fuel		MDF	MDF	MDF	MDF	MDF	MDF	MDF	MDF
Mean value	bar			159	186		171	163	
Charge air pressure	bar	0,33	1,05	1,85	2,60	2,80	2,14	1,81	0,91
HT-water pressure	bar	2,90	2,80	2,80	2,80	2,80	2,60	2,60	2,30
LT-water pressure	bar	2,70	2,70	2,70	2,70	2,70	2,70	2,70	2,70
Lubricating oil pressure	bar	5,00	4,90	4,80	4,80	4,70	4,70	4,60	4,40
Fuel oil pressure	bar	7,00	6,80	6,70	6,70	6,60	6,70	7,00	7,20
Extra Measurements									

WÄRTSILÄ

Test Protocol No.	21306
Report	RA_058
Version	1.0.0.0
Printed	23.11.2001

Operation Data

Mode		
Loadpoint: Power/ Torque		25
Time		19:25
Fuel		MDF

Ambient Data		
Total barometric pressure	hPa	1013
Temperature of intake air	°C	26,0
Relative humidity of intake air	%	9,0

Alternator Data		
Alternator efficiency		94,3
Alternator output	kW	868
Alternator voltage, nominal	V	11000
Alternator current, nominal	A	427.8

Engine Data		
Power	kW	920
Speed	rpm	595
Load indicator position		3,5
Fuel rack position, A-bank	mm	17,0
Turbocharger speed, A-bank	rpm	10287
Exh. gas temp, cylinder A1	°C	305
Exh. gas temp, cylinder A2	°C	338
Exh. gas temp, cylinder A3	°C	321
Exh. gas temp, cylinder A4	°C	311
Exh. gas temp, cylinder A5	°C	326
Exh. gas temp, cylinder A6	°C	327
Exh. gas temp, cylinder A7	°C	312
Exh. gas temp, cylinder A8	°C	349
Mean value	°C	324
Main bearing temp, bearing 0	°C	79
Main bearing temp, bearing 1	°C	77
Main bearing temp, bearing 2	°C	77
Main bearing temp, bearing 3	°C	76
Main bearing temp, bearing 4	°C	77
Main bearing temp, bearing 5	°C	78
Main bearing temp, bearing 6	°C	78
Main bearing temp, bearing 7	°C	78
Main bearing temp, bearing 8	°C	78
Main bearing temp, bearing 9	°C	78
Mean value	°C	78
Exh. gas temp. bef. TC, A-bank	°C	437
Exh. gas temp. aft. TC, A-bank	°C	389
Charge air temp. in air receiver	°C	33
HT-water temp. bef. engine	°C	86
HT-water temp. aft. engine	°C	89
LT-water temp. bef. CAC	°C	32
LT-water temp. aft. CAC	°C	33
LT-water temp. bef. LOC	°C	33
LT-water temp. aft. LOC	°C	37
Lub. oil temp. bef. LOC	°C	70
Lub. oil temp. aft. LOC	°C	59
Fuel oil temperature	°C	36
Firing pressure, cylinder A1	bar	
Firing pressure, cylinder A2	bar	
Firing pressure, cylinder A3	bar	
Firing pressure, cylinder A4	bar	
Firing pressure, cylinder A5	bar	
Firing pressure, cylinder A6	bar	
Firing pressure, cylinder A7	bar	
Firing pressure, cylinder A8	bar	

WÄRTSILÄ

Test Protocol No.	21306
Report	RA_058
Version	1.0.0.0
Printed	23.11.2001

Operation Data

Mode	
Loadpoint: Power/ Torque	25
Time	19:25
Fuel	MDF

Mean value	bar	
Charge air pressure	bar	0,31
HT-water pressure	bar	2,30
LT-water pressure	bar	2,70
Lubricating oil pressure	bar	4,40
Fuel oil pressure	bar	7,30

Extra Measurements

WÄRTSILÄ

Test protocol no	21306
Report	RA_0591
Version	1.0.0.0
Printed	23.11.2001

ADJUSTMENT OF STOP SWITCHES:

Alarm for low prelubricating oil pressure [bar]:	0,5	Tripping speed of mechanical overspeed trip device [rpm]:	-
Stop for low lubricating oil pressure [bar]:	2,3	No load value for the governor:	1,8
Stop for high HT-water temperature [°C]	-	No load value for the rack [mm]:	7,0
Tripping speed of pneumatic overspeed trip device [rpm]:	858	Fuel limiter [mm]:	-
Tripping speed of pneum. overspeed trip device (2) [rpm]:	870		

ADJUSTMENT OF FUEL PUMPS:

Fuel rack position, when				Delivery
Starting lever at:	*Work*	*Stop*	*Work*	commencem.
Governor lever at:	*Min*	*Max*	*Max*	before TDC
Safety device:	*Not rel.*	*Not rel.*	*Released*	
Cylinder:				
A1	1,5	1,5	1	9,5
A2	1,5	1,5	1	9,5
A3	1,5	1,5	1	9,5
A4	1,5	1,5	1	9,5
A5	1,5	1,5	1	9,5
A6	1,5	1,5	1	9,5
A7	1,5	1,5	1	9,5
A8	1,5	1,5	1	9,5

GOVERNOR TEST

Load Application:

% - % n - min n - nom dn sec

Load Reduction:

% - % n-max n - nom dn sec

AIM OF THE TEST

The aim of the test run performed was to check the general quality of the production and to prove that the engine performance values fullfill the prescribed requirements.

PRESENT AT THE TEST RUN

Wärtsilä Finland Oy WÄRTSILÄ Marine 26.11.2001 Quality Assurance, Projects **Customer(s)**

M. Merisaari, Quality Assurance Manager, Marine

Wärtsilä Finland Oy Vaasa Factory

T. Lerstrand, Test Run Manager, Vaasa Factory

F. Jorgensen

On behalf of

Classification Society

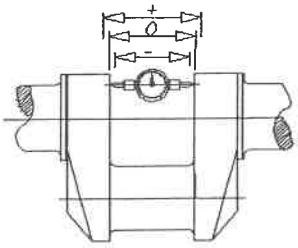
MSA No. R-1456

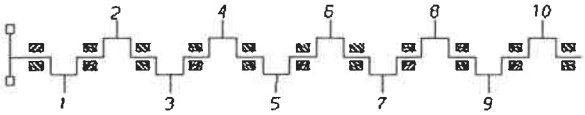
P. Koskinen, Det Norske Veritas

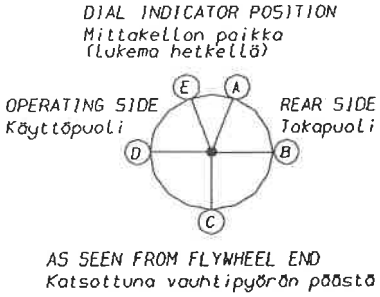
WÄRTSILÄ

Test protocol no	21306
Report	RA_060
Version	1.0.0.0
Printed	23.11.2001

Crankshaft Measurements







HOT ENGINE

Room temperature when values were measured [°C]:
Initials:
Engine running continuosly before indicating [h]:
The time between stop and indicating [min]:
Temperature of lubricating oil [°C]:
Temperature of cooling water before engine [°C]:

Gauge Position	Cylinder 1	2	3	4	5	6	7	8		
Rear side top *Takasivu ylhäällä*										
Rear side *Takasivulla*										
Bottom *Alhaalla*										
Operating side *Käyttösivulla*										
Operating side top *Käyttösivu ylhäällä*										

Deviations 1/100 mm

Measurement of crankshaft alignment in main assembly

COLD ENGINE

Room temperature when values were measured [°C]: 20 °C
Initials: T.S

Gauge Position	Cylinder 1	2	3	4	5	6	7	8		
Rear side top *Takasivu ylhäällä*	-1	0	0	0	+0,5	+1	+1	0		
Rear side *Takasivulla*	-4	+1,5	+2,5	+1,5	+3	+2	+1,5	0		
Bottom *Alhaalla*	-4	+3,5	+4	+3,5	+3	+2	+1	-1		
Operating side *Käyttösivulla*	-2	+2	+3	+2	+1,5	+1	0	-0,5		
Operating side top *Käyttösivu ylhäällä*	0	0	0	0	0	0	0	0		

Deviations 1/100 mm

WÄRTSILÄ

Test protocol no	21306
Report	RA_061
Version	1.0.0.0
Printed	23.11.2001

Inspection of the Wärtsilä Engine

Project:	LANGSTEN 189
Order number:	8243
Engine type:	W8L32
Engine number:	21306
Classification society:	DNV
Test run date(s)	23.11.2001
Inspection date:	23.11.2001

It has been agreed that the following openings and inspections are to be carried out at the delivery test run attended by the buyer and / or the representative of the classification society.

Inspections:		**Results:**
Big end bearing No.	3	OK
Main bearing No.	7	OK
Thrust bearing	Yes	OK
Endoscope inspection	Yes	OK
Opening of covers	Yes	OK
Test of nozzles	Yes	Changed, nozzle for cyl. no 8 changed OK

The following corrections should be made before delivery:

Wärtsilä Finland Oy

WÄRTSILÄ Marine 26.11.2001 Quality Assurance, Projects

M. Merisaari, Quality Assurance Manager, Marine

Customer(s)

F. Jorgensen

Wärtsilä Finland Oy Vaasa Factory

T. Lerstrand, Test Run Manager, Vaasa Factory

On behalf of
Classification Society

MSA No. R-1456

P. Koskinen, Det Norske Veritas

WÄRTSILÄ

Test protocol no	21306
Report	RA_062
Version	1.0.0.0
Printed	23.11.2001

Fuel Oil Consumption According to ISO 3046/1

Engine number:	21306
Project:	LANGSTEN 189
Order number:	8243
Engine type:	W8L32
Output/100% [kW]:	3680
Speed [rpm]:	750

K = ratio of indicated power
α = power adjustment factor
P_x = barometric pressure during test [hPa]

P_{ra} = standard reference barometric pressure [1000 hPa]
m = 0,7 exponent
T_{ra} = reference air temperature [298 K]
T_x = air temperature during test [K]
n = 1,2 exponent
T_{cr} = reference charge air coolant temperature [298 K]
T_{cx} = charge air coolant temperature during test [K]

s = 1 exponent
Mek = mechanical efficiency
Q_{test} = lower heating value of the fuel oil during test [MJ / kg]
Q_{ISO} = lower heating value of the fuel oil (ISO) [MJ / kg]
Be = fuel oil consumption on test bed [g / kWh]
BISO = fuel oil consumption according to ISO [g / kWh]
M = measured fuel quantity [g]
MLS = flow of clean leak fuel [g / s]
P = output [kW]
S = time [s]
EDP = engine driven pumps [g / kWh] (calculated with or without EDP according to the contract)

$$K = \left(\frac{P_x}{P_{ra}}\right)^m * \left(\frac{T_{ra}}{T_x}\right)^n * \left(\frac{T_{cr}}{T_{cx}}\right)^s$$

$$\alpha = K - 0{,}7 * (1 - K) * \left(\frac{1}{Mek} - 1\right)$$

$$Be = \frac{(M - S * MLS)}{P * S} * 3600 \Rightarrow [g / kWh]$$

$$BISO = \frac{\alpha}{K} * Be * \frac{Qtest}{QISO} - EDP \Rightarrow [g / kWh]$$

Calculations:

Load [%]:	85	Lower heating value during test [MJ/kg]:	43,07
Fuel:	MDF	Lower heating value (ISO) [MJ/kg]:	42,70
Output [kW]:	3128	Mechanical efficiency:	0,80
Measured fuel quantity [g]:	29 620,0	Engine driven pumps [g/kwh]:	3,00
Clean leak fuel [g/s]:	0,80		
Mean time [s]:	180,0		

Air pressure during test [hPa]:	1 012,2	
Air temperature during test [°C]:	27	300 [K]
Charge air coolant temp. during test [°C]:	33	306 [K]

K:	0,975867	**Be:**	188,5
α:	0,971644	**BISO:**	186,3