WÄRTSILÄ

TEST PROTOCOL

Project:	LANGSTEN 189
Number:	21305
Type:	W8L32
Date(s):	21.11.2001 22.11.2001
Class. Soc.	DNV

WÄRTSILÄ

Test protocol no	21305
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:	21305
Nominal output [kW]:	3680
Nominal speed [rpm]:	750
Rotation direction:	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	21305
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: 21305

Engine type: W8L32

Test run date(s): 21.11.2001
22.11.2001

Time: Start	Stop	Dur. [min]	Speed [rpm]	Shaft load [%]	Engine power [kW]	η	Load power [kW]	Fuel	Oper. data	Notices
19:40	19:45	5	750	0				MDF		Verification of HT-water and OIL stops.
19:45	20:05	20	750	0 25				MDF		
20:05	20:25	20	750	25	920	94,3	868	MDF	X	
20:25	20:30	5	750	0				MDF		
20:30	20:50	20	750	0 50				MDF		
20:50	21:10	20	750	50	1840	96,2	1770	MDF	X	
21:10	21:15	5	750	0				MDF		
21:15	21:35	20	750	0 75				MDF		
21:35	21:55	20	750	75	2760	97,3	2685	MDF	X	
7:20	7:25	5	750	0				MDF		22.11.2001
12:45	13:20	35	750	0 100				MDF		
13:20	14:20	60	750	100	3680	97,6	3592	MDF	X	
14:20	14:50	30	750	110	4048	97,6	3951	MDF	X	
14:50	15:50	60	710	85	3128	97,4	3047	MDF	X	
15:50	16:20	30	681	75	2760	97,3	2685	MDF	X	
16:20	16:50	30	595	50	1840	96,2	1770	MDF	X	
16:50	17:20	30	595	25	920	94,3	868	MDF	X	

Check of overspeed devices

WÄRTSILÄ

Test Protocol No.	21305
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		20:15	21:00	21:45	13:30	14:30	15:00	16:00	16:30
Fuel		MDF	MDF	MDF	MDF	MDF	MDF	MDF	MDF
Ambient Data									
Total barometric pressure	hPa	995	995	995	986	989	989	990	990
Temperature of intake air	°C	21,0	22,0	23,0	26,0	26,7	25,0	27,0	25,0
Relative humidity of intake air	%	24,0	22,0	21,0	11,9	10,5	12,0	10,0	11,0
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		3,5	5,1	6,7	8,3	9,1	7,5	7,0	5,7
Fuel rack position, A-bank	mm	16,0	27,0	37,0	45,0	50,0	41,0	38,0	30,0
Turbocharger speed, A-bank	rpm	11424	16814	20548	23404	24436	21508	20133	15563
Exh. gas temp, cylinder A1	°C	300	321	352	388	412	365	362	390
Exh. gas temp, cylinder A2	°C	289	314	347	398	416	374	368	382
Exh. gas temp, cylinder A3	°C	278	314	346	403	427	371	361	379
Exh. gas temp, cylinder A4	°C	283	311	352	407	430	376	366	378
Exh. gas temp, cylinder A5	°C	290	320	353	394	424	374	365	385
Exh. gas temp, cylinder A6	°C	290	312	345	405	424	371	367	386
Exh. gas temp, cylinder A7	°C	335	326	355	396	417	368	364	376
Exh. gas temp, cylinder A8	°C	395	312	336	392	414	361	362	376
Mean value	°C	308	316	348	398	421	370	364	382
Main bearing temp, bearing 0	°C	75	77	79	80	80	79	78	76
Main bearing temp, bearing 1	°C	75	79	81	83	84	81	80	77
Main bearing temp, bearing 2	°C	78	83	86	88	89	86	84	80
Main bearing temp, bearing 3	°C	77	81	84	87	87	85	83	79
Main bearing temp, bearing 4	°C	77	82	85	88	89	85	84	80
Main bearing temp, bearing 5	°C	79	82	85	88	89	86	84	80
Main bearing temp, bearing 6	°C	78	82	85	88	89	86	84	81
Main bearing temp, bearing 7	°C	80	84	87	89	90	87	85	81
Main bearing temp, bearing 8	°C	78	82	85	88	89	86	84	80
Main bearing temp, bearing 9	°C	79	82	84	86	86	84	82	79
Mean value	°C	78	81	84	87	87	85	83	79
Exh. gas temp. bef. TC, A-bank	°C	372	418	442	486	519	461	463	501
Exh. gas temp. aft. TC, A-bank	°C	307	327	316	327	349	325	342	403
Charge air temp. in air receiver	°C	33	36	41	50	52	45	41	35
HT-water temp. bef. engine	°C	90	90	93	91	91	90	91	91
HT-water temp. aft. engine	°C	92	93	96	95	96	95	95	96
LT-water temp. bef. CAC	°C	33	33	33	33	33	33	33	31
LT-water temp. aft. CAC	°C	34	37	42	47	48	43	41	34
LT-water temp. bef. LOC	°C	34	37	42	47	48	43	41	34
LT-water temp. aft. LOC	°C	37	42	47	53	55	49	46	39
Lub. oil temp. bef. LOC	°C	65	71	73	78	79	76	74	72
Lub. oil temp. aft. LOC	°C	59	61	62	64	64	62	62	60
Fuel oil temperature	°C	41	52	55	36	41	50	50	51
Firing pressure, cylinder A1	bar			157	188		171	163	
Firing pressure, cylinder A2	bar			154	187		170	161	
Firing pressure, cylinder A3	bar			155	186		166	159	
Firing pressure, cylinder A4	bar			155	187		169	162	
Firing pressure, cylinder A5	bar			157	188		171	163	
Firing pressure, cylinder A6	bar			155	187		170	160	
Firing pressure, cylinder A7	bar			152	185		166	158	
Firing pressure, cylinder A8	bar			155	186		170	161	

WÄRTSILÄ

Test Protocol No.	21305
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		20:15	21:00	21:45	13:30	14:30	15:00	16:00	16:30
Fuel		MDF	MDF	MDF	MDF	MDF	MDF	MDF	MDF
Mean value	bar			155	187		169	161	
Charge air pressure	bar	0,34	1,02	1,81	2,56	2,73	2,12	1,77	0,87
HT-water pressure	bar	2,80	2,80	2,80	2,60	2,70	2,50	2,40	2,10
LT-water pressure	bar	2,70	2,70	2,70	2,70	2,70	2,60	2,70	2,60
Lubricating oil pressure	bar	5,70	5,50	5,50	5,40	5,30	5,30	5,20	4,90
Fuel oil pressure	bar	6,10	6,00	5,90	5,80	6,00	6,20	6,30	6,50

Extra Measurements

WÄRTSILÄ

Test Protocol No.	21305
Report	RA_058
Version	1.0.0.0
Printed	23.11.2001

Operation Data

Mode		
Loadpoint: Power/ Torque		25
Time		17:00
Fuel		MDF

Ambient Data		
Total barometric pressure	hPa	991
Temperature of intake air	°C	26,1
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		3,8
Fuel rack position, A-bank	mm	18,0
Turbocharger speed, A-bank	rpm	10206
Exh. gas temp, cylinder A1	°C	336
Exh. gas temp, cylinder A2	°C	316
Exh. gas temp, cylinder A3	°C	322
Exh. gas temp, cylinder A4	°C	331
Exh. gas temp, cylinder A5	°C	333
Exh. gas temp, cylinder A6	°C	340
Exh. gas temp, cylinder A7	°C	331
Exh. gas temp, cylinder A8	°C	338
Mean value	°C	331
Main bearing temp, bearing 0	°C	75
Main bearing temp, bearing 1	°C	74
Main bearing temp, bearing 2	°C	77
Main bearing temp, bearing 3	°C	75
Main bearing temp, bearing 4	°C	76
Main bearing temp, bearing 5	°C	76
Main bearing temp, bearing 6	°C	77
Main bearing temp, bearing 7	°C	77
Main bearing temp, bearing 8	°C	77
Main bearing temp, bearing 9	°C	77
Mean value	°C	76
Exh. gas temp. bef. TC, A-bank	°C	441
Exh. gas temp. aft. TC, A-bank	°C	389
Charge air temp. in air receiver	°C	34
HT-water temp. bef. engine	°C	92
HT-water temp. aft. engine	°C	94
LT-water temp. bef. CAC	°C	33
LT-water temp. aft. CAC	°C	34
LT-water temp. bef. LOC	°C	34
LT-water temp. aft. LOC	°C	38
Lub. oil temp. bef. LOC	°C	68
Lub. oil temp. aft. LOC	°C	59
Fuel oil temperature	°C	47
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.	21305
Report	RA_058
Version	1.0.0.0
Printed	23.11.2001

Operation Data

Mode	
Loadpoint: Power/ Torque	25
Time	17:00
Fuel	MDF

Mean value	bar	
Charge air pressure	bar	0,26
HT-water pressure	bar	2,20
LT-water pressure	bar	2,60
Lubricating oil pressure	bar	5,10
Fuel oil pressure	bar	6,60

Extra Measurements	

WÄRTSILÄ

Test protocol no	21305
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]:	2,0	No load value for the governor:	-
Stop for high HT-water temperature [°C]	-	No load value for the rack [mm]:	2,0
Tripping speed of pneumatic overspeed trip device [rpm]:	858	Fuel limiter [mm]:	7,00
Tripping speed of pneum. overspeed trip device (2) [rpm]:	882		

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

M. Merisaari, Quality Assurance Manager, Marine

Wärtsilä Finland Oy Vaasa Factory

T. Lerstrand, Test Run Manager, Vaasa Factory

Customer(s)

F. Jorgensen

On behalf of
Classification Society

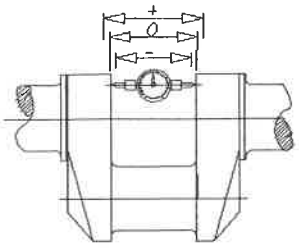
MSA No. R-1456

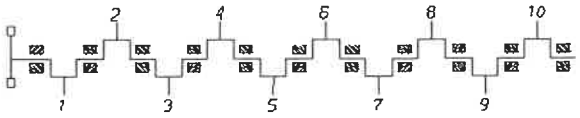
P. Koskinen, Det Norske Veritas

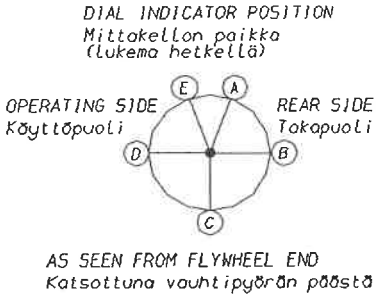
WÄRTSILÄ

Test protocol no	21305
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: TLE

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

Deviations 1/100 mm

WÄRTSILÄ

Test protocol no	21305
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:	21305
Classification society:	DNV
Test run date(s)	21.11.2001
	22.11.2001
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.	7	Changed, Bearing changed OK
Main bearing No.	5	OK
Thrust bearing	Yes	OK
Endoscope inspection	Yes	OK
Opening of covers	Yes	OK, Chamshaft piece changed cyl. no 3
Test of nozzles	Yes	Changed, nozzle for cyl. no 3 changed OK

The following corrections should be made before delivery:

Wärtsilä Finland Oy WÄRTSILÄ Marine Quality Assurance, Projects 20.11.2001 **Customer(s)**

M. Merisaari, Quality Assurance Manager, Marine

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	21305
Report	RA_062
Version	1.0.0.0
Printed	23.11.2001

Fuel Oil Consumption According to ISO 3046/1

Engine number:	21305
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)

$$K = \left(\frac{Px}{Pra}\right)^m * \left(\frac{Tra}{Tx}\right)^n * \left(\frac{Tcr}{Tcx}\right)^s$$

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

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

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

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]:	29 770,0	Engine driven pumps [g/kwh]:	3,00
Clean leak fuel [g/s]:	0,80		
Mean time [s]:	180,0		

Air pressure during test [hPa]:	989,0	
Air temperature during test [°C]:	25	298 [K]
Charge air coolant temp. during test [°C]:	33	306 [K]

K:	0,966345	**Be:**	189,4
α:	0,960455	**BISO:**	186,9