



Marine Diesel Engine Service & Repairs
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PERFORMANCE SEA TRIAL AND GENERAL ENGINE INSPECTION REPORT

Customer's Name: Captain Michael Murphy / rgzahnsr@prospectcdg.com Date: 10-16-2024

Phone: 954-225-1827 / fortitudecaptain@aol.com

Yacht Name: FORTITUDE

Location: 957 Hillsboro Mile – Hillsboro Beach – FL 33062

Conditions of this performance sea trial report acceptance:

This report represents the surveyor's honest and unbiased opinion and was performed visually with the aid of various test instruments. No disassembly of any component was performed unless specifically stated in this report.

All details and particulars in this report are believed to be true, but are not guaranteed accurate. All judgments, conclusions and recommendations are expressions of opinion of the undersigned based on his skill, training and experience

This report sets forth the conditions existing at the time of inspection and sea trial. By acceptance of this report it is understood by all parties that it is not to be considered a warranty or guarantee either expressed or implied and does not create any liability on the part of the surveyor. The use of any part of this report constitutes acceptance of these conditions.

YT. Fortitude

Builder: Intermarine

Model: 136 Tri-Deck Motor Yacht

Class: Megayacht

Hull Material: Fiberglass

Year: 1999 Reported

Length: 136'

Beam: 28'

Draft: 6' 11"

Gross Tonnage: 398 Tons

Net Tonnage: 119 Tons

Callsign: ZGQJ9

IMO Number: 8653310

MMSI: 538070819

Official Number: 750828

Port of Registry: George Town

Main Engines: MTU

Model #: 12V396TE94

Year: 1996

1680 KW (2250 HP) @ 2000 rpm

Port Serial # 5583116

Stbd Serial # 5583117

Note: Hours presented herein do not verify, confirm or validate the total time of operation of equipment

Port Engine Hours: 15,425 hs (LOP)

Stb Engine Hours: 15,428 hs (LOP)

ENGINE DESCRIPTION:

Water cooled 4-stroke diesel engine with 12 cylinders in 90 Deg V design, twin sequential turbochargers, intercooler, direct fuel injection, wet type cylinder liners, piston cooling and electronic governor control. The cylinder bore diameter is 165mm and the stroke is 185 mm with a displacement of 3.96 liters per cylinder.

COMPONENTS:

Cylinder heads, valve gear: Single cylinder heads with 4 valves (two intake and two exhaust) per cylinder. Replaceable valve seat inserts and valve guides.

Fuel System: Bosch type injection pump, electronic governor. Fuel line filter and prefilter with water separator.

Air System: Air cleaners, two exhaust gas driven turbochargers located at the end of the exhaust manifolds and an intercooler (charge air cooler).

The turbochargers are sequential and controlled electronically and pneumatically.

The intercooler serves to cool the combustion air making it more dense and in conjunction with the turbo chargers, allows more fuel to be burned efficiently increasing the engine horsepower.

Engine Block: High strength casting with integrated oil and water ducts and with replaceable cylinder liners.

Engine Lubrication: Closed system with force feeding, oil cooling and filtering. Oil filters and sump available in different designs.

Type of Cooling: Heat exchanger with engine and sea water circuits.

Monitoring System: MTU electronic monitoring alarm system with standard LOP control panels in the engine room and monitoring and alarms in the wheel house and bridge.

Transmissions: ZF

Model: BW465

Part List # 3085 011 036

Ratio: 2.025:1A

Port Serial # 1568

Stbd Serial # 1567

CHARACTERISTICS:

The ZF marine transmissions are manufactured in Friedrichshafen, Germany.

They utilize a light alloy cast housing and are hydraulically operated. The internal parts consist of an input shaft, output shaft, reversing shaft, related gearing and a forward and reverse clutch pack. The gearbox is a reduction and a reversing unit with replaceable clutch packs. The selector valve serves to direct oil flow to the clutch packs thereby providing forward, neutral or reverse depending upon direction of oil flow.

Generators: NORTHERN LIGHTS

Duty: Prime

KW: 80

Volts: 120/208

Note: Hours presented herein do not verify, confirm or validate the total time of operation of equipment

Port Model John Deere 6068TF001

Port Serial # T06068T574352

Port Hour Meter: 7,735 hs

Stbd Model John Deere 6068TF001

Stbd Serial # T06068T574353

Stbd Hour Meter: 7,610 hs

GENERATORS LOAD TEST:

The generators carried the load and operated within manufacturer's specifications.

RUNNING PARAMETERS:

PORT GENERATOR:

Oil pressure: 58 psi

Coolant Temp: 170 F

Voltage: 27V

STBD GENERATOR

Oil pressure: 58 psi

Coolant Temp: 180 F

Voltage: 27V

General Observations during visual inspection:

Coolant levels were close to the max mark on both main engines.

Oil levels were between the low and full mark on both engines and transmissions. (Normal)

Oil levels were between the low and full mark on generators. (Normal)

Engine Room Appearance: Fair

Bilges: Dirty

Engine Control Room LOP's lamp test: OK. All lit.

A sea trial was conducted: 10-16-2024: Location: Hillsboro Beach

SEA TRIAL:

RPM	1600	1750	1800	2000
Port Actual DBR (mm)	15.39	14.41	16.42	18.08
Port Fuel Rack (mm)	8.53	10.27	10.50	12.07
Port ETC Speed A1 (krpm)	45.0	52.5	40.1	48.6
Port ETC Speed B1 (krpm)	0.0	0.0	51.0	62.5
Port T Exhaust ETC A (C)	473	537	587	631
Port T Exhaust ETC B (C)	486	559	625	658
Port Oil Pressure (bar)	5.38	5.38	5.40	5.42
Port Coolant P (bar)	4.69	5.41	5.65	6.68
Port Coolant T (C)	75.0	76.6	78.3	77.5
Port Oil Lube T (C)	77.0	78.8	79.6	80.0
Port Gear Oil P (bar)	19.8	19.7	19.8	20.1
Port Gear Oil T (C)	55.6	56.9	59.7	65.1
Port Raw Water P (bar)	2.60	3.1	3.34	4.00
Port Fuel P (bar)	4.26	4.48	4.56	4.68
Port Charge Air P (bar)	1.23	1.48	1.00	1.65
Port Charge Air T (C)	61.4	60.4	57.6	56.8
Port Speed Demand (rpm)	1603	1756	1803	2008
Port Engine Speed (rpm)	1605	1756	1804	2005

Stbd Actual DBR (mm)	14.38	15.25	15.49	17.19
Stbd Fuel Rack (mm)	10.48	11.95	12.41	14.56
Stbd ETC Speed A1 (krpm)	50.0	42.3	44.0	50.9
Stbd ETC Speed B1 (krpm)	0.0	53.4	55.8	64.6
Stbd T Exhaust ETC A (C)	556	652	654	681
Stbd T Exhaust ETC B (C)	575	683	689	711
Stbd Oil Pressure (bar)	5.12	5.16	5.17	5.10
Stbd Coolant P (bar)	2.53	2.89	3.01	3.65
Stbd Coolant T (C)	79.6	79.4	79.1	81.4
Stbd Oil Lube T (C)	80.1	79.7	80.2	82.5
Stbd Gear Oil P (bar)	18.2	18.4	18.3	18.4
Stbd Gear Oil T (C)	54.6	56.2	58.2	61.9
Stbd Raw Water P (bar)	2.45	2.77	2.96	3.55
Stbd Fuel P (bar)	4.26	4.35	4.49	4.48
Stbd Charge Air P (bar)	1.58	1.29	1.40	1.93
Stbd Charge Air T (C)	53.8	48.9	47.4	46.2
Stbd Speed demand (rpm)	1604	1749	1799	2003
Stbd Engine Speed (rpm)	1604	1751	1801	2002

RPM

W.O.T: 2098 & 2101

Port Actual DBR (mm)	17.83
Port Fuel Rack (mm)	14.05
Port ETC Speed A1 (krpm)	51.7
Port ETC Speed B1 (krpm)	66.5
Port T Exhaust ETC A (C)	649
Port T Exhaust ETC B (C)	677
Port Oil Pressure (bar)	5.42
Port Coolant P (bar)	7.00
Port Coolant T (C)	79.8
Port Oil Lube T (C)	82.7
Port Gear Oil P (bar)	19.8
Port Gear Oil T (C)	66.2

Port Raw Water P (bar)	4.00
Port Fuel P (bar)	4.69
Port Charge Air P (bar)	1.92
Port Charge Air T (C)	52.7
Port Speed Demand (rpm)	2100
Port Engine Speed (rpm)	2098
Stbd Actual DBR (mm)	17.09
Stbd Fuel Rack (mm)	14.02
Stbd ETC Speed A1 (krpm)	53.8
Stbd ETC Speed B1 (krpm)	68.0
Stbd T Exhaust ETC A (C)	707
Stbd T Exhaust ETC B (C)	735
Stbd Oil Pressure (bar)	5.18
Stbd Coolant P (bar)	4.11
Stbd Coolant T (C)	84.5
Stbd Oil Lube T (C)	85.1
Stbd Gear Oil P (bar)	18.4
Stbd Gear Oil T (C)	63.1
Stbd Raw Water P (bar)	3.95
Stbd Fuel P (bar)	4.67
Stbd Charge Air P (bar)	2.16
Stbd Charge Air T (C)	47.6
Stbd Speed demand (rpm)	2100
Stbd Engine Speed (rpm)	2101

Load conditions:

Fuel: 20% of fuel capacity / 90% water / 8 people on board

BOAT SPEED:

WOT (2100 rpm): 16.6 knots

Observations during sea trial:

The engines were slowly brought up to max rpm in order to allow temperatures and pressures to stabilize.

The engines were tested at different speeds, data was collected and smoke was monitored.

The temperatures were double checked with the use of an infrared gun.

Overall the engines performed well, both engines attained max rpm's at wide-open throttle (W.O.T).

The turbochargers sequential switching worked well on both engines.

All the pressures and temperatures were within the parameters at different rpm's during the sea trial.

*A vibration was felt after 1200 rpm's.

There were no alarms during the sea trial.

The reverse was tested okay on both transmissions.

The shaft seals did not leak.

GENERAL INSPECTION: Several pictures in engine room were taken. (See them attached)

PORT ENGINE:

Primary Fuel Filter: (3) 2020 Racors / 15 microns

Air Filters: Clean

Fuel Lines: *Fuel seepage at injection pump return line.

Lube oil Lines: No signs of leakage.

Raw water system: Serviceable.

Raw water pump: Not leaking.

Motor Mounts: Secure. No excessive movement noted while maneuvering.

Tachometers: *Tachometer in engine room control room is inoperative.

STBD ENGINE:

Primary Fuel Filter: (3) 2020 Racors /15 microns.

Air Filters: Clean.

Fuel Lines: No signs of leakage.

Lube oil Lines: No signs of leakage.

Raw water system: Serviceable.

Raw water pump: Not leaking.

Motor Mounts: Secure. No excessive movement noted while maneuvering.

Tachometers: *Tachometer in engine room control room is inoperative.

PORT TRANSMISSION:

Visual inspection: ok, appears to be in good condition.

There was no slippage and drive oil temperature, pressure and shifting were normal.

STBD TRANSMISSION:

Visual inspection: ok, appears to be in good condition.

There was no slippage and drive oil temperature, pressure and shifting were normal.

OILS:

Oil Samples were pulled from both mains; transmissions and generators (please see detailed results reports attached).

The analysis incorporates three different tests. The first part of the report examines the units oil for wear metals, measured in parts per million. Wear metals are minute particles of metal suspended in the unit's oil, which are formed by friction between moving parts, abrasion or corrosion. The second part of the analysis inspects the oil for contaminants such as fuel, water, sodium, potassium, glycol, dirt (silicon) and soot. The third check the oil for its ability to lubricate and protect the unit properly (oxidation, viscosity, SAE and TBN).

OIL SAMPLE RESULTS: (Please see separate Oil Lab Reports)

Neither a borescope inspection nor a compression test was requested/performed at this time. The internal condition of the engines is unknown.

Maintenance Records:

The engineer provided a W-6 report done on both engines by Mendol USA when the vessel was called "Lagniappe" with a completion date of July 13, 2018.

However this report does not show the engine hours at that time.

The engineer also informed about the following work done on the engines in the last 2 years:

06/22/22: Stbd engine starter replaced.

10/12/22: Port engine raw water pump replaced.

03/02/23: Port engine starter replaced.

04/12/23: Port engine heat exchanger cleaned.

04/24/23: Stbd engine heat exchanger cleaned.

10/11/23: Stbd engine coolant pump replaced.

10/11/23: Fuel supply line to injection pump replaced.

12/08/23: Port and Stbd engines speed sensor replaced.

07/15/24: Port thermostat assembly changed. Port intercooler cleaned and serviced.

09/03/24: Port "A" and "B" turbochargers rebuilt.

Recommendations:

The engines had a W-6 (complete overhaul) done in 2018, however there are no records of any major work done on the transmissions. They are the original transmissions and have the following service hours:

Port: 15,425 hs / Stbd: 15,428 hs

Therefore it is highly recommended to perform a thorough internal inspection of both transmissions (by a ZF technician) to determine their actual condition and proceed accordingly with the necessary service.

Check bottom of vessel and running gears (shafts and propellers) to investigate cause of vibration.

Specific MTU maintenance service recommendation:

At this time I recommend to perform a W-4 maintenance service as per MTU guidelines, which includes a valve adjustment, remove and service the injectors and perform a borescope inspection of the cylinders. This way the internal condition of the engines can be observed.

Miscellaneous service and repairs recommendations:

Replace Port engine injection pump fuel return line.

Repair/replace Port & Stbd tachometers in engine control room.

Overall, very important recommendation:

Keep the maintenance echelons as per MTU / ZF / NORTHERN LIGHTS (John Deere) specifications.

General recommendations:

As a good practice, keep a record of oil sample results every time the oil is changed.

Operating at the recommended cruising speed will help to provide the maximum engine service life and the most economical operation.

Fuel Conservation Practices:

The efficiency of the engines can affect the fuel economy, therefore be aware of the properties of the different fuels. Use only the recommended fuels.

Avoid unnecessary idling.

Shut off the engines rather than idle for long periods of time.

Keep the air filters clean.

Ensure that the turbochargers are operating correctly so that the proper air/fuel ratio is maintained. Clean exhaust indicates proper functioning.

No part of this report is issued as an expressed or implied warranty of the condition or life expectancy of the vessel's engines, transmissions and generators, or of the cost of repairs.

It is agreed that Scarano Marine Inc. shall not be held liable or responsible for any errors, omissions, or oversights in the inspection of the above described yacht.

This report is issued without prejudice to the rights of whom it may concern.

Sincerely,

Adolfo Scarano

Certified Marine Engineer-Surveyor

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Certified MTU

Authorized MAN Dealer

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