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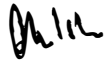
66M ANCHOR HANDLING / OFFSHORE SUPPORT VESSEL MAIN PROPULSION Technical Specification

Designer:

设计院: Wartsila Ship Design Singapore Pte Ltd.

ANDREW LOH H. H.

签字:



Maker: Caterpillar Motoren GmbH CO.,KG

卖方: Eric Kwak

签字:



叶德培 2013-3-29

1. 总则

General

1.1 规范

Rules

The vessel is to comply with:

- a) International Loadline Convention 1966
- b) Radio Communication Regulation to Government regulations
- c) GMDSS regulations for Area A3
- d) IMO Intact and Damage stability SPS Code 2008.
- e) Dynamic positioning systems (DYNPOS-AUTR)
- f) International Convention of Prevention of Collisions at Sea 1972 including Amendment of 1981 and latest Amendments
- g) International Tonnage Admeasurement Convention 1969
- h) Safety equipment to comply with Government Authority & SOLAS 1974 consolidated Edition 1988, 1992, 2004 etc. and including latest Amendments for this type of vessel.
- i) Marpol 1973/ 78 including latest Amendments for Annex I, II, IV, V & VI
- j) Maritime Laws and Regulations of Marshall Islands port authorities.
- k) Noise level Guideline as per IMO Resolution A. 468 (XII)
- l) Maritime Labour Convention 2006
- m) Shipboard marine pollution emergency plan (SMPEP/SOPEP) – Shipyard
- n) Garbage disposal management plan - Shipyard
- o) Cargo securing manual - Shipyard
- p) Fire fighting class I operating manual – Shipyard
- q) International safety management manual (ISM) – Shipyard
- r) SPS Code for special personnel not more than 60
- s) Ship security alert system manual – Shipyard
- t) International Ballast Water Management convention, BWM
- u) Performance Standards for Protective Coating (in Ballast tanks), PSPC
- v) P & A Manual – Shipyard
- x) DP Operation Manual - Shipyard

These regulations shall be applied with all amendments in force or adopted by the relevant bodies at the date of signing the shipbuilding contract.

1.2 标准

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Standard

标准采用 ISO, 单位采用国际单位。

ISO standard to be followed generally. SI units to be adopted

1.3 船级社

Classification

该船将按下列入级符号建造:

The vessel is to be constructed, machinery installed and equipment and spare parts provided in accordance with the latest Rules for Building & Classing of Steel Vessel to DET NORSKE VERITAS (DNV) (hereinafter referred to as classification) and to their special survey to hull and machinery for class DNV, Maltese Cross + 1A1, Offshore Service Vessel, AHTS, SPS, Clean, DYNPOS-AUTR, E0, Fire Fighter I, COMF-V(rating 3), OILREC (OILREC is optional), TMON, Recycable, BIS for unrestricted service.

1.4 挂旗

Flag

Marshall Islands

2. 要求

Requirement

2.1 环境条件:

Conditions

设备可在下述条件中运行。

All machinery outputs are to be rated for continuous duty under the following conditions:

Ambient temperature: 0°C --45 °C

Sea Water temperature: 0°C --32 °C

Air pressure: 1 bar

Relative humidity: ≤90%

2.2 提供无石棉声明

Asbestos-free declaration to be supplied.

2.3 提供配对法兰、接头及软管, 提供电缆填料函, 详细尺寸认可图确定

Counter flanges to be provided by maker. Cable glands should be provided by Supplier. For detail dimension shall be offered by Shipyard during the period of approval drawing.

2.4 铭牌

Nameplate

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铭牌的材料为不锈钢，语言为英语。

The material for name plate to be stainless steel, language in English.

2.5 语言

Language

本设备所有文件、资料、传真、邮件为中英文。如有不同之处，应以英文为准。

All document, data, E-mail and fax for this equipment is written in Chinese and English. The English is to take the precedence should there be any conflicts.

3 产品技术参数

Technical particular

4 图纸和文件（每船套）

4.1 认可资料

Approval drawing

1) 在合同签定后 2 周内提供 6 套参考认可图（附 2 套光盘 CAD 文件格式），6 周内提供正式认可图，

The Maker should submit primary Auto CAD approval drawing within two weeks after the Contract is signed. The Maker should submit 6 sets with Auto CAD of formal approval drawings for approval within six weeks after the Contract is signed.

2) 电子文档应以 E-MAIL 的方式与纸质资料同时发给船厂（ ）。注：
a 邮件应标明船号和专业联系人姓名。

Electronic document should be send by e-mail to shipyard together with the approval drawings. Shipyard's E-mail: _____

Note: Hull Number, Name of professional should be clearly marked in e-mail.

4.2 认可资料确认

Approval of document

收到供货方提供的认可资料后，15 个工作日内由船厂将意见汇总反馈给供货方。

Shipyard should return one (1) copy of approval drawings with comments (if any) to the Maker within 15 working days upon receipt of the approval drawings.

4.3 工作图

Working drawing

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设备厂家从船厂收到认可意见后, 在 10 个工作日内内提供 5 套工作图, 附 1 套 CAD 文件格式光盘发给船厂。电子文档同时以 E-MAIL 方式发船厂。发船厂邮件必须采用 EMS 邮寄。

The Maker should submit 5 sets with Auto CAD of working drawings within 10 working days upon receipt of returned approval drawings from the Shipyard. All of these drawings to be posted to Shipyard by EMS as item 4.1. Electronic document should be send by e-mail to shipyard together with the working drawings.

4.4 完工资料

Final drawing

设备厂家在交付设备时提供完工资料每船共 5 套, 完工图纸包括以下内容。

The Maker should submit 5 sets of Final drawings together with the equipment delivery. Following items to be included in final drawings.

a. 装置总图;

General drawings of equipment

b. 系统图;

System drawings

c. 原理图;

Principle drawing

d. 安装、使用及维护保养说明书;

Installation Operation and Maintenance Manuals

e. 备品备件清单;

Spare part list

f. 产品合格证 (1 份/机);

Manufacturer certificates (1 per machine)

g. 证书 (一正两副);

Certificates (1 original and 2 copies)

h. 其它

Others according to the maker's practice/standard

5 设备清单 (规格书中要明确以下清单)

Equipment list (following list to be included in this specifications)

5.1 设备供货范围清单:

Supply list

附件清单:

Accessories list

5.2 备品备件和工具清单:

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注：备件及工具清单应满足规范要求。

Remarks: spare part & tools list shall comply with rules.

6 质保期

Guarantee Period

As per contract.

7 其他

Others

If there are some omission, the two parts will discuss with each other friendly to resolve them.

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TECHNICAL SPECIFICATION

MAIN PROPULSION ENGINE

Marine main diesel engine to drive a propeller (CPP)

Ship type	:	66M Anchor Handling – Offshore Support Vessel
	:	OSV66-01 /02/03/04
Hull no.	:	
Ship Owner	:	Caterpillar Motoren GmbH & Co. KG
Supplier	:	2 x MaK 8M25C
Engine type	:	P120654
CAT project no.	:	xxxx
Flag	:	
	:	DnV
Class notation	:	

Caterpillar Motoren GmbH & Co. KG

March 29th, 2013

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MaK

Caterpillar Marine Asia Pacific Pte Ltd
Registered Seat: Singapore
Register of Companies No. 199907500 E

1. Engine General

- 1.1 Engine type and design
- 1.2 Rated output
- 1.3 Consumption
- 1.4 Exhaust gas emission
- 1.5 IMO SOLAS
- 1.6 Documents to be supplied
- 1.7 Engine components
- 1.8 Acceptance test and preservation
- 1.9 Scales, required current, lettering plates

2. Engine Control and Monitoring

- 2.1 Indicators
- 2.2 Control devices
- 2.3 Monitoring for unattended operation
- 2.4 LESS (Large Engine Safety System)

3. Engine (Auxiliary) Systems

- 3.1 Starting air system
- 3.2 Air intake system
- 3.3 Diesel oil system
- 3.4 Exhaust gas system
- 3.5 Cooling freshwater system
- 3.6 Lubricating oil system

4. Accessories

- 4.1 Engine interfaces
- 4.2 Connecting parts - Engine
- 4.3 Tools

5. Spare Parts

- 5.1 Engine spares

6. Marine Propulsion System – Gearbox(es) and CPPs system (long version)

1. Engine General

1.1 Engine Type and Design:

2 MaK four-stroke marine main diesel engine to drive a propeller (2 CP propeller)

Type: 8 M 25 C

**Design: 8 cylinders in-line, IMO II
1 counter-clockwise rotation
1 clockwise rotation
compressed-air starting,
suitable for operation with MDO ,
max. viscosity: 11 cSt/40 °C,**

1.2 Rated Output:

2,666 kW at 750 rpm

reference conditions to ISO 3046/1:

45 °C (318 K)	air temperature
38 °C (311 K)	charge-air cooling water temperature
60 %	humidity
1 bar (100 kPa)	air pressure

**The engine will be run at 110% continuous rating on the test bed.
The fuel rack position will then be limited to 100%.**

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1.3 Consumption:

Fuel : 187* g/kWh at 100 % rated output
 184* g/kWh at 85 % rated output

Tolerance: 5 %

Additional fuel consumption per engine driven pump: 1 %

Reference conditions to ISO 3046/1:

Calorific value	LCV = 42,700 kJ/kg
air pressure	1 bar (100 kPa)
intake-air temperature	25 °C (298 K)
charge-air temperature after cooler	45 °C (318 K)
charge-air refrigerant temperature	25 °C (298 K)

In case of different reference conditions conversion of fuel consumption according to ISO 3046/1 Paragraph 10.4 and 13.2 shall be effected.

Lub oil : 0.6 g/kWh over the entire load range (related to 100 % engine output).
The tolerance is ± 0.3 g/kWh

1.4 Exhaust Gas Emission:

NOx emission evidence for the engine about compliance with IMO-Marpol effective as of January 2011 through EIAPP certificate or EAPP Documents of Compliance or EAPP statement of compliance according to the authorization by the flag state and related technical file.

For constant speed / generator operation visible smoke (FSN>1.0) in the load range<25% and for combinator operation invisible smoke (FSN<0.5) in the entire load range in quasi-stationary engine operation and if the ramp-up times according to the Project Guide are complied with.

Note: * Preliminary Figure

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1.5 IMO SOLAS:

Additional equipment on engine as pre-requisite for IMO SOLAS, Chapter II-2, Part A15 (new B4), Regulation 2.9 to 2.11 and 3:

- jacketed high pressure fuel pipes
- leak fuel collecting system with collecting tank and sensor for alarm
- exhaust lagging
- covers for indicator valve and safety valve
- covers for connections in the fuel system
- covers for connections in the lub oil system

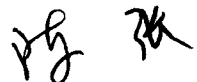
Provided that other flammable media (i.e. hydraulic oil) could be concerned IMO SOLAS Chapter II-2, Part A15 (new B4), Regulation 4 has to be followed.

1.6 Documents to be Supplied:

- 8 set (2 sets as CD-ROM) of installation documents English
- 4 set (2 sets as CD-ROM) of documents consisting of :
 - operating instructions (book A) in English
 - tool and spare parts list and spare parts catalogue (book B) in German/English
 - supplement folder (book C) in English
- 1 set DnV certificate will be provided in accordance to class requirement

1.7 Engine Components:

- 2 motor-driven barring gear, fitted on engine, including reversing contactor and push button switch with cable, with starting interlock when barring device is engaged
- 2 mechanical / hydraulic governor
- 2 emergency shut-down equipment, fitted on engine, with push-button, loose supply, for manual emergency stop
- 2 power take off on free end of crankshaft, < 1750kW and with flexible coupling



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1.8 Acceptance Test and Preservation:

Standard acceptance test run of the engine at the water brake on the test bed with MDO or gas oil.

Test:	Acceptance of the engine and the accessories subject to testing with certificate issue by DnV
Preservation:	Engine painted according to Caterpillar Motoren-standard N 576-3.2 Accessories according to maker standard
Inside preservation:	According to Caterpillar Motoren-standard N 576-3.3 After test bed trial, all internal spaces of the engines are preserved.

1.9 Scale, Required Current, Lettering/plates:

Scale:	Pressure	in bar
	Temperature	in °C,
	Speed	in rpm
Current:	Three-phase current:	440 Volt / 60 Hz
	Alternating current:	230 V
	Direct current:	24 V DC

The electric power supply and the pump controls / electric starter panels are not included in the MaK scope of supply.

Lettering/plates:	Lettering and plates in English
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2. Engine Control and Monitoring

2.1 Indicators – Engine:

- 2 gauge board, fitted on engine, with 1 set liquid damped pressure gauges each for:

- fuel
- lubricating oil
- fresh water
- starting air
- charge air

- 2 set thermometers on the engine for:

- lubricating oil
- fresh water
- charge air

Electric remote speed indicator, consisting of:

- 2 rpm pick-up, fitted on engine
- 2 rpm indicator, 96x96 mm, fitted in gauge board

- 2 turbocharger speed indicator, consisting of:

- pulse generator, fitted on engine
- indicator, 96x96 mm, fitted on gauge board
- indicator, loose supply, 96x96 mm

- 2 exhaust gas temperature indicator, with selector switch, fitted in gauge board

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2.2 Control Devices:

2 manual control on engine, consisting of:

- control panel with start/stop key
- speed setting device
- mechanical shut-down device
- change-over of control functions from engine to remote control

2 electric start/stop logic on engine

The signals required for change-over of the engine remote control functions must be provided by a central unit for the transfer of control supplied by yard.

From ECR:

The control unit for speed setting is to be provided by yard.

From Bridge:

interface:

interface to emergency stop, override, reset, all the buttons & lamps by yard.

Control of the CP propeller is to be provided by yard.

The fuel rack position signal is supplied by MaK. The overload protection/load control equipment is to be provided by yard.

3K 28

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2.3 Monitoring for Unattended Operation:

The monitoring is carried out analogue and binary sensors.
(Analogue sensors are specifically indicated).

2 set of pressure switches, fitted on engine, for:

lub oil press low at full load	alarm
lub oil press at full load below danger level	alarm/reduction
lub oil press low	alarm/analogue sensor
lub oil press low	start of stand-by pump
lub oil press below danger level	alarm/engine stop
fresh water inlet press low	alarm/analogue sensor
fresh water inlet press below danger level	alarm/engine stop
fresh water inlet press low	start of stand-by pump
fresh water press low (LT)	alarm/analogue sensor
fresh water press low (LT)	start of stand-by pump
starting air press low	alarm/analogue sensor
control air press/shutdown air press low	alarm
fuel inlet press low	alarm/analogue sensor
fuel inlet press low	start of stand-by pump

2 set of temperature switches, fitted on engine, for:

lub oil inlet temp high	alarm/analogue sensor
lub oil inlet temp above danger level	alarm/reduction or engine stop
fresh water outlet temp high	alarm/analogue sensor
fresh water outlet temp above danger level	alarm/reduction or engine stop
charge air inlet temp high	alarm/analogue sensor

2 set of level switches and others, fitted on engine, for:

lub oil level in wet sump oil pan low	alarm
charge air duct water detection	alarm
leak fuel level	alarm
alarm contact for fuel oil filter diff. press high	alarm
alarm contact for lub oil back flushing filter diff. press high	alarm

2 set of thermocouples (Ni/CrNi, signals in mV), after each cylinder, before and after turbocharger.

Exhaust gas mean-value monitoring equipment is not included in the MaK scope of supply.

The exhaust gas monitoring equipment must be equipped for mean-value monitoring with suppression depending on load or temperature, temperature recording before turbocharger and a temperature monitoring (high) per cylinder and after turbocharger.

2 crankcase oil mist detector, fitted on engine
(high smoke development – alarm/engine stop)

2.4 LESS (Large Engine Safety System):

- 2 LESS (Large Engine Safety System)** build into the engine terminal box, consisting of:

Protection system with display unit with automatic and manual stop input signals. All of the signal input units and the emergency shutdown solenoid are monitored for wire break. The equipment works according to the open circuit system.

Protection device with input and output signals for:

- optional automatic stops
- automatic load reduction
- starting interlock

Start/stop system with following signal outputs:

- rpm contacts for alarm suppression
- rpm contacts for pump controls
- fuel rack position signals 4-20mA and 0-10V
- contacts for overload

- 2** set N3000 data converter built into the engine terminal box, for binary and analogue monitoring signals for data transfer via a serial interface RS485/Modbus RTU to the alarm system

Alarm system is not delivered by MaK.

The alarm system has to be equipped for analogue and binary inputs and an interface for RS485/Modbus RTU.

The exhaust gas monitoring equipment must be integrated in the alarm system.

The temperature and pressure remote indicators analogue outputs are to be provided according to the requirements of classification societies.

3. Engine (Auxiliary) Systems:

3.1 Starting Air System:

- 2 air bottle, loose supply, 500 litres, with pressure gauge, filling, relief valve with pipe connection and drain valve
- 2 Automatic drain valve, loose supply

3.2 Air Intake System:

- 2 air intake filter, fitted on turbocharger

3.3 Diesel Oil System:

- 2 circulating pump, fitted on engine
- 2 circulating pump, loose supply, horizontal or vertical installation are possible, driven by electric motor
- 2 duplex primary filter, loose supply
- 2 duplex filter, fitted on engine, with differential pressure indication

3.3 Exhaust Gas System:

- 2 turbocharger at free end, with transition nozzle,
Nozzle position: 0 degrees from the vertical and away from the engine, with compressor cleaning device
- 2 expansion joint, loose supply
- 2 silencer and spark arrestor, supply loose, unlagged, 35 dB(A)

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3.4 Cooling Fresh Water System: (designed for two-circuit cooling)

- 2 HT pump, fitted on engine
- 2 stand-by HT pump, loose supply, vertical design, electric motor driven
- 2 LT pump, fitted on engine
- 2 stand-by LT pump, loose supply, vertical design, electric motor driven

- 2 HT thermostat, not powered, loose supply
- 2 LT thermostat, not powered, loose supply
- 2 electronic charge air temperature control (to be installed in a console) with control valve, loose supply, without part load heating
- 2 engine preheating equipment, loose supply, consisting of: electric preheater, switch box, pump

3.5 Lubricating Oil System:

- 2 plate cooler, loose supply (material : stainless steel)
- 2 force pump, fitted on engine
- 2 stand-by force pump, loose supply, vertical design, electric motor driven
- 2 automatic backflushing filter, fitted on engine, with differential pressure indication
- 2 pressure control valve, fitted
- 2 thermostat, not powered, loose supply
- 2 wet sump pan, fitted on engine, without dip stick
- 2 oil dip stick, fitted on wet sump pan

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4. Accessories

4.1 Engine Interfaces:

Engine interfaces with screwed union, counter flange and gasket as well as electric terminal box will be provided.

All connections (including material) between engine interfaces and plant components are not included in the MaK scope of supply.

4.2 Connecting Parts – Engine:

2 set of connecting parts between flange coupling and flywheel

2 flexible flange coupling between engine and gearbox

2 flexible PTO shaft coupling – for shaft alternator

2 three-phase synchronous shaft alternator

manufacturer : Leroy Somer

type : -

1500kVA, 1200kW at 0.8p.f/ 1800rpm

440V / 60 hz.

acceptance : DnV

protection : IP 23

design : brushless, antifriction bearing, IM B3, anti condensation heater, self-excitation, damper winding sensor, marine design, voltage regulator (loose supply)

note : 1 set of spares (bearing+electronic parts), 3 CTs built in, 3 CTs loose

2 set of conical elements for direct resilient mounting of the engine

2 set of flexible pipe connections

2 flexible flange coupling between engine PTO and FiFi pumps.



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4.3 Tools:

- 1 set tools for the engine (basic equipment) including hydraulic tightening tools and nozzle tester
- 1 set of tools for turbocharger (basic equipment)
- 1 crank web deflection dial gauge
- 1 inside micrometer for cylinder liners
- 1 ruler for cylinder liner micrometer

5. Spare Parts

5.1 Engine spares:

- 1 set of engine spares for unrestricted voyage according to classification society in accordance to table:

Preliminary

Description	Quantity
Main bearing	1
Thrust washer	1
Cylinder liner, complete	1
Cylinder head, complete	1
Set bolts and nuts for cylinder head	0,5
Set of exhaust valves for one cyl. head	2
Set of intake valves for one cyl. Head	1
Starting air valve, complete	1
Relief valve, complete	1
Set of injection valves for one engine	1
Set of con-rod top & bottom bearing for 1 cyl.	1
Piston, complete	1
Connecting rod	1
Gudgeon pin with bushing for one cylinder	1
Set of piston rings	1
Fuel injection pump	1
Fuel injection piping	1
Set of gaskets and packing for one cylinder	1
Exhaust compensator between cylinders	1

- 1 set of spare flexible pipe connections

6.0 Marine Propulsion System – Gearbox(es) and CPP System (short version)

2 Single Marine Reduction Gearboxes

Type T²RECS-710L

Single-stage design

Shaft vertically offset

Center distance of the shafts 710mm

With one multiple disc clutch for each input shaft

(for the design of the multiple-disc clutch(es) we require mass moments of inertia of propeller (0-pitch) and generator.)

Power data:

P = 2666 kW (MaK 8M25C)

n = 750 / 135.9 rpm

I = 5.519 : 1

Survey : DNV

Ice class : without

Each gearbox incl. 1 primary-PTO for

P_{max.} = 1.200 kWel. at n = 1800 rpm

PTO shaft(s) above input shaft, center distance 560 mm

Gearbox incl. cooling- and lubrication system, double filter, piping and instruments.

Output shaft(s) bored for cpp.

Internal bearings of the multiple-disc clutch as well as shaft(s) in roller bearings.

Built-in thrust bearing, construction type RENK for a maximum propeller thrust of plus/minus 472kN.

Stand-by pump with electric motor, coupling and bell housing not included.

Oil cooler for 38deg.C, fresh water, attached.

Instruments incl. wiring up to terminal box in accordance with the classification society DnV-EO.

Set weight: 14, 800 kg approx.

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TECHNICAL SPECIFICATION FOR MAIN CONTROLLABLE PITCH PROPELLER 66m AH / Offshore Support Vessel BCP 850

Berg Propulsion Project No: 33124M – 3 rev2
Berg Propulsion Order No:

Classification Society: DNV
Class Notation: DP 2
Ice Class: No Ice

Notes:

This CPP proposal is suitable for prime mover rated at 2666 kW @ 750 rpm with a suitable reduction gearbox having reduction ratio 5.515:1

0	08-10-2012	First Issue	SU
1	15-11-2012	Diameter and rpm changed (was 3500mm, 151 rpm)	SU
2	18-01-2013	Seal details added. Alignment calculation is included into the scope of supply.	SU

Handwritten signatures and initials

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3. Classification

4. Documents and drawings (per ship set)

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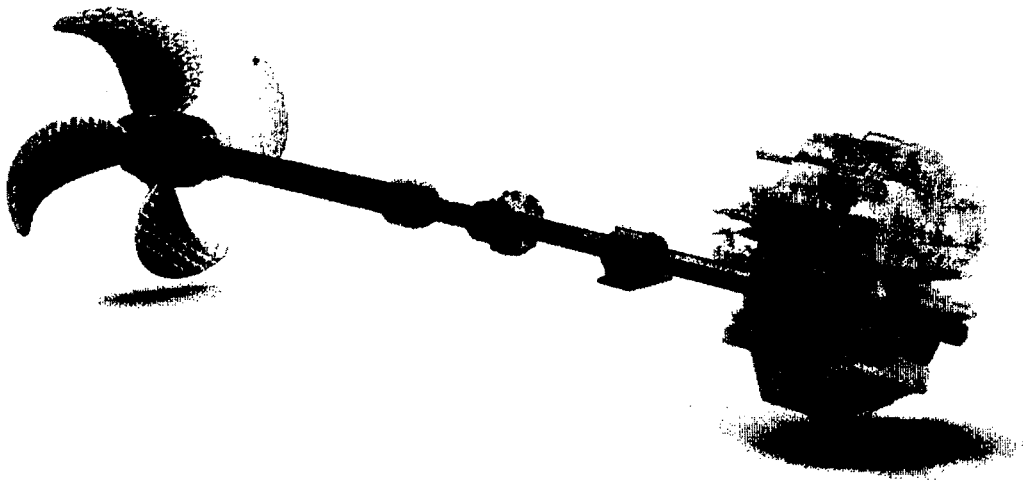
6. Alignment Calculations

7. Commissioning and Setting to work (per ship set)

8. Items not included

TECHNICAL SPECIFICATION

The items listed below are for a single shaft line installation including BERG BCP 850 main propeller equipment in a Twin Screw ship.
Technical data and dimensions are preliminary.



The picture might differ from the system delivered

Type: BCP 850

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General Data

Twin Screw AHTS with Nozzle propellers

100% MCR

Prime Mover Power (KW)	PB	2666
Propeller speed (RPM)	n	136
Ship design speed (Knots)	V	14
Mean wake	w	0.12
Diameter (mm)	D	3650
Number of blades	Z	4
Prop. Efficiency	η_p	0.609
Calc. thrust at bollard pull (Ton)	Tb	55 per propeller x 2 = 110 Total
Guarantee bollard pull		99 tons

Propeller rotations

Propeller rotation sense, Port Anti-clockwise (looking from aft)

Propeller rotation sense, Stbd Clockwise (looking from aft)

Power supply on board 440V 60 Hz / 24V DC

Certificates

The installation will be supplied with certificates from: DNV

2. Scope of Delivery

2.1 BCP 850 Propeller Hub and Blades

One propeller hub, with built in hydraulic cylinder in Cu-Ni-Al bronze. Design for blade removal in nozzle.

Four propeller blades in Cu-Ni-Al bronze with moderate skew back design, machined, polished and balanced. All blade bolts and bolts for propeller hub to shaft flange are included.

Blade manufacturing accuracy according to ISO 484/1 (1981) class 1.
Blade surface roughness according to class 1.

2.2 Nozzle

The propeller is designed to be used in combination with a nozzle.
One Type 19A nozzle suitable for propeller diameter, 3650mm in shroud ring stainless steel. Flare cone mild steel with head box height max. 250mm, bottom of nozzle prepared for sole piece.

2.3 Shaft Line

One shaft line arrangement consisting of one propeller shaft and 1 intermediate shaft.

One propeller shaft in shaft steel, hollow bored.
Length of propeller shaft: 10800 mm

One intermediate shaft Nr.1 in shaft steel, hollow bored, with flanges on both aft and fwd ends.
Length of intermediate shaft 1 6000 mm

The shaft line includes:

- One flange coupling type OMC for hydraulic mounting on the propeller shaft connecting to intermediate shaft Nr. 1
- One set of final machined bolts and nuts for connection between OMC coupling flange and intermediate shaft flange.
- One set of oversized bolts and nuts for connection between gearbox flange and intermediate shaft flange.
- One set of oil pipes, mounted in the hollow bored shaft line arrangement.
- One journal bearing for intermediate shaft, material of bearing bush Cast iron, lining white metal, 38 C fresh water cooling.
- One bulkhead seal is included on intermediate shaft 1 with one adaptor plate.
- One shaft earthing device including mV meter, brush, silver tape.
- One shaft speed sensor (supplied loose)

Note – Total distance between propeller centre and gearbox output flange is approx. 17165 mm.

2.4 Stern Tube and Bearing

One stern tube of steel, with welded flange in aft end and connection flange in forward end for chock fast (or shrink fit) mounting to shipyard supplied stern and forward boss. One forward and aft white metal lined stern tube bearing shrink fitted into the stern tube.

Stern Tube Length 6,600 mm (between flanges)
One set of bolts for connection of stern tube to the ship.

Aft Seal

One aft seal, type non-split with 3-lips, with mounting screws, gaskets and measuring calliper.
Material of liner: Chromium Steel
Material of housing part: Bronze
Material of sealing rings: FPM
Mounting bolts: Stainless Steel

Fwd Seal

One fwd seal, type non-split with 2-lips, with mounting screws and gaskets, including 5L oil tank.
Material of liner: Cast Iron
Material of housing part: Cast Iron
Material of sealing rings: FPM
Mounting bolts: Steel

The Stern Tube is delivered with the following add-on articles

- One gravity tank for stern tube lubrication
- One rope guard in split design
- One set of net cutter knives in stainless steel material
- One temperature sensor for aft bearing, double elements one operation one spare type PT 100
- One protection pipe for aft temperature sensor.
- One temperature sensor for fwd bearing, single elements type PT 100
- One protection pipe for forward temperature sensor.

2.5 Pitch Control Unit

One hydraulic pitch control unit type HDX for the regulation and transfer of hydraulic fluid under pressure to the hydraulic cylinder for regulation of the propeller pitch.

Size HDX 105

Length 850 mm (Including space for dismounting)

The following features are included in the pitch control unit:

- One visual pitch feedback system and one mounted redundant feedback sensor.
- One emergency pitch system in case of total failure of the hydraulic system.

2.6 Hydraulic and Lubrication System

The hydraulics and lubrication system incorporates the following items

2.6.1 Hydraulic System

One hydraulic tank unit with one main PTO driven axial piston pump and one electric driven standby axial piston pump, shop assembled for installation as a complete assembly.

The power pack incorporates the following items

- One oil tank
- One local tank level indicator
- One local temperature indicator
- One hydraulic pump closely coupled to an electric motor in the standby auto start mode
- One Duplex pressure filter unit with manual change over

- One special filter mounted in the lubrication oil static tank supply line.
- One oil pressure manometer
- One low oil pressure switch for auto start of standby pump
- One emergency hand pump

Hydraulic System Alarm Sensors

- One low hydraulic oil level sensor
- One high hydraulic oil temperature sensor
- One oil pressure sensor
- One pressure filter blocked sensor
- One lubrication filter blocked sensor

The following items are delivered loose:

- One PTO driven pump to be mounted on gearbox pump drive.
- One hydraulic pump motor starter with auto start function.
- One 24 V solenoid operated 4-way hydraulic control valve fitted with mechanical push buttons for manual operation.

2.6.2 Hub Lubrication System

The hub is lubricated through the oil distribution box and pipes in the hollow bored propeller shaft. The lubrication oil is continuously circulating. In order to ensure a constant flow regardless of the temperature and to minimise pressure drop high viscosity index oil is used in the hydraulic system.

The lubrication system consists of the following parts:

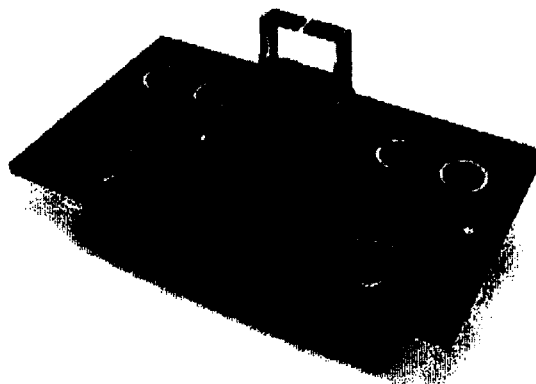
- One Gravity tank complete with level alarm and sight glass

Lubrication Oil Water Saturation Monitoring System

One lubrication oil water saturation monitoring system, supplied mounted on the hydraulic power pack. The system includes a sensor mounted in the tank unit for monitoring the moisture saturation and temperature of the return hub lubrication oil.

The sensor provides analogue output signals for oil temperature and saturation level to the remote control system. The saturation level is monitored and connected to an alarm.

2.7 Remote Control System is supplied by yard



The system can be configured to control propeller pitch, prime mover speed, prime mover load and clutch position as required.

Bridge Main Panels supplied by yard

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Engine Control Panel supplied by yard

centre unit provided by yard

Cable glands on Berg equipment input side supplied domestically by Berg. The shipyard will inform the actual cable sizes 90 days before the contractual delivery of the equipment.

Clutch Control System provided by yard

The control and operation of all clutches will be carried out in a safe manner as required by classification and the gearbox manufacturer. The clutch control system will manage the following clutch:

- Main Clutch

Redundancy and Emergency Control:

- Main Control - system from any control position provided by yard
- Local Control - Local unit in engine room
- Emergency control - Manual control at hydraulic control valve

Physical Configuration

Complete physical configuration will be issued with the installation manual and is depending on vessel type and system configuration.

2.7.1 Alarms

The delivered propeller system includes following alarm output signals to an external alarm & monitoring system:

Control Alarms

- One alarm control failure -Contact ON/OFF
- One alarm main power failure -Contact ON/OFF
- One alarm backup power failure -Contact ON/OFF

Hydraulic System Alarms

- One low hydraulic oil level switch for alarm ON/OFF
- One high hydraulic oil temperature switch for alarm ON/OFF

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- One low oil pressure switch for alarm ON/OFF
- One high oil pressure switch for alarm ON/OFF
- One pressure filter blocked switch for alarm ON/OFF
- One lubrication filter blocked switch ON/OFF

Hub and Lubrication System Alarms

- One alarm output "Header Tank Low Level" -Contact ON/OFF
- One alarm output "Hub lubrication system fault" -Contact ON/OFF (From Controls)

Other Alarms

- One stern tube aft bearing high temperature – PT100
- One stern tube fwd bearing high temperature – PT100
- One low level, stern tube gravity tank – contact on/off
- Twin journal bearing high temperature – PT100

2.7.2. Power Supply (UPS/Continuous) Requirements provided by yard

- Main 24VDC +/- 20% 300W provided by yard
- Standby 24VDC +/- 20% 300W (Battery Back-up, Yard supply)

2.7.3. Interface Signal Requirements (detail to be discussed later)

OUT

- One speed setting signal 4 - 20 mA suitable for interfacing with the existing electric controlled governor.
- One prime mover start permit signal ("Clutch Out")
- Main Clutch engage signal
- Main Clutch disengage signal

IN

- Overload signal from prime mover
- Local / remote from prime mover
- One engine load signal 4-20mA
- One engine speed signal 4-20mA
- Signal from safety system "Autostop/Shut down"
- Signal from safety system "Auto load Reduction/Slow down"
- Main Clutch engaged signal

2.8 Spare Parts (per ship set)

Spare parts that are required in accordance to the classification society for unrestricted service and BERG recommendation will be supplied with the installation.

- One set of filter inserts

2.9 Special Tools (per ship set)

One set of special tools per ship set will be supplied with each ship set and is consisting of:

- One socket for propeller blade bolts
- One spanner for propeller shaft OMC coupling
- One mounting equipment for hydraulic mounted couplings.

3 Classification

Classification Society DNV

The equipment will be built in accordance with the rules in force at the date of this Contract. Official certificates required by DNV will be provided.
Classification Certificate will be separately delivered after the delivery of the Equipment. All charges for classification and certificates are included in the Contract price.

4 Documents and Drawings (per ship set)

Following drawings and documents are supplied.
eight (8) installation manuals in English containing:

- electric interface drawings
- Hydraulic system drawings
- Mechanical installation drawings

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Four (4) Operation and Maintenance Manuals with spare parts in English.
One (1) digital media including all information mentioned above.

5 Torsional Vibration Calculations (In MaK Scope)

When an order is received BERG Propulsion provide drawings of the drive line and propeller together with moment of inertia (J) values for the torsional vibration calculations (TVC). These calculations to be carried out by the prime mover manufacturer, who also is responsible for submitting them to the classification society concerned for approval. If the TVC show that the shaft dimensions stated in the quotation must be increased in order to avoid critical shaft speeds and supplementary stresses due to these, the costs for this increase is debited extra.

6 Alignment Calculations

The Alignment calculation is to be carried out by BERG. It is the buyer's/MaK/yard responsibility to supply BERG with required information about the buyer supplied equipment such as gearbox, flexible couplings, shaft bearing etc.

7 Commissioning and Setting to Work (per ship set)

Commissioning and setting to work by experienced Berg Propulsion Service engineer for total of xx normal working days and maximum of x trips included.

Installation of the propeller system on board, including mounting of all components, cabling, piping are buyer's responsibility. However, our service engineers are available for the commissioning, start up and sea trial.

8 Items not included

Stern boss & forward boss
Chock fasting
Spare blades
All foundation bolts
All Pipes outside of Berg equipment and pipe connections
All Electric cables outside of Berg equipment
Hydraulic oil and lubricants
Zinc anodes for cathodic protection
Telegraph system
Control desk or consol
All optional items
Items not specifically described in the technical specification
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