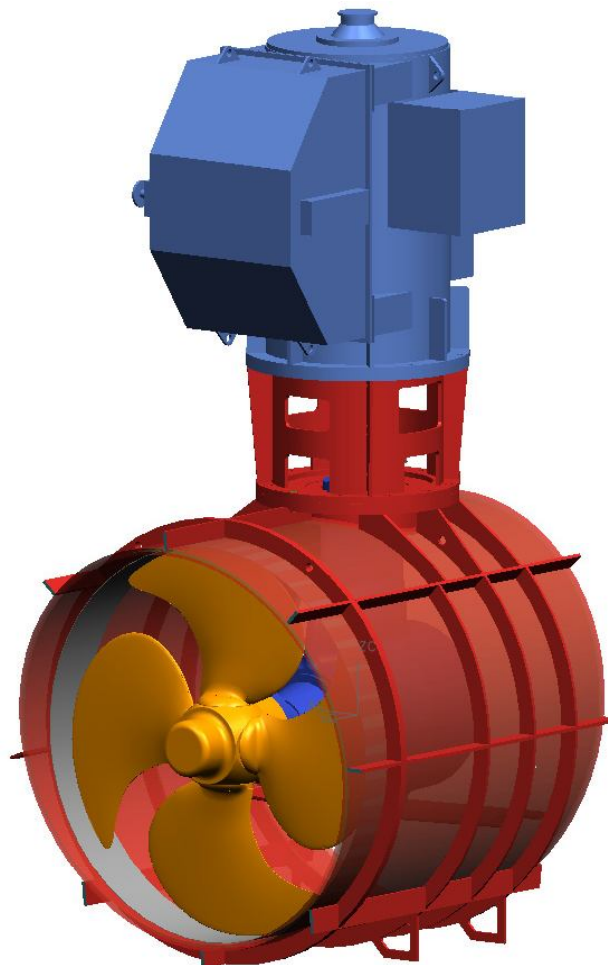


Technical Specification

5 Units, Bow #1 #2 #3 and Stern #1 #2 on 1 Vessel

Type : Rolls-Royce TT2400 DPD CP
Quotation no. : AMS-12-0284-Rev D
Version : BT123ST12#04
Date : 31 Jul 2012
Author : Trond Eikås
Customer :
Customer proj.no. : Peregrine 1
Shipyard : NA
Yard no. : NA
RRM Unit no. : NA



VI WORK

Illustration only

This document is the property of Rolls-Royce and may not be redistributed or reproduced in any way, without the written permission of Rolls-Royce. Failure to do so is a violation of copyright laws.



0 System Description

Application info

Type	TT2400 DPD CP
Application.....	Continuous running
Thruster operation.....	S1 Continuous operation
Classification society	DNV Dynpos
Vessel type.....	Production
Vessel class notation	NA

Thruster motor

Thruster motor type.....	Se separate specification
Thruster motor power	1380 kW

Thruster motor starter

Thruster motor starter type.....	Not scope of supply
----------------------------------	---------------------

Thruster/Tunnel

Propeller speed.....	211 rpm
Reduction gears.....	K141507/K141506 11/51
Predicted side-force (optimized *1)	210 kN
Propeller tip speed.....	26.5 m/s
Direction of propeller rotation	Clockwise
Propeller blade diameter	2400 mm (or made for existing diameter)
Propeller blade design.....	Skew design
Propeller type	Controllable pitch
Number of propeller blades	4
Propeller material, hub / blades.....	Ni.Al Bronze / Ni.Al.Bronze
Tunnel diameter, inner on existing tunnel.....	2475 mm

Hydraulic System

Pitching time full - starboard / port.....	15 Seconds (Approx.)
Oil pump flow.....	33.2 l/min
Cooling water flow (max 38°C).....	200 l/min
Power supply for drain pump unit.....	1.5 kW / 3 x 380V 50Hz
Oil volume in thruster unit.....	620 Litres
Oil volume in gravity tank	180 Litres
Oil volume in seal tank	55 Litres
Oil volume in drain tank	40 Litres
Required oil volume for total installation.	895 Litres
Starter for servo pump	

Weights

Weight of thruster and tunnel (dry)	10900 kg
Weight of electric Drive Motor and starter	Installation info

Notes

*1) A steady force generated without operation of a nearby TT and ideally integrated with the hull with optimum inlet geometry, no grid and without any degradation effects from current and waves (ventilation).

Scope of supply / Technical Specification.

1.1 General Information

1.1.1 Equipment Not Supplied

Scope of supply is defined in scope of supply / technical specification.

Not included in scope of supply are:

- **Remote control.**
- **Shaft brake.**
- **Special mounting and dismantling tools.**
- **Piping interface to yard's piping.**
- **Cathodic protection of tunnel and thruster.**
- **Tunnel grids.** (RRM may assist in the design work.)
- **Oil and lubrication grease.**
- **External hydraulic piping.**
- **Electric cables with supports and protection.**
- **Cable glands.**

1.1.2 Technical Information - Installation manual

Necessary technical information for shipyard engineering and mounting of thruster into the ship, commissioning, starting-up and sea trial are part of the installation manual issued for each installation.

1.1.3 Propeller Blade Design

Tunnel thrusters are delivered with skewed propeller blades in order to reduce the tip cavitation tendency. This will give a major reduction of the propeller induced vibrations and therefore reduction of the propeller induced noise.

1.1.4 Location of Tunnel / Thruster in Hull

RRM recommend adherence to the guidelines given in drawing no. 216841 "Location of Tunnel / thruster in hull". An optimal location / tunnel inlet design will reduce noise / vibration excitation forces from the thruster and maximize manoeuvring performance.

1.1.5 Torsional Vibration Calculation

Torsional vibration calculations for electrical driven system, will be performed if required by classification society.

1.1.6 Workshop Testing

Thruster system is workshop tested according to the class requirement and RRM standard.

1.1.7 Corrosion Protection And Surface Treatment

The thruster unit is treated with one coat of corrosion preventing primer, and is intended for protection under normal transport conditions and storage period. Inboard parts are finish treated. All according to following specification.

- **Tunnel w/ motor foundation**
 - Not scope of supply.
- **Thruster unit**
 - Sandblasting to SA 2.5 (ISO 8501-1)
 - Touch-up painting.
 - One layer of Epoxy Primer, Interguard 269 EGA, 088 / 089, approx. 40 – 80 micron.
- **Oiltanks**
 - Sandblasting to SA 2.5 (ISO 8501-1)
 - One layer of Epoxy Primer, Interguard 269 EGA, 088 / 089, approx. 40 – 80 micron.
 - One layer Interlack DQE 322, green color, Ral 6019, appr. 50 micron.
- **Thruster Motor**
 - Delivered acc. to the sub-supplier's standard painting specification.
- **Thruster Motor Starter cabinet**
 - Delivered acc. to the sub-supplier's standard painting specification.

This document is the property of Rolls-Royce and may not be redistributed or reproduced in any way, without the written permission of Rolls-Royce. Failure to do so is a violation of copyright laws.



1.1.8 Shipment

Depending on transport methods and delivery times, components may be shipped separately. Installation into the ship and mounting of components are client's responsibility if not otherwise stated.

1.1.9 Safe Storage

All equipment is prepared for storage in dry and dustfree environments for up to 6 months from delivery, according to specification given in installation manual.

1.1.10 Interfacing, Piping And Cabling

Piping and cabling between components supplied by Rolls-Royce Marine and components supplied by others are the responsibility of the client. Type of pipes and cables are given in the diagrams and mounting instructions as part of the installation manual.

1.1.11 Installation, Commissioning, Starting Up And Seatrial

Installation of the thruster system in the ship and mounting of components are the client's responsibility if not otherwise stated. Instruction for installation, commissioning, starting up and seatrial is part of the installation manual.

1.1.12 User Manuals

Number of User Manuals is mentioned in System Description. All drawings, documents and sign plates on the equipment are delivered in English language.

1.2 Tunnel Thruster unit Controllable pitch

If not otherwise stated the, thruster is mounted in the tunnel, ready for welding into the ship.

1.2.1 1x Adapter flange

- Adapter flange (connecting new thrusters into old tunnels).

1.2.2 1x Thruster Motor Foundation

The motor foundation for the vertical Thruster Motor will be designed by Rolls Royce.

Motor foundation not scope of supply

1.2.3 1x Thruster Unit

The thruster unit is bolted to the tunnel at the top and has a horizontal supporting bracket at the lower gearbox.

The unit consist of:

- **CP Propeller hub** cast in one piece, with the propeller blades bolted to the propeller by stainless steel bolts. The propeller hub incorporates the main pitch setting servomotor and its internal parts are lubricated by the hydraulic oil, a system for flushing of oil through hub is included. The hub is flange mounted to the hub coupling on the propeller shaft.
- **Propeller blades** machined, polished and balanced according to the requirements of ISO R 484 class II.
- **Gear housing** designed as a combined speed reduction and pitch actuating unit. Gear house made of Nodular cast iron.
- **Propeller shaft** of forged steel, hollowed bored and with a hydraulic mounted flange coupling for connecting hub to shaft.
- **Spherical and Conical roller bearings** to support propeller shaft and drive shaft. The thrust in each direction is absorbed by conical roller bearings. The outer rings of the spherical roller bearings are mechanically locked to the housing. Bearing lifetime calculated according to class requirements.
- **Gear wheels** are of high quality spiral bevel gear type, made of case hardened alloy steel. Calculated according to class requirements.
- **Propeller shaft seal** of radial lip seal 3 ring type with "pressure control and drain connection / leakage detection". Two seal rings of material "Viton Super lip" (Oil side), One seal ring of material "Perbunan" (Water side), running on a ceramic coated stainless steel liner.
- **A Rope Guard** is mounted on gearhousing to protect the propeller shaft seal. Cathodic protection is mounted under the rope guard.
- **Vertical drive shaft seal** is arranged with two seals. There is one white metal seal with a small leakage which are drained to the system oil tank, or a separate drain unit. The other radial seal is running on an adjustable steel liner, sealing ring is made of Viton, and make a static sealing when the thruster is stopped.
- **OD-Box** is located on the forward end of the oil distribution pipe.

1.2.4 1x Pitch feedback arrangement

Pitch feedback is mechanically transmitted from the propeller mechanism to the electrical feedback transmitter, mounted outside on the thruster top.

1.2.5 2 Halves. Shaft Coupling

Flexible coupling, to connect the thruster input shaft to the Thruster Motor shaft. Drive shaft coupling is mounted on thruster drive shaft , and on the Thruster Motor output shaft. The coupling can be removed without removing the Thruster Motor.

1.3 Hydraulic System

1.3.1 1x Hydraulic Module

The delivery contains one hydraulic module. The location of the module is important and shall be located in accordance to RRM requirement.

Following hydraulic components are built on a module including internal piping and cabling:

- **2x System Pump Unit.**
 - Pump type: Gear pump.
 - The hydraulic system including one pitch / cooling oil pump, with 100% delivery.
- **2x El. Motor.**
 - Marine squirrel cage type for direct online starting,
 - Enclosure IP 54,
 - Insulation class F,

This document is the property of Rolls-Royce and may not be redistributed or reproduced in any way, without the written permission of Rolls-Royce. Failure to do so is a violation of copyright laws.

- Certification (IC 41).
- **1x Duplex Pressure Oil Filter.**
 - Double inline filter.
 - Equipped with a visual and electric sensor for clogged filter element and isolating valve for change of filter element.
- **1x Pitch Control Valve.**
 - Proportional control valve, load independent, combined direction and position control for electric remote control and local emergency activation. The valve has incorporated sequence and safety valve for pitch oil pressure.
- **1x Pressure gauge** for pitch servo oil pressure, with shut-off valve.
- **3x Pressure switch** (on/ off)
 - Alarm low servo oil pressure sensor (on/ off).
 - Alarm high servo oil pressure sensor (on/ off).
 - Interlock Thruster Motor (on/ off).
 - The pressure sensors are supplied with shut-off valves and control connection.
- **Junction box** for internal and external cable connections.
- **1x System Pump Starter.**
 - Direct online starter with thermal relay for overload protection, start / stop push button with run indication.

1.3.2 1x Cooler Unit

The delivery contains one Cooler unit. The location of the cooler is important and shall be located in accordance to RRM requirement.

Following hydraulic components are built on the cooler unit:

- **1x Oil Cooler** for seawater / freshwater cooling.
 - Cooler type: Tube type
 - Cooling water inlet temperature max 38°C.
- **1x Thermostatic valve** for constant oil temperature.
- **2x Thermometer** for visual inspection of temperature.
- **1x Spring loaded check valve** for bypassing oil cooler.

1.3.3 1x Gravity Oil Tank - Pressurized

The tank is equipped with:

- **Oil filling plug.**
- **Air safety valve.**
- **Air supply connection.**
- **Air pressure controller.**
- **Air filter.**
- **Pressure gauge.**
- **Pressure switch for alarm low air pressure.**
- **Check valve.**
- **Sensor** for high and low oil level alarm.
- **Sensor** for high oil temperature alarm.

The tank is designed for a maximum pressure of 2.0 bar. A calculation sheet for gravity tank location is part of the installation manual.

1.3.4 1x Hand Pump for emptying of thruster

The unit consist of:

- **Hand pump.**
- **Shut-off valves.**

1.3.5 1x Gravity Tank for propeller shaft seal lubrication

1.3.6 The tank is equipped with:

- **Oil filling / air breather cap**
- **Sounding rod**
- **Sensor** for low / high oil level alarm.

This document is the property of Rolls-Royce and may not be redistributed or reproduced in any way, without the written permission of Rolls-Royce. Failure to do so is a violation of copyright laws.

The tank is to be located to give oil pressure inside the shaft seal. A calculation sheet for tank location is part of the installation manual.

1.3.7 1x Drain Pump Unit for vertical shaft seal

The drain unit consist of:

- **Oil tank**
- **Air breather cap**
- **Sounding rod**
- **Pump unit**
 - Gear pump
- **1x El. Motor**
 - Marine squirrel cage type for direct online starting,
 - Enclosure IP 54,
 - Insulation class F,
 - Certification (IC41).
- **Level switch** for automatic start/stop of pump and high oil level alarm.

1.3.8 1x Drain Pump starter in Thruster Motor cabinet

- Direct online starter with thermal relay for overload protection, start / stop push button with run indication.

~~The starter is incorporated in the Thruster Motor starter cabinet.~~



1.4 **Thruster Motor System**

See separate specification

1.5 **Spare Parts & Tools**

- 4x Filter elements (two to be used for commissioning).
 - 1x Wrench for drive shaft coupling
 - 1x Injector pump.
-