CP Propeller Equipment

Contents:

MAN B&W Diesel A/S, Alpha, Denmark

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Introduction

The purpose of this Product Information brochure is to act as a guide in the project planning of the MAN B&W Alpha propeller equipment.

The brochure gives a description of the basic design principles of the MAN B&W Alpha controllable pitch (CP) propeller equipment. It contains dimensional sketches, thereby making it possible to work out shaft line and engine room arrangement drawings. Furthermore, a guideline to some of the basic layout criteria is given.

Our design department is available with assistance concerning speed and bollard pull prognoses, determining power requirements from the propeller, as well as advice on more specific questions like installation aspects and different modes of operation.

All our product range is constantly under review, being developed and improved as needs and conditions dictate.

We therefore reserve the right to make changes to the technical specification and data without prior notice.

In connection with the propeller equipment the Alphatronic Control System is applied. Special literature covering this field can be forwarded on request.

General Description

MAN B&W Alpha have manufactured more than 6,500 controllable pitch propellers of which the first was produced in 1902.

In 1903 a patent was taken out covering the principle of the CP propeller. Thus more than a century of experience is reflected in the design of the present MAN B&W Alpha propeller equipment.

The basic design principles are well-proven, having been operated in all types of vessels including ferries, tankers, container, cruise, supply vessels and navy ships many of which comply with high classification requirements.

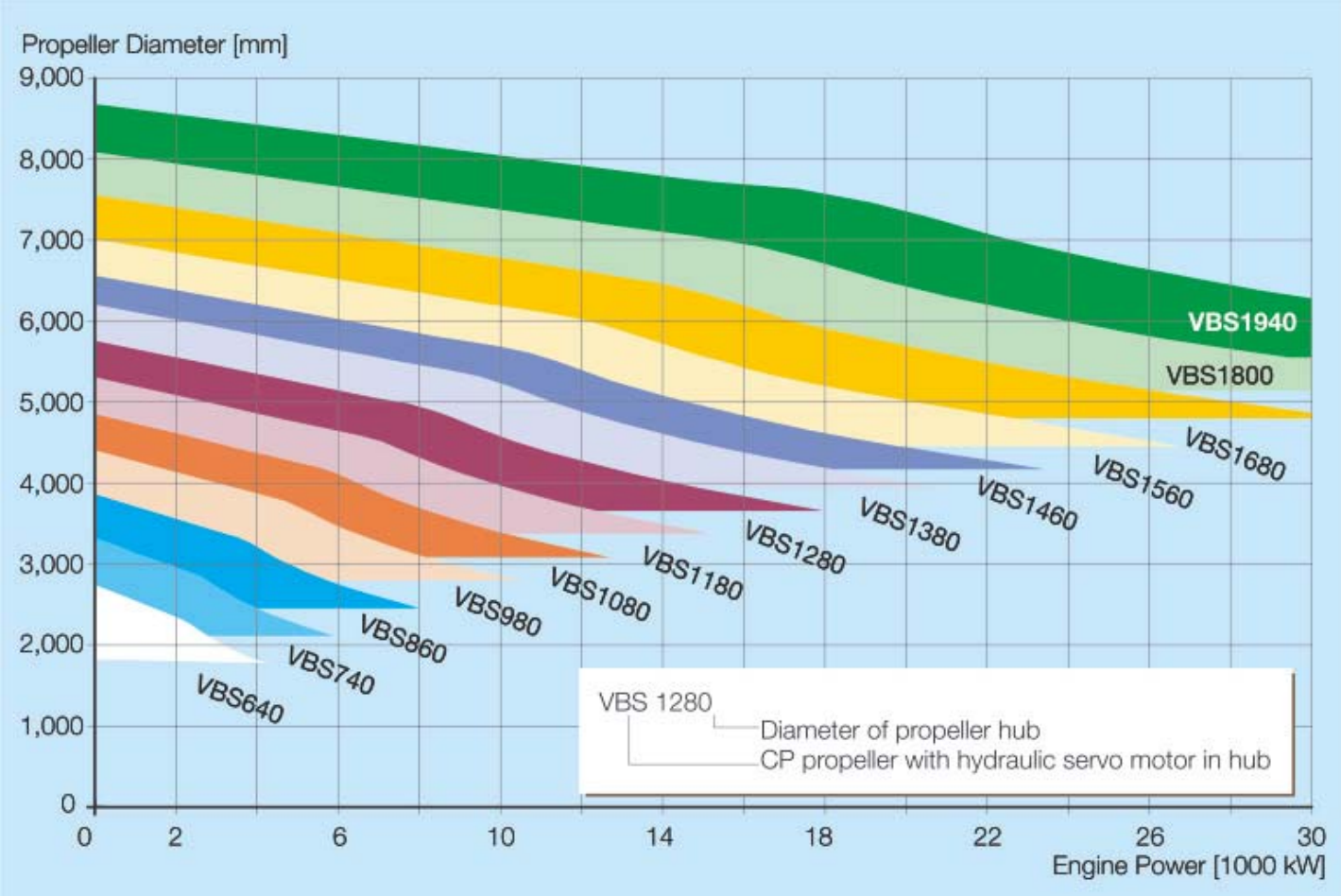

Fig. 1: VBS propeller programme

Today the MAN B&W Alpha controllable pitch propeller equipment portfolio handle engine output up to 30,000 kW, fig 1.

Controllable pitch propellers can utilize full engine power by adjusting blade pitch irrespective of revolutions or conditions.

They offer not only maximum speed when free sailing, but also maximum power when towing, good manoeuvrability with quick response via the Alphatronic control system and high astern power.

These are just a few of many advantages achieved by controllable pitch propellers.

Propeller equipment

The standard propeller equipment comprises a four bladed CP propeller complete with shafting, stern tube, outer and inboard seals, oil distributor (OD) box and coupling flange.

The location of the OD-box depends on the propeller and propulsion configuration.

Propeller type VBS

The present version of the MAN B&W Alpha propeller equipment is designated VBS and was introduced in 1996. It features an integrated servo motor located in the aft part of the hub and sturdy designed internal components.

A well-distributed range of different hub sizes makes it possible to select an optimum hub for any given combination of power, revolutions and ice class. The different hub sizes are in principle geometrical similar and incorporate large servo piston diameter with low pressure and reaction forces and few components, while still maintaining short overall installation length.

- Oil Distributor box

The VBS propeller equipment can be supplied with three different oil distribution systems for controlling the pitch de pending on the type of propulsion system i.e. direct driven two-stroke or geared four-stroke. All three types incorporate the possibility for emergency

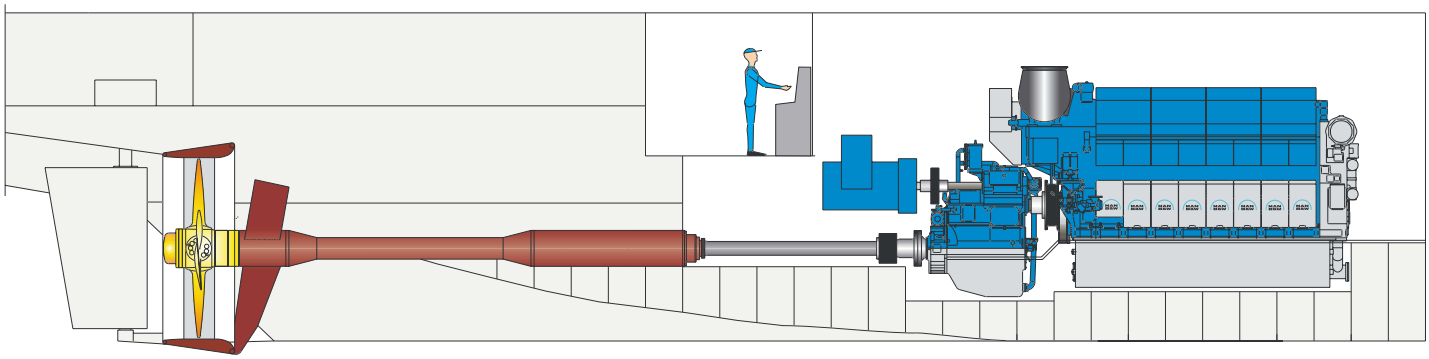

Fig. 2: Propeller equipment type VBS-ODG (8L27/38 engine, AMG28EV reduction gear, VBS860 propeller)

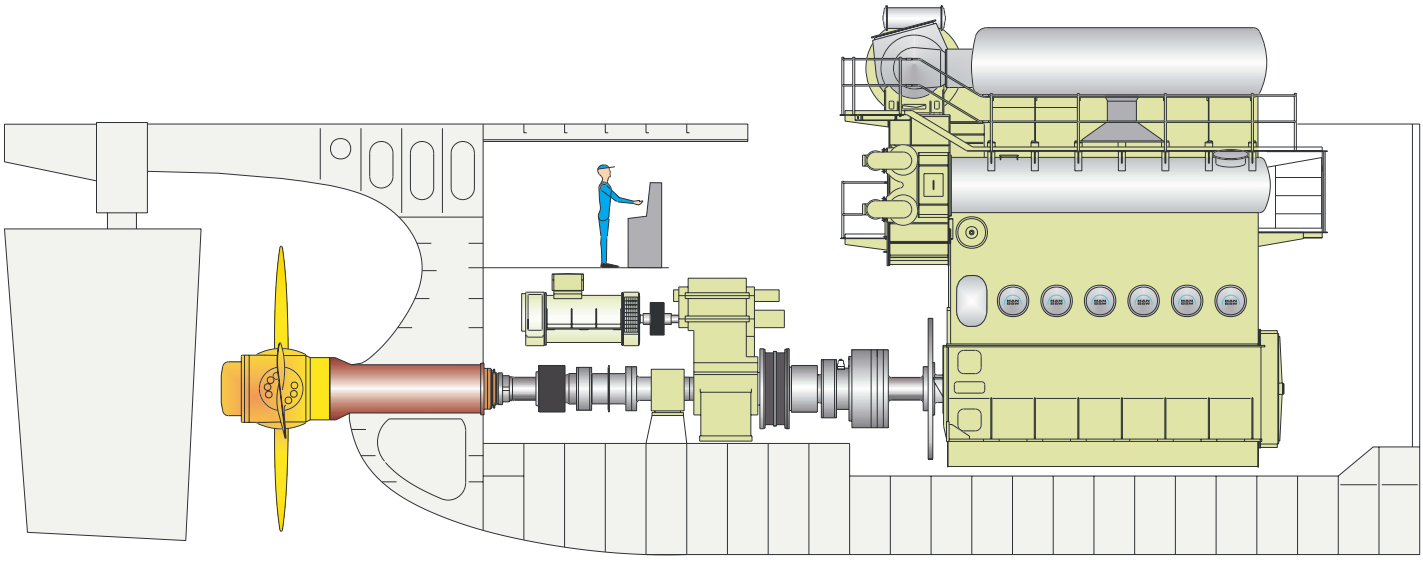

Fig. 3: Propeller equipment type VBS - ODS (6S42MC engine, Tunnel gear, Alpha Clutcher, VBS1380 propeller)

operation and a valve box that will keep the propeller pitch fixed in case the hydraulic oil supply is interrupted. The latter is required by classification societies and will prevent the propeller blades from changing the pitch setting.

- ODS - Shaft mounted OD-box

For direct driven propellers without reduction gearboxes the oil distribution box must be located in the shaft line.

The ODS type is intended for this type of installations and features beside the oil inlet ring a hydraulic coupling flange, pitch feed-back and the valve box. The unit design ensures short installation length and all radial holes and slots are located on the large diameter coupling flange and are carefully designed to avoid stress raisers.

- ODF - Gearbox mounted OD-box

For geared four-stroke propulsion plants the oil distribution box is usually located on the forward end of the reduction gearbox.

The ODF contains the same elements as the ODS type and comes in different sizes according to the selected type of VBS propeller equipment.

For long shaft lines with one or more intermediate shafts it is recommended to use the ODS type of oil distribution that will ensure a short feed-back system leading to a more precise control of the pitch setting.

- ODG - Gearbox integrated OD-box

For MAN B&W designed gearboxes (AMG, Alpha Module Gears) the oil distribution and pitch control system is an integral part of the gearbox. Apart from the stand-by pump no external hydraulic power unit is needed thus facilitating a simple and space saving installation.

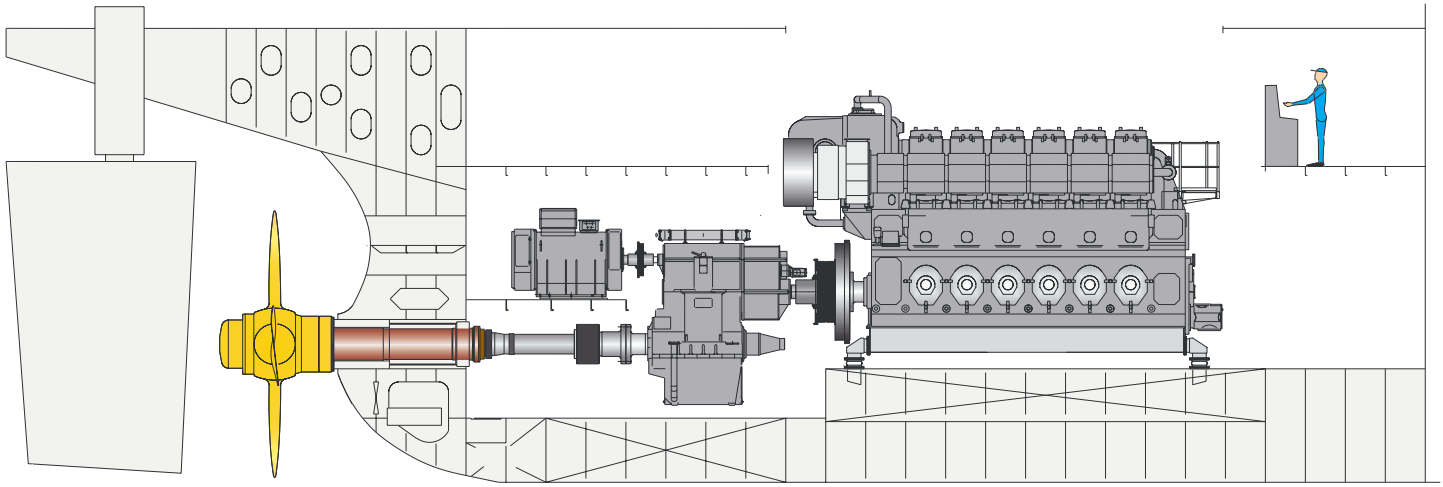

Fig. 4: Propeller equipment type VBS - ODF (6L48/60B engine, reduction gear, VBS1380 propeller)

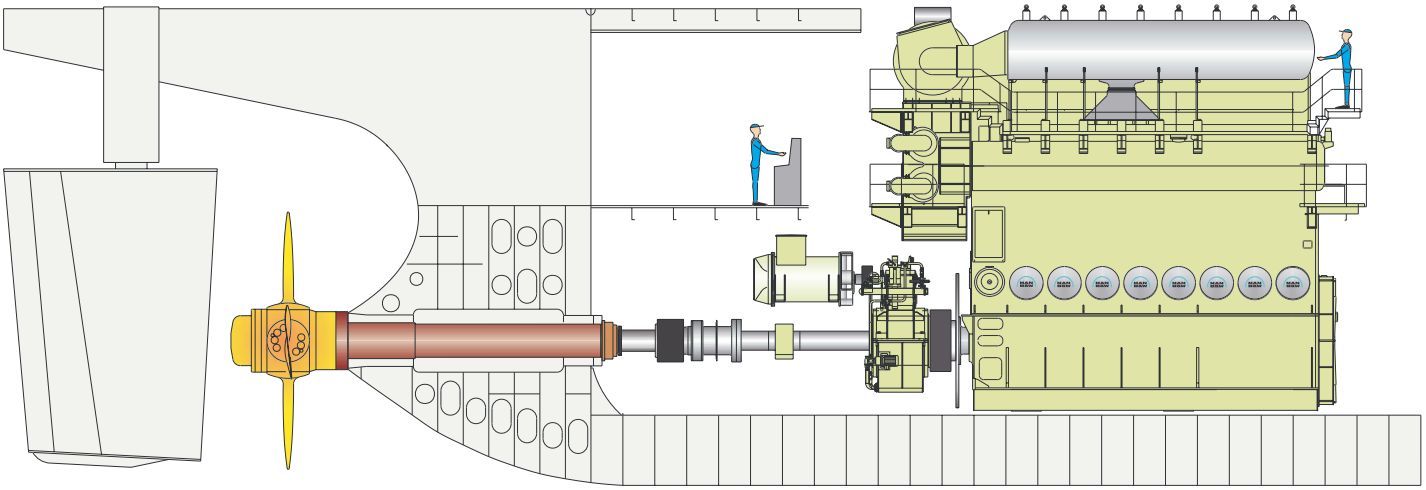

Fig. 5: Propeller equipment type VBS - ODS (8S50MC-C engine, Renk tunnel gear, VBS1680 propeller)

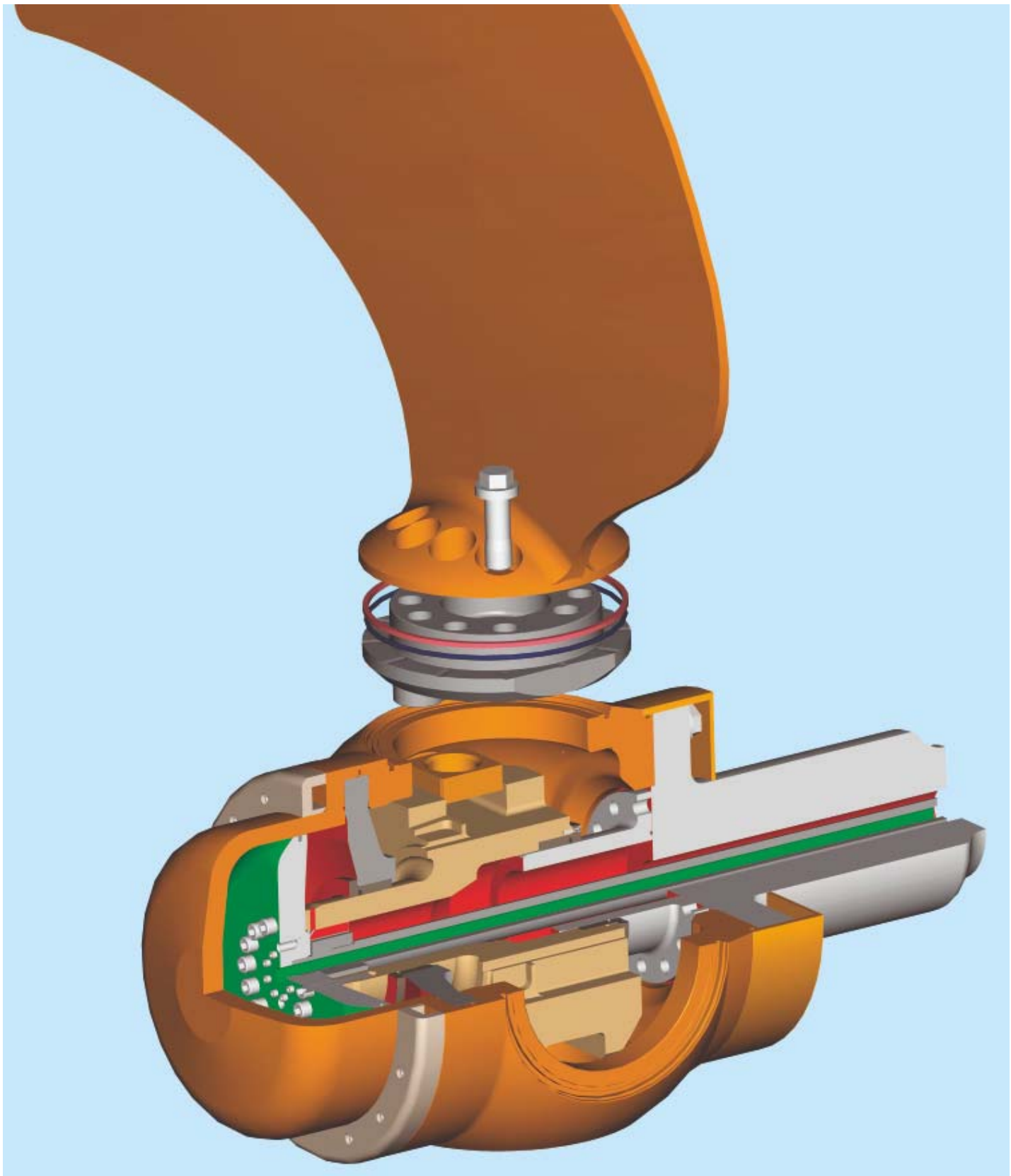

Fig. 6: Propeller hub type VBS

Mechanical Design

Hub design

The hydraulic servo motor for pitch setting is an integral part of the propeller hub. The design is shown in fig 6. The propeller hub is bolted to the flanged end of the tailshaft, which is hollow bored to accommodate the servo oil and pitch feed-back tube. The servo piston which is bolted to the pitch control head, forms the hydraulic servo motor together with the propeller cap.

The high pressure servo oil system at the aft end of the hub is completely isolated from the pitch regulating mechanism and thus also from the blade flanges, which means that the blade sealings only are subjected to gravitation oil pressure.

By using a large servo piston diameter and balanced blade shapes, the oil pressure and reacting forces are minimized.

Blade sealing rings are placed between blade foot and hub, fig 7. A compressed O-ring presses a PTFE (teflon) slide ring against the blade foot.

This design ensures maximum reliability and sealing without leakages, also under extreme abrasive wear conditions.

Optionally an intermediate flange can be inserted, by which underwater replacement of propeller blades is possible.

For servicing and inspection of the internal parts, the hub remains attached to the shaft flange during disassembly thereby reducing time and need for heavy lifting equipment. Access to all internal parts is even possible without dismantling the propeller blades thus reducing the time for inspection and maintenance during docking.

A hydraulic tube, located inside the shafting, is connected to the piston. With hydraulic oil flowing through the tube, oil

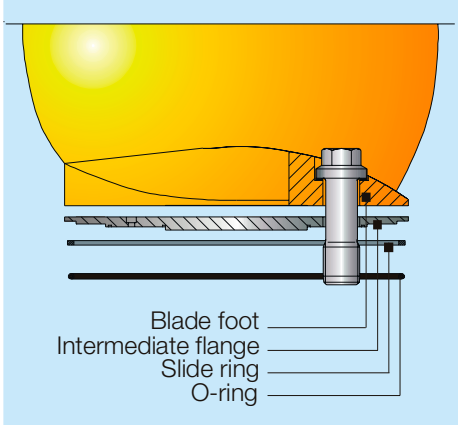

Fig. 7: Blade sealing rings

is given access into the after section of the propeller hub cylinder, displacing the servo piston forward, into an ahead pitch position. The displaced hydraulic oil from forward of the piston is returned via the annular space between the tube and shaft bore to the oil tank. Reverting the flow directions will move the propeller in astern position.

OD-Box Design

ODS type

The shaft mounted unit, fig. 8, consists of coupling flange with OD-ring, valve box and pitch feed-back ring. Via the oil distribution ring, high pressure oil is supplied to one side of the servo piston and the other side to the drain.The piston is hereby moved, setting the desired propeller pitch. A feed-back ring is connected to the hydraulic pipe by slots in the coupling flange. The feed–back ring actuates one of two displacement transmitters in the electrical pitch feed-back box which measures the actual pitch.

The inner surface of the oil distribution ring is lined with white-metal. The ring itself is split for easy exchange without withdrawal of the shaft or dismounting of the hydraulic coupling flange.

The sealing consists of mechanical throw-off rings which ensures that no wear takes place and that sealing rings of V-lip-ring type or similar are unnecessary.

The oil distributor ring is prevented from rotating by a securing device comprising a steel ball located in the ring.

Acceptable installation tolerances are ensured and movement of the propeller shaft remains possible.

In the event of failing oil pressure or fault in the remote control system, special studs can be screwed into the oil distribution ring hereby making manual oil flow control possible. A valve box located at the end of the shaft ensures that the propeller pitch is maintained in case the servo oil supply is interrupted.

ODF type

The gearbox mounted unit, fig 9, consists in principle of the very same mechanical parts as the ODS type. However, the pitch feed-back transmitter is of the inductive type that operates contactless and thus without wear.

The drain oil from the oil distribution is led back to the hydraulic power unit tank.

ODG type

The gearbox-integrated unit, fig 10, consists in principle also of the very same parts as the ODF type. The main difference is the use of the gearbox sump as oil reservoir for both the propeller and gearbox.

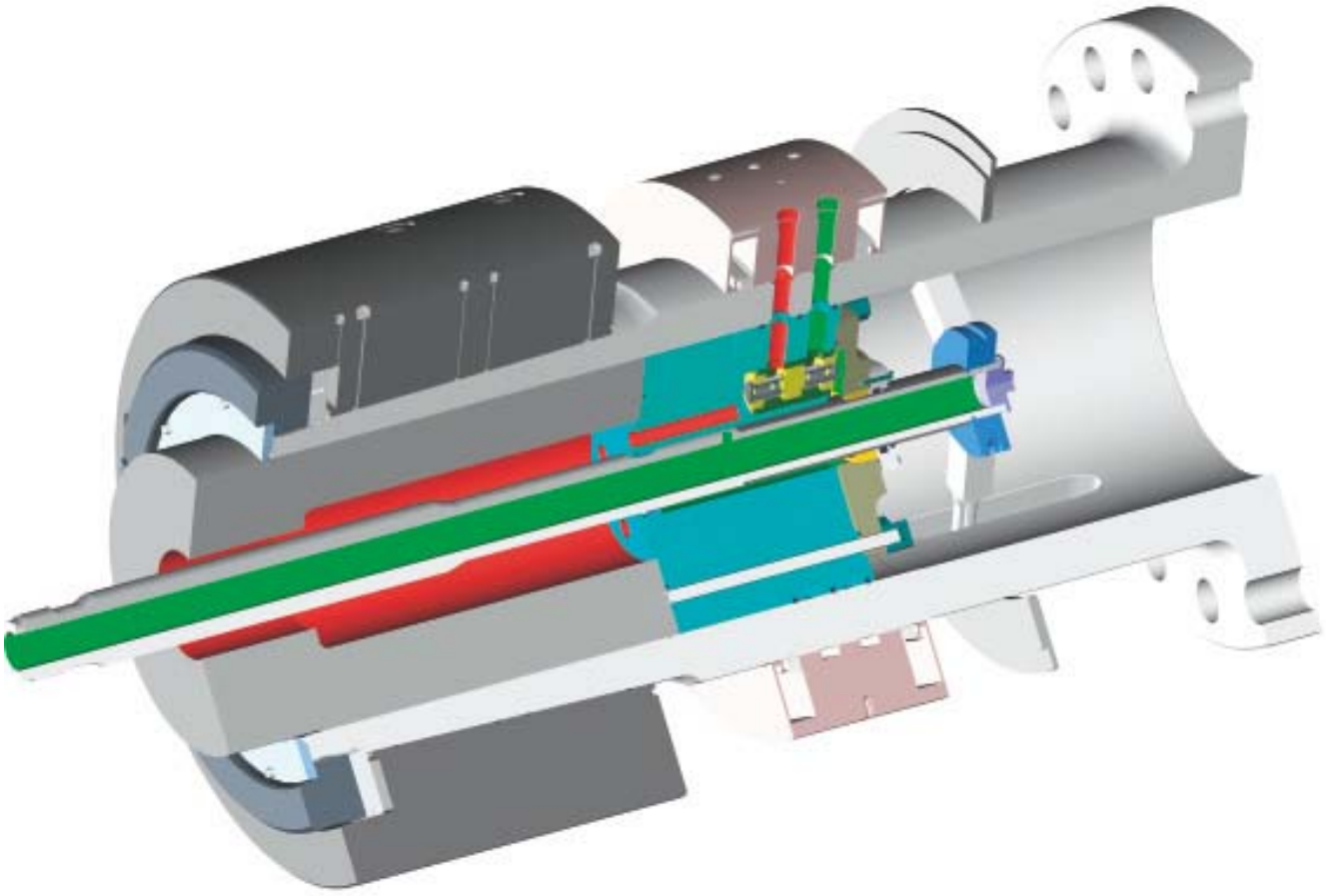

Fig. 8: ODS type - OD box with coupling flange and pitch feed-back ring

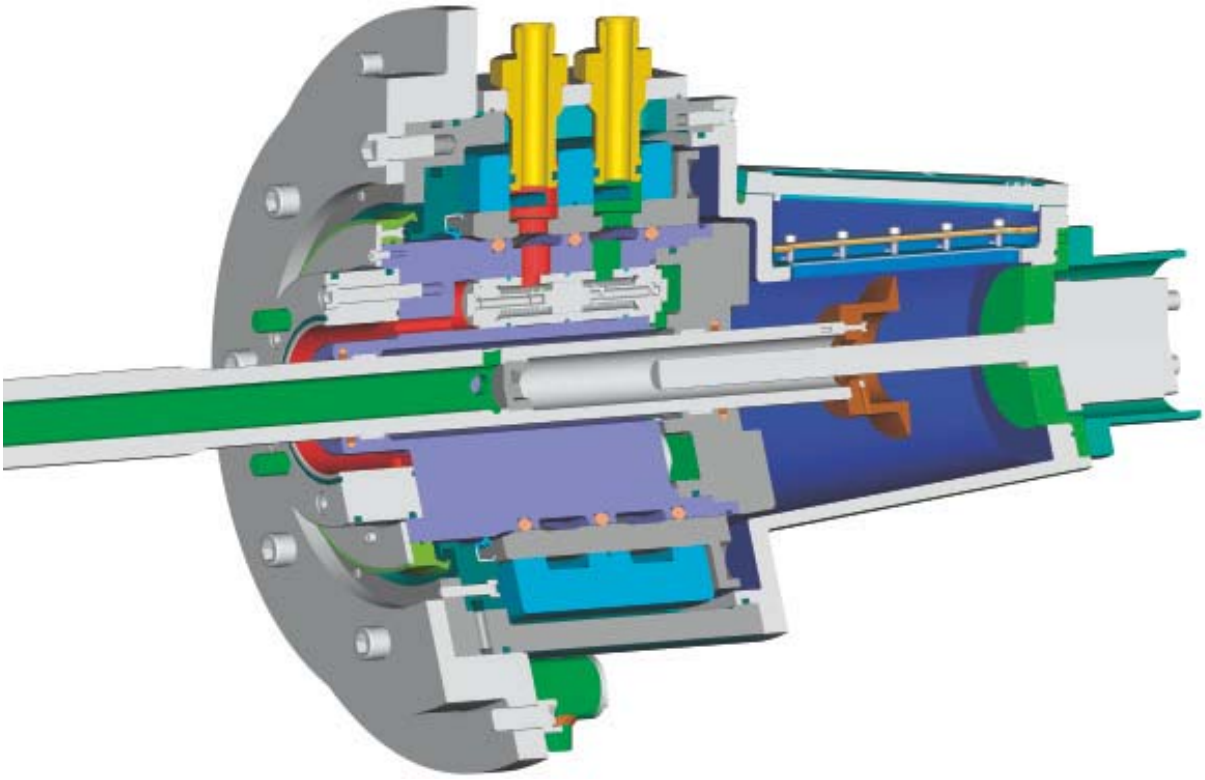

Fig. 9: ODF type – for gearbox mounting

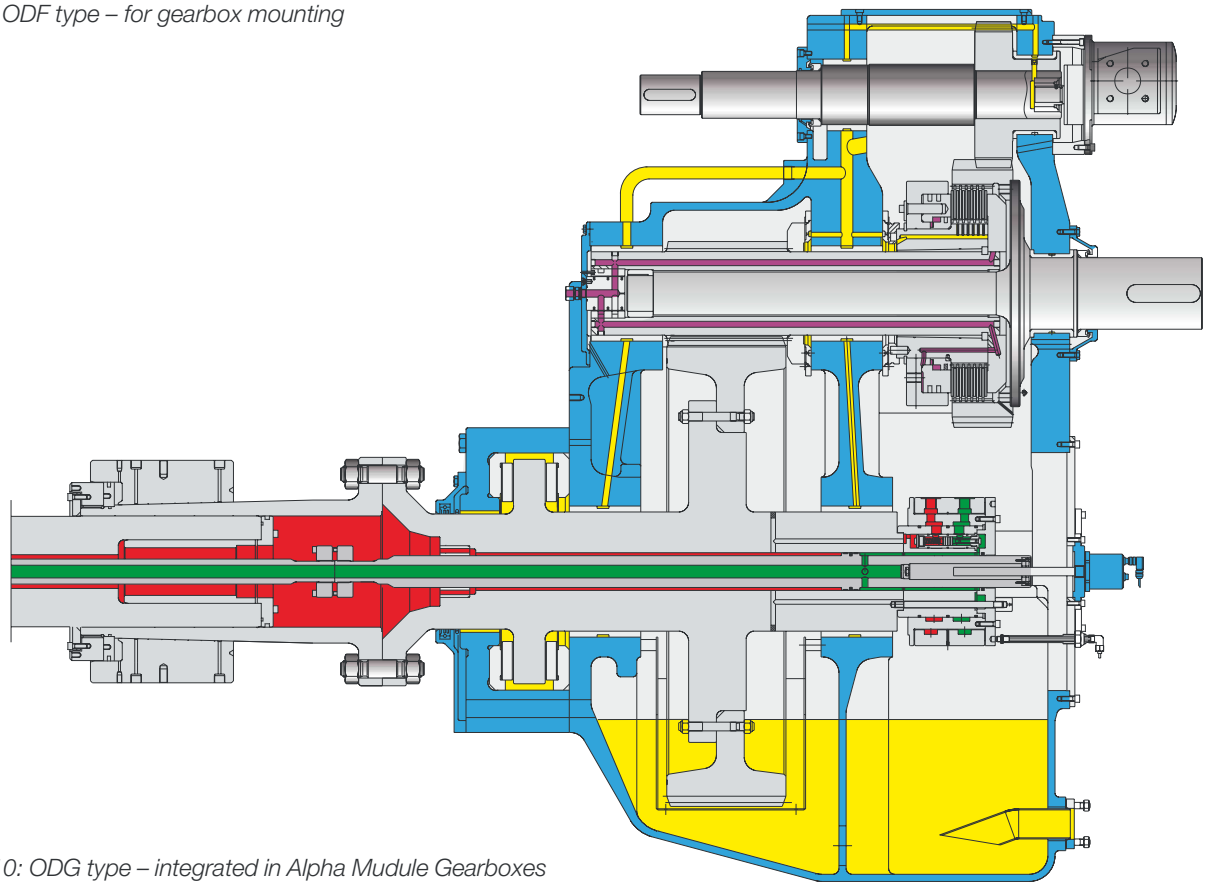

Fig. 10: ODG type – integrated in Alpha Mudule Gearboxes