Rolls-Royce

User Manual
Kamewa$_{TM}$ CP-A D

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User Manual – List of Contents

Part	Document		Instruction Number	Rev
	Drain Gravity Tank from Condensed Water		49267-E	
	Drain OD-box from Condensed Water	(FA)	49374-E	
	Inspect Earthing Device		49375-E	
	Inspect Remote Control System		49570-E	
	Monthly Maintenance			
	Inspect Onboard Shafts, Flanges, and Couplings		49585-E	
	Visually Inspect OD-box		49376-E	
	Inspect the Chain Tightener		49377-E	
	Clean and Inspect Feed Back Box		49378-E	
	Inspect Remote Control System		49591-E	
	Clean and Inspect RPM Transmitter		49592-E	
	Every Third Month Maintenance			
	Take an Oil Sample		49279-E	
	Clean and Inspect Outboard Shafts under Water		49380-E	
	Every Sixth Month Maintenance			
	Clean, Inspect, and Treat Inboard Shafts with New Corrosive Preventive Agent		49381-E	
	Clean and Inspect Propeller Hub and Blades under Water		49379-E	
	Test the Shut-off Valves		49268-E	
	Test the Emergency Operating System		49269-E	
	Inspect Level Switch Hydraulic Power Pack		49270-E	
	Inspect Level Switch Gravity Tank		49271-E	
	Inspect Temperature Sensor		49272-E	
	Inspect Thermometer		49342-E	
	Inspect Autostart of the Pump Units		DMN200002747	

Part	Document	Instruction Number	Rev
	Inspect Pressure Transmitter	49274-E	
	Test Safety Valve V1	DMN200002574	
	Test Relief Valve V8	49277-E	
	Test Check Valve V17	49278-E	
	Replace Circulation filter	DMN200002748	
	Visually inspect Feed Back Box	49382-E	
	Inspect Lifting Tools	49361-E	
	Inspect Stored Spare Parts	49366-E	
	Inspect Cathodic Protection	49367-E	
	Yearly Maintenance		
	Functional Inspection Pitch Indicators	49385-E	
	Inspect Remote Control System	49602-E	
	Every Fifth Year		
	Replace Blade Sealing Ring - Overview	DMN200002613	
	Drain Centre Part of Propeller Hub	49386-E	
	Flush Propeller Blade Flange with Freshwater	DMN200002611	
	Remove Propeller Blade	DMN200002749	
	Replace Blade Sealing Ring	48026-E B	
	Install Propeller Blade	DMN200001323	A
	Fill Oil and Flush Propeller Hub	48028-E	
	Propeller Hub Pressure Test	48029-E	
	Replace Hydraulic Hoses	49307-E	
	Corrective Maintenance		
	Corrective Maintenance Task List	49335-E	
	Apply Corrosion Preventative on Inboard Shafts and Couplings	49605-E	
	Replace Propeller Blade Under Water Overview	DMN200002742	

Part	Document	Instruction Number	Rev
	Drain Centre Part of Propeller Hub	49386-E	
	Flush Propeller Blade Flange with Freshwater	DMN200002611	
	Remove Propeller Blade	DMN200002749	
	Replace Blade Sealing Ring	48026-E	
	Install Propeller Blade	DMN200001323	A
	Fill Oil and Flush Propeller Hub	48028-E	
	Fill Oil to the Hydraulic System	49282-E	
	Replace Air Breather Filters	49283-E	
	Replace Circulation Filter Element	49281-E	
	Replace Level Switch Hydraulic Power Pack LS1	49285-E	
	Replace Level Switch on Gravity TankLS3	49608-E	
	Replace Temperature Sensor TT1	49286-E	
	Replace Pressure Switch PS1, PS2	49288-E	
	Replace Pressure Transmitters PT1, PT3	49290-E	
	Replace Thermometer TH1	49291-E	
	Replace Test Gauges	49292-E	
	Replace Control Valve V2 or V3	49295-E	
	Replace Safety Valve V1	49297-E	
	Replace Pressure Relief Valve V8	49298-E	
	Replace Pressure Relief Valve V14	49300-E	
	Replace Selector Valve V12	49301-E	
	Replace Control Valve V11/V28	49302-E	
	Replace Check Valve V36	49303-E	
	Replace Valves of Screw in Type	49305-E	
	Replace Needle Valve V16	49399-E	
	Replace Pressure Valve for By-pass Cooler V20	49398-E	

Part	Document	Instruction Number	Rev
	Replace Pump Unit P1 or P2	49293-E	
	Replace Pump Unit P3	49294-E	
	Repair Pump Motor Starter P1, P2, P3	49611-E	
	Replace hydraulic hoses	49441-E	
	Repair Remote Control System	49614-E	
	Handling and Preservation	49340-E	
	Service Journal	49618-E	
	Damage Report	49360-E	
	Returning of Units	49619-E	
8	**Troubleshooting**		
	Troubleshooting	49620-E	
	Diagnostic Description for System Failure Warning	49691-E	
	Hand Held Terminal Guide	49692-E	
	Alarm Handling	49693-E	
9	**Contact List**		
	Contact List	45349	
10	**Spare Parts**		
	Introduction	49623-E	
	Hub Tools	RM200011922	
	Hydraulic Spare Parts drw	RRM200007040	
	OD-box Spare Parts drw	R214017A	
	Starters Spare Parts drw	RRM200007041	
11	**Tools**		
	Tools	49624-E	
	Shafting Tools drw	R104500A	
	Emergency Control Tools drw	R940832A	
	Hub Tools	RRM200010894	

Part	Document	Instruction Number	Rev
12	**Design Drawings**		
	List of Drawings Mechanical and Hydraulic	10S000239/49625-E	
	List of Drawings Remote Control System	DMN200000951	
13	**Revision**		
	Revision Table	49627-E	
14	**Sub Supplier Manuals**		
	The Vessel's Subsupplier Manuals	10S000239/49628-E	

Introduction User Manual

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Purpose

The purpose of the User Manual is to provide the necessary information for handling, operating, preserving, and maintaining the product.

This manual shall also provide information that allows easy and straightforward ordering of spare parts from Rolls-Royce.

Target Groups

The target groups for this User Manual is the following:

- Captain
- Chief engineer/engineers
- Helmsman
- Equipment operator

Reading this User Manual

The information structure of this user manual is divided into parts for respective subjects, for example, part Maintenance, which contains several sections, for example, Preventative Maintenance and Corrective Maintenance. To complement the general information in this manual a few selected application specific drawings are appended in a part for drawings.

The operating instructions are intended for equipment operators. If the personnel operating the vessel are uncertain on any operating task, please consult Rolls-Royce Marine Global Support Network (GSN).

The service and maintenance instructions are intended for personnel on board the vessel which have experience of maintenance work of a propulsion system. The maintenance chapter is not meant as a guide for inexperienced personnel. If the personnel performing the maintenance are uncertain of how to perform a maintenance task, please consult Rolls-Royce Marine Global Support Network before proceeding.

Please note that all illustrations in this manual are schematically correct but they may not be an exact copy of the corresponding equipment on your vessel. For detailed information see part Design Drawings.

Writing Conventions

When referring to information within a part, the word “section” is used. When referring to information found in another part, the word “part” is used.

All cross references regarding parts, sections, and figures are shown without page numbers. See the table of contents for page numbers to parts and sections.

The titles of any referred drawings are spelled with capital letters, for example, the Hydraulic Diagram drawing.

Acronyms and Abbreviations

The following acronyms and abbreviations are used in the manual:

As Req. - As required

CAN - Controller area network

CanMan - Controller area network manoeuvering system platform

CCN unit - CanMan control node circuit board

DP - Dynamic positioning

Drw - Drawing

ECR - Engine control room

EMI - Electro magnetic interference

ESD - Electrostatic discharges

FPS - Fuel pump setting

GSN - Global Support Network

HPP - Hydraulic power pack

I/I - Current in put/ current out put

I/O - In/Out

I/U - Current in put/ voltage out put

LED - Light emitting diode

LIC - Load increase control

LLS - Load limit settings

O.D. - Oil distribution

OD-box (M0) - Oil distribution box type M0

OD-box (FA) - Oil distribution box type FA

PC - Printed circuit

PC Board - Printed circuit board

PTI - Power Take In

PTO - Power Take Off

Cross Ref. No. - Cross reference number

RPM - Revolutions per minute

SLIO unit - Serial linked input/output circuit board

VDR - Voyage data recorder

Qty - Quantity

Safety

Introduction

Read the safety precaution chapter very carefully. It concerns your safety as well as the safety of others and of the propulsion system.

This introduction describes how the safety information is presented in the manual and it gives a general information of which safety precautions to take when working on the propulsion system.

Warning: The warning sign indicates that there is a great risk of personal injury as well as serious damage to the product if the warning text is ignored.

Caution: The caution sign indicates that minor personal injury as well as damage to the product or major operating faults can occur if the caution text is ignored.

Note: The note text draws attention to important information which facilitates the reading of the instructions.

General Statement

Undertaking any work envisaged by this document may either directly or indirectly create risks to (1) the safety and health of the person undertaking the work or (2) the propulsion system and/or its components whilst the work is being undertaken.

It is the responsibility of the user to ensure that appropriate controls and precautions are identified and applied in relation to the work envisaged by this document in accordance with relevant statutory, legal and industry requirements to protect the health and safety of the persons undertaking the work.

Neither this document, nor its use, in any way absolves the user from their responsibility to ensure that the controls and precautions referred to above are implemented.

If, whilst undertaking any work envisaged by this document, you become aware of any Rolls-Royce product design related feature which could create risk to a person undertaking work or to the propulsion system and/or its components please contact Rolls-Royce Marine Global Support Network (GSN) immediately.

It is the user's responsibility to make all relevant hazard identifications and risk assessments of all the activities associated with the use of this document.

It is the user's responsibility to design and implement safe systems of work and to supply safe equipment (including, without limitation, safety equipment) and training (including, without limitation, health and safety training) to anyone using this document to work on products to which it relates.

A user without the relevant experience of working in accordance with this document or with products, or similar products, to which it relates should seek appropriate advice to enable them to identify the appropriate health and safety controls and precautions and controls and precautions to protect against risks to the propulsion system and/or its components whilst work is being undertaken. Technical assistance can be sought from Rolls-Royce and will be subject to Rolls-Royce's terms and conditions.

Safety Instructions

General Safety Precautions

Warning: PPE (personal protection equipment) must be used according to local regulations. Examples of PPE are hard boots, overall, protective glasses, ear protectors, hard hat, and gloves.

Warning: All rotating parts between the main engine and the stern tube must be permanently covered by adequate protective equipment. After installation and maintenance make sure to install all protective equipment before start up.

Warning: As a general rule, make sure to perform installation and maintenance work with the engine stopped.

Warning: All adjustments in close connection with the shafts must be performed with the engine stopped and the shafts secured.

Warning: Make sure that the propeller has enough room to rotate before rotating the shaft in a dry dock. Make sure to communicate with the operator on board the vessel.

Warning: Make sure that the personnel who are lifting the Rolls-Royce equipment have studied the appended lifting instructions

Warning: Always use Rolls-Royce lifting tools if such have been provided by Rolls-Royce.

Warning: Never work alone while lifting heavy components. Most lifting devices require two persons, one to operate the lifting device and one to ensure that the components do not get damaged.

Warning: Most chemicals intended for the propulsion system are harmful to your health. Always read the warning label on the packaging of the chemical and act according to its instructions.

Warning: Using other hydraulic oil than recommended by Rolls-Royce can cause malfunctions when manoeuvring the vessel. The malfunctions can cause personal injury and equipment damage.

Warning: All fuels and many chemicals are flammable. Do not allow naked flame or smoking during installation and maintenance. Make sure that the work area has got good ventilation and to always have a fire extinguisher at hand.

Caution: Make sure that the warning or information decals are always visible on the propulsion system. Replace decals that are damaged or painted over.

Caution: Make sure that there is enough room for mounting and dismantling before any work is performed on the propulsion system

Caution: It must not be possible to come in contact with rotating components, hot surfaces or sharp edges, while working on the propulsion system. Take proper measures of precaution.

Caution: Shut off the electric voltage before any work is performed concerning electricity.

Caution: Prior to welding, make sure that the electrical system of the propulsion system is disconnected. If the electrical system is not disconnected the supply filters and the control system can be damaged.

Caution: During welding the earthing must be connected as close as possible to the object on the propulsion system which is being welded. If earth leakage current passes through, for example a bearing, it can be damaged.

Caution: In orde to prevent corrosion please take care of the propulsion system’s parts immediately at arrival. All parts must be unpacked and inspected. The corrosion prevention must be renewed, since the parts have been treated with corrosion prevention for transport only.

Caution: All disassembled parts of the propulsion system such as shafts, hydraulic components and control system components must be protected against moist, sand and dirt in an adequate way during installation and maintenance.

Caution: Before assembly the disassembled parts must be clean and dry.

Special Safety Precautions

Propeller Hub

Warning: The engine must be stopped and the shaft secured, while work is being performed on the propeller hub or blades

Warning: The torque tool must be dimensioned with consideration taken to the torque values. This also includes the power socket which must have correct dimension for the width across flats.

Caution: The propeller and blade are machined to great accuracy and smoothness. Handle them with care.

Caution: Do not clean the blade flange with a high-pressure jet cleaning unit, because it can damage the blade sealing ring.

Caution: Make sure to handle the torque tool with care to prevent personel injuries due to the massive forces used.

Shafting

Warning: The engine(s) must be stopped and the shaft secured, while work is being performed on the shafts and couplings.

Warning: Read the appended sleeve coupling manual carefully before any work is performed on the sleeve coupling.

Caution: The corrosion prevention must be renewed immediately at spots where it may have been removed.

Hydraulic System and Oil Distribution Box

Warning: The hydraulic system uses high pressurized oil for functioning. The pressure might be high even when the engine is not running. Always take great care when, for example, opening nipples.

Warning: Depressurize the hydraulic system before performing any installation or maintenance work.

Warning: Hydraulic oil is harmful to your health. Always read the warning label on the hydraulic oil packaging and act according to its instructions.

Warning: The pressurized oil in the hydraulic system can be hot! Damage on hoses, pipes or couplings can lead to serious personal injuries.

Warning: Air mixed with oil may explode if the oil comes in contact with hot machine parts. There is also a risk of fire.

Caution: Mineral oil and additives can cause eczema or allergic reactions. Oil mist can cause irritation, headaches and nausea if inhaled.

Caution: Always use protective gloves while handling hydraulic pipes and hoses.

Caution: Oil mist spread into work areas or oil dripping onto walkways increases the risk of slipping.

Caution: Use only oil in the hydraulic system which meets the hydraulic oil standards recommended by Rolls-Royce. Using other hydraulic oil might damage the propulsion system.

Caution: It is highly important to prevent dirt and particles to enter the hydraulic system. Always use clean equipment when working with the hydraulic system. Clean the working area and the parts before assembly and disassembly.

Remote Control / Closed Loop System for Main Propeller

Warning: Radio waves from for example walkie-talkies and mobile phones can interfere with the signals from the feed back unit and the central unit. Be cautious when using such equipment when the propulsion system is running, since this can disturb the control system.

Warning: Only trained personnel are allowed to operate the main propellers using the main propeller control system.

Warning: Make yourself familiar with the emergency systems before starting to operate the propellers.

Warning: Do not open the control system cabinet doors and do not touch the wiring during operation.

Warning: Never allow water to enter inside the cabinets or control panels. Like with other electrical equipment, water may cause danger for electrical shocks and serious damages on the equipment.

Warning: Test the back-up system regularly.

Warning: Do not stop the pitch control hydraulics while the main engine(s) is/are running and is/are engaged.

Warning: Do not start and engage the main engines until the pitch control hydraulics are running.

Caution: **The pitch feed back box and the central unit cabinet contain components that are sensitive to Electrostatic Discharges (ESD). To prevent damage to the equipment, always use a grounded ESD bracelet while work is performed inside the feed back box and inside the central unit cabinet.**

Remote Control System for Main Propeller

Warning: **Test the emergency clutch out (if included) regularly.**

Caution: **Use emergency clutch out solely in emergency situations. Do not use it for regular clutch out as it will wear on the clutches.**

Caution: **The possibility to override the load limit and the LIC function is intended for temporarily risen power requirements and should not be used in regular operation.**

Caution: **In back-up mode no automatic load control will take place. Observe the "ENGINE OVERLOAD" lamp on the control panel, and reduce the pitch immediately if the lamp is lit.**

System Description Mechanical and Hydraulic

General

The following information describes the scope of supply of the Kamewa controllable pitch propeller type A. It includes descriptions of the different sub system.

The characteristic of the Kamewa controllable pitch propeller is that the propeller blades can be turned about their own axis. The blade axis is perpendicular to the propeller shaft. The propeller blades can be controlled from the bridge or the engine room. The blades turn simultaneously by means of hydraulic pressure which is controlled by a hydraulic system.

This propulsion system gives the possibility to set the pitch angle in any position between full power ahead and full power astern, which makes it unnecessary to reverse the rotation of the propeller shaft when going from ahead to astern direction. This provides for quicker, more responsive manoeuvring and improved operative economy.

The advantage of changing the angle of the propeller blades is maintaining engine speed and making full use of the propulsion power. For example, in case of an emergency situation, the stopping distance and stopping time are much shorter than with a fixed pitch propeller. However, the efficiency ratio is slightly lower when going astern, than with a fixed pitch propeller.

Each Kamewa propeller is supplied with blades designed specifically for the particular vessel. Consideration is given to factors such as:

- Power
- Shaft speed
- The hull wake field
- Draught
- Clearance between propeller and hull
- Rules of the classification societies

If any of these factors are changed, the performance (efficiency, noise, and vibration) could be influenced. Thanks to the flexibility of the controllable pitch propeller a re-optimization is simple. The modifications are normally limited to revision of the relationship between shaft speed and pitch.

Main Components

The main components in the propulsion system are described in figure 1. The dashed poses in the figure means that the components are optional Rolls-Royce delivery.

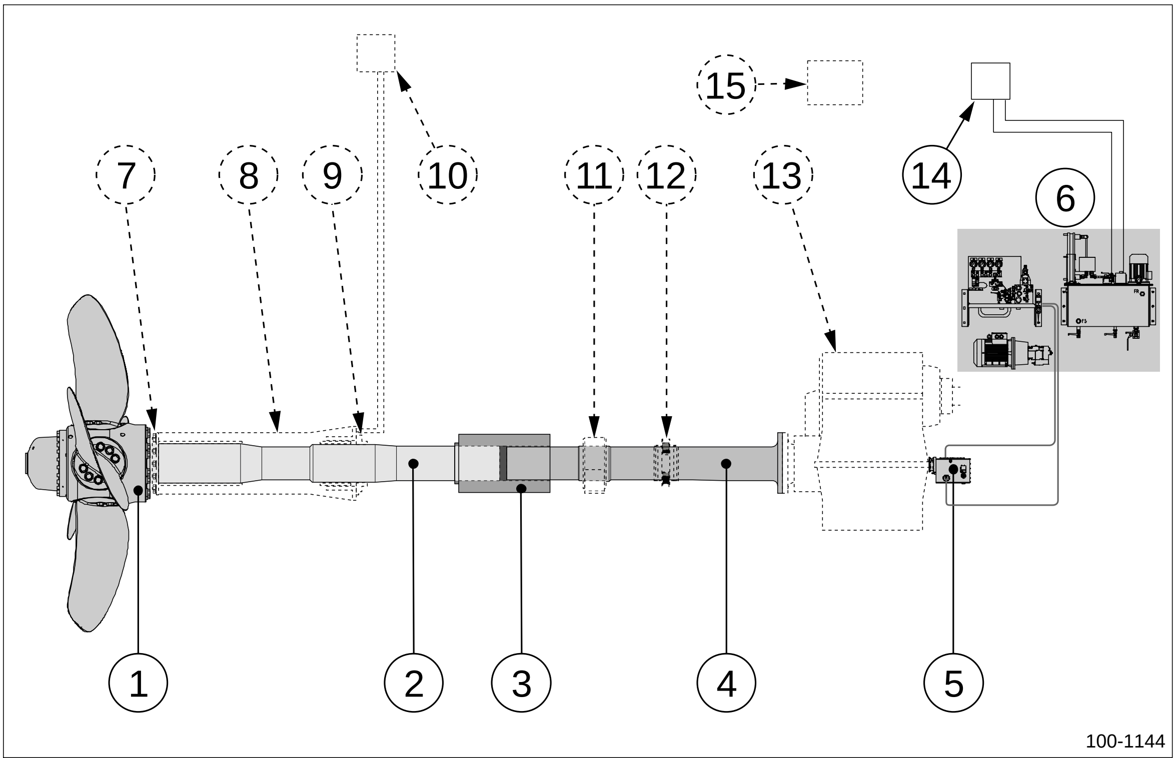


Figure 1 An overview of a propulsion system with an OD-box type FA.

1. Propeller hub with blades
2. Propeller shaft
3. Sleeve coupling
4. Intermediate shaft
5. Oil Distribution Box (FA)
6. Hydraulic power pack
7. Stern tube aft sealing (Optional Rolls-Royce delivery)
8. Stern tube (Optional Rolls-Royce delivery)
9. Stern tube forward sealing (Optional Rolls-Royce delivery)
10. Stern tube header tank (Optional Rolls-Royce delivery)
11. Support bearing (Optional Rolls-Royce delivery)
12. Earthing device (Optional Rolls-Royce delivery)
13. Gear box (Optional Rolls-Royce delivery)
14. Gravity tank
15. Remote control system or closed loop system (Optional Rolls-Royce delivery)

Functional Description

The propulsion system uses pressurised hydraulic oil to control the pitch angle of the propeller blades. The pressurised oil is guided to the propeller hub through a twin tube which runs through a hollow bored shaft line. The twin tube is connected in the forward end to an oil distribution box (OD-box) and in the aft end it is bolted to the piston in the propeller hub. The turning of the propeller blades is managed by applying hydraulic oil pressure to either side of the piston, which in turn moves the piston rod back and forth. It is by means of the OD-box that the hydraulic oil pressure is applied to the desired side of the piston. When the piston rod is pushed forward this turn the propeller blades to an ahead pitch. For astern pitch setting, the piston rod is pushed aft ward.

The twin tube, propeller shaft, and bearings are installed in a stern tube which is filled with oil for lubrication purposes. The stern tube header tank contains the oil at a certain height above sea level to achieve a static pressure from the gravity force. The stern tube, together with shaft bearings and seals, can be delivered as a complete unit from Rolls-Royce or other manufacturers on the market.

The lubrication of the propeller hub is maintained by static pressurised hydraulic oil, guided to the propeller hub by the hollow bored shaft line. The oil is contained in the hydraulic power pack, which could be equipped with a supplementary gravity tank. The static pressure is achieved by a pump unit on the power pack. Pressurised oil is necessary to prevent ingress of water in the propeller hub and to maintain sufficient blade bearing lubrication. To prevent the hydraulic system from over pressure, safety valves are included in the hydraulic system.

The mounting of a supplementary gravity tank must be at a specified height above sea level (maximum draught) to ensure sufficient oil pressure. It is also possible to achieve sufficient oil pressure by applying pneumatic pressure in the gravity tank which enables lower mounting height. The gravity tank can be delivered as a complete unit from Rolls-Royce or other manufacturers on the market.

Sub Systems (FA)

Propeller Hub and Blades

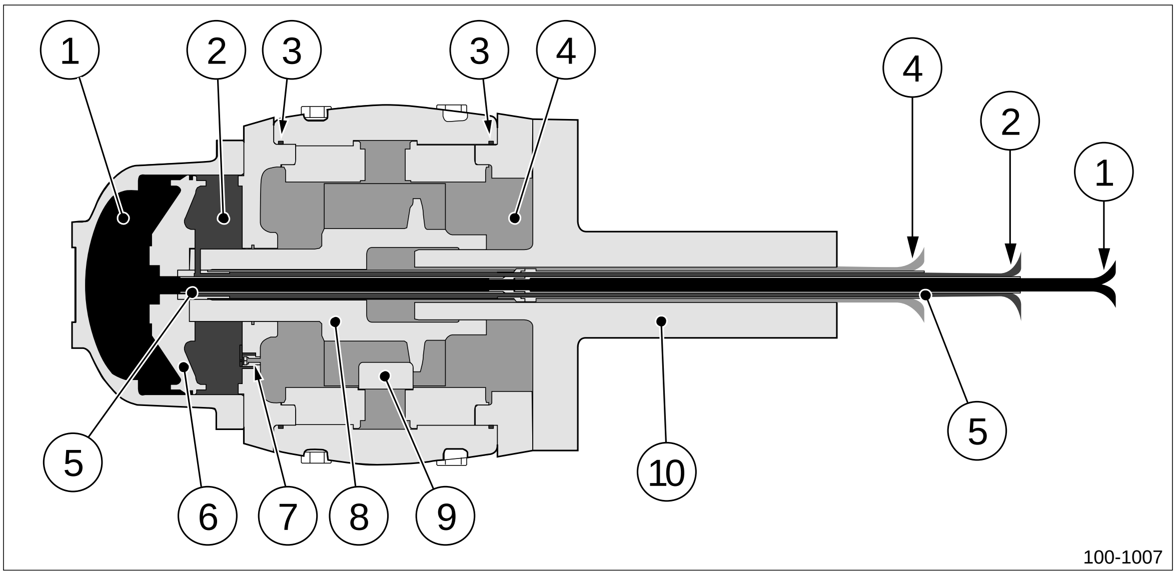


Figure 2 The propeller and propeller shaft.

1. Pressurised hydraulic oil for Ahead setting
2. Pressurised hydraulic oil for Astern setting
3. O-ring
4. Low pressurised oil for static hub pressure
5. Twin tube
6. Piston
7. Oil circulation valve
8. Piston rod
9. Sliding shoe
10. Propeller shaft

The propeller is manufactured with integrated blade bearings and O-rings (3) for sealing off sea water at each blade. The lubrication of the propeller hub is provided by the static pressurised hydraulic oil (4).

Inside the hub body, the twin tube (5) is bolted to the piston (6) and piston rod (8), which are the components that mechanically turn the propeller blades around their axis.

When hydraulic pressure is applied through the twin tube on either the aft side (1) or the forward side (2) of the piston, the piston rod moves forth and back, thus forces the sliding shoes (9) to move as well. As the sliding shoes move with the piston rod they describe a circular movement in their guiding trails. Each propeller blade is turned around by a crank pin, which is guided by the sliding shoe.

The propeller hub is equipped with a hub oil circulation system. The oil circulation system allows a constant flow of oil from the highly pressurised oil (2) through the oil circulation valve (7) into the static pressure parts (4) of the hub.

Propeller Shaft

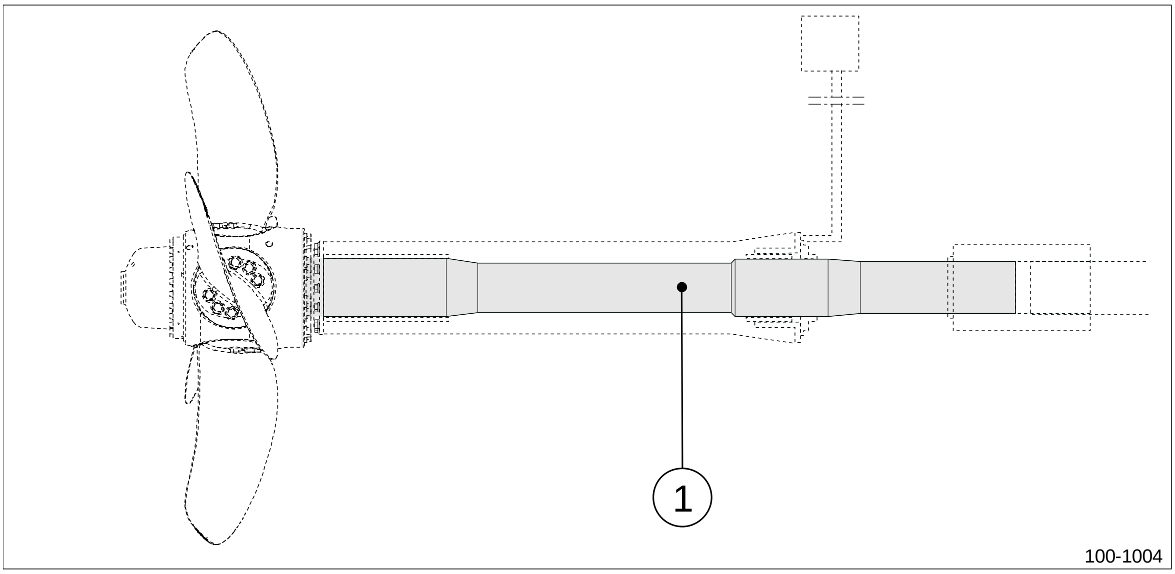


Figure 3 The propeller shaft.

1. Propeller shaft

The propeller shaft is hollow bored to allow the twin tube to run through it. The shaft line can be split in parts of manufacturing reasons and connected by sleeve couplings.

Sleeve Coupling

Two types of friction couplings can be used in the shaft line. A sleeve coupling can be used to connect two shaft parts if the shaft is split into more than one part. And a flange coupling can be used for the flanged connection towards the gear box.

The couplings consist basically of two sleeves of high quality steel, a thin inner sleeve and a thick outer sleeve. The couplings are mounted by driving the outer sleeve up on the taper of the inner sleeve using the hydraulic unit incorporated in the couplings. The inner sleeve is compressed onto the shaft and thus creating a powerful interference fit.

For more information concerning sleeve couplings, please see the Sub Supplier Manuals part in this manual.

Intermediate Shafts

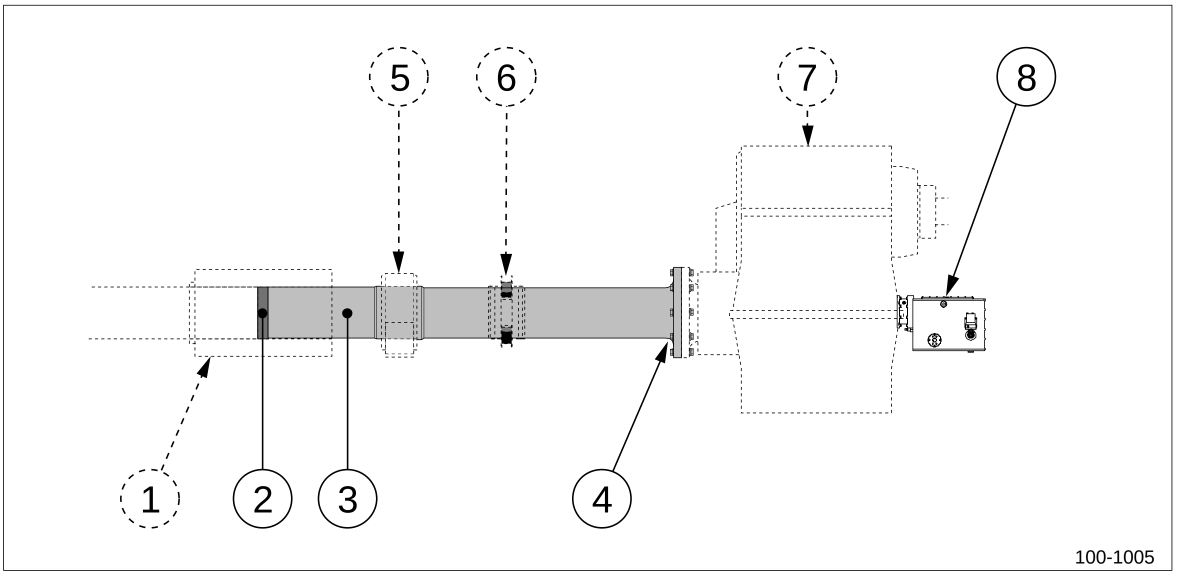


Figure 4 Intermediate Shaft.

1. Sleeve coupling (Optional Rolls-Royce delivery)
2. Split distance ring
3. Intermediate shaft
4. Flange with fitting bolts
5. Bearing (Optional Rolls-Royce delivery)
6. Earthing device (Optional Rolls-Royce delivery)
7. Gear box (Optional Rolls-Royce delivery)
8. OD-box (FA)

The intermediate shafts are hollow bored to allow the twin tube to run through them. The shaft line can be split in parts of manufacturing reasons and connected by sleeve couplings and flange connections.

Twin Tube and OD-box FA

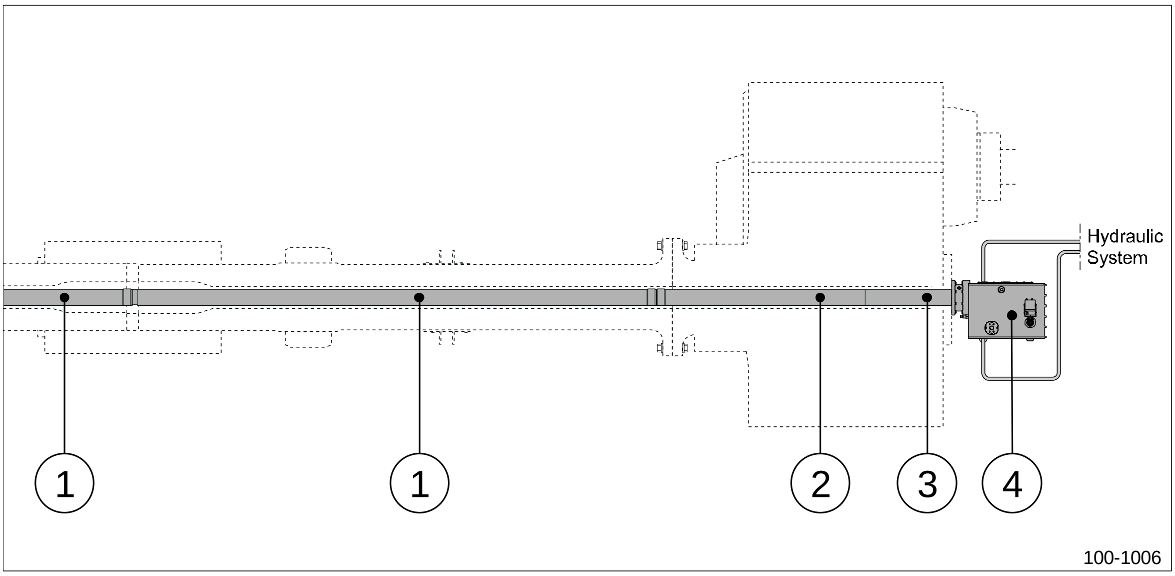


Figure 5 OD-box (FA).

1. Intermediate twin tube
2. Forward twin tube
3. Oil transfer tube
4. OD-box (FA)

The OD-box is located on the forward side of the gear box and is the component which mechanically guides the pressurised hydraulic oil to the twin tube for the desired pitch setting. The twin tube is fastened to the OD-box by a bolted connection and passes through the gear box into the hollow bored shaft line. In the propeller hub, the twin tube is fastened to the piston. When the piston moves back and forth depending on the pitch setting, the twin tube also moves together with the piston and the movement is fed back to the control system by a feed back box.

Oil Distribution Box, Type FA

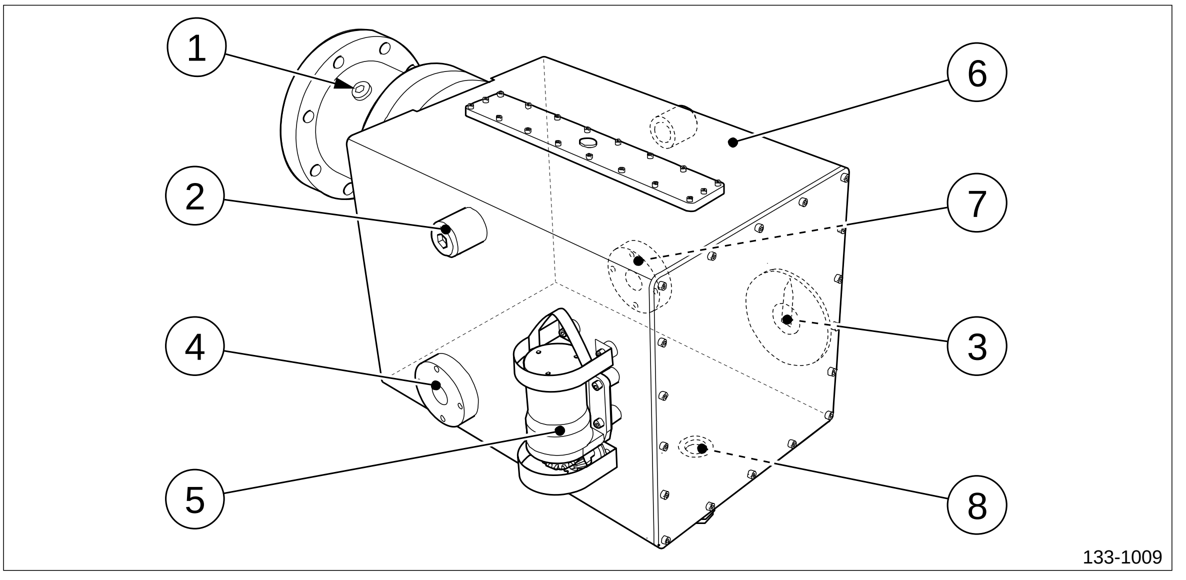


Figure 6 OD-box FA.

1. Connection for static pressure, SP
2. Connection R
3. Pointer and scale
4. Connection A
5. Feed back box
6. Box housing
7. Connection B
8. Shut-off valve (Yard supply)

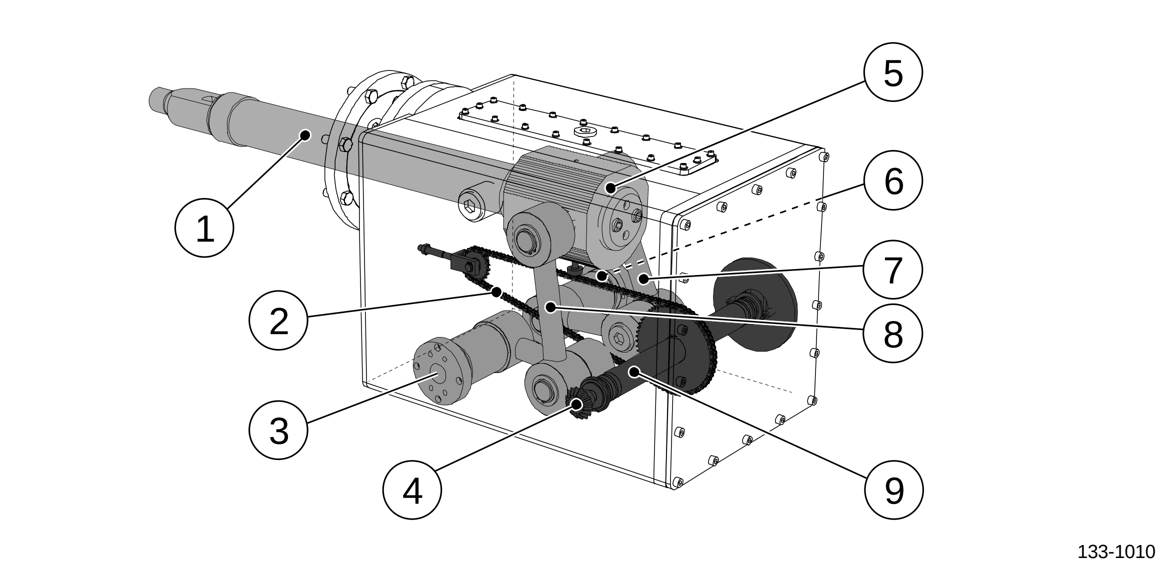


Figure 7 OD-box, type FA.

1. Oil transfer tube
2. Feed back chain
3. Connection A
4. Connection to feed back box
5. OD-box ring and stub shaft
6. Connection B
7. Swivel B
8. Swivel A
9. Feed back shaft

The oil distribution box is an arrangement that feeds two different oil pressures; low pressurised oil and a high pressurised oil.

The low pressurised oil in the box housing is guided to the propeller hub by the hollow bored shaft line.

The high pressurized oil is feed into the twin tube for ahead (6) or astern (3) pitch setting in the propeller hub. The pressurised oil is transferred through two separate swivels (7 and 8) into a stub shaft (5), which is connected to an oil transfer tube (1).

As the high pressurised hydraulic oil is lead into the propeller hub, this causes the twin tube and stub shaft to move back and forth. When the stub shaft moves, the feed back shaft (9) is turned by the feed back chain (2). The feed back box translates the mechanical turning of the feed back shaft into an electrical signal which is used by the electric remote control system to verify the actual pitch setting. The pitch position can also be read (in millimetres) directly from the mechanical scale (pos 3, figure 6) on the OD-box.

Hydraulic System

General Description

The hydraulic system pressurises hydraulic oil which enables the turning of the propeller blades. It consists of a hydraulic power pack system, hydraulic oil, and piping. Note that the piping is not part of the Rolls-Royce delivery. The system can also be equipped with PTO-driven pump unit and a gravity tank as optional equipment.

The main components in the hydraulic system are the hydraulic oil tank, control panel, pump unit and connection box. The hydraulic system provides two different pressure levels; a high oil pressure used for the pitch setting and a low oil pressure used for the lubrication of the propulsion system and for static pressure in the propeller hub.

Main Components

Note that the illustrations may not be an exact copy of the actual hydraulic power pack system on board the vessel. For more specific scope of supply see part Design Drawings.

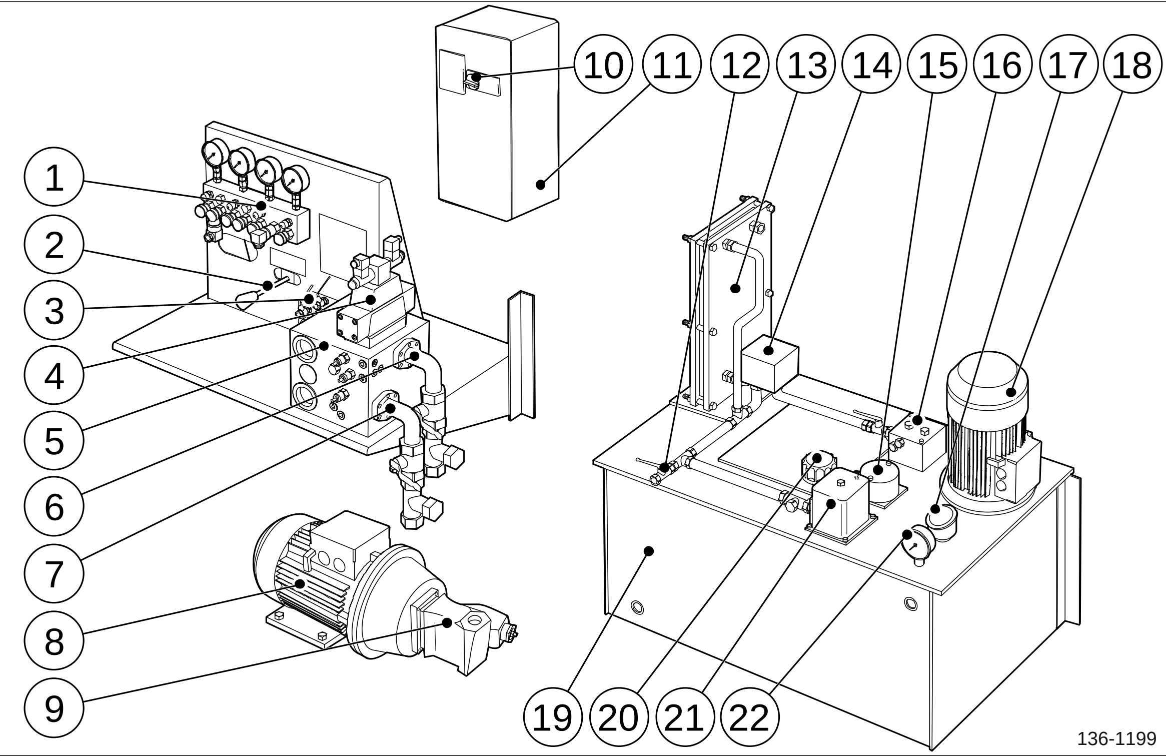


Figure 8 Hydraulic system.

1. Control panel
2. Selector for control valve V12
3. Emergency control panel
4. Proportional control valve V3
5. Valve manifold
6. Connection A
7. Connection B
8. Electric motor M1
9. Pump unit P1
10. Remote/local switch
11. Connection box
12. Connection Z (shut-off valve)
13. Oil cooler C1
14. Temperature control valve TV1
15. Level switch LS1
16. Valve manifold
17. Temperature transmitter
18. Static pressure circulation pump unit P3
19. Hydraulic oil tank
20. Air breather filter
21. Circulation filter
22. Temperature gauge

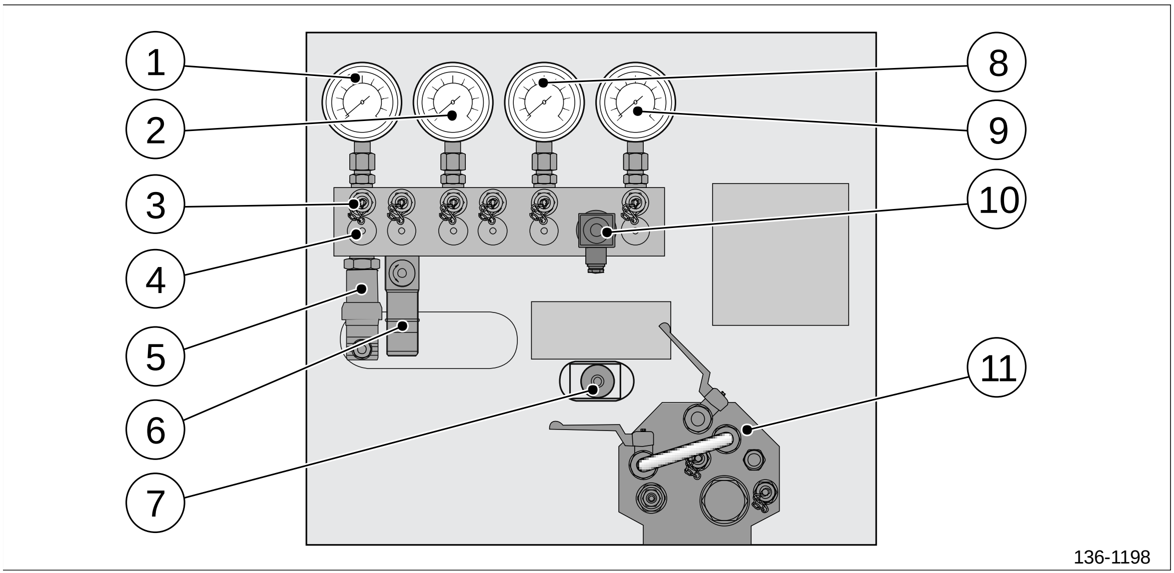


Figure 9 Control panel with emergency manoeuvre block and gauge panel.

1. Pressure gauge, system pressure, G1
2. Pressure gauge, astern pitch, G3
3. Test nipples
4. Shut off valves
5. Pressure transmitter PT2
6. Pressure switch PS1
7. Emergency control valve V12
8. Pressure gauge, ahead pitch, G4
9. Pressure gauge, static pressure, G5
10. Pressure transmitter PT3
11. Emergency valve manifold

The hydraulic power pack unit

The hydraulic power pack system is equipped with electrical motor driven pumps, oil tank, and all the necessary valves, oil filters, and sensors are integral parts of the unit.

The electrically driven pump (pos 9, figure 8) is used as main pump and supplies oil pressure for the pitch control.

The electrical pump is of load sensing variable displacement type. Its special feature is to give flow and oil pressure to the hydraulic system only when needed and when not needed it is in idle mode. This feature minimizes not only noise and vibrations but it also makes the pump power-saving.

Two pressure levels

The hydraulic power pack provides two different pressure levels; a high oil pressure part used for the pitch setting and a low oil pressure part used for the lubrication of the propulsion system and for static pressure in the propeller hub. A number of control valves and safety valves, which are controlled by the electric remote control system, manage the oil flow in both the high and low oil pressure parts.

The manoeuvring of the pitch is controlled by the proportional control valve V3 (pos 4, figure 8) located on the valve manifold.

The low oil pressure is maintained by a continuously running pump unit P3 (pos 18, figure 8) during operation. The pump is an electrical motor driven double pump and both pump units are run simultaneously. One of the pump units supplies the pressure to the lubrication and static pressure system and the other one runs the oil cooler system and the oil filtration system. The pump unit P3 should always be running to make sure that the oil in the hydraulic system is filtrated even though the main pump units are stopped.

Gravity tank

The hydraulic power pack unit can be equipped with an supplementary gravity tank. The gravity tank will maintain the static pressure in the propeller hub if the pump unit P3 and the main pumps are stopped. When the oil level in the gravity tank decreases the level switch in the tank starts the pump unit P3 and when the tank is full the level switch stops the pump.

Oil cooler

The hydraulic system is equipped with an oil cooler (pos 13, figure 8). The current oil temperature are shown on a gauge on the control panel (pos 22, figure 8).

The cooling water to the oil cooler can be controlled by a thermostat control valve as an optional feature. The thermostat control valve only opens when the oil temperature rises above a pre-set value.

Filtration

The filter (pos 21, figure 8) in the filtration system is equipped with electrical and visual indication. The filter has a by-pass function and the filter element can be replaced during operation.

Operating Modes

The hydraulic system can be operated in three different ways:

• The vessel’s remote control system.

• The vessel’s back-up control system.

• Manually by the pushing the buttons on the proportional control valve V3.

For more information about how to operate the hydraulic system see Part Operating Instructions.

Emergency operating

In case of an emergency situation, such as OD-box failure or complete loss of pressure in the high oil pressure part, it is possible to control the pitch setting by using the pump unit P3 and an emergency manoeuvre block on the hydraulic power pack unit. For more information about the emergency operating instructions please see Part Operating Instructions.

System Description
G-design Blade Flange

General

The following information describes the scope of supply of the G-design propeller blade. It includes functional and technical descriptions of the design.

The characteristic of the G-design blade flange is that each propeller blade can be replaced under water since the blade flanges is environmental friendly sealed off - no oil leakage occur from the hub to the sea water and all excess oil used when flushing the blade flange is collected.

Blade Foot, G-design

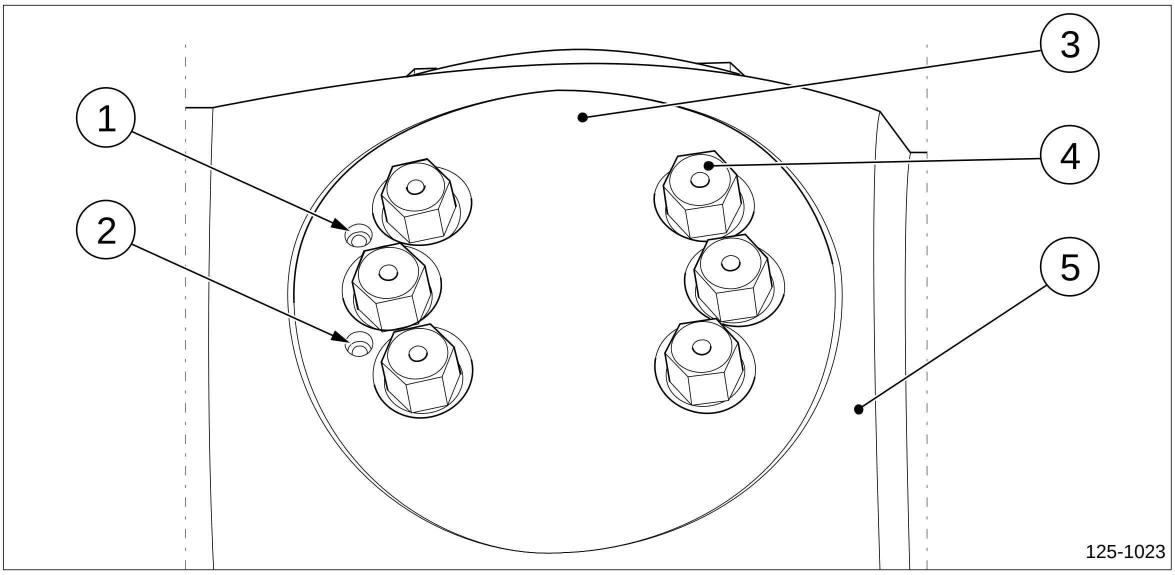


Figure 1 Blade foot, G-design.

1. Oil connection hole marked “OUT”
2. Oil connection hole marked “IN”
3. Blade flange
4. Blade bolts
5. Hub body

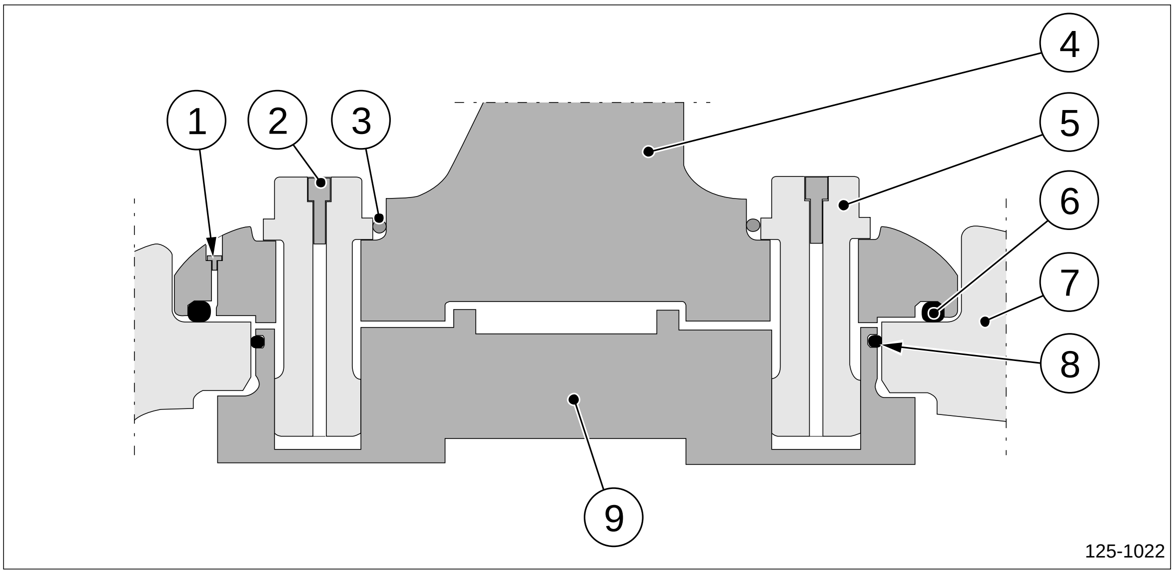


Figure 2 Cross-section of blade foot, G-design.

1. VSTI plugs for oil connection IN/OUT
2. Sealing screws
3. Locking pins
4. Propeller blade / blade flange
5. Hollow bored blade bolts
6. Blade sealing O-ring
7. Hub
8. O-ring
9. Crank pin ring

Technical and Functional Description

Each propeller blade (pos 4, figure 2) is mounted to the hub body (pos 7, figure 2) by the blade bolts (pos 5, figure 2) which are fastened to the crank pin ring (pos 9, figure 2). The crank pin ring seals off the blade flange with an O-ring (pos 8, figure 2).

Each propeller blade is manufactured with integrated blade bearings and a blade sealing O-ring (pos 6, figure 2) for sealing off sea water at each blade. The lubrication of the propeller blade flange is provided by oil injected through the blade flange using the oil connections (pos 1 and 2, figure 1). The oil connections are marked with “IN” and “OUT”. When replacing the blades an oil pump is connected to the “IN” connection hole and an oil container is connected to the “OUT” connection hole. The excessive oil used for flushing the blade flange is collected so no oil leakage will occur.

The G-design blade flange is manufactured with oil channels which connects the blade sealing ring, the blade bolt holes and the space between the blade flange and the crank pin ring.

Technical Description Pump Motor Starter

Introduction

This technical description describes all pump motor starters which can be supplied by Rolls-Royce and if your vessel is not equipped with for example a pump unit P5 or a gravity tank please disregard the descriptions regarding those features.

Pump Motor Starter P1 and P2

This instruction is valid for a vessel equipped with two electrically driven main pumps.

Introduction

This chapter describes the main components and functions of the main pump motor starters which control the hydraulic main pump units in the propulsion system.

Use the pump motor starter drawings as reference material and the Remote Supervision drawing, see part Drawings.

If the vessel is not equipped with a pump motor starter control panel from Rolls-Royce, equivalent functionality must still be available.

Main Components

In Engine Room

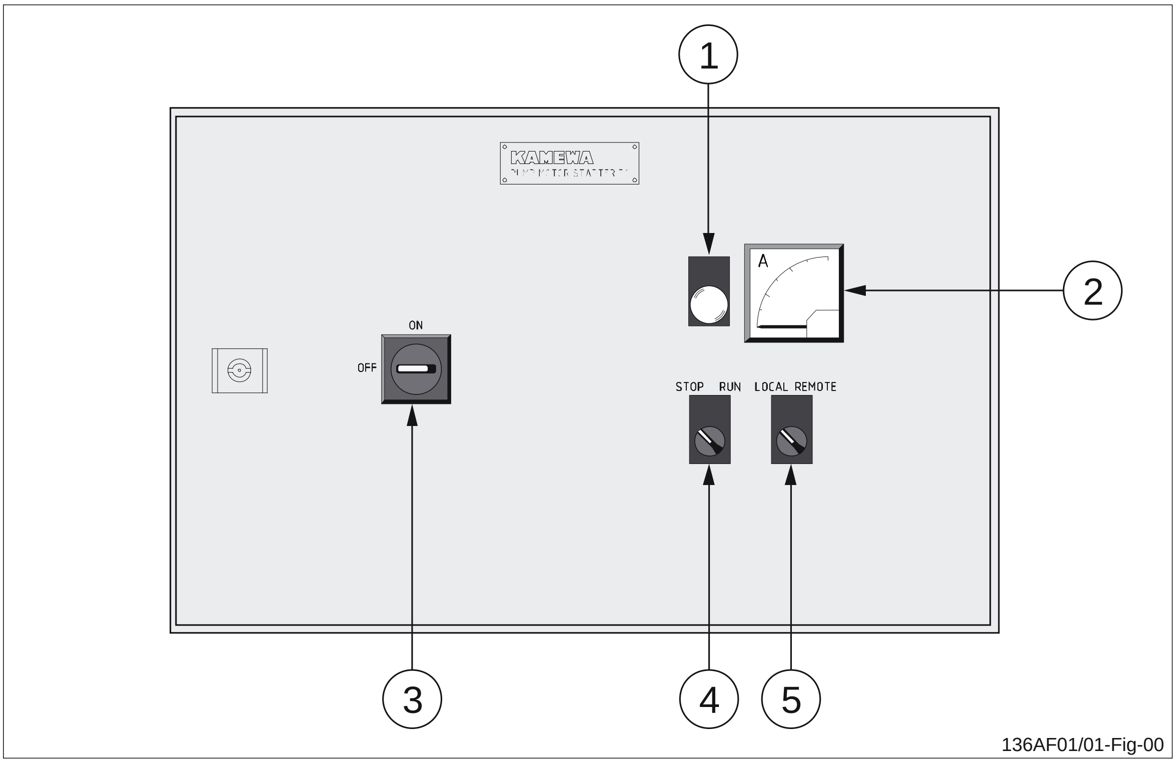


Figure 1 Front view of pump motor starter cabinet P1 or P2.

1. Run indicator lamp, H1
2. Ampere meter, P1 or P2
3. Main switch, Q1
4. Stop/run switch, S1
5. Local/remote switch, S2

The following pump motor starter equipment is located in the engine room:

• A pump motor starter cabinet for each main pump unit

• A pressure switch PS1.X for each main pump stand-by-start

Each pump motor starter cabinet includes a stop/run switch S1 and a selector switch local/remote S2, see position 4 and 5 in figure 1.

In Control Room/Bridge (Optional Equipment)

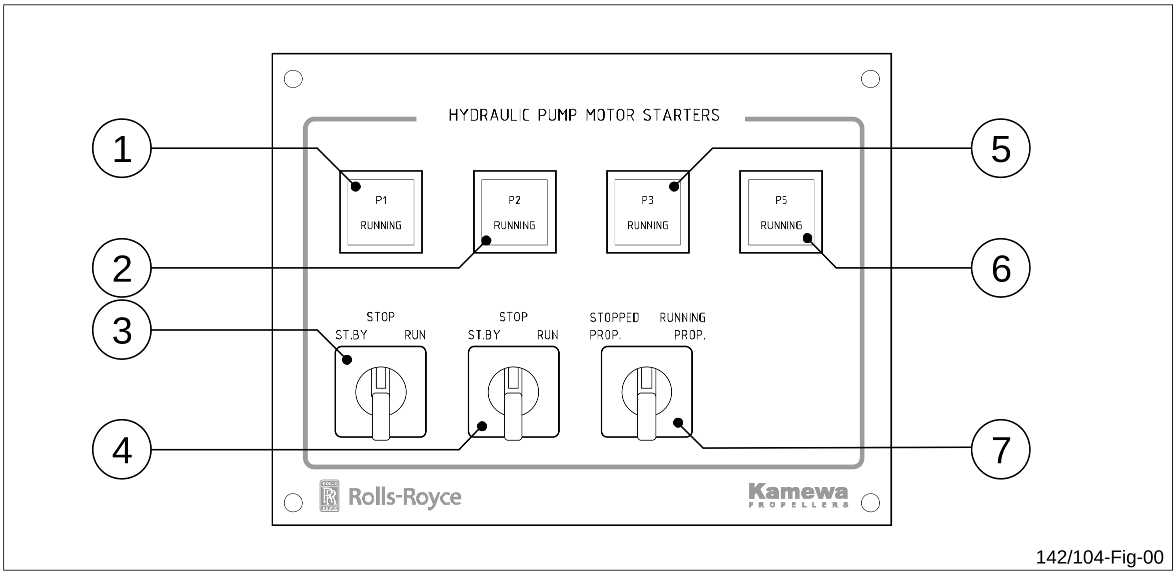


Figure 2 Example of a pump motor starter control panel.

1. Run indicating lamp, pump unit P1
2. Run indicating lamp, pump unit P2
3. Selector switch, pump unit P1
4. Selector switch, pump unit P2
5. Run indicating lamp, pump unit P3 (optional)
6. Run indicating lamp, pump unit P5 (optional)
7. Selector switch, pump unit P3

The following pump motor starter equipment is located on the control panel:

• A selector switch for each main pump unit which has three positions:

- ST-BY (stand-by)
- STOP
- RUN

• A lamp indicating RUN

Note that each main pump unit has a separate selector switch.

Functional Description

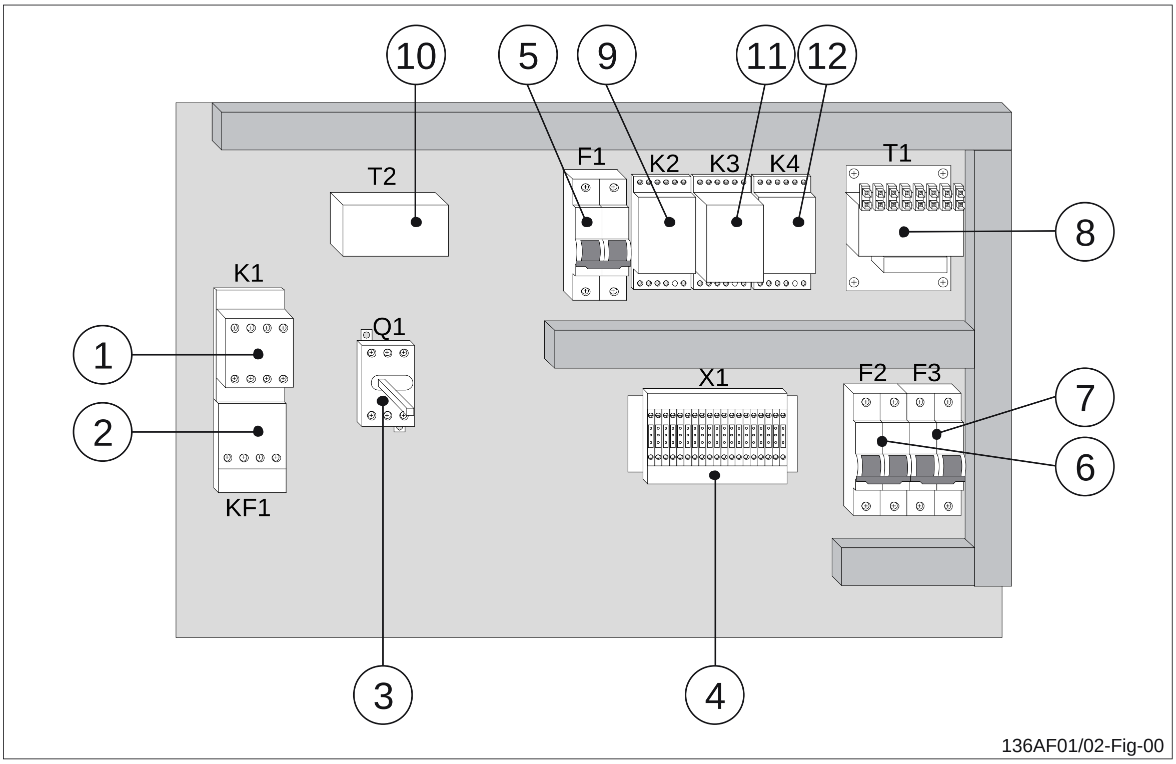


Figure 3 Internal equipment of pump motor starter P1 and P2.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal strip, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2
10. Current transformer, T2
11. Time relay, K3
12. Time relay, K4

• Automatic fuse F1 is feeding the transformer T1.

• Automatic fuse F2 is feeding the operation circuits.

• Automatic fuse F3 is feeding indication lamps with 24 volt.

If the selector switch for one of the main pump units is in ST.BY (stand-by) position and the selector switch for the other pump unit is in RUN position, the pump unit in stand-by position will start automatically if the pump unit in RUN position fails.

After a voltage failure, the pump motor with the selector switch to RUN position will start automatically.

The pump motor starter P1 and P2 give voltage-free closed contacts for example running indication to the alarm system.

Pump Motor Starter, Local Mode

If the local/remote switch S2 (pos 5, figure 1) on the pump motor starter is in LOCAL position the pump unit is controlled from the switches on the pump motor starter cabinet in the engine room.

With the remote/local switch S2 in LOCAL position and switch stop/run S1 (4, figure 1) in RUN position the main contactor K1 (pos 1, figure 3) is activated and the pump motor will run.

The local mode deactivates the stand-by mode and the pump unit in stand-by has to be started manually.

Pump Motor Starter, Remote Mode

If the local/remote switch S2 on the pump motor starter is in REMOTE position the pump unit is controlled from the control panel in the control room or on the bridge.

With the local/remote switch S2 in REMOTE position and the selector switch on the control panel in RUN position the main contactor K1 is activated and the pump motor will run.

With the local/remote switch S2 in REMOTE position and the selector switch on the control panel in ST-BY position, time relay K3 is activated. If the pump unit in run mode fails and the hydraulic pressure drops, the pressure switch PS1.X is closed and time relay K4 is activated after a preset period. This will activate contactor K2 which connects main contactor K1 and the pump motor in stand-by will run.

For time adjustment of the time relays see the Remote Supervision drawing in part Drawings.

Operating Settings

Settings at Narrow Waters and Harbour:

Both selector switches, on the control panel, for each main pump units must be turned to RUN position.

Settings at Open Sea:

The selector switch, on the control panel, for one main pump unit is turned to RUN position and the selector switch for the other main pump unit can be turned to stand-by position.

Pump Motor Starter P1 (PTO)

This instruction is valid for a vessel equipped with a PTO driven main pump and an electrically driven main pump unit P1.

Introduction

This chapter describes the main components and functions of the main pump motor starters which control the hydraulic main pump units in the propulsion system.

Use the pump motor starter drawings as reference material and the Remote Supervision drawing, see part Drawings.

If the vessel is not equipped with a pump motor starter control panel from Rolls-Royce, equivalent functionality must still be available.

Main Components

In Engine Room

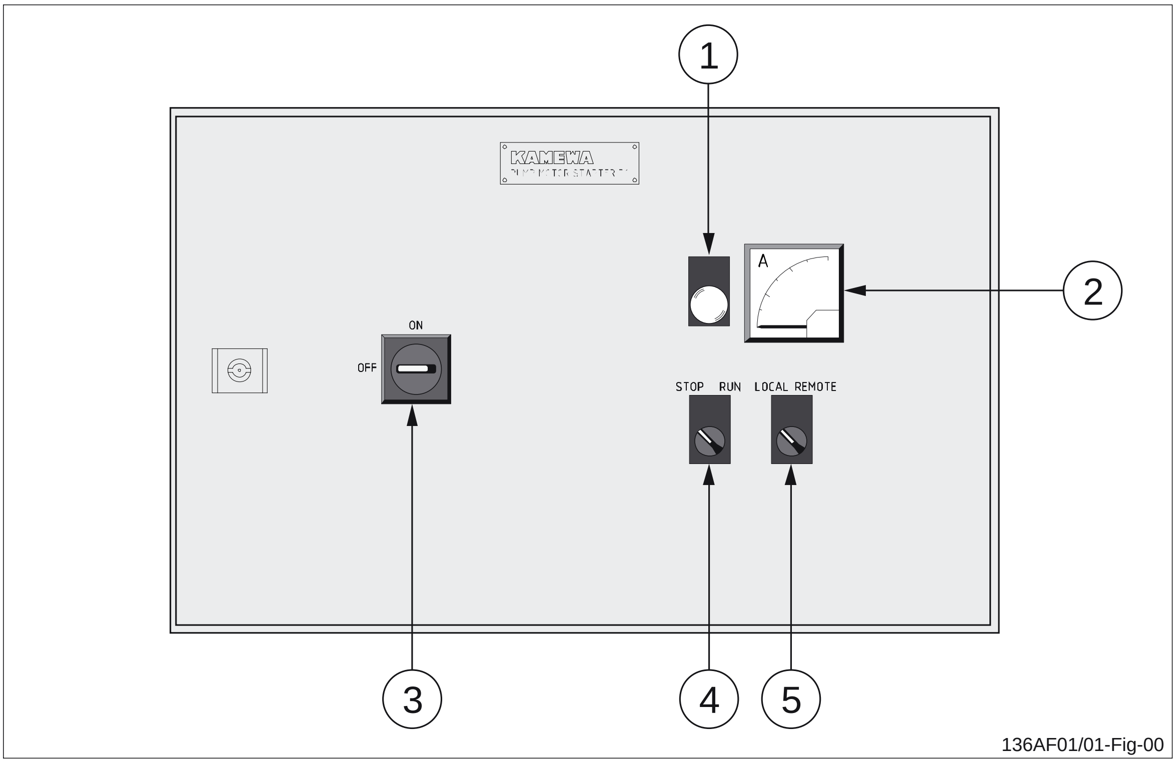


Figure 4 Front view of pump motor starter cabinet P1.

1. Run indicator lamp, H1
2. Ampere meter, P1
3. Main switch, Q1
4. Stop/run switch, S1
5. Local/remote switch, S2

The following pump motor starter equipment is located in the engine room:

• A pump motor starter cabinet for main pump unit P1

• A pressure switch PS1.X for the PTO driven main pump

The pump motor starter cabinet includes a stop/run switch S1 and a local/remote S2 switch (pos 4 and 5, figure 1).

In Control Room/Bridge (Optional Equipment)

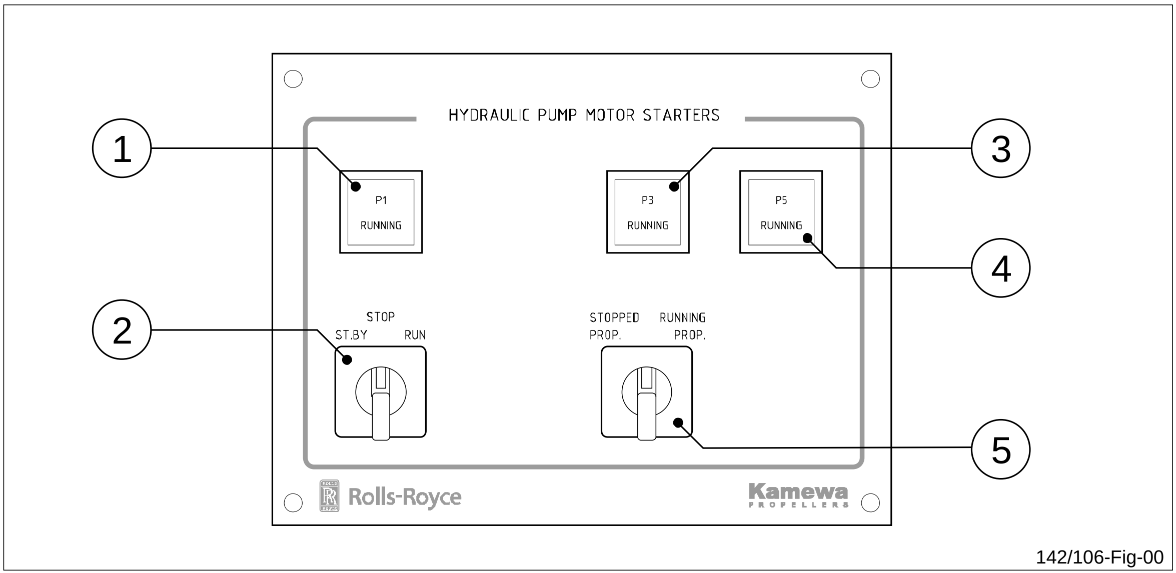


Figure 5 Example of a pump motor starter control panel.

1. Run indicating lamp, pump unit P1
2. Selector switch, pump unit P1
3. Run indicating lamp, pump unit P3 (optional)
4. Selector switch, pump unit P3 (optional)
5. Run indicating lamp, pump unit P5 (optional)

The following pump motor starter equipment is located on the control panel:

• A selector switch for the main pump unit P1 which has three positions:

- ST-BY
- STOP
- RUN

• A lamp indicating RUN

Functional Description

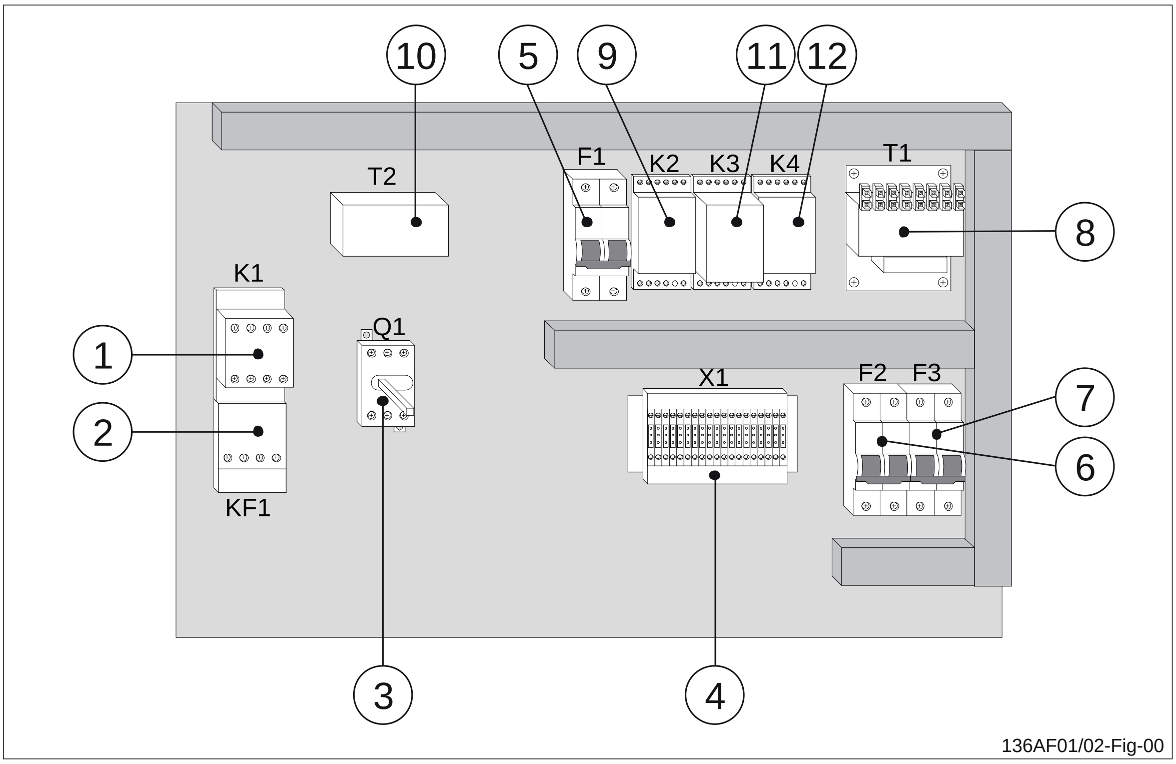


Figure 6 Internal equipment of pump motor starter P1.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal strip, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2
10. Current transformer, T2
11. Time relay, K3
12. Time relay, K4

• Automatic fuse F1 is feeding the transformer T1.

• Automatic fuse F2 is feeding the operation circuits.

• Automatic fuse F3 is feeding indication lamps with 24 volt.

If the selector switch for main pump unit P1 is in ST.BY (stand-by) position, the pump unit P1 will start automatically if the PTO driven pump fails and the hydraulic pressure drops.

After a voltage failure, the pump motor P1 will start automatically if the selector switch is in RUN position.

The pump motor starter P1 gives voltage-free closed contacts for example running indication to the alarm system.

Pump Motor Starter, Local Mode

If the local/remote switch S2 (pos 5, figure 1) on the pump motor starter is in LOCAL position the pump unit is controlled from the switches on the pump motor starter cabinet in the engine room.

With the remote/local switch S2 in LOCAL position and switch stop/run S1 (pos 4, figure 1) in RUN position main contactor K1 (pos 1, figure 3) is activated and the pump motor will run.

The local mode deactivates the stand-by mode and the pump unit in stand-by mode has to be started manually.

Pump Motor Starter, Remote Mode

If the local/remote switch S2 on the pump motor starter is in REMOTE position the pump unit is controlled from the control panel in the control room or on the bridge.

With the local/remote switch S2 in REMOTE position and the selector switch on the control panel in RUN the main contactor K1 is activated and the pump motor will run.

With the local/remote switch S2 in REMOTE position and the selector switch on the control panel in ST.BY (stand-by) position, time relay K3 is activated. If the PTO driven pump fails and the hydraulic pressure drops, the pressure switch PS1.X is closed and time relay K4 is activated after a preset period. This will activate contactor K2 which connects main contactor K1 and pump unit P1 in stand-by will run.

For time adjustment of the time relays see the Remote Supervision drawing in part Drawings.

Operating Settings

Settings at Narrow Waters and Harbour:

The selector switch for the pump unit P1 must be turned to ST.BY (stand-by) position and the PTO driven pump must be running.

Settings at Open Sea:

The selector switch for the pump unit P1 must be turned to ST.BY (stand-by) position and the PTO driven pump must be running.

Pump Motor Starter P3 (without Gravity Tank)

Introduction

This chapter describes the main components and functions of the pump motor starter for the static pressure pump unit P3. This description is valid for a vessel which is not equipped with a gravity tank.

Use the pump motor starter drawings as reference material and the Remote Supervision drawing, see part Drawings.

If the vessel is not equipped with a pump motor starter control panel from Rolls-Royce equivalent functionality must still be available.

Main Components

In Engine Room

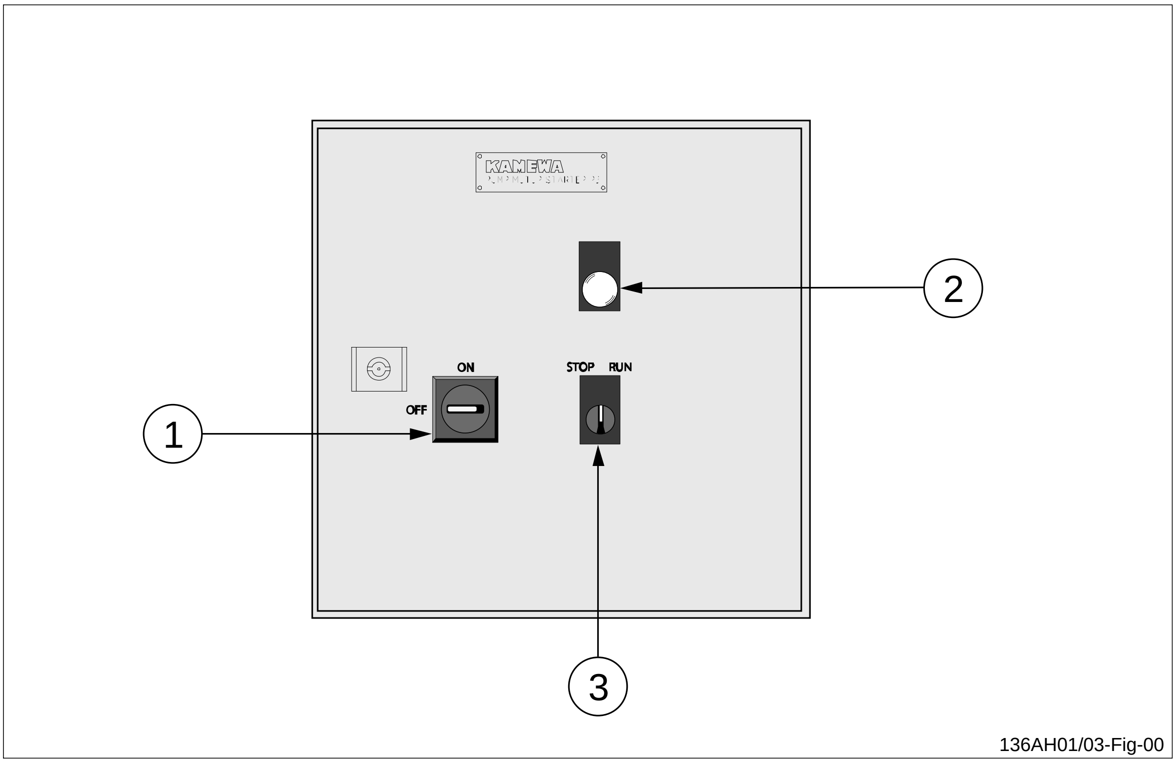


Figure 7 Front view of pump motor starter cabinet P3.

1. Main switch, Q1
2. Run indicator lamp, H1
3. Stop/run switch, S1

The following pump motor starter equipment is located in the engine room:

• A pump motor starter cabinet

The pump motor starter cabinet includes a stop/run switch S1 (see position 3, in figure 7).

In Control Room/Bridge (Optional Equipment)

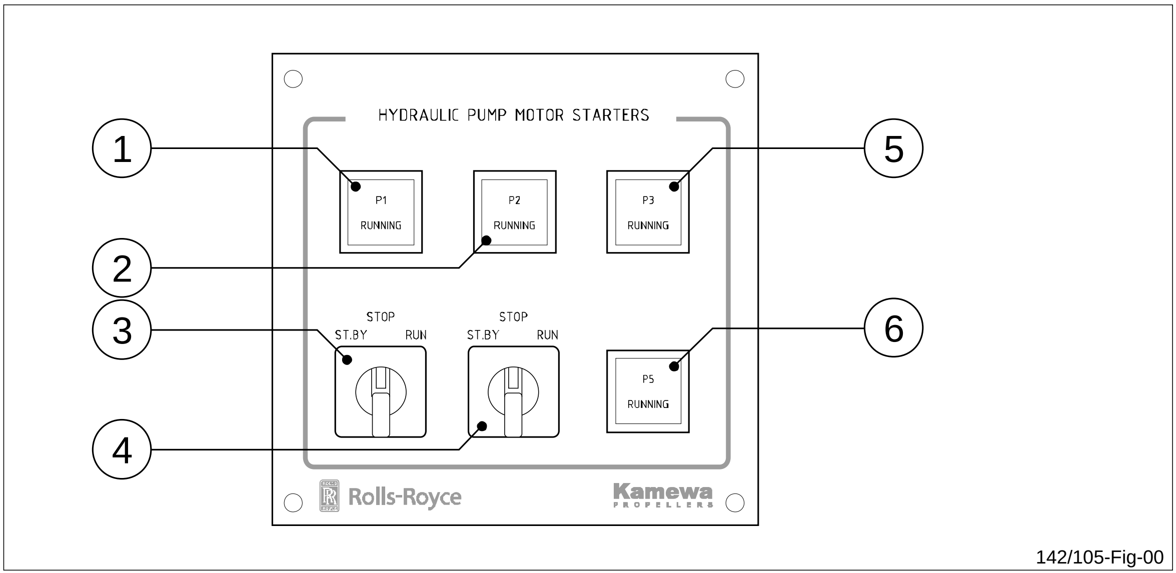


Figure 8 Example of a pump motor starter control panel.

1. Run indicating lamp, pump unit P1
2. Run indicating lamp, pump unit P2 (optional)
3. Selector switch, pump unit P1
4. Selector switch, pump unit P2 (optional)
5. Run indicating lamp, pump unit P3
6. Run indicating lamp, pump unit P5 (optional)

The following pump motor starter equipment is located on a control panel:

• A lamp indicating RUN.

Functional Description

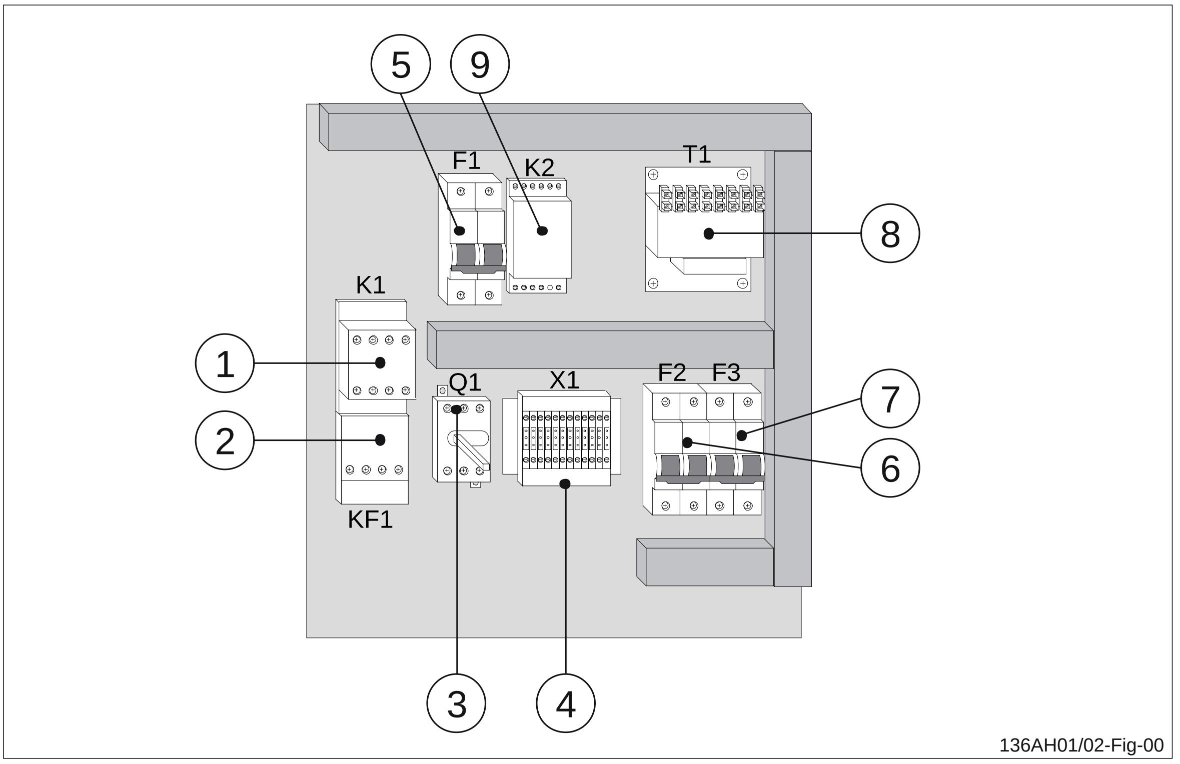


Figure 9 Internal equipment of pump motor starter cabinet P3.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal strip, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2

• Automatic fuse F1 is feeding the transformer T1.

• Automatic fuse F2 is feeding the operation circuits.

• Automatic fuse F3 is feeding indication lamps with 24 volt.

It is also possible to connect an external emergency stop to the pump unit. If the external emergency stop is not used, strap terminal connection X1:25 to terminal connection X1:26.

The static pressure pump P3 must run continuously regardless if the propeller is running or stopped.

• The pump unit P3 runs continuously if the stop/run switch S1 (pos 3, figure 7) is turned to RUN position.

• The pump unit P3 stops if the stop/run switch S1 (pos 3, figure 7) is turned to STOP position.

If start/stop switch S1 is in STOP position or if the external emergency stop is ordered, the pump unit P3 stops. Note that the pressure maintaining pump P3 must normally be continuously running.

After a voltage failure, the pump motor P3 must be manually restarted.

Pump Motor Starter P3 (with Gravity Tank)

Introduction

This chapter describes the main components and functions of the pump motor starter for the static pressure pump unit P3. This description is valid for a vessel which is equipped with a gravity tank.

Use the pump motor starter drawings as reference material and the Remote Supervision drawing, see part Drawings.

If the vessel is not equipped with a pump motor starter control panel from Rolls-Royce equivalent functionality must still be available.

Main Components

In Engine Room

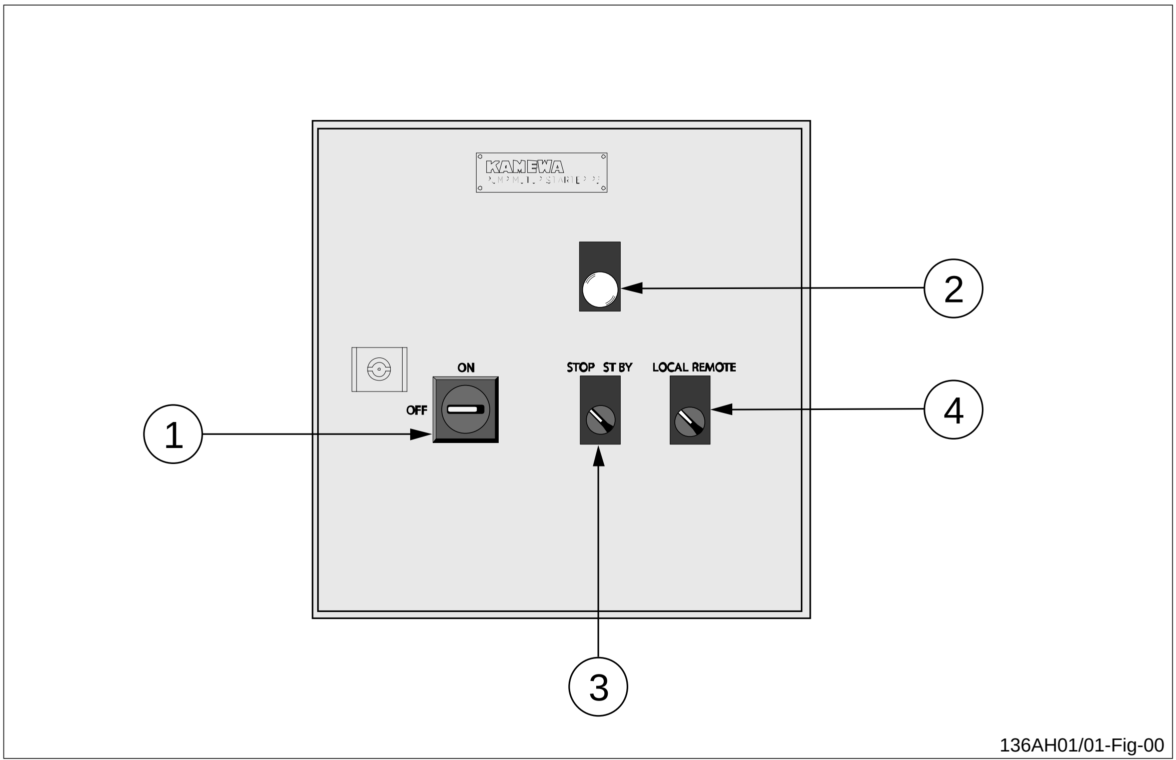


Figure 10 Front view of pump motor starter cabinet P3.

1. Main switch, Q1
2. Run indicator lamp, H1
3. stop/stand by switch, S1
4. Local/remote switch, S2

The following pump motor starter equipment is located in the engine room:

• A pump motor starter cabinet

The pump motor starter cabinet includes a stop/run switch S1 and local/remote switch S2, (pos 3 and 4, figure 10).

In Gravity Tank

The following pump motor starter equipment is located in the gravity tank:

• A level switch

The level switch in the gravity tank gives voltage-free closed contacts to the pressure maintaining pump P3 unit indicating high or low oil level in gravity tank. This function starts and stops pump unit P3 automatically.

Note that the function of the level switch is only valid if the pump unit is in stopped propeller mode. If the pump unit is in running propeller mode this mode will override the function of the level switch, see section Pump Motor Starter, Remote Mode.

In Control Room/Bridge (Optional Equipment)

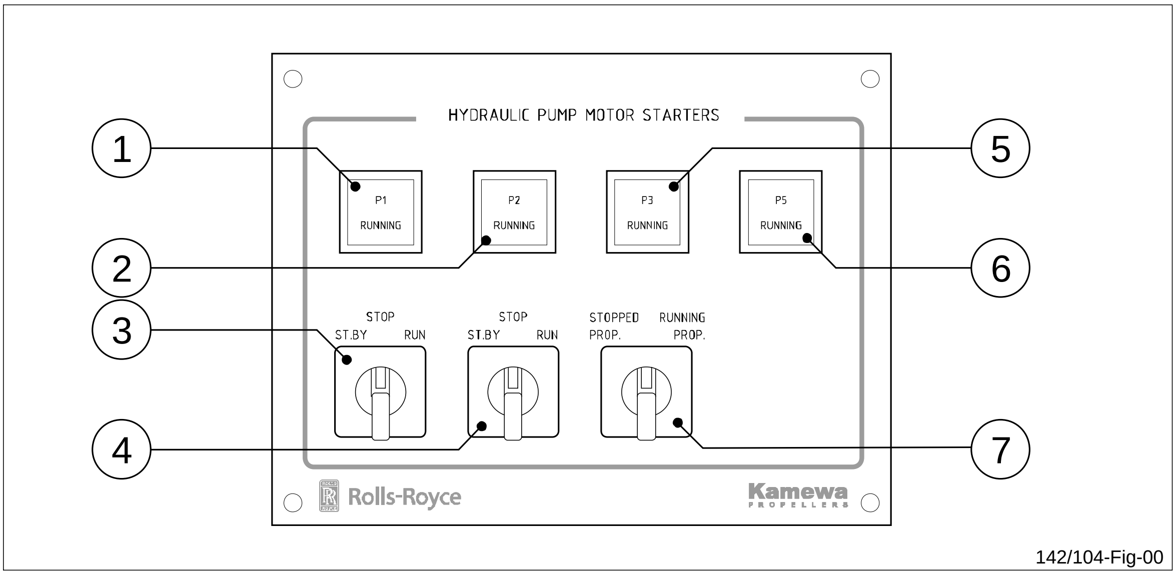


Figure 11 Example of a pump motor starter control panel.

1. Run indicating lamp, pump unit P1
2. Run indicating lamp, pump unit P2
3. Selector switch, pump unit P1
4. Selector switch, pump unit P2
5. Run indicating lamp, pump unit P3 (optional)
6. Run indicating lamp, pump unit P5 (optional)’
7. Selector switch, pump unit P3

The following pump motor starter equipment is located on a control panel:

• A selector switch which has two positions:

- RUNNING PROPELLER

- STOPPED PROPELLER

• A lamp indicating RUN.

Functional Description

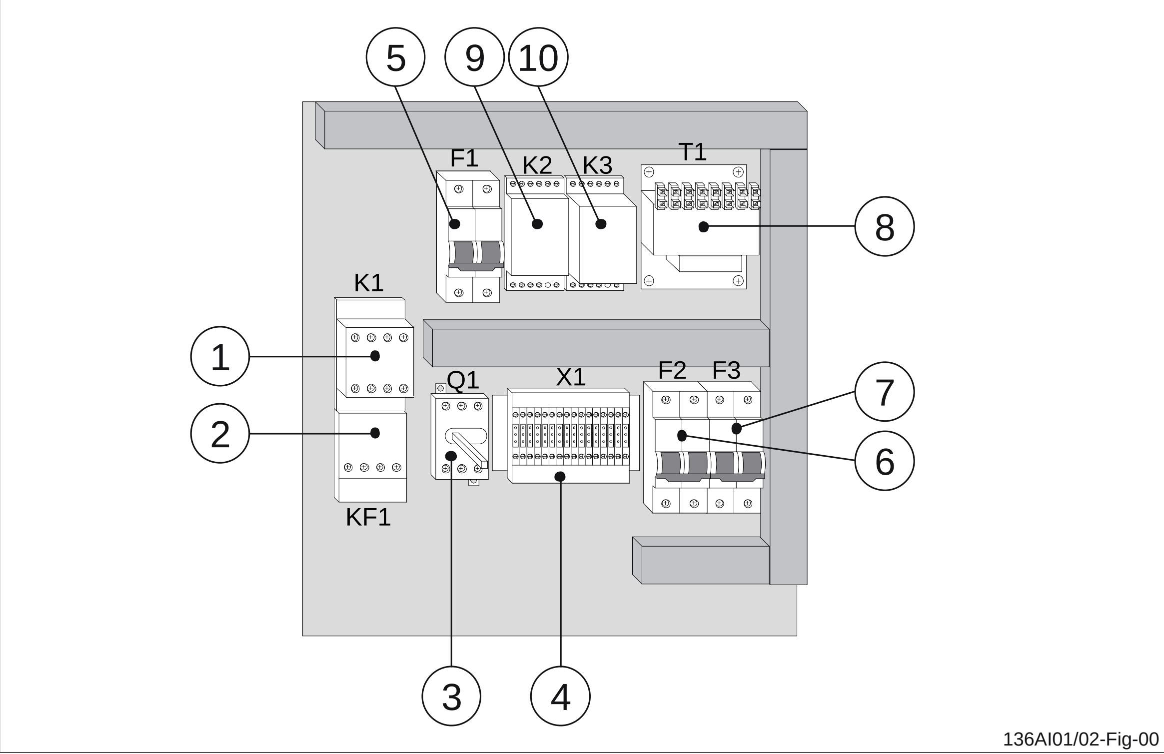


Figure 12 Internal equipment of pump motor starter P3.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal strip, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2
10. Time relay, K3

• Automatic fuse F1 is feeding the transformer T1.

• Automatic fuse F2 is feeding the operation circuits.

• Automatic fuse F3 is feeding indication lamps with 24 volt.

It is also possible to connect an external emergency stop to the pump motor starter. If the external emergency stop is not used, strap terminal connection X1:25 to terminal connection X1:26.

Pump Motor Starter, Remote Mode

In remote mode the pump unit P3 must be able to be set in two modes, to make full use of the benefits of the gravity tank:

• Running propeller mode:
It is important to note that when the propeller is running the pump unit P3 must be running continuously even though a gravity tank is installed.

• Stopped propeller mode:
When the vessel is equipped with a gravity tank the pump unit P3 can be stopped when the hydraulic system is shut off and the propeller is stopped. Due to internal leakage it can be necessary to fill up the gravity tank by starting pump unit P3. A level switch in the gravity tank is used to automatically start and stop the pump unit P3.

Running Propeller Mode

The pump unit P3 must be running continuously if the propeller is running, even though the hydraulic system is equipped with a gravity tank.

When the propeller is running, the selector switch (pos 7, figure 11) for the pump unit P3 must be turned to RUNNING PROP. position.

This mode enables the pump unit P3 to run continuously without being influenced by the level switch in the gravity tank.

Stopped Propeller Mode

When the propeller is stopped, the selector switch (pos 7, figure 11) for pump unit P3 can be turned to STOPPED PROP. position.

During this mode, the pump unit will automatically be started and stopped by the level switch in the gravity tank, depending on the oil level in the tank.

Pump Motor Starter, Local Mode

If the local/remote switch S2 on the pump motor starter cabinet P3 is in LOCAL position, the pump unit P3 can be manually operated by the switches on the pump motor starter cabinet:

• The pump unit P3 runs continuously if the stop/stand by switch S1 (pos 3, figure 10) is turned to RUN position.

• The pump unit P3 stops if the stop/stand by switch S1 (pos 3, figure 10) is turned to STOP position.

Pump Motor Starter P5

Introduction

This chapter describes the main components and functions of the pump motor starter for drain pump unit P5.

Use the pump motor starter drawings as reference material and the Remote Supervision drawing, see part Drawings.

If the vessel is not equipped with a pump motor starter control panel from Rolls-Royce equivalent functionality must still be available.

Main Components

In Engine Room

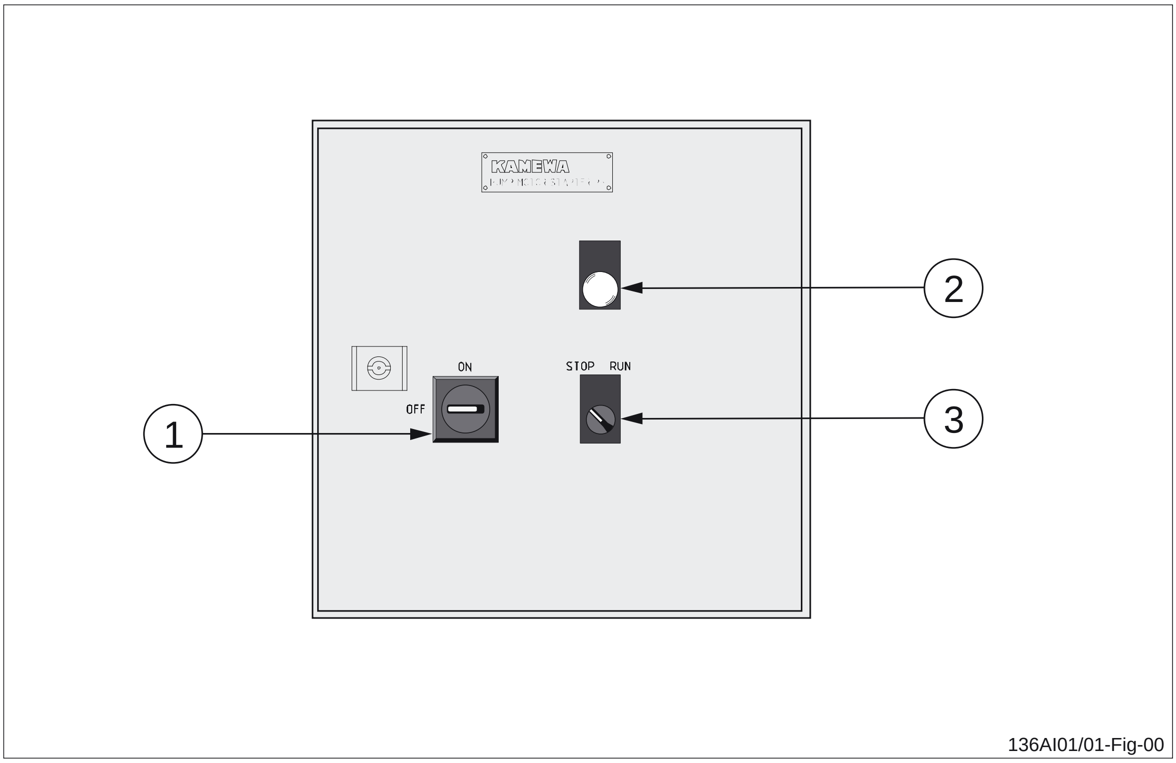


Figure 13 Front view of pump motor starter P5.

1. Main switch, Q1
2. Run indicator lamp, H1
3. Stop/run switch, S1

The following pump motor starter equipment is located in the engine room:

• A pump motor starter cabinet.

The pump motor starter cabinet includes a stop/run switch S1 (pos 3, figure 13).

In Drain Pump Unit Tank

The following pump motor starter equipment is located on a control panel:

• A level switch.

The level switch in the drain pump unit tank gives voltage-free closed contacts to pump unit P5 unit indicating high or low oil level in the tank. This function starts and stops pump unit P5 automatically.

In Control Room/Bridge (Optional Equipment)

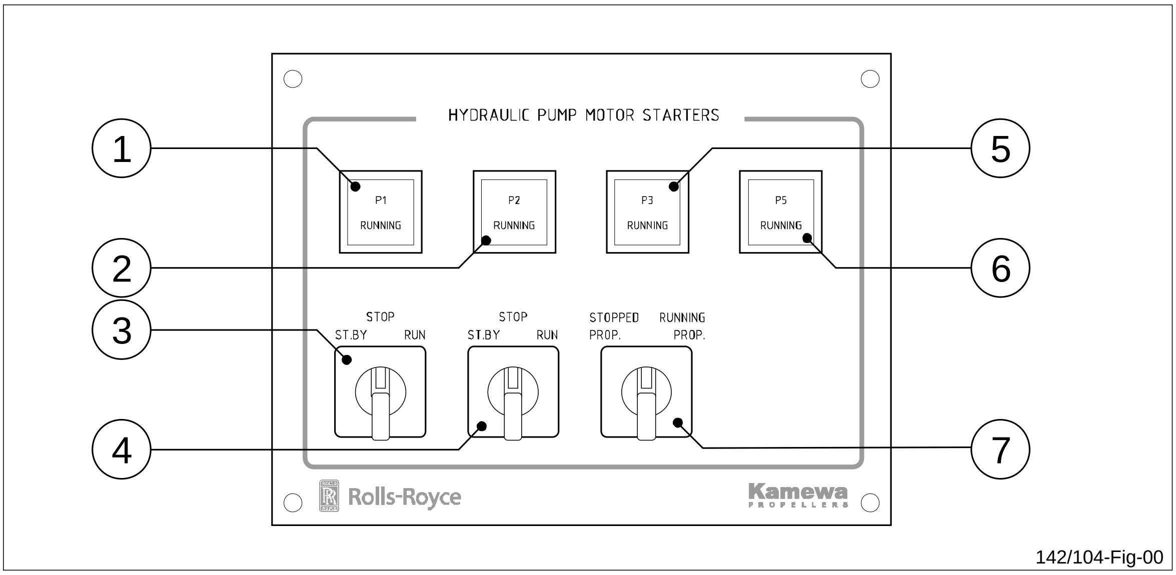


Figure 14 Example of a pump motor starter control panel.

1. Run indicating lamp, pump unit P1
2. Run indicating lamp, pump unit P2
3. Selector switch, pump unit P1
4. Selector switch, pump unit P2
5. Run indicating lamp, pump unit P3 (optional)
6. Run indicating lamp, pump unit P5
7. Selector switch, pump unit P3 (optional)

The following pump motor starter equipment is located on a control panel:

• A lamp indicating RUN.

Functional Description

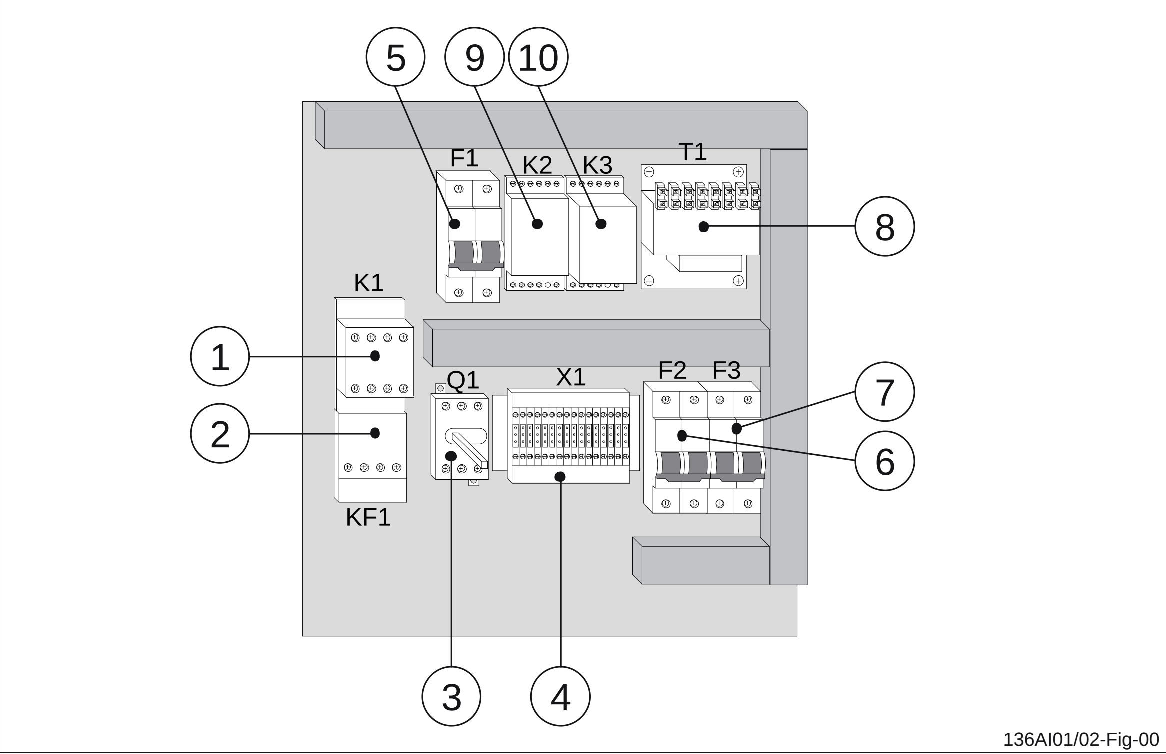


Figure 15 Internal equipment of pump motor starter P5.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2
10. Time relay, K3

• Automatic fuse F1 is feeding the transformer T1.

• Automatic fuse F2 is feeding the operation circuits.

• Automatic fuse F3 is feeding indication lamps with 24 volt.

It is also possible to connect an external emergency stop to the pump motor starter. If the external emergency stop is not used strap terminal connection X1:25 to terminal connection X1:26.

The stop/run switch S1 (pos 3, figure 13) is in RUN position. The level switch in the drain oil tank will start and stop the pump unit P5.

After a voltage failure, the time relay K3 (pos 10, figure 15) will be activated after 5 seconds and it activates main contactor K1 (pos 1, figure 15) and the drain oil pump motor starts automatically.

System Description Remote Control System Twin Propeller

Reading this Chapter

This chapter describes the manoeuvre equipment, the system components, and the functions of the Twin Propeller with Controllable Pitch

Some of the functions of the control system are optional, see section see ” General Description”.

If there are any problems following the instructions of any task, please consult Rolls-Royce Marine Global Support Network (GSN) before proceeding.

General Description

The main propeller manoeuvre system is a microprocessor based remote control system. The system controls the pitch of the main propellers and the RPM (revolutions per minute) of the main engines. These factors together determine the size and direction of the propulsive force that the propellers generate on the ship.

The control system takes orders from the manoeuvre equipment, process them and activates required output commands to the hydraulic pitch control systems and the engine RPM governors. For follow-up and indication it monitors continuously the pitch and shaft RPM of the propellers, and the fuel pump settings (FPS) of the engines by reading local transmitters.

The basic functions of the control system can be summarized as follows:

- control of propeller pitch and engine RPM according to thrust commands given by the operator or possible other manoeuvring systems (such as joystick, dynamic positioning, and speed-pilot);
- manoeuvre responsibility management;
- automatic load control of the main engines;
- a load increase control program for engine warming up stages;
- two control modes: combinator mode and constant RPM mode;
- pitch and RPM indication on the control panels;
- error detection, status supervision and alarm activation.

In addition the system may include the following optional functions:

• Communication with joystick, speed-pilot, and dynamic positioning (DP) systems

• Clutch control of the main engines

• Additional control modes

• Separate RPM control

• Fine adjustment of constant RPM

• Load sharing between engines on the same shaft

• Pitch and RPM indication on Panama indicators

• Information transfer to manoeuvre recorder, voyage data recorder (VDR)

• Auto and manual zero pitch control

The main propeller control system is a customized design based on the CanMan control system platform. The control units of the system are distributed around two redundant (doubled) CAN buses which handle the data communication between the units. On the bridge, all control units, in/out units, and communication lines are doubled to form a master system and an identical slave system. In case of an error in the master system, the slave system takes over.

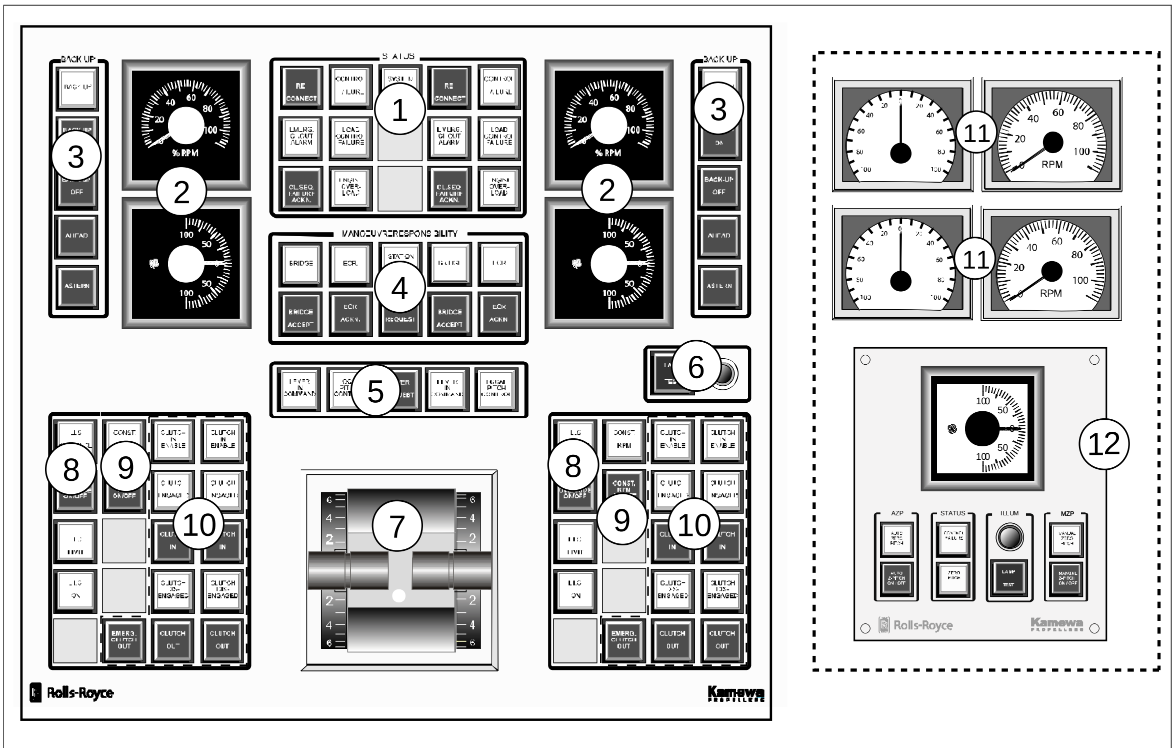
The operator controls the propellers from the engine control room or from a bridge station. There may be up to three control stations on the bridge.

In case of a break-down in the main control system, a back-up system of non-follow up type can be used for propeller pitch setting. The back-up system has its own power supply and would therefore operate even at a power break in the main system.

System Description

Manoeuvre Equipment

Each bridge station has a main control panel with a thrust control lever, pitch and RPM indicators, indication lamps and push buttons (see figure 1). The bridge equipment may also include Panama Indicators (an optional feature). Panels located outdoors are equipped with water protection covers.



142/0591-Fig-00

Figure 1 The main propeller manoeuvre equipment found at the bridge stations.

1. Alarm and warning indication lamps and reset buttons (see part Alarm Handling and Trouble Shooting)
2. Pitch and RPM indicators (see part Operating Instructions)
3. Back-up control (see part Operating Instructions)
4. Manoeuvre responsibility buttons and indication lamps (see part Operating Instructions)
5. Command mode handling (see part Operating Instructions)
6. Dimmer knob and lamp test button (see part Operating Instructions)
7. Thrust control lever (see part Operating Instructions)
8. Load control buttons and indication lamps (see part Operating Instructions)
9. Control mode selection and indication (see part Operating Instructions)
10. Clutch control with emergency clutch out (option) (see part Operating Instructions)
11. Panama indicators
12. Zero pitch control panel (option) (see part Operating Instructions)

¨The figure 2 shows the manoeuvre equipment found in the ECR.

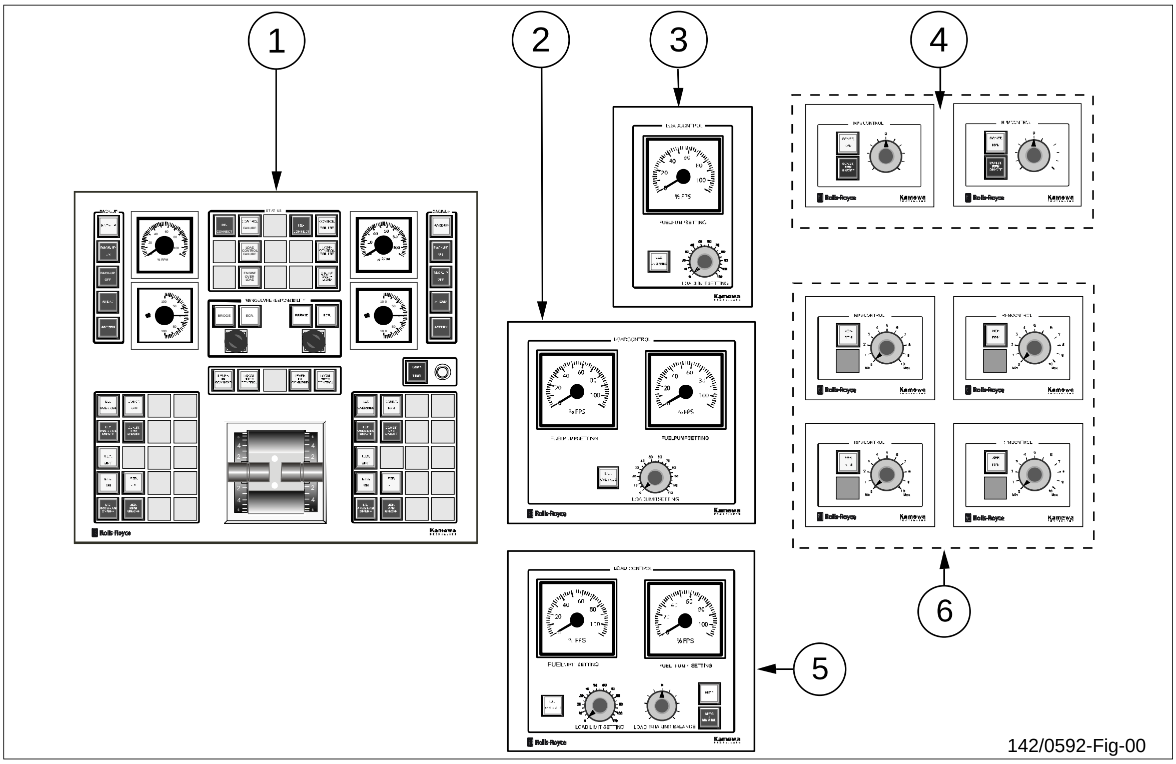
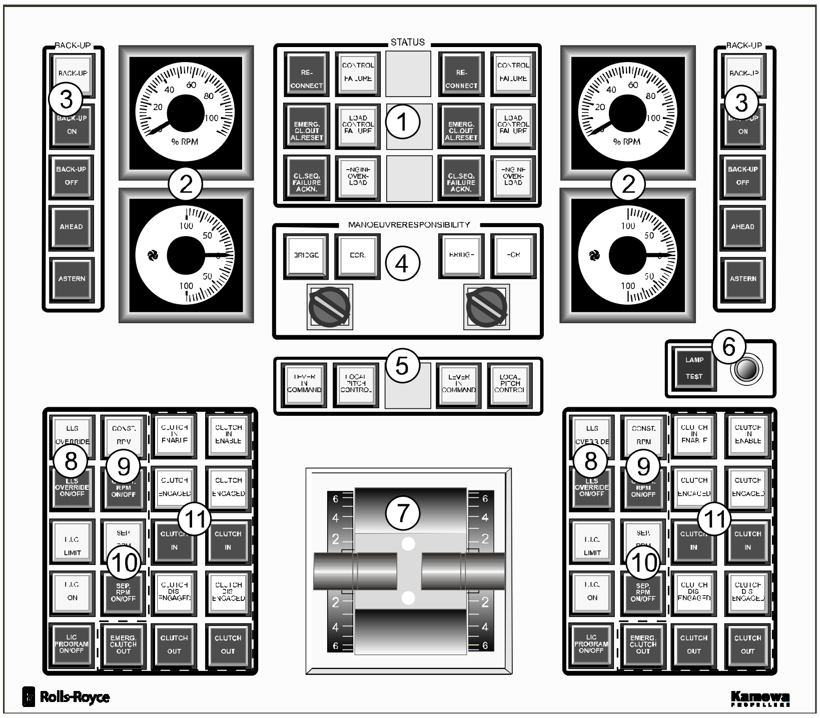


Figure 2 Main propeller manoeuvre equipment found in the engine control room (ECR).

1. Main control panel (see figure 3)
2. Load control panel for two-engine installations (see part Operating Instructions)
3. Load control panel for one-engine installations (see part Operating Instructions)
4. Separate RPM control panels (option)
5. Load control panel with load sharing balance (see part Operating Instructions)
6. Panel for fine adjustment of constant RPM (option)

The figure 3 shows a closer view of the main control panel in the ECR.



142/0593-Fig-00

Figure 3 The main control panel in the ECR.

1. Alarm and warning indication lamps and reset buttons (see part Alarm Handling and Trouble Shooting)
2. Pitch and RPM indicators (see part Operating Instructions)
3. Back-up control (see part Operating Instructions)
4. Manoeuvre responsibility switch and indication lamps (see part Operating Instructions)
5. Command mode indication lamps (see part Operating Instructions)
6. Lamp test button (see part Operating Instructions)
7. Thrust control lever (see part Operating Instructions)
8. Load control buttons and indication lamps (see part Operating Instructions)
9. RPM control mode selection and indication (see part Operating Instructions)
10. Separate RPM control activation and indication (option) (see part Operating Instructions)
11. Clutch control with emergency clutch out (option) (see part Operating Instructions)

As a rule a lit indication lamp on a control panel indicates an active state, while a lit push button indicates that the button is enabled to be activated with a push. Generally, a push button that is not lit is not applicable for the moment due to the prevailing situation and a push on the button will have no effect. Indication lamps and buttons of special importance are in red. A yellow lamp indicates a warning or another state that requires the operator’s attention. Green lamps indicate active mode, and blue ones indicate back-up control.

Only one control station at a time can be in command of the main propeller control system (have the manoeuvre responsibility). The control system will only obey orders from the station in command. The indicators however, and the alarm indication lamps will always work at all stations, like the emergency clutch out buttons (if included).

The control levers at stations that are not in command are continuously synchronized with the levers at the station in command. The levers are positioned by means of electrical motors situated inside the levers.

Control System Components

Overview

The electronics of the control system is situated in the cabinets on the bridge, in the ECR. See the simplified picture of the control cabinets and their connections in figure 4.

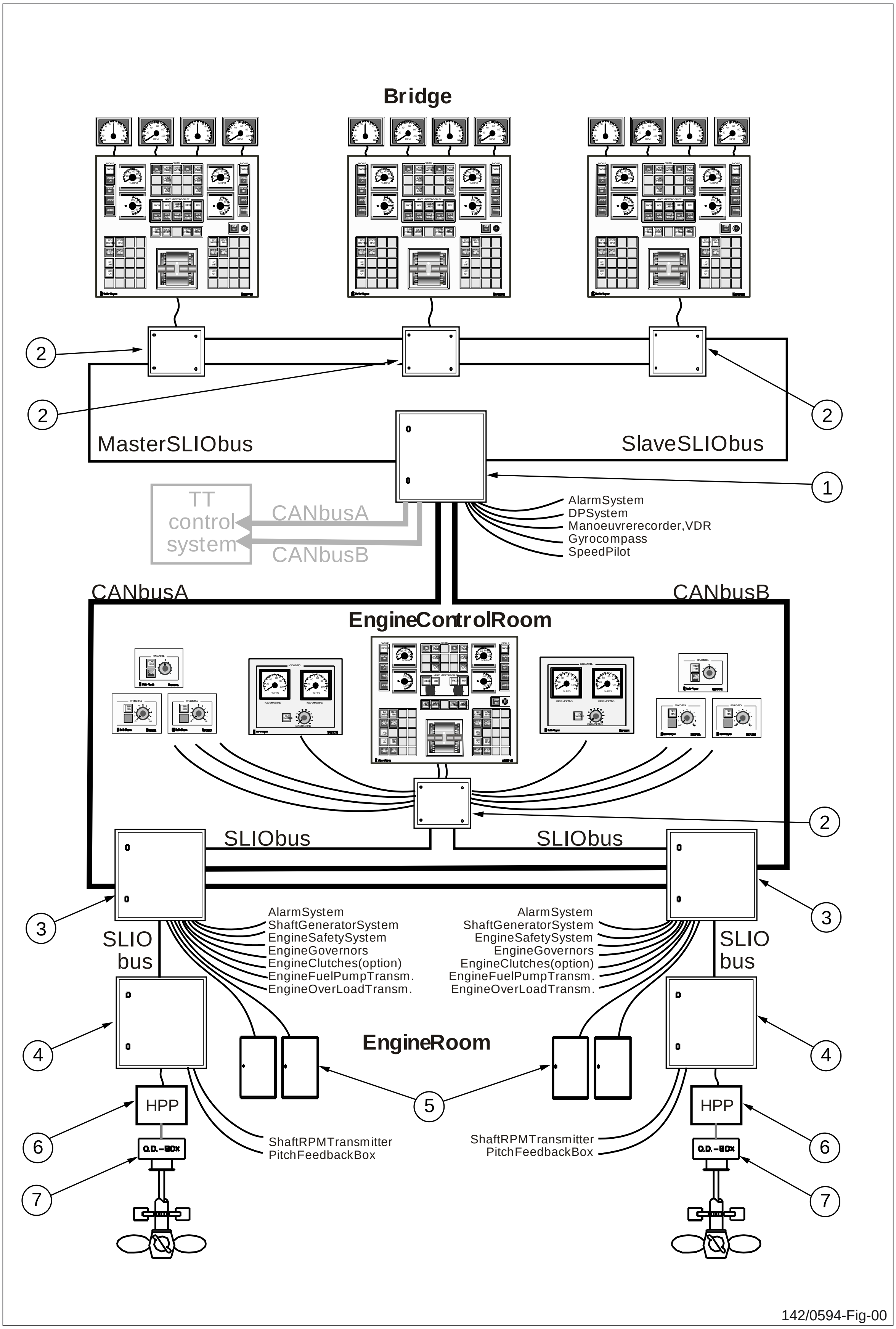


Figure 4 The control system cabinets and their connections (all options included).

1. Bridge Unit
2. Station I/O Units
3. ECR Unit
4. HPP Units
5. Electro-pneumatic converters (present only when pneumatic engine governors are used
6. Hydraulic Power Packs (HPP)
7. Oil Distribution Boxes

Inside the cabinets there are two types of units with similar appearance but different functions (see figure 5).

• Control nodes or application nodes (CCN). These are intelligent units programmed to perform certain tasks. An application node consists of a processor with specialized software and connections to in/out units.

• SLIO (In/Out Units). These are un-intelligent units with no other task than to receive input signals from the supervising instrumentation (transmitters) and manoeuvre equipment (control levers, selectors, switches and push buttons), and send output signals to the actuating devices (for instance hydraulic control valves).

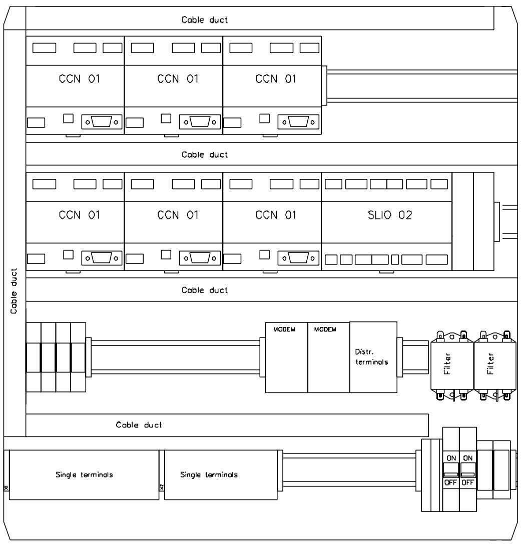


Figure 5 The inside of a bridge unit (example).

Application nodes are found in the bridge cabinet and in the ECR cabinet. The Station I/O Units (2) and the HPP Unit (4) cabinets contain solely SLIO units.

The application nodes communicate with each other via a doubled Controller Area Network (CAN) bus, CAN bus A and B, and with SLIO units via SLIO buses.

On bridge, every control node, SLIO unit and SLIO bus is doubled so that there is a master system and a slave system with separate power supplies. Each of the two CAN buses is connected to the master nodes as well as the slave nodes. At a malfunction in a master node, master SLIO unit or master SLIO bus, the slave system takes over.

For more information, see the cable diagram found among the electrical drawings.

General

The numbers in the sections 4.3-4.6 correspond to the numbers in figure 4.

Bridge Unit

The application nodes in the Bridge Unit (1) handle the communication with the SLIO Units in the Station I/O Units (2) on the bridge.

There is one master node, which is normally running, and one slave node which is ready to take over at an error in the master system. The joystick system has its own nodes, one master node and one slave node.

The master nodes communicate with master SLIO Units, and slave nodes communicate with slave SLIO Units. The master nodes and the slave nodes have separate power supplies.

If the application includes a joystick the Bridge Unit (1) contains a joystick node. It may also contain a status node with SLIO Units for alarm handling and communication with special interfaces, such as Speed-Pilot, Gyro Compass and DP System (1). In connection with the status node there may be a VDR node for data transfer to a voyage data recorder (VDR) (1). The status and VDR nodes may be situated in any cabinet.

Station In/Out Units

The Station In/Out (2) Units contain SLIO Units, which are connected to the manoeuvre equipment.

ECR Units

The ECR Units (3) contains a node for communication with the SLIO in the Station I/O Unit. The Station I/O Unit is connected to the control panels and for communication with the SLIO in the HPP Units (4). It has also SLIO units that are directly connected to the engine RPM governor, transmitters, etc.

HPP Units

The HPP Units (4) contain a SLIO Unit, which is connected to:

• the hydraulic system, which controls the propeller pitch;

• the pitch feedback box;

• the shaft RPM transmitter via the connection box.

CAN Buses A and B

The CAN bus is a communication link for serial communication between the application nodes. When a node has a message to another node it puts the message on the bus. The node to which the message is directed will receive it and take required actions.

The CAN buses are redundant which means that the application nodes, master nodes as well as slave nodes, are connected with two independent buses. Both buses are continuously transmitting messages. If a failure occurs on a bus the other one continues to take care of the data communication.

SLIO buses

The serial SLIO buses are CAN buses intended for communication between application nodes and there SLIO units. In other respects, they are similar to the A and B buses.

Functional Description

Thrust Control

When the operator brings the thrust control lever ahead or astern the thrust command signal is passed to the ECR unit. In the ECR Unit the control system transforms the command signal to a pitch command and an RPM command according to a combinator program. The RPM command is sent to the engine RPM governor, and the pitch command is sent to a pitch controller. The pitch controller compares the command with the pitch response signal and sends “increase” or “decrease” commands to the hydraulic system when needed.

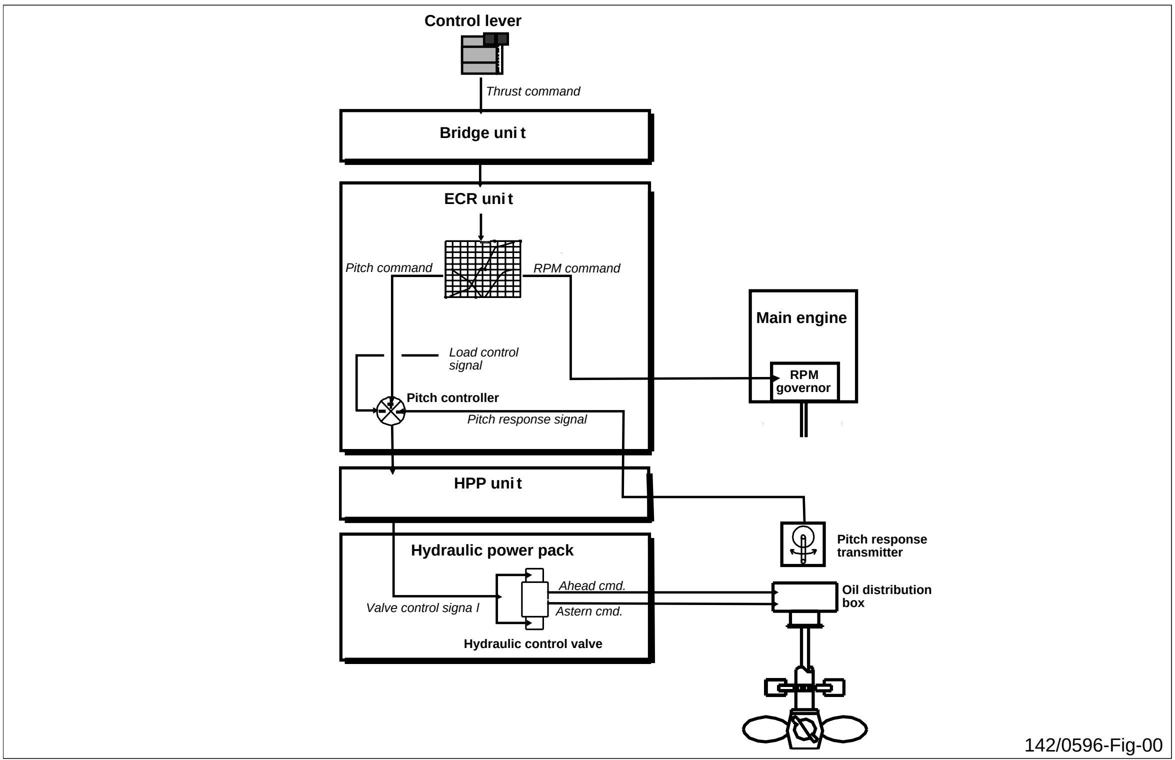


Figure 6 The thrust control function (SLIO Units left out).

The figure 7 shows an example of a simplified combinator diagram. The exact combinator diagram for the ship can be found in the instruction book of the propeller system.

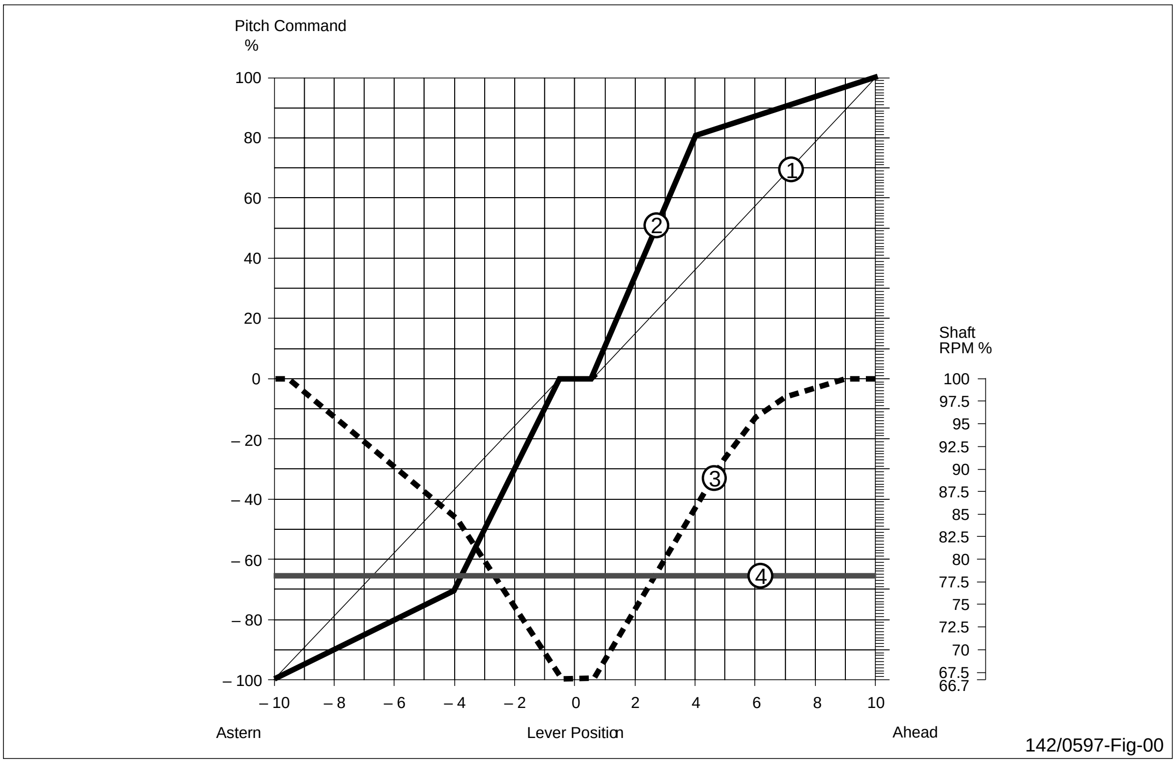


Figure 7 An example of a combinator diagram.

1. Pitch setting in constant RPM mode and when the engine is disengaged
2. Pitch setting in combinator mode
3. RPM setting in combinator mode
4. RPM setting in constant RPM mode

At a certain lever position the control system sets the pitch to the value taken from one of the upward curves and the RPM to a value taken from the V-shaped curve (combinator mode) or the horizontal line (constant RPM mode). For example, at lever position 5 ahead in combinator mode, according to the combinator diagram above, the system would order a pitch setting of about 85% and an RPM of about 90%.

The thrust command signal (both pitch and RPM), may be affected by the Load Increase Control function, and the pitch setting may be reduced by the load control function and by the windmill protection function, if it is in use. The windmill protection function, which can be switched on with a software parameter, prevents the pitch from decreasing at high shaft RPM in combination with simultaneous low engine load.

At a slowdown command from an engaged engine, the RPM in combinator mode will be limited to a value determined by a software parameter (default: 70%). At a shutdown command from an engaged engine, the engines on the same shaft are given idle RPM and the lever in command is automatically set in zero position. At a shutdown command from a disengaged engine, only the actual engine is given zero RPM command.

Engine Load Control

The purpose with load control is to prevent the engines from becoming overloaded. The load control system supervises the load of one or two engines in accordance with the engine loading characteristics. The shaft RPM makes the basis of maximum allowed fuel pump setting (FPS), which is obtained from a load curve programmed with the FPS limit as a function of shaft RPM. Depending on a software parameter setting, the system may switch between two different load curves: a curve used during one-engine operation and another one used during two-engine operation.

The load control system measures the RPM of the propeller shaft and the fuel pump setting of each engine, and compares the FPS response value with the load curve. If it exceeds the maximum allowed value at measured RPM, the pitch setting is reduced by means of a pitch command correction signal.

If two engines on the same shaft are running and engaged, the most loaded one is regarded.

Maximal, the load control function can reduce the pitch down to a preset level (40% by default).

The figure 8 shows an example of a load curve. The exact load curve for the ship can be found in the propeller system instruction manual. The example below shows the load curve for a load limit of 100%. In case another load limit is applied, the entire curve is multiplied with the load limit factor. If the load limit setting is <100%, the entire load curve is moved downwards. The load limit can be set manually in the ECR by means of the load limit setting knob.

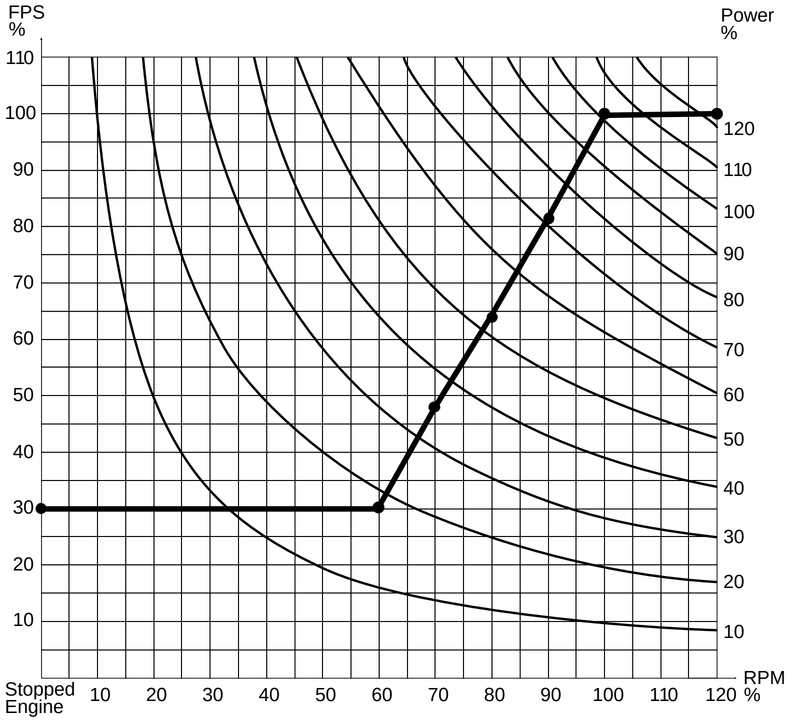


Figure 8 An example of a load curve.

Although the load curve would allow a certain pitch setting, the pitch may still be reduced due to low charge air pressure (scavenging air pressure).

In case of a failure in the load control system (e.g. failure in the fuel pump setting signal), the system is set in overload protection mode, where the overload switches on the fuel racks are used for initiating a pitch reduction when activated.

In back-up mode no automatic load control takes place. Engine overload must be supervised manually by watching the engine overload indication lamp, which is activated by the overload switches on the fuel racks.

Load Increase Control

The purpose with the load increase control (LIC) program is to minimize the thermal stresses on the engines during warming up stages by delaying the command signal in accordance with a ramp function at steep raises of the lever command.

The LIC program, which can be switched on and off during operation, reads the lever command signal and transforms it so that it is kept below a preprogrammed load increase curve. The load increase curve limits the maximum allowed command signal as a function of the time passed since the change of lever position.

The figure 9 illustrates a LIC process. It shows the resulting output command signal at different physical lever commands. At steep increases of the physical lever command, the output lever command signal will follow an upwards inclining line.

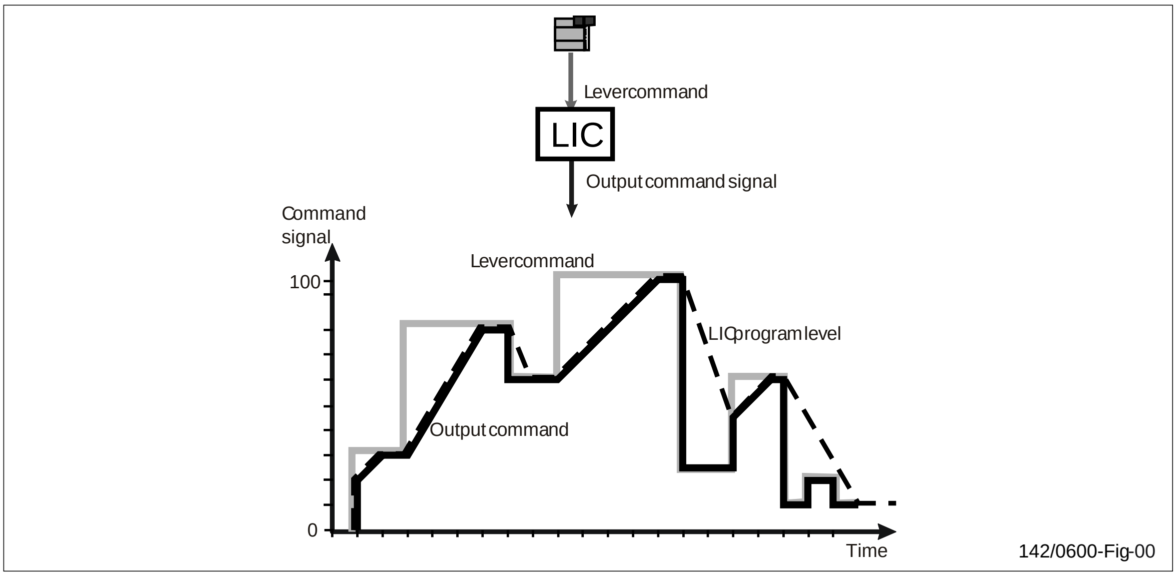


Figure 9 An example of a load increase control process.

As an option (turned on and off by a software parameter) the LIC program may include a cooling down program for delaying the command signal when the lever command is reduced.

Pitch and RPM Indication

The pitch indicators are updated from the potentiometers at the pitch feedback box, and the RPM indicators from the shaft RPM indication pick-up. The indicator signals are taken directly from separate indication units situated in the HPP cabinet via dedicated indication cables. As the indication system also has separate power supply, the indicators will show correct values even if a control system failure has occurred.

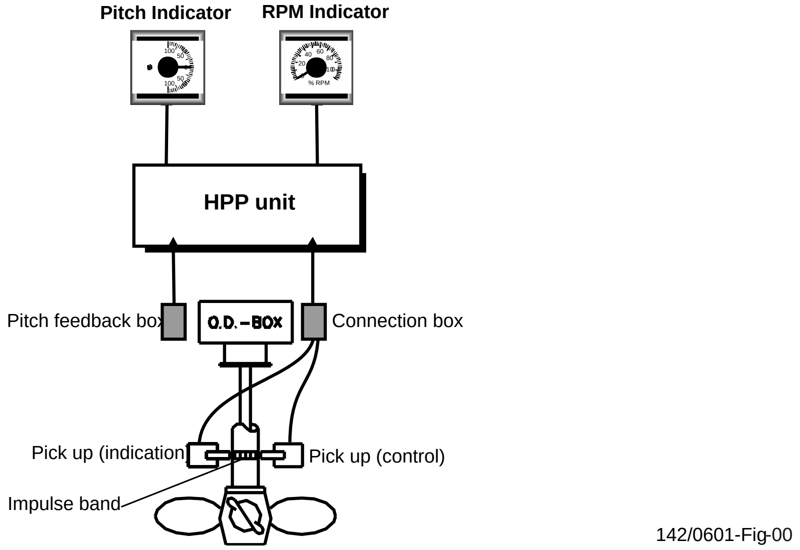


Figure 10 Indication System.

Error Detection and Alarm Activation

The main propeller control system supervises continuously the pitch control function and the signals from the transmitters and the control levers. A control failure alarm is activated at a failure in the pitch control function, a control lever in command, or pitch feedback signal.

A warning is activated at a failure in one of the doubled CAN buses and in non-active equipment.

Load Sharing (optional)

The load sharing function, which is applicable for two-engine installations, balances the engine loads (fuel rack positions) of two engines on the same shaft in accordance with a desired load relation. The engine load levels are balanced by an RPM correction signal sent to the engine RPM governors. The operator sets the load sharing relation with a balance knob.

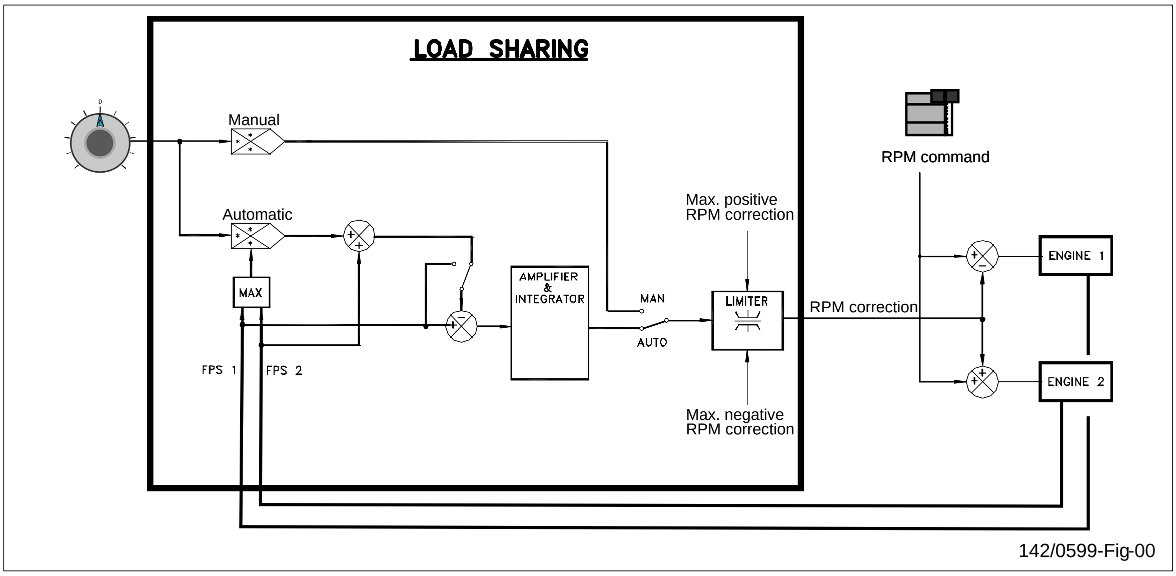


Figure 11 Load sharing.

Load sharing can be used in automatic or manual mode. In automatic mode the balance knob signal is taken as a set value for the FPS difference between the two engines. The load sharing function reads the FPS feedback values, compares them and sends an RPM correction signal as needed. In manual mode the balance knob signal is taken as RPM correction signal.

Clutch Control (optional)

The clutch control function supervises the conditions of the engines, clutches, and propellers, and determines whether to allow a clutch engagement or not. The following conditions must be fulfilled for an engagement:

- engine is running at an RPM ready for clutch in;
- the propeller pitch is zero (first engine only);
- the clutch is disengaged and a time delay has elapsed since previous clutch in/out operation;
- low supply oil pressure to clutch has not been detected;
- low supply air pressure has not been detected;
- emergency clutch out is not active;
- sequence failure alarm is not active;
- shaft brake is not engaged;
- request for simultaneous clutch in of both engines has not been done.

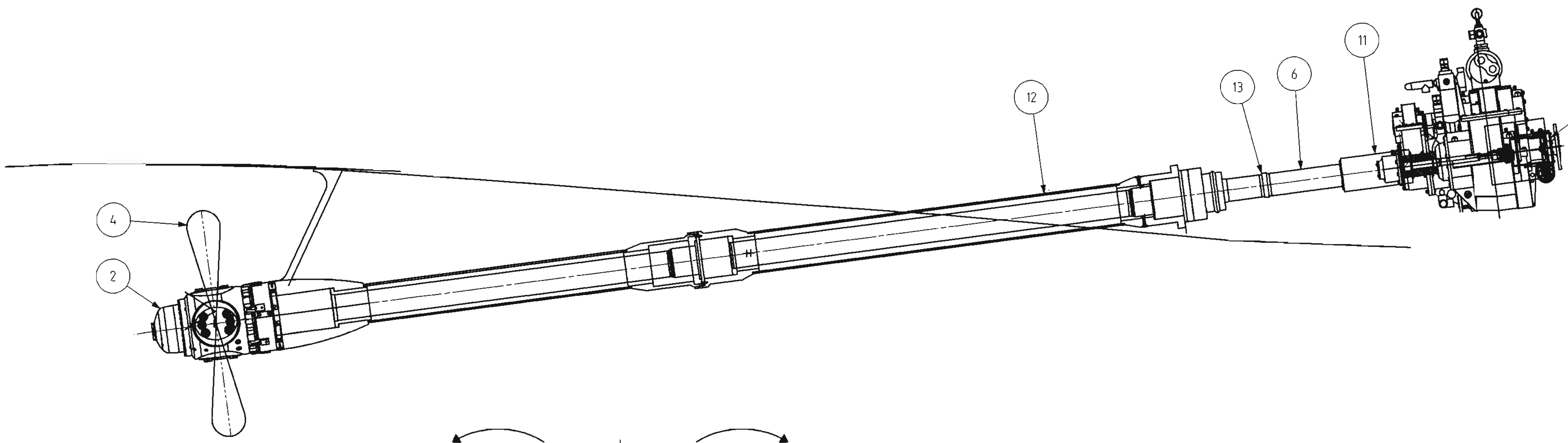
Clutch engagement is not possible when the engine is in LOCAL state.

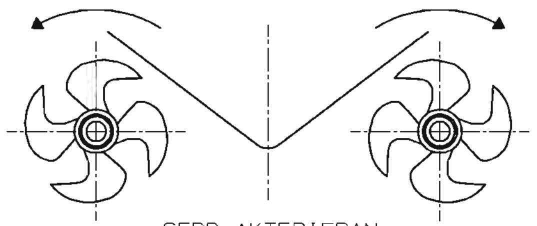
Produced by: SS Approved by: Nna
Creation date: 2005-05-31

Revision: Sign:
Revision date:

Delivery Specification

PORT SIDE SHOWN





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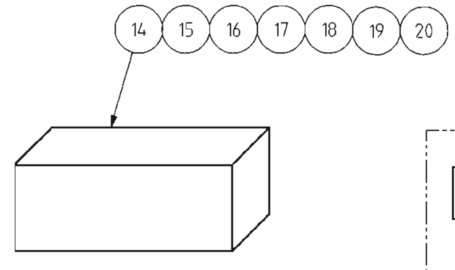

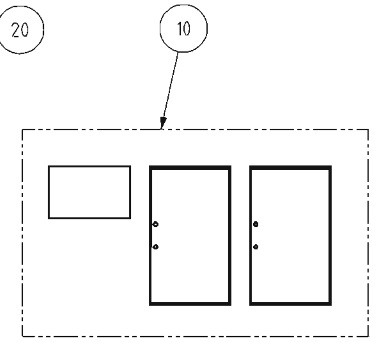

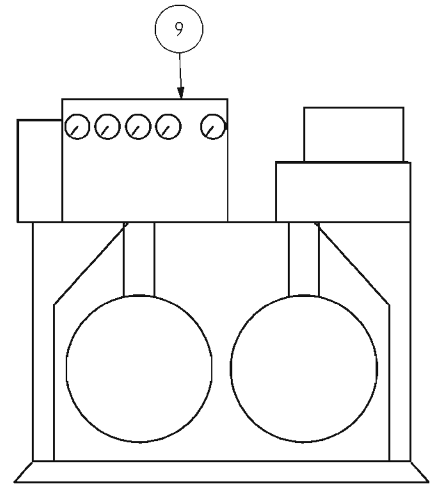

MÄRKNING AV DETALJER

DETAILS TO BE MARKED

		BABORD PORT	STYRBORD STARBOARD
		VÄNSTER-ROTERANDE LEFT HAND TURNING	HÖGER-ROTERANDE RIGHT HAND TURNING
ORDER NO.	NYB. NR. YARD NO.	RR MÄRKNING RR MARKING	RR MÄRKNING RR MARKING
10S000239	K-200-1	16514	16515
10S000240	K-200-2	16516	16517
10S000241	K-200-3	16518	16519
10S000242	K-200-4	16520	16521
10S000243	K-200-5	16522	16523
10S000244	K-200-6	16524	16525
10S000245	K-200-7	16526	16527
10S000246	K-200-8	16528	16529
10S000247	K-200-9	16530	16531

	Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark
HYDRAULIC SYSTEM	9	1	HYDRAULIKSYSTEM	RRM200007036	---	---
O.D.-BOX ASSY LEFT	7	1	T.O.-BOX SMST VÄNSTER	RRM200009766	---	Note 1
PROPELLER SHAFT ASSY.	6	1	PROPELLERAXEL SMST	RRM200005966	---	Note 1
PROPELLER BLADE	4	4	PROPELLERBLAD, VÄNSTER	RRM200005946	---	---
PROPELLER HUB	2	1	PROPELLERNAV, VÄNSTER	RRM200009345	---	---

Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark
9	1	HYDRAULIKSYSTEM	RRM200007036	---	---
8	1	T.O.-BOX SMST HÖGER	RRM200005985	---	Note 1
6	1	PROPELLERAXEL SMST	RRM200005966	---	Note 1
5	4	PROPELLERBLAD, HÖGER	RRM200005943	---	---
3	1	PROPELLERNAV, HÖGER	RRM200009225	---	---

Note 1: Shaft and O.D.-BOX assemblies includes the twin tube

DESCRIPTION	ITEM NO.	NO. OF	SWEDISH DESCRIPTION	REFERENCE
TOOLS EMERGENCY CONTROL	20	1	VERKTYG NÖDMANÖVER	940832A
TOOLS SHAFTING	19	1	VERKTYG AXELLEDNING	104500A
TOOLS HUB	18	1	VERKTYG NAV	---
SPARE PARTS STARTERS	17	1	RESERVDELAR STARTERS	RRM200007041
SPARE PARTS HYDRAULIC	16	1	RESERVDELAR HYDRAULIK	RRM200007040
SPARE PARTS O.D.-BOX	15	1	RESERVDELAR T.O.-BOX	214017A
INSTALLATION SPARE KIT HUB	14	1	INSTALLATIONSSATS NAV	---
EARTHING DEVICE	13	2	JORDNINGSUTRUSTNING	RRM200005977
STERNTUBE ASSY	12	2	AXELHYLSA SMST	RRM200006467
SHAFT COUPLING	11	2	KOPPLING	RRM200005975
CONTROL SYSTEM ASSY	10	1	MANÖVERSYSTEM SMST	RRM200005995
SHAFTING ARRANGEMENT	1	1	AXELARRANGEMANG	DMN200000864

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	-

Drawing, Assembly
55A/4D -35FA
Main assy & Mark drawing

Rolls-Royce

Rolls-Royce AB
S-681 29 KRISTINEHAMN

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Drawing no: DMN200001313 Revision: A

Access List:

RR AB's Info class

Produced by: KK295 Approved by: anl
Creation date: 6 september 2010
Revision: Sign:
Revision date:

Technical Data

General

Building yard:	Halifax Shipyard
New building number:	6094-6099, 6101-6103
RRAB manufacturing number (Port):	16514, 16516, 16518, 16520, 16522, 16524, 16526, 16528, 16530
RRAB manufacturing number (Starboard):	16515, 16517, 16519, 16521, 16523, 16525, 16527, 16529, 16531
RRAB file number:	10s000239

Propeller

Hub size:	55A DBG
Propeller diameter:	1700 mm
Number of blades:	4
Material in hub:	NiAl Bronze
Material in blades:	NiAl Bronze

Shaft Coupling

Make:	OKCAX 160
Type:	SKF Couplings

Weights (approximation)

Propeller hub with blades:	932 kg
Propeller blade (each):	102 kg
Propeller shaft:	1770 kg

Hydraulic Oil

See the document Requirements for Lubricating Oil in either part Maintenance (User Manual) or part Installation (Installation Manual).

Oil volume in hub and shaft line:	Approx. 62 litres
Oil volume in hydraulic power pack tank:	Approx. 120 litres
Total oil volume for the system:	Approx. 182 litres

Hydraulic Pumps with Electric Motors

See drawing Hydraulic diagram in part Design Drawings.

Tightening Torques

For information of tightening torques see the applicable drawing in the Installation Manual part Design Drawings.

Safety Valves

The safety valve in the hydraulic system must be set on a pressure according to hydraulic diagram (can be inspected by reading the pressure gauge when the propeller pitch is in its mechanical end position).

Produced by: SS Approved by: Nna Revision: g Sign: Nna
Creation date: 31 May 2005 Revision date: 14 December 2010

Requirements for Lubricating Oil

Lubrication of Hub and Hydraulic System

The oil used in the CPP system must be of type mineral gear oil with EP additives (Extreme Pressure) single grade oil. The oil must fulfill the requirements stated in DIN 51517 part 3 for CLP lubricating oils.

Viscosity Grade

The viscosity grade must meet the requirements of ISO VG 68 (68 cSt at 40^{o}C). If other viscosity grade is to be used an approval from Rolls-Royce must be granted.

Degree of Cleanliness

We know from experience that gear oils are sensitive to contamination. That can deteriorate the filterability. It is therefore of utmost importance that the oil is clean at first filling of the system and therefore the following directions must be followed:

- New gear oil must not be mixed up with other oils, even in very small quantities.
- Equipment used to fill the oil must be clean.
- External piping of the hydraulic systems must be carefully cleaned before connection to the hydraulic system.
- New gear oil must be filtered before filling. Rolls-Royce AB recommends as a minimum requirement a cleanliness level of 18/16/13, according to ISO 4406:1999. This is an approximate equivalent of contamination classes NAS 1638 class 7 and SAE AS 4059 class 8. This cleanliness grade will normally be obtained when using a 6 to 8 micron filling filter.

Example of Oil Types

The lubricants in this chapter are typical products only and should not be construed as exclusive recommendations. Example of oils that fulfil Rolls-Royce’s requirements are as following:

- AGIP Blasia 68
- Amoco Permagear EP LUB 68
- BP Energol GR-XP 68
- Caltex Meropa 68
- Castrol Alpha SP 68
- Chevron NL Gear Compound EP 68
- Elf Epona Z 68

- Esso Spartan EP 68
- Fina Pontonic N 68
- Mobil Gear 626
- SERVO, Servomesh SP 68
- Shell Omala oil 68
- Statoil Loadway EP 68
- Statoil Loadway Marine 68
- Texaco Meropa 68

Lubrication of Sterntube

The lubricating oil used in the sterntube must be of type mineral gear oil with EP additives (Extreme Pressure) single grade oil.

The oil must fulfill the requirements stated in DIN 51517 part 3 for CLP lubricating oils. A special oil intended for sterntube systems can also be used. In that case the oil must be tested to make sure that it suits both the bearings and the sterntube sealings.

Viscosity Grade

The viscosity grade must meet the requirements of ISO VG 100 (100 cSt at 40^{o}C). If other viscosity grade is to be used an approval from Rolls-Royce must be granted.

Degree of Cleanliness

We know from experience that gear oils are sensitive to contamination. That can deteriorate the filterability. It is therefore of utmost importance that the oil is clean at first filling of the system and therefore the following directions must be followed:

- New gear oil must not be mixed up with other oils, even in very small quantities.
- Equipment used to fill the oil must be clean.
- External piping of the sterntube systems must be carefully cleaned.
- New gear oil must be filtered before filling. Rolls-Royce AB recommends as a minimum requirement a cleanliness level of 18/16/13, according to ISO 4406:1999. This is an approximate equivalent of contamination classes NAS 1638 class 7 and SAE AS 4059 class 8. This cleanliness grade will normally be obtained when using a 6 to 8 micron filling filter.

Example of Oil Types

The lubricants in this chapter are typical products only and should not be construed as exclusive recommendations.

Example of oils that fulfil Rolls-Royce's requirements are as following:

- AGIP Blasia 100
- BP Energol GR-XP 100
- Castrol Alpha SP 100

- Chevron NL Gear Compound EP 100
- Esso Spartan EP 100
- Mobil Gear 627
- Shell Omala 100
- Statoil Loadway Marine 100

Produced by: KK174 Approved by: Fnl Revision: Sign:
Creation date: 2008-01-04 Revision date:

Location of Manufacturing Number

Finding the Manufacturing Number

Propeller Blade

The manufacturing number is placed at the blade flange, above the classification number, see figure 1.

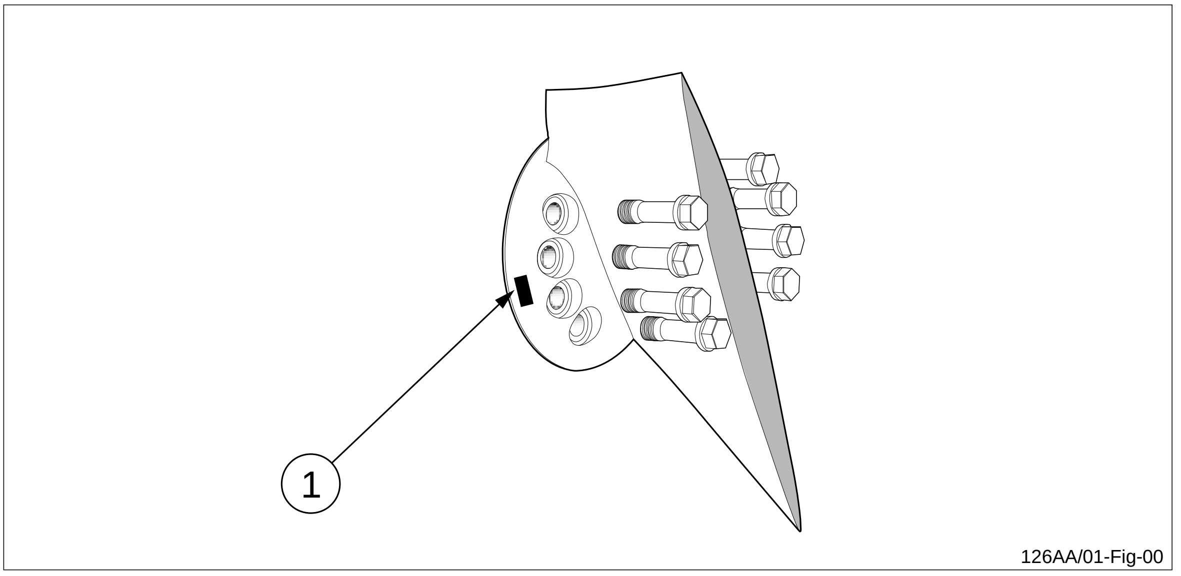

Figure 1 Propeller blade.

1. Manufacturing number

OD-box type F0

The manufacturing number is placed at the flange, see figure 2.

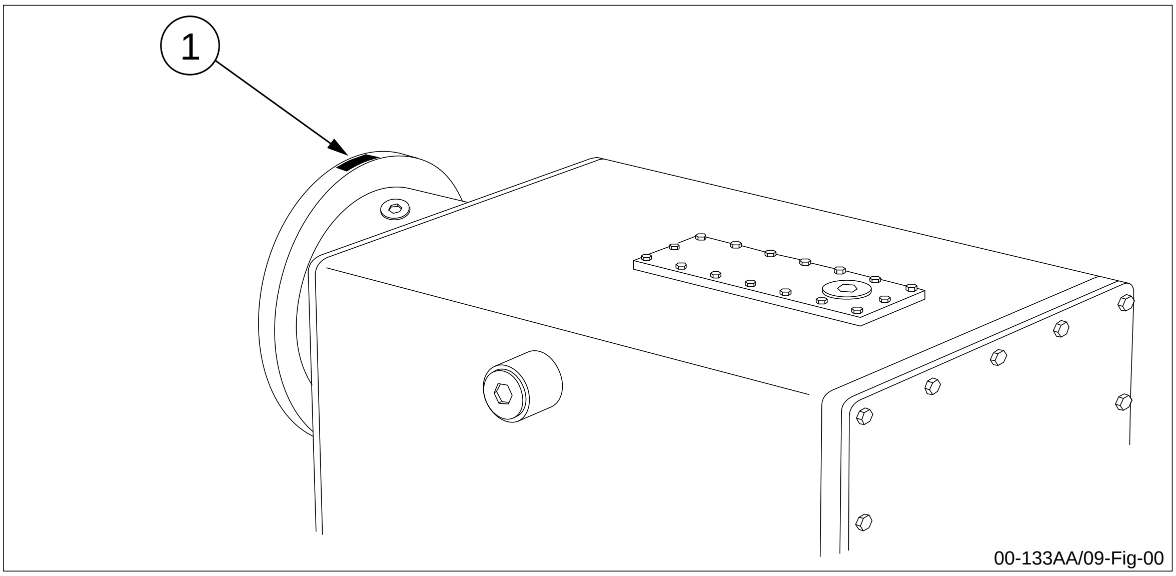

Figure 2 OD-box type FA.

1. Manufacturing number

OD-box Type M0

The manufacturing number is placed on the shaft flange, see figure 3.

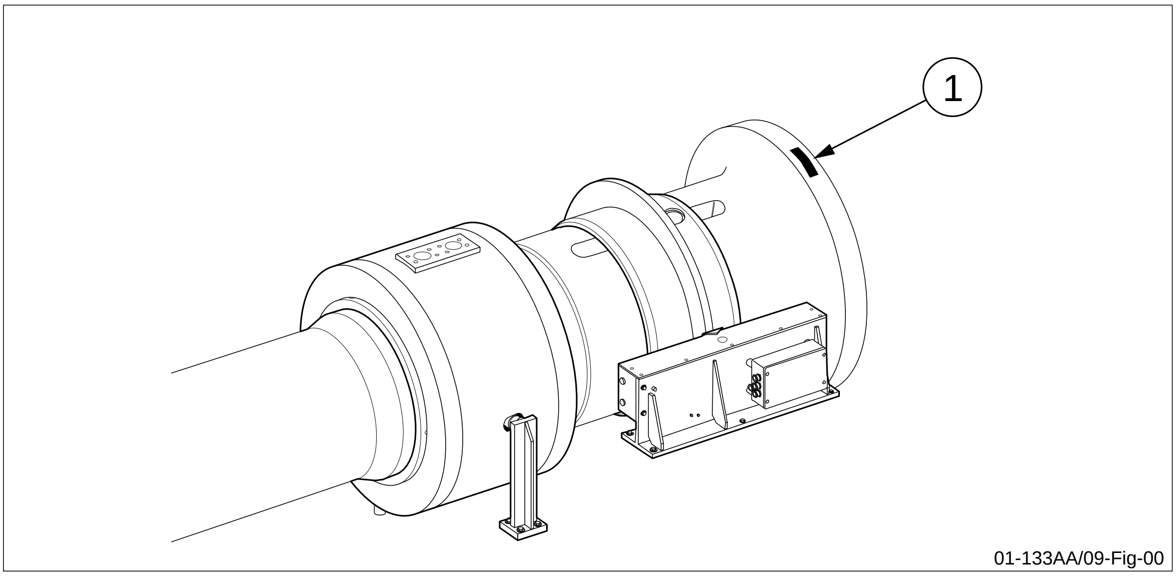

Figure 3 OD-box type M0.

1. Manufacturing number

Twin Tubes

The manufacturing number is placed at the stern end of each twin tube, at the female muff, see figure 4.

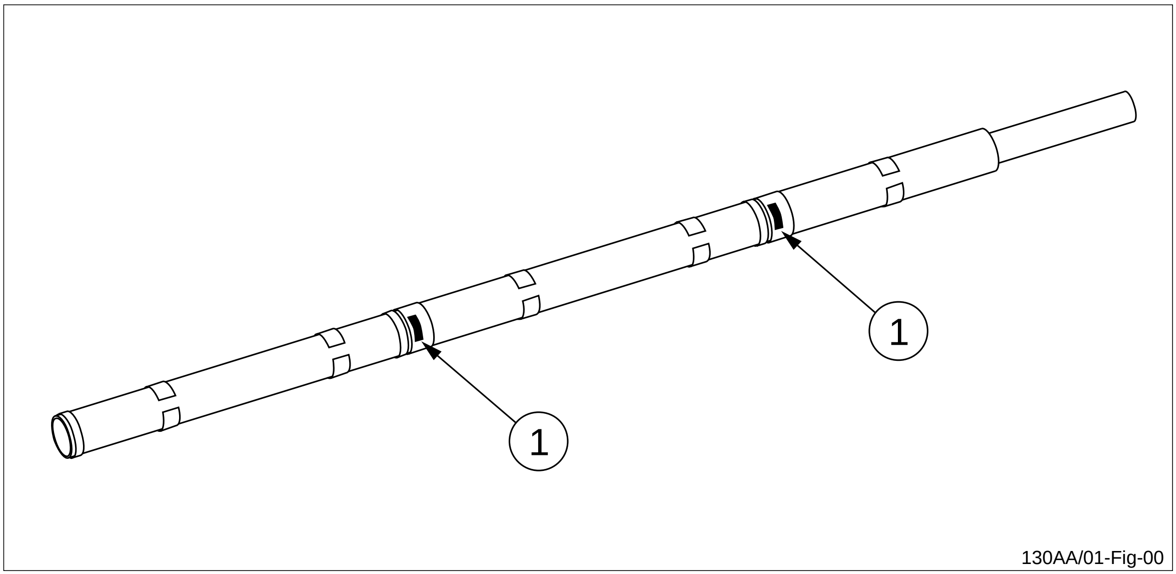

Figure 4 Twin tubes without flanges.

1. Manufacturing number

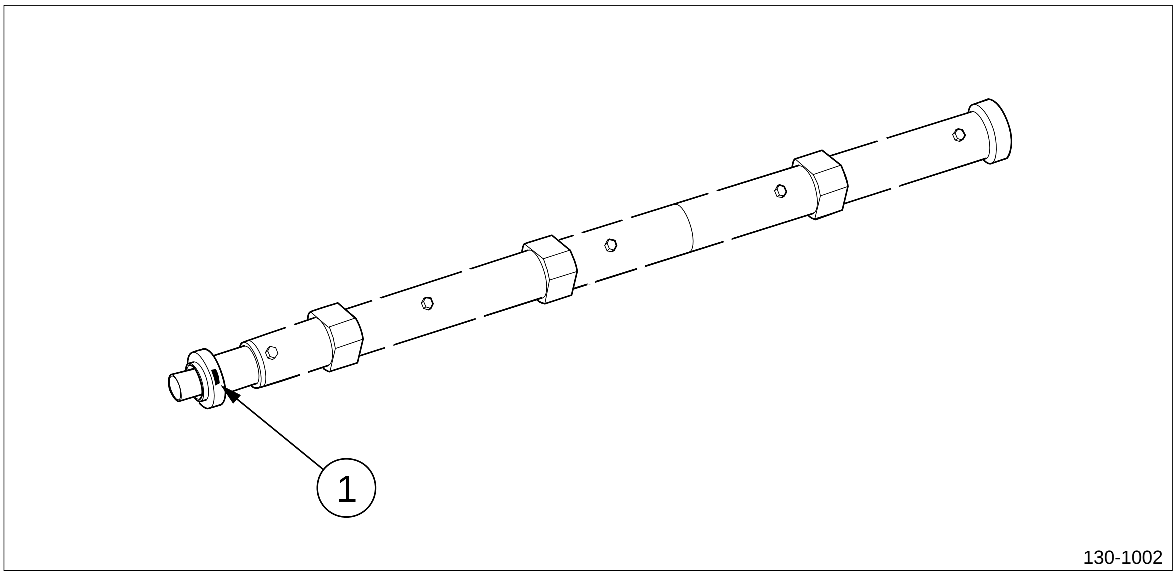

Figure 5 Twin tube with flanges.

1. Manufacturing number

Shaft

For shafts without a flange, the manufacturing number is placed at the end of the shaft, above the classification number, see figure 6.

For shafts with one or several flanges, the manufacturing number is placed on the flange above the classification number, see figure 7.

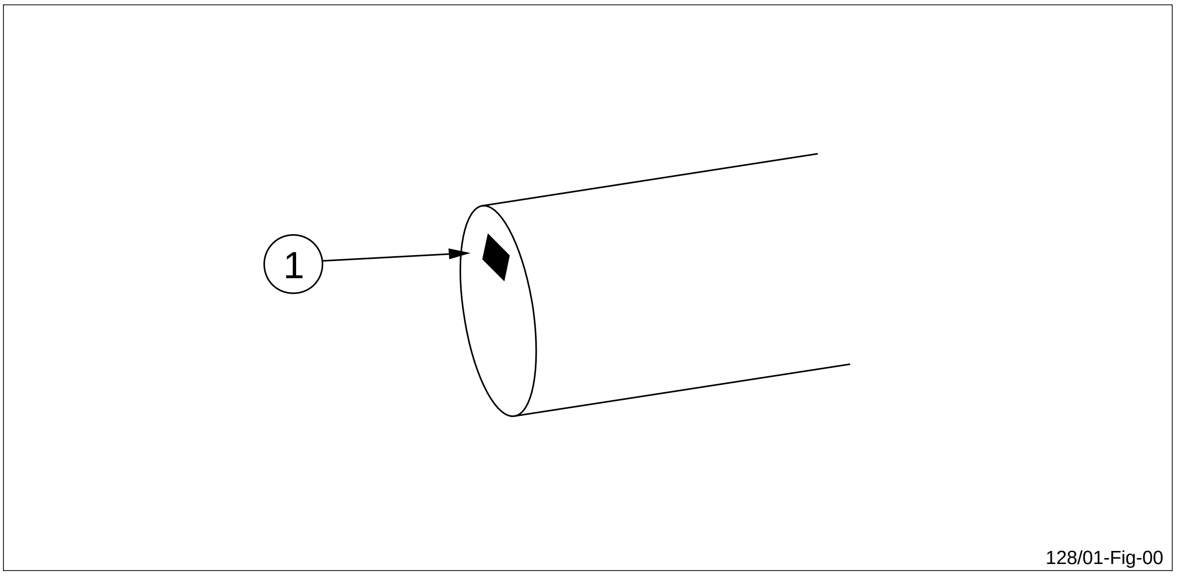

Figure 6 Shafts without a flange.

1. Manufacturing number

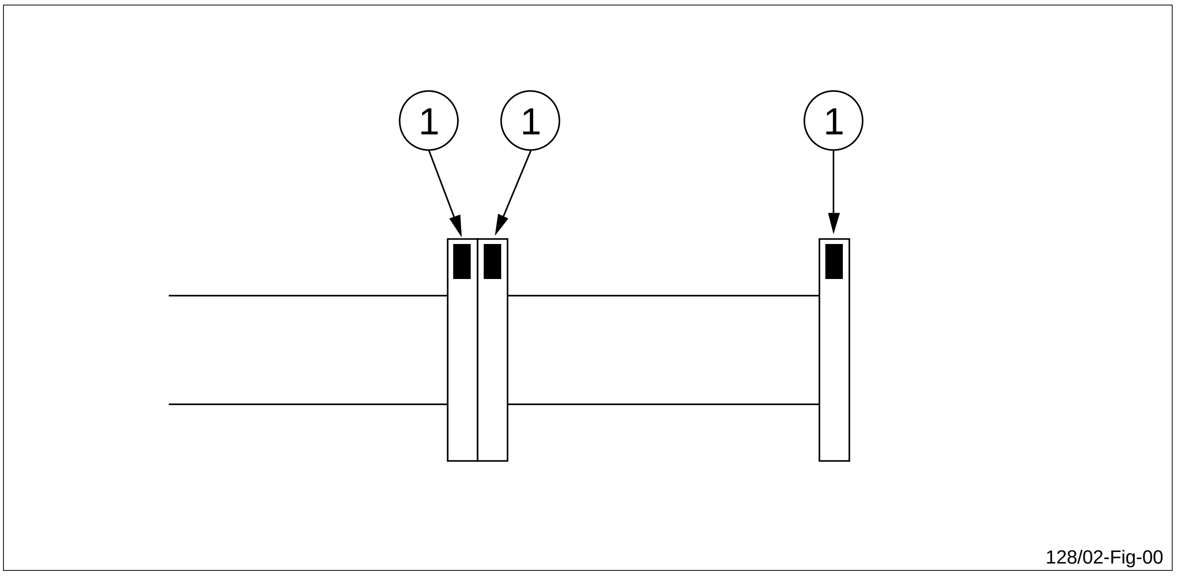

Figure 7 Shafts with one or several flanges.

1. Manufacturing number

Hub Body

The manufacturing number is placed in the forward end of the Hub Body face and next to the propeller shaft, together with the classification number, see figure 8.

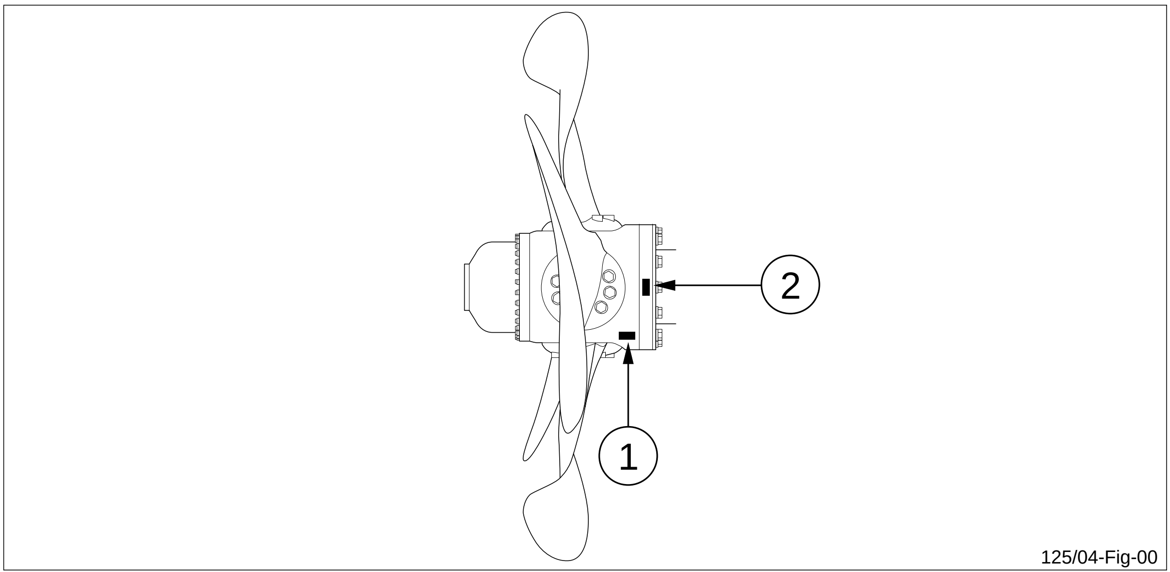

Figure 8 Hub body.

1. Manufacturing number and classification number at hub body
2. Manufacturing number and classification number at propeller shaft

Hydraulic System

The manufacturing number is placed on a sign on the front side of the hydraulic power pack tank, see figure 9.

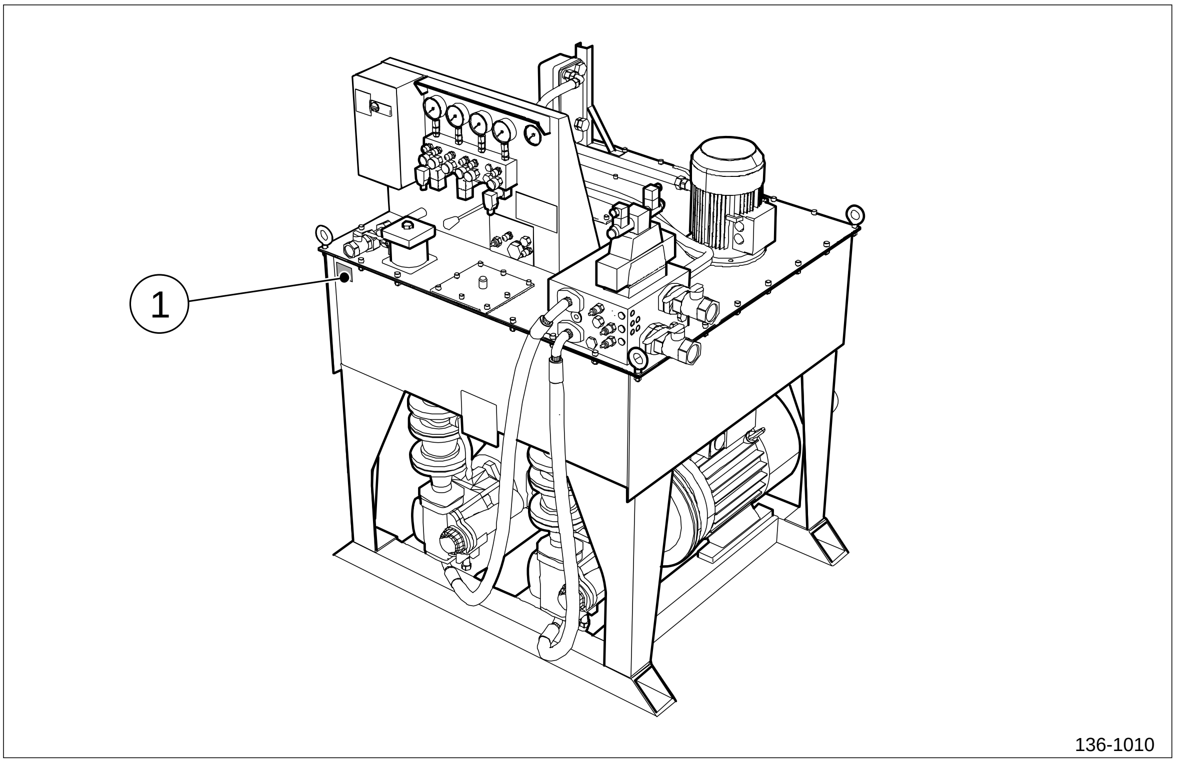

Figure 9 Hydraulic system.

1. Manufacturing number

Operating Instruction

Reading this Part

The part Operating Instructions is divided into instructions before departure, mechanical operating instructions, and control system operating instructions (optional feature).

The instructions in section Before Departure (System Start-up) must be performed each time the vessel departs from harbour.

Section Emergency Operating Instruction describes how to set the pitch if the hydraulic system and/or the OD-box is damaged.

If there are any questions about the operating instructions please consult Rolls-Royce Marine Global Support Network before proceeding.

Operating Instructions

Before Departure (System Start-Up)

The inspections described in this section must be performed prior to start-up and every departure.

Initial Inspections

Perform the preventive mainenance tasks at interval “Before Departure (System Startup)” and at interval “Daily Maintenance”, which are described in part Maintenance Instructions.

System Inspections

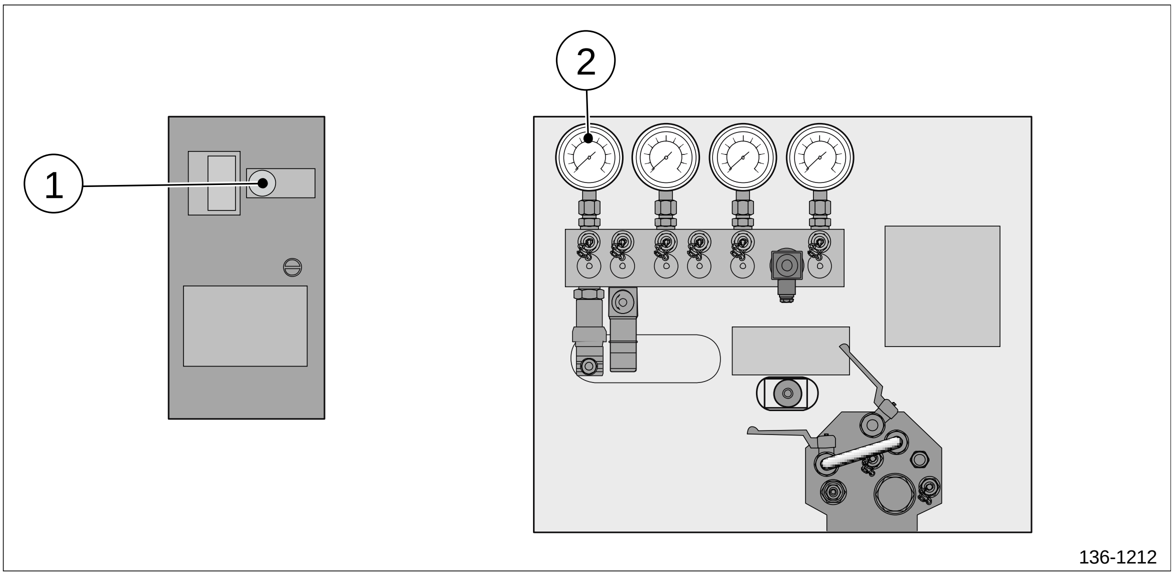

Figure 1 Control panel on the hydraulic power pack unit.

1. Local/remote switch
2. Gauge G1

Caution: The main pump unit must never be run at the same time as any of the stand-by pump units.

Caution: Make sure the propeller is set to zero pitch before engaging the clutch.

1. Make sure the local/remote switch on the hydraulic power pack is set to remote control (pos 1,figure 1).
2. If any, make sure the shaft brake/shaft locking device is disengaged.
3. Make sure the pump units are set to their correct position for start-up according to operating instructions from Rolls-Royce or other manufacturer.
4. Inspect the pressure gauge G1 (pos 2 figure 1) to make sure they indicate pressure.
   4.1. The pressure gauge indicate normal pressure if the main pump unit has started and is running properly.
5. Make sure the pressure maintaining pump unit P3 is running.
6. Make sure the pitch is set to zero before engaging the clutch.

This inspection is now completed.

Verification of Pitch Indication before Departure

Description

This task describes how to verify that the pitch indication reflects the setting of the lever in control before departure.

Instruction

Warning: The main engine must be shut-off or disengaged during this procedure.

Caution: Make sure that the hydraulic system is running before starting this task

A working hydraulic pressure must be available to enable the propeller pitch setting to follow the control lever setting, see section Start of the Hydraulic System before Departure. Inspect also the synchronization of all other levers.

Test the control lever in command

1. Shut-off or disengaged the main engine.
2. Bring the control lever to an optional position ahead or astern and wait until the propeller pitch has changed.
3. Make sure that the pitch is following the lever in command. Read the value on the pitch indicator.
4. Bring the lever into a few other ahead and astern positions and check the resulting pitch in the same way.
5. Inspect that the control levers at the other stations follow the lever in command.
6. The main engine may now be started or engaged.

The time required for changing the propeller pitch depends on the propeller size and the capacity of the hydraulics system.

First action in case of deviating results

1. Inspect the alarms. Make sure no alarms are active.
2. Make sure neither the back-up control system, nor the local control mode is active.
3. Inspect the hydraulic system.
4. Contact Rolls-Royce Marine Global Support Network (GSN) if the pitch values do not follow the control lever properly.

This task is now completed.

Produced by: LJ Approved by: Gnh
Creation date: 2011-05-09
Revision: Sign:
Revision date:

Inspections Prior to Departure

Start of Hydraulic System

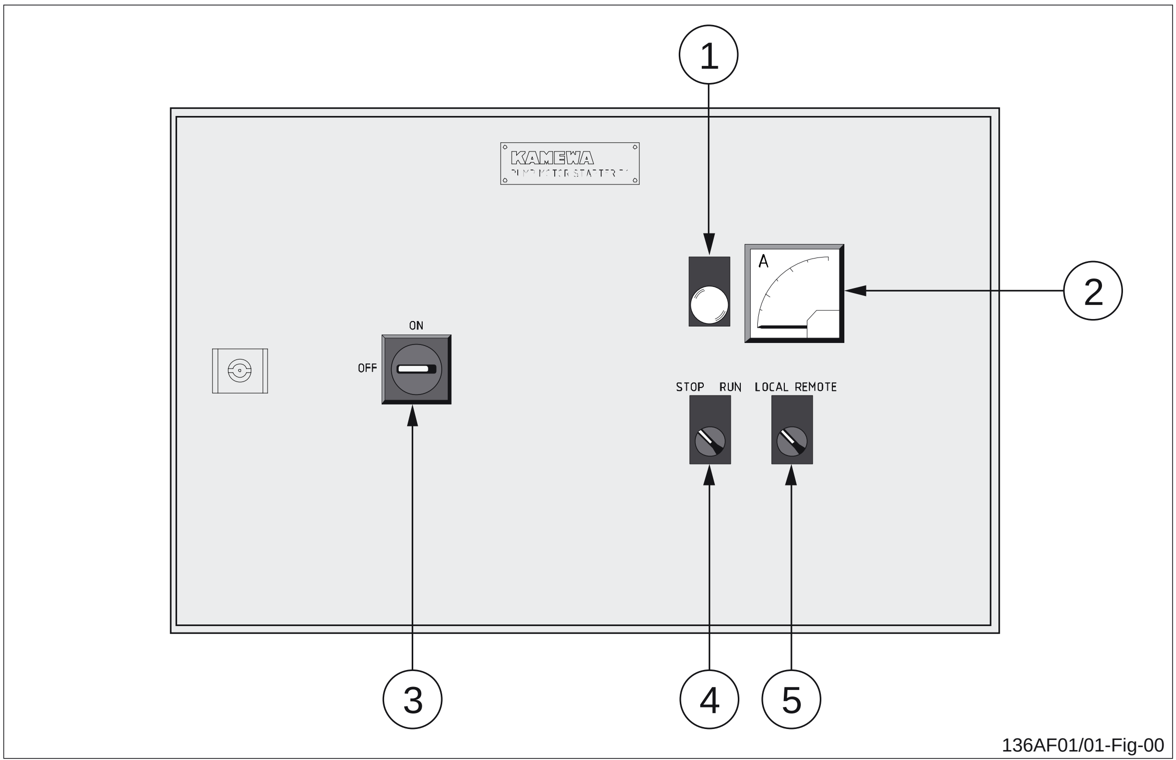

Figure 1 Front view of pump motor starter cabinet P1

1. Run indicator lamp, H1
2. Ampere meter, P1
3. Main switch, Q1
4. Stop/run switch, S1
5. Local/remote switch, S2

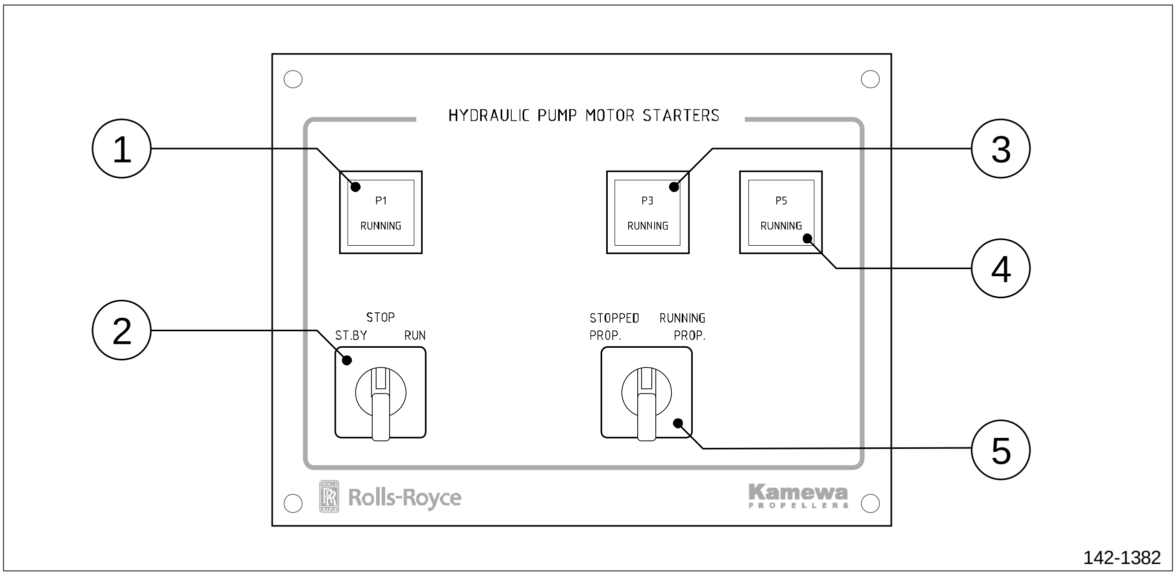

Figure 2 An example of a pump motor starter control panel.

1. Run indicating lamp, pump unit P1
2. Selector switch, pump unit P1
3. Run indicating lamp, pump unit P3 (optional)
4. Run indicating lamp, pump unit P5 (optional)
5. Selector switch, pump unit P3 (optional)

This instruction is valid for starting up a hydraulic system equipped with one electrically driven main pump unit.

1. Make sure that the local/remote switch S2 (see position 5, in figure 1) on pump motor starter cabinet, P1, is in REMOTE position.

2. Start pump unit P1 by turning the selector switch (see position 3 and 4, in figure 2) for the main pump unit to RUN position.

3. If the vessel is equipped with a gravity tank, turn the selector switch (see position 5, in figure 2) for pump unit P3 to RUNNING PROP. position.

Running One of the Twin Propellers

Settings to Minimize the Water Resistance

The one propeller in use is operated according to normal procedures.

Rolls-Royce recommends, as a first hand choice, that the propeller not in use is set according to chapter Windmilling. With this setting the propeller will create the least water resistance.

However, if the propeller cannot be windmilled the setting described in chapter Locked Shaft should be used. If the vessel is not equipped with a locking device the settings in chapter Zero Pitch can be used as a last alternative.

The Zero Pitch setting is not the recommend way to set the propeller while this creates the highest water resistance, but the setting does not damage the propulsion system in any way.

Windmilling

The following settings will give the lowest water resistance from the propeller that is not in operation.

• The hydraulic system must be in operation

• Set the pitch to full ahead

• Leave the shaft free running - windmilling

Do not set the pitch in astern position, this will give reversed shaft direction of rotation.

It is important to check that it is possible to windmill the propulsion system considering lubrication, the reduction gear etc.

Locked Shaft

If it is not possible to let the propeller windmill, use the following setting:

• The hydraulic system must be in operation.

• Set the pitch to full ahead

• Lock the shaft by means of a locking device or a shaft brake

Do not set the pitch in astern position, this will give reversed shaft direction of rotation.

Zero Pitch

If it is neither possible to let the propeller windmill nor to lock the shaft, use the following setting:

• The hydraulic system must be in operation.

• Set the pitch to zero pitch

Do not set the pitch in astern position, this will give reversed shaft direction of rotation.

Operating Instruction

Reversing the Propulsion System

If for any reason the direction of rotation is reversed, high stress can occur in the propeller blade tips. Rolls-Royce therefore recommends that such manoeuvrings only take place with maximum 70% shaft RPM (approximately 50% of the engine power).

Rolls-Royce also recommends that this restriction is noted on a sign that should be placed closed to the manoeuvring stands by the engine and on the bridge.

Operating Instruction Control System, Twin Propeller

Reading this Chapter

This chapter covers instructions on how to operate the control system of twin propellers with controllable pitch

The instructions on how to operate the control system is divided into two parts; “Operation from Bridge” and “Operation from the Engine Control Room (ECR)”. Most of the operations from bridge and in the engine control room are similar, but there are some differences. The sections “Safety Notes” and “Routine Inspections” concern both operation from the bridge and from the engine control room.

This chapter includes description of optional features, which may not be found in your application. The following optional features may be:

• Communication with joystick, speed pilot, and dynamic positioning (DP) systems

• Clutch control of the main engines

• Additional control modes

• Separate RPM control

• Fine adjustment of constant RPM

• Load sharing between engines on the same shaft

• Pitch and RPM indication on Panama indicators

• Information transfer to manoeuvre recorder Voyage data recorder (VDR)

• Auto and manual zero pitch control

If there are any problems following the instructions of any task, please consult Rolls-Royce Marine Global Support Network (GSN) before proceeding.

Before starting to use the control system, read the next safety notes!

Safety Notes

• Only trained personnel are allowed to operate the main propellers using the main propeller control system.

• Make yourself familiar with the emergency systems before starting to operate the propellers.

- Do not start and engage the main engines before the hydraulic systems are running.
- Do not stop the hydraulic systems as long as the main engines are running and engaged.
- Do not open the control system cabinet doors and do not touch the wiring during operation.
- Test the emergency clutch-out (if included) and the back-up system regularly.
- To achieve fast stop of the movement of the ship, do a crash stop as described on page 55.
- In case of an emergency situation where the control system is out of operation, use back-up control as described in the section see ”Using Back-up Control” on page 60.
- To get an immediate stop of the main propellers in case of emergency, use the “EMERGENCY CLUTCH OUT” buttons on the control panel of the station in command (provided that the application includes clutch control). These buttons activate a fast clutch out of the main propeller shafts. See Emergency clutch out.

Measures at Start and Stop

Task: Switching On and Off Control System

Description

This task describes how to switch on the control system when it has been switched off, and how to switch off the control system completely.

Normally the control system is always running and not switched off. It may however be switched off in certain situations, for example during docking or other maintenance work.

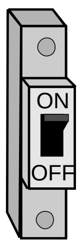

Figure 1 An automatic fuse.

After the system has been switched on, the manoeuvre responsibility for both propellers is initially in the engine control room. For more information on how to transfer the manoeuvre responsibility. See Transferring Manoeuvre Responsibility.

During the starting up process the control system activates control failure alarms. As long as the hydraulic system of a propeller has not been started, the propeller pitch cannot be controlled and the control system will activate a control failure alarm if the control lever in command is moved to a position that does not correspond to the actual pitch.

After a power interruption the system is switched on automatically. Alarms are emitted and the system takes default settings similar to a manual start.

Instruction

To Switch on the Control System when it has been Switched off

1. Switch on the automatic fuses on the bridge, ECR and HPP units.

To Switch off the Control System Completely

1. Switch off the automatic fuses in the mentioned cabinets.

To Reset Alarms

1. Press the "SYSTEM RECONNECT" buttons at the station in command.

Task: Starting and Stopping Hydraulics

The pitch control hydraulics start and stop by other control systems. The pitch control hydraulics must start before engaging the main engines.

Warning: Do not stop the pitch control hydraulics while the main engines are running and engaged.

Task: Tests before Sailing

This task describes how to test the synchronization of the levers.

Instruction

Test once a day after starting the hydraulics (but before starting the main engines, or before engaging them) that the propeller pitch settings obey the control levers in command. Check also the synchronization of the levers.

To Test the Synchronization of the Levers:

1. Bring the lever into an arbitrary position ahead or astern and wait a while until the propeller pitch has changed.
2. Watch the resulting pitch value on the pitch indicator and check with the combinator curve found in the propeller instruction book that the pitch follows the linear curve (corresponding to the curve in Figure 2-7). As no engine is engaged no load control and hence no pitch reduction takes place.
3. Check that the levers at the other stations follow the lever in command.

4. Bring the lever into a few other ahead and astern positions and check the resulting pitch in the same way.

The time required for changing the propeller pitch depends on the propeller size and the capacity of the hydraulics system.

Task: Starting and Stopping Propulsion

The main engines are started and stopped by other control system.

Warning: Do not start and engage the main engines until the pitch control hydraulics are running.

Operation from Bridge

Task: Transferring Manoeuvre Responsibility

Description

This task describes how to transfer manoeuvre responsibility between the bridge and the engine control room and between one bridge station to another.

Selector switches in the engine control room, one for each propeller, determine whether the manoeuvre responsibility is on the bridge or in the engine control room. The “BRIDGE” lamp is lit on the control panel when the manoeuvre responsibility is on the bridge. The “ECR” lamp is lit when the manoeuvre responsibility is in the engine control room.

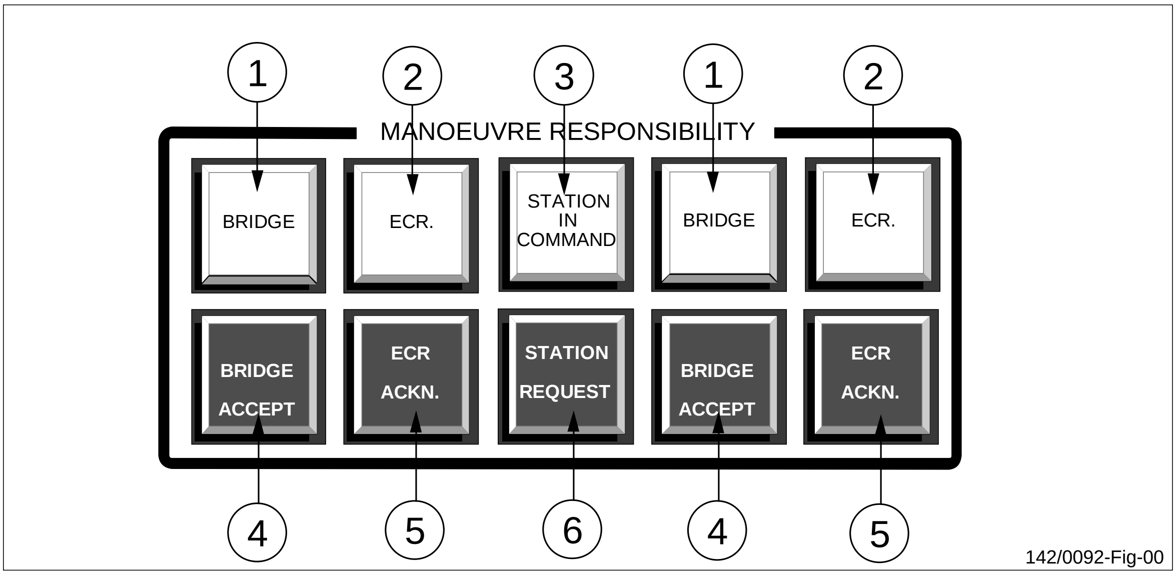

Figure 2 Manoeuvre responsibility buttons and indication lamps.

1. Indication lamp which is lit when the manoeuvre responsibility is on the bridge
2. Indication lamp which is lit when the manoeuvre responsibility is in the engine control room
3. Indication lamp which is lit when the station is in command
4. Button for accepting transfer of the manoeuvre responsibility from the engine control room to the bridge (possible only at the bridge station in command)
5. Button for acknowledging transfer of manoeuvre responsibility from the bridge to the ECR (possible only at the bridge station in command)
6. Button for taking the station into command

The “STATION IN COMMAND” lamp is lit at the bridge station in command. When the manoeuvre responsibility is on the bridge, this station alone has control over the thrust commands and most functions found on the control panels. The alarm indications however, and the emergency clutch out (if included) will always work at all stations, both on the bridge and in the engine control room.

One of the bridge stations is always in command, even though the manoeuvre responsibility is in the engine control room. In that case no control operations can be performed from the station, but the “STATION IN COMMAND” lamp is lit. The station may have command over other systems (for instance tunnel thrusters) that follow the same manoeuvre responsibility as the main propeller control system.

Manoeuvre responsibility transfer between the bridge and the engine control room can be done for each of the propeller individually. When the manoeuvre responsibility is on the bridge, both propellers are controlled from the same bridge station.

Instruction

To Transfer Manoeuvre Responsibility from ECR to Bridge

The transfer of manoeuvre responsibility from ECR (the engine control room) to the bridge must be initiated in the engine control room (for further details see ”To Transfer Manoeuvre Responsibility from ECR to Bridge” on page 45):

1. Turn the selector switch to “BRIDGE”.

The buzzer starts to sound and the “BRIDGE” lamp starts to flash. The manoeuvre responsibility remains in the engine control room and the “ECR” lamp is still lit.

To accomplish the transfer:

2. Press the “BRIDGE ACCEPT” button at the bridge station in command (the bridge station where the ”STATION IN COMMAND” lamp is lit).

If the bridge unit is OK the “ECR” lamp goes out and the “BRIDGE” lamp is lit.

If the bridge node is not OK the manoeuvre responsibility remains in the engine control room.

When the manoeuvre responsibility is transferred from the engine control room to the bridge, the active command mode chosen on the bridge (lever, joystick, or Dynamic Positioning (DP)) will resume control.

To Transfer Manoeuvre Responsibility from Bridge to ECR

1. Turn the switch to “ECR” position in the engine control room.

The manoeuvre responsibility is immediately transferred to the engine control room.

The “BRIDGE” lamp goes out, the buzzer starts to sound and the “ECR” lamp starts to flash.

2. Press “ECR ACKN” button to acknowledge the transfer and silence the buzzer.

To Transfer Manoeuvre Responsibility from one Bridge Station to another

1. Press the “STATION REQUEST” button at the new station.

The manoeuvre responsibility is transferred to the station in question, where the “STATION IN COMMAND” lamp is lit to indicate that the station is in command.

Task: Changing Command Mode

Description

This task describes how to request lever control and how to transfer from local to remote pitch.

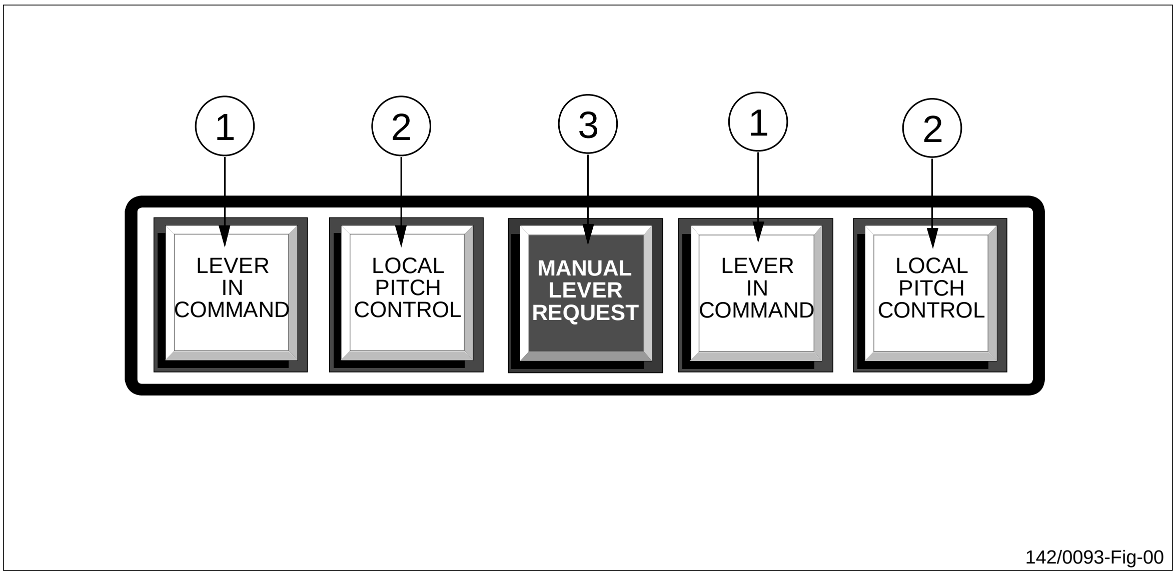

Figure 3 Command mode indication lamps and button.

1. Indication lamp lit at the station in command when the lever controls either the pitch or the RPM, or both
2. Lamp indicating that the pitch is controlled locally at the hydraulic power pack
3. Button for requesting lever control when the propeller is controlled by joystick or speed pilot (present only when the application includes joystick or speedpilot)

The “LEVER IN COMMAND” lamp (figure 30) is lit at the station in command when the lever has command over either the pitch control or RPM (revolutions per minute) control, or both. The light is out if neither the pitch nor the RPM is controllable with the lever. The lever has no effect on the thrust control and the light of the “LEVER IN COMMAND” is out in the following cases:

• The propeller is controlled from another source (for instance, DP, joystick, speed pilot).

• Local pitch control is used (the “LOCAL PITCH CONTROL” lamp is lit) while constant RPM mode is active.

• Local pitch control and separate RPM control are used.

• Back up control is switched on.

Taking Control with Other Systems

If the application contains joystick, speed pilot, or Dynamic Positioning (DP) systems, any of these systems can take command with functions found on the control panels of the respective system.

The DP system has priority over all other systems and can take command any time.

A command transfer to speed pilot requires that the manoeuvre responsibility is on the bridge and that the lever in command is positioned above a treshold value (1.5 ahead by default). A speed pilot request when joystick is in command will have the same effect as a manual lever request.

Instruction

To Request Lever Control

If the propeller is controlled by another system (joystick, speed pilot, or DP system) the “LEVER IN COMMAND” lamp is off, and neither the pitch nor the RPM is controllable with the lever.

1. If joystick or speed pilot is in command, press “MANUAL LEVER REQUEST” button to take command with the lever (figure 48).

The command is also automatically transferred from speed pilot to lever control if the lever is brought below the treshold value (1.5 ahead by default), or if the station in command is changed.

It is not possible to make manual lever request if the propeller is controlled by DP. A return to manual lever control must be done at the DP system.

To Transfer Control from Local to Remote Pitch

When the lamp “LOCAL PITCH CONTROL” is lit the LOCAL/REMOTE switch on the HPP control panel is in LOCAL position, and the pitch is controlled locally. The pitch cannot be controlled with the main propeller control system, not even the back-up control system. When local pitch control is used the control levers will not be synchronized with the actual propeller pitch.

To get a bump-free change over when returning from local control to lever control:

1. Set the pitch to zero locally.
2. Set the lever at the station in command in zero position.
3. Switch over from “LOCAL” to “REMOTE” control.

Task: Choosing Control Mode

Description

This task describes how to make a transfer between the two control modes “Combinator mode” and “Constant RPM mode”.

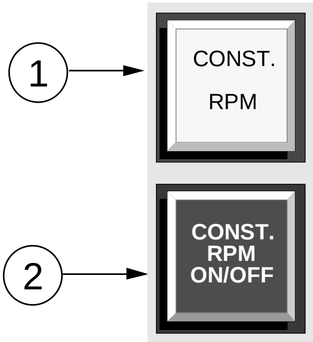

Figure 4 Button and indication lamp of the control mode.

1. Indication lamp showing that constant RPM is active
2. Button for switching constant RPM mode on and off

At least the following two control modes are available:

Combinator mode
In this mode the thrust control lever controls both pitch and RPM according to the combinator diagram, see flap System Guide.

Constant RPM mode
In constant RPM mode the engine is running at a constant preprogrammed RPM which is specific for the ship. The lever controls only the propeller pitch.

Instruction

Constant RPM mode is active when the “CONST.RPM” lamp is lit on the control panel. Otherwise the control mode is in combinator mode.

Note: If a shaft generator is connected constant RPM mode is blocked and cannot be switched off.

1. Push the button “CONST.RPM ON/OFF” to choose constant RPM. Push the button again to return to combinator mode.

Other possible control modes are indicated and chosen correspondingly.

Task: Engaging and Disengaging Clutches

This feature is optional, which means that it may not be found in your application.

Description

This task describes how to engage and disengage the clutches.

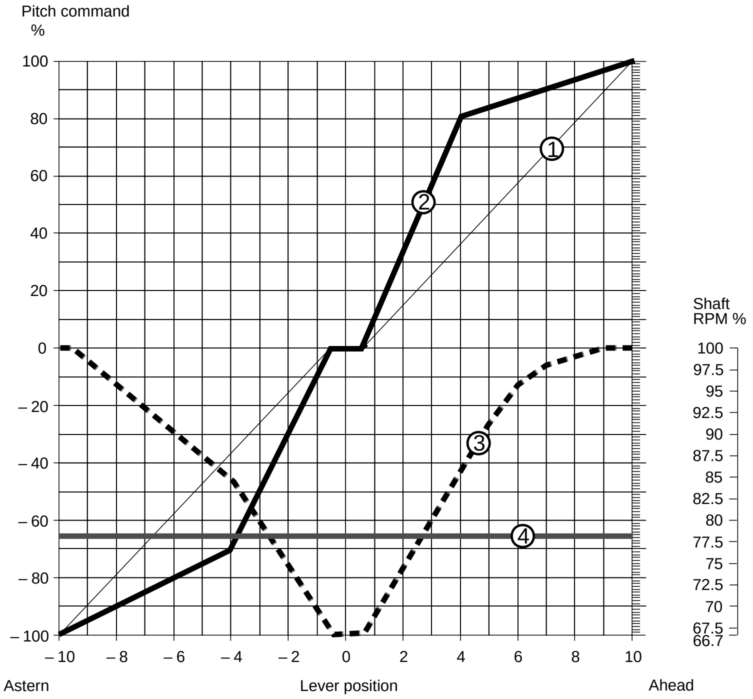

Figure 5 An example of a combinator diagram.

1. Pitch setting in constant RPM mode and when the engine is disengaged
2. Pitch setting in combinator mode
3. RPM setting in combinator mode
4. RPM setting in constant RPM mode

As long as no engine clutches are engaged on the shaft, no engine force is transferred to the propeller. Moving the control lever ahead and astern will increase and reduce the pitch according to linear pitch curve and the RPM according to chosen control mode (see figure 32).

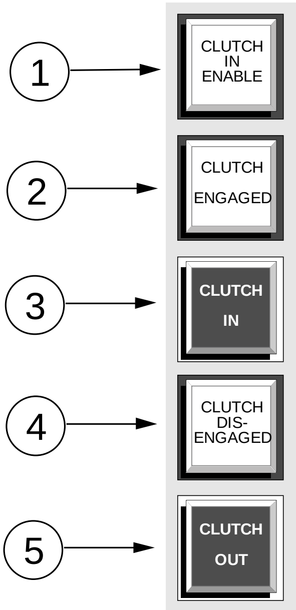

Figure 6 Buttons and lamps for engaging and disengaging a clutch.

1. Lamp indicating that the "clutch in" conditions are fulfilled and the clutch is ready to be engaged
2. Lamp indicating that the clutch is engaged
3. Button for engaging the clutch
4. Lamp indicating that the clutch is disengaged
5. Button for disengaging the clutch

Engaging a clutch requires that certain conditions are fulfilled, see flap System Guide. The lamp "CLUTCH IN ENABLED" indicates that all conditions for engaging the clutch are fulfilled.

If the lamp is not lit, ensure that:

• the engine is running at "clutch in" speed;

• that the shaft brake is not engaged;

• that "EMERGENCY CLUTCH OUT" has not been applied;

• that the control lever is in zero position (first engine).

After a clutch has been disengaged it cannot be engaged again until a time delay (default=three minutes) has elapsed.

If an emergency clutch out has been applied the clutches can be engaged again only after the emergency clutch out alarm has been reset.

Note: **If clutch control is included on the bridge, engagement, disengagement and emergency clutch out works in the same way as in the engine control room, except that emergency clutch out reset is possible only in the engine control room.**

Instruction

To Engage Clutches

It is not possible to engage two clutches simultaneously.

To engage the clutch of the first engine of the propeller shaft:

1. Set the control lever in zero position.
2. Press the “CLUTCH IN” button for the engine.

The “CLUTCH ENGAGED” lamp starts to flash. If the clutch engagement succeeded the “CLUTCH ENGAGED” lamp is lit with a steady light to indicate that the engine clutch is engaged, and the “CLUTCH DISENGAGED” lamp goes out.

To engage the clutch of the second engine on the propeller shaft:

1. Press the “CLUTCH IN” button for the engine.

In this case there is no demand for zero lever command. The second engine system is given a request for RPM synchronization with the first engine. After synchronization the engine is engaged.

If the buzzer sounds and the “SEQUENCE FAILURE ACKN.” lamp in the STATUS section of the control panel is lit the clutch engagement did not succeed.

To Disengage Clutches

To disengage the clutch of an engine when two engines are engaged:

1. Press the “CLUTCH OUT” button for the engine.

The system sends an unloading command to the engine control system and disengages the engine when it is unloaded

To disengage the clutch when only one engine is engaged:

1. Bring the control lever to zero position to unload the engine (not required but recommended).
2. Press the “CLUTCH OUT” button.

The CLUTCH DISENGAGED lamp starts to flash. If the disengagement has succeeded the CLUTCH DISENGAGED lamp is lit with a steady light, and the CLUTCH ENGAGED lamp goes out.

If the buzzer starts to sound and the “SEQUENCE FAILURE ACKN.” lamp is lit, the clutch out did not succeed.

Two engines on the same propeller shaft can be disengaged simultaneously.

Emergency clutch out

Warning: **Use emergency clutch out solely in emergency situations. Do not use it for regular clutch out as it will cause wear on the clutches.**

Note: **The engines cannot be engaged again until the emergency clutch out alarm has been reset. Resetting the emergency clutch out alarm can only be performed in the engine control room. See the section Emergency Clutch Out**

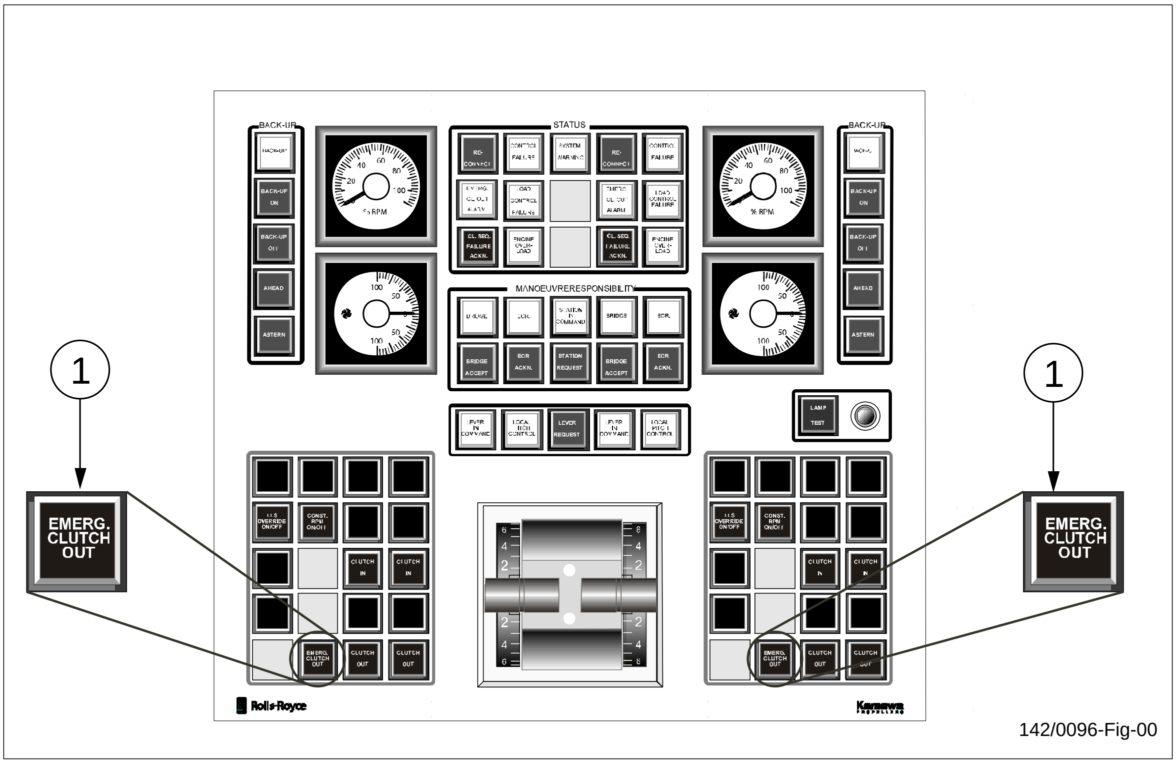

Figure 7 The emergency clutch out buttons (1).

The emergency clutch out buttons are protected by transparent covers which can be opened. The buttons are always enabled on all control panels.

In case of an emergency situation where an immediate stop of the main propellers is needed:

1. Press the “EMERGENCY CLUTCH OUT” buttons.

When emergency clutch out is applied the alarm buzzer starts to sound and the “EMERG. CLUTCH OUT ALARM” lamps start to flash.

Task: Manoeuvring with Control Levers

Description

This task describes how to move ahead or astern and to perform a crash stop using the thrust control lever.

Thrust Control Lever

Each control lever contains two levers for thrust control of the propellers. Bringing a lever ahead will give the propeller a thrust ahead, and bringing a lever astern will give the propeller a thrust astern.

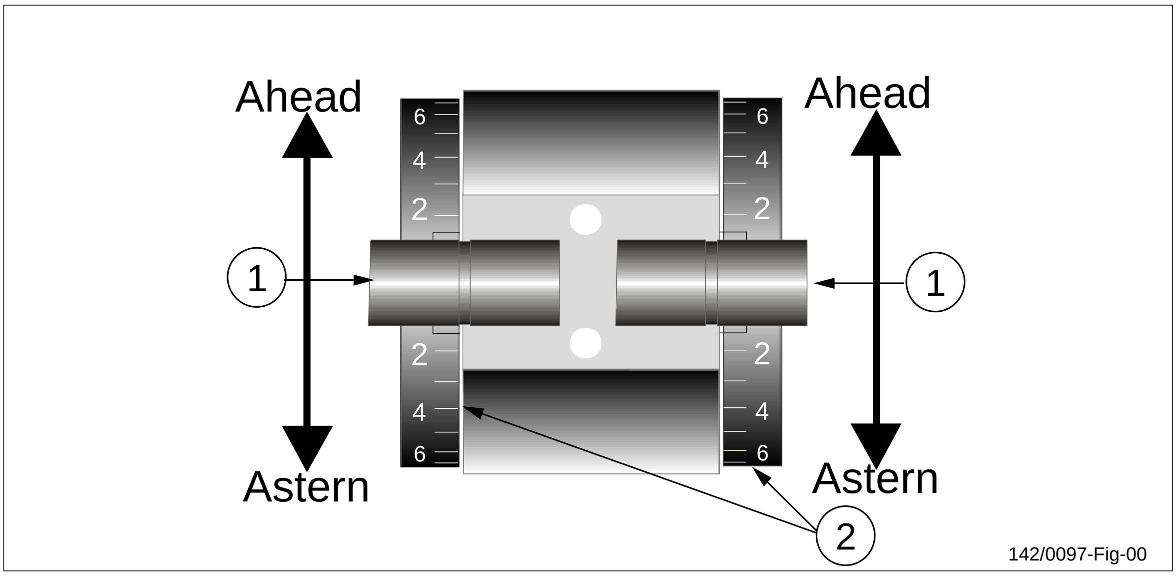

Figure 8 The thrust control lever on the port side.

1. Thrust control lever
2. Thrust indication pointer

The levers are indexed 0... 10 in both ahead and astern direction. At a certain lever position the resulting pitch and RPM follow the combinator diagram (See figure 32) in accordance with the chosen operating mode. In zero position the propeller pitch is always zero, and the RPM is idle (in combinator mode), or has a fixed value (in constant RPM mode).

The levers at stations that are not in command are continuously synchronized with the levers in command.

Instruction

Note: During acceleration the engine load control function will probably reduce the pitch due to dynamic high engine load conditions.

Note: **At a shutdown command from an engaged engine (the engines on the same shaft are given idle RPM) the thrust control lever is automatically brought to zero position.**

To Move Ahead and Astern

Order a thrust ahead by bringing the levers ahead, and a thrust astern by bringing the levers astern.

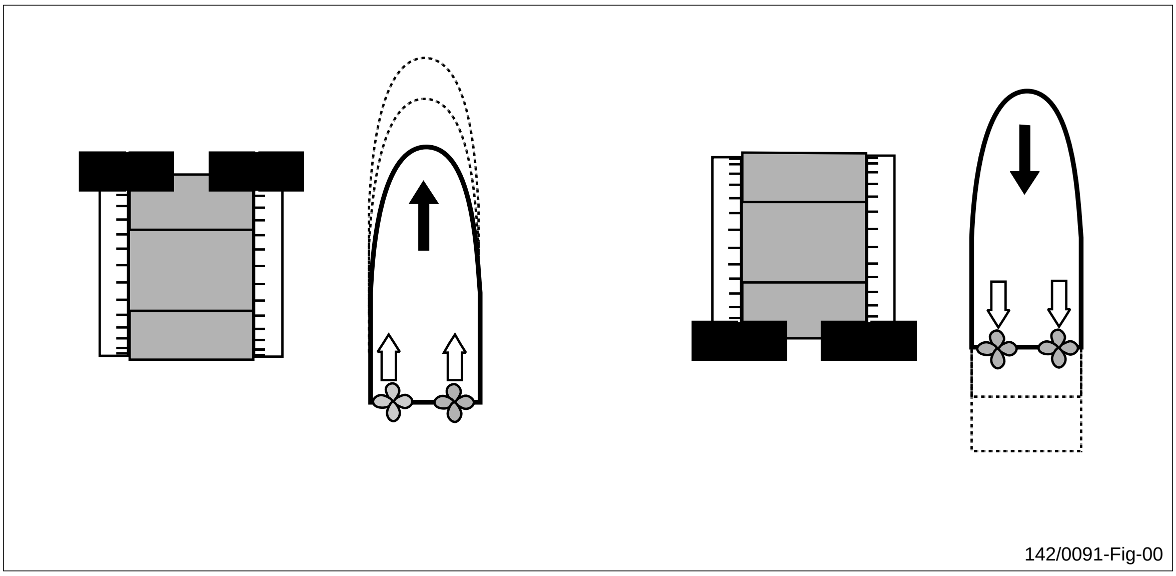

Figure 9 Moving ahead and astern.

Giving the starboard and port propellers different thrust will result in a turning effect on the ship.

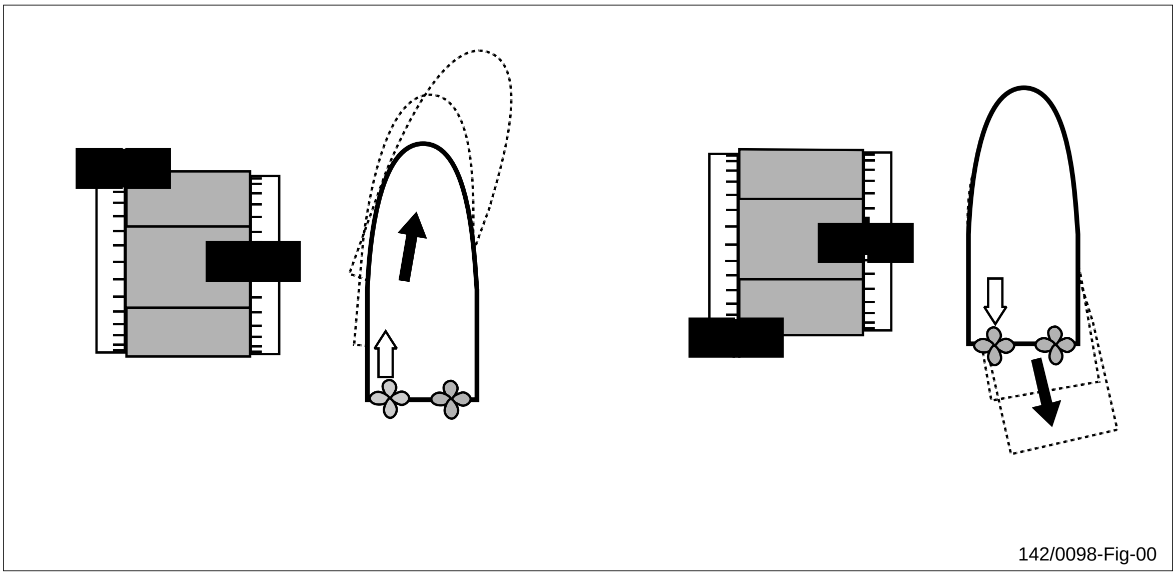

Figure 10 Giving the propellers different thrust.

The lever command may be delayed by the load increase control program (LIC), and the ordered pitch may be reduced by the engine load control function which depends on the load limit setting in the engine control room. The load limit and the load increase control program can be temporarily overridden. See Load Control Handling.

To Perform a Crash Stop

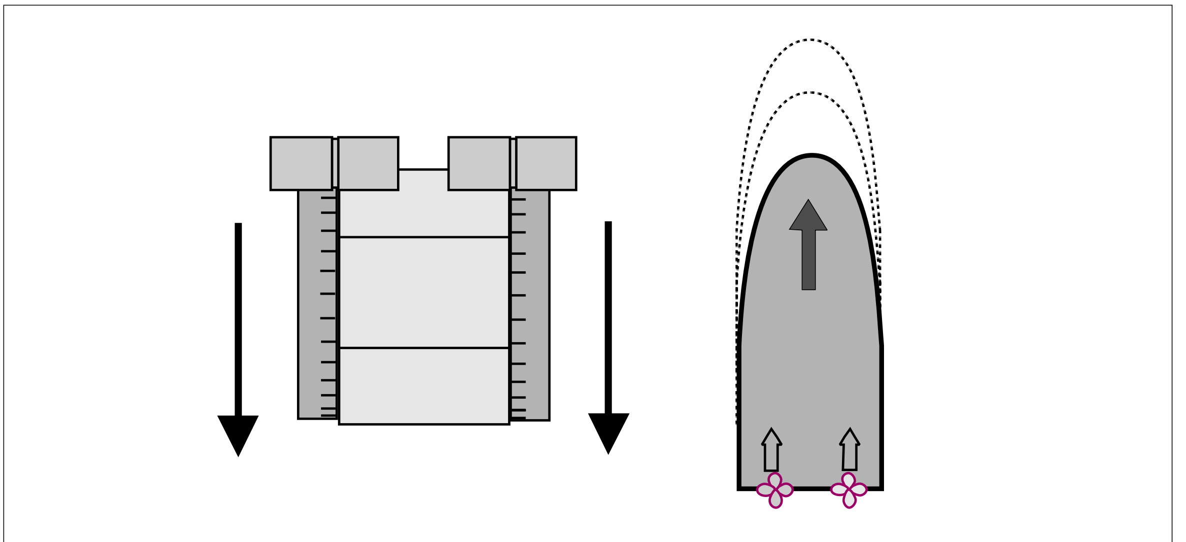

Figure 11 Performing a crash stop.

To stop the movement of the ship ahead or astern in an emergency situation:

1. Move the control levers of both main propellers in the opposite direction to the driving direction.

When the ship has almost stopped:

2. Bring the levers to zero position.

In combinator mode the RPM is automatically decreased to idle RPM when the system notices a crash stop, and is kept on this level as long as the propeller pitch is in the opposite direction (ahead or astern) to the lever. This feature has been implemented to reduce the distance required for stopping the ship.

Task: Load Control Handling

Description

This task describes how to override the load limit and Load Increase Control (LIC) functions, and how to handle overload situations.

The engine load control function depends on the load limit setting in the engine control room. See To Set Load Limit.

Load Increase Control (LIC)

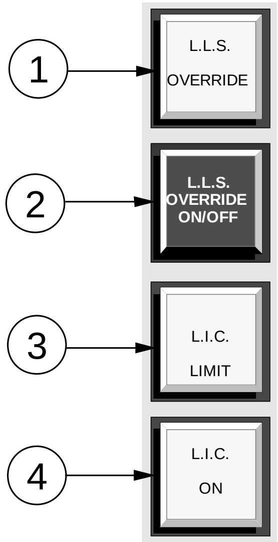

Figure 12 The lamps and buttons related to engine load control and load increase control.

1. Indication lamp showing that the load control program and the load limit setting are being overridden
2. Button for overriding the LIC program and the load limit setting
3. Lamp indicating that the LIC program is reducing the lever command
4. Lamp indicating that the LIC program is in use

When the load increase control program (LIC) is in use the control system delays the lever command signal by a pre-programmed ramp. See flap System Guide.

Load increase control is switched on and off in the engine control room. The lamp “L.I.C. ON” on the control panel indicates that load increase control is in use. The “L.I.C. LIMIT” lamp is lit (or optionally flashing, depending on a software parameter) when the LIC program is reducing the lever command signal.

Instruction

Caution: The possibility to override the load limit and the LIC function is intended for temporarily risen power requirements and should not be used in regular operation.

To Override Load Limit and LIC Function

In situations where all available engine resources are needed, the limitations caused by the L.L.S. (load limit setting) in the engine control room and the LIC program can be temporarily overridden. This means that a fixed load limit is applied (default 100%), and the LIC function is disregarded. The engine load control function remains active and may still reduce the pitch.

To override the load limit and the LIC function:

1. Press the “L.L.S. OVERRIDE ON/OFF” button (figure 38).

The “L.L.S. OVERRIDE” lamp is lit to indicate that the load limit setting and the LIC function are being overridden.

To stop overriding the limitations:

1. Press the “L.L.S. OVERRIDE ON/OFF” button so that the “L.L.S. OVERRIDE ON/OFF” lamp goes out.

To Handle Overload Situations

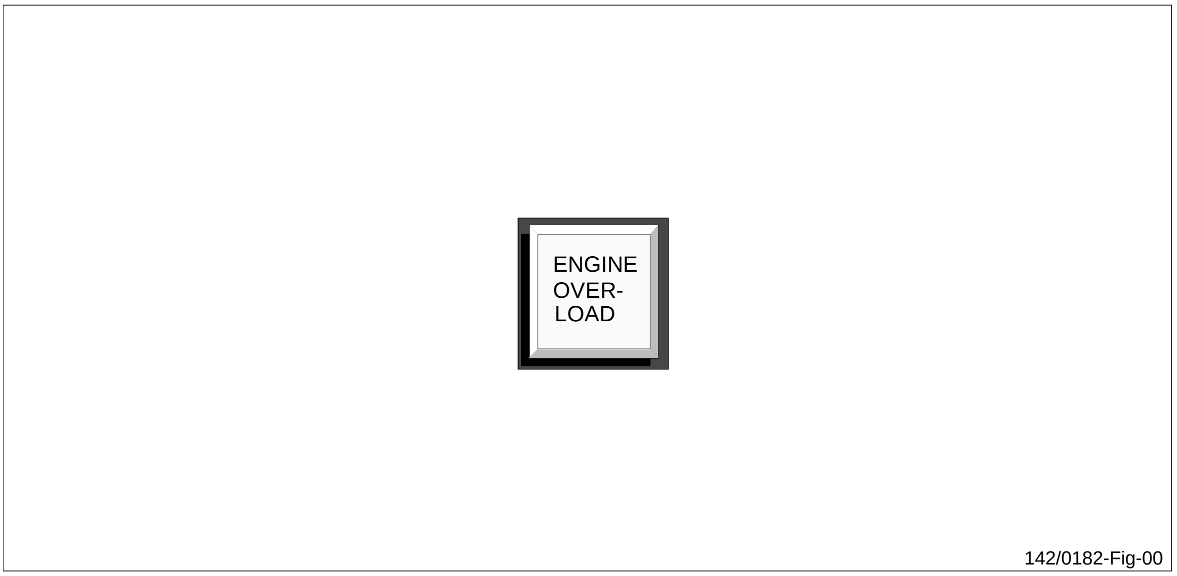

Figure 13 The engine overload indication lamp.

The “ENGINE OVERLOAD” indication lamp in the “STATUS” section of the control panel indicates when lit that the engine is being overloaded. Overload may occur in extreme situations, and when the load control function is disconnected (during back-up and local pitch control) or out of operation due to a failure.

1. Reduce the pitch immediately if the “ENGINE OVERLOAD” lamp is lit.

The “ENGINE OVERLOAD” lamp is directly connected to the fuel rack overload switches of the engines.

Supervising Indicators

Panama pitch indicator and Panama RPM indicator are optional features, which means that they may not be found in your application.

Description

This section describes the function of the pitch indicators and the RPM indicators.

Pitch Indicators

The pitch indicators indicate the actual propeller pitch.

The pitch indicators are continuously updated from dedicated propeller pitch transmitter via a separate indication system. Hence the pitch indicators will show correct values even in case of a control system failure.

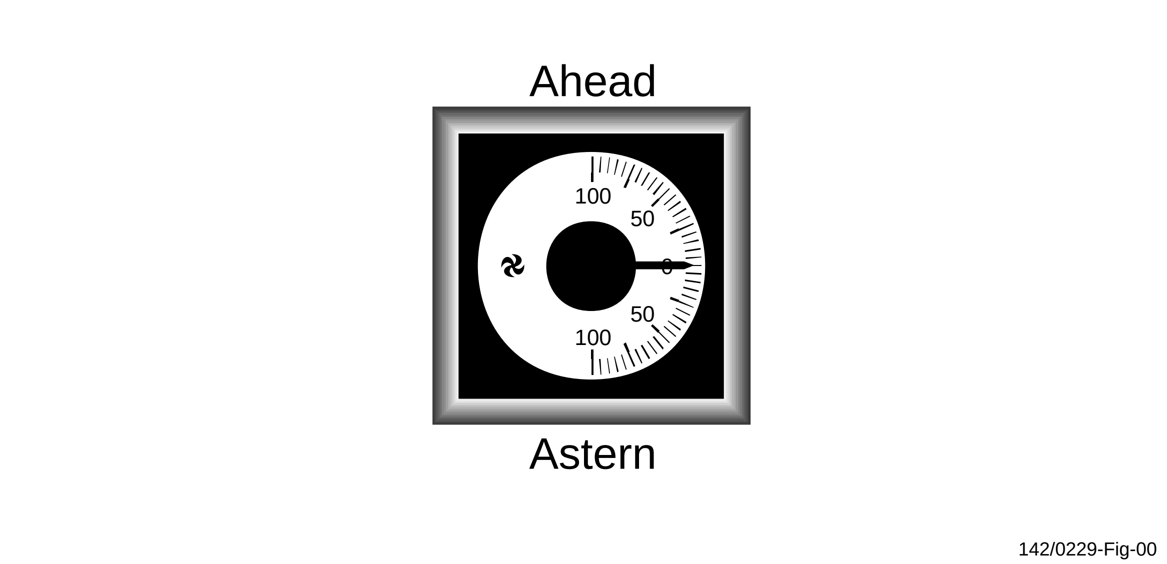

Figure 14 Pitch indicator on the control panel.

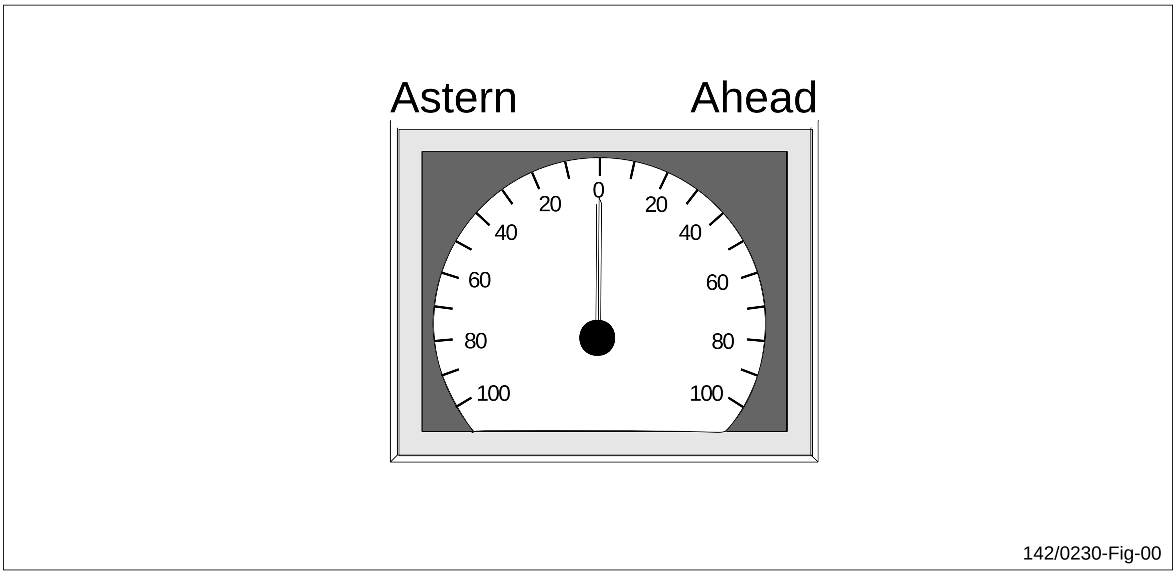

Figure 15 Panama pitch indicator (optional).

RPM Indicators

The RPM indicators show the actual RPM of the propeller shaft in percentage of maximum RPM.

The RPM indicators are continuously updated from a dedicated RPM indication transmitter via a separate indication system. Hence the RPM indicators will show correct values even in case of a control system failure.

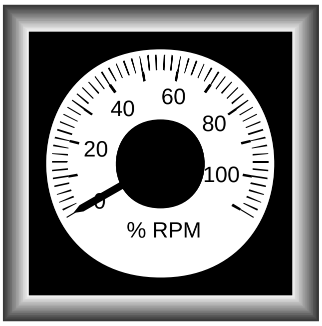

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Figure 16 RPM indicator on the control panel.

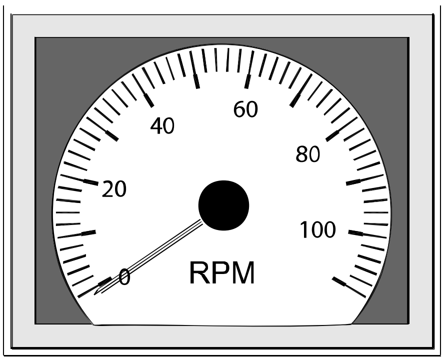

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Figure 17 Panama RPM indicator (optional).

Task: Using Back-up Control

Description

This task describes how to switch on and off the Back-up control, and how to control the pitch in a back-up mode.

Back-up control is an emergency system meant to be used when a malfunction has occurred in the main control system.

In back-up mode no automatic control functions are provided. The hydraulic pitch control valve is disconnected from the main system and connected directly to the back-up section of the control panel. The operator controls the pitch by activating the valve ahead/astern with push buttons.

When the manoeuvre responsibility is on the bridge back-up mode is accessible at all bridge stations. When the manoeuvre responsibility is in the ECR back-up is accessible only in the engine control room. It is not accessible if local pitch control is being used.

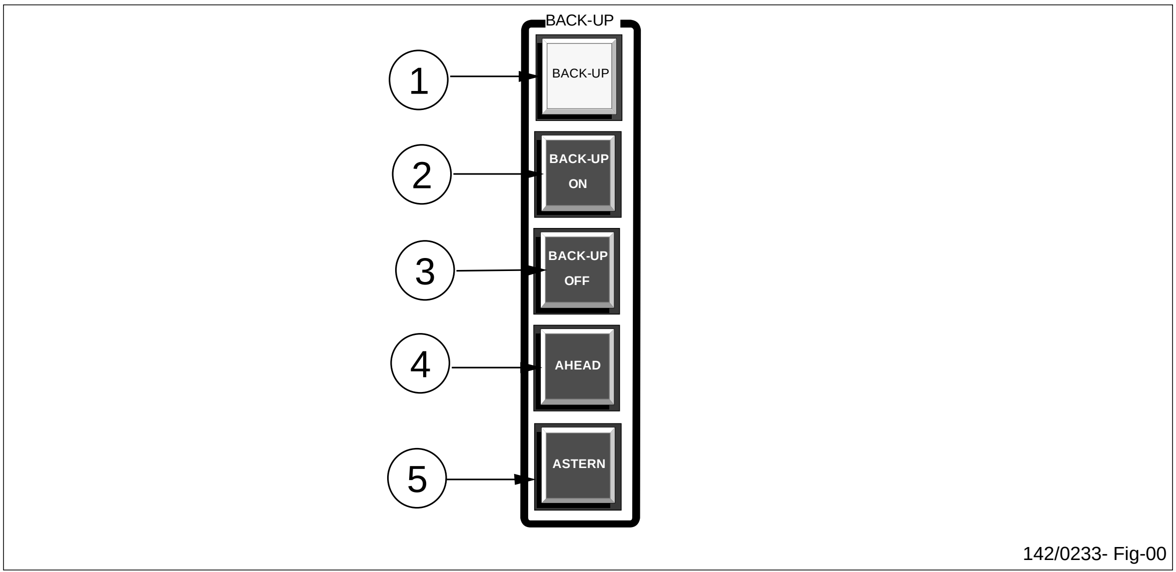


Figure 18 The back-up control section of the control panel.

1. Lamp for indicating that back-up control is switched on
2. Push button for switching on back-up control
3. Push button for switching off back-up control
4. Button for increasing the pitch ahead
5. Button for increasing the pitch astern

Instruction

Caution: In back-up mode no automatic load control will take place. Observe the “ENGINE OVERLOAD” lamp (See figure 39) on the control panel, and reduce the pitch immediately if the lamp is lit.

Note: When back-up is switched on the ordinary control system is automatically disconnected. Lever commands from the main system will have no effect. No automatic load control takes place.

To Switch Back-up Control On and Off

To activate the back up system:

1. Press the “BACK-UP ON” button.

The “BACK-UP” lamp is lit to indicate that back-up is in use.

To switch off back-up operation and return to the main control system:

1. Set the lever in command in a position roughly corresponding to the present propeller pitch.
2. Press the “BACK-UP OFF” button. The main control system will resume control.

To Control Pitch in Back-up Mode

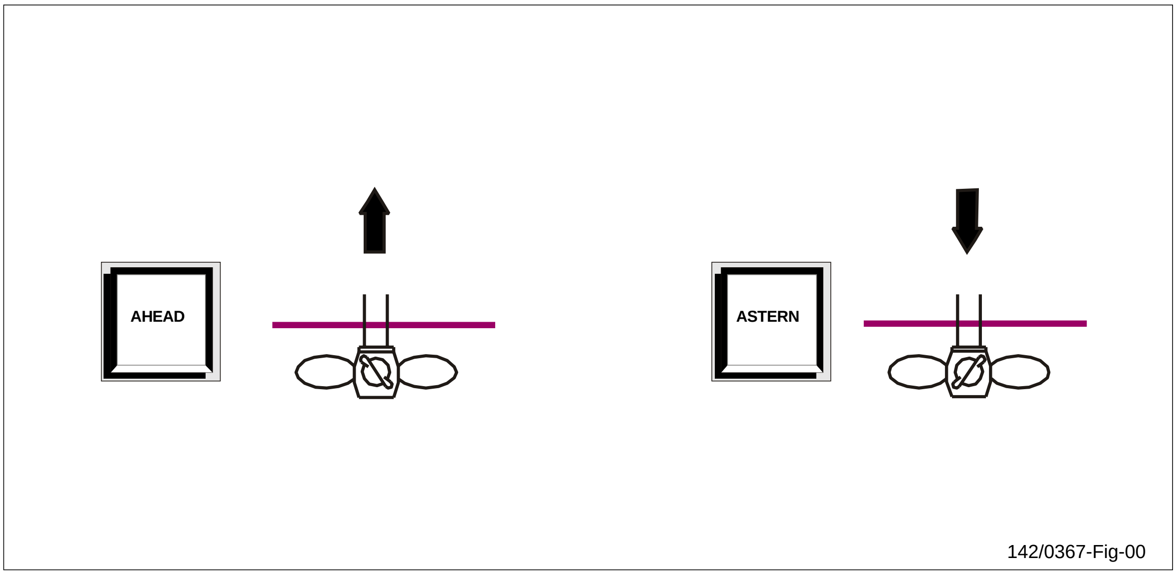


Figure 19 Controlling propeller pitch in back up mode.

To increase the pitch ahead (decrease the pitch astern):

1. Press the “AHEAD” button.

The propeller pitch will keep changing towards ahead direction as long as the button is kept depressed or until maximum pitch ahead is obtained.

To increase the pitch astern (decrease the pitch ahead):

1. Press the “ASTERN” button.

The pitch will keep changing towards astern direction as long as the button is kept depressed or until maximum pitch astern is obtained.

Due to the internal leakage in the hydraulic system, it may be necessary to adjust the pitch setting repeatedly in order to keep the pitch constant.

Task: Zero Pitch Control Panel (Optional Equipment)

This task describes how to use the auto and manual zero pitch function.

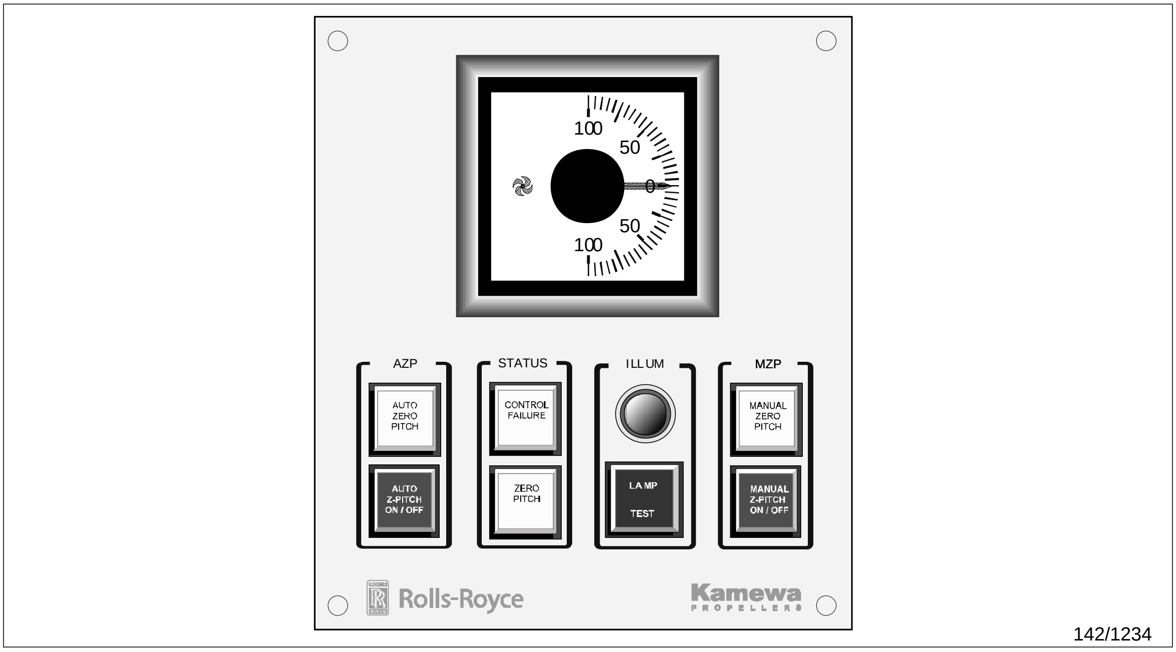


Figure 20 The zero pitch control panel.

The zero pitch control panel is an optional equipment and it is only available on vessel's equipped with a dynamic positioning (DP) system.

To be able to activate the auto or manual zero pitch the following conditions must be fulfilled:

- The control system must not be in back-up mode.
- The DP system must be in command.
  After the DP system has been turned off the auto or manual zero pitch can be activated within a pre-set time limit (default 5 seconds).

Caution: Activation of auto and manual zero pitch are not possible during back-up mode.

Activate the auto zero pitch function

1. Make sure that the control system is in DP mode.
2. Push the "AUTO Z-PITCH ON/OFF" button.
3. When the "AUTO ZERO PITCH" indication lamp is lit the auto zero pitch system is activated.

When the auto zero pitch system is activated the pitch will automatically be set to zero pitch position if a control failure occurs. At a control failure the "CONTROL FAILURE" indication lamp is lit and the "ZERO PITCH" indication lamp will start to flash. The “ZERO PITCH” indication lamp gets a steady light when the pitch has reached zero position.

De-activate the auto zero pitch function

1. Push the “AUTO Z-PITCH ON/OFF” button.
2. When the “AUTO ZERO PITCH” indication lamp goes out the auto zero pitch system is de-activated

Activate manual zero pitch function

1. Make sure that the control system is in DP mode.
2. Remove the cover on the “MANUAL Z-PITCH ON/OFF” button.
3. Push the “MANUAL Z-PITCH ON/OFF” button to activate the zero pitch function. The “MANUAL ZERO PITCH” indication lamp is lit when the manual zero pitch function is active.
4. The “ZERO PITCH” indication lamp starts to flash as soon as the button is pushed and gets a steady light when the pitch has reached zero position.

The “MANUAL Z-PITCH ON/OFF” button has a cover to prevent the operator from accidentally pushing the button.

De-activate manual zero pitch function

1. Push the “MANUAL Z-PITCH ON/OFF” button again to de-activate the zero pitch function.
2. When the “MANUAL ZERO PITCH” indication lamp goes out the manual zero pitch function is deactivated.

Task: Setting Panel Illumination

Description

This task describes the setting of the panel illumination.

The illumination of the knob on a control panel can be adjusted with the dimmer knob. The dimmer knob will affect all indication lamps and buttons on the panel, except alarm lamps which cannot be dimmed. The indication lamps and buttons cannot be completely blacked out.

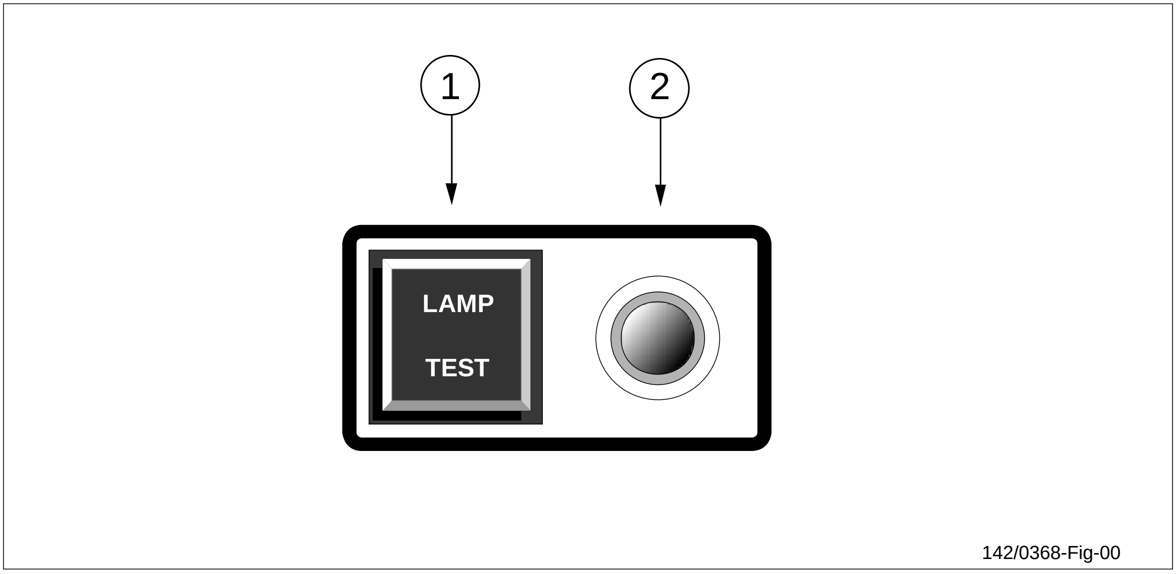


Figure 21 Lamp test button (1) and dimmer knob (2).

The panama indicators (if included) can be dimmed with dimmer knobs found at the bottom of the indicators.

Operation from the Engine Control Room (ECR)

Task: Transferring Manoeuvre Responsibility

Description

This task describes how to transfer manoeuvre responsibility between the bridge and the engine control room.

The manoeuvre responsibility can be transferred for each propeller individually from the bridge to the engine control room, and vice versa, with the selector switches on the control panel in the engine control room.

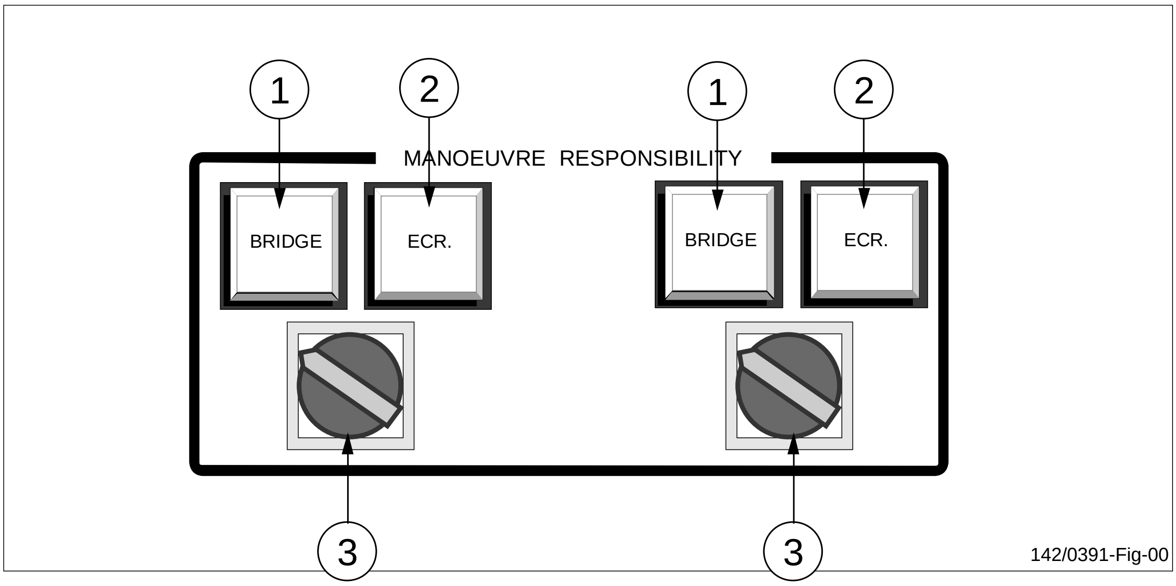


Figure 22 Switches for transferring manoeuvre responsibility between the engine control room and the bridge, and corresponding indication lamps.

1. Lamp indicating that the bridge is in command
2. Lamp indicating that the engine control room (ECR) is in command
3. Selector switch for switching manoeuvre responsibility between bridge and engine control room

When the bridge is in command the “BRIDGE” lamp is lit on the control panel. You can monitor the indication and status lamps in the engine control room, but you cannot perform any manoeuvres or give any commands with the main control panel, except emergency clutch-out (if included) and L.I.C. “PROGRAM ON/OFF”. The “ECR” lamp is lit when the engine control room is in command.

Load control limit setting and fine adjustment of constant RPM (if included) are always accessible even when the bridge has the manoeuvre responsibility.

The manoeuvre responsibility selector switch also controls the accessibility to back-up control.

Instruction

Note: If the bridge is not OK the manoeuvre responsibility remain in the engine control room, although the switch has been turned to “BRIDGE” position.

To Transfer the Manoeuvre Responsibility from Bridge to ECR

To transfer the manoeuvre responsibility from the bridge to the engine control room:

1. Turn the switch into “ECR” position.

The manoeuvre responsibility is immediately transferred to the engine control room. The ”BRIDGE” lamp goes out. The “ECR” lamp starts to flash and continues to flash until the transfer is acknowledged on the bridge with the “ECR. ACKN.” button. (See figure 29.) During this time the buzzer sounds both in the engine control room and on the bridge.

To Transfer the Manoeuvre Responsibility from ECR to Bridge

To transfer the manoeuvre responsibility from the engine control room to the bridge:

1. Turn the switch into “BRIDGE” position.

The manoeuvre responsibility is in the engine control room until the transferred is accepted on the bridge with the “BRIDGE ACCEPT” button (figure 29). While the system waits for the acceptance from the bridge, the “BRIDGE” lamp is flashing and the buzzer sounds. After acceptance the bridge receives the manoeuvre responsibility, the “BRIDGE” lamp gets a steady light, and the “ECR” lamp goes out.

Task: Changing Command Mode

Description

This task describes how to request lever control and how to transfer from local to remote pitch.

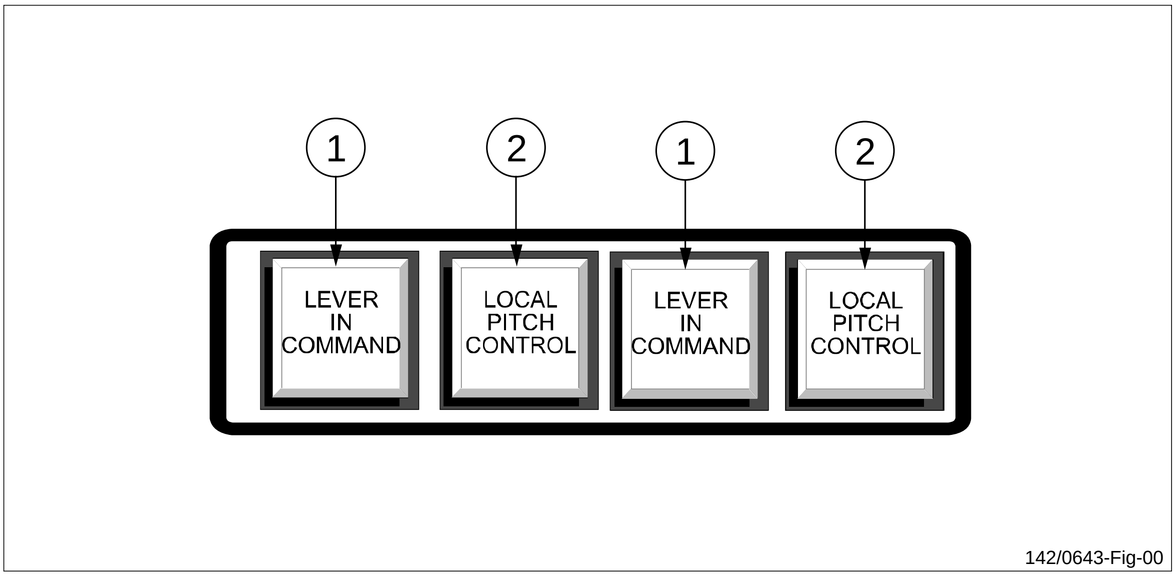


Figure 23 Command mode indication lamps.

1. Indication lamp lit at the station in command when the lever has command over the either the pitch, the RPM, or both
2. Lamp indicating that the pitch is controlled locally at the hydraulic power pack

The “LEVER IN COMMAND” lamp is lit at the station in command when the lever has command over either the pitch control or RPM control, or both. The lamp is off if neither the pitch nor the RPM is controllable with the lever. The lever has no effect on the thrust control, and the lamp is off, in the following cases:

• Local pitch control is used (the “LOCAL PITCH CONTROL” lamp is lit) while constant RPM mode is active.

• Local pitch control and separate RPM control are used.

• Back up control is switched on.

Instruction

To Transfer from Local to Remote Pitch Control

When the lamp “LOCAL PITCH CONTROL” is lit the “LOCAL/REMOTE” switch on the Hydraulic Power Pack (HPP) control panel is in local position, and the pitch is controlled locally. The pitch cannot be controlled with the main propeller control system, not even the back-up control system. When local pitch control is used the control levers will not be synchronized with the actual propeller pitch.

To get a bump-free change over when returning from local control to lever control:

1. Set the pitch to zero locally.
2. Set the lever at the station in command in zero position.
3. Switch over from “LOCAL” to “REMOTE” control.

Task: Choosing Control Mode

Description

This task describes how to make a transfer between the two control modes “Combinator mode” and “Constant RPM mode”.

Control mode can be chosen on the main control panel in the same way as on the bridge.

If there is an RPM fine adjustment panel constant RPM mode can also be chosen on the RPM fine adjustment panel.

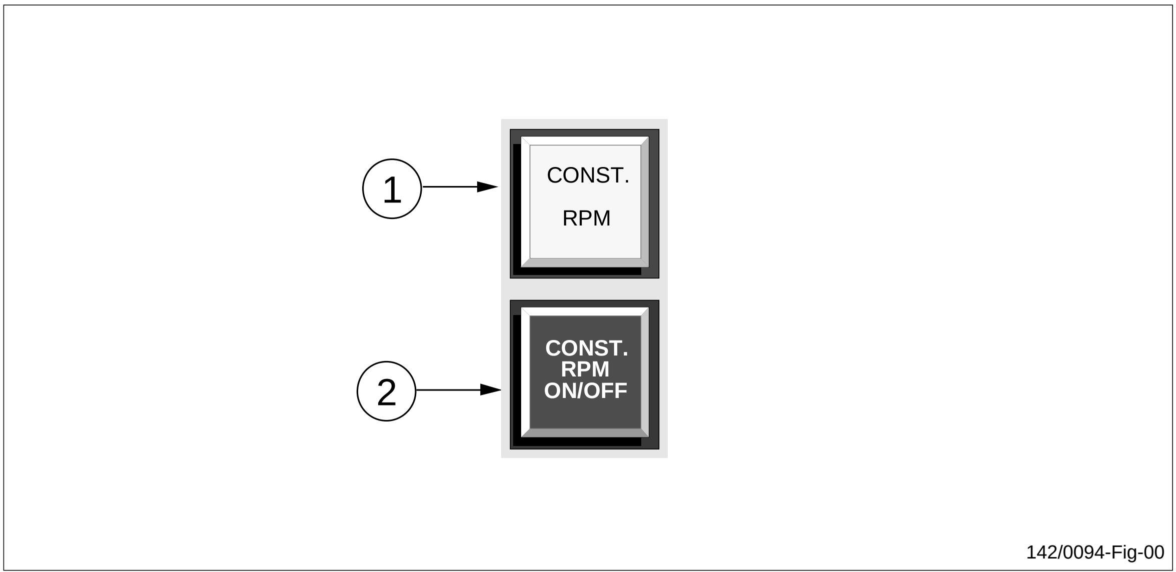


Figure 24 Button and indication lamp of the control mode.

1. Indication lamp showing that constant RPM is active
2. Button for switching constant RPM mode on and off

At least the following two control modes are available:

Combinator mode

In this mode the thrust control lever controls both pitch and RPM according to the combinator diagram, see flap System Guide.

Constant RPM mode

In constant RPM mode the engine is running at a constant preprogrammed RPM, which is specific for the ship. The lever controls only the propeller pitch.

Instruction

Note: If a shaft generator is connected constant RPM mode is blocked and cannot be switched off.

Constant RPM mode is active when the “CONST. RPM” lamp is lit on the control panel. Otherwise the control mode is in combinator mode.

1. Push the button “CONST. RPM ON/OFF” to choose constant RPM. Push the button again to return to combinator mode.

Other possible control modes are indicated and chosen correspondingly.

Task: Engaging and Disengaging Clutches

This feature is optional, which means that it may not be found in your application.

Description

This task describes how to engage and disengage the clutches.

Engagement, disengagement, and emergency clutch out works in the same way as on the bridge.

As long as no engine clutches are engaged on the shaft no engine force is transferred to the propeller. Moving the control lever ahead and astern will increase and reduce the pitch according to linear pitch curve, and the RPM according to chosen control mode.

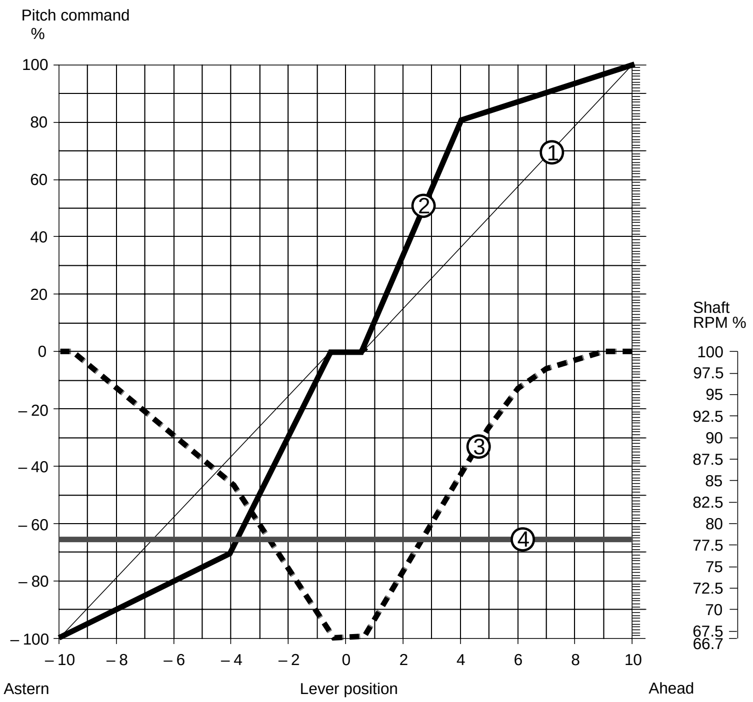


Figure 25 An example of a combinator diagram.

1. Pitch setting in constant RPM mode and when the engine is disengaged
2. Pitch setting in combinator mode
3. RPM setting in combinator mode
4. RPM setting in constant RPM mode

Engaging a clutch requires that certain conditions are fulfilled, see flap System Guide.

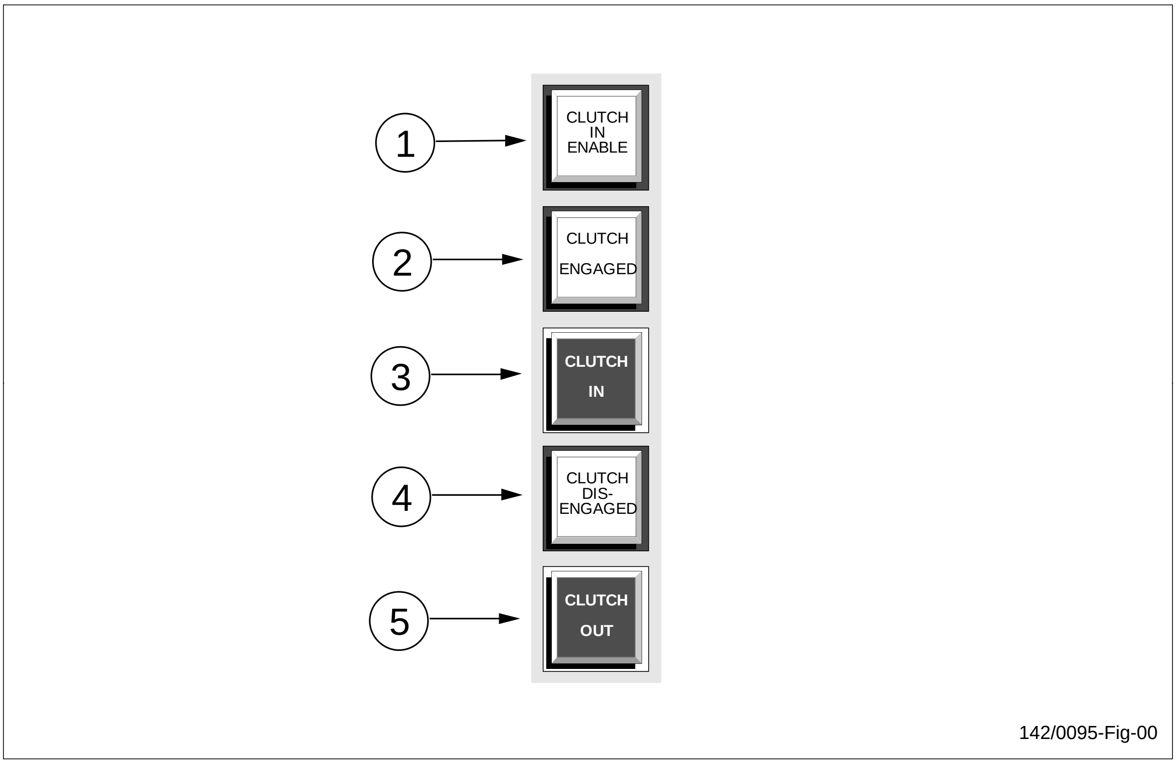


Figure 26 Buttons and lamps for engaging and disengaging a clutch.

1. Lamp indicating that the “clutch in” conditions are fulfilled and the clutch is ready to be engaged
2. Lamp indicating that the clutch is engaged
3. Button for engaging the clutch
4. Lamp indicating that the clutch is disengaged
5. Button for disengaging the clutch

The lamp “CLUTCH IN ENABLED” indicates that all conditions for engaging the clutch are fulfilled. If the lamp is not lit, ensure that:

• the engine is running at “clutch in” speed;

• that the shaft brake is not engaged;

• that “EMERGENCY CLUTCH OUT” has not been applied;

• that the control lever is in zero position (first engine).

After a clutch has been disengaged it cannot be engaged again until a time delay (default=three minutes) has elapsed.

If an emergency clutch out has been applied the clutches can be engaged again only after the emergency clutch out alarm has been reset.

Instruction

To engage clutches

It is not possible to engage two clutches simultaneously.

To engage the clutch of the first engine of the propeller shaft:

1. Set the control lever in zero position.

2. Press the “CLUTCH IN” button for the engine.

The “CLUTCH ENGAGED” lamp starts to flash. If the clutch engagement has succeeded the “CLUTCH ENGAGED” lamp is lit with a steady light to indicate that the engine clutch is engaged, and the “CLUTCH DISENGAGED” lamp goes out.

To engage the clutch of the second engine on the propeller shaft:

1. Press the “CLUTCH IN” button for the engine.

In this case there is no demand for zero lever command. The second engine system is given a request for RPM synchronization with the first engine. After synchronization the engine is engaged.

If the buzzer sounds and the “SEQUENCE FAILURE ACKN.” lamp in the “STATUS” section of the control panel is lit the clutch engagement did not succeed. Refer to the flap about alarms for instructions.

To Disengage Clutches

Note: Two engines on the same propeller shaft can be disengaged simultaneously.

Note: In an emergency situation use emergency clutch out.

To disengage the clutch of an engine when two engines are engaged:

1. Press the “CLUTCH OUT” button for the engine.

The system sends an unloading command to the engine control system and disengages the engine when it is unloaded.

To disengage the clutch when only one engine is engaged:

1. Bring the control lever to zero position to unload the engine (not required but recommended).

2. Press the “CLUTCH OUT” button.

The “CLUTCH DISENGAGED” lamp starts to flash. If the disengagement has succeeded the “CLUTCH DISENGAGED” lamp is lit with a steady light, and the “CLUTCH ENGAGED” lamp goes out.

If the buzzer starts to sound and the “SEQUENCE FAILURE ACKN.” lamp is lit, the clutch out did not succeed.

Emergency Clutch Out

Warning: Use emergency clutch out solely in emergency situations. Do not use it for regular clutch out as it will cause wear on the clutches.

Note: The engines cannot be engaged again until the emergency clutch out alarm has been reset.

The emergency clutch out buttons are protected by transparent covers which can be opened. The buttons are always enabled on all control panels.

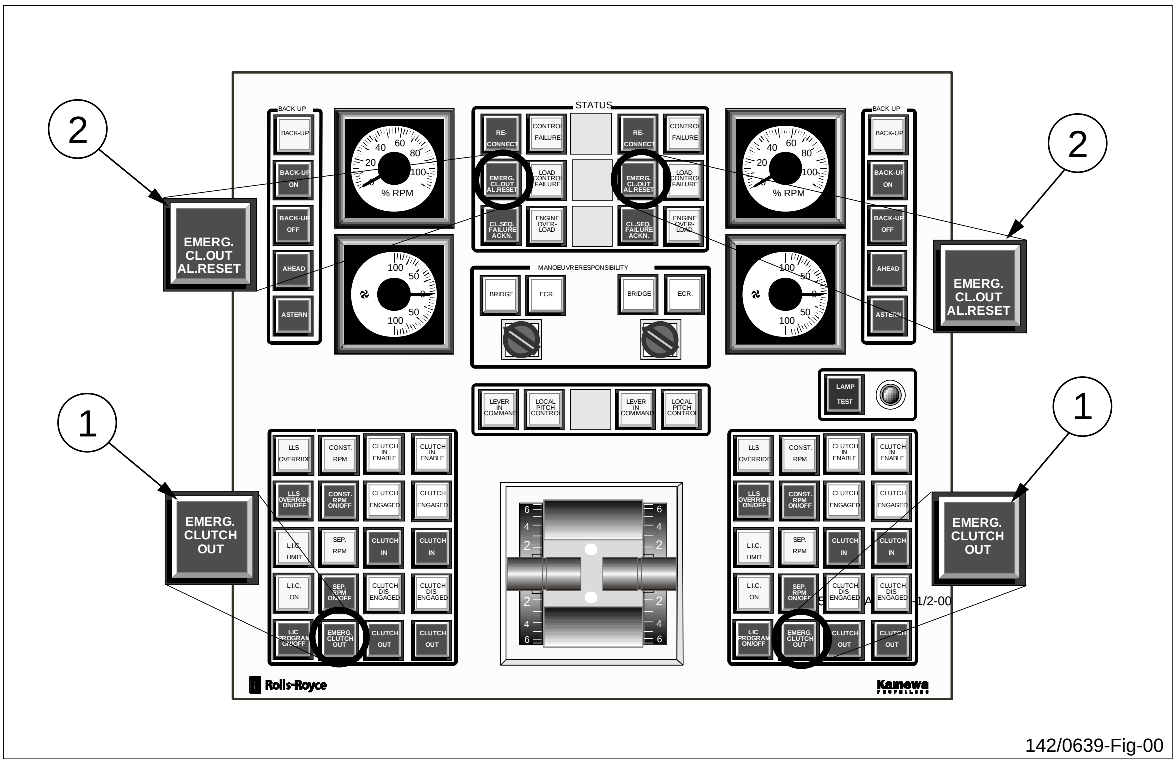


Figure 27 The emergency clutch out buttons (1) and the reset buttons (2).

In case of an emergency situation where an immediate stop of the main propellers is needed:

1. Press the “EMERGENCY CLUTCH OUT” buttons.

When emergency clutch out is applied, the alarm buzzer starts to sound and the “EMERG. CLUTCH OUT AL. RESET” buttons to flash.

Reset the emergency clutch out alarm:

1. Press the “EMERG. CLUTCH OUT RESET” buttons.

Task: Manoeuvring with Control Levers

Description

This task describes how to move ahead or astern and how to perform a crash stop using the thrust control lever.

Thrust Control Lever

Each control lever contains two levers for thrust control of the propellers. Bringing a lever ahead will give the propeller a thrust ahead, and bringing a lever astern will give the propeller a thrust astern.

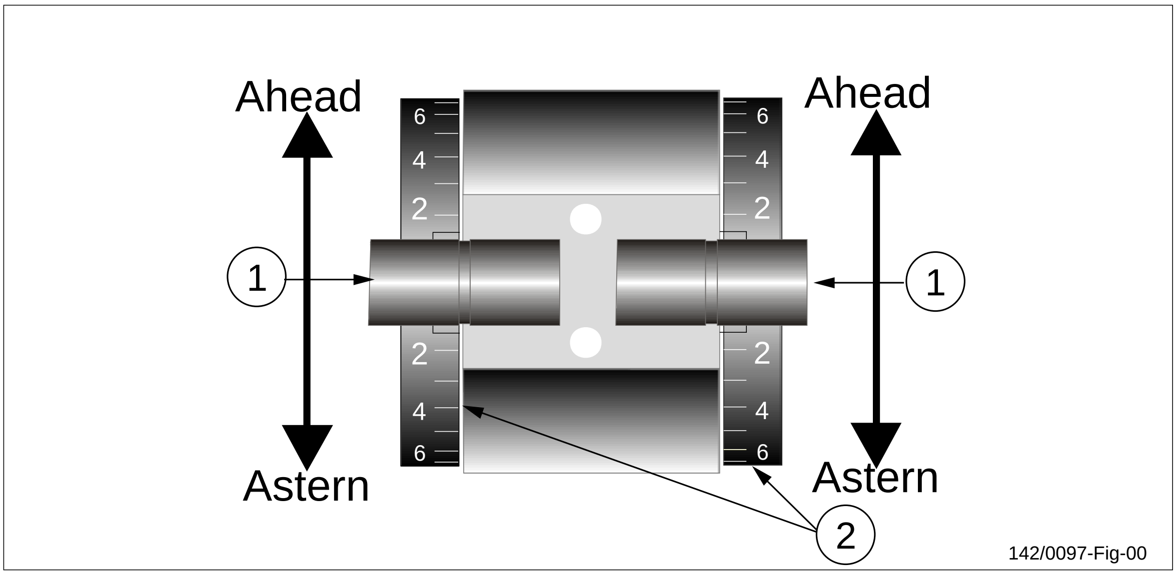


Figure 28 The thrust control lever on the port side.

1. Thrust control lever
2. Thrust indication pointer

The levers are indexed 0 ... 10 in both ahead and astern direction. At a certain lever position the resulting pitch and RPM follow the combinator diagram (see figure 50) in accordance with the chosen operating mode. In zero position the propeller pitch is always zero, and the RPM is idle (in combinator mode), or has a fixed value (in constant RPM mode).

The levers at stations that are not in command are continuously synchronized with the levers in command.

Instruction

Note: **During acceleration the engine load control function will probably reduce the pitch due to dynamic high engine load conditions.**

Note: **At a shutdown command from an engaged engine, the engines on the same shaft are given idle RPM, the thrust control lever is automatically brought to zero position, and an automatic emergency clutch out takes place.**

To Move Ahead and Astern

Order a thrust ahead by bringing the levers ahead, and a thrust astern by bringing the levers astern.

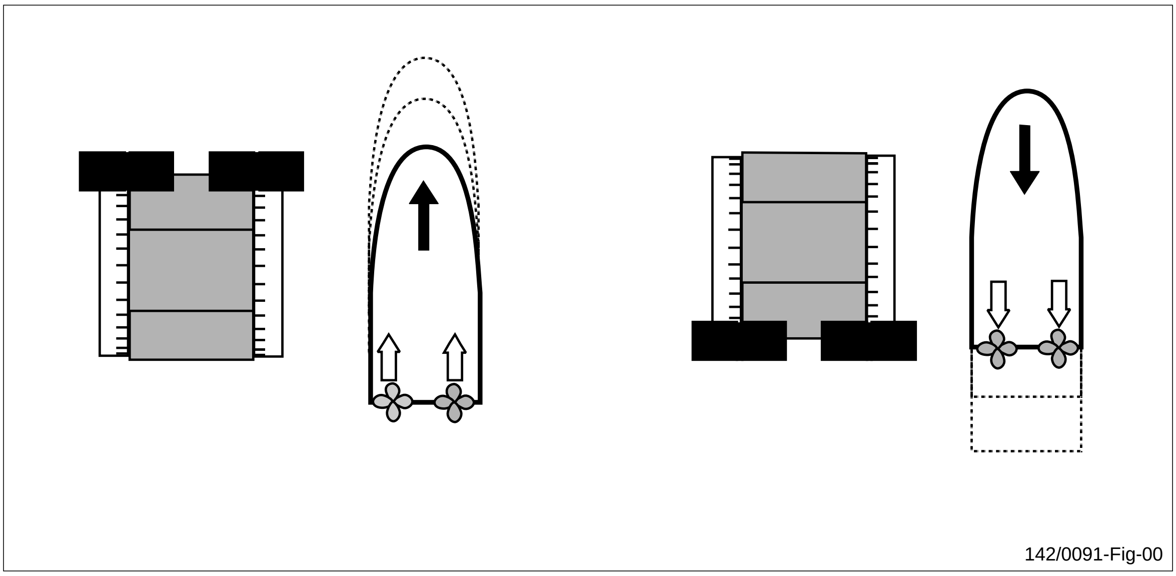
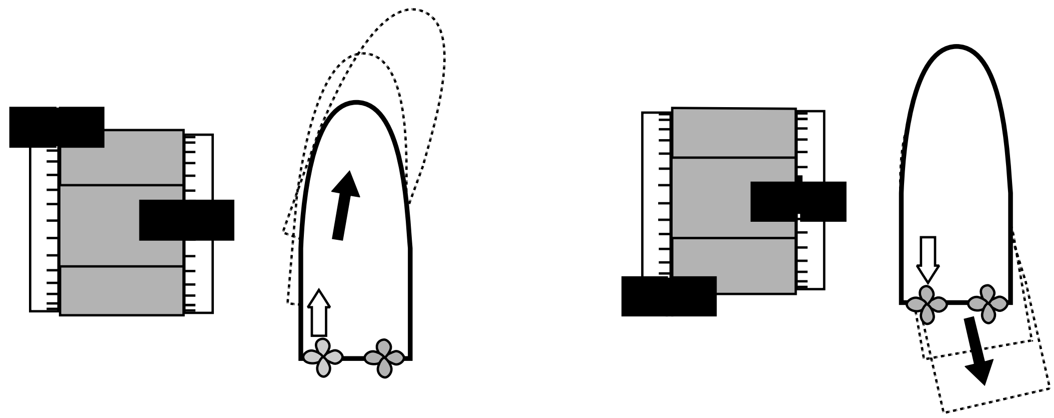


Figure 29 Moving ahead and astern.

Giving the starboard and port propellers different thrust will result in a turning effect on the ship.

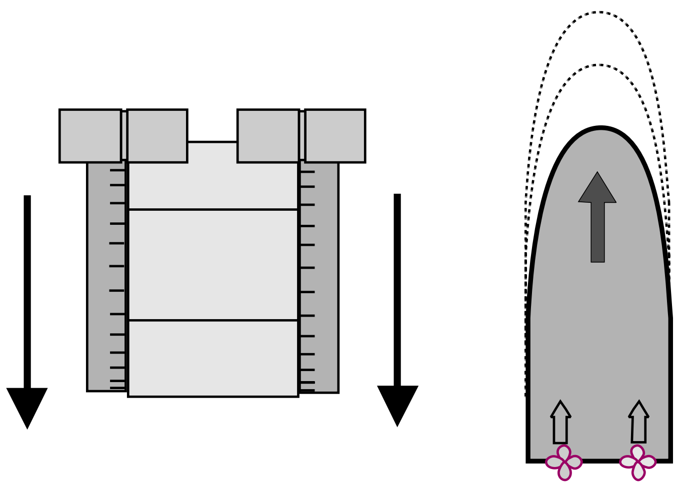


142/0098-Fig-00

Figure 30 Giving the propellers different thrust.

The lever command may be delayed by the load increase control program (LIC), which can be temporarily overridden. The ordered pitch may be reduced by the engine load control function, which depends on the load limit setting in the engine control room. The load limit can be temporarily overridden as well. See Load Control Handling.

To Perform a Crash Stop



142/0099-Fig-00

Figure 31 Performing a crash stop.

To stop the movement of the ship ahead or astern in an emergency situation:

1. Move the control levers of both main propellers in the opposite direction to the driving direction.

When the ship has almost stopped:

2. Bring the levers to zero position.

In combinator mode the RPM is automatically decreased to idle RPM when the system notices a crash stop. This level is kept on as long as the propeller pitch is in the opposite direction (ahead or astern) to the lever. This feature has been implemented to reduce the distance required for stopping the ship.

Task: Load Control Handling

Description

This task describes how to set the load limit and the load difference between two engines, how to use and override the Load Increase Control (LIC), and how to handle overload situations.

The load control system prevents the engines from becoming overloaded. In order to further restrict the allowed load level and suit it to the prevailing circumstances you can adjust the load limit in the range 0...110%.

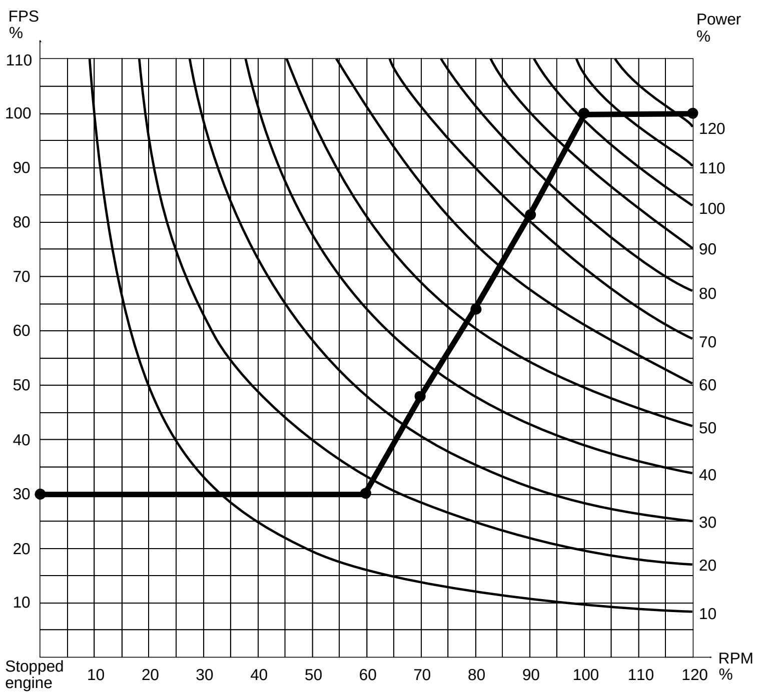


Figure 32 Example on a load curve.

The used load curve which is determined for 100% load limit, will be multiplied with the load limit setting. If, for instance, the load limit is 90%, the entire load curve is multiplied by 0.9.

Instruction

To Set Load Limit

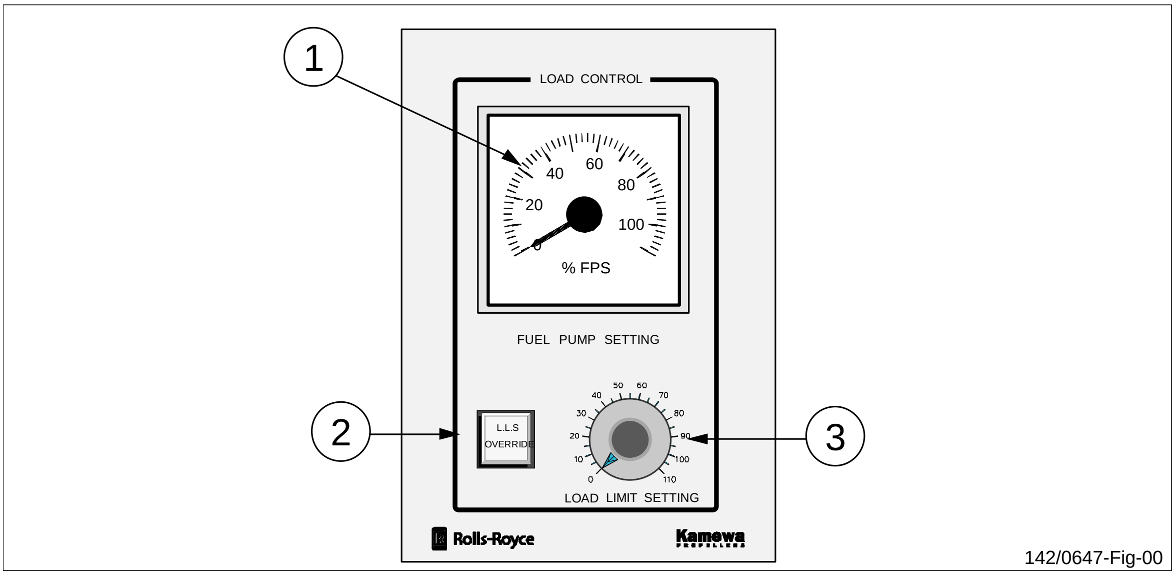


Figure 33 Panel for setting a load limit in two-engine installations.

1. Fuel pump setting indicator
2. Lamp indicating that the load limit is being overridden
3. Load limit setting knob

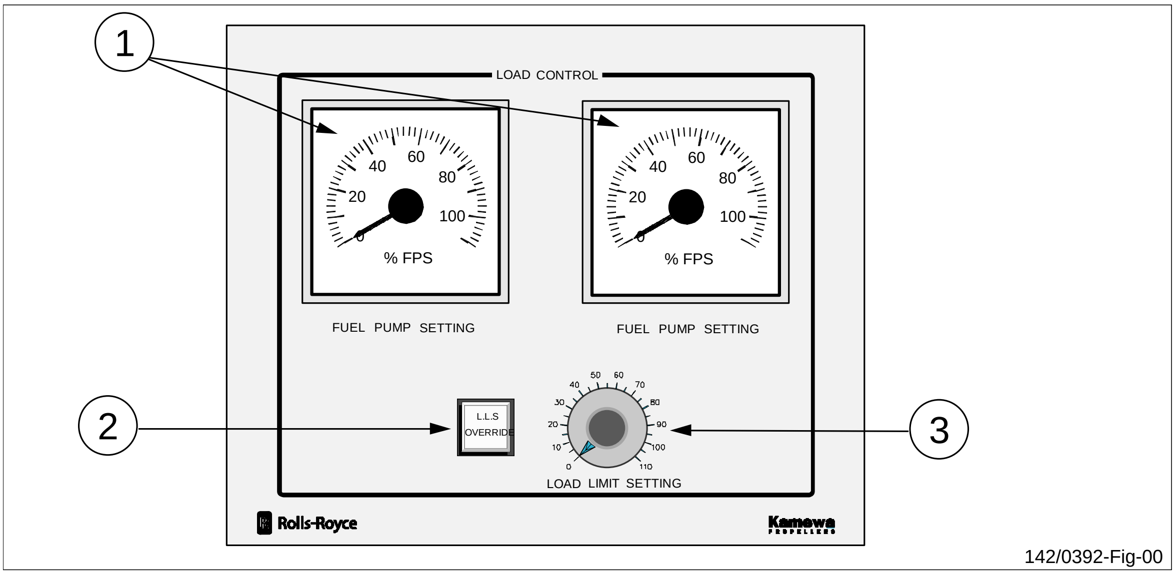


Figure 34 Panel for setting a load limit in two-engine installations.

1. Fuel pump setting indicators
2. Lamp indicating that the load limit is being overridden
3. Load limit setting knob

To set a load limit:

1. Turn the “LOAD LIMIT SETTING” knob on the load control panel.

In two-engine installations the same limit will apply to both engines. The indicators on the load control panel show the present fuel pump settings of the engines. The limit can be changed any time, independently of whether the engine control room is in command or not.

The load limit setting on the load control panel can be overridden by choosing “LLS OVERRIDE” on the control panel at the station in command. When the load limit is being overridden, the lamp “LLS OVERRIDE” is lit on the load control panel and on the main control panel. At a “SLOW DOWN” command from the engine control system, the load limit will automatically be forced down to a preset parameter value (default: 50%). This limit cannot be overridden.

To Use Load Sharing

The load sharing function is optional, which means that it may not be found in your application.

By means of the load sharing function, the shaft torque can be shared between two engines on the same shaft in a way that is suitable for the prevailing engine conditions. For more information see flap System Guide.

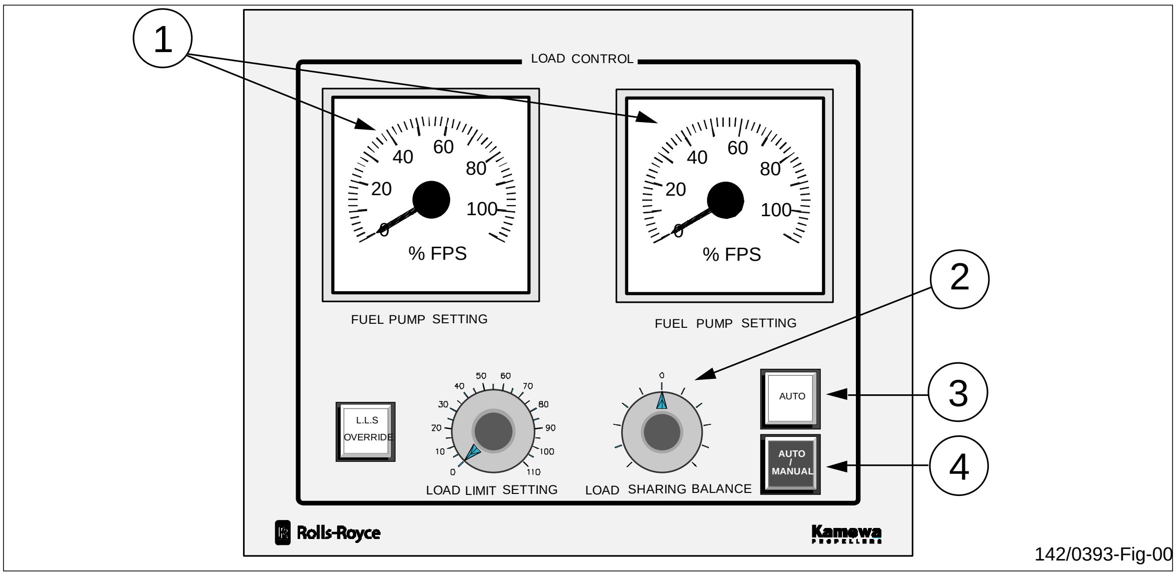


Figure 35 Load limit panel with load sharing balance.

1. Fuel pump setting indicators (engine 1 and engine 2)
2. Balance knob
3. Lamp indicating that automatic mode is active
4. Toggle button for switching between manual and automatic mode

In **automatic** mode the knob when turned in either direction increases the load on the corresponding engine (and decreases the load on the other one) to a load difference of up to 25% (default value, settable by a software parameter). With the knob in zero position both engines are equally loaded.

In **manual** mode the command given by the balancing knob is used as RPM correction signal to the engine governors. The outmost positions of the balance knob implies a difference in the RPM command signals of 1% (default value, settable by a software parameter). The resulting load difference depends on the speed drop of the engine RPM governors. With a speed droop of 4% for example and an RPM correction of 1% the effect on the FPS will be approximately 25%. When the balancing knob is in 0 position both engines are given the same RPM command.

To set the load difference between two engines:

1. Select auto or manual mode with the toggle button “AUTO/MANUAL”.

Auto mode is active when the “AUTO” lamp is lit, otherwise manual mode is active.

2. Turn the balancing knob on the load control panel.

The effect of the knob differs depending on the chosen load sharing control mode - automatic or manual

If neither the “AUTO” lamp nor the “AUTO/MANUAL” button are lit the load sharing function is disabled. The reason may be:

• that one or both engines are disengaged;

• a failure has occurred in the FPS transmitter;

• separate RPM control is active;

or

• the RPM is controlled from an external source (for instance locally).

To Use Load Increase Control (LIC)

To spare the engines at cold start and during warming up stages the automatic load increase control function can be used. When using load increase control the control system delays the lever command signal by a pre-programmed ramp. See flap System Guide.

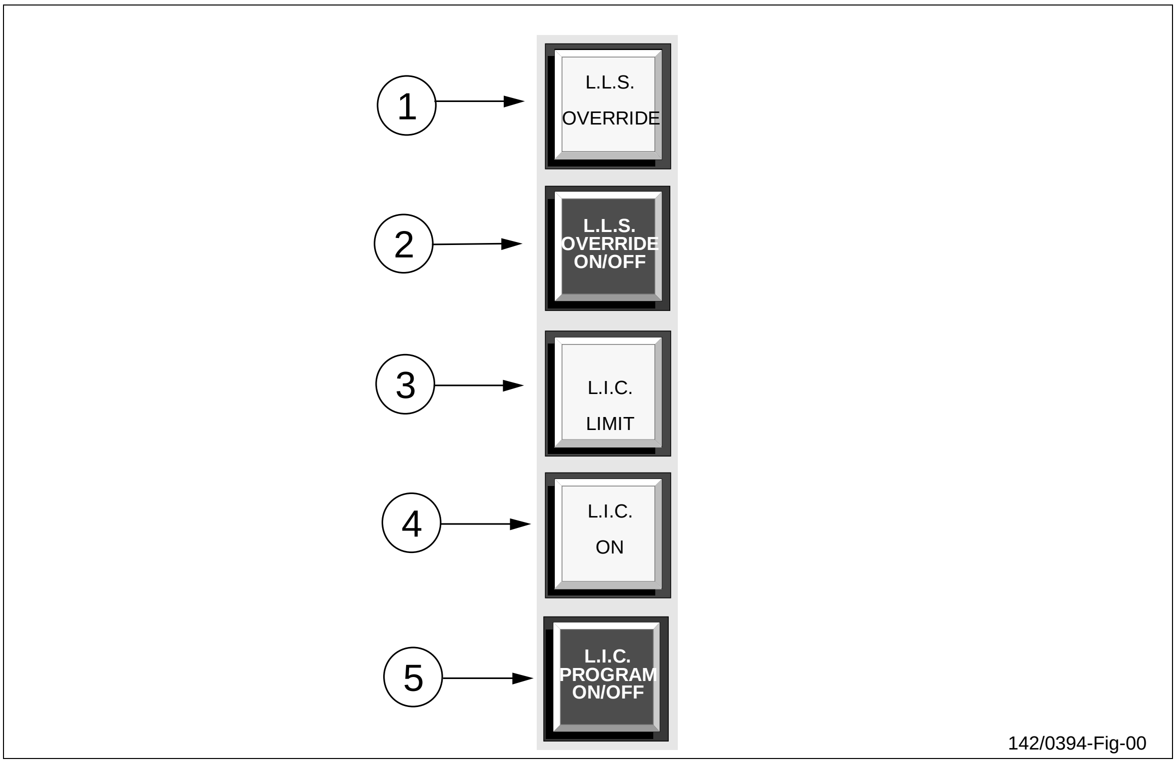


Figure 36 Buttons and indication lamps for using load increase control and for overriding the load limit and load increase control.

1. Indication lamp showing that the LIC program and the load limit are being overridden
2. Toggle button for starting/stopping the override of the LIC program and the load limit
3. Lamp indicating that the LIC program is delaying the lever command
4. Lamp indicating that the LIC program is in use
5. Button for switching on and off the load LIC program

To switch the load increase control program (LIC) on and off:

1. Press the toggle button “L.I.C. PROGRAM ON/OFF” on the main control panel.

The lamp “L.I.C. ON” is lit when LIC is in use. The “L.I.C. LIMIT” lamp is lit when the LIC program is reducing the lever command signal.

The “L.I.C. PROGRAM ON/OFF” button is enabled in the engine control room even when the bridge is in command. The LIC function is not accessible when the engines are disengaged. Neither is it accessible when “L.L.S. OVERRIDE” has been chosen.

To Override Load Limit and LIC Function

In situations where all available engine resources are needed, the limitations caused by the L.L.S. (load limit setting) in the engine control room and the LIC program can be temporarily overridden. This means that a fixed load limit is applied (default 100%), and the LIC function is disregarded. The engine load control function remains active and may still reduce the pitch.

To override the load limit and the LIC function:

1. Press the “L.L.S. OVERRIDE ON/OFF” button (figure 38).

The “L.L.S. OVERRIDE” lamp is lit to indicate that the load limit setting and the LIC function are being overridden.

To stop overriding the limitations:

1. Press the “L.L.S. OVERRIDE ON/OFF” button so that the “L.L.S. OVERRIDE ON/OFF” lamp goes out.

Caution: The possibility to override the load limit and the LIC function is intended for temporarily risen power requirements and should not be used in regular operation

To Handle Overload Situations

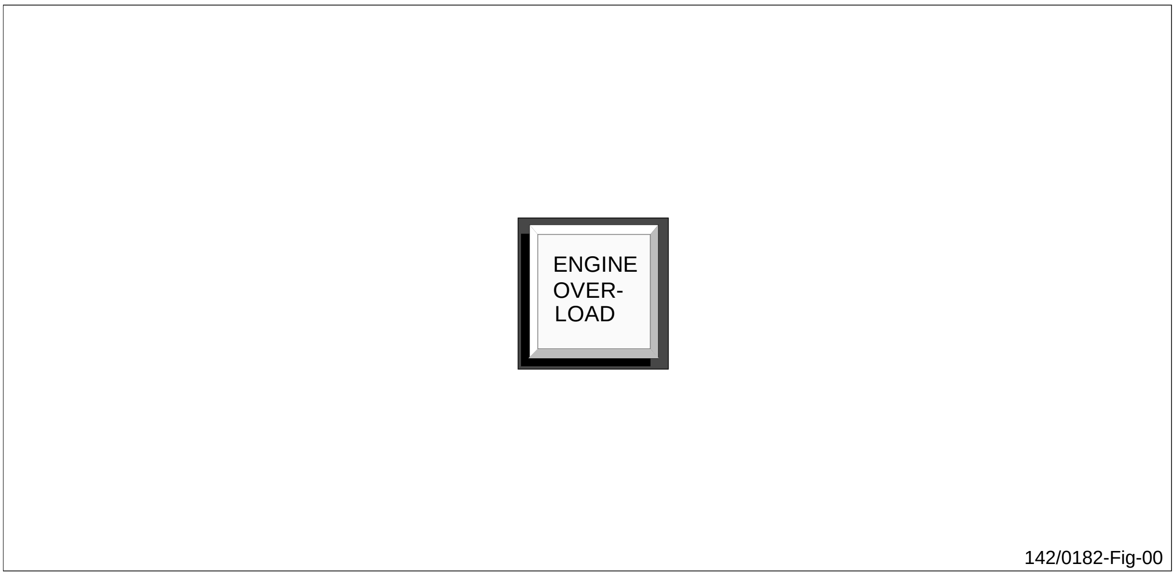


Figure 37 The engine overload indication lamp.

The “ENGINE OVERLOAD” indication lamp in the “STATUS” section of the control panel indicates when lit that the engine is being overloaded. Overload may occur in extreme situations, and when the load control function is disconnected (during back-up and local pitch control) or out of operation due to a failure.

1. Reduce the pitch immediately if the “ENGINE OVERLOAD” lamp is lit.

The “ENGINE OVERLOAD” lamp is directly connected to the fuel rack overload switches of the engines.

Task: Supervising Indicators

Panama pitch indicator and Panama RPM indicator are optional features, which means that they may not be found in your application.

Description

This section describes the function of the pitch and the RPM indicators.

Pitch Indicators

The pitch indicators indicate the actual propeller pitch.

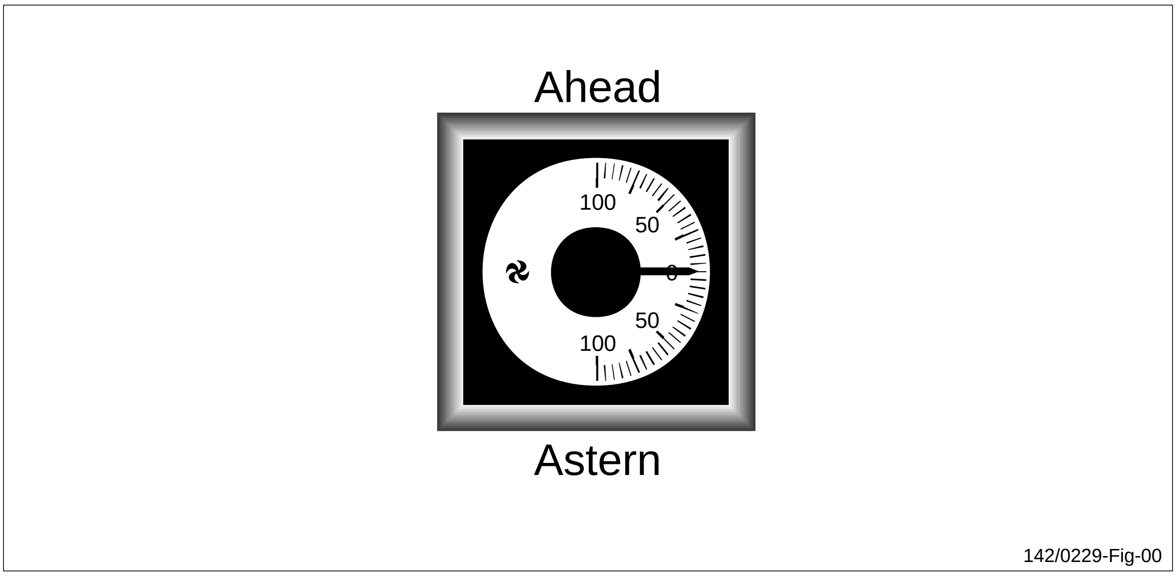


Figure 38 Pitch indicator on the control panel.

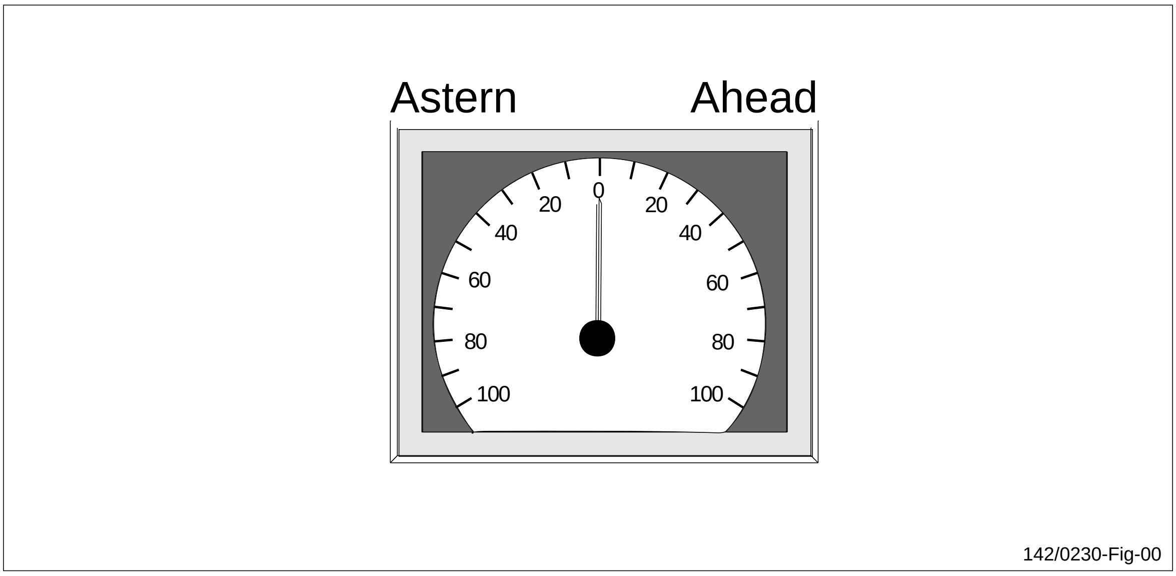


Figure 39 Panama pitch indicator (optional).

The pitch indicators are continuously updated from dedicated propeller pitch transmitter via a separate indication system. Hence the pitch indicators will show correct values even in case of a control system failure.

RPM Indicators

The RPM indicators shows the actual RPM of the propeller shaft in percentage of maximum RPM.

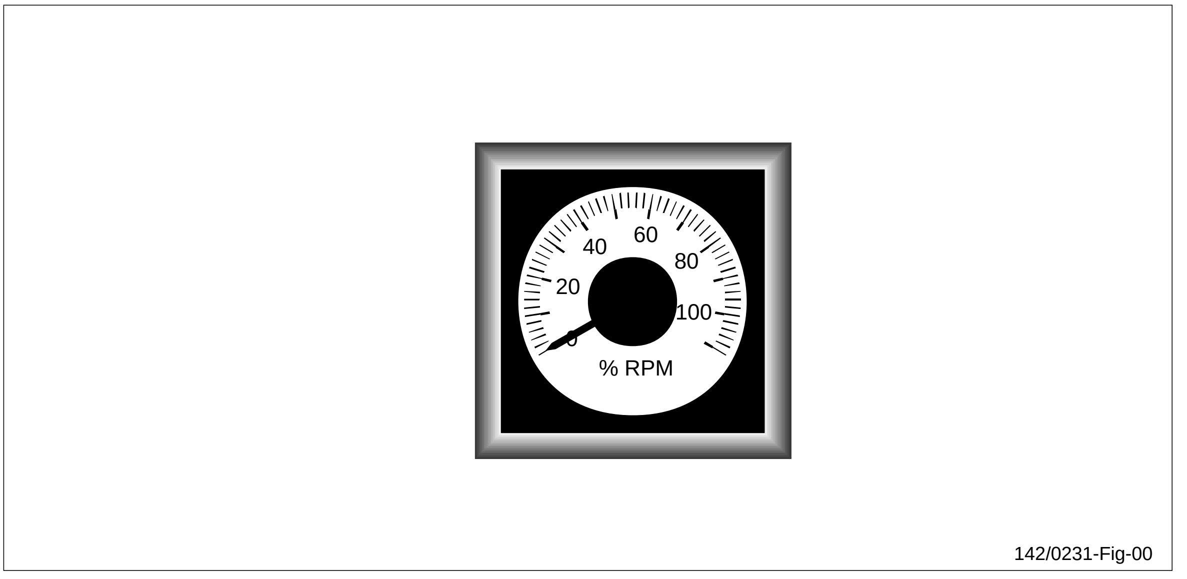


Figure 40 RPM indicator on the control panel.

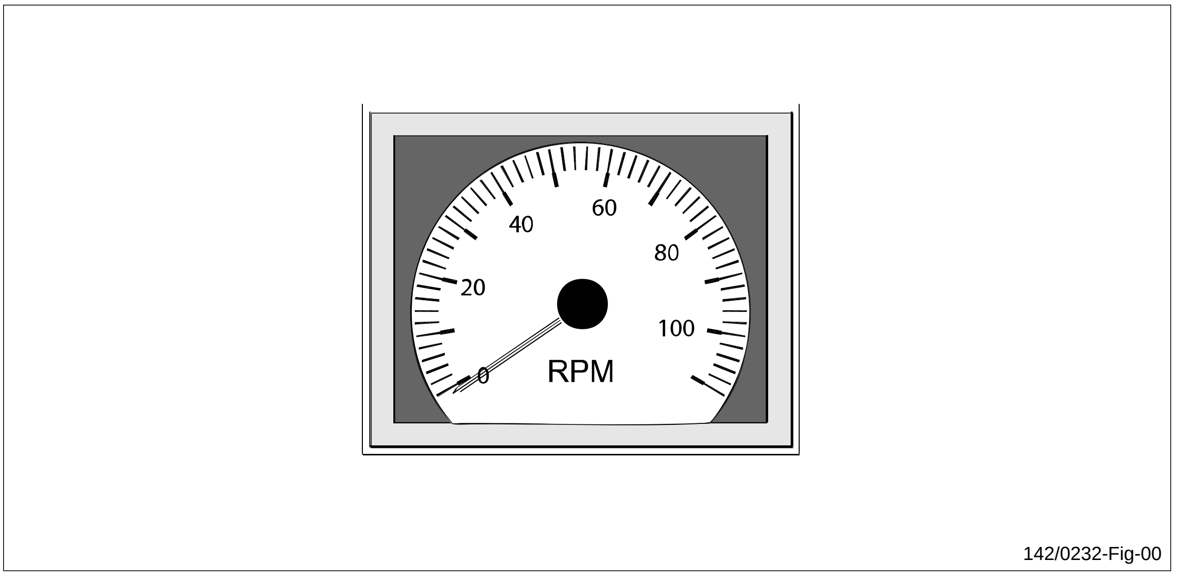


Figure 41 Panama RPM indicator (optional).

The RPM indicators are continuously updated from a dedicated RPM indication transmitter via a separate indication system. Hence the RPM indicators will show correct values even in case of a control system failure.

Task: Using Separate RPM Control

The separate RPM control is optional, which means that it may not be found in your application.

Description

This task describes how to use the separate RPM control.

By using RPM control the operator can control the RPM of disengaged engines manually with direct RPM commands to the engine control systems.

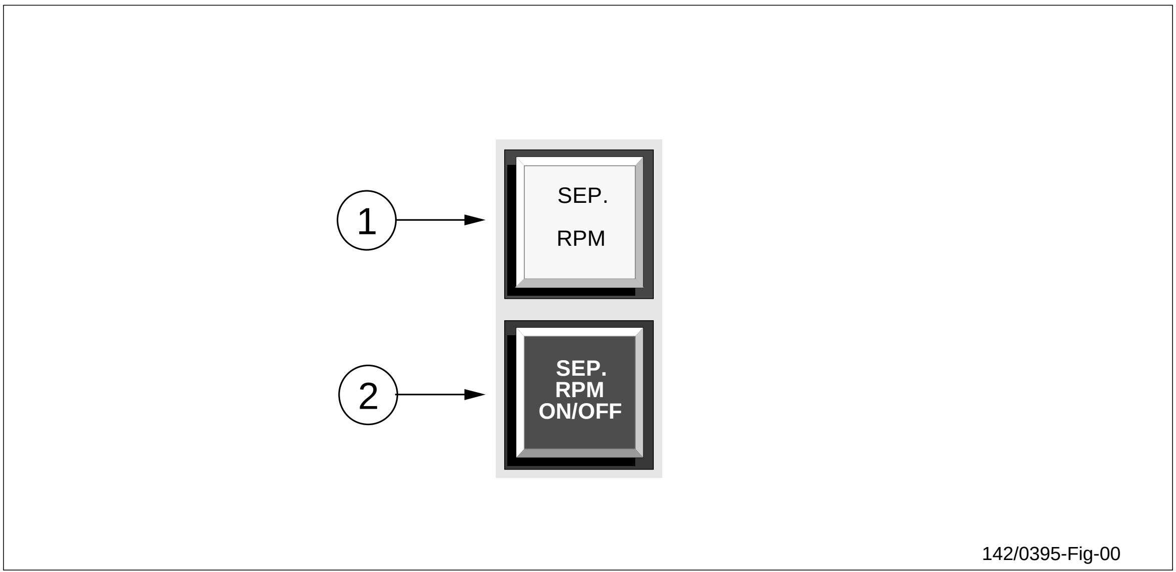


Figure 42 Buttons and indication lamps for choosing RPM control mode (common activation).

1. Lamp indicating that separate RPM control is active
2. Button for switching separate RPM control on and off

When an engine has been switched to separate RPM control the engine RPM command is taken from the RPM control panel. Each engine has its own panel. The “SEP. RPM” indication lamp is lit when one or two engines on the same shaft are controlled from separate RPM control panels. If the engines have individual indication lamps (“SEP.RPM” and “SEP.RPM 2”) a lamp is lit when the respective engine is running in separate RPM mode.

In two-engine installations only disengaged engines can be switched over to separate RPM control. If two engines per shaft are running and one is engaged while the other one is disengaged only the disengaged engine will be switched over to separate RPM control with the “SEP. RPM ON/OFF” button. If the other engine is disengaged later it will be switched over to separate RPM control automatically. If an engine is running in separate RPM control mode, it will automatically exit the separate RPM control mode and return to lever control according to the chosen RPM control mode (combinator mode or constant RPM mode).

In one-engine installations with fixed clutch is separate RPM control available only when the manoeuvre responsibility is in the engine control room. It is not available when a shaft generator is connected.

Instructions

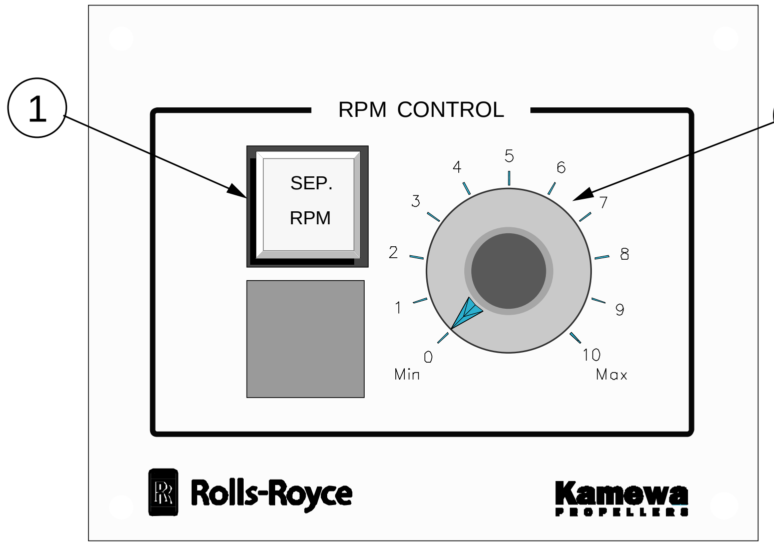


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Figure 43 Panel for controlling RPM in separate mode.

1. Indicator lamp which is lit when separate RPM control is in use
2. Turning knob for RPM setting during separate RPM control

To set a RPM in separate RPM control mode:

1. Turn the RPM control knob.

The knob is graded 0-10, where 0 = min. RPM and 10 = max. RPM. The RPM values are specified by two software parameters.

Switch on and off separate RPM control with the “SEP.RPM on/off” button on the main control panel. When separate RPM is switched off the control system resumes the active RPM control mode, that is either constant RPM or combinator mode.

Task: Fine Adjustment of Constant RPM Control

Description

This task describes how to fine adjust the RPM in constant RPM mode.

In constant RPM mode the RPM can be adjusted up and down with the knob on the fine adjustment panel. By default the adjustment range is ± 5% (determined by a software parameter).

The fine adjustment knob can be used in constant RPM mode even when the manoeuvre responsibility is on the bridge. Constant RPM mode can be switched on and off with the “CONST RPM ON/OFF” button on the fine adjustment panel as well as on the main control panel, but only when the engine control room is in command.

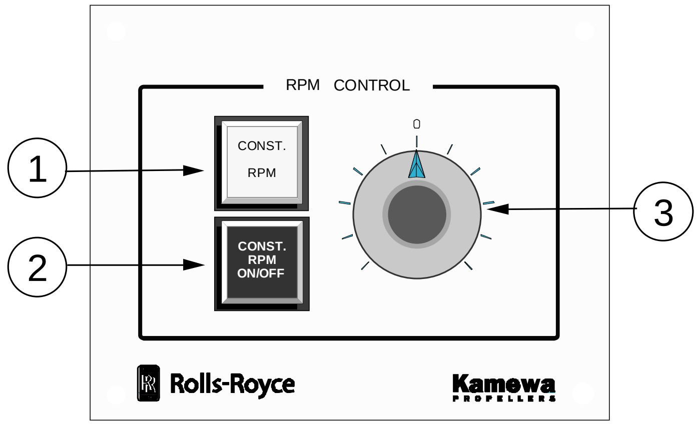

Figure 44 Panel for fine adjusting the RPM in constant RPM mode.

1. Indicator lamp which is lit when constant RPM mode is active
2. Button for switching constant RPM on and off
3. Turning knob for fine adjusting the RPM in constant RPM mode

If there are more than one constant RPM mode the fine adjustment applies to one of them.

Task: Using Back-up Control

Description

This task describes how to switch on and off the Back-up control, and how to control the pitch in a back-up mode.

Back-up control can be used in the same way as on the bridge. Back-up control is available in the engine control room only when the manoeuvre responsibility switch is in ECR position.

Back-up control is an emergency system meant to be used when a malfunction has occurred in the main control system.

In back-up mode no automatic control functions are provided. The hydraulic pitch control valve is disconnected from the main system and connected directly to the back-up section of the control panel. The operator controls the pitch by activating the valve ahead/astern with push buttons.

When the manoeuvre responsibility is on the bridge back-up mode is accessible at all bridge stations. When the manoeuvre responsibility is in the ECR back-up is accessible only in the engine control room. It is not accessible if local pitch control is being used.

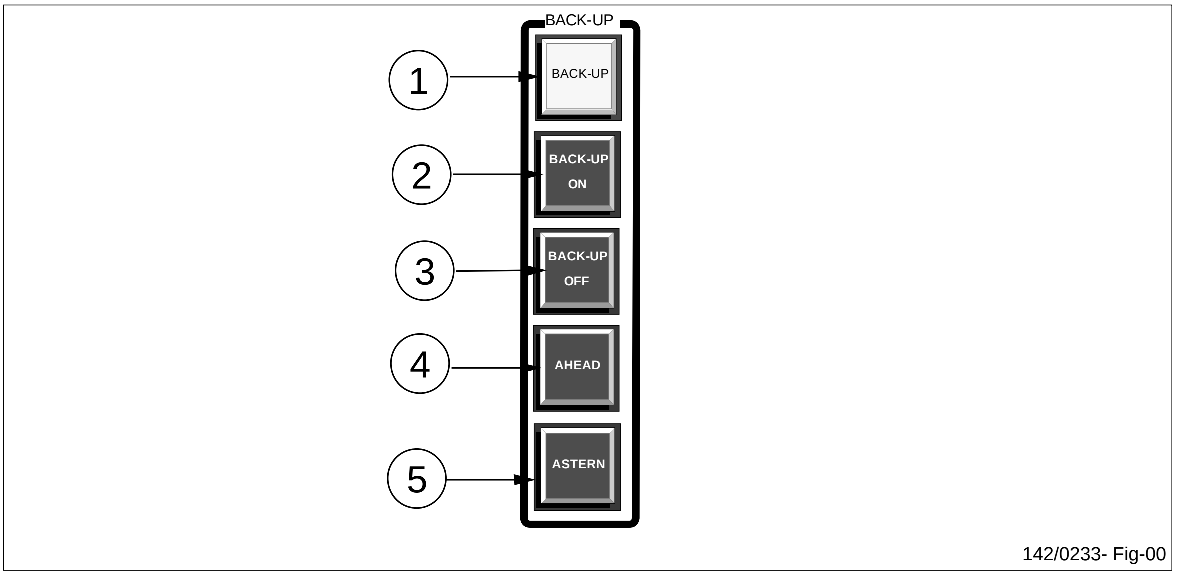

Figure 45 The back-up control section of the control panel.

1. Lamp for indicating that back-up control is switched on
2. Push button for switching on back-up control
3. Push button for switching off back-up control
4. Button for increasing the pitch ahead
5. Button for increasing the pitch astern

Instructions

To Switch Back-up Control on and off

To activate the back up system:

1. Press the “BACK-UP ON” button.

The “BACK-UP” lamp is lit to indicate that back-up is in use.

Note: **When back-up is switched on the ordinary control system is automatically disconnected. Lever commands from the main system will have no effect. No automatic load control takes place.**

To switch off back-up operation and return to the main control system:

1. Set the lever in command in a position roughly corresponding to the present propeller pitch.
2. Press the “BACK-UP OFF” button. The main control system will resume control.

To Control Pitch in Back-up Mode

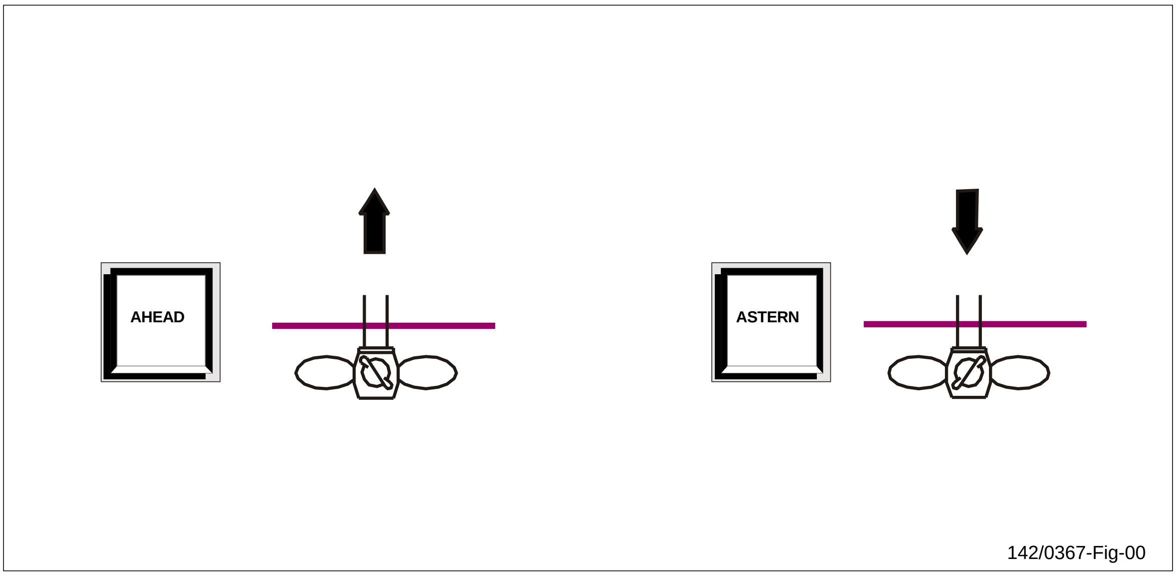

Figure 46 Controlling propeller pitch in back up mode.

To increase the pitch ahead (decrease the pitch astern):

1. Press the “AHEAD” button.

The propeller pitch will keep changing towards ahead direction as long as the button is kept depressed or until maximum pitch ahead is obtained.

To increase the pitch astern (decrease the pitch ahead):

1. Press the “ASTERN” button.

The pitch will keep changing towards astern direction as long as the button is kept depressed or until maximum pitch astern is obtained.

Due to the internal leakage in the hydraulic system it may be necessary to adjust the pitch setting repeatedly in order to keep the pitch constant.

Caution: In back-up mode no automatic load control will take place. Observe the “ENGINE OVERLOAD” lamp (See figure 61) on the control panel and reduce the pitch immediately if the lamp is lit.

Routine Inspections

Task: Regular Checks and Tests

This task describes the recommended regular checks and tests.

Daily Checks and Tests

Test daily after starting the hydraulics system but before starting (or engaging) the main engines that the pitch follows the movement of the control levers. As long as the engines are disengaged the pitch should follow the lever position in accordance with the linear combinator curve. See Tests before Sailing”.

Weekly Checks and Tests

Test once a week all functions that have not been used during the week.

• Test the levers of stations that have not been in command.

• Test the back-up system by operating the pitch as described in the section see ”Using Back-up Control” on page 88.

• Test emergency clutch out (if included).

• Perform lamp tests on the control panels by pressing the LAMP TEST button.

All indication lamps and buttons on the panel should be lit and the buzzer should sound.

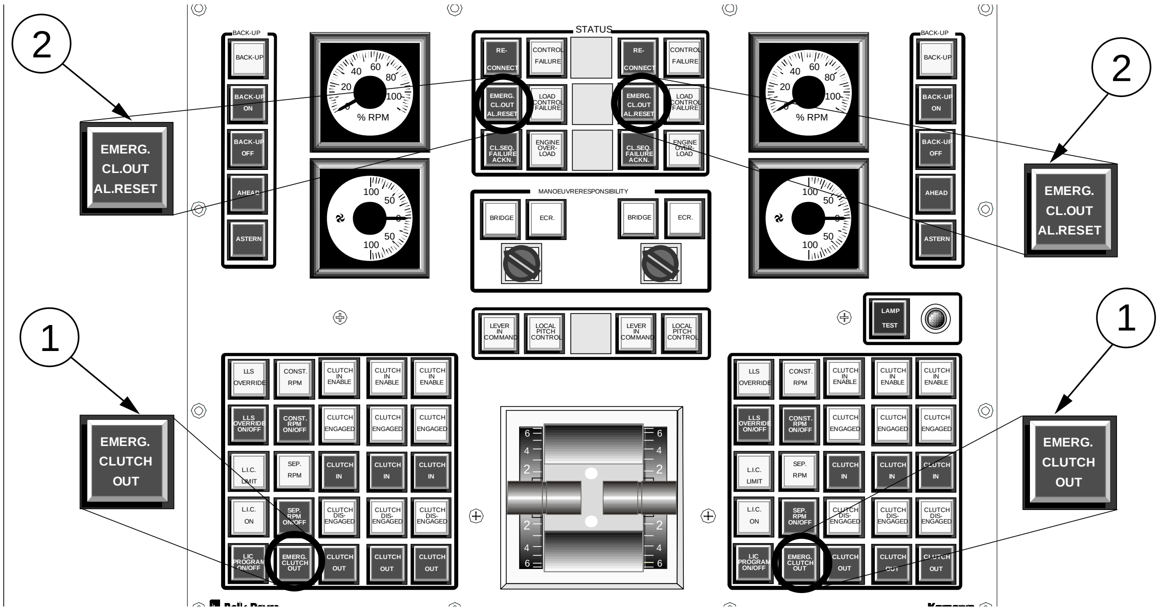

Figure 47   Lamp test button (1).

Monthly Checks and Tests

Test the alarm signals by simulating alarms (for instance by moving the thrust control lever when the hydraulics is not running, or by disconnected command/response transmitters).

Yearly Checks

Check the connection terminals in the control system cabinets.

Cleaning

Dust the equipment using a dry or slightly damp cloth. Do not use wet cleaning utensils. In other respects the control system sets no special requirements on the cleaning.

Warning: Never allow water to enter inside the cabinets or control panels. Water may cause serious damage to electrical equipment and harm the person handling it.

Preventive Maintenance

Take measures to prevent condensation in the control system cabinets. If there is a risk for condensation, use oxidation inhibitors in the cabinets.

Emergency Operating Instructions (FA)

Operating Twin Propeller during Emergency Pitch Setting

Rolls-Royce recommends, as a first hand choice, that the damaged propeller is put out of operation and that the undamaged propeller is run according to normal procedures. If that is not an option set the damaged propeller according to section Emergency Pitch Control Mode 1 or section Emergency Pitch Control Mode 2.

The following settings are recommended when running the vessel using one emergency operated propeller and one undamaged propeller.

- Set the damaged propeller pitch in mechanical end position ahead.
- Run the shaft of the damaged propeller at the maximum speed of 70% rpm. This will reduce the risk of the propeller pitch drifting astern.
- The undamaged propeller must be run at a lower power output than the emergency operated propeller. This to reduce the spindle torque values on the emergency operated propeller.

Note that it must be possible to override the interlock system for start of the engine or to clutch in the system, due to the fact that the propeller is not in zero position when starting.

Emergency Pitch Setting

Introduction

If the hydraulic system, the electric system or the OD-box is not functioning, it is still possible to set the pitch to full ahead position (mechanical end position) using pump unit P3 and the emergency manoeuvre block.

The hydraulic pressure produced by pump unit P3 is directed by valve V12 and it fills the B side (ahead) of the piston in the propeller hub with oil and that forces the oil on the A side (astern) back into the hydraulic power pack tank.

The propeller is set to mechanical end position ahead since the propulsion system is designed to need a low pressure to stay in this position. When the emergency pitch setting is used the propeller will work as a fixed propeller at reduced RPM.

When operating the propeller during emergency pitch setting, the propeller must be set to an emergency pitch control mode, either control mode 1 or control mode 2 depending on the damage on the propulsion system:

- Emergency Pitch Control Mode 1
  The emergency pitch control mode 1 is used when the OD-box and the hydraulic piping is intact, but there is no hydraulic pressure.

- Emergency Pitch Control Mode 2
  The emergency pitch control mode 2 is used when the OD-box or the hydraulic piping is damaged.

The emergency pitch control mode 1 should be the first-hand choice. But if it is impossible to reach enough hydraulic pressure to move the pitch, then the emergency pitch control mode 2 must be used.

There is a sign located on the control panel of the hydraulic power pack, which briefly describes how to perform the emergency pitch control mode 1 and mode 2.

Emergency Pitch Setting for OD-box (FA)

Description

This task describes how to perform the emergency pitch setting mode 1 and mode 2 on a vessel equipped with an OD-box (FA).

Support Items

Spare Parts	Ref. No.

Special Tools and Test Equipment	Qty
Emergency hose (Included in the Rolls-Royce delivery)	2
Emergency plunger with two screws (Included in the Rolls-Royce delivery)	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty

Instruction

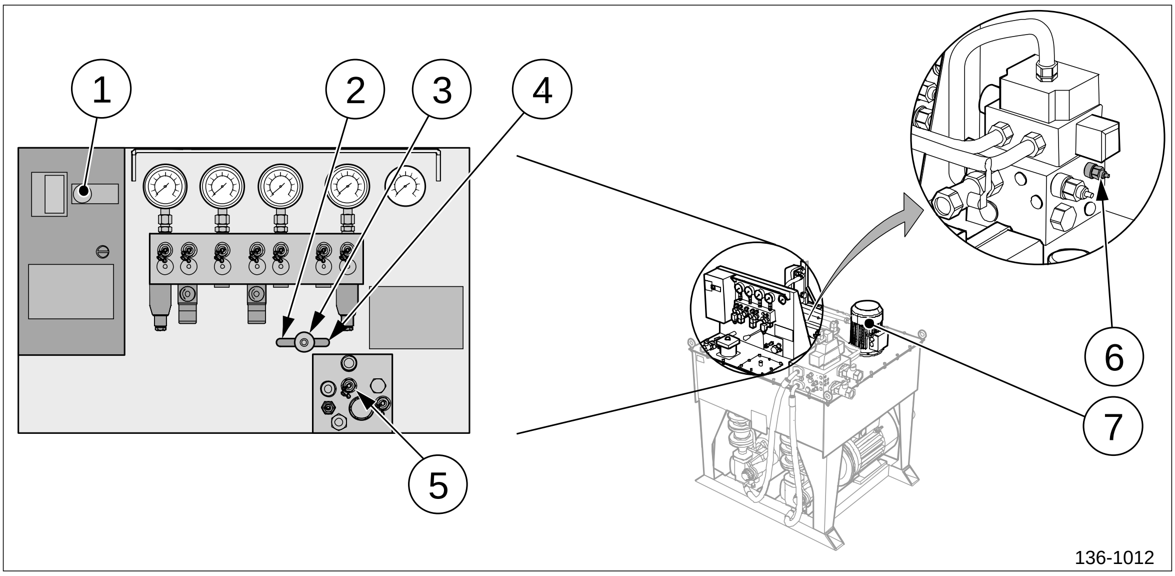

Figure 1 Hydraulic power pack with the emergency manoeuvre panel.

1. Pump unit P3
2. Valve V12, normal position
3. Valve V12, emergency control 1
4. Remote/local control switch
5. Relief valve V14
6. Test point TP3

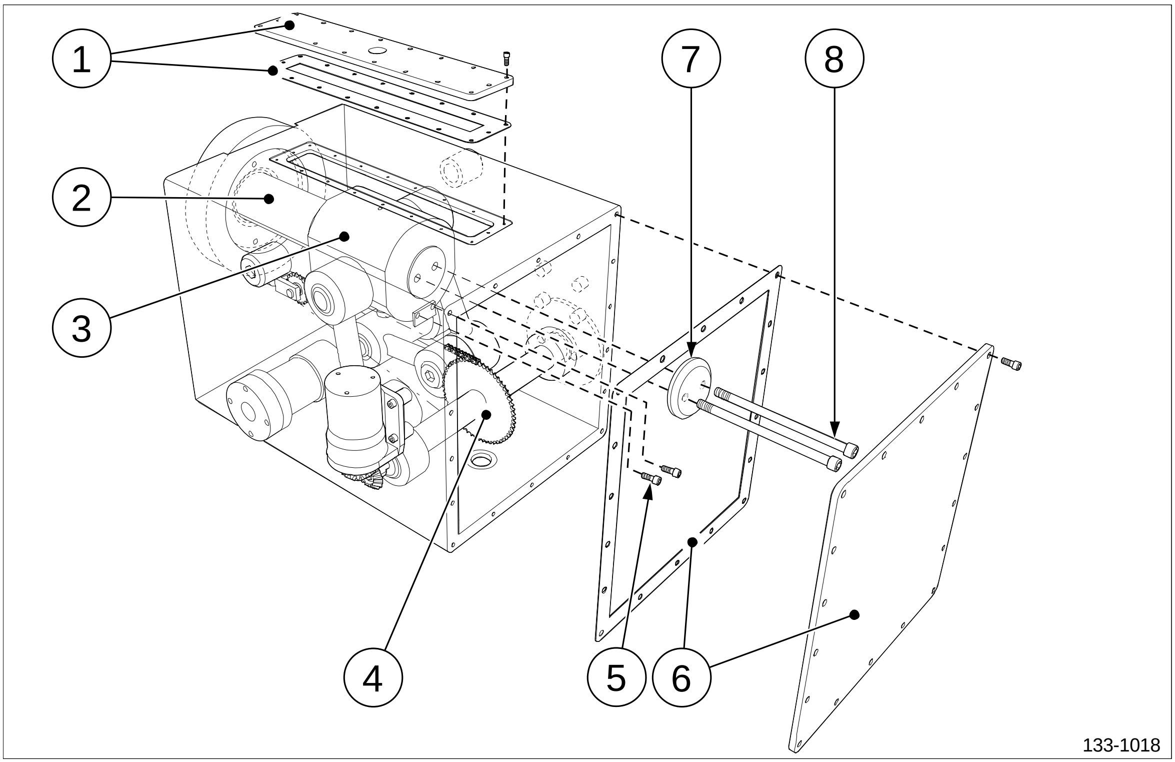

Figure 2 Preparing an OD-box (FA) for emergency pitch control mode 2.

1. Top cover and sealing
2. Stub shaft
3. OD-box ring
4. Chain wheel
5. Screws
6. End cover and sealing
7. Washer
8. Screws

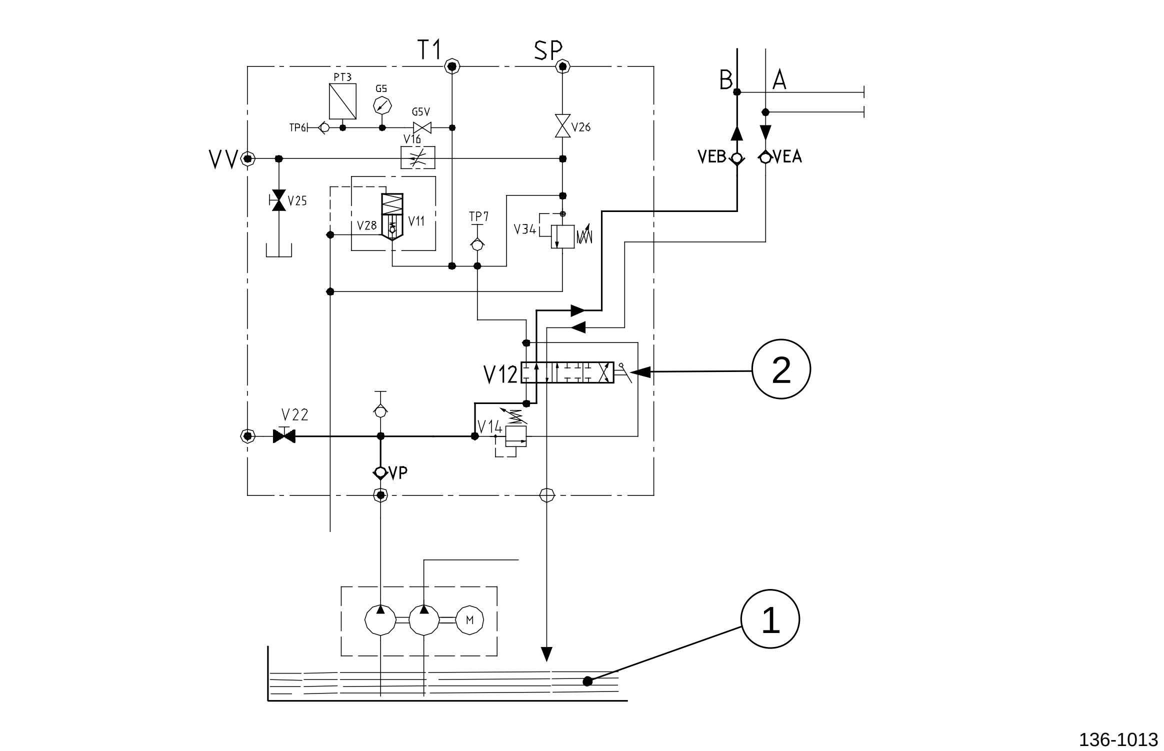

Figure 3 Hydraulic diagram showing the pitch setting using static pressure pump P3.

1. Hydraulic power pack tank
2. Valve V12 in position emergency control 1

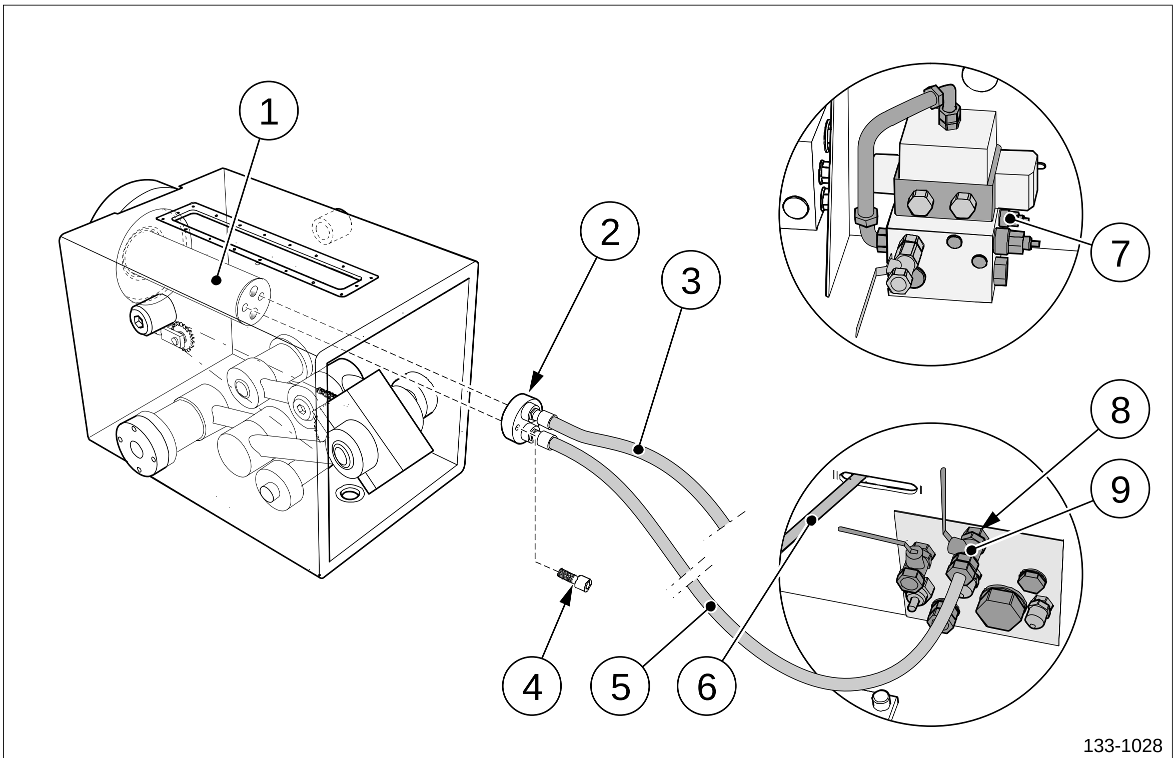

Figure 4 OD-box prepared for emergency pitch control mode 2.

1. Oil transfer tube
2. Emergency plunger
3. EP hose, oil return hose
4. Screws
5. EP hose, ahead pressure
6. Valve V12, emergency control 2 (HPP control panel front)
7. Relief valve V14 (HPP control panel back)
8. Connection EP (HPP control panel front)
9. Shut-off valve V22 (HPP control panel front)

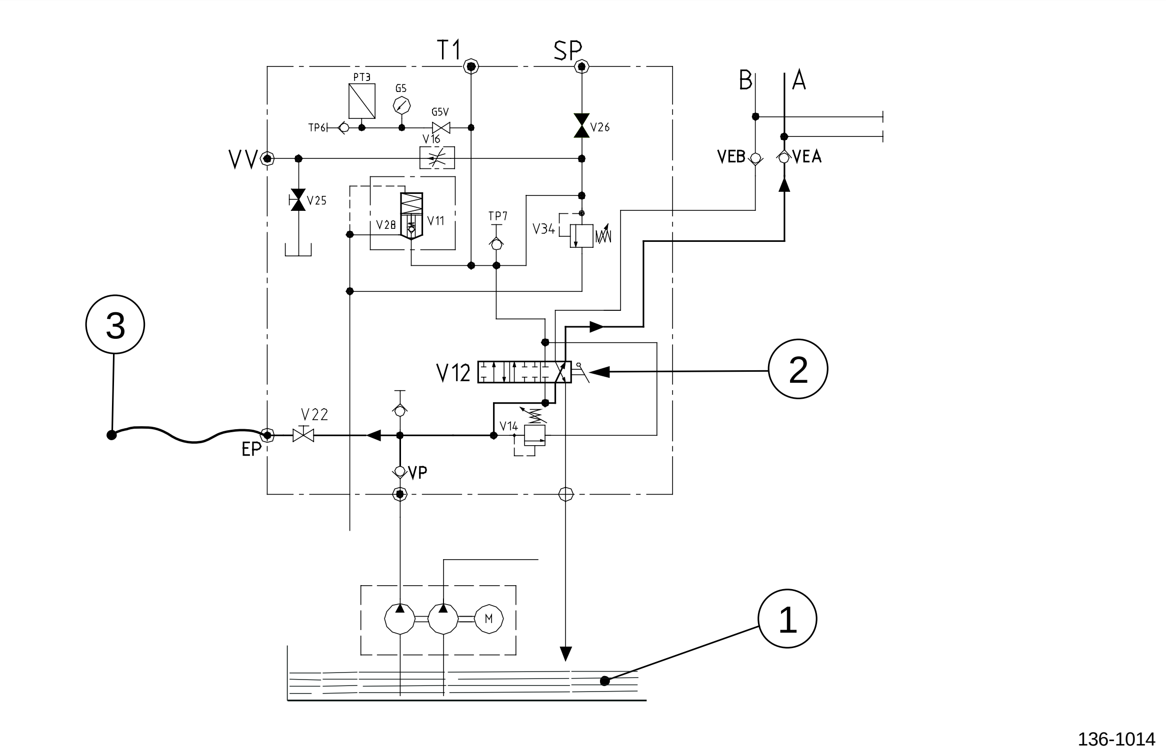

Figure 5 Diagram; emergency manoeuvre block and the EP hose connected to the OD-box.

1. Hydraulic power pack tank
2. Valve V12 in position emergency control 2
3. Hose connected to emergency plunger in OD-box

Warning: The pressurized oil can be hot!

Warning: Air mixed with oil can explode if it comes in contact with hot machine parts. There is also a risk of fire.

Caution: Use protective gloves and eye protection.

Caution: Oil mist or oil dripping onto walkways increases the risk of slipping.

Emergency Pitch Control Mode 1

Preparations for Emergency Control Mode 1

1. Turn off the main engine(s) and stop the shaft.
2. Turn the remote/local switch on the connection box on the hydraulic power pack to LOCAL CONTROL (pos 4, figure 1).
3. Set the pump units to local mode.
4. Turn off all pump units, except pump unit P3.

Performing the Emergency Control Mode 1

5. Set the emergency control valve V12 to EMERG CONTROL 1 (pos 3, figure 1) and increase the pitch to approximately 50% ahead.
6. Start the propulsion system and run it at idle speed.
7. When the desired pitch has been reached turn the emergency control valve V12 back to NORMAL position (pos 2, figure 1).
8. Increase the RPM to approximately 70%.
9. Set the emergency control valve V12 to EMERG CONTROL 1. The pressure from the pump unit P3 will now move the pitch to mechanical end position ahead. Leave the valve V12 in emergency control mode 1.
10. Connect a test gauge to test point TP3 (pos 6, figure 1) and inspect the hydraulic pressure. The normal pressure is 6 Mpa, but a deviation between +/- 1 Mpa is acceptable.
11. If the pressure is out of range the pressure relief valve V14 (pos 7, figure 4) has to be adjusted.

Always consult Rolls-Royce Marine Global Support Network when the emergency pitch setting mode has been used.

Emergency Pitch Control Mode 2

Preparations for Emergency Pitch Control 2

1. Turn off the main engine(s).
2. Lock and secure the shaft.
3. Turn the switch on the connection box on the hydraulic power pack to Local Control (pos 4, figure 1).
4. Set the pump units to local mode.
5. Turn off all the pump units.
6. Drain the OD-box completely from oil. For information see section Drain OD-box.
7. Open the OD-box end cover (pos 5, figure 2) and disconnect the feed back chain holder on the OD-box ring, remove the two screws (pos 5, figure 2).
8. Prepare a safe way to lower and remove the box ring and the stub shaft (pos 2 and 3, figure 2).

9. Remove the retaining screws (pos 7, figure 2) and the end plate (pos 9, figure 2).
10. Lower the box ring and the stub shaft. If the box ring and the stub shafts ends up outside the OD-box, lift the swivel knee and place the box ring in place inside the OD-box. Make sure to secure the box ring to the stub shaft to prevent the parts from falling apart.

Performing the Emergency Pitch Control Mode 2

1. Use the two screws to connect the emergency plunger (pos 4, figure 4) to the oil transfer tube (pos 1, figure 4). Note the position of the emergency plunger is given by the guide pin.
2. Connect one emergency hose (pos 5, figure 4) to connection B on the emergency plunger.
3. Connect one emergency hose (pos 3, figure 4) to connection A on the emergency plunger.
4. Connect the other end of hose B to the quick connection on the shut-off valve V22 (pos 9, figure 4) which is connected to the EP (pos 8, figure 4) on the emergency block on the hydraulic power pack.
5. Connect the other end of hose A to a collecting container or to the hydraulic power pack tank.
6. Start the pump unit P3.
7. Set the emergency control valve V12 to EMERG CONTROL 2 (pos 6, figure 4).
8. Carefully, open the shut-off valve V22 (pos 9, figure 4). The pressure from the pump unit P3 will move the pitch.
9. Turn off the pump unit P3 when mechanical end position ahead is reached.
10. Close valve V22.
11. Remove the hoses from the emergency plunger.
12. Re-attach the end cover on the OD-box. This will prevent dirt from entering the OD-box.
13. Set the valve V12 back to NORMAL position (pos 2, figure 1).
14. Start pump unit P3.
15. Unlock the shaft.
16. Start the propulsion system and run the shaft with maximum 70% of the shaft speed.

If the pitch moves from mechanical end position ahead, stop the shaft, and repeat step 1-15. Make sure to reduce the shaft speed.

Drain OD-box

Task: Drain OD-box Size 35 and 50 Completely (Without Gravity Tank)

Description

This task describes how to drain an OD-box size 35 and 50 completely from oil. The OD-box must be drained before the emergency pitch setting is performed.

Support Items

Spare Parts	Ref. No.

Special Tools and Test Equipment	Qty
Container to collect the oil	As req.
Draining pump (if used)	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

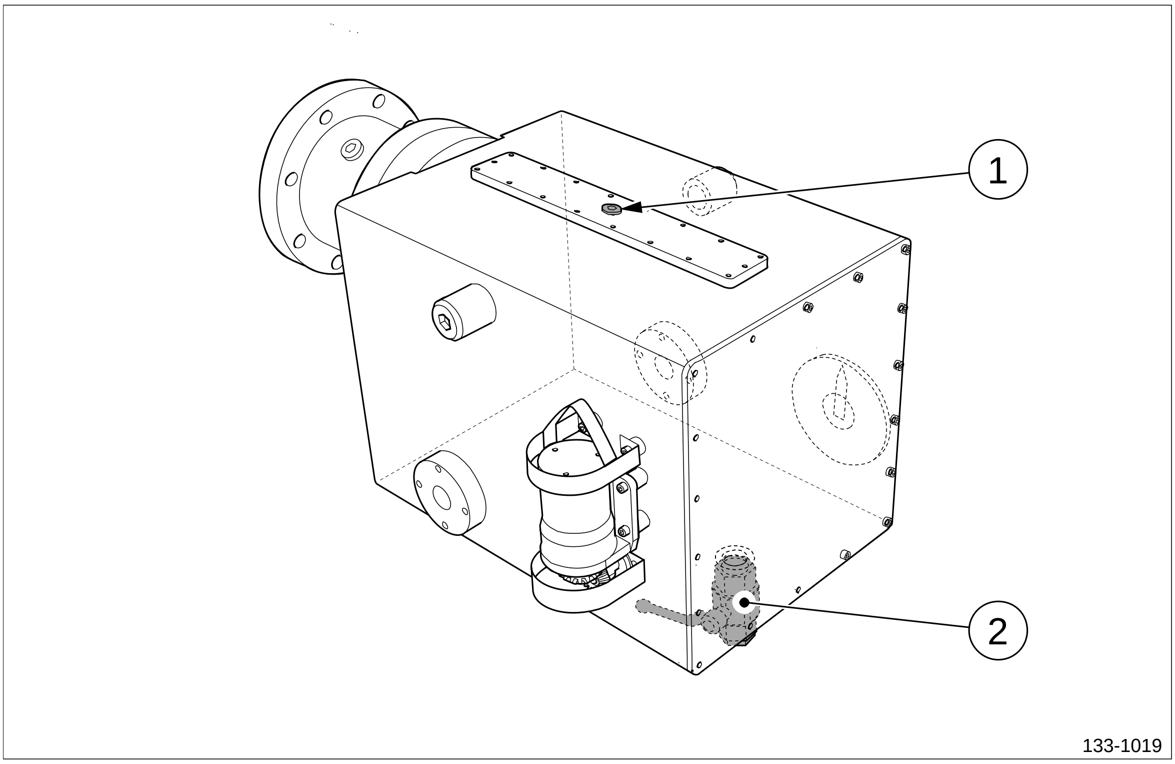

Figure 6 The OD-box drain valve.

1. Plug
2. Drain valve T

Warning: Turn off and secure the propulsion system before starting the draining.

Note: The drained oil to be disposed.

Note: The drain valve T is not part of Rolls-Royce delivery.

Before starting the draining

1. Turn off the main engine(s).
2. Set the pump units to local mode.
3. Turn off all pump units.
4. Set the local/remote switch on the hydraulic power pack tank to Local control.

Drain the OD-box

5. Place a container under the drain valve T on the OD-box (pos 2, figure 6).
6. Open the drain valve T and drain the OD-box completely.
7. Remove the plug (pos 1, figure 6) to allow air to flow into the OD-box.
8. Reinstall the plug to prevent dirt to enter the OD-box.

The OD-box can also be drained using a separate draining pump.

This task is now completed, it is now possible to continue with the emergency pitch setting procedure.

Task: Drain OD-box Size 35 and 50 Completely (With Gravity Tank)

Description

This task describes how to drain an OD-box size 35 and 50 completely from oil. The OD-box must be drained before the emergency pitch setting is performed.

Support Items

Spare Parts	Ref. No.

Special Tools and Test Equipment	Qty
Container to collect the oil	1
Draining pump (if used)	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

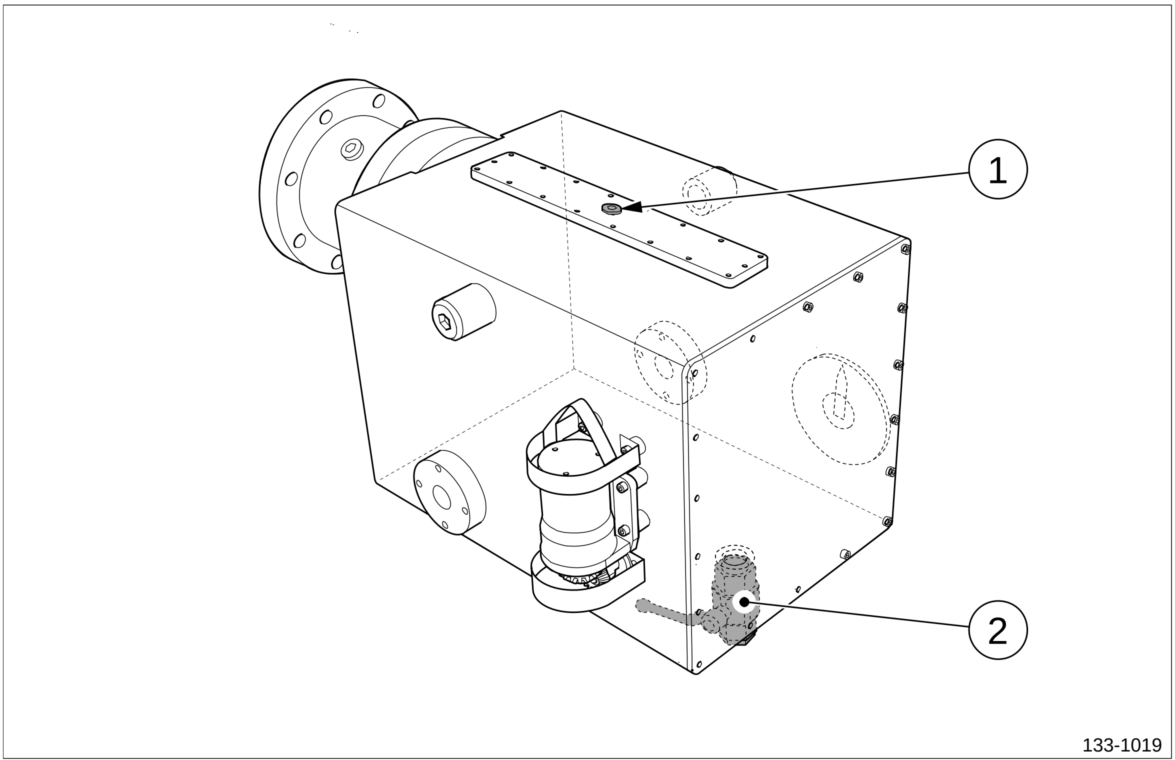

Figure 7 The OD-box drain valve.

1. Plug
2. Drain valve T

Warning: Turn off and secure the propulsion system before starting the draining.

Note: The drained oil to be disposed.

Note: **The drain valve T is not part of Rolls-Royce delivery.**

Before starting the draining

1. Turn off the main engine(s).
2. Set the pump units to local mode.
3. Turn off all pump units.
4. Set the local/remote switch on the hydraulic power pack tank to Local control.

Drain the OD-box

5. Open valve V25 on the hydraulic power pack and drain the oil in the gravity tank into the hydraulic power pack tank.
6. Close drain valve V25 when the gravity tank is drained.
7. Place a container under drain valve T on the OD-box (pos 2, figure 7).
8. Open the drain valve T and drain the OD-box completely from hydraulic oil. Make sure NOT to contaminate the oil, if it is to be re-used.
9. Remove plug (pos 2, figure 7) to allow air to flow into the OD-box.
10. Close drain valve T and plug to prevent dirt to enter the OD-box.

The OD-box can also be drained using a separate draining pump.

This task is now completed, it is now possible to continue with the emergency pitch setting procedure.

Task: Drain OD-box Size 70, 100, 140 Completely (Without Gravity Tank)

Description

This task describes how to drain an OD-box size 70, 100 and 140 completely from hydraulic oil. The OD-box must be drained before the emergency pitch setting is performed.

Support Items

Spare Parts	Ref. No.

Special Tools and Test Equipment	Qty
Container to collect the oil	As req.
Draining pump (if used)	

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

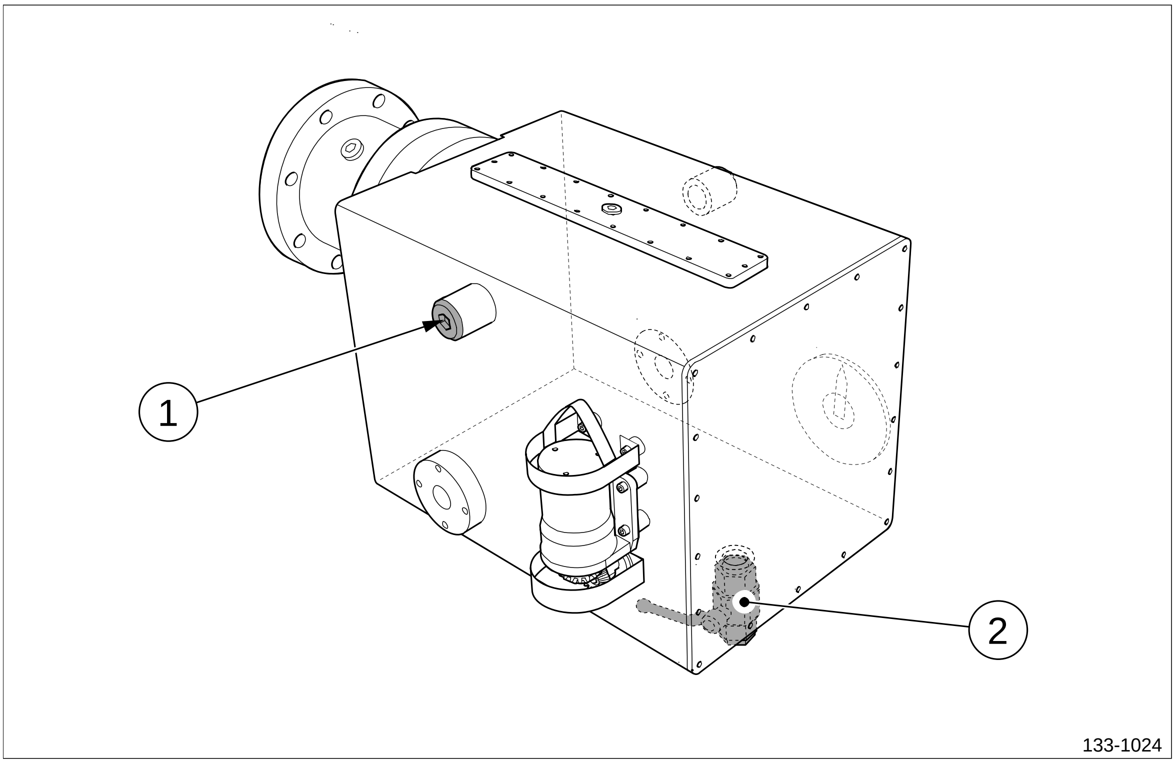

Figure 8 The OD-box drain valve and R plug.

1. R plug
2. Drain valve T

Warning: Turn off and secure the propulsion system before starting the draining.

Note: The drained oil to be disposed.

Note: **The drain valve T is not part of Rolls-Royce delivery.**

Before starting the draining

1. Turn off the main engine(s).
2. Set the pump units to local mode.
3. Turn off all pump units.
4. Set the local/remote switch on the hydraulic power pack tank to Local control.

Drain the OD-box

5. Place a container under the drain valve T on the OD-box (pos 2, figure 8).
6. Disconnect pipe connection R at the hydraulic power pack tank. This must be done to prevent the draining of the whole power pack tank.
7. Open the drain valve T and drain the OD-box completely from hydraulic oil. Make sure NOT to contaminate the oil, if it is to be re-used.
8. Close drain valve T to prevent dirt to enter the OD-box.

The OD-box can also be drained using a separate draining pump.

This task is now completed, it is now possible to continue with the emergency pitch setting procedure.

Task: Drain OD-box Size 70, 100 and 140 Completely (With Gravity Tank)

Description

This task describes how to drain an OD-box size 70, 100 and 140 completely from hydraulic oil. The OD-box must be drained before the emergency pitch setting is performed.

Support Items

Spare Parts	Ref. No.

Special Tools and Test Equipment	Qty
Container	As req.
Draining pump	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

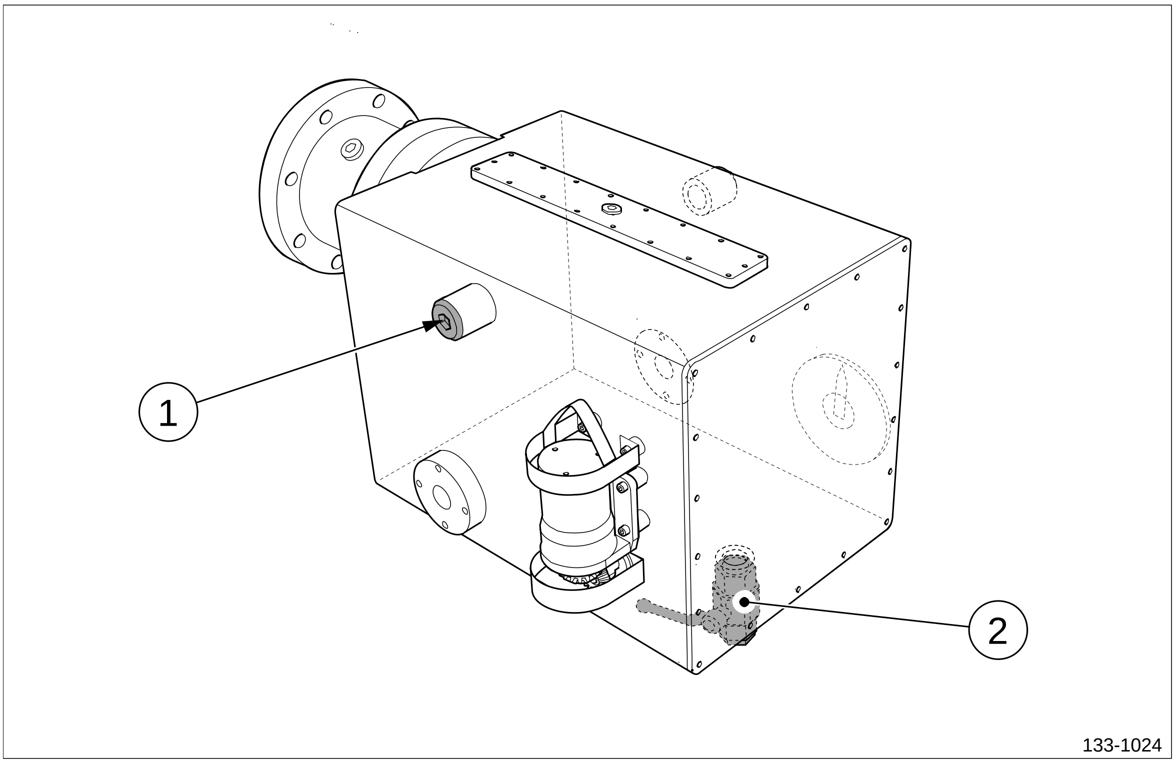

Figure 9 OD-box drain plug and R plug.

1. R plug
2. Drain valve T

Warning: Turn off and secure the propulsion system before starting the draining.

Note: The drained oil to be disposed.

Note: **The drain valve T is not part of Rolls-Royce delivery.**

Before starting the draining

1. Turn off the main engine(s).
2. Set the pump units to local mode.
3. Turn off all pump units.
4. Set the local/remote switch on the hydraulic power pack tank to Local control.

Drain the OD-box

5. Place a container under the drain valve T on the OD-box (pos 2, figure 9).
6. Disconnect the pipe connection R at the hydraulic power pack tank. This must be done to prevent the draining of the whole power pack tank.
7. Open the drain valve T and drain the OD-box completely from hydraulic oil. Make sure NOT to contaminate the oil, if it is to be re-used.
8. Close drain valve T to prevent dirt to enter the OD-box.

The OD-box can also be drained using a separate draining pump.

This task is now completed, it is now possible to continue with the emergency pitch setting procedure.

Maintenance

Reading this Part

General

This part covers the required maintenance of the propulsion system parts which are manufactured by Rolls-Royce. The needed documentation from each sub-supplier is appended in part Sub-supplier Manuals. Make sure to also read the sub-supplier documentation carefully before starting any maintenance.

The Maintenance part contains information and maintenance tasks of how to perform maintenance of the CPP system.

If there are any questions about how to perform a maintenance task, please consult Rolls-Royce Marine Global Support Network before proceeding.

The task instructions are divided into preventive maintenance and corrective maintenance. The preventive maintenance is divided into the following time intervals: before departure (system-start-up), daily, monthly, every third month, every sixth month, yearly, and every fifth year maintenance.

The corrective maintenance chapter covers the unscheduled corrective maintenance activities on board the vessel.

The preventive and corrective maintenance chapters cover the maintenance and faults that can be taken care of on board the vessel by the vessel’s own personnel, please note that it does not cover advanced maintenance which must be performed in a dry dock and/or by an service engineer.

Support Items Table

Every maintenance task includes a Support Items chapter. This chapter provides information which will be needed during the maintenance task. The following information is included in the table:

• Spare part name and cross reference number

• Special/Additional tools and test equipment

• Reference documents

• Consumables

The tool table covers the special/additional tools needed to perform a task, not the standard tools. Rolls-Rolls presumes that standard tools are available on board the vessel. For more information see part Tools.

The reference documents are found in part Design Drawings or part Sub Supplier Manuals.

Maintenance Plan

Introduction

This maintenance plan is intended as a guide when planning maintenance tasks. All tasks are described by means of step-by-step instructions in the part Maintenance.

For each task, there are two levels specified, facility level and skill level. These two levels determine the maintenance level of a task. There are four maintenance levels; A, B, C, and D. This user manual consists of level A and B maintenance tasks, but the C level is also presented in the Maintenance Plan.

Skill level

The skill levels indicate the skill level of the person responsible for the maintenance task. The codes for skill level are:

A – Crew member

B – Technical engineer (senior staff onboard or external engineer)

C – Rolls-Royce engineer

Facility

The facility indicates the physical location of the vessel during the maintenance procedure. The codes for facility are:

A – Onboard

B – Harbour

C – In dry dock

D – At Rolls-Royce workshop

Maintenance level

The maintenance levels indicate the combination of the skill levels and facility. The codes for maintenance level are:

Skill / Facility	A: Crew	B: Technical engineer	C: Rolls-Royce engineer
A: Onboard	A	B	C
B: Harbour		B	C
C: Dry dock		B	C
D: RR workshop			D

Preventive Maintenance

For planning maintenance concerning any sub supplier equipment, please see respective Sub Supplier's manual for its periodic maintenance.

The preventive maintenance is performed on a scheduled basis and is supposed to prevent any equipment from getting damaged.

The maintenance task listed in section "Overhaul in Drydock" is a general recommendation from Rolls-Royce and the order of the maintenance tasks may differ between the shipyards.

ID	System	Task Description	Skill level	Facility
Before Departure				
1	Shafting	Inspect shaft arrangement (visually)	B	A
2	Hydraulic	Inspect oil levels and oil pressure	B	A
Daily Maintenance				
1	General	General Inspection	B	A
2	Shafting	Inspect shaft arrangement (visually)	A	A
3	Hydraulic	Inspect hydraulic system	A	A
4	Hydraulic	Inspect gravity tank	A	A
Weekly Maintenance				
1	Hydraulic	Drain the hydraulic power pack from condensed water	A	A
2	OD-box	Drain the drain pump unit tank from condensed water (M0)	A	A
3	Hydraulic	Drain the gravity tank from condensed water	A	A
4	OD-box	Drain the OD-box from condensed water (FA)	A	A
5	Shafting	Inspect earthing device	A	A
6	Control	Inspect remote control system	A	A
Monthly Maintenance				
1	Shafting	Inspect onboard shaft, flanges, and couplings	B	A
2	Shafting	Inspect Stern Tube Oil Quality	B	A
3	OD-box	Visually inspect the OD-box (FA)	A	A

ID	System	Task Description	Skill level	Facility
4	OD-box	Inspect the chain tightener	A	A
5	OD-box	Clean and inspect the feed back box (FA)	A	A
6	OD-box	Visually inspect OD-box for leakage (M0)	B	A
7	OD-box	Inspect feed back unit assembly (M0)	B	A
8	OD-box	Inspect and adjust indicating rollers (M0)	A	A
9	OD-box	Lubricate feed back unit (M0)	A	A
10	Control	Inspect remote control/closed loop system	A	A
11	Control	Clean and inspect RPM transmitter	A	A
Every Third Month Maintenance				
1	Hydraulic	Take an oil sample	B	A
Every Six Month Maintenance				
1	Shafting	Clean and inspect outboard shafts under water	B	B
2	Shafting	Clean, inspect, and treat inboard shafts with new corrosive preventive agent.	B	B
3	Propeller	Clean and inspect propeller hub and blades under water.	B	B
4	Hydraulic	Test the shut-off valves	A	A
5	Hydraulic	Test emergency operating system	B	B
6	Hydraulic	Inspect level switch LS1 hydraulic power pack	A	B
7	Hydraulic	Inspect level switch LS3 gravity tank	A	B
8	Hydraulic	Inspect temperature sensor TT1	B	A
9	Hydraulic	Inspect autostart of the pump units	B	B
10	Hydraulic	Inspect pressure transmitter PT1, PT3	B	B
11	Hydraulic	Test safety valve V1	B	B
12	Hydraulic	Test relief valve V8	B	B
13	Hydraulic	Test check valve V17	B	B
14	Hydraulic	Replace circulation filter	A	B
15	OD-box	Visually inspect feed back box (FA)	B	A
16	OD-box	Inpect axial ring (M0)	A	A
17	OD-box	Inspect box support stay on OD-box (M0)	A	A
18	OD-box	Inspect feed back unit assembly on OD-box (M0)	A	A
19	OD-box	Inspect level switch on drain oil tank (M0)	A	A
20	OD-box	Inspect temperatur sensor on OD-box (M0)	B	A
21	General	Inspect lifting tools	B	B
22	General	Inspect stored spare parts	B	B
23	General	Inspect the cathodic protection	B	B
Yearly Maintenance				
1	General	General functional inspection of complete propulsion system	C	B
2	General	Functional inspection pitch indicator on OD-box	B	A
3	Control	Inspect remote control/closed loop system	B	B
Every Fifth Year Maintenance (Or earlier if vessel is docked)				
1	Propeller	Replace blade sealing ring	B	C
2	Hydraulic	Replace all hydraulic hoses. Also replace the emergency hose and spare hoses	A	B

ID	System	Task Description	Skill level	Facility
Overhaul in Dry Dock				
1	Shafting	Measure the maximum run out of shaft and twin tube before any overhaul	C	C
2	Shafting	Run-out check of the shaft alignment before any overhaul, on both ends of the coupling on shaft	C	C
3	Shafting	Clean and inspect shaft flanges and couplings	C	C
4	Shafting	Inspect shaft brake, shaft locking device, and shaft turning system (If applicable)	C	C
5	Shafting	Inspect the shaft sealings	C	C
6	Shafting	Perform a liquid penetrant inspection on all inboard shafts	C	C
7	Shafting	Clean and inspect the outboard shafts	C	C
8	Shafting	Inspect the outboard shaft plastic coating	C	C
9	Shafting	Treat the shafts with new corrosive preventive agent.	B	B
10	Shafting	Clean and inspect faring cover (eddy plates) and rope guards	C	C
11	Shafting	Inspect the shaft flange protection system	C	C
12	Shafting	Clean and inspect the shaft bearings	C	C
13	General	Check that the sacrificial anodes are intact	C	C
14	Shafting	Shaft withdrawal, inspect the shaft and stern tube bearing for wear and water ingress	C	C
15	Propeller	Clean and inspect the propeller blades and hub	C	B
16	Propeller	Liquid penetrant inspection of the propeller blades.	C	C
17	Propeller	Take oil samples from the centre part of the hub	C	C
18	General	Drain the centre part of the propeller hub and the shaft line	C	C
19	Propeller	Inspect the blade bolts	C	C
20	Propeller	Replace the blade sealing rings	B	C
21	General	Refill oil to the centre part of the propeller hub and the shaft line	C	C
22	Hydraulic	Drain the hydraulic system (hydraulic power pack and gravity tank)	A	A
23	Hydraulic	Clean and inspect the hydraulic power pack	A	B
24	Hydraulic	Clean and inspect the gravity tank	A	B
25	Hydraulic	Replace all the hydraulic hoses	A	B
26	Hydraulic	Fill oil and flush the hydraulic system	A	B
27	Hydraulic	Bleed air from the high pressure system	A	B
28	Hydraulic	Functional inspection of the hydraulic system	C	C
29	General	Pressure test the propeller hub	C	C
30	OD-box	Drain and inspect the OD-box	C	C
31	OD-box	Functional inspection of OD-box	C	C
32	OD-box	Pressure test the OD-box	C	C
33	General	Inspect the marking on the propeller hub against the pitch indicator on the OD-box	C	C

ID	System	Task Description	Skill level	Facility
34	OD-box	Adjust the OD-box scale	C	C
35	OD-box	Inspect the bushes in the feed back box for cracks	C	C
Extended Overhaul in Dry Dock				
1	General	Carry out the tasks listed in Overhaul in Drydock	C	C
2	General	Overhaul main propeller system	C	C
3	Shafting	Clean and inspect outboard shaft flanges (penetrant inspection)	C	C
4	Shafting	Clean and inspect inboard shaft flanges and couplings (penetrant inspection)	C	C
5	Shafting	Overhaul twin tubes	C	C
6	Shafting	Inspect shaft brake/shaft locking device thoroughly	C	C
7	Hydraulic	Test hydraulic system (completely)	C	C
8	OD-box	Overhaul OD-box assembly including feed back box	C	C
9	Control system	Inspect and test the remote control/closed loop system	C	C

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Revision date:

Before Departure, Shafting

Task: Inspect Shaft Arrangement (visually)

Description

This task describes how to visually inspect the shaft arrangement.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
Shafting arrangement drawing

Consumables	Qty

Instruction

1. Inspect the shaft arrangement regarding fastening. Make sure all nuts and bolts are fitted and tightened.
2. Inspect the shaft arrangement for leakage.
3. Inspect the oil level in the intermediate shaft bearing.
4. Inspect the oil level in the stern tube (if applicable.

This task is now completed.

Hydraulic System

Inspect Oil Level and Oil pressure

Description

This task describes how to inspect the oil level and oil pressure in the hydraulic system. The hydraulic system must be inspected in order to keep the system operating without any disturbance. This task also describes how to fill oil in the hydraulic power pack.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Filling unit for hydraulic systems	1

Reference Documents
Hydraulic power pack assembly drawing

Consumables	Qty
Linen rags	As req.
Oil, according to the oil requirements	As req.

Instruction

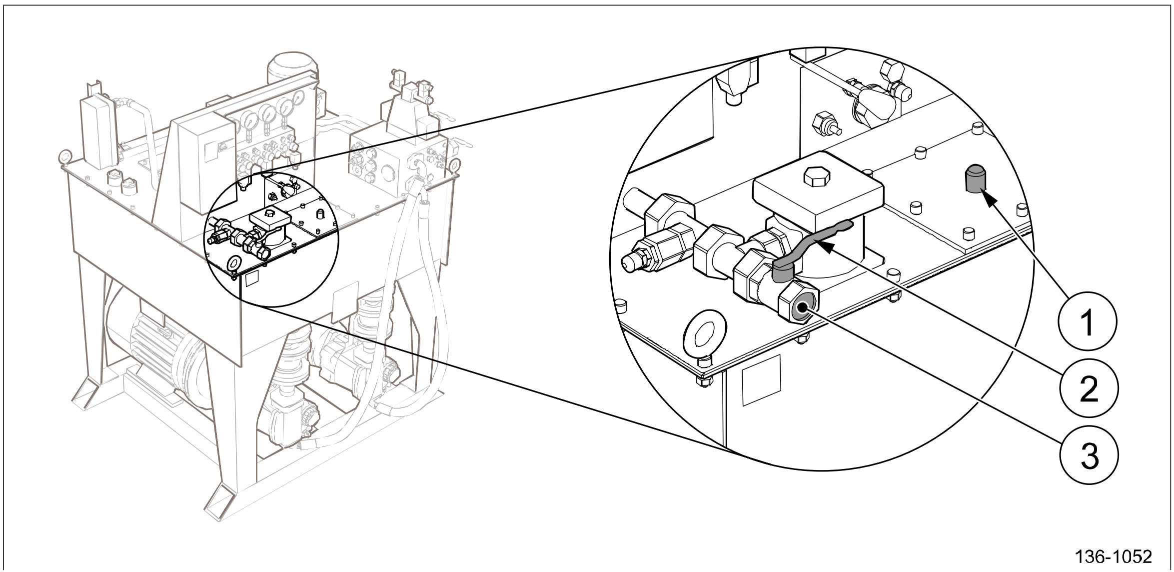

Figure 1 Return block on the hydraulic power pack.

1. Dipstick
2. Shut off valve Z
3. Connection Z

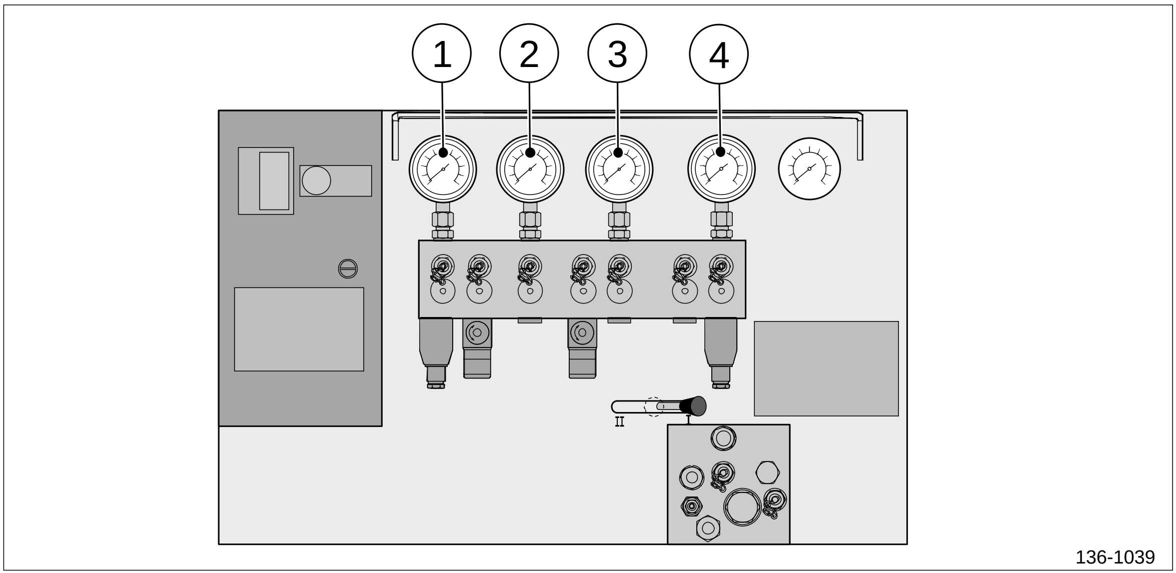

Figure 2 Oil pressure gauges on the hydraulic power pack control panel.

1. Servo pump pressure (G1)
2. Booster pump pressure (G2)
3. A-port - astern working pressure (G3)
4. B-port - ahead working pressure (G4)

Caution: The oil in the hydraulic system can be hot.

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

Note: Always use clean equipment when inspecting the oil level.

Note: The oil must always be filled through connection Z in order not to by-pass the filter function.

Note: The hydraulic power pack must be filled with oil that fulfils the requirements in section Oil Requirements in part Technical Data.

Inspect oil level

1. Locate the dip stick on the hydraulic power pack (pos 1, figure 1).
2. Unscrew the dip stick.
3. Use the dip stick to inspect the oil level. Use a clean linen rag to wipe off the dip stick.
4. Refill oil if necessary. Refill according to instruction Subtask: Refill Oil.
5. Fit the dip stick on the hydraulic power pack. Make sure to tighten correctly.

Refill oil

6. Turn off all hydraulic pumps.
7. Locate the connection Z (pos 3, figure 1) on the hydraulic power pack.
8. Wipe off the connection Z with a clean linen rag.
9. Connect the filling unit to the connection Z.
10. Open shut-off connection Z (pos 2, figure 1).
11. Fill the hydraulic power pack tank to its maximum level. Make sure to keep the filling pressure below 0.3 MPa during filling.

12. Close the shut off valve Z.
13. Disconnect the filling unit.
14. Start the hydraulic pumps and let them run for 30 minutes.
15. Inspect the oil level in the hydraulic power pack again and refill oil if necessary.

Inspect oil pressure

16. Use the pressure gauges (G1 - G5, see figure 2) to inspect the oil pressure. For maximum pressure values see the Hydraulic Diagram drawing.
17. Report any major disturbances to Rolls-Royce Marine Global Support Network.

This task is now completed.

Daily Maintenance

General Inspection

A general inspection of the complete propulsion system is performed while performing the usual daily maintenance tasks.

This means that anything which deviates from the normal state of the propulsion system should be noticed and attended. The inspection includes viewing, listening, and smelling anything that normally is not there.

Examples of things to pay attention to while performing a general inspection are:

• Pipes, couplings, and connections

• Shaft line

• OD-box

• Electrical equipment, cables, glands, and connections

• Oil tanks

• Nuts and bolts

• Oil spillage

• Pumps

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Revision date:

Daily Maintenance, Shafting

Task: Inspect Shaft Arrangement (visually)

Description

This task describes how to visually inspect the shaft arrangement when the propulsion system is in operation.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
Shafting Arrangement drawing

Consumables	Qty

Instruction

1. Inspect the shaft arrangement regarding fastening. Make sure all nuts and bolts are fitted and tightened.
2. Inspect the shaft arrangement for leakage. Make sure to inspect the stern tube seal.
3. Inspect the shaft arrangement regarding any abnormal sounds, any abnormal vibrations, etc.
4. Inspect the oil level in the intermediate shaft bearing.
5. Inspect the oil flow in the intermediate shaft bearing through the inspection glass on top of the bearing.
6. Inspect the shaft bearing temperature. The temperature should be below 65^{o}C.
7. If applicable, inspect that the shaft brake is properly disengaged.

This task is now completed.

Daily Maintenance, Hydraulic System

Task: Inspect Hydraulic System

Description

This task describes how to inspect the hydraulic system. The hydraulic system must be inspected in order to keep the system operating without any disturbance.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

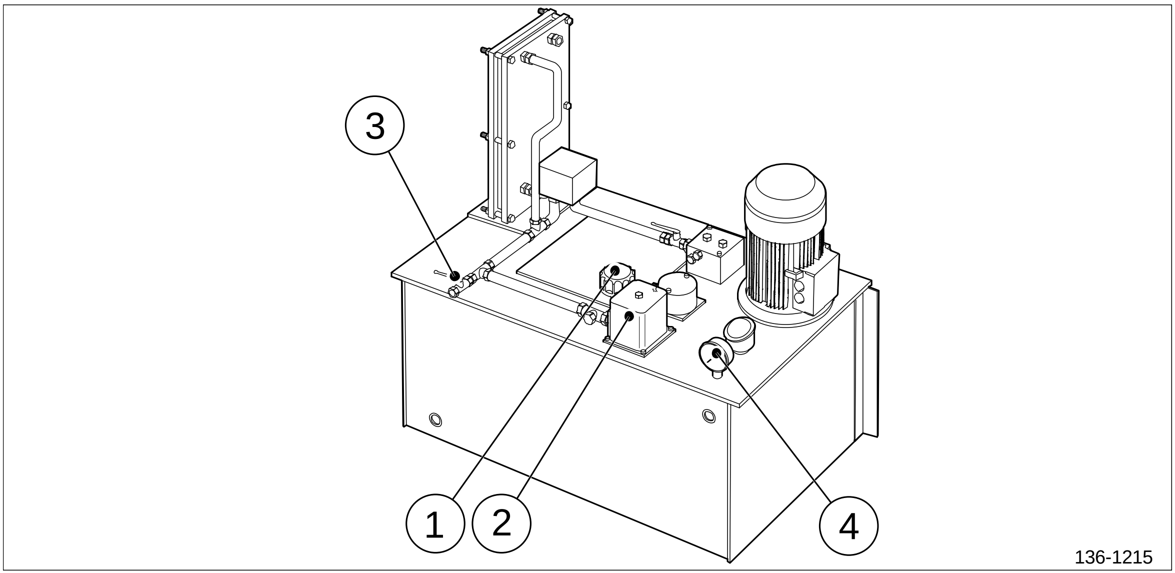

Figure 1 The dipstick is located under the lid.

1. Dipstick and air breather filter
2. Circulation filter
3. Connection/Shut-off valve Z
4. Temperature Gauge

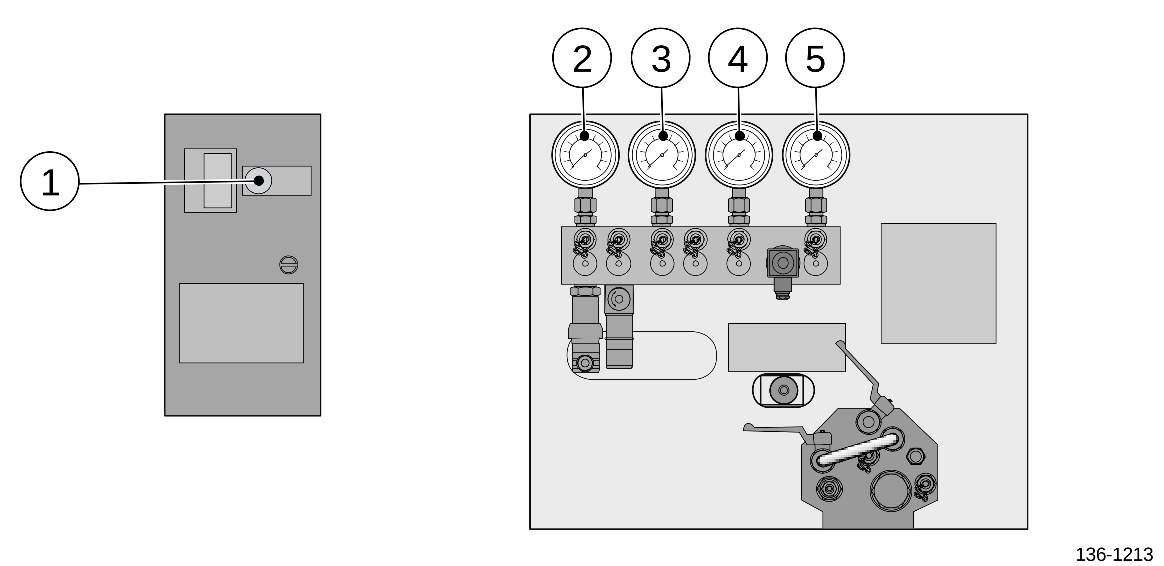

Figure 2 Oil pressure gauges located on the hydraulic power pack control panel.

1. Local/remote switch
2. Gauge G1: actual oil pressure in servo pump line
3. Gauge G3: A port - astern working pressure
4. Gauge G4: B port - ahead working pressure
5. Gauge G5: static pressure

Caution: **Oil in the hydraulic system is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions. The oil in the hydraulic system can be hot.**

Note: **Make sure to use clean equipment when inspecting the oil level.**

Inspect Pipes, Hoses, Flange Connections, and Test Points

1. Make sure that the hydraulic system is running.
2. Visually inspect all pipes, hoses, flange connections, and test points on the hydraulic system for leakage. Tighten if needed.
3. Inspect all cables and electrical connections on the hydraulic system. If there is any wear or damage, consult an electrician.

Inspect Oil Level and Air Breather Filter

4. Locate the dipstick on the hydraulic power pack (pos 1, figure 1).
5. Unscrew the dipstick lid. The dipstick and an air breather filter are fastened in the lid.
6. Use the dipstick to inspect the oil level. Use a clean linen rag to wipe off the dipstick.
7. Inspect the air breather filter. Replace the filter if it is contaminated or worn out.
8. Refill oil if necessary. For more information, see Task: Refill Oil. Make sure to use oil that meets the recommendations in the document Requirements for Lubrication oil.
9. Fit the dipstick in place on the power pack unit and tighten the lid.

Inspect Oil Pressure

10. Use the pressure gauges (figure 2) to inspect the oil pressure. For maximum pressure values see Hydraulic Diagram drawing.
11. Inspect the static pressure on gauge G5. Make sure that the pressure corresponds with the pressure values stated on the Hydraulic Diagram drawing. (pos 5, figure 2)
12. Please report any major disturbances to Rolls-Rolls Marine Global Support Network.

Inspect Oil Temperature

13. Use the temperature gauge to inspect the oil temperature. The temperature must be below 65^{O}C.(pos 4, figure 1)

Inspect Contamination of Circulation Filter

14. A filter indicator is located on the circulation filter (pos 2, figure 1). Check the indicator and replace the filter element if necessary, see instruction in Task: Replace Circulation Filter Element.

Inspect the Electrical Pump Units

15. Make sure that the hydraulic system is running.
16. Visually inspect all the pipes, hoses, flange connections connected to the pump units for leakage. Tighten if needed.
17. Inspect the pump units regarding abnormal vibrations, etc.
18. If the main pump unit (P1) is found faulty, turn it off.
    Replace according to Task: Replace Pump P1.
19. If the static pressure and circulation pump unit P3 is faulty, turn it off and replace the whole pump unit according to Task: Replace the Pump Unit P3.
20. Consult Rolls-Royce Marine Global Support Network if necessary.

This task is now completed.

Inspect the PTO Pump (if applicable)

21. Make sure that the hydraulic system is running.
22. Visually inspect all the pipes, hoses, flange connections connected to the PTO pump unit for leakage. Tighten if needed.
23. Inspect the PTO pump regarding abnormal vibrations, etc.
24. If the PTO pump is found faulty, disconnect it. Use pump unit P1 until it is possible to replace the PTO pump.
25. Consult Rolls-Royce Marine Global Support Network if necessary.

This task is now completed.

Daily Maintenance, Hydraulic System

Task: Inspect Gravity Tank

Description

This task describes how to inspect the pipe connections and the oil level in the gravity tank. The gravity tank must be inspected in order to keep the system operating without any disturbance.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty

Reference Documents

Consumables	Qty
Linen rags	As req.

Instruction

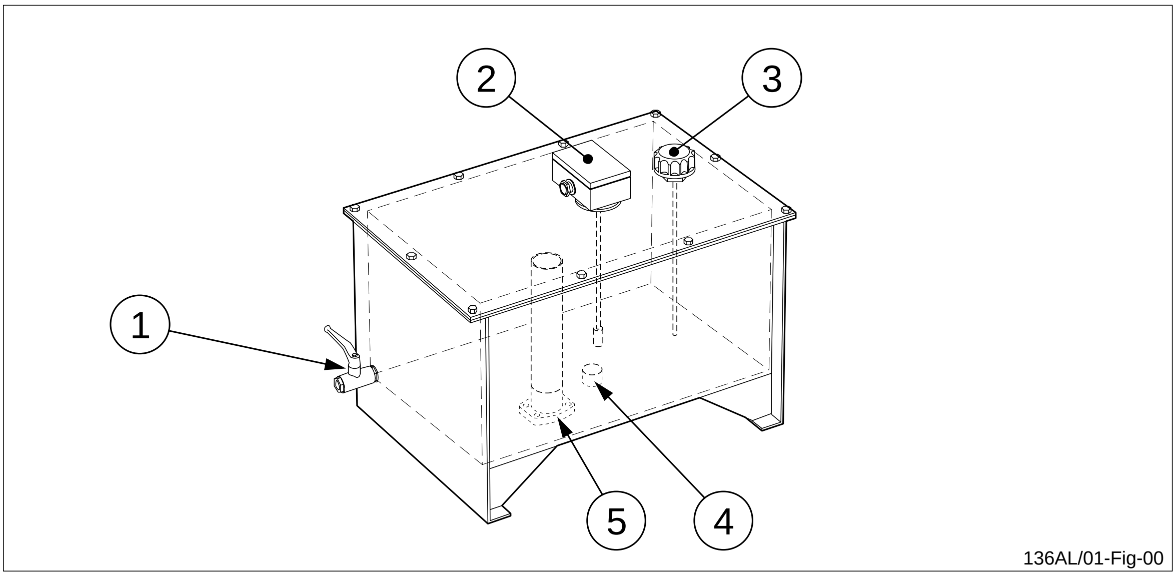

Figure 1 Gravity tank.

1. Drain valve
2. Level switch
3. Dipstick, including air breather filter
4. Connection VV
5. Connection TT

Warning: Inspection during operation is associated with great risks for personal safety due to rotating shaft.

Caution: Oil in the hydraulic system is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions. The oil in the hydraulic system can be hot.

Note: Make sure to use clean equipment when inspecting the oil level.

Inspect pipe connections

1. Make sure that the hydraulic system is running.
2. Visually inspect all pipe connections on the gravity tank for leakage. Tighten if needed.
3. Take the necessary actions if any leakage is found.

Inspect oil level

4. Locate the dipstick on the gravity tank (pos 3, figure 1).
5. Unscrew the dipstick lid. The dipstick is fastened in the lid.
6. Use the dipstick to inspect the oil level. Make sure to use a clean linen rag to wipe off the dipstick.
7. Fit the dipstick if the oil level is acceptable and tighten the lid.
8. Consult Rolls-Royce if the oil level is below the minimum level.
9. Inspect that pump unit P3 is running properly if the oil level is below minimum level.
10. Consult Rolls-Royce if necessary.

This task is now completed.

Weekly Maintenance, Hydraulic System

Task: Drain Condensed Water from Hydraulic Power Pack

Description

This task describes how to drain condensed water from the hydraulic system. The water must be drained from the hydraulic system in order to keep the system operating without disturbance.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Container to collect oil	As req.

Reference Documents
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

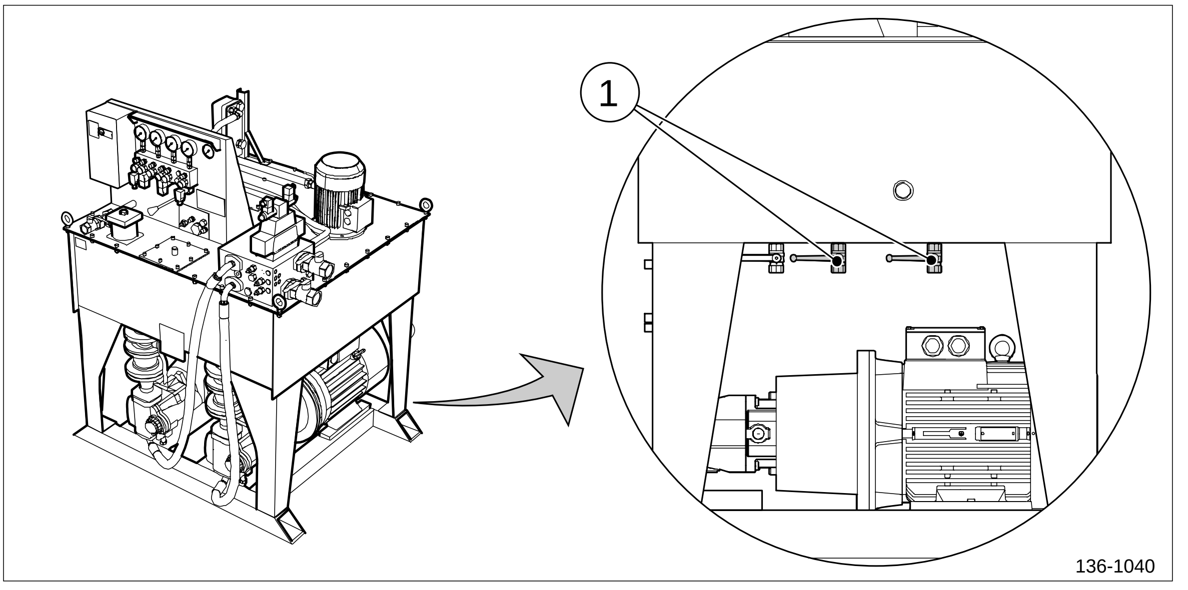

Figure 1 The shut-off valves placed on the side of the hydraulic power pack.

1. Shut-off valve X1 and X2

Warning: The propulsion system must be turned off and the shaft must be locked and secured during this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off all pump units one hour before draining in order to let the water sink to the bottom of the oil tank.
2. Make sure the pump units are set to local control and that they cannot be started.

Drain the condensed water

3. Place the container under the shut-off valves X1 and X2 (see figure 1).
4. Open the shut-off valves X1 and X2 and drain until only clean oil comes out of the shut-off valves.
5. Close the shut-off valves X1 and X2.
6. Set the pump units to remote control.
7. Make sure there is no leakage from the shut-off valves X1 and X2.
8. Wipe off any oil spillage.
9. Inspect the oil level in the hydraulic power pack and refill if necessary. Refill purified oil according to instruction Task: Refill Oil to the Hydraulic System .
10. Dispose the collected oil according to local regulations.

This task is now completed.

Weekly Maintenance, Hydraulic System

Task: Drain Condensed Water from the Gravity Tank

Description

This task describes how to drain condensed water from the gravity tank. The water must be drained from the gravity tank in order to keep the hydraulic system operating without disturbance.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Container to collect oil	As req.

Reference Documents
Gravity Tank Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

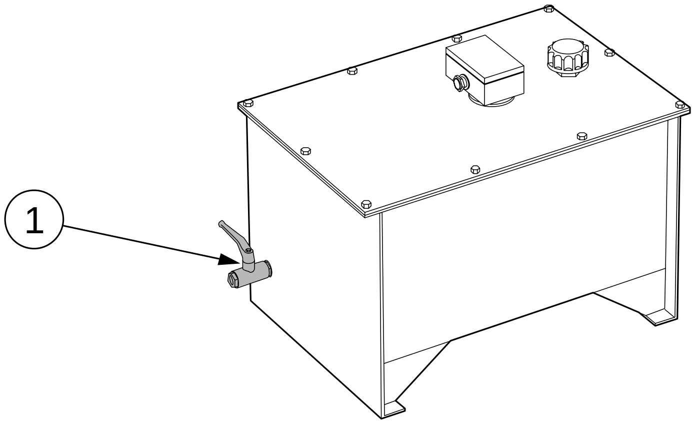

Figure 1 Gravity tank.

1. Shut-off valve

Warning: The propulsion system must be turned off and the shaft must be locked and secured during this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting the task

1. Turn off all pump units one hour before draining in order to let the water sink to the bottom of the gravity tank.
2. Make sure the pump units are set to local control and that they cannot be started.

Drain the condensed water

3. Place the container under the shut-off valve.
4. Open the shut-off valve and drain until only clean oil comes out of the shut-off valve.
5. Close the shut-off valve on the gravity tank.
6. Wipe off any oil spillage.
7. Set the pump units back to remote control.
8. Inspect the oil level in the hydraulic power pack and refill if necessary. Refill purified oil according to the instructions in Task: Refill Oil to the Hydraulic System.
9. Dispose the collected oil according to local regulations.

This task is now completed.

Weekly Maintenance, OD-box

Task: Drain OD-box from Condensed Water

OD-box Size 35 and 50, System Without Gravity Tank

Description

This task describes how to drain an OD-box size 35 and 50 from condensed water. The OD-box must be drained from condensed water in order to keep the system operating without any disturbance.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Container 10 litres, to collect the oil spillage	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

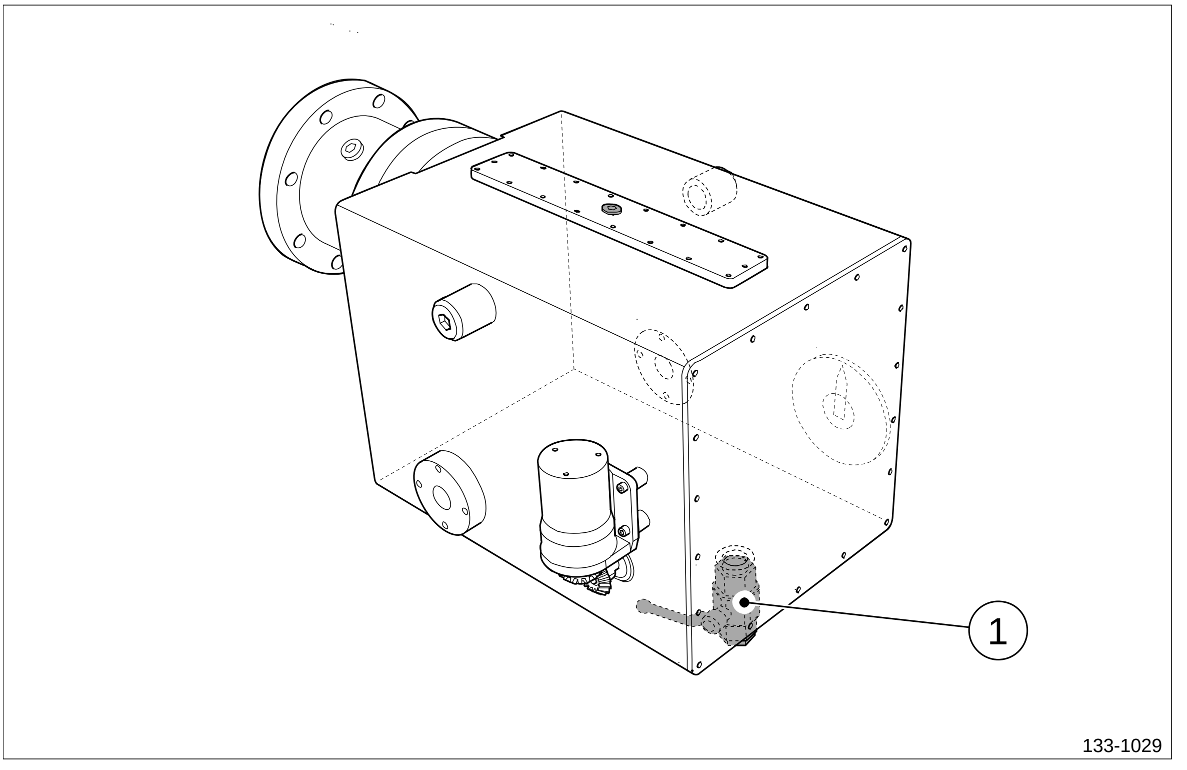

Figure 1 OD-box (FA).

1. Drain valve T

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

Note: Make sure to turn the remote/local switch on the pump motor starters to LOCAL position.

1. Turn the remote/local switch on the pump motor starters P1 and P2 to LOCAL position.
2. Turn the stop/run switch on the all pump motor starters to STOP position, except pump motor starter P3, one hour before draining to allow the oil to settle.
3. Place a container under the drain valve T on the OD-box (pos 1, figure 1).
4. Open drain valve T and drain oil until clean oil comes out of the drain valve.

5. Close the drain valve T. Make sure that no oil is leaking from the drain valve.
6. Inspect the oil level in the hydraulic power pack. Refill oil to the hydraulic power pack tank if the oil level is below the minimum level. For more information see instruction Refill Oil to the Hydraulic System in section Corrective Maintenance.
7. Turn the remote/local switch on the pump motor starters P1/P2 to REMOTE position.

This task is now completed, it is safe to start the propulsion system.

OD-box Size 35 and 50, System with Gravity Tank

Description

This task describes how to drain an OD-box size 35 and 50 from condensed water. The OD-box must be drained from condensed water in order to keep the system operate without any disturbance.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Container 10 litres, to collect the oil spillage	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

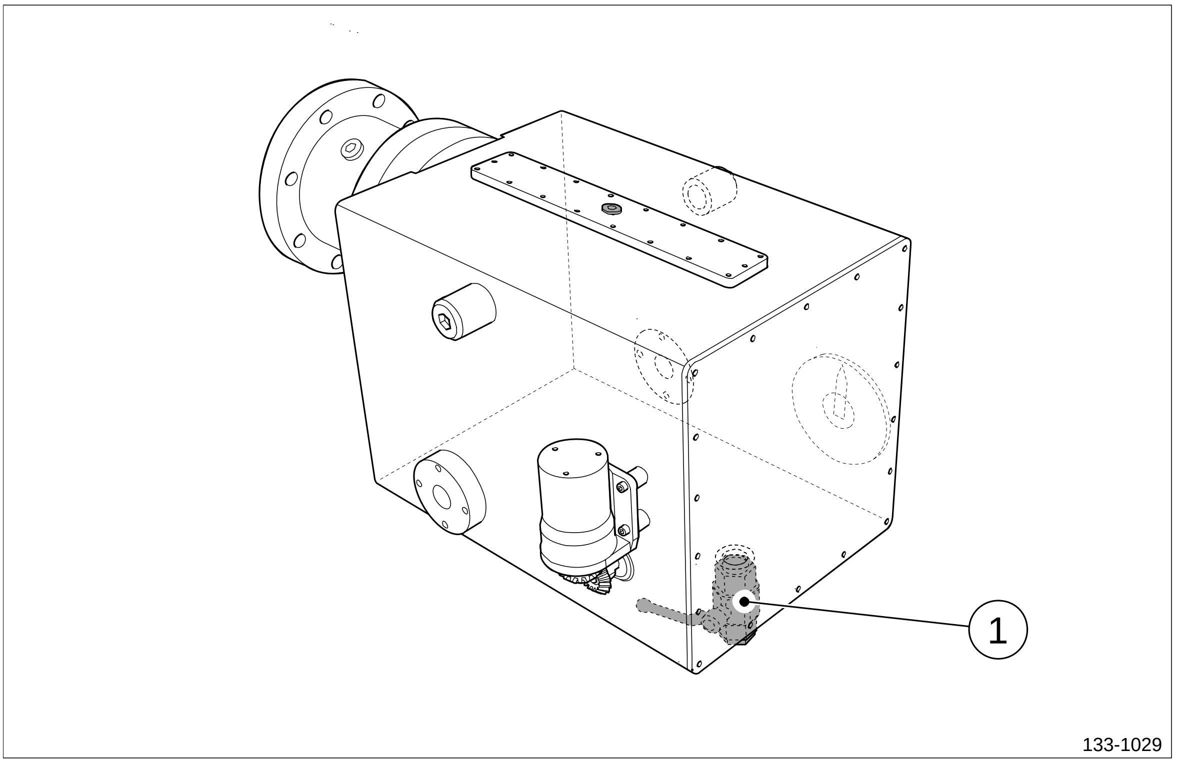

Figure 2 OD-box (FA).

1. Drain valve T

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

Note: Make sure to turn the remote/local switch on the pump motor starter P1 and P2, if any, to LOCAL position.

1. Turn the remote/local switch on pump motor starters P1 and P2 to LOCAL position.
2. Turn the stop/run switch on all pump motor starters to STOP position one hour before draining to allow the oil to settle.
3. Place a container under the drain valve T on the OD-box (pos 1, figure 2).
4. Open drain valve T and drain oil until clean oil comes out of the drain valve.
5. Close drain valve T. Make sure that no oil is leaking from the drain valve.
6. Start pump unit P3.
7. Inspect the oil level in the hydraulic power pack. Refill oil to the hydraulic power pack tank if the oil level is below the minimum level. For more information see instruction Refill Oil to the Hydraulic System in section Corrective Maintenance.
8. Turn the remote/local switch on pump motor starters P1 and P2 to REMOTE position.Turn the remote/local switch on pump motor starters P1 and P2, if any, to REMOTE position.

This task is now completed, it is safe to start the propulsion system.

OD-box Size 70,100 and 140

Description

This task describes how to drain an OD-box size 70, 100 and 140 from condensed water. The OD-box must be drained from condensed water in order to keep the system operating without any disturbance.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Container 10 litres, to collect the oil spillage	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

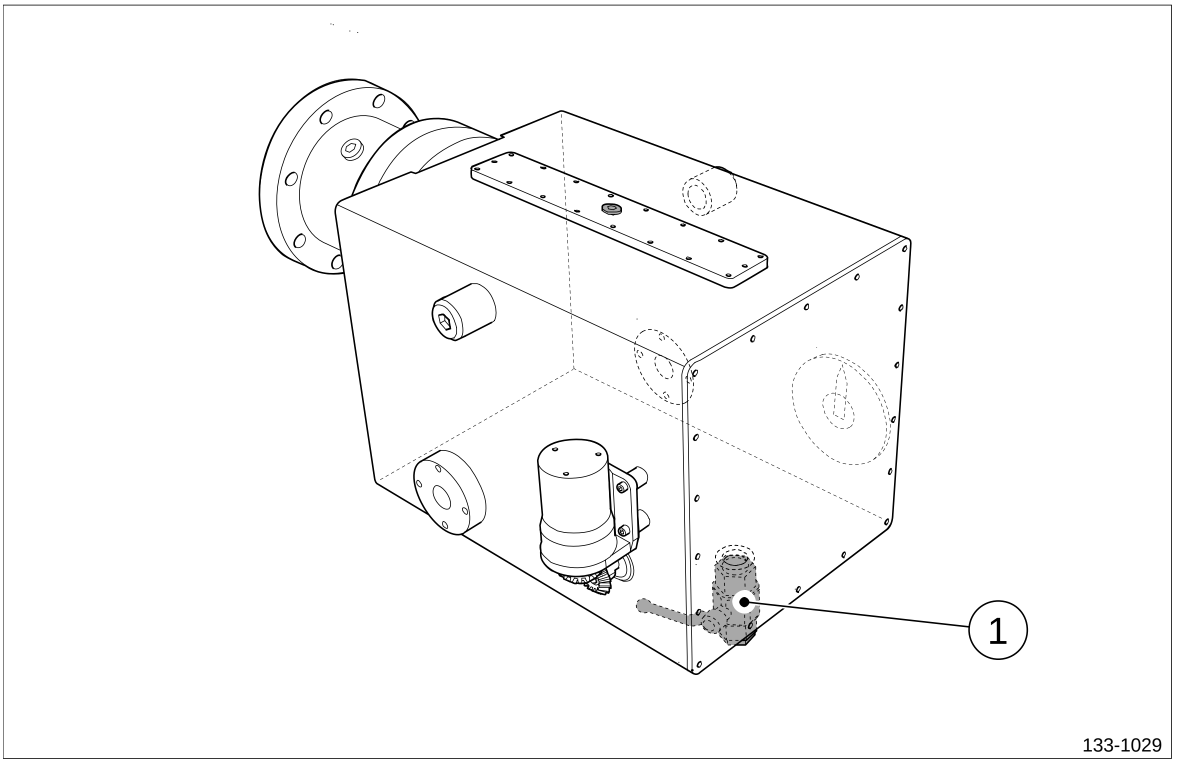

Figure 3 OD-box (FA)

1. Drain valve T

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

Note: Make sure to turn the remote/local switch on the pump motor starters P1 and P2 to LOCAL position.

1. Turn the remote/local switch on pump motor starters P1 and P2 to LOCAL position.Turn the remote/local switch on pump motor starters P1 and P2 to LOCAL position.
2. Turn the stop/run switch on all pump motor starters to STOP position one hour before draining to allow the oil to settle.
3. Place a container under drain valve T on the OD-box (pos 1, figure 3).
4. Open drain valve T and drain oil until clean oil comes out from the drain valve.
5. Close drain valve T and make sure that no oil is leaking.
6. Start the hydraulic pumps.
7. Inspect the oil level in the hydraulic power pack. Refill oil to the hydraulic power pack tank if the oil level is below the minimum level. Use connection Z to refill new oil. For more information see instruction Refill Oil to the Hydraulic System in section Corrective Maintenance.
8. Turn the remote/local switch on pump motor starters P1 and P2 to REMOTE position.

This task is now completed, it is safe to start the propulsion system.

Weekly Maintenance, Shafting

Task: Inspect Earthing Device (locked shaft)

Description

The earthing device must be inspected in order to ensure its proper function. If the earthing device is not working properly, there is a risk that the propulsion system will be damaged.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
Shafting arrangement drawing

Consumables	Qty

Instruction

Warning: Lock and secure the shaft before starting the inspection. The shaft must then remain locked and secured during the entire inspection.

1. Lock and secure the shaft. Make sure the shaft is locked and secured during the entire inspection.
2. Perform the inspection according to instructions in the sub-supplier manual found in part Sub-supplier Manuals.

This task is now completed.

Produced by: SS Approved by: Nna
Creation date: 2005-10-25
Revision: a Sign: Nna
Revision date: 2005-10-25

Weekly Maintenance

Task: Weekly Inspection of the Remote Control System

Description

This task describes the weekly inspection of the remote control system.

Support Items

Spare Part Name	Cross Ref. No.

Special/Additional Tools and Test Equipment	Qty

Reference Documents

Consumables	Qty

Instruction

Once a week, all the functions that have not been used during the week, must be tested.

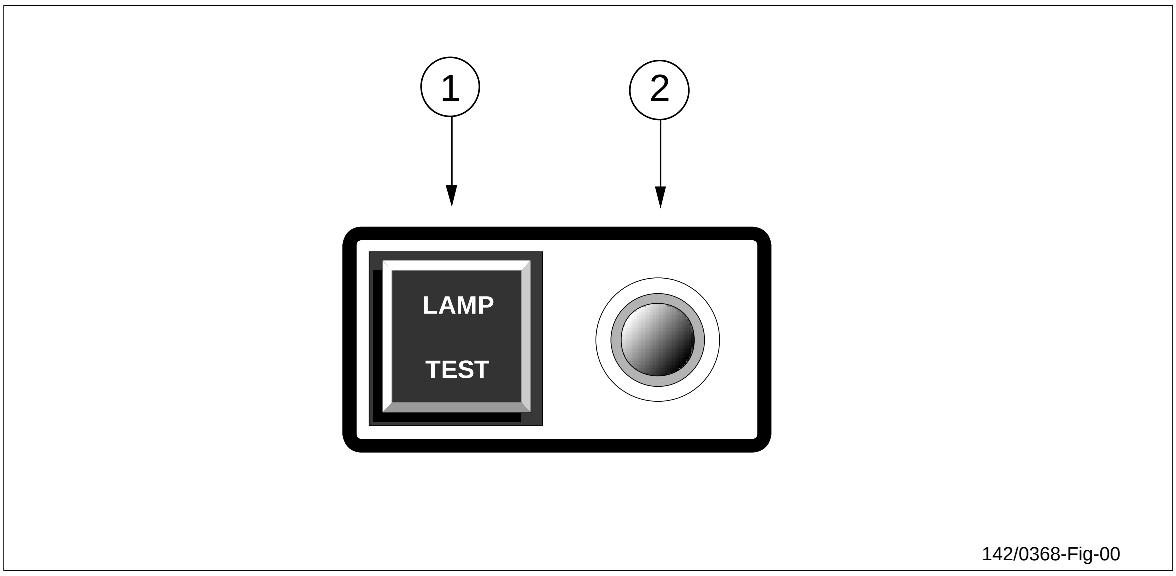

Figure 1 Lamp test button (1) and the dimmer knob.

1. Indicating lamp
2. LAMP TEST button

- Test the levers of stations that have not been in command.
- Test the back-up system by operating the pitch as described in the section Using Back-up Control in part Operating Instructions.
- Test emergency clutch out (if included).
- Perform lamp tests on the control panels by pressing the LAMP TEST button. All indication lamps and buttons on the panel should be lit and the buzzer should sound.
- Perform all manoeuvres described under each task in part Operating Instructions.

This task is now completed.

Produced by: SS Approved by: Nna
Creation date: 2005-05-31
Revision: a Sign: Nna
Revision date: 2005-10-24

Monthly Maintenance, Shafting

Task: Inspect Inboard Shafts, Flanges, and Couplings

Description

This task describes how to inspect the shafts, flanges, and couplings on board the vessel to ensure a safe operating propulsion system.

Support Items

Spare Part Name	Cross Ref. No.

Special/Additional Tools and Test Equipment	Qty

Reference Documents

Consumables	Qty
Linen rags	As req.

Instruction

If the vessel is equipped with two propellers, the following inspection must be performed on both starboard and port shafts. Make sure to consult the subcontractors documentation before performing any maintenance on the couplings.

Warning: The propulsion system must be stopped and the shafts must be secured when inspecting the shafts and couplings.

Warning: All personnel on the vessel must be aware that the shafts, flanges, and couplings are being inspected.

Inspect Intermediate Shafts and OD-box Shaft

Visually inspect all intermediate shafts and OD-box shafts on board the vessel.

1. Make sure that the shaft cannot rotate.

2. Visually inspect the shaft.
3. Make sure that there are no signs of damage or rust.
4. Make sure that the corrosion prevention film is intact. If the film is damaged, see instruction Apply Corrosion Preventative on Inboard Shafts and Couplings.

Inspect Sleeve Couplings

Visually inspect all sleeve couplings on board the vessel.

1. Make sure that the shaft cannot rotate.
2. Clean the sleeve coupling on the intermediate shaft. Make sure that there are no signs of damage or rust.

For more information, see part Sub Supplier Manuals.

Inspect Shaft Flanges and Locking Devices

Visually inspect all shaft flanges and locking devices on board the vessel.

1. Make sure that the shaft cannot rotate.
2. Visually inspect the flanges and the radial transition between the flange and shaft for any cracks or deformation.
3. Make sure that all the fitting bolts are locked by an intact split pin.
4. Make sure that no oil is leaking from the joint between the shafts.

This task is now completed.

For instructions on how to replace the fitting bolts and split pins, please consult Rolls-Royce Marine Global Support Network (GSN).

Monthly Maintenance, Shafting

Task: Inspect OD-box for leakage (visually)

Description

This task describes how to visually inspect the OD-box for leakage.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
OD-box Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

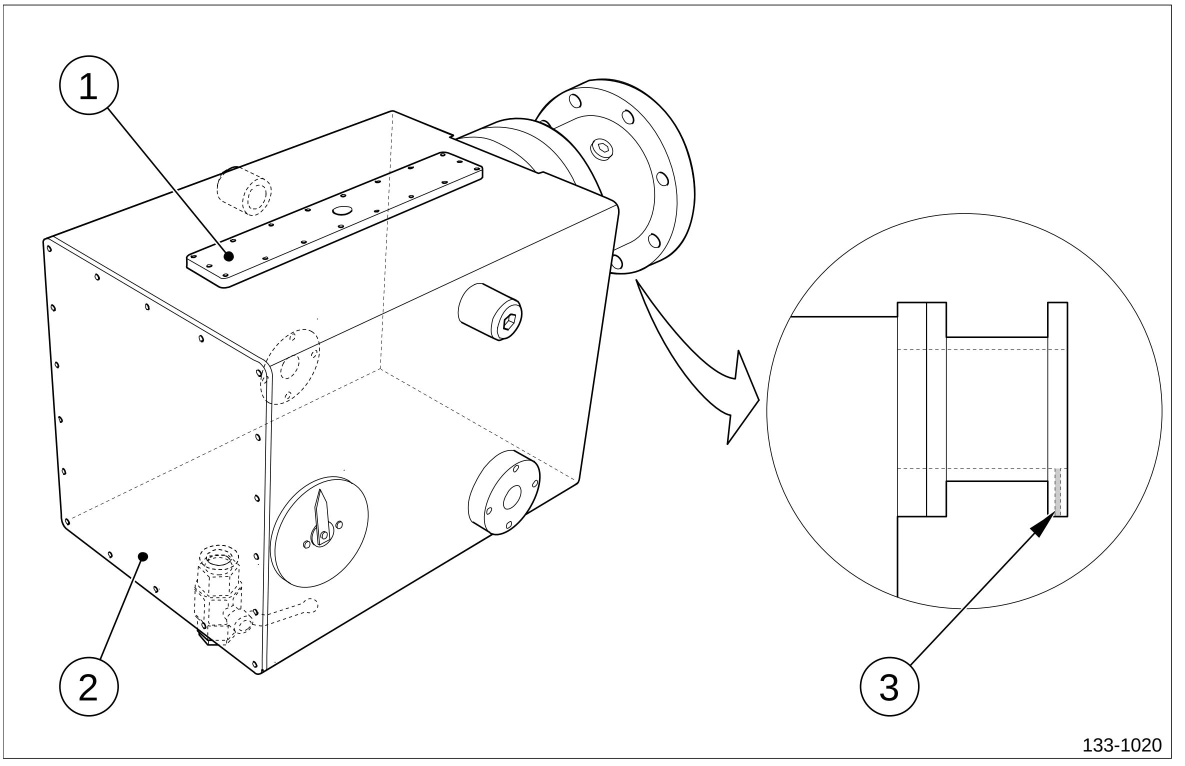

Figure 1 The drain hole is located at the bottom of the flange connection of the OD-box.

1. Cover
2. Cover
3. Drain hole

Warning: Make sure the space around the OD-box is safe to enter during operation.

Warning: Make sure the drain hole is cleared, and always is kept cleared, from any debris or other foreign objects.

1. Clean the OD-box using linen rags before inspection.
2. Inspect the OD-box covers (pos 1 and 2, figure 1) and the pipe connections for leakage. Tighten the pipe connections and the screws of the OD-box cover if necessary.
3. Inspect the drain hole (pos 3, figure 1) for dirt or any other foreign objects. The drain hole must always be kept open.

4. Inspect the drain hole for oil leakage (pos 3, figure 1). If oil is leaking in an abnormal amount (more than a few drops an hour) from the drain hole, the OD-box must be drained and inspected to determine the cause of the leakage. Consult Rolls-Royce Marine Global Support Network for more information.

This task is now complete.

Produced by: KK174 Approved by: Fnl
Creation date: 2008-05-06
Revision: Sign:
Revision date:

Monthly Maintenance, OD-box (FA)

Task: Inspect the Chain Tightener on the OD-box

Description

This task describes how to visually inspect the chain tightener on the OD-box.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
OD-box Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

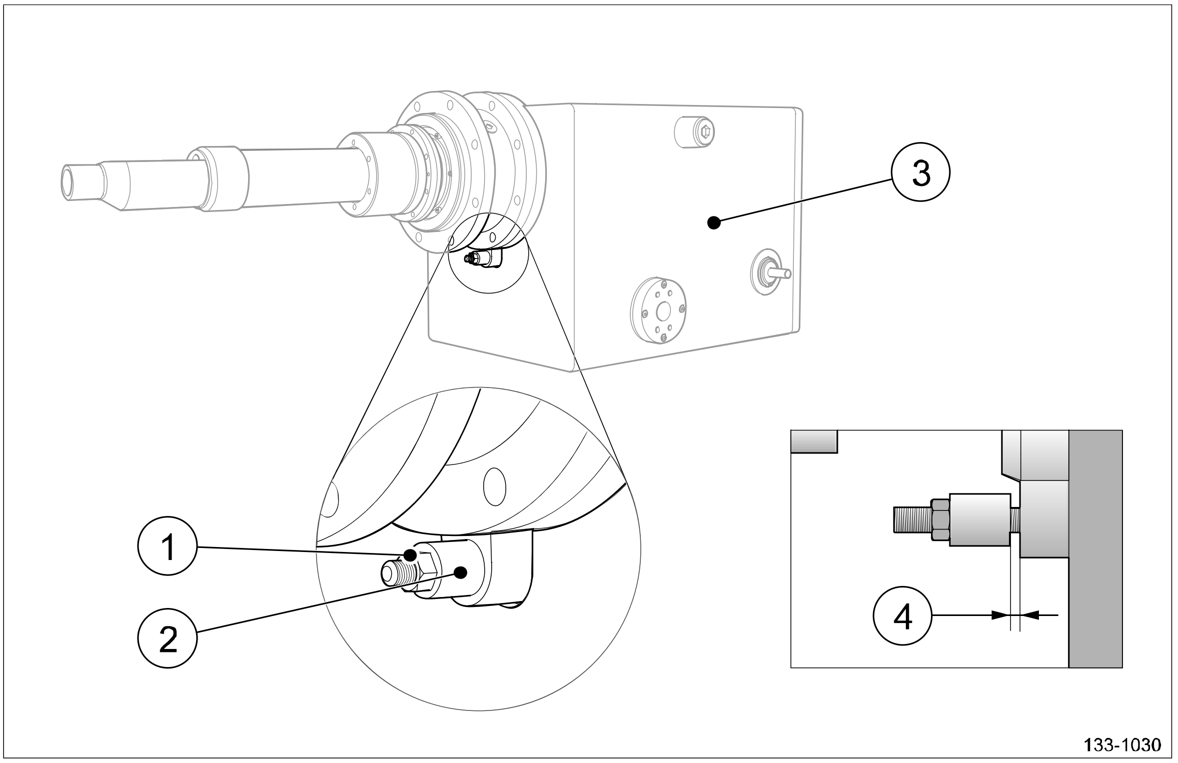

Figure 1 The chain tightener on the OD-box.

1. Tightening nut
2. Yoke
3. OD-box
4. Play

Warning: Make sure the space around the OD-box is safe to enter during operation.

1. Clean the chain tightener using linen rags before inspection.
2. Inspect the tightening play (pos 4, figure 1) with a feeler gauge. The play must be between 0,1 - 0,2 mm.
3. Tighten or untighten the nut (pos 1, figure 1) if necessary.

This task is now completed

Monthly Maintenance, Feed Back Unit (FA)

Task: Visually Inspect Feed Back Unit

Description

This task describes how to visually inspect the feed back unit (FA). The feed back unit must be inspected in order to ensure its proper function.

Support Items

Spare Part Name	

Special/Additional Tools and Test Equipment	Qty

Reference Documents
Feed Back Unit Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

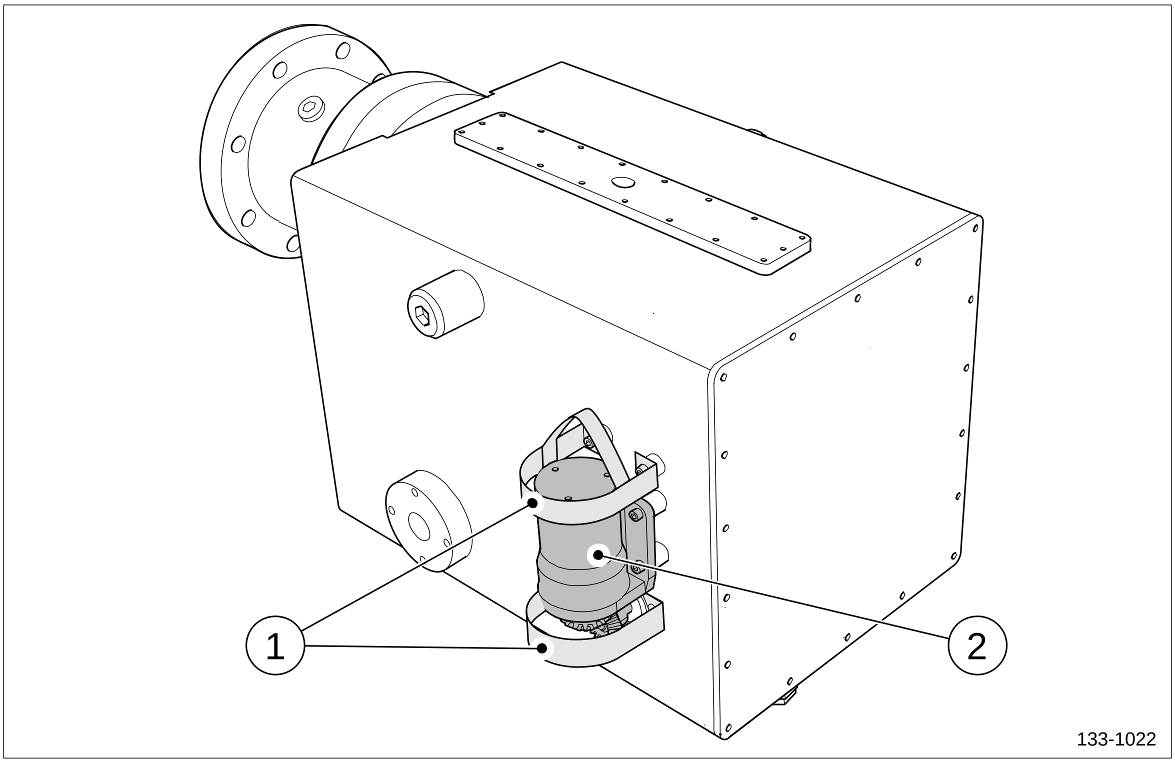

Figure 1 OD-box and feed back unit.

1. Protection bars
2. Feed back unit

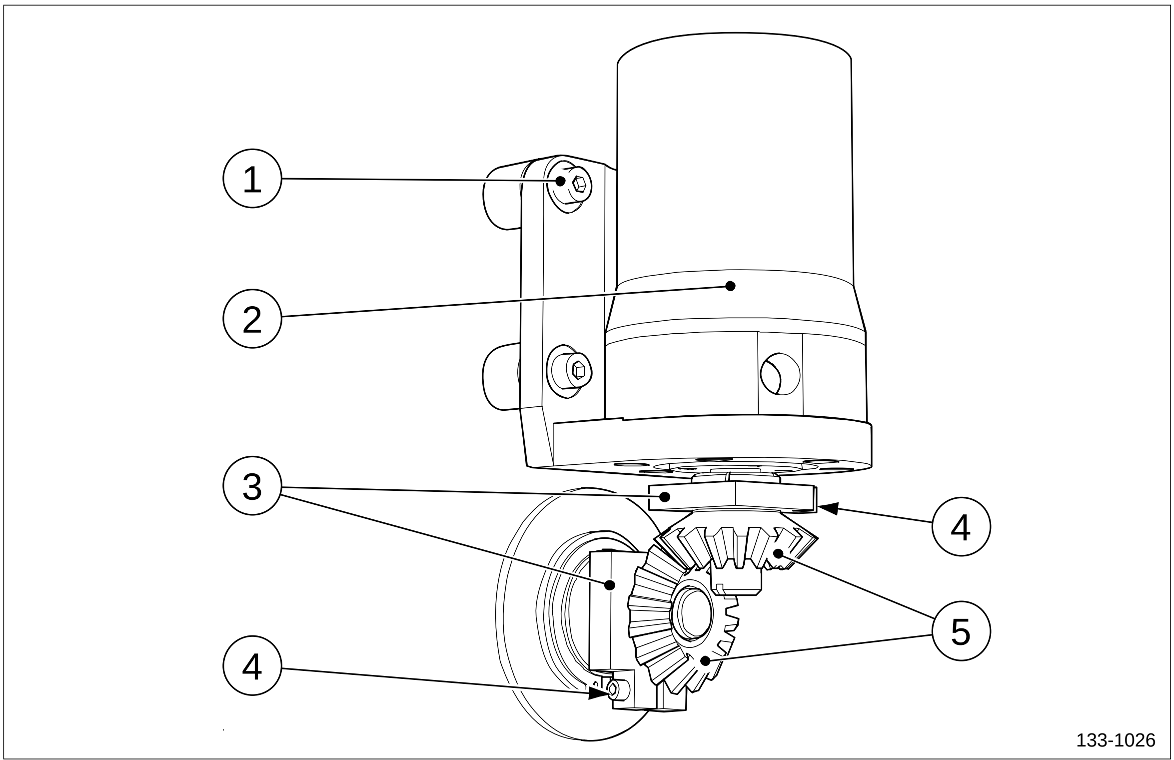

Figure 2 Feed-back unit.

1. Socket screws
2. Feed-back unit cover
3. Clamps
4. Set screws
5. Conical tooth wheels

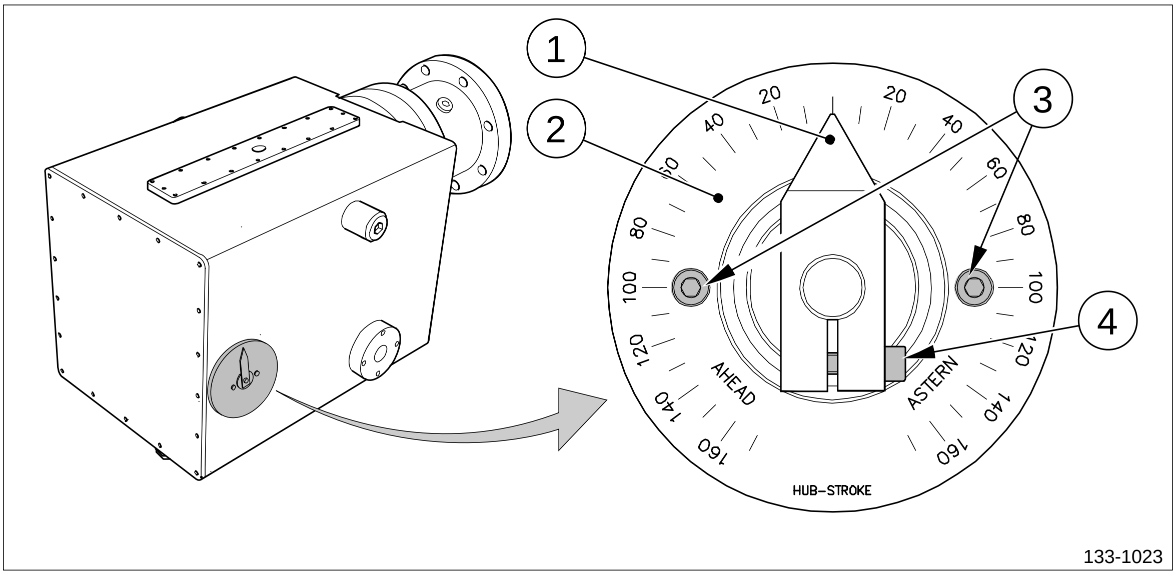

Figure 3 Pointer and scale on OD-box.

1. Pointer
2. Scale
3. Socket screws
4. Socket screw

Caution: Use insulated screwdrivers when working on the feed back unit.

Note: Make sure the pump units are set to local mode and that they cannot be started.

1. Turn off the propulsion system.
2. Make sure the pump units are set to local mode and that they can not be started.
3. Use linen rags to clean the feed back unit before the inspection.
4. Remove the protection bars (pos 1, figure 1). Make sure the screws (pos 1, figure 2), which secures the feed-back unit to the OD-box, are properly tightened. Tighten if necessary.
5. Make sure the screws (pos 1, figure 2), which secures the feed-back unit to the OD-box, are properly tightened. Tighten if necessary.
6. Make sure the set screws (pos 4, figure 2) on the clamps (pos 3, figure 2), which secures the conical tooth wheels on the shafts, are properly tightened. Tighten if necessary.
7. Clean the conical tooth wheels (pos 5, figure 2) with linen rags. Make sure that the backlash between the conical tooth wheels is as little as possible. If any damages or remarks are found, please contact Rolls-Royce Marine Global Support Network for further assistance.
8. Re-install the protection bars (pos 1, figure 1) and make sure that they are intact and properly tightened. Replace the bars if they are damaged. Tighten the screws if necessary.
9. Make sure the screw (pos 4, figure 3) which secures the pointer (pos 1, figure 3) on the mechanical pitch indicator, is properly tightened. Tighten if necessary.
10. Make sure the screws (pos 3, figure 3), which secures the scale (pos 2, figure 3) on the OD-box, are properly tightened. Tighten if necessary.
11. Reset the pump units.
12. Reset the propulsion system.

Please report any major damages on the feed back unit to the Rolls-Royce Marine Global Support Network.

This task is now completed.

Monthly Maintenance
Remote Control System

Task: Monthly Inspections of the Remote Control System

Description

This task describes the monthly inspection of the remote control system.

Support Items

Spare Part Name	Cross Ref. No.

Special/Additional Tools and Test Equipment	Qty

Reference Documents

Consumables	Qty

Instruction

Test Alarms

- Test the alarm signals by simulating alarms (for example, by moving the thrust control lever when the hydraulics is not running, or by disconnected command/response transmitters).

Cleaning

- Dust the outside of the cabinets using a dry or slightly damp cloth. Do not use wet cleaning equipment. In other respects the control system sets no special requirements on how the cleaning is performed.

Warning: Never allow water to enter inside the cabinets or control panels. Water may cause serious damage to electrical equipment and harm the person handling it.

This task is now completed.

Produced by: SS Approved by: Nna Revision: Sign:
Creation date: 2005-05-31 Revision date:

Monthly Maintenance, Remote Control System

Task: Clean and Inspect RPM Transmitter

Description

This task describes how to clean and inspect the RPM transmitter for the control system and the indication system.

The RPM-transmitter consists of an peg band and an RPM pick-up. The switch box is not part of the Rolls-Royce delivery.

The RPM transmitter must be cleaned from metal filings which stick to the magnetic RPM pick-up.

Support Items

Spare Part Name	Cross Ref. No.

Special/Additional Tools and Test Equipment	Qty

Reference Documents

Consumables	Qty
Linen rags	As req.

Instruction

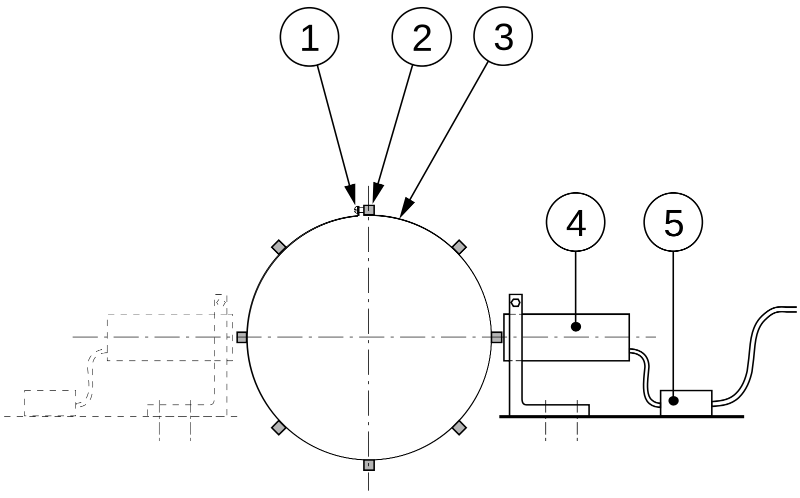

Figure 1 RMP transmitter

1. Screw (Non magnetic)
2. Peg
3. Peg band
4. RPM pick-up
5. Switch box (Not Rolls-Royce Delivery)

Caution: Make sure that the propulsion system is stopped and secured.

1. Stop and secure the propulsion system.
2. Clean the RPM pick-up (see position 4 figure 1) from all metal filings and grease. Do not use magnetic tools to clean the RPM pick-up.
3. Inspect the pegs on the impulse band. Make sure that all the pegs are intact.

This task is now completed.

If the peg band or the RPM pick-up is damaged please consult Rolls-Royce Marine Global Support Network (GSN).

Every Third Month Maintenance, Hydraulic System

Task: Take an Oil Sample

Description

This task describes how to take an oil sample. The oil must be analysed regularly to test its purity.

To get reliable results, always use the same connection and the same procedure when taking the oil sample.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Container to collect the oil	1
Sample bottle	1

Reference Documents
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.
Oil, according to document Requirements for Lubricating Oil.	As req.

Instruction

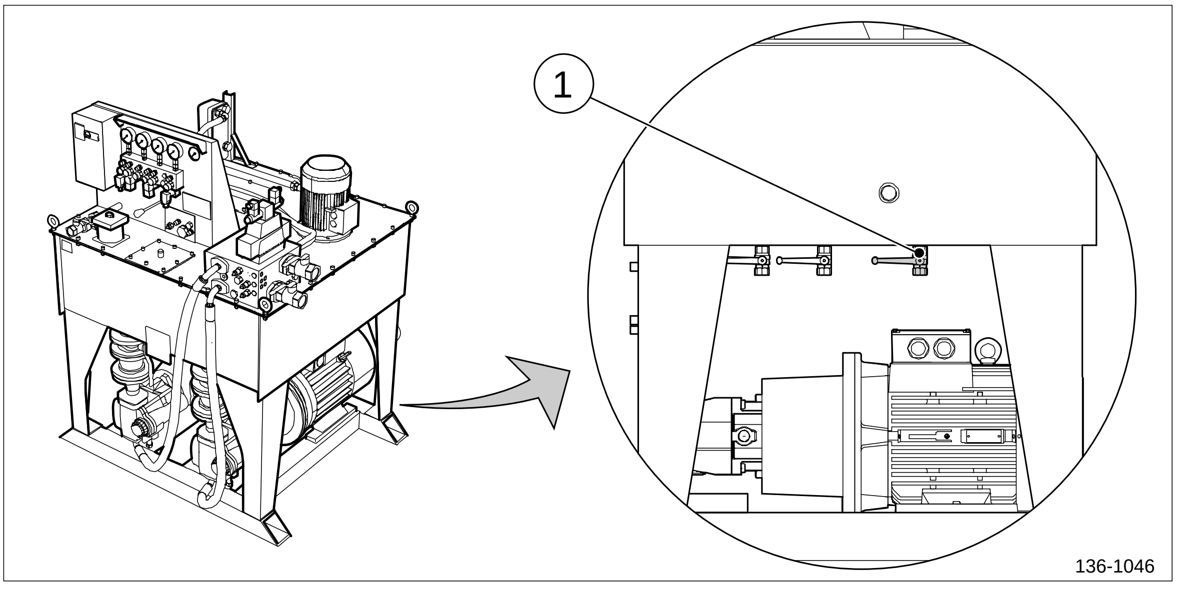

Figure 1 The hydraulic power pack.

1. Shut-off valve X3

Warning: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

Note: Make sure the hose and the linen rags are clean before use.

Note: Make sure the sample bottle is chemically pure. Always follow the instructions on the sample bottle.

1. Locate shut-off valve X3 (see figure 1).
2. Clean shut-off valve X3 with a clean linen rag.
3. Place the container under the shut-off valve X3.
4. Open the shut-off valve X3 carefully and fill the container with a minimum of two litres of oil. This oil is to be disposed.
5. Fill the sample bottle with oil from the shut-off valve X3.
6. Close the shut-off valve X3.

7. Mark the sample bottle and send it for analysis.
8. Inspect the oil level in the hydraulic power pack tank and refill if necessary. Refill purified oil through air breather filter F5 during operation or according to instruction Task: Fill Oil to Hydraulic System.
9. Dispose the collected oil spillage according to local regulations.

This task is now completed.

Every Sixth Month Maintenance, Shafting

Task: Clean and Inspect Outboard Shaft under Water

Description

This task describes how to clean and inspect the outboard shaft under water.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Adequate cleaning equipment	As req.

Reference Documents
Shafting Arrangement drawing

Consumables	Qty

Instruction

Warning: Turn off the propulsion system before starting the inspection.

Warning: Lock and secure the shaft before starting the inspection. The shaft must then remain locked and secured during the entire inspection.

Warning: Make sure all personnel involved are aware of the cleaning and inspection in progress.

Caution: Clean the shaft with caution at the area between the plastic coating and the liner in order to prevent the plastic from getting damaged.

Before starting this task

1. Make sure the propulsion system is turned off and that the shaft is locked and secured.

Inspect the shaft line

2. Remove micro-organism and marine growth from the shaft and the flanges. Make sure to clean the joint between the plastic coating and the liner carefully.
3. Inspect the propeller shaft visually.
4. Inspect the anti-fouling coating visually.
   4.1. If the anti-fouling coating is severely damaged, the marine growth can damage the plastic coating. Consult Rolls-Royce Marine Global Support Network for more information.
5. Inspect and repair any found damages on the shaft flange cover, the rope guard, or the fairing covers. Consult Rolls-Royce Marine Global Support Network for more information.
6. Inspect the outboard bearings. For instructions, see the part Sub-supplier Manuals.
7. Inspect the stern seal visually.
8. Reset the propulsion system.

This task is now completed.

Produced by: KK174 Approved by: Nna
Creation date: 2008-05-06

Revision: Sign:
Revision date:

Every Sixth Month Maintenance, Shafting

Task: Clean, Inspect, and Treat the Inboard Shaft with new Corrosive Preventive Agent

Description

This task describes how to clean, inspect, and treat the inboard shafts with corrosive preventive agent.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
Shafting arrangement drawing

Consumables	Qty
Corrosive preventive agent	As req.
Linen rags	As req.

Instruction

Warning: Turn off the propulsion system before starting the inspection.

Warning: Lock and secure the shaft before starting the inspection. The shaft must then remain locked and secured during the entire inspection.

Warning: Make sure all personnel involved are aware of the cleaning and inspection in progress.

Before starting this task

1. Make sure the propulsion system is turned off and that the shaft is locked and secured.

Clean and inspect the shaft

2. Clean the shaft using linen rags.
3. Inspect the shaft visually:
   - 3.1. Make sure there is no sign of damage or corrosion.
   - 3.2. Make sure the corrosion preventative film is intact. Treat the shaft with new corrosion preventative if necessary.

Treat the shaft with corrosion preventive

1. Clean the area where the corrosion preventative is to be applied carefully. Use water and a scrub brush to clean. Use a degreaser if necessary.
2. Polish away minor corrosion carefully.
3. Wipe off the water from the shaft using linen rags.
4. Treat the shaft with corrosion preventive according to the recommendations from the manufacturer of the corrosion preventive.
5. Reset the propulsion system.

This task is now completed.

Produced by: KK174 Approved by: Fnl Revision: Sign:
Creation date: 2008-06-23 Revision date:

Every Sixth Month Maintenance, Propeller

Task: Clean and Inspect Propeller Blades and Hub under Water

Description

This task describes how to clean and inspect the propeller blades and the hub under water.

Micro-organisms and marine growth must be removed from the propeller blades and the hub to ensure proper function of the propulsion system. The need for cleaning depends on the sea characteristics and on how long the vessel has been in harbour.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Adequate cleaning equipment	As req.

Reference Documents
Shafting Arrangement drawing
Hub Assembly drawing

Consumables	Qty

Instruction

Warning: Turn off the propulsion system before starting the inspection.

Warning: Lock and secure the shaft before starting the inspection. The shaft must then remain locked and secured during the entire inspection.

Warning: Make sure all personnel involved are aware of the cleaning and inspection in progress.

Warning: Clean the anti-singing edges with caution. They must NOT be rounded or grinded.

Caution: Clean the blade flange with caution in order to protect the blade sealing ring from getting damaged.

1. Make sure the propulsion system is turned off and that the shaft is locked and secured.
2. Remove micro-organism and marine growth from the propeller blades and the hub. Clean the anti-singing edges and the blade flange with caution.
3. Examine each propeller blade visually. Look for any sign of damage, deformation, and cavitation. The blade edges should be free from bends and notches. Make sure the blade screws and locking devices are intact.
4. Examine the propeller hub visually. Look for any sign of damage. Make sure there is no oil leakage. Make sure the screws, plugs, and locking devices are intact.
5. Reset the proplusion system.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Test the Shut-off Valves

Description

This task describes how to test the shut-off valves. The shut-off valves must be opened and closed regularly to lubricate the seals and prevent the valves from seizing or getting stuck in their normal position.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

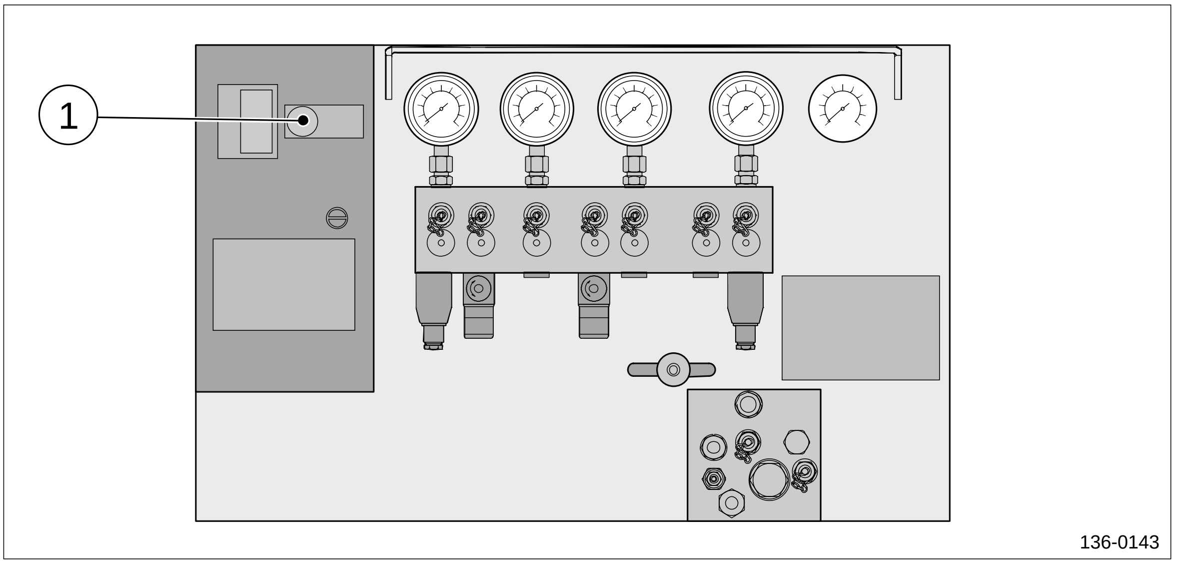

Figure 1 Control panel on the hydraulic power pack.

1. Local/remote switch

Warning: The propulsion system must be turned off and the shaft must be locked and secured during this task.

Warning: Test the shut-off valves carefully in order to prevent damage of the seals.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

1. Make sure the propulsion system is turned off and that the shaft is locked and secured.
2. Set the pump units to local control.
3. Set the local/remote switch (see figure 1) on the hydraulic power pack control panel to LOCAL CONTROL.
4. Place the container under the shut-off valve to be tested.
5. Open the shut-off valve and then close it.
6. Wipe off any oil spillage.
7. Repeat the steps above on every shut-off valve in the system.
8. If any of the shut-off valves is found defective, replace it according to the instructions in Task: Replace Screw-in Valves.
9. Dispose the collected oil according to local regulations.
10. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
11. Set the pump units to remote control.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Test Emergency Valve Settings

Description

This instruction describes how to test the emergency valve V12.

As the valves in the emergency manoeuvre block can get stuck, it is important to test their functions regularly to prevent malfunction of the emergency manoeuvre system.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Pressure test gauge (0-10 MPa) with Minimess connection 16x2	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

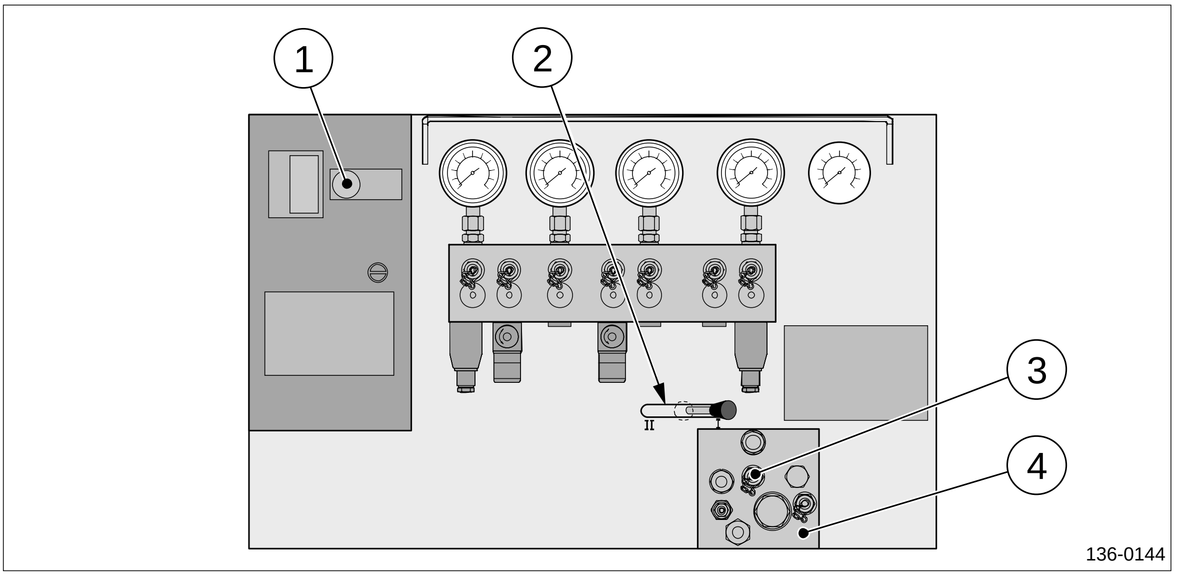

Figure 1 Control panel on the hydraulic power pack.

1. Local/remote switch
2. Emergency control valve V12 lever
3. Test nipple P3T
4. Emergency control panel

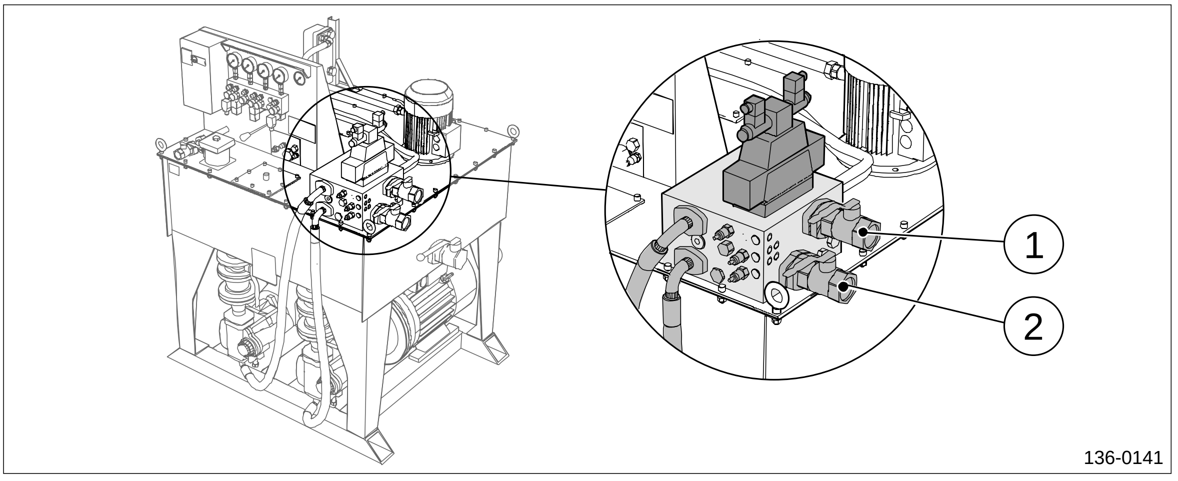

Figure 2 Hydraulic power pack unit.

1. Shut-off valve V40
2. Shut-off valve V39

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off the pump units.
4. Set the local/remote switch (see figure 1) on the hydraulic power pack control panel to LOCAL CONTROL.

Test emergency pitch control mode 1

5. Close the shut-off valve V40 (pos 1, figure 2).
6. Make sure that pump unit P3 is running.
7. Manoeuvre the emergency control valve V12 lever (pos 2, figure 1) from normal position to EMERGENCY CONTROL I - AHEAD until full ahead is reached.
8. Manoeuvre the emergency control valve V12 lever back to normal position.
9. Manoeuvre the emergency control valve V12 lever from normal position to EMERGENCY CONTROL I - ASTERN until full astern is reached.
10. Open the shut-off valve V40.

Test emergency pitch control mode 2

11. Close the shut-off valve V39 (pos 2, figure 2).
12. Manoeuvre the emergency control valve V12 lever from normal position to EMERGENCY CONTROL II.

13. Connect a pressure test gauge to the test nipple P3T (pos 3, figure 1) and inspect the pressure. The pressure should correspond with the value stated for V14 on the Hydraulic Diagram drawing.
14. Set the emergency control valve V12 lever back to normal position.
15. Open the shut-off valve V39.
16. Disconnect the pressure test gauge.
17. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
18. Set the pump units to remote control.

Report any disturbances to Rolls-Royce.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Inspect Level Switch LS1

Description

This task describes how to test the function of the level switch on the hydraulic power pack. The level switch measures the oil level in the power pack tank and indicates if the level is low.

The level switch must be inspected to ensure its proper function.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.
Bundle straps	As req.

Instruction

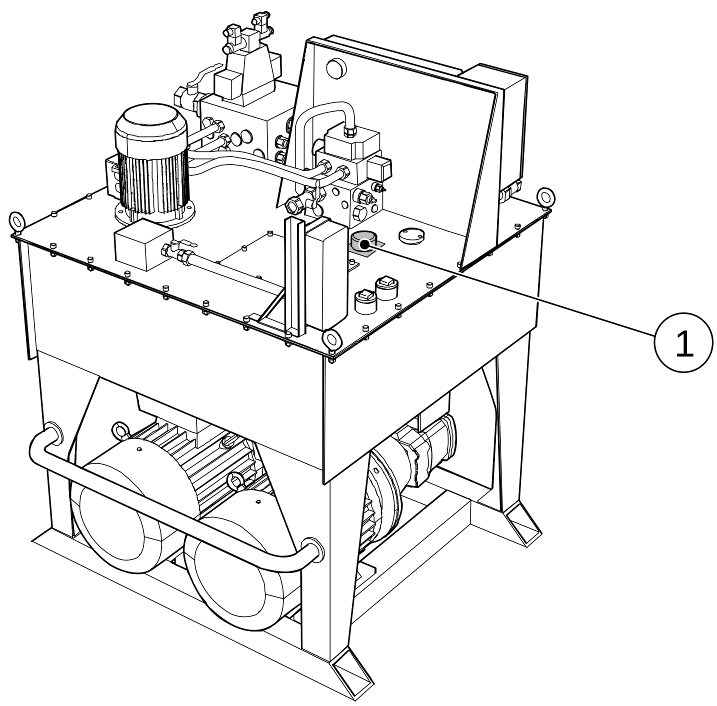

Figure 1 Level switch on the hydraulic power pack.

1. Level switch LS1

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

1. Locate the level switch LS1, see figure 1.
2. Cut the bundle straps which hold the cable.
3. Loosen and remove the screws on the level switch's mounting plate.
4. Test the function of the level switch by lifting up the whole level switch unit until the alarm "Oil level low" in main tank goes off.
5. Move the float on the level switch above the minimum level mark and the alarm should become silent.
6. Replace the level switch if it does not function properly.
7. Put the level switch back into position.
8. Refit and tighten the screws on the mounting plate.
9. Refit and tighten new bundle straps to hold the cable.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Inspect Level Switch LS3 on Gravity Tank and Static Pressure Pump P3

Description

This task describes how to test the function of the level switch LS3 on the gravity tank and how to visually inspect the static pressure pump P3. The level switch indicates if the oil level in the gravity tank is low.

The level switch must be inspected to ensure its proper function.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
Gravity Tank Assembly drawing
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

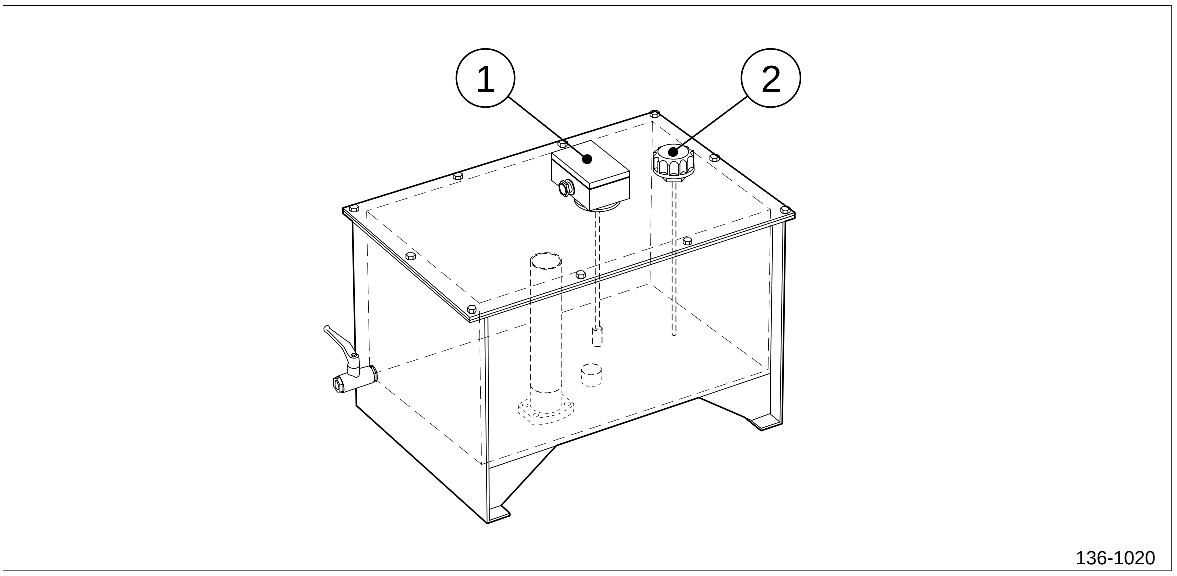

Figure 1 Gravity tank.

1. Level switch LS3
2. Dipstick

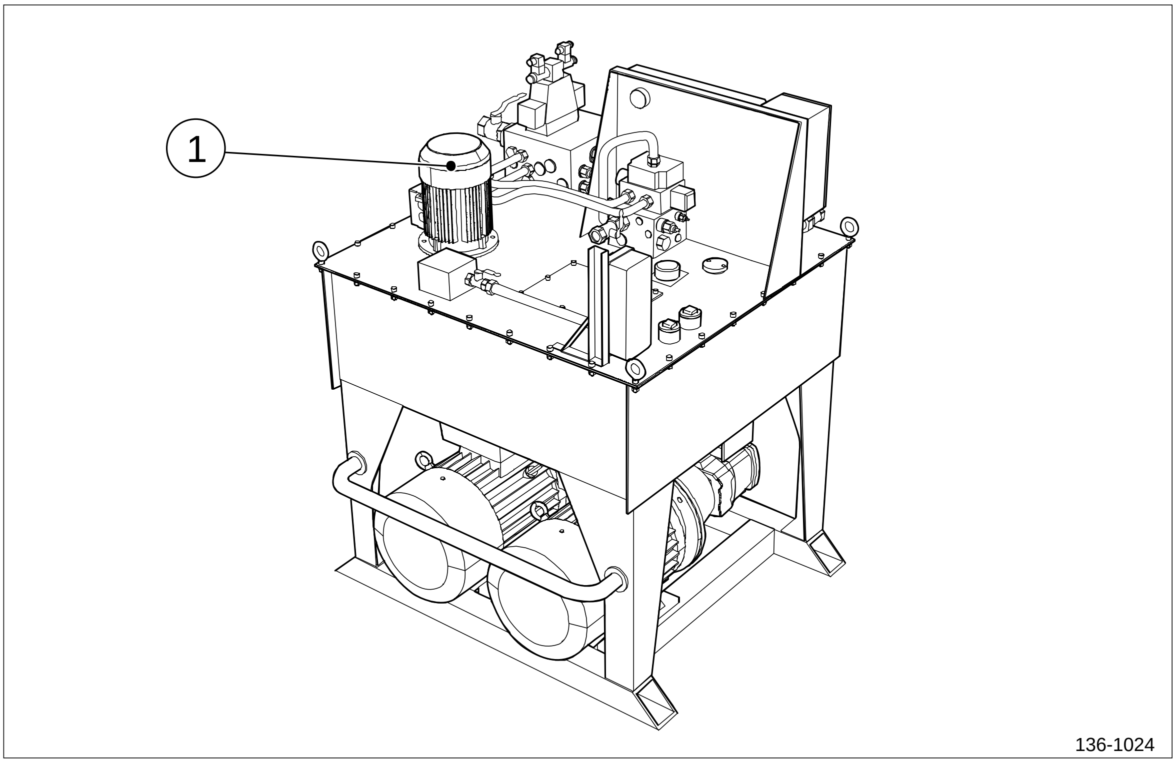

Figure 2 Front view of the hydraulic power pack.

1. Static pressure circulation pump unit P3

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

1. Locate the level switch and the dipstick, see figure 1.
2. Unscrew the dipstick. Use the dipstick and the dipstick hole to test the function of the level switch on the gravity tank.
3. Use the dipstick to push the float below the minimum oil level. This should start the static pressure pump unit P3 and set off the alarm “Oil level low” in gravity tank.
4. Use the dipstick to inspect the oil level in the gravity tank. If the oil level is low, make sure the static pressure pump unit P3 is running properly. Consult Rolls-Royce Marine Global Support Network if necessary.
   - 4.1. Replace the static pressure pump P3 (see figure 2) if it is found faulty. Replace according to Task: Replace Pump Unit P3.
5. Put the dipstick back into position and tighten the lid.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Inspect Temperature Sensor

Description

This task describes how to inspect the function of the temperature sensor to ensure its proper function. The temperature sensor indicates if the oil temperature is too high.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Hot water: >65 ^{o}C	As req.

Reference Documents

Consumables	Qty
Linen rags	As req.
Cable ties	As req.

Instruction

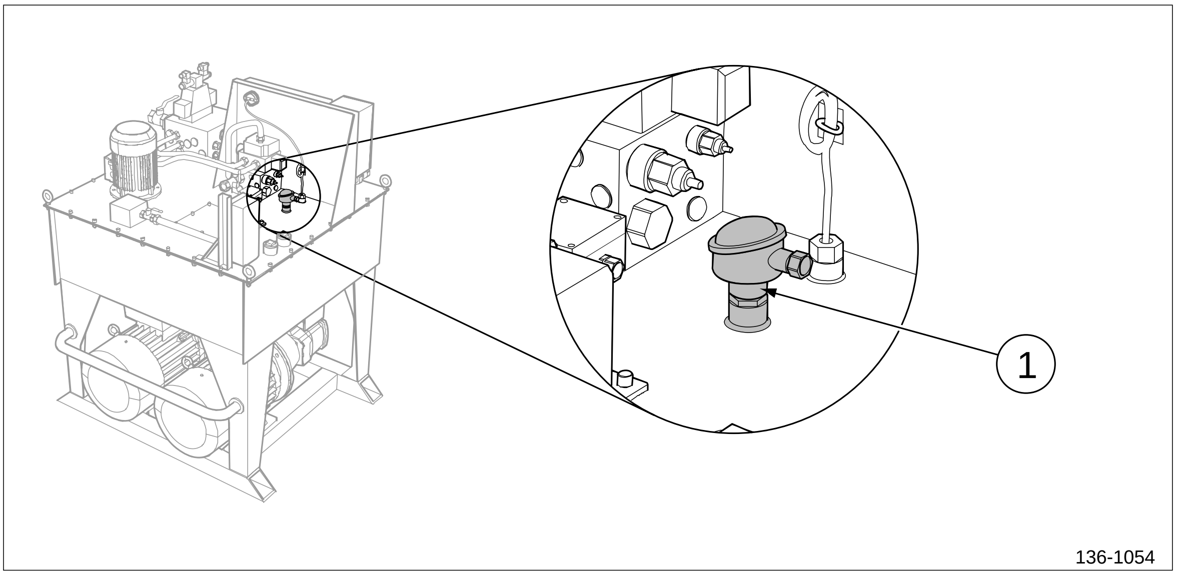

Figure 1 Temperature sensor on the hydraulic power pack.

1. Temperature sensor TT1

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off the pump units.
4. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Test function of temperature sensor

5. Locate the temperature sensor (figure 1).
6. Cut the cable ties which holds the temperature sensor cable in place.
7. Loosen the temperature sensor and lift it up.
8. Lower the bottom part of the temperature sensor in hot water (at least 65 ^{o}C). This should set off the alarm for high oil temperature.
9. If the temperature sensor is not functioning properly, replace it according to Task: Replace the Temperature Sensor.
10. Wipe the sensor clean from water and dirt using linen rags.
11. Put the temperature sensor back into the tank and fasten it.
12. Fit and tighten new cable ties to hold the cable in place.

Finishing

13. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
14. Set the pump units to remote control.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Inspect Thermometer

Description

This task describes how to inspect the thermometer bulb and the temperature gauge to ensure the proper function of the thermometer.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Hot water: >65 ^{o}C	As req.

Reference Documents

Consumables	Qty
Linen rags	As req.
Cable ties	As req.

Instruction

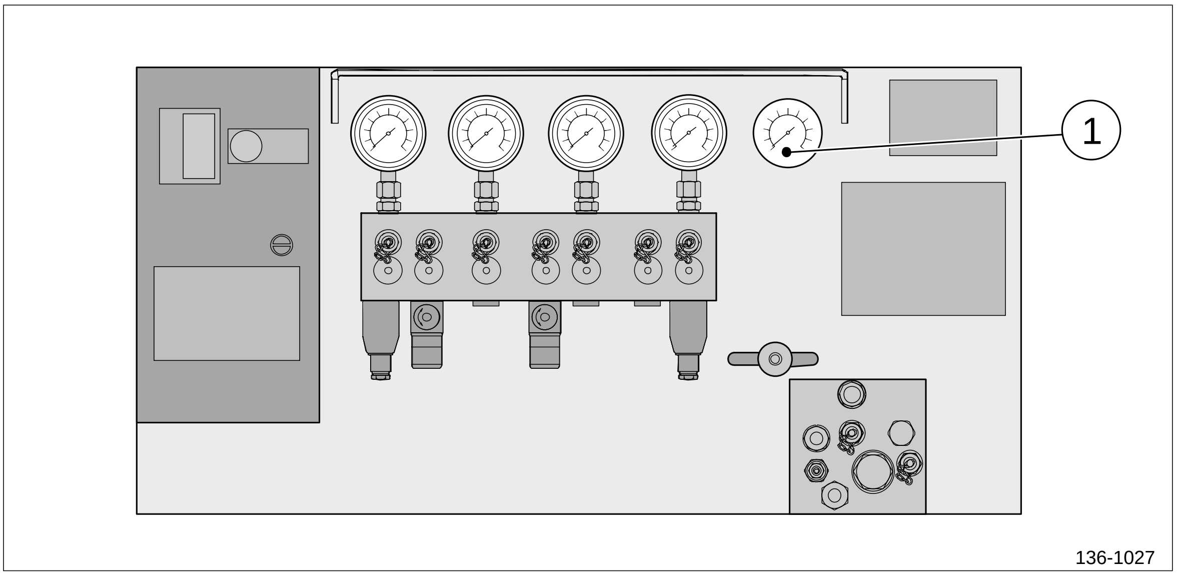

Figure 1 The control panel on the hydraulic power pack unit.

1. The temperature gauge

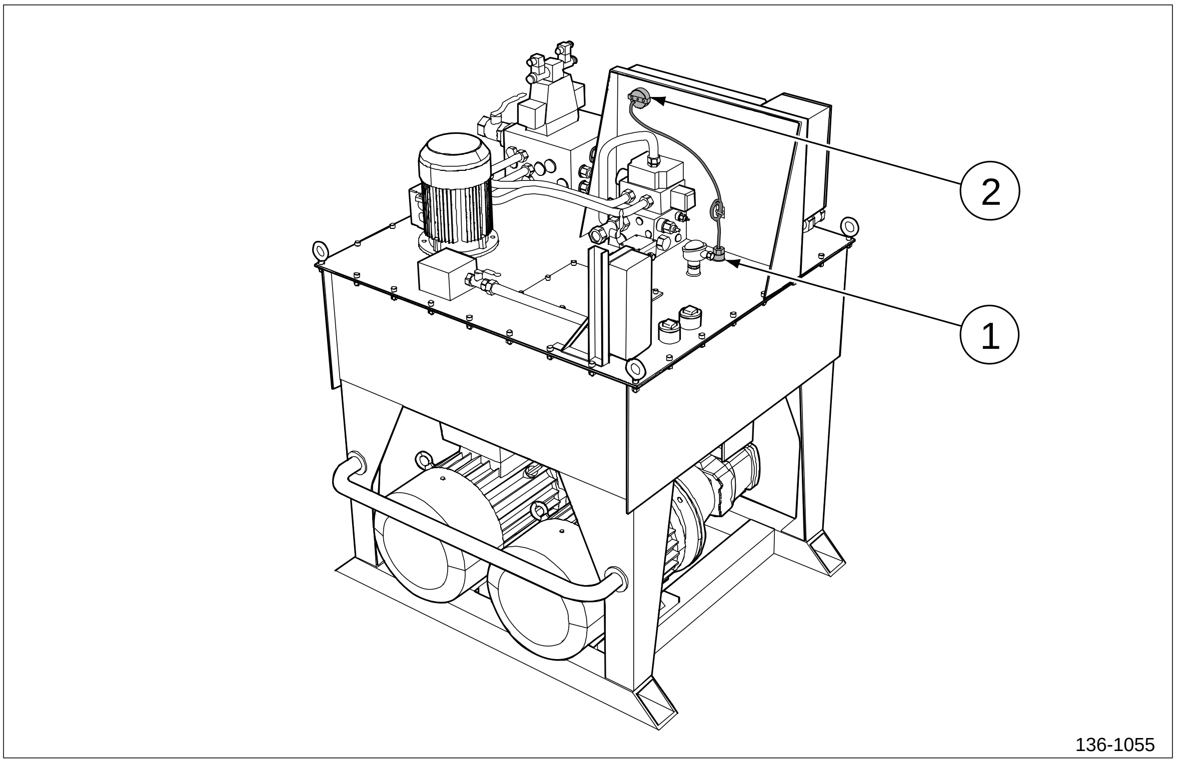

Figure 2 The thermometer is positioned on the hydraulic power pack.

1. Thermometer bulb
2. The temperature gauge (seen from behind)

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Turn off the main engine(s) before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off the pump units.
4. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Test function of thermometer

5. Locate the thermometer bulb (figure 2) and the temperature gauge (figure 1).
6. Cut the cable ties which holds the bulb cable in place.
7. Loosen the bulb and lift it up.
8. Lower the bottom part of the bulb in hot water (at least 65 ^{o}C). Make sure that the rise in temperature is shown on the gauge (figure 1).
9. If the bulb or the gauge is not functioning properly, replace it according to Task: Replace the Thermometer.

10. Wipe the bulb clean from water and dirt using linen rags.
11. Put the bulb back into the tank and fasten it.
12. Fit and tighten new cable ties to hold the cable in place.
13. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
14. Set the pump units to remote control.

This task is now completed.

Maintenance, Hydraulic System

Task: Inspect the Automatic Start of the Pump Unit P3

Description

This task describes how to inspect the automatic start of the pump unit P3. This instruction is valid for a hydraulic system with one electrical driven pump unit P1 and one static pressure circulation pump unit P3.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing
Hydraulic power pack assembly drawing

Consumables	Qty

Instruction

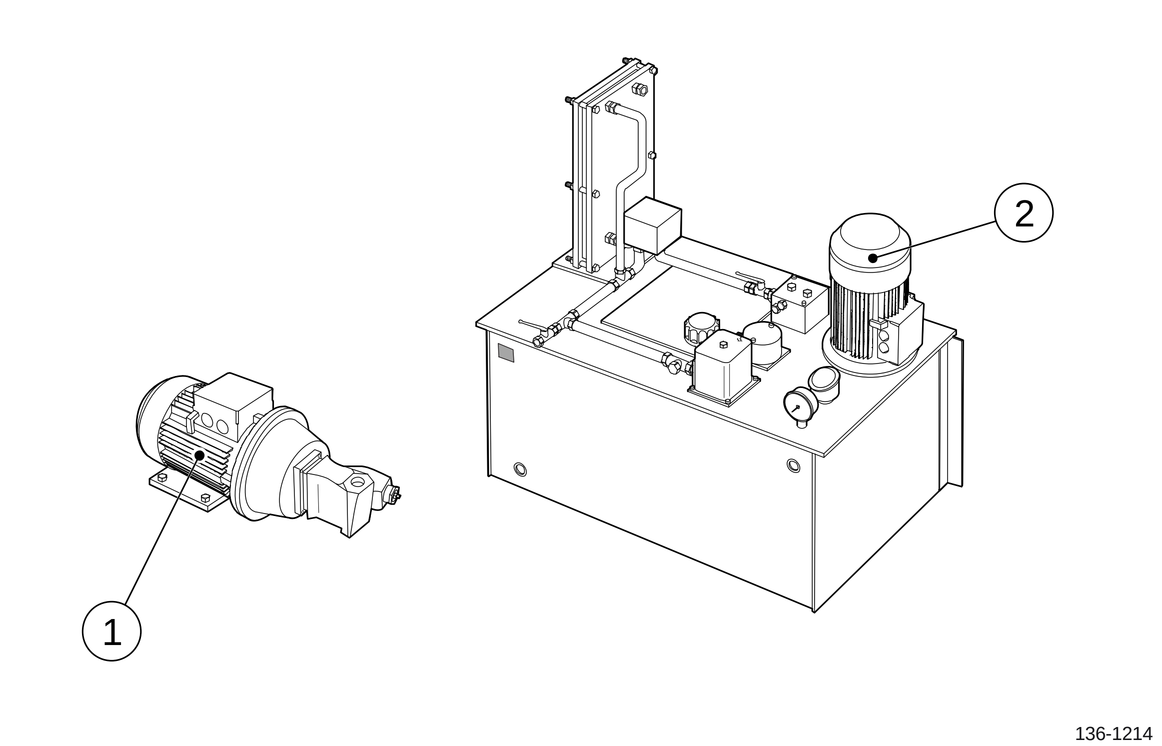

Figure 1 The pump units on the hydraulic power pack tank.

1. Pump unit P1
2. Pump unit P3

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Inspect the automatic start of the pump unit P3 (if the vessel is equipped with a gravity tank)

4. Turn the selector switch for pump unit P3 on the panel in the control room, to STOPPED PROP. position.
5. Simulate low oil level in the gravity tank by unscrewing the dipstick lid and using the dipstick to push the level switch float downwards. Make sure that the level switch LS3 starts pump unit P3.
6. Simulate high oil level in the gravity tank by using the dipstick to pull the level switch float upwards. Make sure that the level switch LS3 stops pump unit P3.

Finishing

7. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
8. Set the pump units to remote control.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Inspect Pressure Transmitter

Description

This task describes how to test the pressure transmitters PT2 and PT3.

If a pressure transmitter is malfunctioning, it must be replaced in order to ensure the functions of the hydraulic system.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Remote Supervision drawing

Consumables	Qty

Instruction

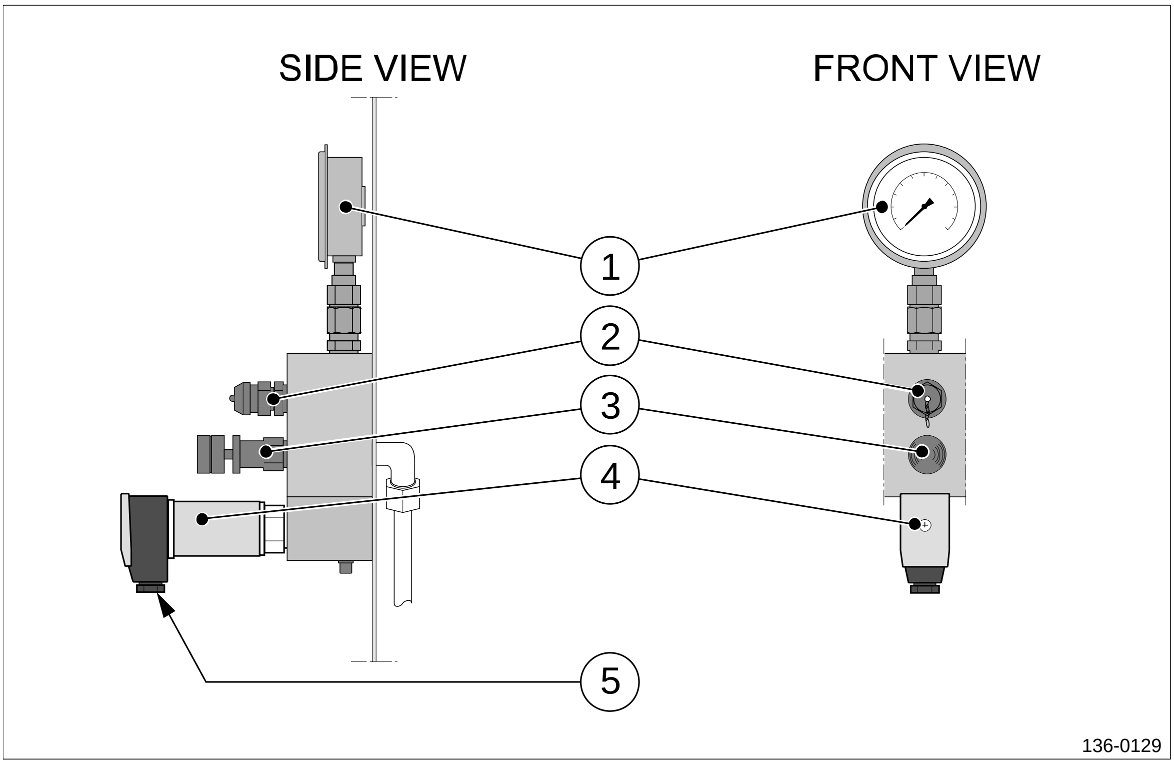

Figure 1 The pressure transmitter on the control panel on the hydraulic power pack.

1. Pressure gauge
2. Test nipple
3. Shut-off valve
4. Pressure transmitter
5. Cable plug

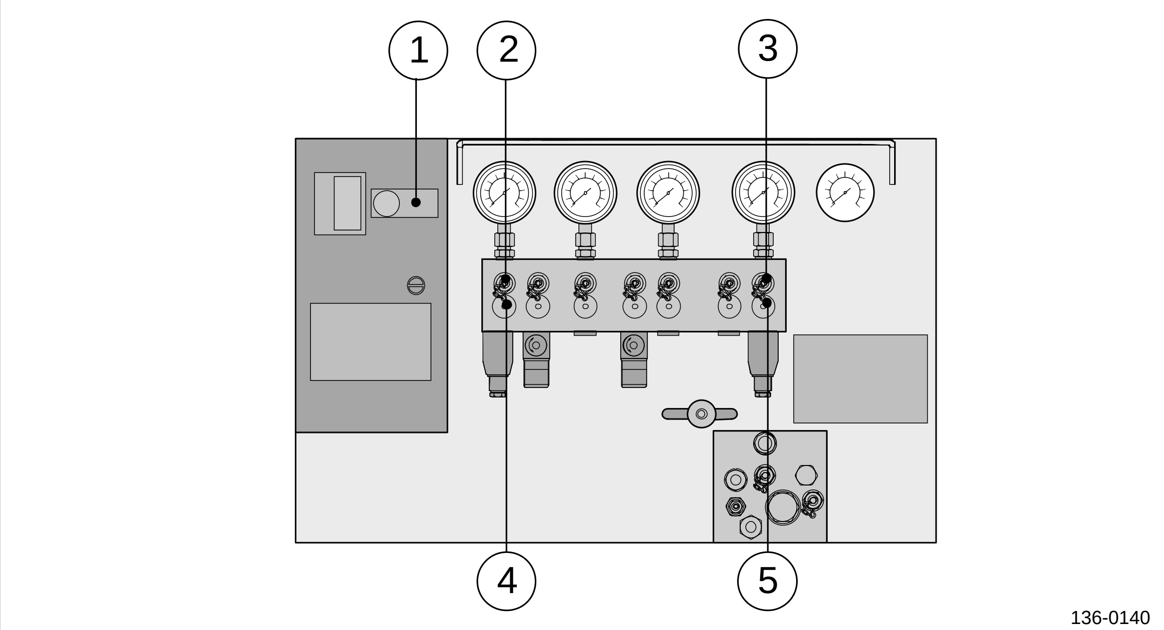

Figure 2 The control panel on the hydraulic power pack.

1. Local/remote switch
2. Test nipple TP3
3. Shut-off valve G5V
4. Shut-off valve G1V
5. Test nipple TP6

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Set the local/remote switch (pos 1, figure 2) on the hydraulic power pack control panel to LOCAL CONTROL.

Test pressure transmitter PT2

4. Close shut-off valve G1V (pos 2, figure 2).
5. Connect a hose with test connection to test nipple TP3 (pos 2, figure 2) and drain oil. Take proper measures to collect the oil. Check the pressure on gauge G1.
6. Make sure that the low system pressure alarm PT2 goes off.
7. If the pressure transmitter does not work properly replace it according to Task: Replace the Pressure Transmitter.
8. Disconnect the hose.
9. Open shut-off valve G1V.

Test pressure transmitter PT3

10. Close shut-off valve G5V (pos 3, figure 2).
11. Connect a hose with test connection to test nipple TP6 (pos 5, figure 2) to drain oil. Take proper measures to collect the oil. Check the pressure on gauge G5. Dispose the oil according to local regulations.
12. Make sure that the low static pressure alarm PT3 goes off.
13. If the pressure transmitter does not work properly replace it according to Task: Replace the Pressure Transmitter.
14. Disconnect the hose.
15. Open shut-off valve G5V.

Finishing

16. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
17. Set the pump units to remote control.

This task is now completed.

Maintenance, Hydraulic System

Task: Test Pressure Relief Valve V1

Description

This task describes how to test the pressure relief valve V1 on the valve manifold.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty

Instruction

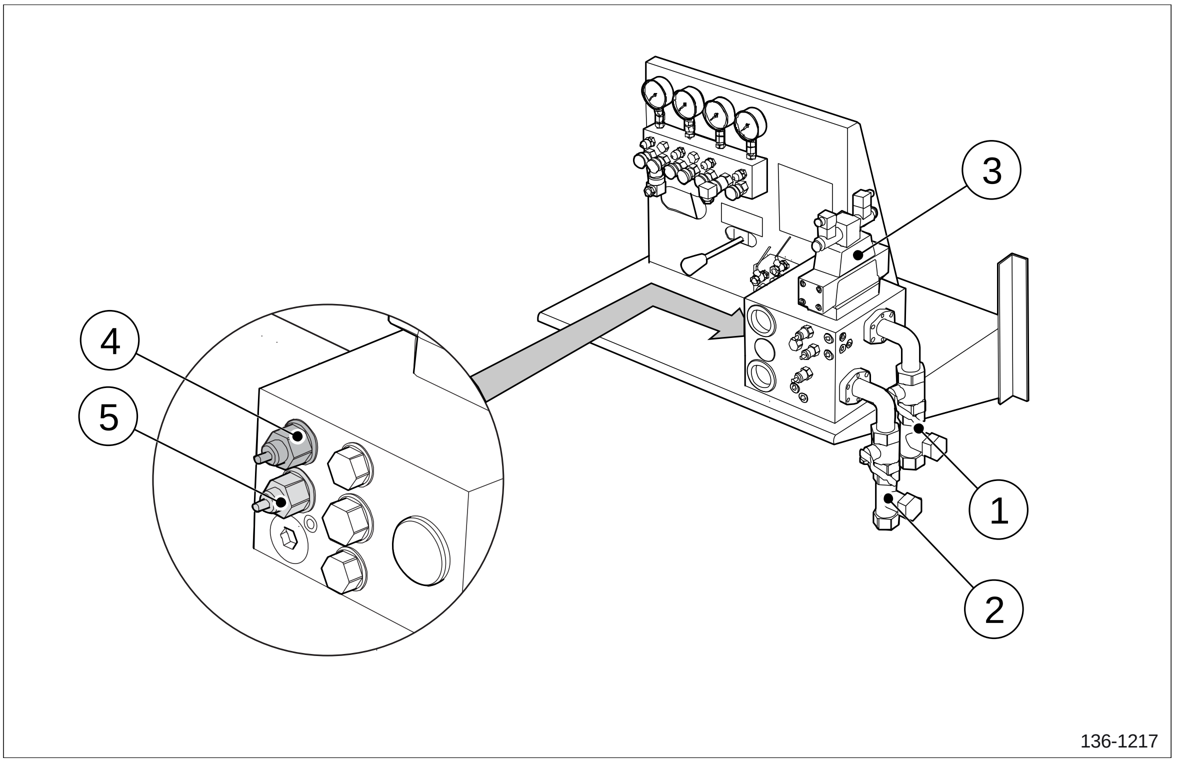

Figure 1 The valve manifold on the hydraulic power pack.

1. Shut-off valve V39
2. Shut-off valve V40
3. Directional proportional control valve V3
4. Pressure relief valve V8
5. Pressure relief valve V1

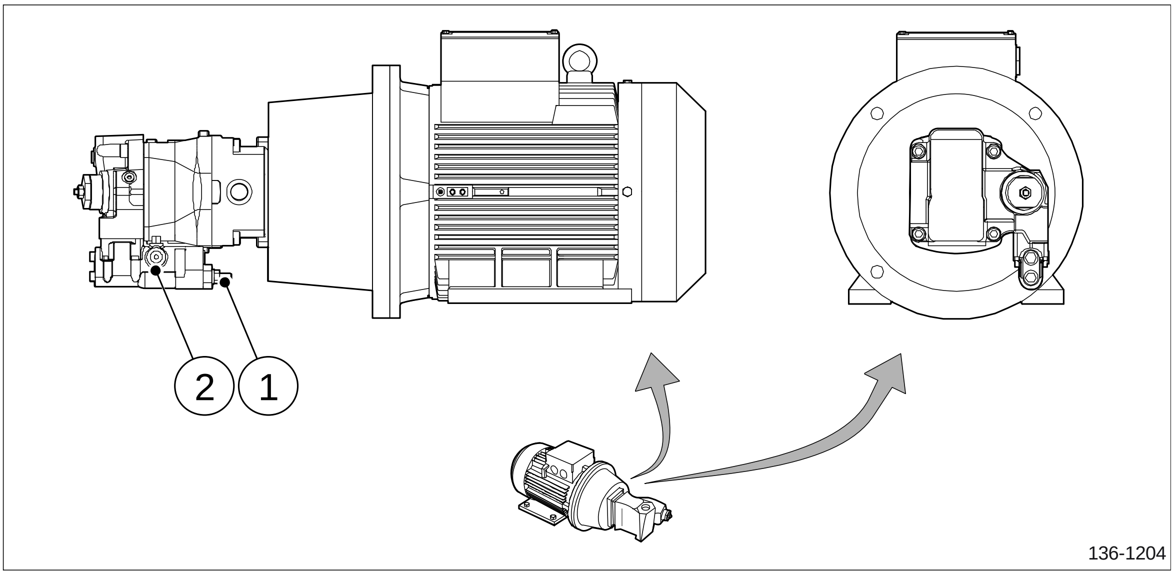

Figure 2 Hydraulic power pack.

1. Pressure regulator
2. Load sensing regulator

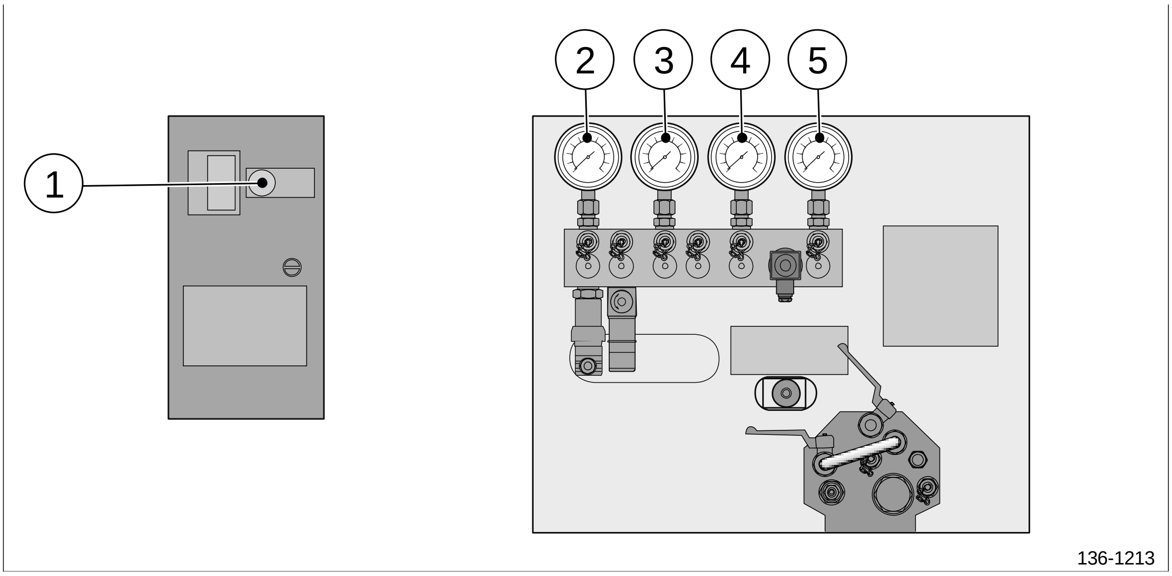

Figure 3 Oil pressure gauges located on the hydraulic power pack control panel.

1. Local/remote switch
2. Gauge G1: system pressure
3. Gauge G3: A port - astern working pressure
4. Gauge G4: B port - ahead working pressure
5. Gauge G5: static pressure

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Turn the remote/local switch on pump motor starters P1 to local position.
3. Set the remote/local switch (pos 1, figure 3) on the hydraulic power pack control panel to LOCAL CONTROL.

Test the Function of the Valve V1

4. Test the function of the valve V1:

    4.1. Start the main pump unit.

    4.2. Close the shut-off valves V39 and V40 (pos 1and 2, figure 1).

    4.3. Manoeuvre the directional proportional control valve V3 (pos 3, figure 1) by hand in ahead direction.
    Check pressure on gauge G1 (pos 2, figure 3) so the pressure is the same as the pressure according to the Hydraulic Diagram Drawing.

    4.4. Carefully increase the pressure by turning the pressure regulator (pos 1, figure 2) clockwise.
    Check pressure on gauge G1 (pos 2, figure 3) so that it stops and does not exceed the pressure according to the Hydraulic Diagram Drawing

4.5. Decrease the pressure by turning the pressure regulator counter clockwise. Set the pressure according to the Hydraulic Diagram drawing.

4.6. Open the shut-off valves V39 and V40.

5. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Test Pressure Relief Valve V8

Description

This task describes how to test the pressure relief valve V8 on the valve manifold.

Valve V8 must be replaced if it is malfunctioning, to ensure the safety and functions of the hydraulic system.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty

Instruction

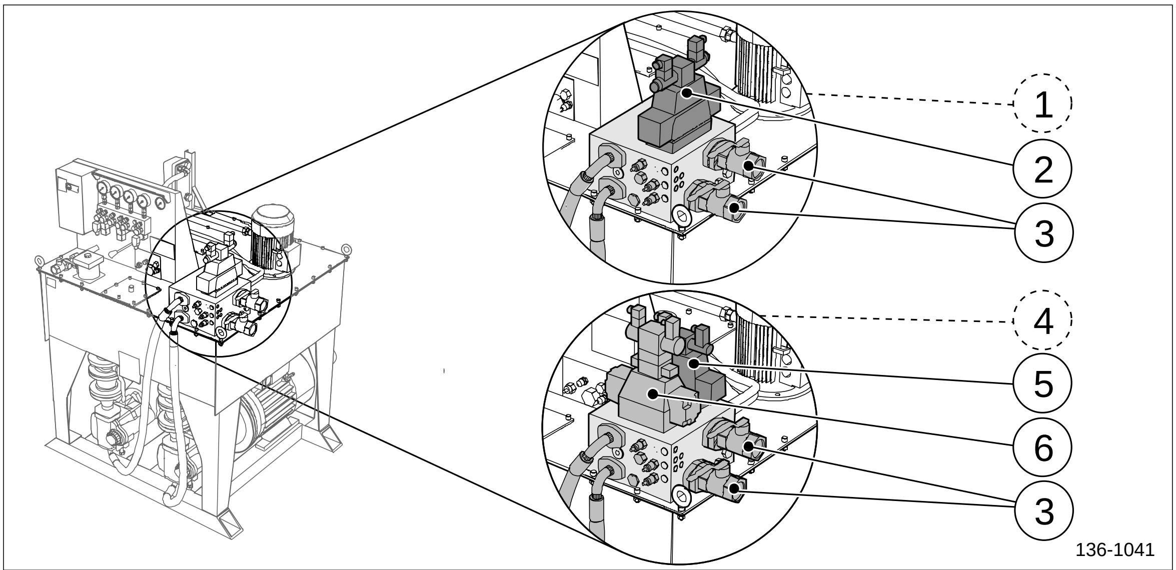

Figure 1 The valve manifold on the hydraulic power pack.

1. Valve manifold on power packs size 150-300 litres
2. Directional proportional control valve V3
3. Shut-off valve V39 and V40
4. Valve manifold on power packs size 500-1000 litres
5. Directional proportional valve V3
6. Directional on/off control valve V2

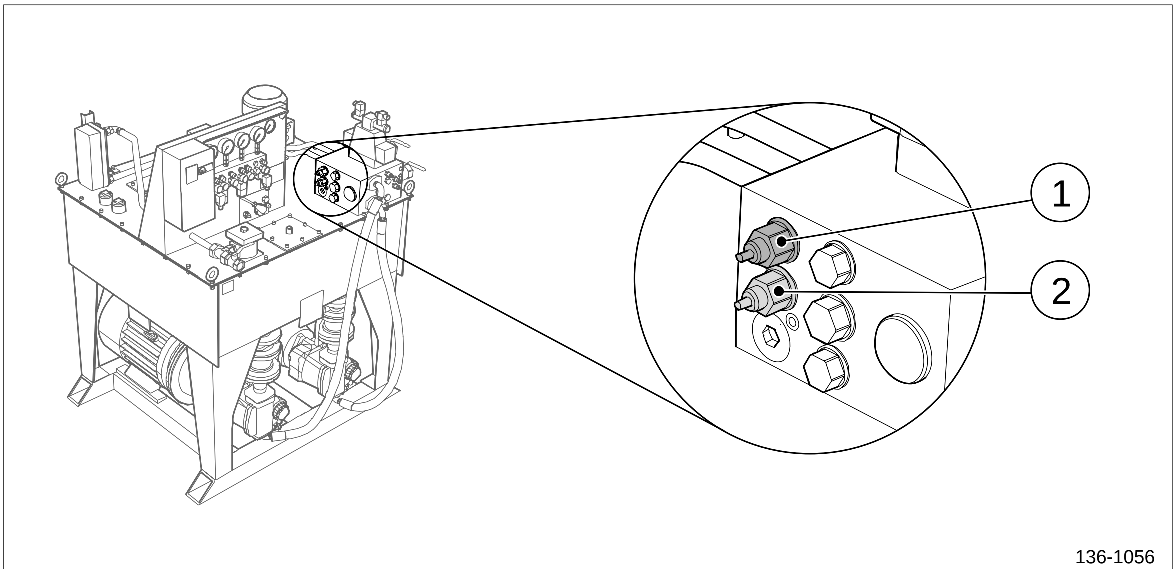

Figure 2 The hydraulic power pack unit.

1. Pressure relief valve V8
2. Pressure relief valve V1

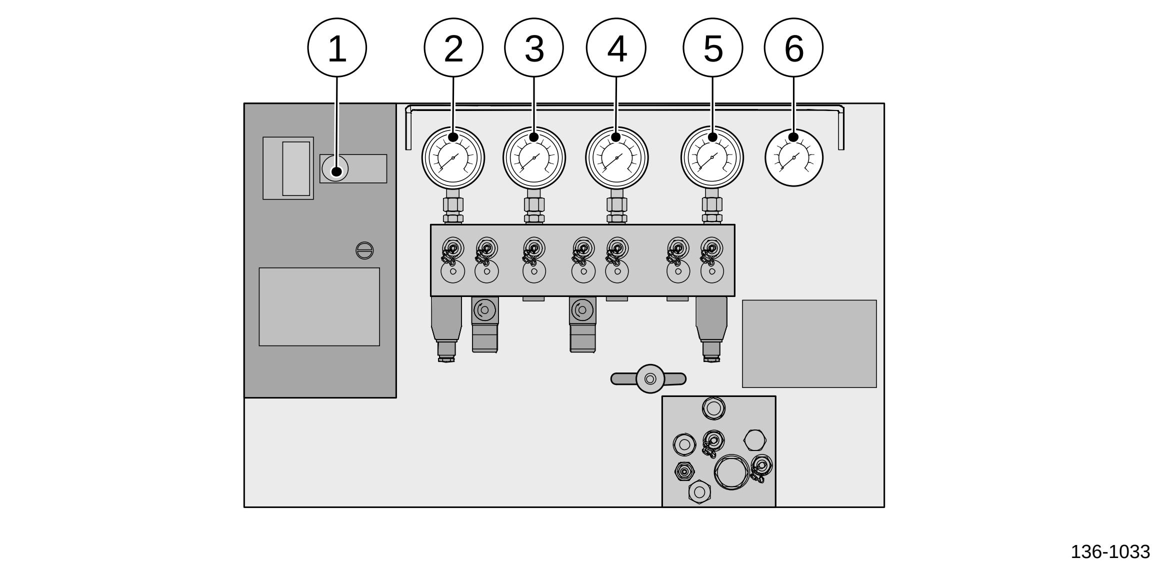

Figure 3 Oil pressure gauges located on the hydraulic power pack control panel.

1. Local/remote switch
2. Gauge G1: system pressure
3. Gauge G3: A port - astern working pressure
4. Gauge G4: B port - ahead working pressure
5. Gauge G5: static pressure
6. Thermometer TH1 for oil temperature in oil tank

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Start one of the main pump units.
4. Set the local/remote switch (pos 1, figure 3) on the hydraulic power pack control panel to LOCAL CONTROL.

Check settings of the pump regulator

5. Close shut-off valves V39 and V40 (see figure 1).
6. Manoeuvre the directional proportional control valve V3 (see figure 1) by hand in ahead direction.
7. Check the pressure on gauge G1 (pos 2, figure 3) and make sure that the pressure is in accordance with the maximum pump pressure, stated on the Hydraulic Diagram drawing.

Test function of relief valve V8

8. Manoeuvre the directional proportional control valve V3 in astern direction.
9. Check the pressure on the pressure gauge G3 (pos 3, figure 3). If the pressure is not in accordance with the pressure value stated for valve V8 on the Hydraulic Diagram drawing the valve V8 has to be adjusted or replaced, see Task Replace the Relief Valve V8.
10. Open the shut-off valves V39 and V40.
11. Set the local/remote switch switch on the hydraulic power pack control panel to REMOTE CONTROL.
12. Set the pump units to remote control.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Test By-pass Valve V17

Description

This task describes how to test the by-pass valve V17.

The valves on the valve manifold must be replaced if they are malfunctioning, to ensure the safety and functions of the hydraulic system.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Pressure test gauge (0-10 MPa) with Minimess connection 16x2	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

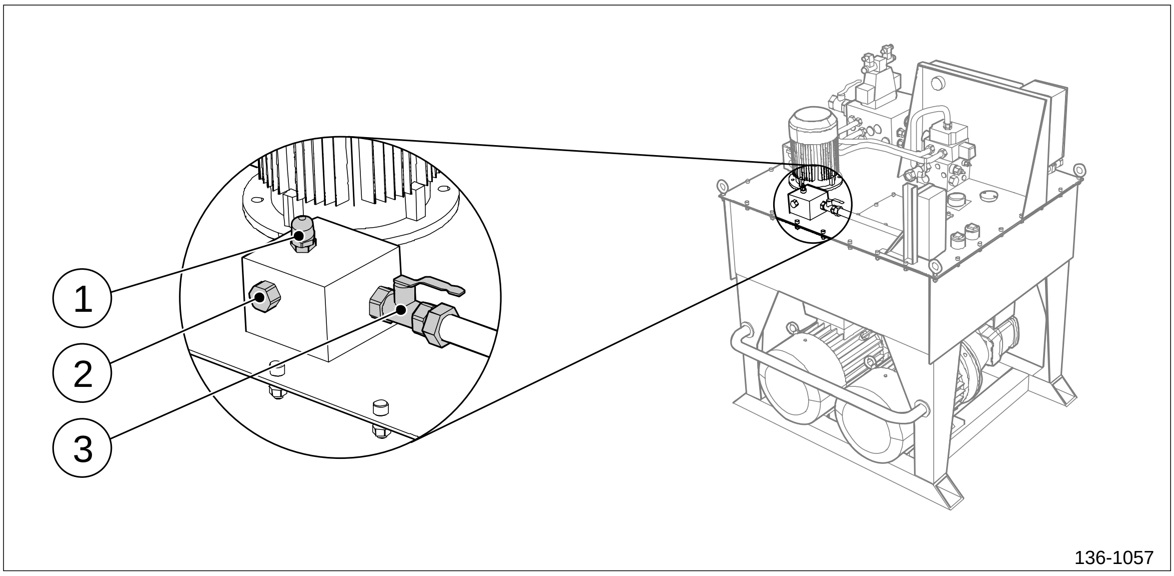

Figure 1 The back of the hydraulic power pack unit.

1. Test nipple, TP8
2. Return block with the by-pass valve V17
3. Shut-off valve V18

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off the pump units.
4. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Test function of the by-pass valve V17

5. Make sure that the pump unit P3 is running.
6. Close shut-off valve V18 (pos 3, figure 1).
7. Connect a pressure test gauge to test nipple TP8 (pos 1, figure 1) and measure the oil pressure. The pressure must be in accordance with the pressure value stated for the by-pass valve V17 on the Hydraulic Diagram drawing.
8. Replace the by-pass valve V17 (pos 2, figure 1) if the pressure is not in accordance with the pressure value indicated ion the Hydraulic Diagram drawing. For more information see Task Replace the By-pass Valve V17.
9. Disconnect the test gauge from the test nipple.
10. Open the shut-off valve V18.
11. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
12. Set the pump units to remote control.

This task is now completed.

Maintenance,
Hydraulic System

Task: Replace Circulation Filter Element

Description

This task describes how to replace the circulation filter element on the hydraulic power pack. The filter element must be replaced once every sixth month even though the filter indicator has not indicated that the filter is clogged.

Support Items

Spare Part Name	Qty
Filter element	1

Special/Additional Tools and Test Equipment	Qty
Container to collect oil	As req.

Reference Documents

Consumables	Qty
Linen rags	As req.

Instruction

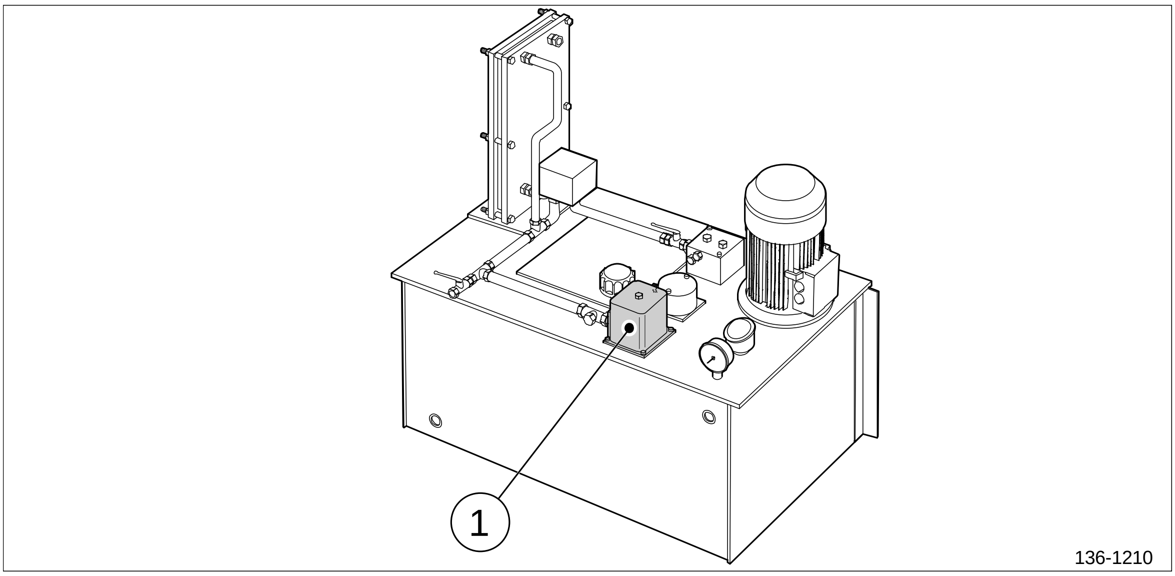

Figure 1 Front of the hydraulic power pack.

1. Circulation filter

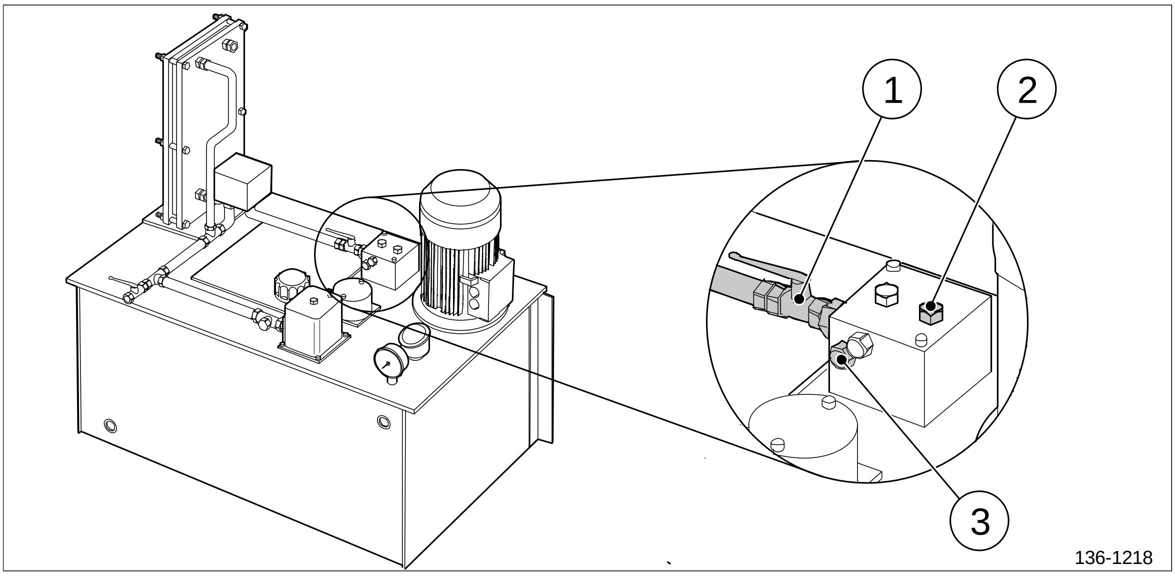

Figure 2 Front of the hydraulic power pack tank.

1. Shut-off valve V18
2. Test nipple TP8
3. By-pass valve V17

Warning: Replacing components during operation is associated with great risks for personal safety due to rotating shaft.

Note: This task can be performed when the propeller system is in operation.

Take out the used filter element

1. Close shut-off valve V18 (pos 1, figure 2).
2. Remove the circulation filter cover (pos 1, figure 1) and pull out the filter element. Take proper measures to collect any oil spillage. Dispose the oil according to local regualations.

Insert new filter element

3. Insert the new filter element. Use a clean linen rag to wipe off oil spillage.
4. Reassemble the return filter cover and make sure it is fitted correctly.
5. Open shut-off valve V18.
6. Make sure that no oil is leaking from the circulation filter. If oil is leaking, make sure that the filter element and the circulation filter cover are correctly fitted.

Inspect the used filter element

7. Inspect the used oil filter and look for metal chips or other particles, which may indicate damage on the propulsion system. Contact Rolls-Royce if any metal chips or other particles are found.

This task is now completed.

Every Sixth Month Maintenance, Feed Back Unit (FA)

Task: Visually Inspect Feed Back Unit

Description

This task describes how to visually inspect the feed back unit (FA). The feed back unit must be inspected in order to ensure its proper function.

Support Items

Spare Part Name	

Special/Additional Tools and Test Equipment	Qty
Insulated screw driver	As req.

Reference Documents
Feed Back Unit Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

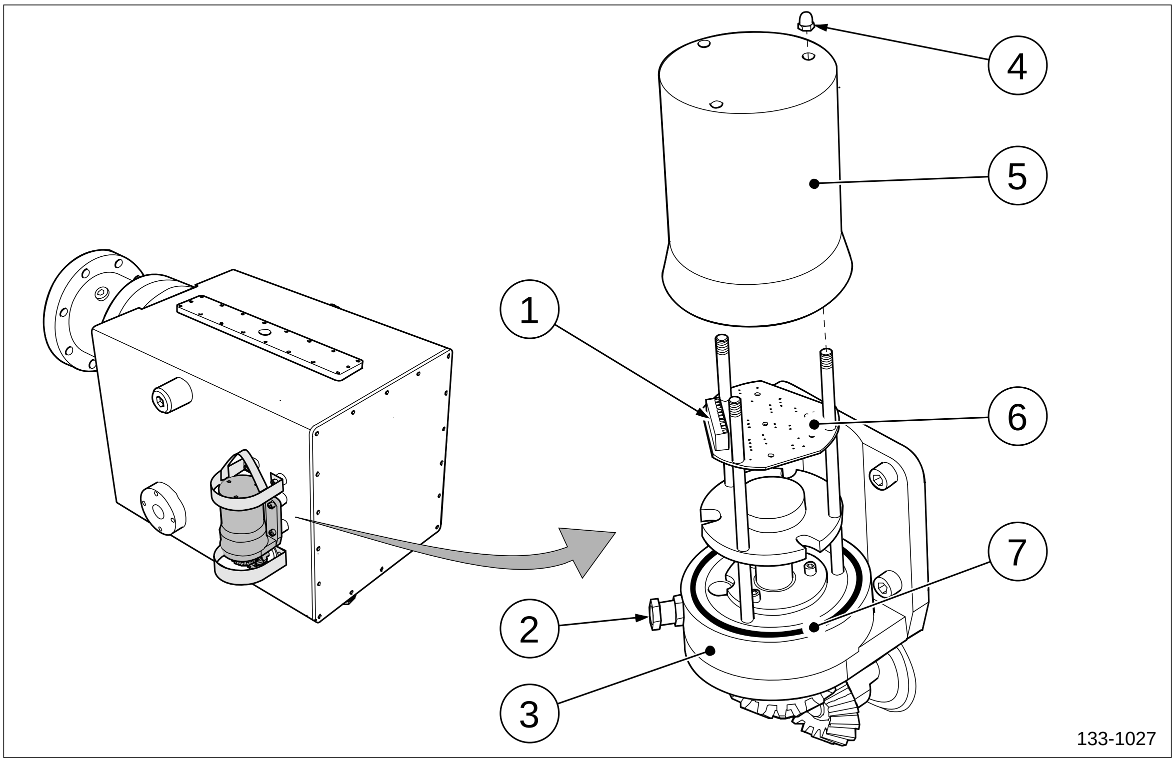

Figure 1 Feed back unit with internal equipment.

1. Connection terminal(s)
2. Cable gland
3. Feed-back unit housing
4. Nut
5. Cover
6. PC-board
7. Sealing

Caution: Use insulated screwdrivers when working on the feed back unit.

Note: Make sure the hydraulic pump motor starters are set to local mode and that they cannot be started.

1. Turn off the CPP remote control system.
2. Make sure the hydraulic pump motor starters are set to local mode and that they can not be started.
3. Use linen rags to clean the feed back unit before the inspection.
4. Inspect the cable gland (pos 2, figure 1) by making sure the glands of the cables are

properly tightened. Pull gently the cable connected to the cable gland to inspect the tightening. Tighten the gland if necessary.

5. Loosen the three screws (pos 4, figure 1) on the feed back unit cover (pos 5, figure 1) and remove the cover.
6. Inspect all internal wiring and the connection terminal(s) (pos 1, figure 1) visually. Make sure the wiring is intact and that the screws on the connetcion terminal(s) are properly tightened. Tighten if necessary.
7. Inspect the the PC-board (pos 6, figure 1). Consult Rolls-Royce Marine Global Support Network if the card is damaged.
8. Inspect the sealing (pos 7, figure 1) for damages. Replace with new sealing if necessary.
9. Reassemble the feed back unit cover and tighten the screws (pos 4, figure 1).
10. Set the hydraulic pump motor starters to remote position.
11. Turn on the CPP remote control system.

Please report any major damages on the feed back unit to the Rolls-Royce Marine Global Support Network.

This task is now completed.

Produced by: KK174 Approved by: Fnl
Creation date: 2008-05-06

Revision: Sign:
Revision date:

Every Sixth Month Maintenance, General

Task: Inspect the Lifting Tools

Description

This instruction will describe how to inspect and maintain the lifting tools supplied by Rolls-Royce AB.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty

Reference Documents
User Manual for lifting rod, lifting yoke

Consumables	Qty
Anti-corrosion agent	As req.

Instruction

Note: The manufacturers guarantees are not valid if any modifications or changes are made to the tool's components without written permission from Rolls-Royce AB (Product Development).

1. Clean the lifting tool with water and a scrub brush. Use degreaser if necessary.
2. Visually inspect the lifting tool. Look for signs of damage. Make sure that the bolts and nuts are undamaged and that the threads runs smoothly.
3. The maintenance must be performed according to User Manuals for lifting tools in part Tools.
4. Apply anti-corrosion on the lifting tool according to the recommendations from the manufacturer of the anti-corrosion agent.

If substantial damage is detected, the lifting tool must be repaired or replaced, please consult the nearest Rolls-Royce Marine Global Support Network.

The manufacturers guarantees are not valid if any modifications or changes are made to the tool's components without written permission from Rolls-Royce AB (Product Development).

This task is now completed.

Produced by: KK174 Approved by: Fnl
Creation date: 2008-05-14
Revision: Sign:
Revision date:

Every Sixth Month Maintenance, General

Task: Inspect Stored Spare Parts

Description

This instruction will describe when to inspect the stored spare parts. For information about how to store spare parts see chapter Handling and Preservation.

Support Items

Spare Part Name	Qty

Special/Additional tools and Test Equipment	Qty

Reference Documents

Consumables	Qty

Instruction

Warning: Make sure that the spare blades stored onboard are properly fastened.

The stored spare parts must be inspected every sixth month with regards to corrosion and handling damage. If any damage is found it must be remedied at once.

Make sure that the spare parts stored onboard, such as propeller blades, are properly fastened, for more information see chapter Handling and Preservation.

The spare parts must be adequately protected during storage against damage, such as impact damage, grinding and welding spray, corrosion, and from long term exposure to aggressive atmospheric conditions

For more information see chapter Handling and Preservation. If there are any other questions regarding the storage of the spare parts please consult the nearest Rolls-Royce Marine Global Support Network.

This task is now completed.

Produced by: KK174 Approved by: Fnl Revision: Sign:
Creation date: 2008-05-06 Revision date:

Every Sixth Month Maintenance, General

Task: Inspect Cathodic Protection (not RR delivery)

Description

This task describes how to inspect the cathodic protection. The propeller must always be protected against corrosion by an effective cathodic protection system. The cathodic protection is not part of Rolls-Royce delivery.

Support Items

Spare Part Name	Qty

Special Tools and Test Equipment	Qty
Soft brush	1

Reference Documents

Consumables	Qty

Instruction

Warning: Turn off the propulsion system before starting the inspection.

Warning: Lock and secure the shaft before starting the inspection. The shaft must then remain locked and secured during the entire inspection.

Warning: Make sure all personnel involved are aware of the inspection in progress.

Before starting this task

1. Turn off the propulsion system.
2. Lock and secure the shaft.

Inspect the cathodic protection

3. Inspect all anodes visually. Make sure they are fitted correctly.
4. Replace the anodes immediately if required. Consult Rolls-Royce Marine Global Support Network if there are any questions regarding replacing the anodes.
5. Reset the propulsion system.

This task is now completed.

Produced by: KK174 Approved by: Fnl
Creation date: 2008-05-06

Revision: Sign:
Revision date:

Yearly Maintenance, OD-box (FA)

Task: Functional Inspection Pitch Indicators

Description

This instruction describes how to inspect that the pitch indicators on the bridge, control room and the hydraulic power pack are in accordance with the mechanical pitch indicator on the OD-box.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty

Reference Documents
Combinator Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

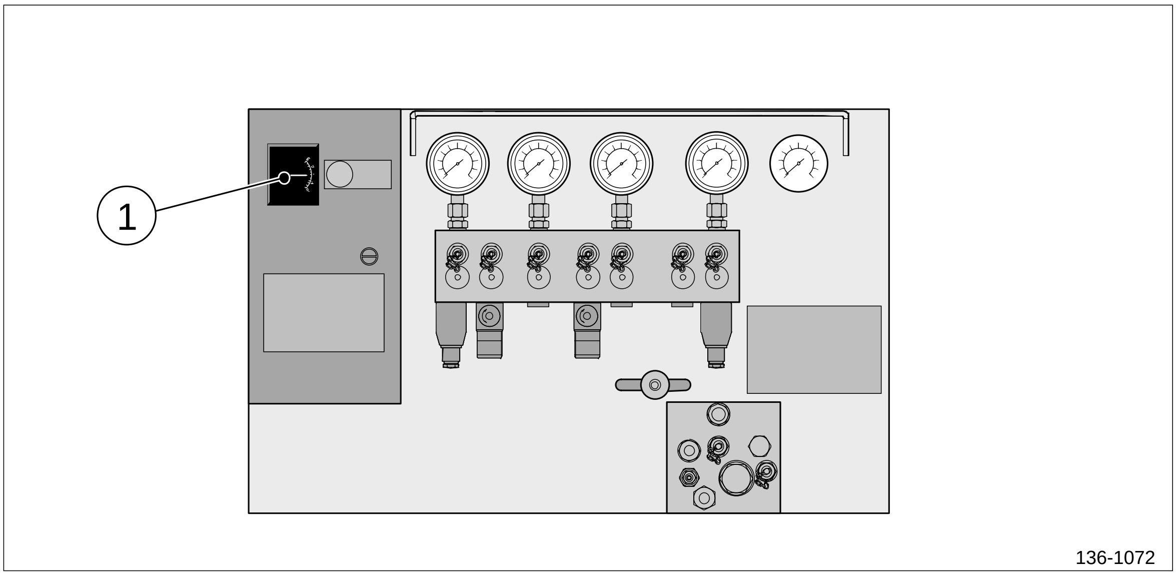

Figure 1 The pitch indicator on the control panel of the hydraulic power pack.

1. Pitch indicator

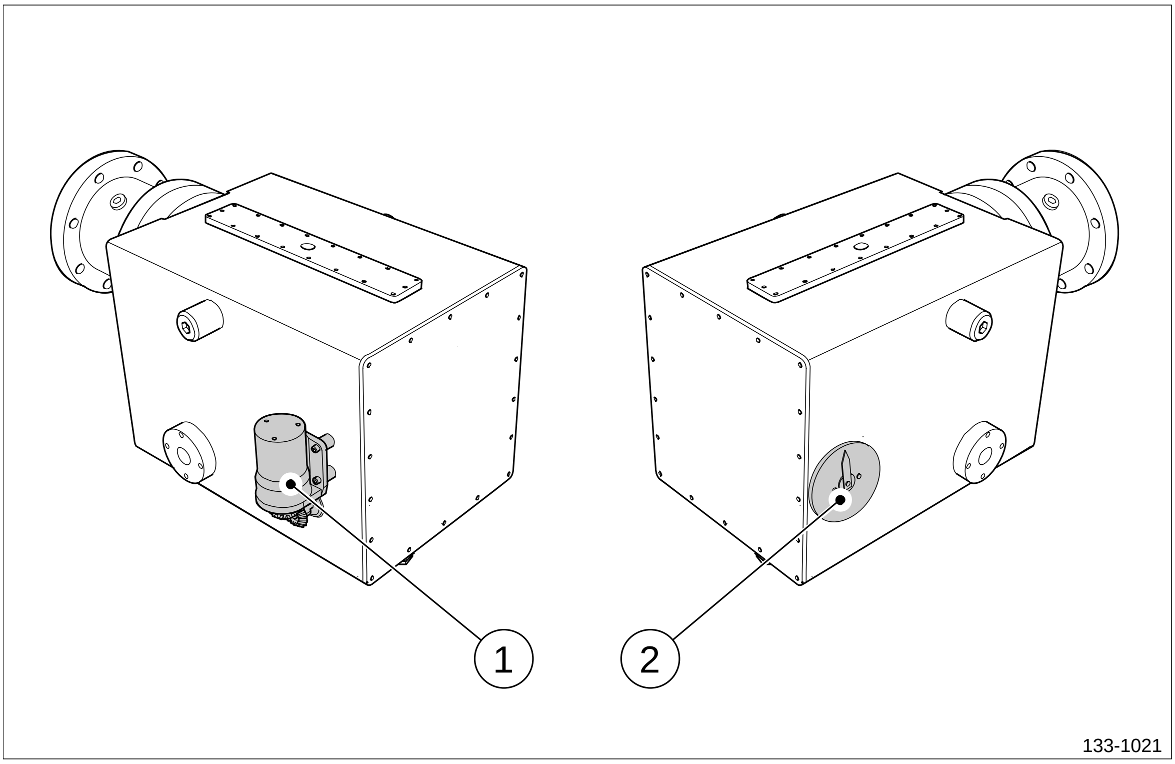

Figure 2 OD-box (FA), feed back box and its mechanical pitch indicator.

1. Feed back box
2. Mechanical pitch indicator

The electronic pitch indicator indicates the pitch in percentage of the maximum values, whereas the mechanical scale indicates the pitch value in millimetres, see Combinator Diagram drawing.

1. Shut off the main engine.
2. Set the pitch to Full Ahead using the control lever.
3. Visually inspect that the mechanical pitch indicator (pos 2, figure 2) on the OD-box is positioned at Full Ahead, according to the Combinator Diagram drawing.
4. Visually inspect that the pitch indicators on the bridge, in the control room and on the hydraulic power pack also indicates Full Ahead.
5. Communicate the pitch indicators positions between the control room and the bridge.
6. Set the pitch control to Full Astern.
7. Visually inspect that the mechanical indicator on the OD-box is positioned at Full Astern, according to the combinator diagram.
8. Visually inspect that the pitch indicators on the bridge, in the control room and on the hydraulic power pack also indicates Full Astern.
9. Communicate the indicators positions between the engine room and the bridge.
10. Set the pitch control to Zero pitch position.
11. Visually inspect that the mechanical pitch indicator on the OD-box is positioned at Zero pitch, according to the marking on the mechanical scale.
12. Visually inspect that the pitch indicators on the bridge, in the control room and on the hydraulic power pack also indicates Zero pitch.
13. If a deviation between the indicators is detected, please consult Rolls-Royce Marine Global Support Network.

This task is now completed, it is safe to start the propulsion system.

Yearly Maintenance, Remote Control System

Task: Inspect Control System Cabinets

Description

This instruction describes how to inspect the control system cabinets.

Support Items

Spare Part Name	Cross Ref. No.

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

Inspect the control system cabinets

1. Inspect the connection terminals in the control system cabinets. Make sure that the teminals and cabling are properly fastened.
2. Make sure that there are no signs of oxidation in the cabinets.

This task is now completed.

Maintenance, Propeller Blade

Replace Blade Sealing Ring - Overview

Prerequisite and Safety Precautions

The vessel must be docked during the whole blade sealing ring replacement procedure and before the vessel is launched a pressure test of the propeller hub must be performed.

Make room around the propeller and hub before the shaft is turned. Make sure that no scaffolds are in the way of the propeller blades or propeller hub.

It is important that all personnel on the vessel and in the dockyard are notified that maintenance is performed on the propeller blades and hub. All personnel must also be notified before the shaft is turned.

Make sure that the lifting of the propeller blades are performed by qualified personnel.

Rolls-Royce recommends that all blade sealing rings are replaced every fourth year.

Work Order

The work order for replacing the blade sealing rings is described in the following bullet list and for detailed descriptions of the replacement procedure see the cross references in the bullet list:

- Drain the propeller hub from oil (see Task: Drain Centre Part of Propeller Hub).
- Flush propeller blade flange with freshwater (see Task: Flush propeller blade flange with freshwater).
- Remove the propeller blade (see Task: Remove Propeller Blade).
- Replace the blade sealing ring (see Task: Replace Blade Sealing Ring).
- Reinstall the propeller blade (see Task: Propeller blade installation).
- Fill oil and flush the propeller hub (see Task: Fill Oil and Flush Propeller Hub).
- Flush propeller blade flange with oil (see Task: Propeller blade installation).
- Pressure test the propeller hub (see Task: Propeller Hub Pressure Test).

Produced by: KK174 Approved by: Fnl Revision: a Sign: Nna
Creation date: 2008-06-16 Revision date: 2009-10-21

Maintenance, Propeller Blade

Task: Drain Centre Part of Propeller Hub

Description

This task describes how to empty the centre part of the propeller hub from oil.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Barrel to collect the oil	1
Shut off valve	1
Standard welding machine	1
Standard grinding machine	1

Reference Documents
Hub Assembly drawing

Consumables	Qty
Grinding disks	As req.
Electrodes, ISO E 23.12.2	As req.
Linen rags	As req.

Instruction

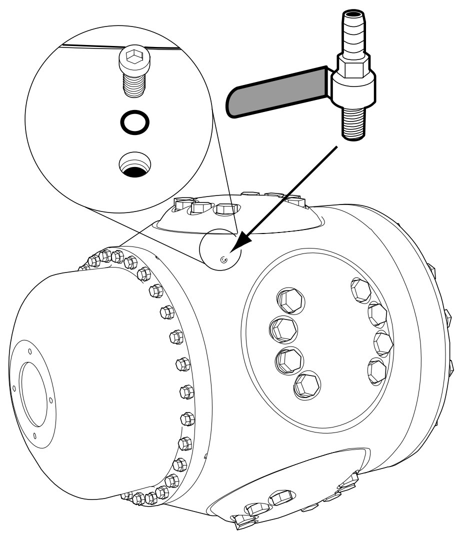

Figure 1 Remove the plug and O-ring, and fit the shut off valve.

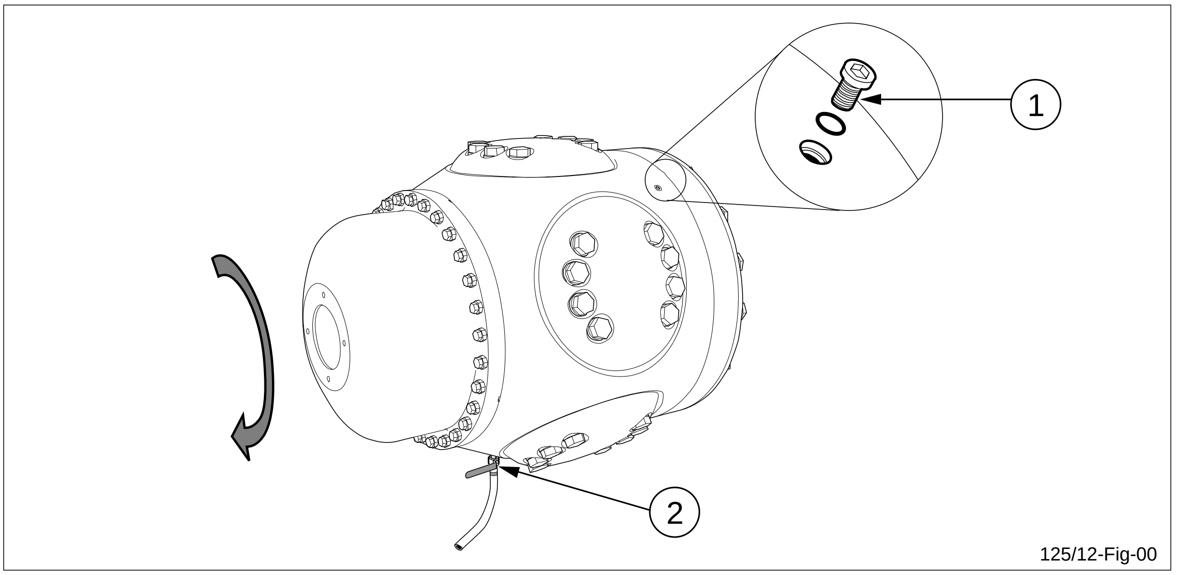

Figure 2 The hub is rotated to be able to remove the forward plug.

1. Forward filling/air venting plug
2. Shut off valve

Warning: The engine must be shut off and locked, when working close to the shafts.

Warning: It is important that there is sufficient space around the propeller hub when turning the shaft.

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

1. Secure and lock the shaft (see part Operating Instructions).
2. Turn the remote/local switch on pump motor starters P1 and P2, if any, to LOCAL position.
3. Stop all pump units.
4. If the vessel is equipped with a gravity tank, close the drain valve on the gravity tank leading to connection V (see Hydraulic Diagram drawing). Do not open the valve until the hub is refilled with oil.
5. Turn the propeller shaft until the forward plug are directed straight downwards and aft plug is directed straight upwards.

6. Use a grinding machine or a chisel to remove the spot welds from the plug.
7. Remove the aft plug, and fit a valve (with a hose) in the plug hole (see figure 1).
8. Turn the shaft until the valve is directed downwards and the forward plug is directed upwards.
9. Use a grinding machine or a chisel to remove the spot welds from the forward plug.
10. Remove the forward plug. This will allow air to flow into the hub.
11. Open the shut off valve (see position 2, in figure 2) and let the oil flow until the hub is emptied.
12. Reinstall the plugs to prevent dirt from entering the hub.

Maintenance, Propeller Blade

Task: Flush the Blade flange with freshwater

Description

This task describes how to flush the propeller blade flange with freshwater before the propeller blades can be removed from the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Air driven pump unit	1
Flushing hoses	2

Reference Documents
Hub Assembly drawing

Consumables	Qty

Instruction

Warning: The propulsion system must be shut off and locked during this procedure.

Caution: Make sure that the propeller are cleaned and dry before this task starts

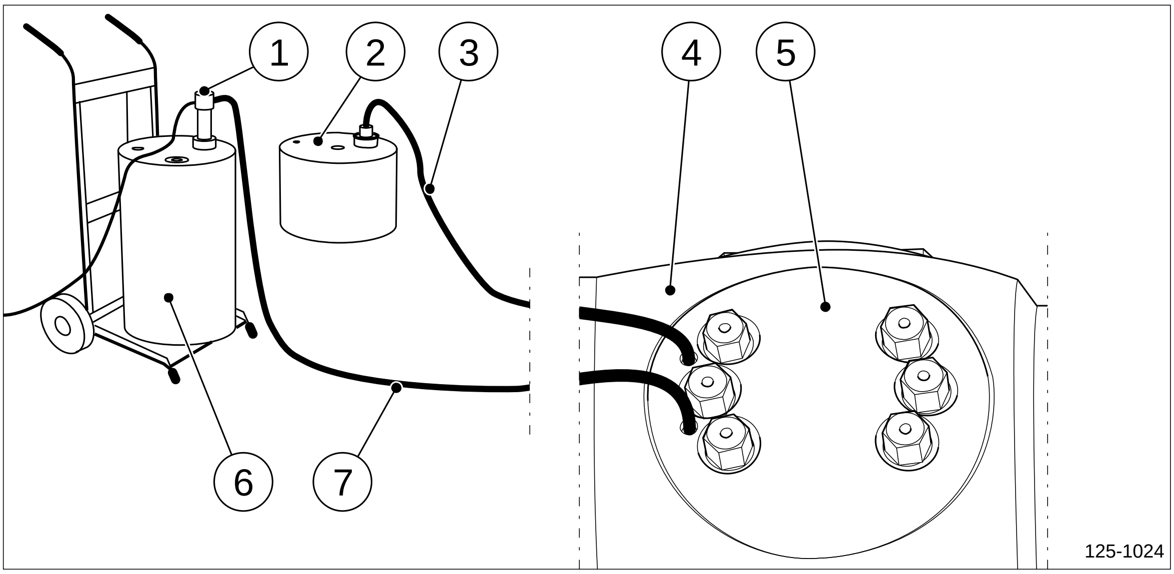

Figure 1 Example of flushing equipment.

1. Air driven pump unit
2. Container for excessive flushed oil and freshwater
3. Hose connected to the connection “OUT” on the blade flange
4. Propeller Hub body
5. Blade flange
6. Flushing freshwater container
7. Hose connected to connection “IN” on the blade flange

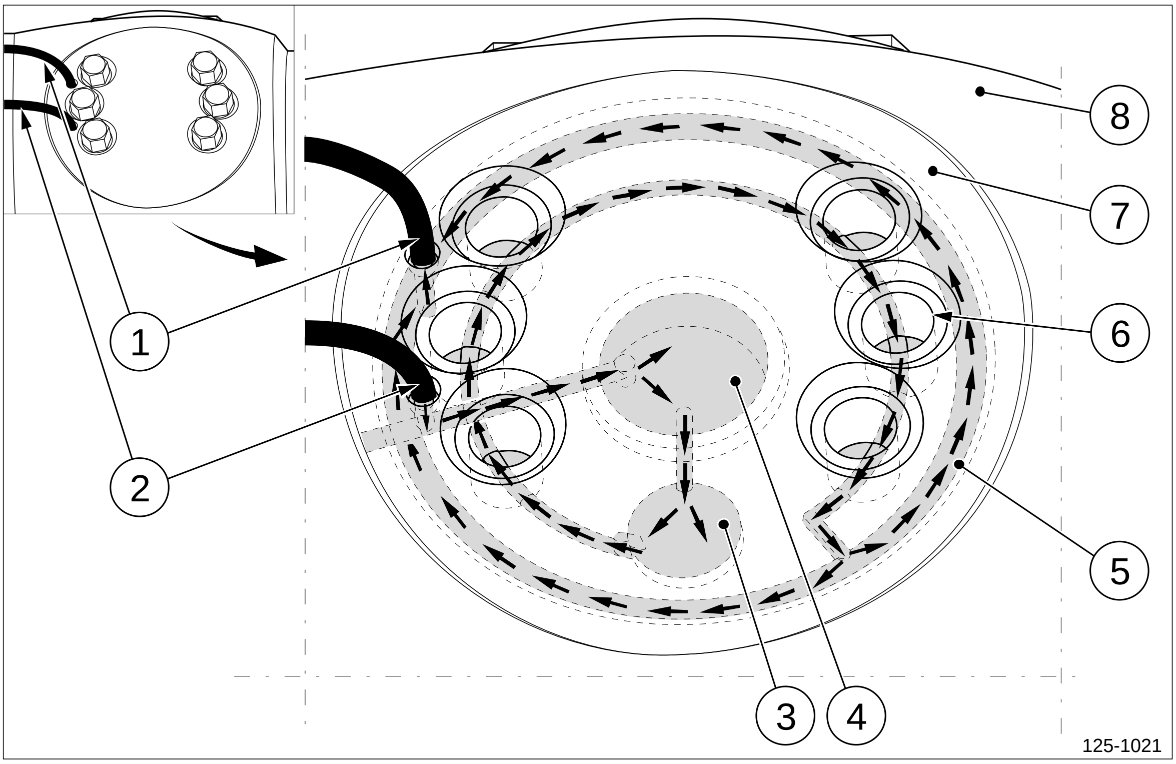

Figure 2 Flushing direction through the blade flange, G-design.

1. Oil connection marked “OUT”
2. Oil connection marked “IN”
3. Guide pin
4. Space between blade flange and crank pin ring
5. Blade sealing ring groove
6. Blade screw holes
7. Blade flange
8. Hub body

Before Starting this Procedure:

Make sure that all parts are clean and dry.

Make sure that all equipment is clean

Flush the blade flange

1. Remove the VSTI plugs from the “IN” and “OUT” holes first
2. Connect the injection pump, flushing nipple and hose to connection marked “IN”.(pos 2, figure 2)
3. Connect the excessive oil/water container flushing nipple and hose to oil connection marked “OUT”.(pos 1, figure 2)
4. Start to flush the blade flange with the pump unit . Use minimum pressure value at first. Slowly increase the pressure.(pos 1, figure 1)
5. When flushing water starts to evacuate in to the excessive oil/water container the flushing of the blade flange is complete. (pos 2,figure 1)
6. Disconnect both hoses with nipples at the “IN” and “OUT” connections on the

blade flange.

7. Install the VSTI plugs in the blade flange.

8. Clean and store the oil injection pump, hoses and excessive oil container in a proper storage.

This task is now completed

Maintenance, Propeller Blade

Task: Remove Propeller Blade

Description

This task describes how to remove the propeller blades from the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Mobile crane or other suitable lifting equipment such as chain falls.	1
Dynamometric wrench	1
Tension tester	1
Standard grinding machine	1
Soft lifting slings	1
Special lifting tool	1

Reference Documents
Hub Assembly drawing

Consumables	Qty
PTFE-compound	As req.
Grinding discs	As req.
Wooden planks	As req.

Instruction

Warning: It is important that only qualified personnel perform the lifting.

Warning: Never work alone when removing heavy components. Most lifting operations require two persons, one operate the lifting device and one ensure that the components do not get damaged.

Warning: The propulsion system must be shut off and locked during this procedure.

Warning: The torque tool must be dimensioned with consideration taken to the torque values. This also includes the power socket which must have correct dimension for the width across flats.

Caution: Make sure to handle the torque tool with care to prevent personel injuries due to the massive forces used.

Caution: After performing the following instruction, it is important to cover the blade bolt holes, the blade sealing groove and the opening in the crank pin ring to prevent sand and dust from entering the hub. Use rubber sheets as cover.

Note: Make sure to have an up to date certificate regarding torque calibration of the torque tool.

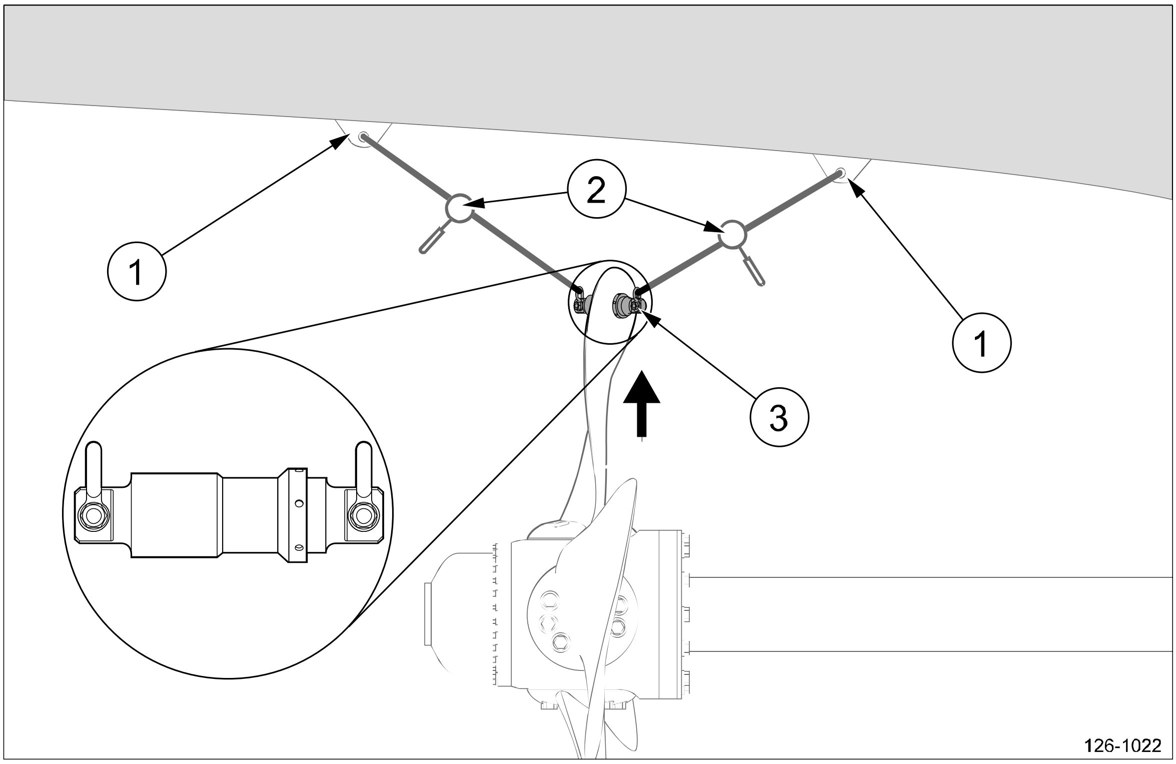

Figure 1 The blade is lifted using the lifting hole and special lifting tool.

1. Lifting ear welded to the hull
2. Pulley block with lifting loop
3. Lifting tool

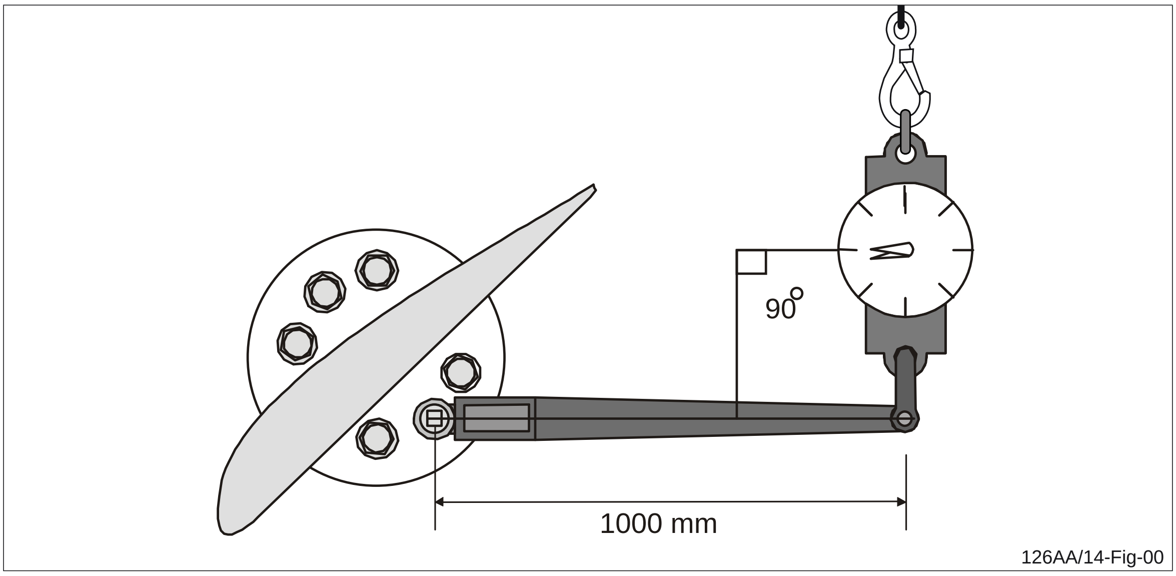

Figure 2 Alternative 1: Tension tester and dynamometric wrench attached to a blade bolt.

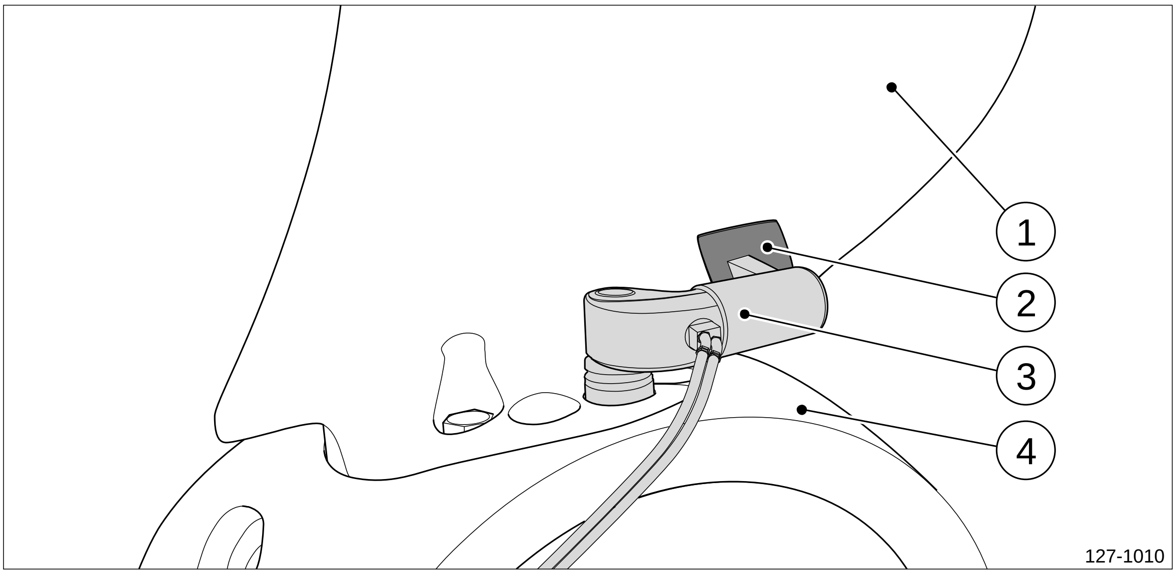

Figure 3 Alternative 2: Torque tool used. for the blade bolts.

1. Propeller blade
2. Protection Plate
3. Example of a Torque Tool
4. Hub body

Before starting this task::

Make sure that proper lifting equipment are available.

Weld brackets onto the ships hull.

Make sure that the blade flange is flushed with freshwater (see Task: Flush the blade flange with freshwater).

Remove propeller blade

1. Secure and lock the shaft (see part Operating Instructions).
2. Use a grinding machine or a chisel to remove the spot weld on the blade screws locking pin.
3. Turn the propeller shaft so that the tension tester and the dynamometric wrench or torque tool can be fitted on the blade screws.
   When using a torque tool according to figure 3, the tool’s support part must be adjusted (the angle) towards the blade to obtain a steady torque force on the screws. To protect the surface on the blade use a thick aluminium, copper or brass plate (pos 2, figure 3) between the tool’s support and the blade. The plate must be bent with a similar radius as the surface to avoid damages to the surface.
4. Slightly loosen each blade bolt. Make a note at which torque the screw loosens.
5. Turn shaft in a position that will allow the blade to be hoisted straight upwards.
6. Attach proper lifting equipment to the propeller. For more information see section Storage and Preservation in part Maintenance.
7. Unscrew and remove the blade screws.
8. Lift the propeller blade. The blade must be lifted straight upwards and be kept in

horizontal position until the blade has come off the guide pin.

9. Inspect the underside of the blade foot. Make sure that there is no signs of wear or pores. If pores are found please contact the nearest Rolls-Royce Global Support Network. If a pore is not taken care of it can damage the blade sealing ring.

10. Place the blade with the blade flange down on a clean wooden foundation.

11. Remove the used blade sealing ring (see Task: Replace Blade Sealing Ring).

12. Cover the blade screw holes, the blade sealing groove and the opening in the crank pin ring with a rubber sheet to prevent sand and dust from getting into the hub.

This task is now completed

Produced by: KK174 Approved by: Fnl
Creation date: 2008-06-16

Revision: b Sign:
Revision date: 2011-05-18

Maintenance, Propeller Blade

Task: Replace Blade Sealing Ring

Description

This task describes how to replace the blade sealing rings. Replace the blade sealing rings every fourth year.

Support Items

Spare Part Name	Qty
Blade sealing ring	

Special/Additional Tools and Test Equipment	Qty
Mobile crane or other suitable lifting equipment such as chain falls.	1
Dynamometric wrench	1
Tension tester	1
Standard welding machine	1
Standard grinding machine	1
Soft lifting slings	1

Reference Documents
Hub Assembly drawing
Instructions for Tightening of Screws, 586 431

Consumables	Qty
PTFE-compound	As req.
Electrodes, ISO E 23.12.2	As req.
Teflon grease (PTFE)	As req.

Instruction

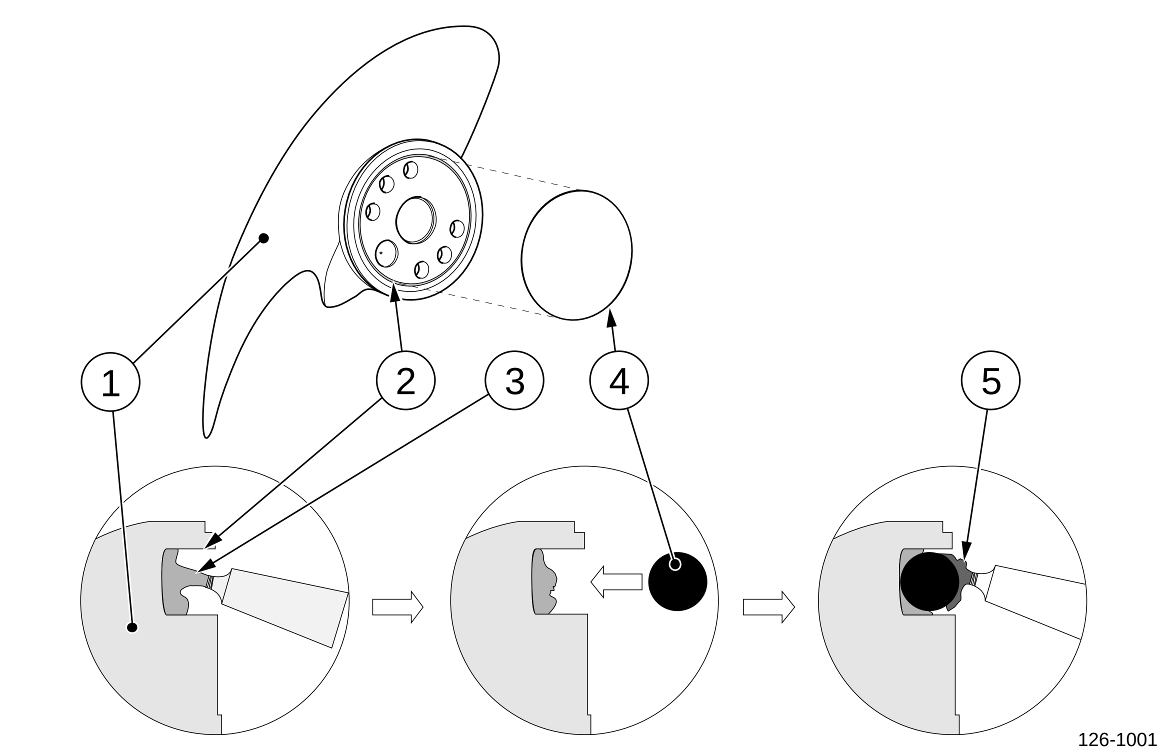

Figure 1 Mounting of blade sealing ring on blade flange.

1. Propeller blade
2. Blade sealing groove
3. Grease
4. Blade Sealing Ring
5. PTFE-compound

Warning: The propulsion system must be shut off and locked during this procedure.

Caution: Do not forget to apply teflon grease on the top surface of the blade sealing ring. Lack of teflon grease may damage the blade sealing ring and that may over time cause substantial damage.

1. Make sure that the shaft cannot rotate.
2. Drain the propeller hub from oil (see Task: Drain centre Part of Propeller Hub).
3. Remove the propeller blade (see Task: Remove Propeller Blade).
4. Remove the used blade sealing ring.
5. Clean the blade sealing groove. Make sure that the groove is dry.

6. Apply grease or similar (pos 3, figure 1), in the blade sealing groove (pos 2, figure 1) on the blade flange in order to keep the blade sealing ring (pos 4, figure 1) in place when the blade flanges are mounted to the hub. Place a new clean blade sealing ring in the groove.

7. Apply teflon grease (PTFE) on the top surface of the blade sealing ring (pos 5, figure 1).

8. Install the propeller blade (see Task: Install Propeller Blade).

9. Fill oil to and flush the propeller hub (see Task: Fill Oil and Flush Propeller Hub).

10. Perform a hub pressure test to make sure that no oil leakage occurs (see Task: Propeller Hub Pressure Test).

This task is now completed.

Propeller Blade Installation, G-design

Description

This task describes how to install the propeller blades on the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Mobile crane or other suitable lifting equipment such as chain falls.	1
Dynamometric wrench or torque tool	1
Tension tester	1
Standard welding machine	1
Soft lifting slings	1

Reference Documents
Hub Assembly drawing
Lifting instructions in Part Handling and Preservation

Consumables	Qty
PTFE-compound	As req.
Sealing compound	As req.
Loctite 648 or similar	As req.
Teflon grease	As req.
Molycote or similar	As req.
Degreasing solvent	As req.
Flushing oil of type: Statoil SL 07-201	As req.

Installation Procedure

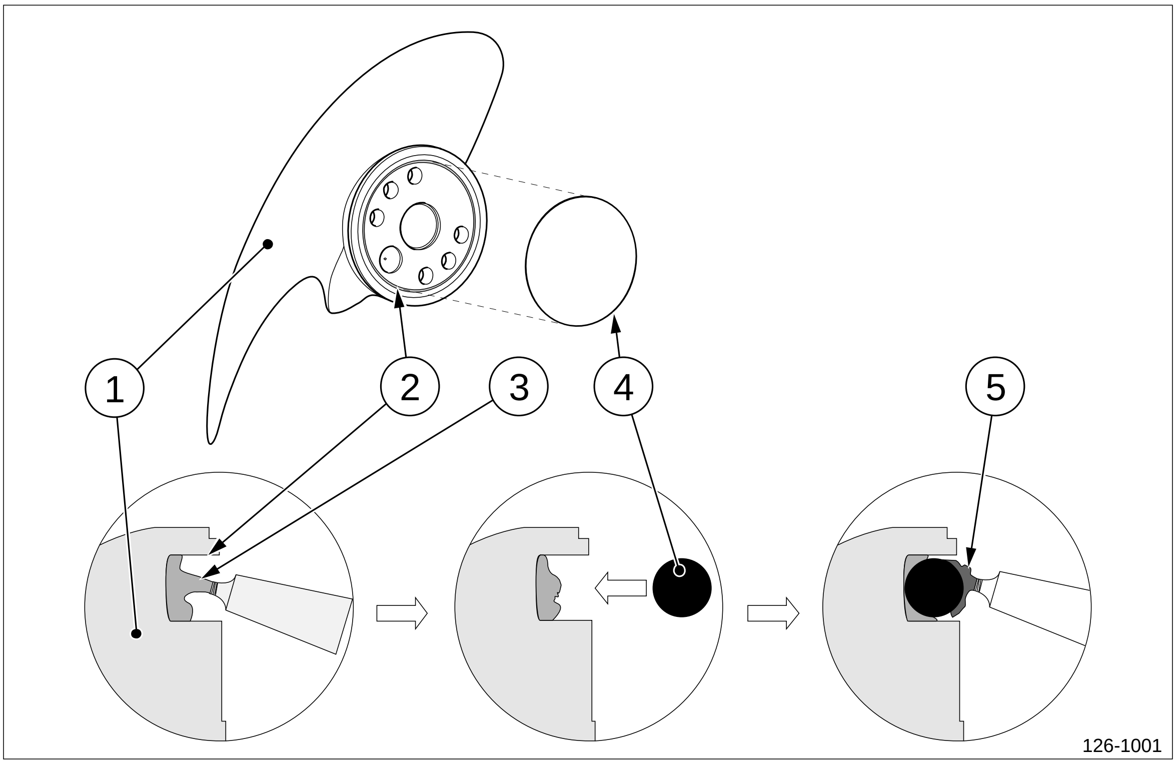

Figure 1 Mounting of blade sealing ring on blade flange.

1. Propeller blade
2. Blade sealing groove
3. Grease
4. Blade Sealing Ring
5. PTFE-compound

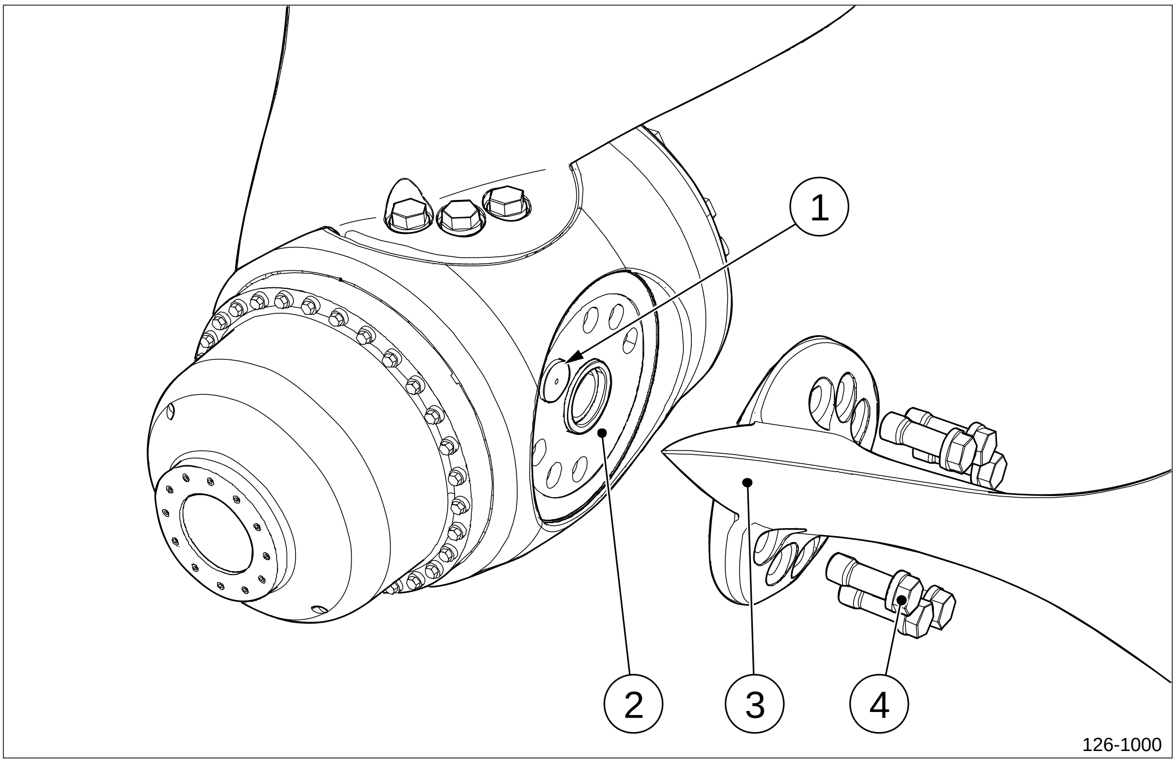

Figure 2 Mount the propeller blade on the hub.

1. Guide Pin
2. Crank Pin Ring
3. Propeller Blade including Blade Sealing Ring
4. Blade Screws

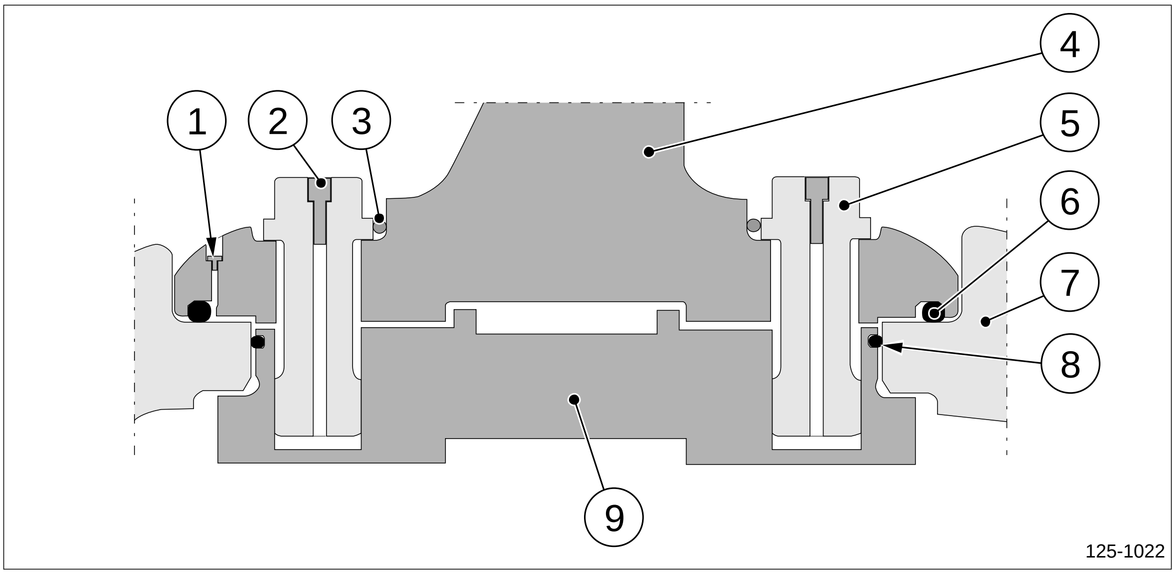

Figure 3 Cross-section of blade foot, G-design.

1. VSTI plugs for oil connection IN/OUT
2. Sealing screws
3. Locking pins
4. Propeller blade / blade flange
5. Hollow bored blade Screws
6. Blade sealing O-ring
7. Propeller Hub body
8. O-ring
9. Crank pin ring

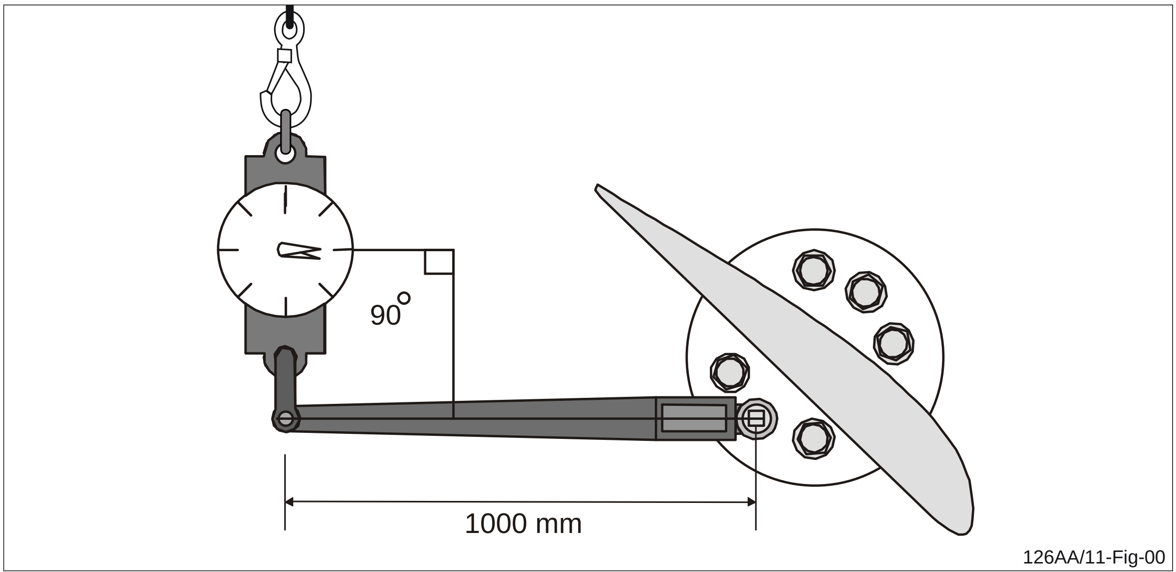

Figure 4 Final tightening of the blade screws alternative 1: Dynamometer and torque wrench attached to a blade bolt.

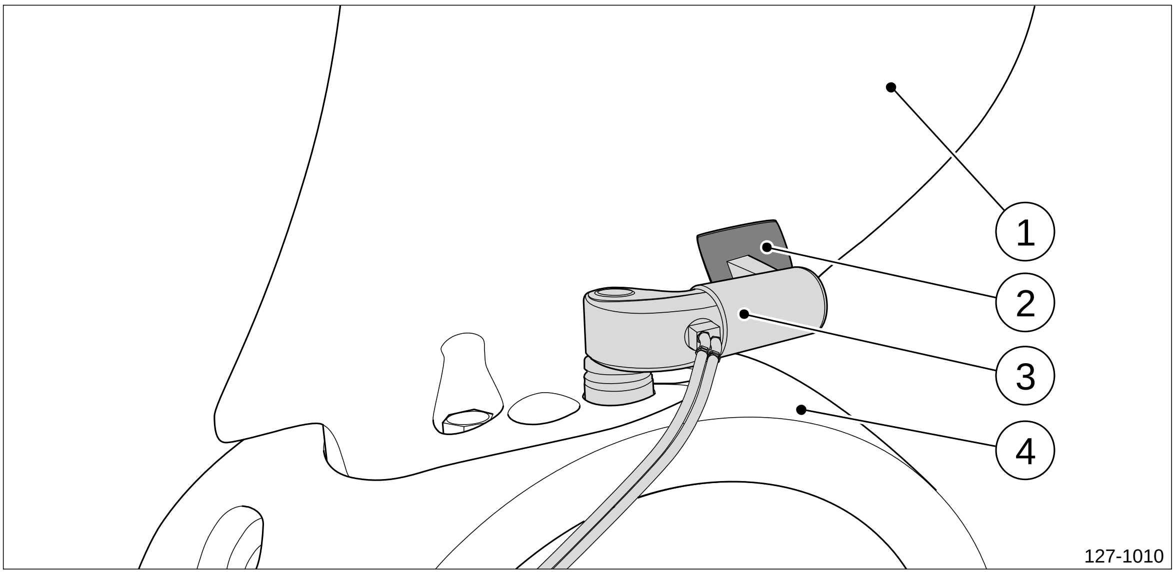

Figure 5 Final tightening of the blade screws alternative 2: Torque tool used..

1. Propeller blade
2. Protection Plate
3. Example of a Torque Tool
4. Propeller Hub body

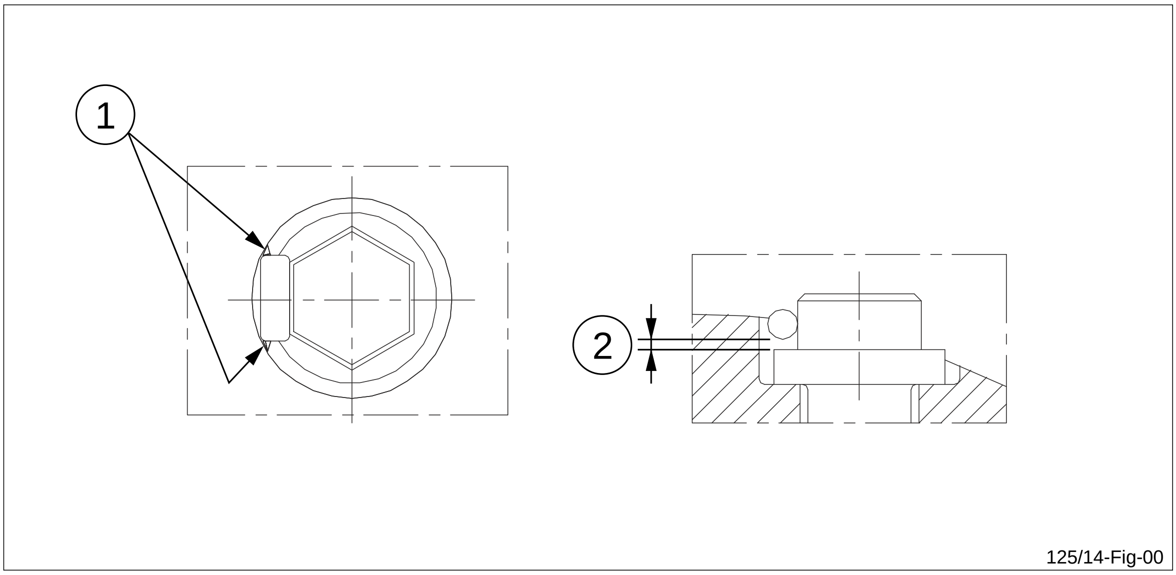

Figure 6 Lock the blade screws by fastening a steel rod by spot welding.

1. Spot welding
2. Space between the locking pin and the screw head

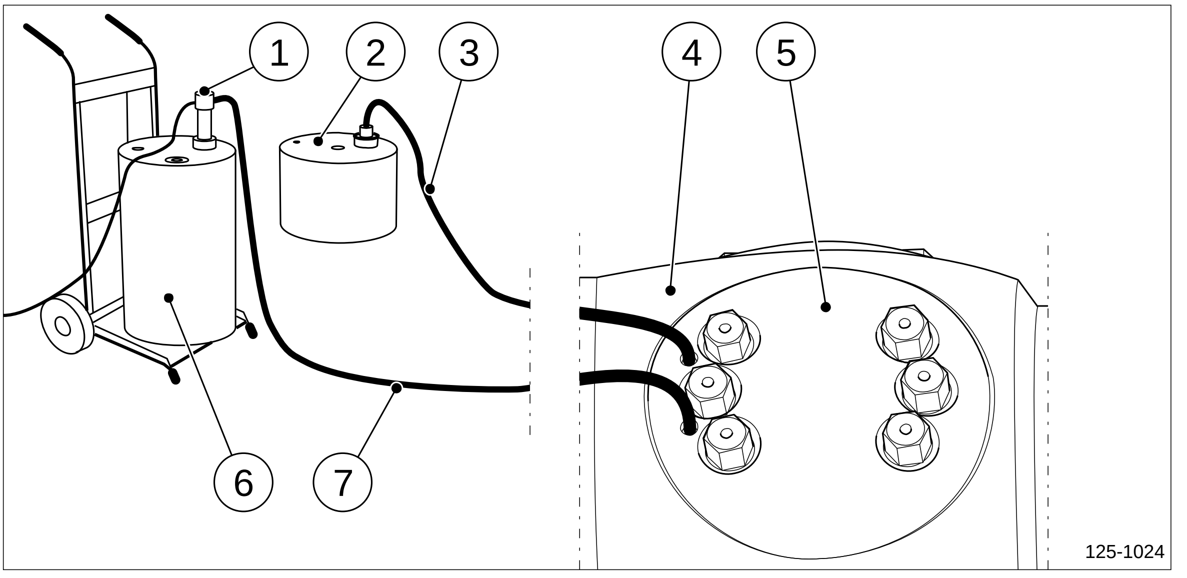

Figure 7 Example of flushing equipment.

1. Air driven pump unit
2. Container for excessive flushed oil
3. Hose connected to the connection “OUT” on the blade flange
4. Proppeler Hub body
5. Blade flange
6. Flushing oil container
7. Hose connected to connection “IN” on the blade flange

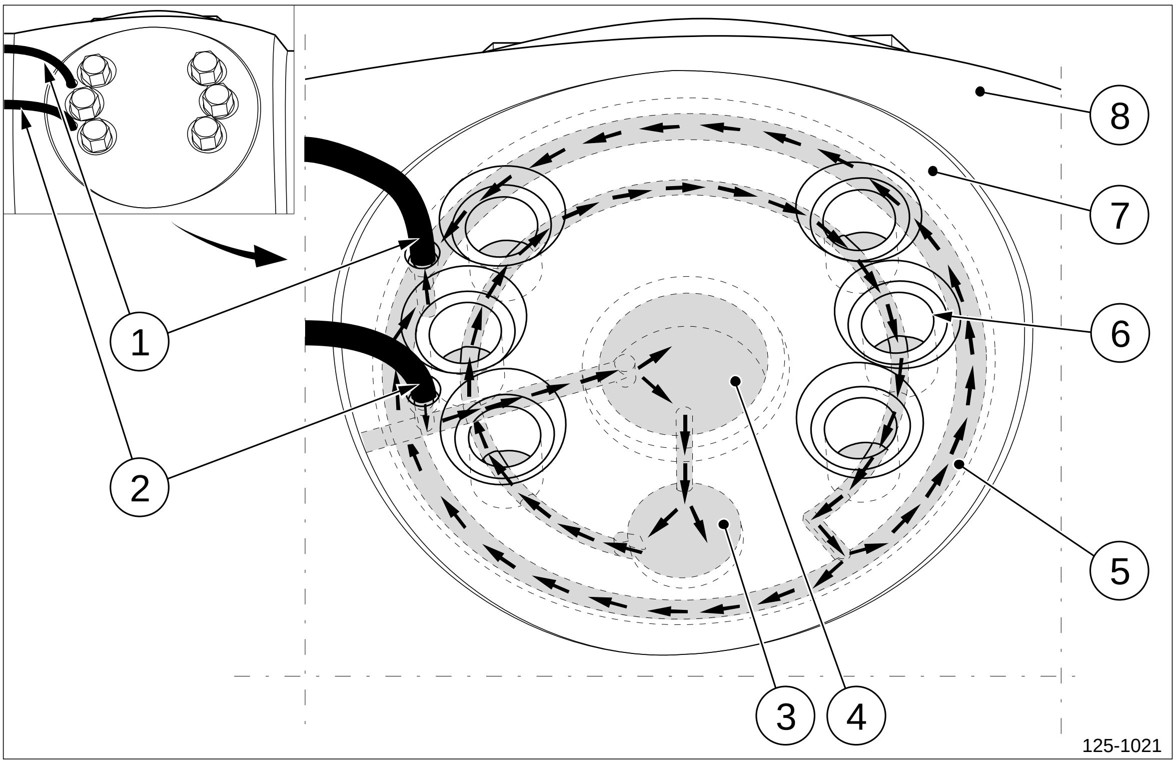

Figure 8 Flushing direction through the blade flange, G-design.

1. Oil connection marked "OUT"
2. Oil connection marked "IN"
3. Guide pin
4. Space between blade flange and crank pin ring
5. Blade sealing ring groove
6. Blade bolt holes
7. Blade flange
8. Propeller Hub body

Warning: Never work alone when lifting heavy components. Most lifting operations require two persons, one operate the lifting device and one ensure that the components do not get damaged.

Warning: The torque tool must be dimensioned with consideration taken to the torque values. This also includes the power socket which must have correct dimension for the width across flats.

Caution: It is important that only qualified personnel perform the lifting.

Caution: Use only clean soft slings when lifting to prevent damage on the blades.

Caution: The parts that are to be assembled must be cleaned and dry before the assembly.

Caution: Make sure to apply PTFE-compound or similar on the blade sealing ring or it will get damaged at the start up.

Caution: Make sure to handle the torque tool with care to prevent personel injuries due to the massive forces used.

Note: Make sure to read the lifting instructions in part Handling and Preservation before starting the installation.

Note: Make sure to have an up to date certificate regarding torque calibration of the torque tool.

This instruction describes how to install propeller blades.

Before Starting this Procedure:

To be able to perform a safe installation with satisfied outcome the following prerequisites must be fulfilled.

Make sure that all parts are clean and dry. It is very important that nothing comes in between the blade foot and crank pin ring.

Make sure that proper lifting equipment are available. Weld brackets onto the ships hull or use a mobile crane to lift the propeller blades.

Make sure that all equipment is clean.

Preparations before the blade is installed

1. Clean the blade flange, screw holes, blade seat and crank pin ring.

2. Wash the blade screws using a de-greasing solvent.

3. Inspect that the guide pins are properly secured. If the guide pins are loose, tighten and lock the screws that are keeping the guide pins in place.

4. Apply thread lubricant, according to Hub Assembly drawing, on the blade guide and on the guide pin.

5. Clean the blade sealing groove.

6. Prepare the flushing equipment (see figure 7). Make sure all hoses are properly connected to the pump and collecting container.

7. Make sure that the holes in the blade screws are unplugged.

Install the blade and level it with the crank pin ring

8. Apply grease (pos 3, figure 1), in the blade sealing groove (pos 2, figure 1) on the blade flange in order to keep the blade sealing ring (pos 4, figure 1) in place when the blade flanges are mounted to the hub.
   Place a new blade sealing ring in its groove (see figure 1) and apply PTFE-compound on the top surface of the blade sealing ring (pos 5, figure 1).

9. Lift the blade in position. Use the lifting tool and lifting equipment suitable to lift the whole weight of the blade (for more information see the lifting instructions in section Storage and Preservation).

10. Use a level to make sure that the foot of the blade and the crank pin ring are absolutely parallel.

11. Lubricate the blade screws heads and the threads according to the Hub Assembly drawing.

12. Fill the blade bolt holes in the crank pin ring (pos 9, figure 3) up to a third with grease according to the Hub Assembly drawing.

13. Mount the blade to the crank pin ring with two blade screws positioned opposite to each other according to the Hub Assembly drawing.

14. Use a ring key and a hammer to slightly tighten two blade screws. Tighten the bolts at the same time as a person is “rocking” the blade to assure that the blade will enter its guides.

Fasten the blade

15. Screw in all blade screws. Excessive grease is evacuated through the hollow bored blade bolts.

16. Use a hand tool to prestress all the blade screws in a cross pattern according to the Hub Assembly drawing.

17. There are two alternatives for final tightening the blade screws, see figure 4 or figure 5.
    When using a torque tool according to pos 3 in figure 5, the tool’s support part must be adjusted (the angle) towards the blade to obtain a steady torque force on the screws.
    To protect the surface on the blade use a thick aluminium, copper or brass plate (pos 2, figure 5) between the tool’s support and the blade. The plate must be bent with a similar radius as the surface to avoid damages to the surface.
    For torque values see Hub Assembly drawing in part Design Drawings.
    Tighten the blade screws in a cross pattern to the torque vale stated on the Hub

Assembly drawing. For more information on how to tighten the blade bolts see Instructions for tightening of screws, 586431.

18. Plug the hole in each blade screws head using a sealing screw (see position 2, figure 3). Tighten the screws to the torque value stated on the Hub Assembly drawing.

Flush the blade flange

19. Remove the VSTI plugs from the “IN” and “OUT” holes first
20. Connect the oil injection pump flushing nipple and hose (pos 2, figure 8) to connection marked “IN”.
21. Connect the excessive oil container flushing nipple and hose (pos 1, figure 8) to oil connection marked “OUT”.
22. Start to flush the blade flange with the oil pump unit (pos 1, figure 7). Use minimum pressure value at first. Slowly increase the pressure until grease and then flushing oil starts to evacuate through the hole.
23. When flushing oil starts to evacuate to the excessive oil container (pos 2, figure 7) the flushing of the blade flange is complete.
24. Disconnect both hoses with nipples at the “IN” and “OUT” connections on the blade flange.
25. Install the VSTI plugs (see position 1, figure 3) and tighten to the torque value stated on the Hub Assembly drawing and by using Loctite.
26. Install the blade lifting hole plug, see instruction in section Storage and Handling.
27. Perform a propeller hub pressure test according to Task: Propeller Hub Pressure Test.
28. Fit stainless steel locking pins between the hexagon part of the blade bolt and the hub. Spot weld the locking pin to the recess on the propeller blade according to figure 6. Make sure to leave a space between the locking pin and the screw (see position 2, figure 6).
29. Clean and store the oil injection pump hoses and excessive oil container in a proper storage.

This task is now completed.

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Creation date: 2008-06-16 Revision date: 2009-10-21

Maintenance, Propeller Blade

Task: Fill Oil and Flush Propeller Hub

Description

This task describes how to fill oil to and flush the centre part of the propeller hub. It also describes how to purify the oil using an external filter before filling the oil to the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Shut off valve	1
External oil filling unit	1
Particle counter	1
Standard welding machine	1
Standard grinding machine	1

Reference Documents
Hub Assembly drawing

Consumables	Qty
Grinding disks	As req.
Electrodes, ISO E 23.12.2	As req.
Linen rags	As req.
Oil (see Requirements for Lubricating Oil)	As req.

Instruction

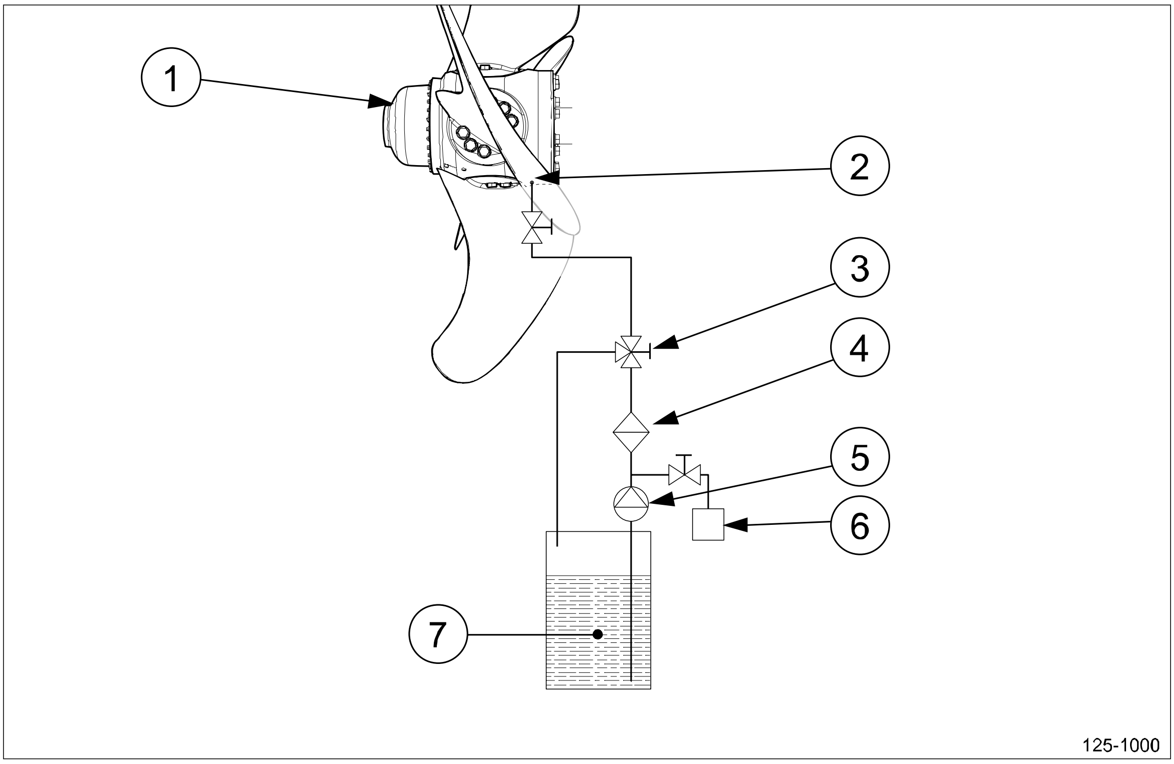

Figure 1 Initial position of the hub when purifying and filling the oil.

1. Aft plug
2. Forward plug
3. Three way valve
4. External filter
5. Pump
6. Sample point for oil test
7. Oil container

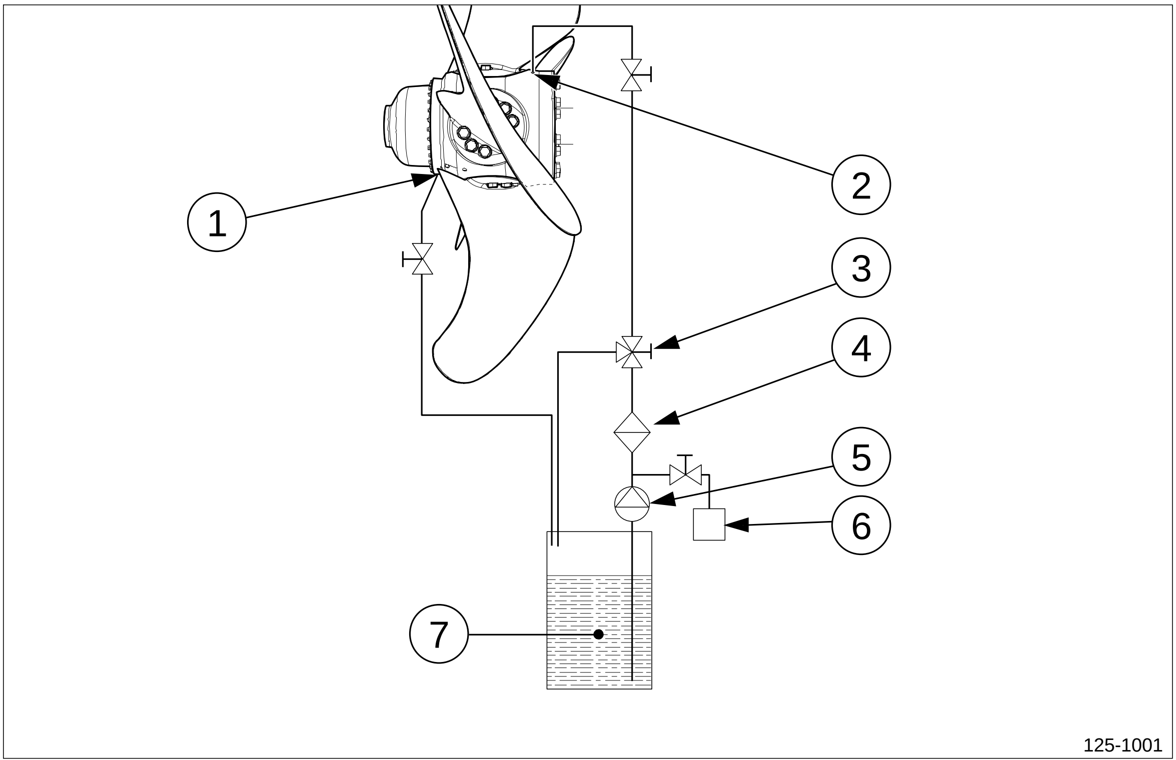

Figure 2 The hub is turned half a turn when flushing the hub.

1. Aft plug
2. Forward plug
3. Three way valve
4. External filter
5. Pump
6. Sample point for oil test
7. Oil container

Warning: It is important that there is sufficient space around the propeller hub when turning the shaft.

Caution: Oil is injurious to your health. Always read the warning label on the oil packaging and act according to the instructions.

Fill oil to and flush the propeller hub using an external filling unit. Also, purify the oil using an external filter before filling oil to the propeller hub. The oil must meet the recommendations in section Requirements for Lubricating Oil.

1. Turn the propeller shaft until the forward plug, on the propeller hub, is directed straight downwards and the aft plug is directed straight upwards (see figure 1).

2. Remove both plugs.

3. Use an external oil filling unit and a filter to purify the oil and to fill the hub. Attach the external oil filling unit and filter according to figure 1.

4. Manoeuvre the three way valve (see position 1 in figure 1) to enable the oil flow to return directly to the oil container (see position 3 in figure 1) without passing through the hub.

5. Purify the oil by circulating it through the external filter until the desired particle value is noted by for example a particle counter. Attach the particle counter to the hub according to position 6 in figure 1.

6. Manoeuvre the three way valve to enable the oil flow to fill the hub from bottom to top. The air trapped inside the hub is allowed to evacuate through the aft plug hole (see position 1 in figure 1).

7. When oil is coming out of the plug hole (see position 1 in figure 1), turn off the filling unit and fit a valve and hose to the plug hole.

8. Start the filling unit again and turn the propeller hub half a turn (180^{o}) (see figure 2).

9. Flush the propeller hub. Let the oil circulate inside the propeller hub and through the external filter and back to the hub. This flushing procedure will make sure that no dust or particles will be left inside the propeller hub. Use a particle counter to measure that the oil meets the recommendations in section Requirements for Lubricating Oil.

10. Turn the shaft so that the aft plug hole is turned upwards. Disconnect the aft valve and reinstall the plug with O-ring.

This task is now completed.

Before the external filling unit is disconnected a hub pressure test can be performed (see Task: Propeller Hub Pressure Test).

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Maintenance, Propeller Blade

Task: Propeller Hub Pressure Test

Description

This task describes how to perform a pressure test on the propeller hub. The pressure test must be done to make sure that no leakage occurs.

Support Items

Spare Part Name	Qty
O-ring	

Special/Additional Tools and Test Equipment	Qty
Shut off valve	1
External oil filling unit	1
Particle counter	1
Standard welding machine	1
Standard grinding machine	1

Reference Documents

Consumables	Qty
Grinding disks	As req.
Electrodes, ISO E 23.12.2	As req.
Linen rags	As req.

Instruction

Note: **The propeller blades must be mounted before the pressure test is performed.**

The propeller blades must be mounted before the pressure test is performed.

Prior to launching the propeller hub is filled with oil and a pressure test must be performed to verify that no leakage occur. Inspect the locking of screws and plugs during the pressure test.

The pressure test can be made using the pressure from the gravity oil tank or using an external pressure pump connected to the venting and oil filling holes see the following description:

1. Fill the propeller hub with oil (see Task: Fill Oil and Flush Propeller Hub).
2. Leave the external filling unit connected to the forward venting/filling hole.
3. Insert a plug in the aft venting/filling hole and start the external pump. Let the pressure rise to 0.10 to 0.15 MPa. Retain the pressure for 1 hour.
4. Inspect the blade seal seats, the bolt head seats and the shaft flange screws for leakage.
5. If leakage occurs take care of the leakage and redo the pressure test.
6. Disconnect the external pump.
7. Plug the venting/filling holes. Make sure to replace the O-rings on the plugs and lock both plugs by spot welding.

This task is now completed. For more information about pressure testing the propeller hub, please contact the nearest Rolls-Royce Marine Global Support Network.

Maintenance, Hydraulic System

Task: Replace Hydraulic Hoses

Rolls-Royce recommends that all hydraulic hoses, connected to for example the OD-box, hydraulic power pack, are replaced every fifth year due to wear and ageing. The emergency hose and the spare hoses must also be replaced.

For more information on how to replace the hoses see section Corrective Maintenance.

Maintenance Plan

Corrective Maintenance Task List

The corrective maintenance tasks are listed below by subsystem.

Note: **Tasks at maintenance level A and B are described in this manual. Tasks at maintenance level C are listed but not described, since they are tasks to be carried out by Rolls-Royce personnel only.**

ID	System	Task Description	Skill level	Facility
Shafting				
1	Shafting	Treat the inboard shafts and couplings with corrosive preventive agent	B	B
Propeller Hub and Blades				
1	Propeller	Change propeller blade in drydock	B	B
2	Propeller	Change propeller blade under water (if applicable)	B	B
Hydraulic System				
1	Hydraulic	Fill oil to the hydraulic system	A	A
2	Hydraulic	Replace air breather filters	A	A
3	Hydraulic	Replace circulation filter element	A	A
4	Hydraulic	Replace level switch on hydraulic power pack	A	A
5	Hydraulic	Replace level switch on gravity tank LS3	B	A
	Hydraulic	Replace level switch on drain oil tank LS5	A	A
5	Hydraulic	Replace temperature sensor TT1	A	A
6	Hydraulic	Replace pressure switch PS1, PS2	B	A
7	Hydraulic	Replace pressure transmitters PT1, PT3	B	A
9	Hydraulic	Replace thermometer TH1	B	A
10	Hydraulic	Replace test gauges	A	A
11	Hydraulic	Replace directional valves V2 or V3		
12	Hydraulic	Replace safety valve V1	B	A
13	Hydraulic	Replace pressure relief valve V8	B	A
14	Hydraulic	Replace pressure relief valve V14	B	A
15	Hydraulic	Replace selector valve V12	B	A
16	Hydraulic	Replace control valve static pressure V11/28	B	A

ID	System	Task Description	Skill level	Facility
17	Hydraulic	Replace check valve V36	B	A
18	Hydraulic	Replace safety vale V34 (M0-box)	B	A
19	Hydraulic	Replace the safety vale V34 (F0-box)	C	A
20	Hydraulic	Repalce the valves of screw in type	B	A
21	Hydraulic	Replace needle valve V16	B	A
21	Hydraulic	Replace pressure valve for by-pass cooler V20	B	A
21	Hydraulic	Replace pump unit PTO	B	B
22	Hydraulic	Replace pump units P1 and P2	B	B
23	Hydraulic	Replace pump unit P3	B	A
24	Hydraulic	Replace drain pump unit P5	B	A
25	Hydraulic	Repair pump motor starter P1, P2, and P3	B	A
26	Hydraulic	Repair pump motor starter P5	B	A
27	Hydraulic	Replace hydraulic hoses	B	A
OD-box (Only applicable on OD-boxes of M0 type)				
1	OD-box	Replace hoses on OD-box	B	A
Remote Control System/Closed Loop				
1	Control	Repair remote control/Closed loop system	B	A

Produced by: SS Approved by: Nna
Creation date: 2005-05-31

Revision: a Sign: Nna
Revision date: 2005-10-25

Corrective Maintenance, Shafting

Task: Apply Corrosion Preventative on Inboard Shafts and Couplings

Description

This task describes how to apply corrosion preventative on the shafts or couplings, where it is missing or has been damaged.

Support Items

Spare Part Name	Cross Ref. No.

Special/Additional Tools and Test Equipment	Qty
Scrub brush	1

Reference Documents

Consumables	Qty
Corrosion preventative	As req.
Linen rags	As req.

Instruction

Warning: The propulsion system must be stopped and the shafts must be secured, when applying corrosion preventative on shafts and couplings.

Caution: Corrosion preventative is harmful to the health. Use proper protective equipment.

1. Make sure that the shaft is secured and cannot rotate.
2. Clean the area where the corrosion preventative is missing with water and a scrub brush. Use degreaser if necessary.
3. Polish away minor corrosion carefully.

4. Wipe off the water from the shaft using linen rags.
5. Apply corrosion preventative on the area according to the recommendations from the manufacturer of the corrosion preventative.

This task is now completed, it is safe to start the propulsion system.

Corrective Maintenance, Propeller Blade

Task: Replace Propeller Blade Under Water - Overview

Prerequisite and Safety Precautions

Warning: All personnel on the ship must be aware of that divers are changing the propeller blade.

Make room around the propeller and hub before the shaft is turned.

It is important that all personnel on the vessel are notified that maintenance is performed on the propeller blades and hub. All personnel must also be notified before the shaft is turned.

Make sure that the lifting of the propeller blades are performed by qualified personnel.

Work Order

The work order for replacing propeller blade under water is described in the following bullet list and for detailed descriptions of the replacement procedure see the cross references in the bullet list:

- Drain the propeller hub from oil (see Task: Drain Centre Part of Propeller Hub).
- Flush propeller blade flange with freshwater (see Task: Flush propeller blade flange with freshwater).
- Remove the propeller blade (see Task: Remove Propeller Blade).
- Replace the blade sealing ring (see Task: Replace Blade Sealing Ring).
- Reinstall the propeller blade (see Task: Propeller blade installation).
- Fill oil and flush the propeller hub (see Task: Fill Oil and Flush Propeller Hub).
- Flush propeller blade flange with oil (see Task: Propeller blade installation).
- Pressure test the propeller hub (see Task: Propeller Hub Pressure Test).

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Creation date: 2008-06-16 Revision date: 2009-10-21

Maintenance, Propeller Blade

Task: Drain Centre Part of Propeller Hub

Description

This task describes how to empty the centre part of the propeller hub from oil.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Barrel to collect the oil	1
Shut off valve	1
Standard welding machine	1
Standard grinding machine	1

Reference Documents
Hub Assembly drawing

Consumables	Qty
Grinding disks	As req.
Electrodes, ISO E 23.12.2	As req.
Linen rags	As req.

Instruction

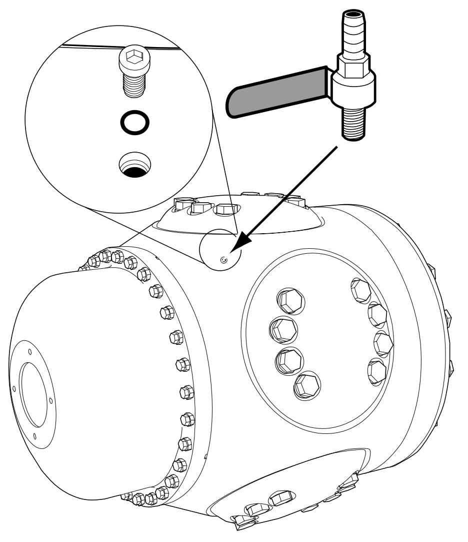

Figure 1 Remove the plug and O-ring, and fit the shut off valve.

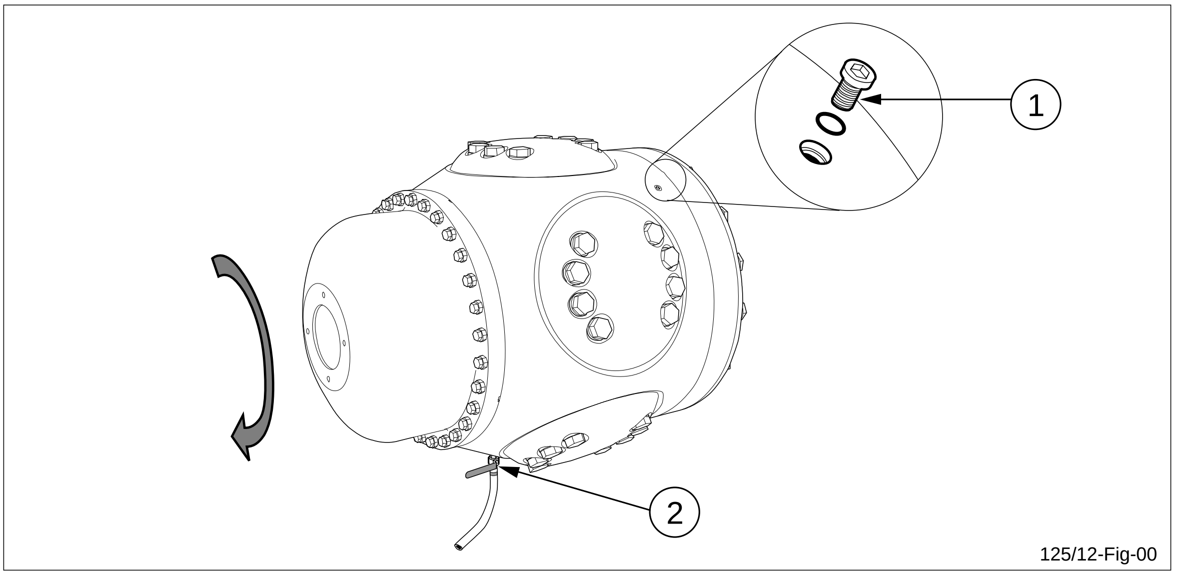

Figure 2 The hub is rotated to be able to remove the forward plug.

1. Forward filling/air venting plug
2. Shut off valve

Warning: The engine must be shut off and locked, when working close to the shafts.

Warning: It is important that there is sufficient space around the propeller hub when turning the shaft.

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

1. Secure and lock the shaft (see part Operating Instructions).
2. Turn the remote/local switch on pump motor starters P1 and P2, if any, to LOCAL position.
3. Stop all pump units.
4. If the vessel is equipped with a gravity tank, close the drain valve on the gravity tank leading to connection V (see Hydraulic Diagram drawing). Do not open the valve until the hub is refilled with oil.
5. Turn the propeller shaft until the forward plug are directed straight downwards and aft plug is directed straight upwards.

6. Use a grinding machine or a chisel to remove the spot welds from the plug.
7. Remove the aft plug, and fit a valve (with a hose) in the plug hole (see figure 1).
8. Turn the shaft until the valve is directed downwards and the forward plug is directed upwards.
9. Use a grinding machine or a chisel to remove the spot welds from the forward plug.
10. Remove the forward plug. This will allow air to flow into the hub.
11. Open the shut off valve (see position 2, in figure 2) and let the oil flow until the hub is emptied.
12. Reinstall the plugs to prevent dirt from entering the hub.

Maintenance, Propeller Blade

Task: Flush the Blade flange with freshwater

Description

This task describes how to flush the propeller blade flange with freshwater before the propeller blades can be removed from the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Air driven pump unit	1
Flushing hoses	2

Reference Documents
Hub Assembly drawing

Consumables	Qty

Instruction

Warning: The propulsion system must be shut off and locked during this procedure.

Caution: Make sure that the propeller are cleaned and dry before this task starts

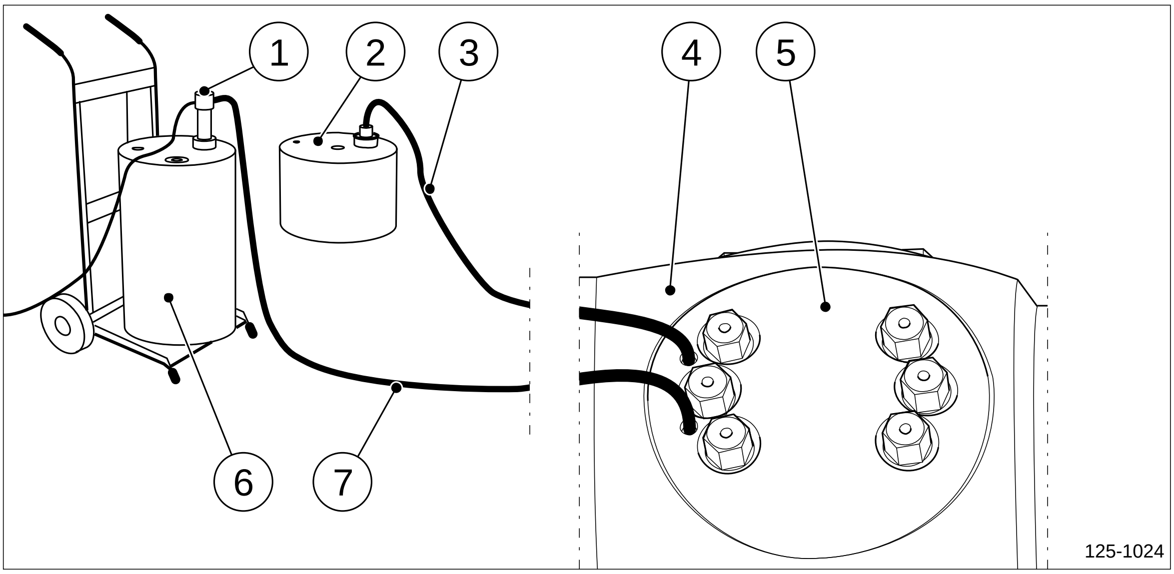

Figure 1 Example of flushing equipment.

1. Air driven pump unit
2. Container for excessive flushed oil and freshwater
3. Hose connected to the connection “OUT” on the blade flange
4. Propeller Hub body
5. Blade flange
6. Flushing freshwater container
7. Hose connected to connection “IN” on the blade flange

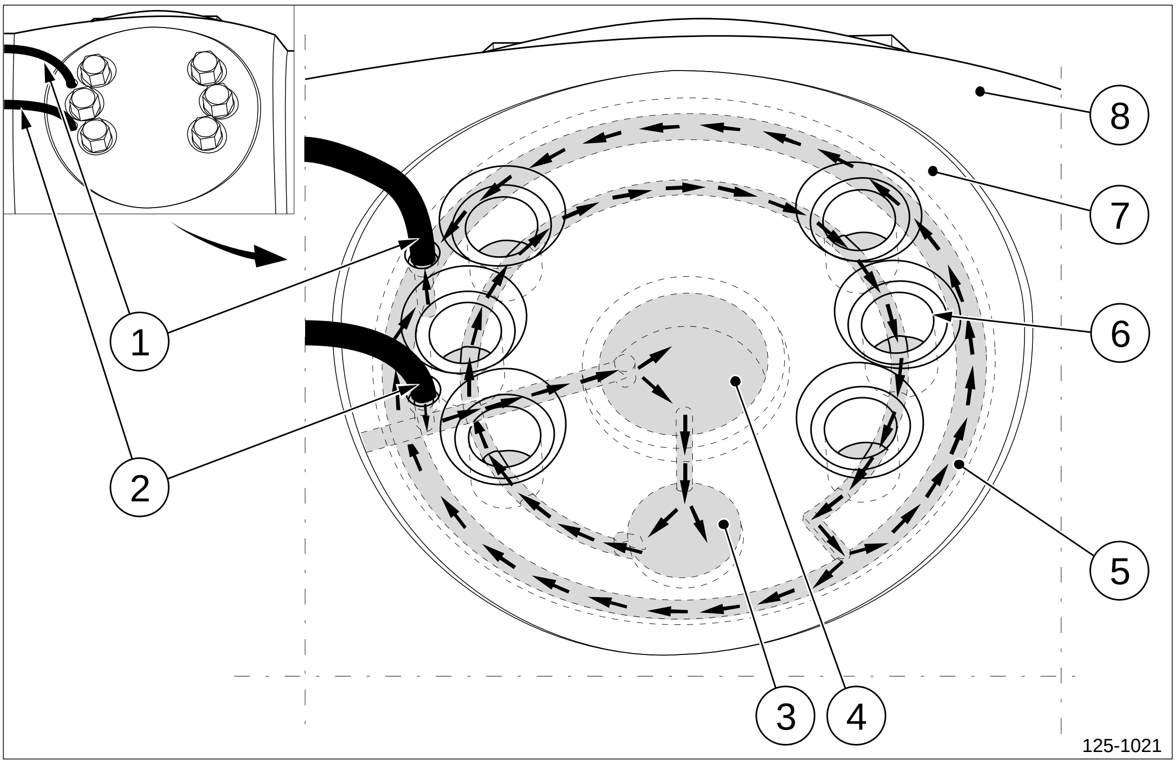

Figure 2 Flushing direction through the blade flange, G-design.

1. Oil connection marked “OUT”
2. Oil connection marked “IN”
3. Guide pin
4. Space between blade flange and crank pin ring
5. Blade sealing ring groove
6. Blade screw holes
7. Blade flange
8. Hub body

Before Starting this Procedure:

Make sure that all parts are clean and dry.

Make sure that all equipment is clean

Flush the blade flange

1. Remove the VSTI plugs from the “IN” and “OUT” holes first
2. Connect the injection pump, flushing nipple and hose to connection marked “IN”.(pos 2, figure 2)
3. Connect the excessive oil/water container flushing nipple and hose to oil connection marked “OUT”.(pos 1, figure 2)
4. Start to flush the blade flange with the pump unit . Use minimum pressure value at first. Slowly increase the pressure.(pos 1, figure 1)
5. When flushing water starts to evacuate in to the excessive oil/water container the flushing of the blade flange is complete. (pos 2,figure 1)
6. Disconnect both hoses with nipples at the “IN” and “OUT” connections on the

blade flange.

7. Install the VSTI plugs in the blade flange.

8. Clean and store the oil injection pump, hoses and excessive oil container in a proper storage.

This task is now completed

Maintenance, Propeller Blade

Task: Remove Propeller Blade

Description

This task describes how to remove the propeller blades from the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Mobile crane or other suitable lifting equipment such as chain falls.	1
Dynamometric wrench	1
Tension tester	1
Standard grinding machine	1
Soft lifting slings	1
Special lifting tool	1

Reference Documents
Hub Assembly drawing

Consumables	Qty
PTFE-compound	As req.
Grinding discs	As req.
Wooden planks	As req.

Instruction

Warning: It is important that only qualified personnel perform the lifting.

Warning: Never work alone when removing heavy components. Most lifting operations require two persons, one operate the lifting device and one ensure that the components do not get damaged.

Warning: The propulsion system must be shut off and locked during this procedure.

Warning: The torque tool must be dimensioned with consideration taken to the torque values. This also includes the power socket which must have correct dimension for the width across flats.

Caution: Make sure to handle the torque tool with care to prevent personel injuries due to the massive forces used.

Caution: After performing the following instruction, it is important to cover the blade bolt holes, the blade sealing groove and the opening in the crank pin ring to prevent sand and dust from entering the hub. Use rubber sheets as cover.

Note: Make sure to have an up to date certificate regarding torque calibration of the torque tool.

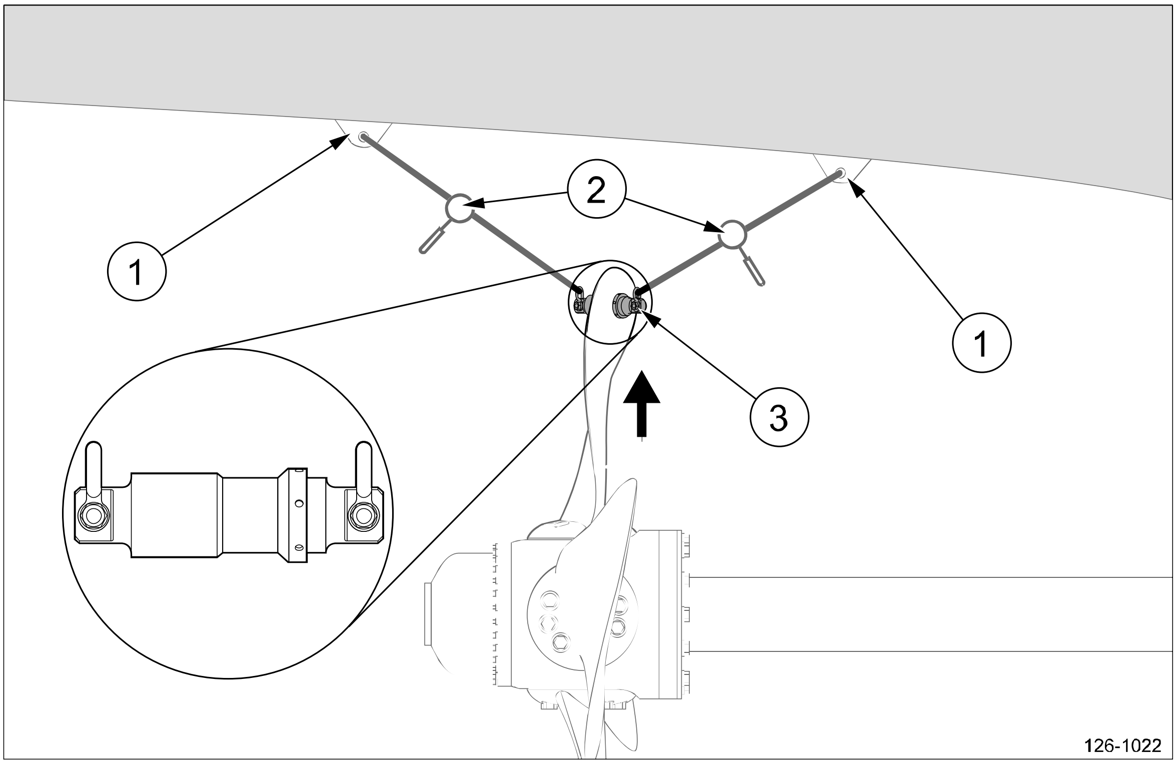

Figure 1 The blade is lifted using the lifting hole and special lifting tool.

1. Lifting ear welded to the hull
2. Pulley block with lifting loop
3. Lifting tool

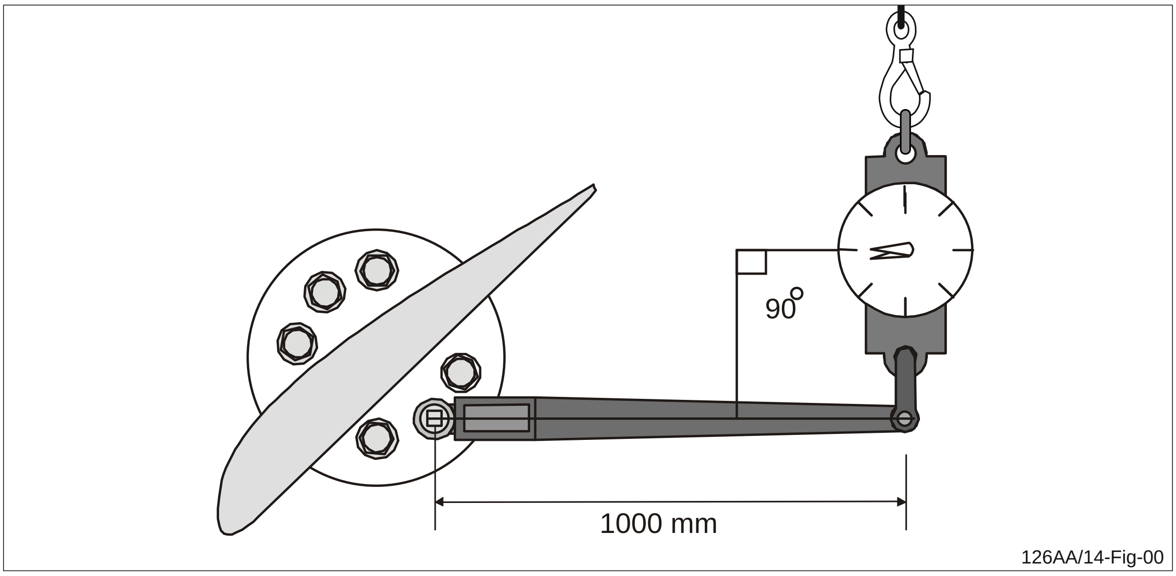

Figure 2 Alternative 1: Tension tester and dynamometric wrench attached to a blade bolt.

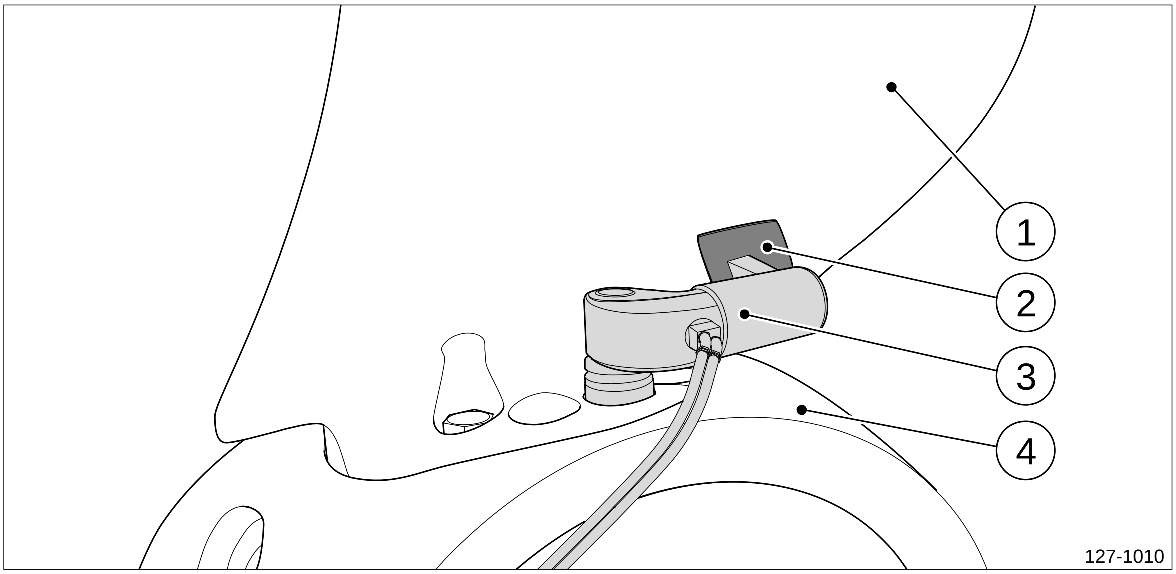

Figure 3 Alternative 2: Torque tool used. for the blade bolts.

1. Propeller blade
2. Protection Plate
3. Example of a Torque Tool
4. Hub body

Before starting this task::

Make sure that proper lifting equipment are available.

Weld brackets onto the ships hull.

Make sure that the blade flange is flushed with freshwater (see Task: Flush the blade flange with freshwater).

Remove propeller blade

1. Secure and lock the shaft (see part Operating Instructions).
2. Use a grinding machine or a chisel to remove the spot weld on the blade screws locking pin.
3. Turn the propeller shaft so that the tension tester and the dynamometric wrench or torque tool can be fitted on the blade screws.
   When using a torque tool according to figure 3, the tool’s support part must be adjusted (the angle) towards the blade to obtain a steady torque force on the screws. To protect the surface on the blade use a thick aluminium, copper or brass plate (pos 2, figure 3) between the tool’s support and the blade. The plate must be bent with a similar radius as the surface to avoid damages to the surface.
4. Slightly loosen each blade bolt. Make a note at which torque the screw loosens.
5. Turn shaft in a position that will allow the blade to be hoisted straight upwards.
6. Attach proper lifting equipment to the propeller. For more information see section Storage and Preservation in part Maintenance.
7. Unscrew and remove the blade screws.
8. Lift the propeller blade. The blade must be lifted straight upwards and be kept in

horizontal position until the blade has come off the guide pin.

9. Inspect the underside of the blade foot. Make sure that there is no signs of wear or pores. If pores are found please contact the nearest Rolls-Royce Global Support Network. If a pore is not taken care of it can damage the blade sealing ring.
10. Place the blade with the blade flange down on a clean wooden foundation.
11. Remove the used blade sealing ring (see Task: Replace Blade Sealing Ring).
12. Cover the blade screw holes, the blade sealing groove and the opening in the crank pin ring with a rubber sheet to prevent sand and dust from getting into the hub.

This task is now completed

Produced by: KK174 Approved by: Fnl Revision: b Sign:
Creation date: 2008-06-16 Revision date: 2011-05-18

Maintenance, Propeller Blade

Task: Replace Blade Sealing Ring

Description

This task describes how to replace the blade sealing rings. Replace the blade sealing rings every fourth year.

Support Items

Spare Part Name	Qty
Blade sealing ring	

Special/Additional Tools and Test Equipment	Qty
Mobile crane or other suitable lifting equipment such as chain falls.	1
Dynamometric wrench	1
Tension tester	1
Standard welding machine	1
Standard grinding machine	1
Soft lifting slings	1

Reference Documents
Hub Assembly drawing
Instructions for Tightening of Screws, 586 431

Consumables	Qty
PTFE-compound	As req.
Electrodes, ISO E 23.12.2	As req.
Teflon grease (PTFE)	As req.

Instruction

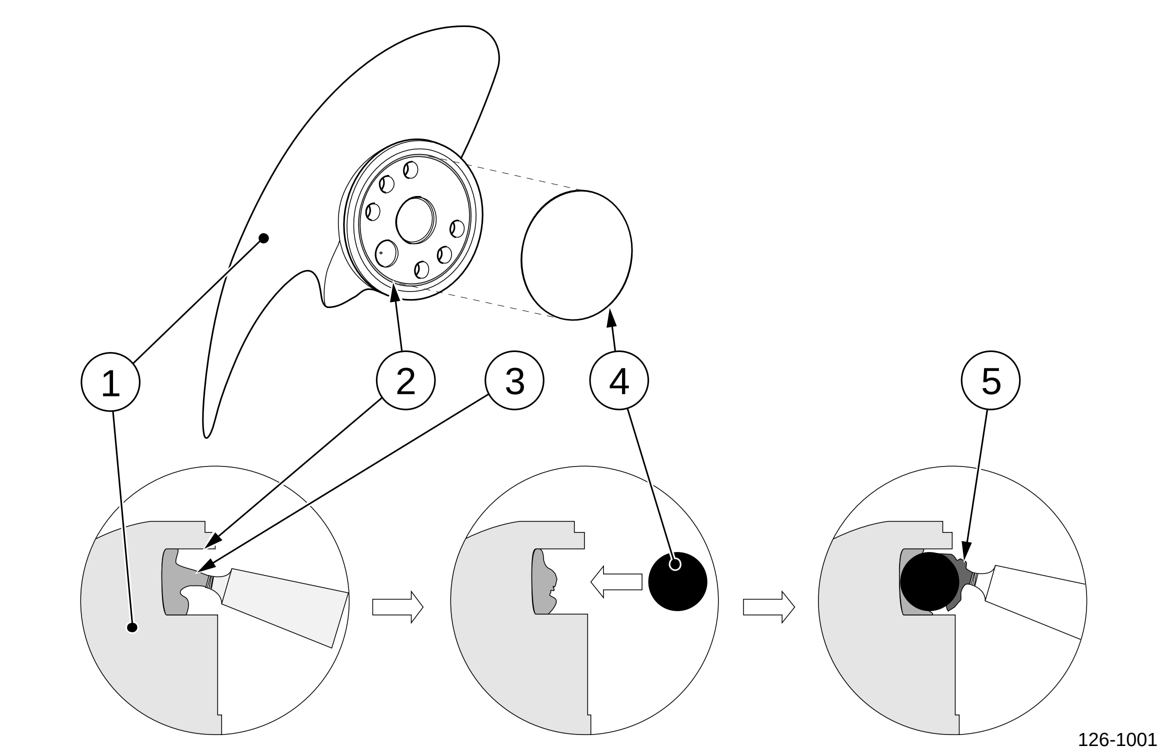

Figure 1 Mounting of blade sealing ring on blade flange.

1. Propeller blade
2. Blade sealing groove
3. Grease
4. Blade Sealing Ring
5. PTFE-compound

Warning: The propulsion system must be shut off and locked during this procedure.

Caution: Do not forget to apply teflon grease on the top surface of the blade sealing ring. Lack of teflon grease may damage the blade sealing ring and that may over time cause substantial damage.

1. Make sure that the shaft cannot rotate.
2. Drain the propeller hub from oil (see Task: Drain centre Part of Propeller Hub).
3. Remove the propeller blade (see Task: Remove Propeller Blade).
4. Remove the used blade sealing ring.
5. Clean the blade sealing groove. Make sure that the groove is dry.

6. Apply grease or similar (pos 3, figure 1), in the blade sealing groove (pos 2, figure 1) on the blade flange in order to keep the blade sealing ring (pos 4, figure 1) in place when the blade flanges are mounted to the hub. Place a new clean blade sealing ring in the groove.
7. Apply teflon grease (PTFE) on the top surface of the blade sealing ring (pos 5, figure 1).
8. Install the propeller blade (see Task: Install Propeller Blade).
9. Fill oil to and flush the propeller hub (see Task: Fill Oil and Flush Propeller Hub).
10. Perform a hub pressure test to make sure that no oil leakage occurs (see Task: Propeller Hub Pressure Test).

This task is now completed.

Propeller Blade Installation, G-design

Description

This task describes how to install the propeller blades on the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Mobile crane or other suitable lifting equipment such as chain falls.	1
Dynamometric wrench or torque tool	1
Tension tester	1
Standard welding machine	1
Soft lifting slings	1

Reference Documents
Hub Assembly drawing
Lifting instructions in Part Handling and Preservation

Consumables	Qty
PTFE-compound	As req.
Sealing compound	As req.
Loctite 648 or similar	As req.
Teflon grease	As req.
Molycote or similar	As req.
Degreasing solvent	As req.
Flushing oil of type: Statoil SL 07-201	As req.

Installation Procedure

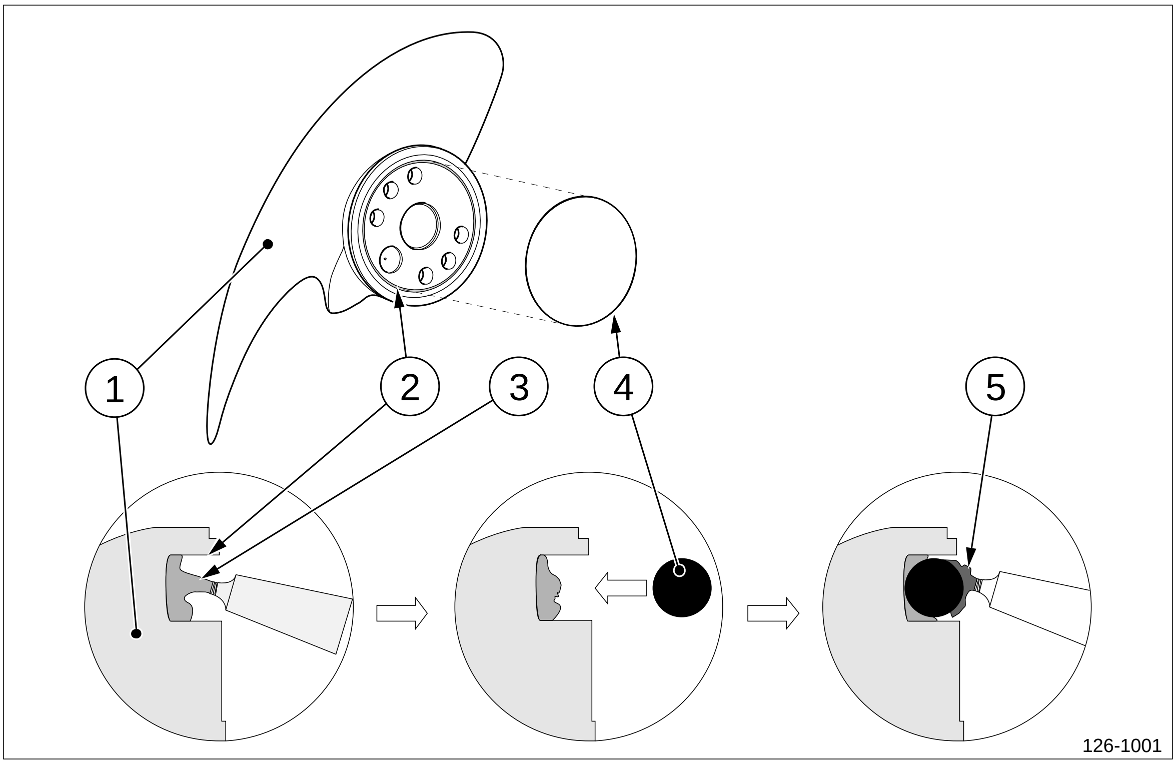

Figure 1 Mounting of blade sealing ring on blade flange.

1. Propeller blade
2. Blade sealing groove
3. Grease
4. Blade Sealing Ring
5. PTFE-compound

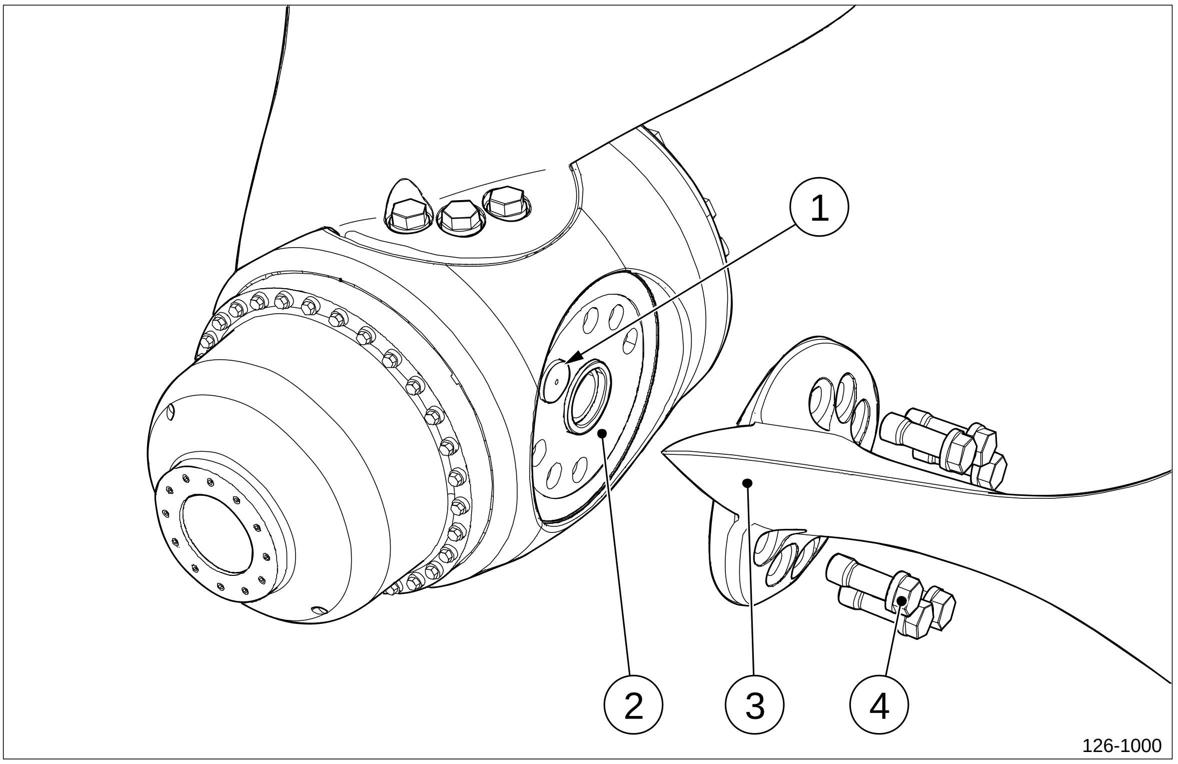

Figure 2 Mount the propeller blade on the hub.

1. Guide Pin
2. Crank Pin Ring
3. Propeller Blade including Blade Sealing Ring
4. Blade Screws

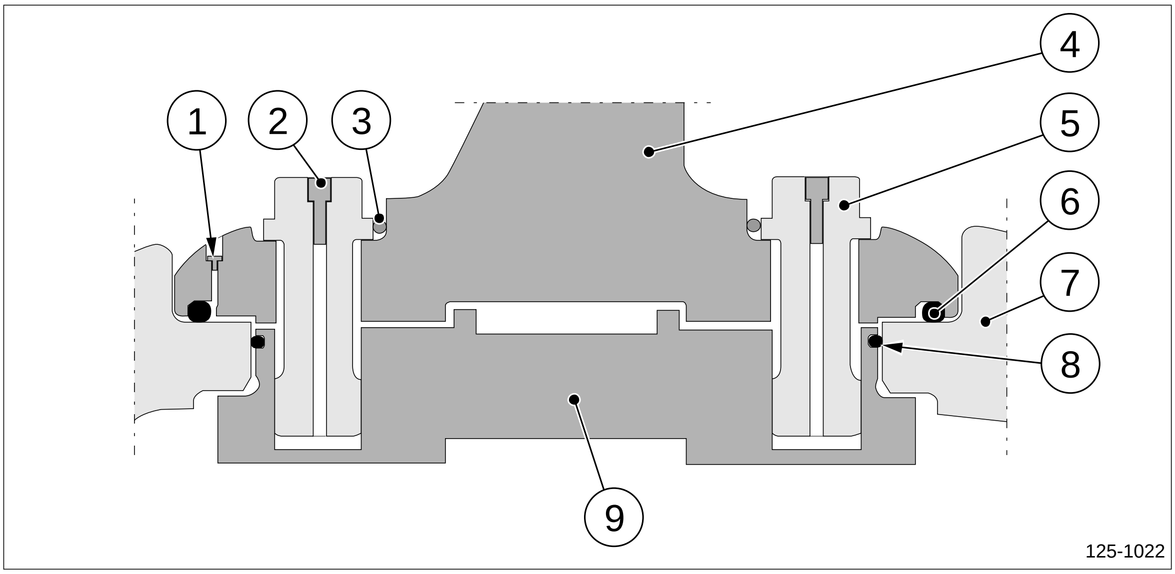

Figure 3 Cross-section of blade foot, G-design.

1. VSTI plugs for oil connection IN/OUT
2. Sealing screws
3. Locking pins
4. Propeller blade / blade flange
5. Hollow bored blade Screws
6. Blade sealing O-ring
7. Propeller Hub body
8. O-ring
9. Crank pin ring

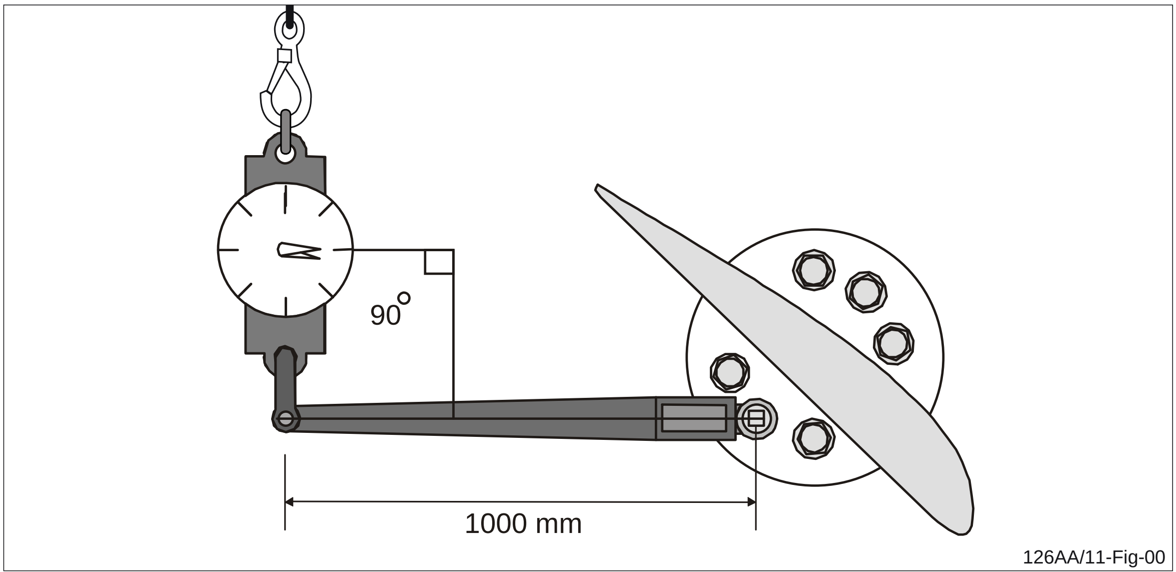

Figure 4 Final tightening of the blade screws alternative 1: Dynamometer and torque wrench attached to a blade bolt.

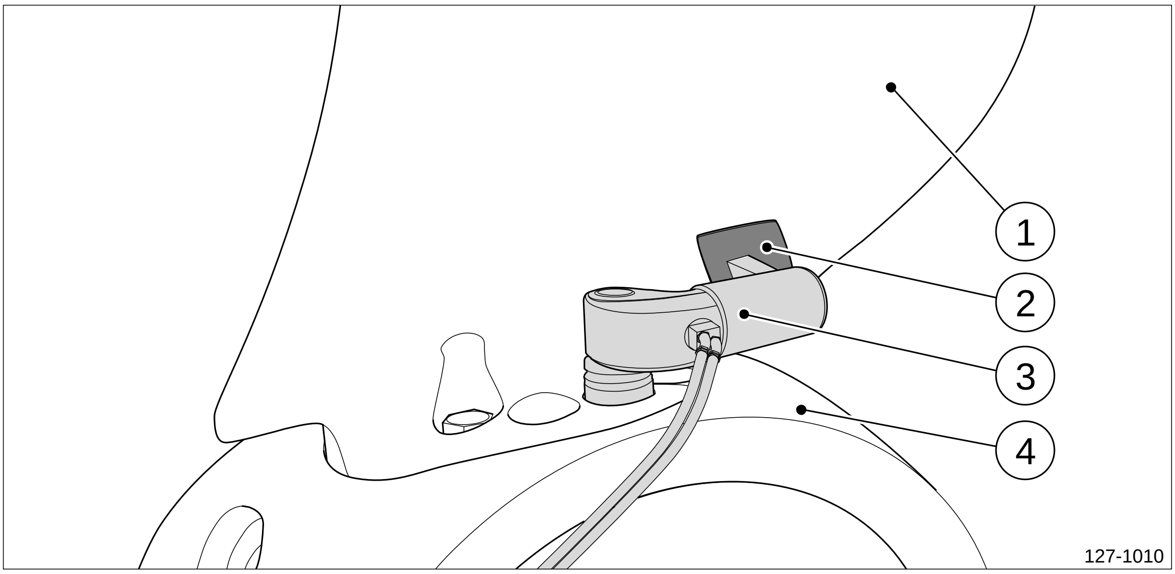

Figure 5 Final tightening of the blade screws alternative 2: Torque tool used..

1. Propeller blade
2. Protection Plate
3. Example of a Torque Tool
4. Propeller Hub body

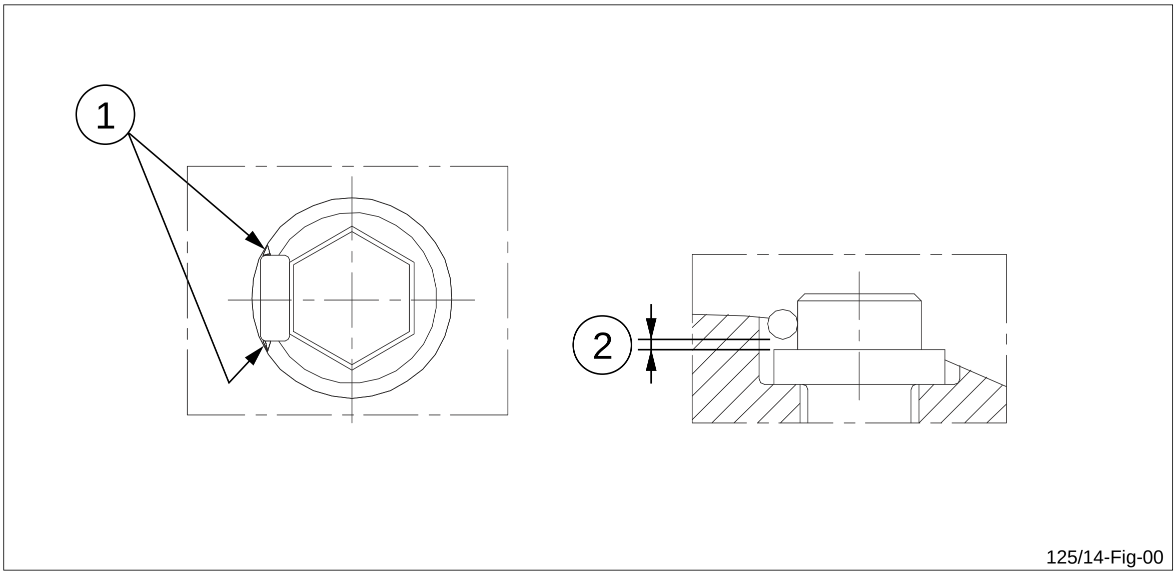

Figure 6 Lock the blade screws by fastening a steel rod by spot welding.

1. Spot welding
2. Space between the locking pin and the screw head

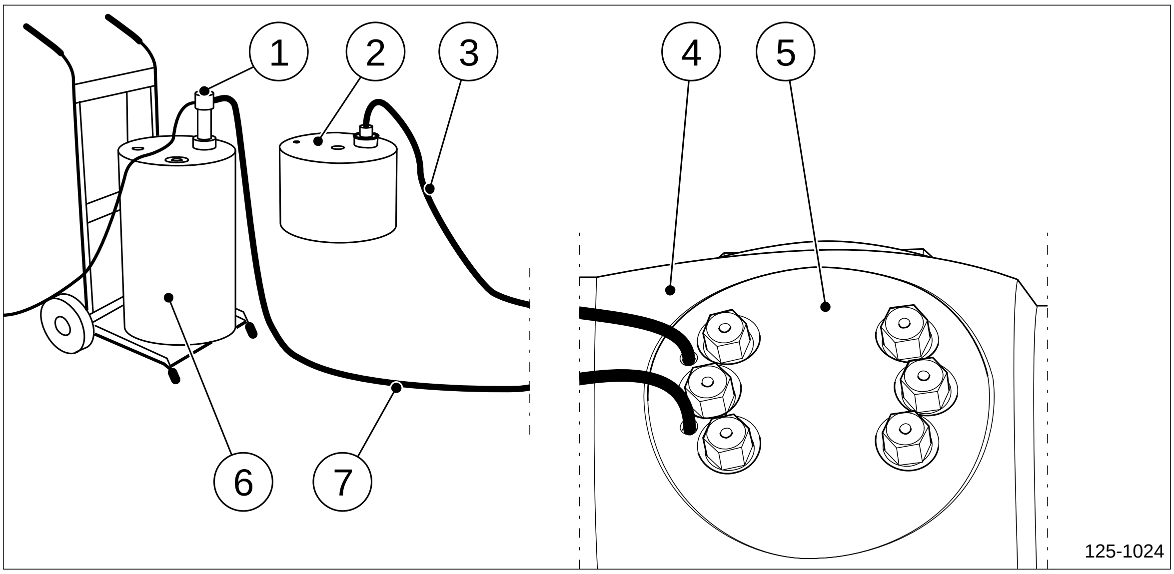

Figure 7 Example of flushing equipment.

1. Air driven pump unit
2. Container for excessive flushed oil
3. Hose connected to the connection “OUT” on the blade flange
4. Proppeler Hub body
5. Blade flange
6. Flushing oil container
7. Hose connected to connection “IN” on the blade flange

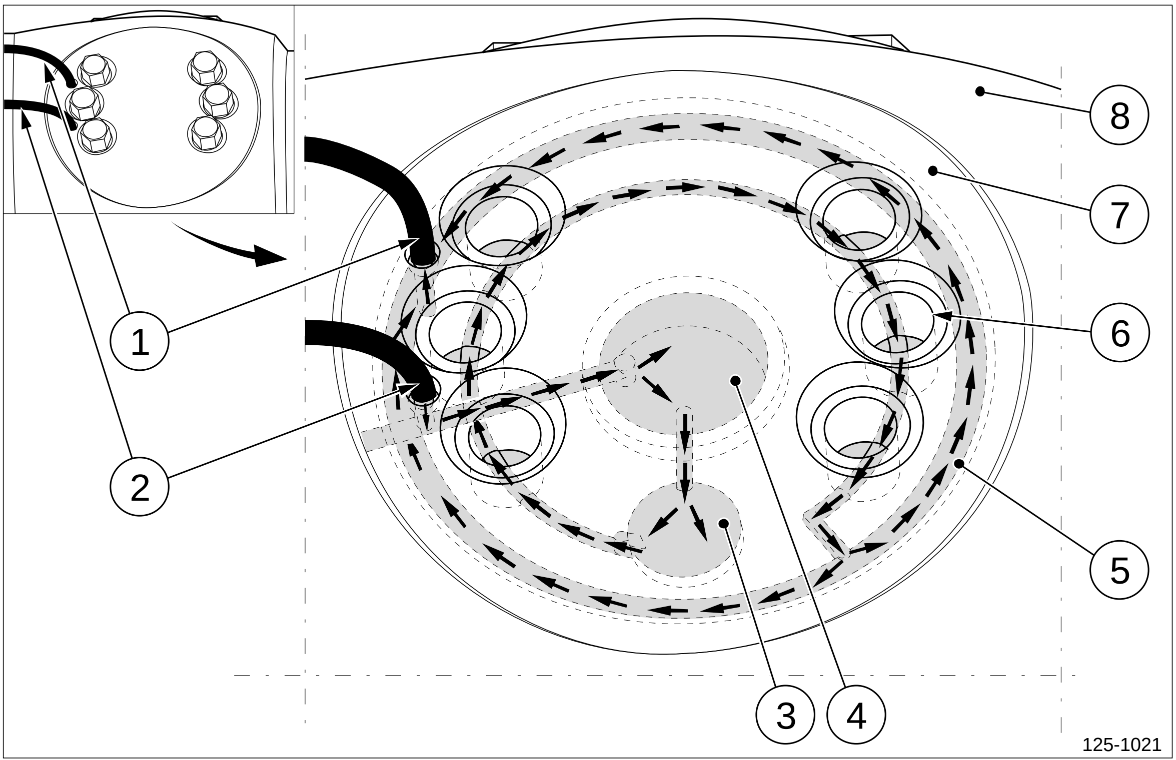

Figure 8 Flushing direction through the blade flange, G-design.

1. Oil connection marked “OUT”
2. Oil connection marked “IN”
3. Guide pin
4. Space between blade flange and crank pin ring
5. Blade sealing ring groove
6. Blade bolt holes
7. Blade flange
8. Propeller Hub body

Warning: Never work alone when lifting heavy components. Most lifting operations require two persons, one operate the lifting device and one ensure that the components do not get damaged.

Warning: The torque tool must be dimensioned with consideration taken to the torque values. This also includes the power socket which must have correct dimension for the width across flats.

Caution: It is important that only qualified personnel perform the lifting.

Caution: Use only clean soft slings when lifting to prevent damage on the blades.

Caution: The parts that are to be assembled must be cleaned and dry before the assembly.

Caution: Make sure to apply PTFE-compound or similar on the blade sealing ring or it will get damaged at the start up.

Caution: Make sure to handle the torque tool with care to prevent personel injuries due to the massive forces used.

Note: Make sure to read the lifting instructions in part Handling and Preservation before starting the installation.

Note: Make sure to have an up to date certificate regarding torque calibration of the torque tool.

This instruction describes how to install propeller blades.

Before Starting this Procedure:

To be able to perform a safe installation with satisfied outcome the following prerequisites must be fulfilled.

Make sure that all parts are clean and dry. It is very important that nothing comes in between the blade foot and crank pin ring.

Make sure that proper lifting equipment are available. Weld brackets onto the ships hull or use a mobile crane to lift the propeller blades.

Make sure that all equipment is clean.

Preparations before the blade is installed

1. Clean the blade flange, screw holes, blade seat and crank pin ring.

2. Wash the blade screws using a de-greasing solvent.
3. Inspect that the guide pins are properly secured. If the guide pins are loose, tighten and lock the screws that are keeping the guide pins in place.
4. Apply thread lubricant, according to Hub Assembly drawing, on the blade guide and on the guide pin.
5. Clean the blade sealing groove.
6. Prepare the flushing equipment (see figure 7). Make sure all hoses are properly connected to the pump and collecting container.
7. Make sure that the holes in the blade screws are unplugged.

Install the blade and level it with the crank pin ring

8. Apply grease (pos 3, figure 1), in the blade sealing groove (pos 2, figure 1) on the blade flange in order to keep the blade sealing ring (pos 4, figure 1) in place when the blade flanges are mounted to the hub.
   Place a new blade sealing ring in its groove (see figure 1) and apply PTFE-compound on the top surface of the blade sealing ring (pos 5, figure 1).
9. Lift the blade in position. Use the lifting tool and lifting equipment suitable to lift the whole weight of the blade (for more information see the lifting instructions in section Storage and Preservation).
10. Use a level to make sure that the foot of the blade and the crank pin ring are absolutely parallel.
11. Lubricate the blade screws heads and the threads according to the Hub Assembly drawing.
12. Fill the blade bolt holes in the crank pin ring (pos 9, figure 3) up to a third with grease according to the Hub Assembly drawing.
13. Mount the blade to the crank pin ring with two blade screws positioned opposite to each other according to the Hub Assembly drawing.
14. Use a ring key and a hammer to slightly tighten two blade screws. Tighten the bolts at the same time as a person is “rocking” the blade to assure that the blade will enter its guides.

Fasten the blade

15. Screw in all blade screws. Excessive grease is evacuated through the hollow bored blade bolts.
16. Use a hand tool to prestress all the blade screws in a cross pattern according to the Hub Assembly drawing.
17. There are two alternatives for final tightening the blade screws, see figure 4 or figure 5.
    When using a torque tool according to pos 3 in figure 5, the tool’s support part must be adjusted (the angle) towards the blade to obtain a steady torque force on the screws.
    To protect the surface on the blade use a thick aluminium, copper or brass plate (pos 2, figure 5) between the tool’s support and the blade. The plate must be bent with a similar radius as the surface to avoid damages to the surface.
    For torque values see Hub Assembly drawing in part Design Drawings.
    Tighten the blade screws in a cross pattern to the torque vale stated on the Hub

Assembly drawing. For more information on how to tighten the blade bolts see Instructions for tightening of screws, 586431.

18. Plug the hole in each blade screws head using a sealing screw (see position 2, figure 3). Tighten the screws to the torque value stated on the Hub Assembly drawing.

Flush the blade flange

19. Remove the VSTI plugs from the “IN” and “OUT” holes first
20. Connect the oil injection pump flushing nipple and hose (pos 2, figure 8) to connection marked “IN”.
21. Connect the excessive oil container flushing nipple and hose (pos 1, figure 8) to oil connection marked “OUT”.
22. Start to flush the blade flange with the oil pump unit (pos 1, figure 7). Use minimum pressure value at first. Slowly increase the pressure until grease and then flushing oil starts to evacuate through the hole.
23. When flushing oil starts to evacuate to the excessive oil container (pos 2, figure 7) the flushing of the blade flange is complete.
24. Disconnect both hoses with nipples at the “IN” and “OUT” connections on the blade flange.
25. Install the VSTI plugs (see position 1, figure 3) and tighten to the torque value stated on the Hub Assembly drawing and by using Loctite.
26. Install the blade lifting hole plug, see instruction in section Storage and Handling.
27. Perform a propeller hub pressure test according to Task: Propeller Hub Pressure Test.
28. Fit stainless steel locking pins between the hexagon part of the blade bolt and the hub. Spot weld the locking pin to the recess on the propeller blade according to figure 6. Make sure to leave a space between the locking pin and the screw (see position 2, figure 6).
29. Clean and store the oil injection pump hoses and excessive oil container in a proper storage.

This task is now completed.

Produced by: KK174 Approved by: Fnl Revision: a Sign: Nna
Creation date: 2008-06-16 Revision date: 2009-10-21

Maintenance, Propeller Blade

Task: Fill Oil and Flush Propeller Hub

Description

This task describes how to fill oil to and flush the centre part of the propeller hub. It also describes how to purify the oil using an external filter before filling the oil to the propeller hub.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Shut off valve	1
External oil filling unit	1
Particle counter	1
Standard welding machine	1
Standard grinding machine	1

Reference Documents
Hub Assembly drawing

Consumables	Qty
Grinding disks	As req.
Electrodes, ISO E 23.12.2	As req.
Linen rags	As req.
Oil (see Requirements for Lubricating Oil)	As req.

Instruction

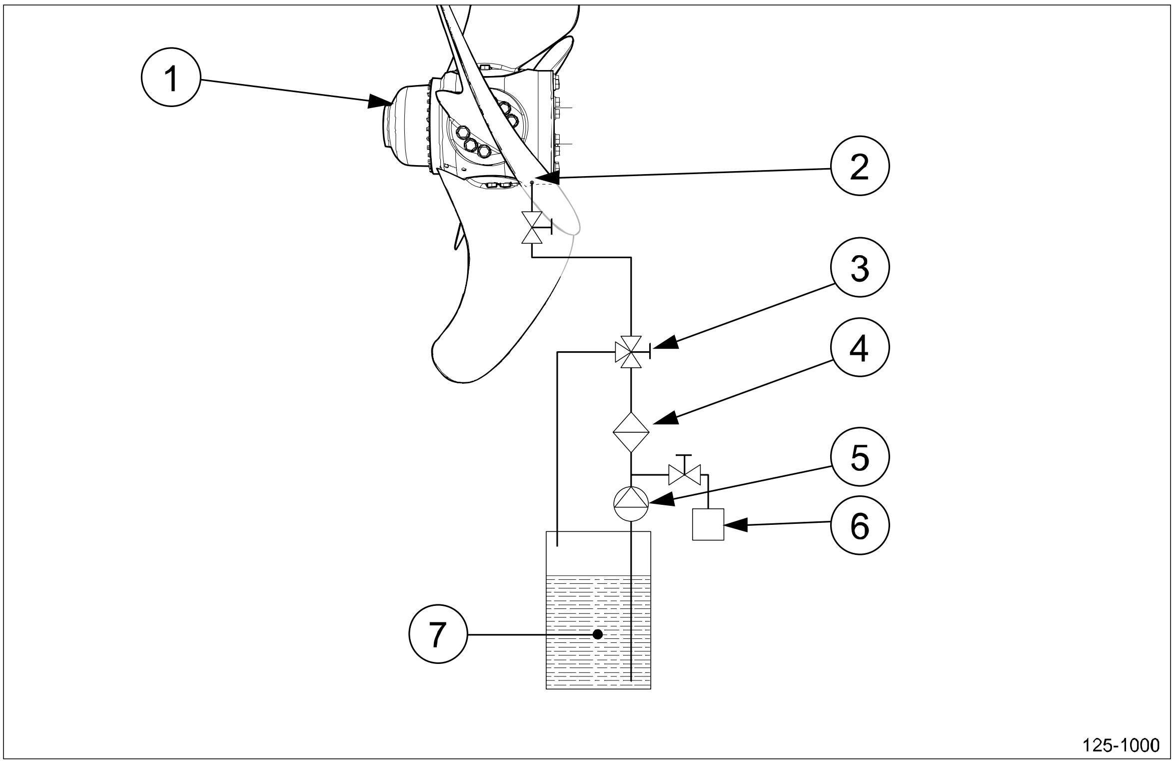

Figure 1 Initial position of the hub when purifying and filling the oil.

1. Aft plug
2. Forward plug
3. Three way valve
4. External filter
5. Pump
6. Sample point for oil test
7. Oil container

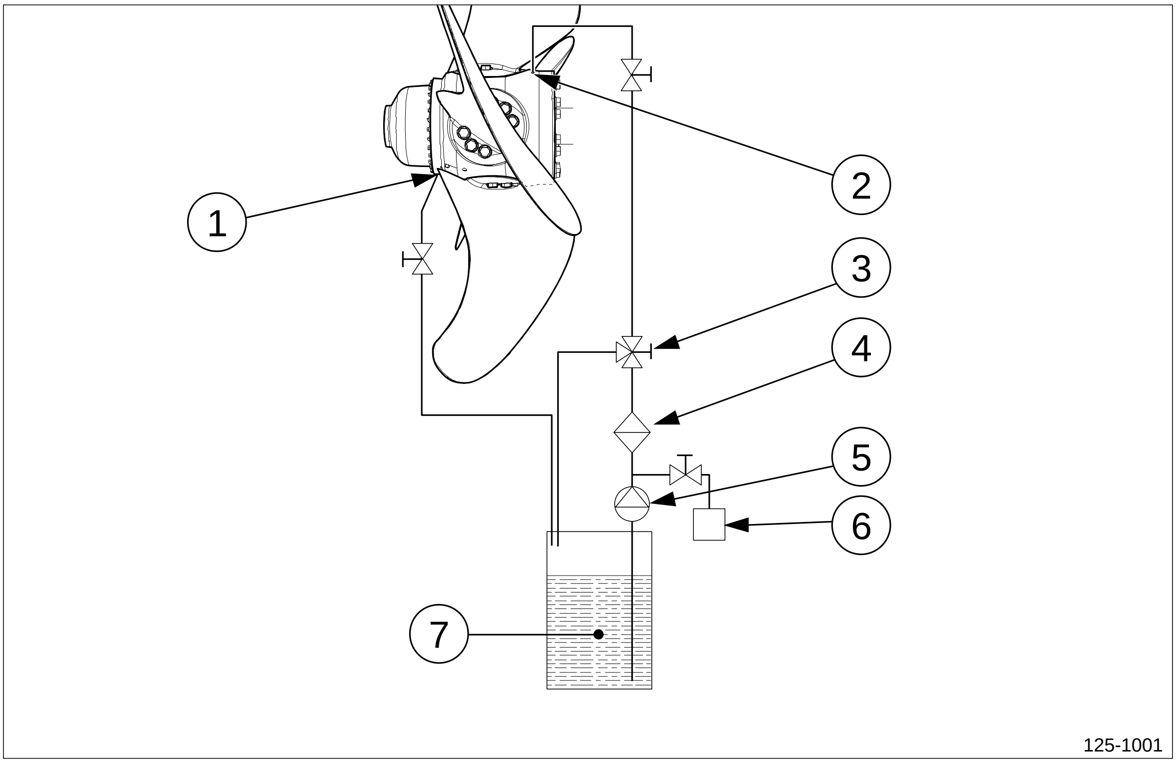

Figure 2 The hub is turned half a turn when flushing the hub.

1. Aft plug
2. Forward plug
3. Three way valve
4. External filter
5. Pump
6. Sample point for oil test
7. Oil container

Warning: It is important that there is sufficient space around the propeller hub when turning the shaft.

Caution: Oil is injurious to your health. Always read the warning label on the oil packaging and act according to the instructions.

Fill oil to and flush the propeller hub using an external filling unit. Also, purify the oil using an external filter before filling oil to the propeller hub. The oil must meet the recommendations in section Requirements for Lubricating Oil.

1. Turn the propeller shaft until the forward plug, on the propeller hub, is directed straight downwards and the aft plug is directed straight upwards (see figure 1).

2. Remove both plugs.

3. Use an external oil filling unit and a filter to purify the oil and to fill the hub. Attach the external oil filling unit and filter according to figure 1.
4. Manoeuvre the three way valve (see position 1 in figure 1) to enable the oil flow to return directly to the oil container (see position 3 in figure 1) without passing through the hub.
5. Purify the oil by circulating it through the external filter until the desired particle value is noted by for example a particle counter. Attach the particle counter to the hub according to position 6 in figure 1.
6. Manoeuvre the three way valve to enable the oil flow to fill the hub from bottom to top. The air trapped inside the hub is allowed to evacuate through the aft plug hole (see position 1 in figure 1).
7. When oil is coming out of the plug hole (see position 1 in figure 1), turn off the filling unit and fit a valve and hose to the plug hole.
8. Start the filling unit again and turn the propeller hub half a turn (180^o) (see figure 2).
9. Flush the propeller hub. Let the oil circulate inside the propeller hub and through the external filter and back to the hub. This flushing procedure will make sure that no dust or particles will be left inside the propeller hub. Use a particle counter to measure that the oil meets the recommendations in section Requirements for Lubricating Oil.
10. Turn the shaft so that the aft plug hole is turned upwards. Disconnect the aft valve and reinstall the plug with O-ring.

This task is now completed.

Before the external filling unit is disconnected a hub pressure test can be performed (see Task: Propeller Hub Pressure Test).

Corrective Maintenance, Hydraulic System

Task: Refill Oil to the Hydraulic System

Description

This task describes how to refill new oil to the hydraulic power pack tank.

Support Items

Spare Part Name	Qty

Special/Additional Tools and Test Equipment	Qty
Filling unit for hydraulic systems	1

Reference Documents

Consumables	Qty
Linen rags	As req.
Oil (see Requirements for Lubricating Oil)	As req.

Instruction

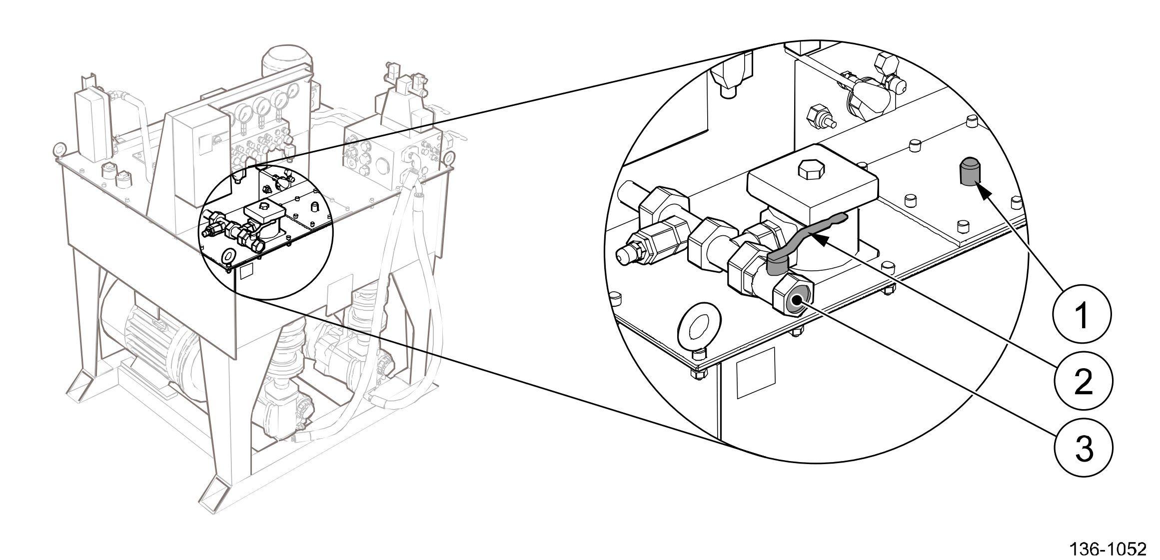

Figure 1 Shut off valve Z, on the return block, on the hydraulic power pack.

1. Dipstick
2. Shut off valve Z
3. Connection Z

Caution: The oil in the hydraulic system can be hot.

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

Note: The hydraulic power pack must be filled with oil that fulfils the requirements in section Requirements for Lubricating Oil.

Note: The oil must be filled through connection Z in order not to by-pass the filter function.

Refill the oil

1. Turn off all the hydraulic pumps.

2. Locate the connection Z (pos 3, figure 1), on the hydraulic power pack.
3. Wipe off connection Z with a clean linen rag.
4. Connect the oil filling unit to connection Z.
5. Open the shut-off valve Z (pos 2, figure 1).
6. Fill the hydraulic power pack tank to its maximum level. Make sure to keep the filling pressure below 0.3 MPa during the filling procedure.
7. Close the shut-off valve Z.
8. Disconnect the filling unit.
9. Start the hydraulic pumps and let them run for 30 minutes.
10. Inspect the oil level in the hydraulic power pack again and refill oil if necessary.
11. Inspect the filter indicator on the circulation filter and replace the filter element if necessary, see Task: Replace Circulation Filter Element.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Air Breather Filter F5

Description

This task describes how to replace the element in the air breather filter F5.

Support Items

Spare Part Name	Qty
Air breather filter	1

Special Tools and Test Equipment	Qty

Reference Documents
Hydraulic Diagram drawing
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

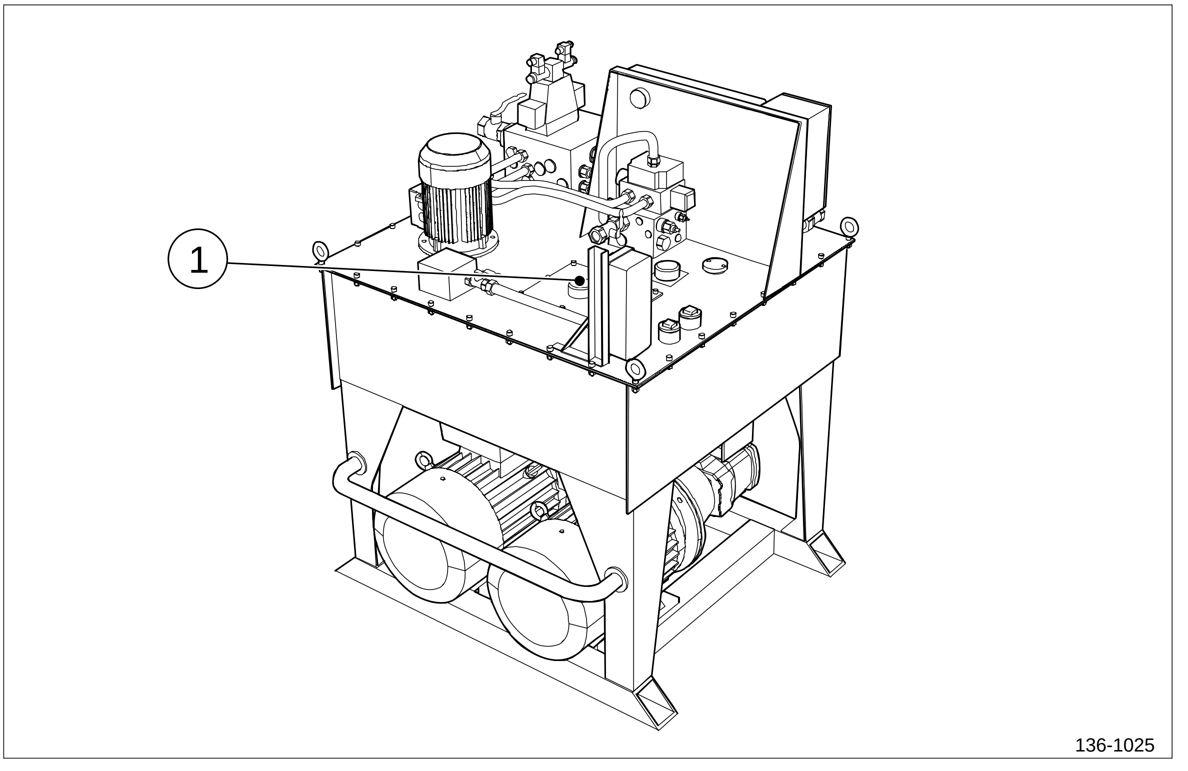

Figure 1 Front view of the hydraulic power pack.

1. Air breather filter F5

Caution: Oil is harmful to your health. Always read the warning label on the oil packaging and act according to the instructions.

Caution: The oil in the hydraulic system can be hot.

1. Locate the air breather filter F5 on the hydraulic power pack (see figure 1).
2. Clean the area around the air breather filter F5.
3. Remove the old air breather filter F5.
4. Fit the new air breather filter F5 on the hydraulic power pack. Make sure to tighten it correctly.

This task is now completed.

Every Sixth Month Maintenance, Hydraulic System

Task: Replace Circulation Filter Element

Description

This task describes how to replace the circulation filter element on the hydraulic power pack. The filter element must be replaced once every sixth month even though the filter indicator has not indicated that the filter is clogged.

Support Items

Spare Part Name	Qty
Filter element	

Special/Additional Tools and Test Equipment	Qty
Container to collect oil	As req.

Reference Documents

Consumables	Qty
Linen rags	As req.

Instruction

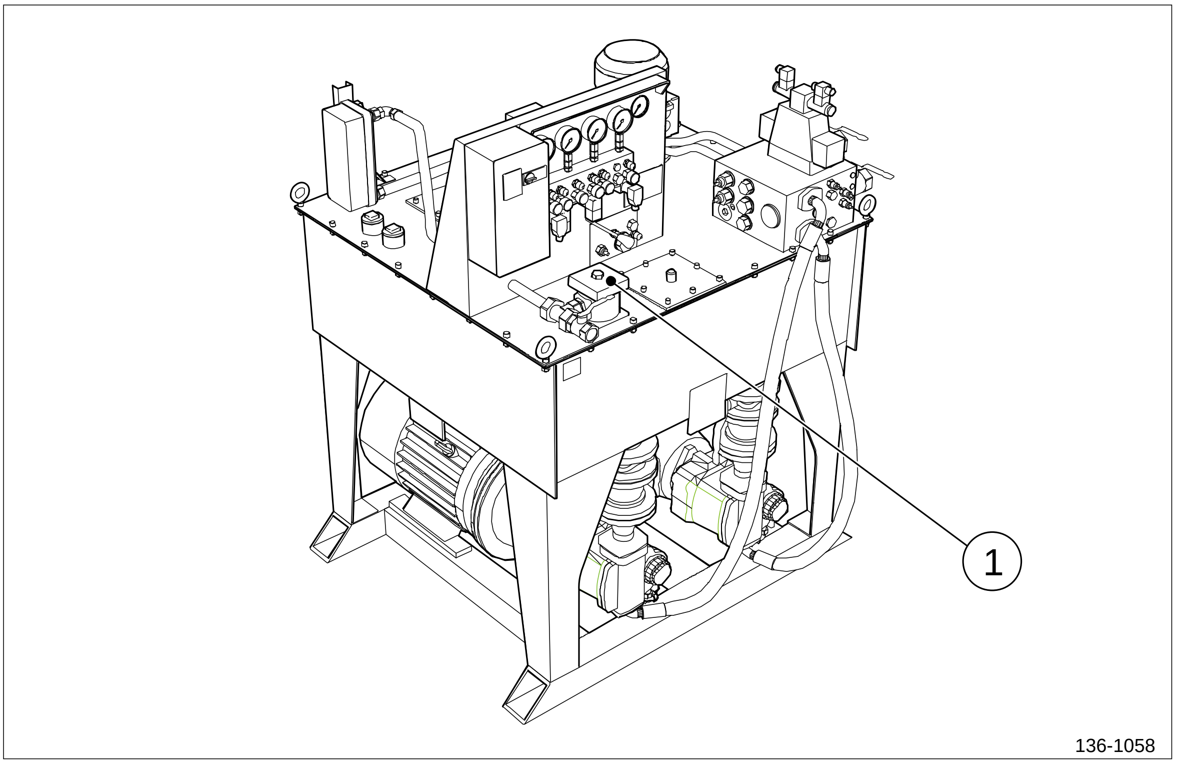

Figure 1 Front of the hydraulic power pack.

1. Circulation filter

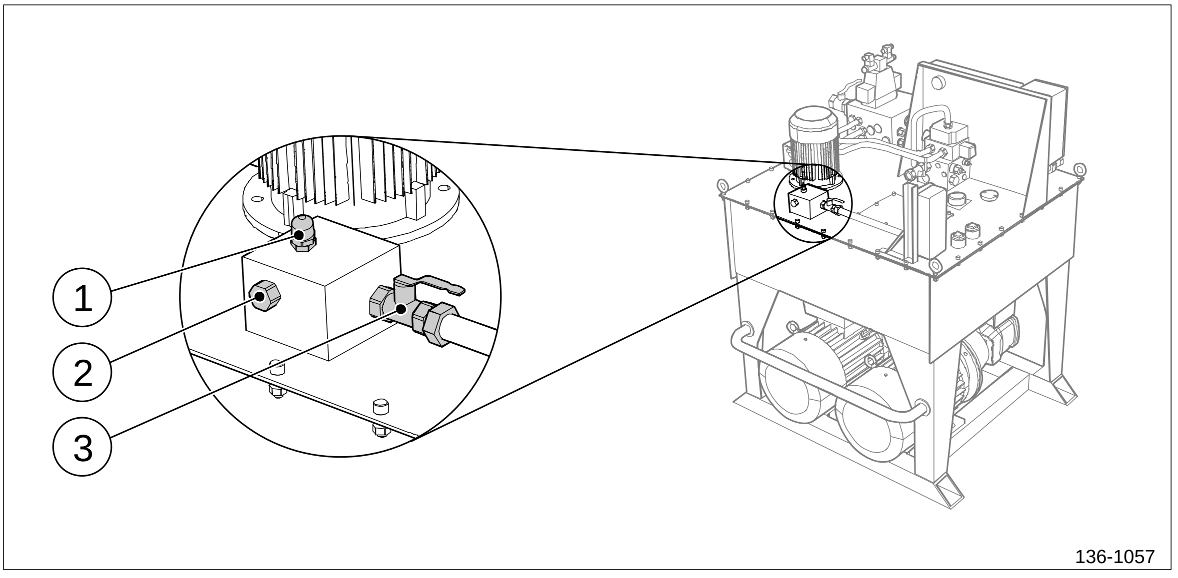

Figure 2 The back of the hydraulic power pack tank.

1. Test nipple TP8
2. By-pass valve V17
3. Shut-off valve V18

Warning: Replacing components during operation is associated with great risks for personal safety due to rotating shaft.

Note: This task can be performed when the propeller system is in operation.

Take out the used filter element

1. Close shut-off valve V18 (pos 3, figure 2).
2. Remove the circulation filter cover (pos 1, figure 1) and pull out the filter element. Take proper measures to collect any oil spillage. Dispose the oil according to local regualations.

Insert new filter element

3. Insert the new filter element. Use a clean linen rag to wipe off oil spillage.
4. Reassemble the return filter cover and make sure it is fitted correctly.
5. Open shut-off valve V18.
6. Make sure that no oil is leaking from the return filter. If oil is leaking, make sure that the filter element and the return filter cover are correctly fitted.

Inspect the used filter element

7. Inspect the used oil filter and look for metal chips or other particles, which may indicate damage on the propulsion system. Contact Rolls-Royce if any metal chips or other particles are found.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Level Switch on Hydraulic Power Pack LS1

Description

This task describes how to replace the level switch LS1 on the hydraulic power pack.

Support Items

Spare Part Name	Qty
Level switch (hydraulic power pack)	1

Special Tools and Test Equipment	Qty

Reference Documents
Hydraulic Diagram drawing
Hydraulic power pack assembly drawing

Consumables	Qty
Insulating tape	As req.
Linen rags	As req.

Instruction

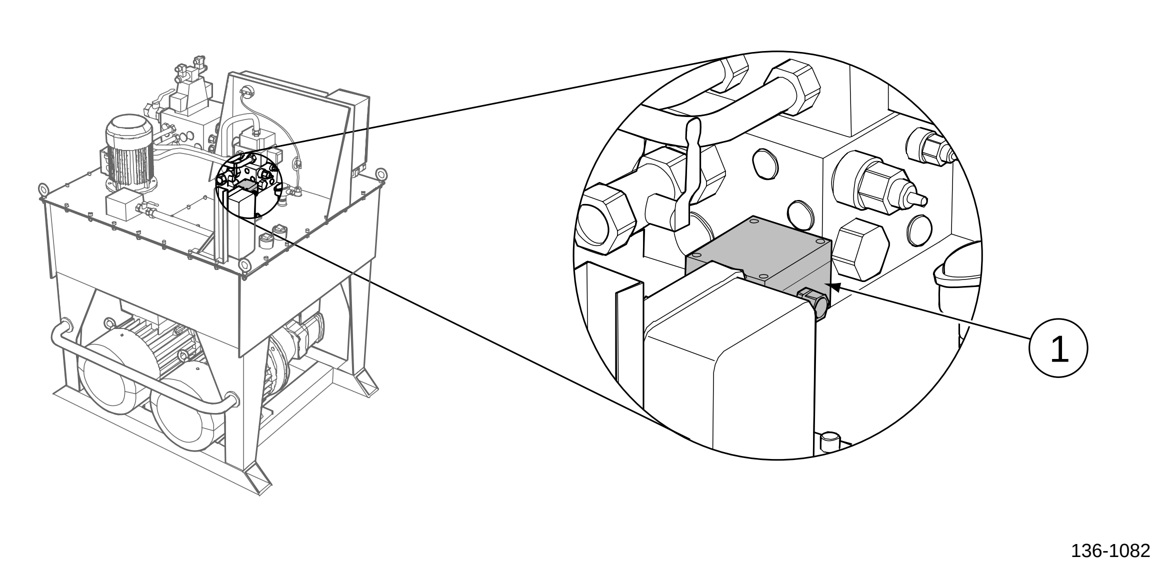

Figure 1 Level switch on the hydraulic power pack.

1. Level switch LS1

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Caution: Turn off and make sure the incoming power is disconnected before dismantling.

Caution: Make sure that the electrical wiring do not short circuit.

Note: This task must be performed by an electrician.

Before starting this task

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off the main pump units.
4. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.
5. Turn off the incoming power.
6. Disconnect the level switch's cables in the connection box. Insulate the disconnected end of the cable with for example insulating tape.

Remove the level switch

7. Locate the level switch LS1 (pos 1, figure 1) on the hydraulic power pack tank.
8. Remove the cover of the level switch.
9. Disconnect the electric cable from the level switch. Insulate the disconnected end of the electric cable with for example insulating tape.
10. Loosen and remove the screws on the level switch's mounting plate.
11. Remove the level switch from the hydraulic power pack tank. Wipe off any oil with linen rags.

Replace the level switch and test function

12. Make sure the new level switch is clean. Wipe with linen rags.
13. Remove the cover from the new level switch.
14. Remove the insulation from the electric cable end.
15. Connect the electric cable to the new level switch.
16. Fit the cover on the new level switch.

17. Remove the insulation and connect the level switch cables' in the connection box.

18. Turn on the electric incoming power.

19. Test the function of the new level switch according to the following procedure:

    19.1. Unscrew the dipstick and use it to push the float on the level switch downwards. When pushed below the minimum oil level, the alarm “Oil level low” should be activated.

    19.2. Start either one of pump unit P1 or P2. Use the dipstick to push the float on the level switch downwards. When pushed far enough, the pump unit should stop.

20. Install the new level switch onto the hydraulic power pack tank.

Finishing

21. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.

22. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Gravity Tank

Task: Replace Level Switch on Gravity Tank

Description

This task describes how to replace the level switch on the gravity tank if it is malfunctioning, to ensure the safety and functions of the propulsion system.

Support Items

Spare Part Name	Cross Ref. No.
Level switch (gravity tank)	1020

Special/Additional Tools and Test Equipment	Qty

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

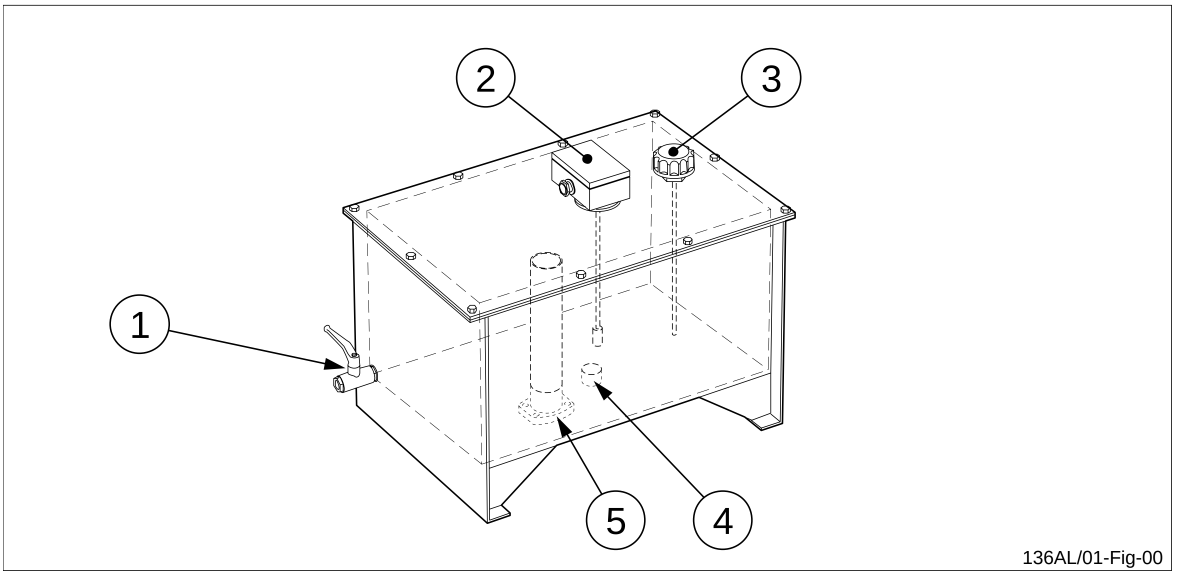

Figure 1 Gravity tank.

1. Drain valve
2. Level switch
3. Sounding rod
4. Connection VV
5. Connection TT

Caution: Turn off and make sure that the electric voltage is dead before dismantling.

Caution: Make sure that the electrical wiring do not short circuit.

Note: This task must be performed by an electrician.

Before starting this procedure

1. Turn off the electric voltage.

Remove the level switch

2. Locate the level switch (figure 1) on the gravity tank.

3. Remove the cover of the level switch.

4. Disconnect the electric cable.
5. Insulate the disconnected end of the cable with for example insulating tape.
6. Loosen and remove the screws on the mounting plate of the level switch.
7. Lift the level swith off the the gravity tank.

Replace the level switch and test function

8. Remove the cover on the new level switch.
9. Remove the insulation from the cable end.
10. Connect the cables to the new level switch.
11. Fit the cover on the new level switch.
12. Turn on the incoming power.
13. Test the function of the new level switch. For more information see instruction Inspect Level Switch on Gravity Tank.
14. Wipe the new level switch clean using a linen rag.
15. Lower the new level switch into the gravity tank.
16. Fit and tighten the screws on the mounting plate of the level switch.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Temperature Sensor TT1

Description

This task describes how to replace the temperature sensor TT1.

Support Items

Spare Part Name	Qty
Temperature sensor	

Special Tools and Test Equipment	Qty

Reference Documents
Hydraulic Diagram
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

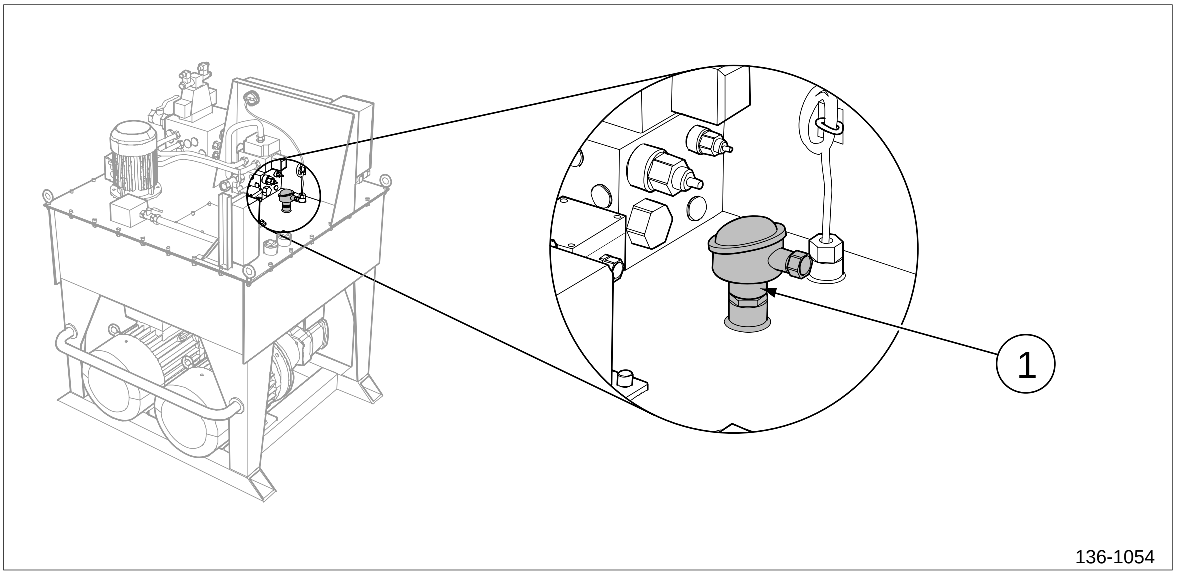

Figure 1 Temperature sensor on the hydraulic power pack.

1. Temperature sensor TT1

Warning: Turn off the hydraulic system before starting the replacement.

Caution: Turn off and make sure the incoming power is disconnected before dismantling.

Note: This task must be performed by an electrician.

Before starting this task

1. Turn off the hydraulic system.
2. Turn off the incoming power before dismantling.

Remove the temperature sensor

3. Locate the temperature sensor TT1 (see figure 1) on the back of the hydraulic power pack.
4. Disconnect the cable to the sensor.
5. Loosen and remove the temperature sensor from the hydraulic power pack.

Replace the temperature sensor

6. Make sure the new temperature sensor is clean.
7. Test the function of the temperature sensor. For more information see Task: Test the Temperature Sensor.
8. Wipe the sensor dry from water using a linen rag.
9. Lower the sensor into the hydraulic power pack tank and fasten it.
10. Connect the cable to the sensor.
11. Use cable ties to fasten the cable.
12. Turn on the incoming power.
13. Turn on the hydraulic system.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Switch

Description

This task describes how to replace either one of the pressure switches PS1, PS2, PST1, and PST2. Make sure that the pressure switches are preset from factory to the value stated on the Remote Supervision drawing.

Support Items

Spare Part Name	Qty
Pressure switch	

Special Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing
Hydraulic Power Pack Assembly drawing
Remote Supervision drawing

Consumables	Qty

Instruction

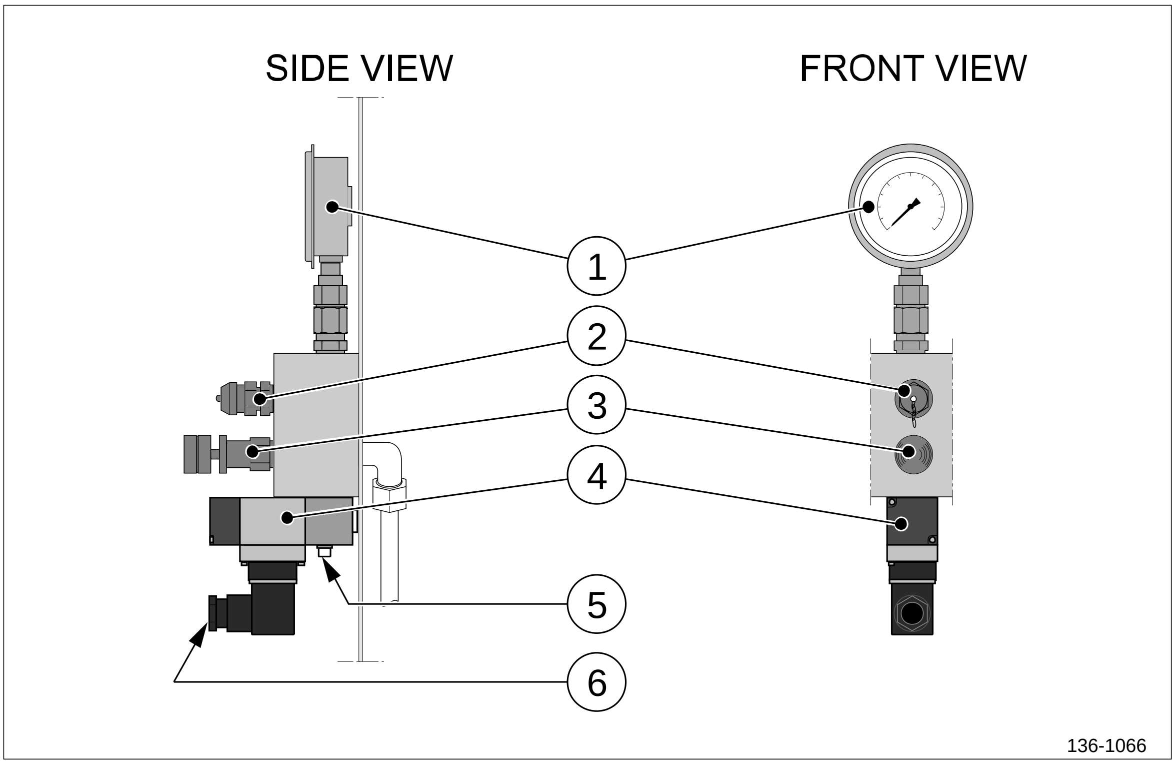

Figure 1 Front, side, and back view of a pressure switch.

1. Pressure gauge
2. Test nipple
3. Shut-off valve
4. Pressure switch
5. Screws
6. Cable plug

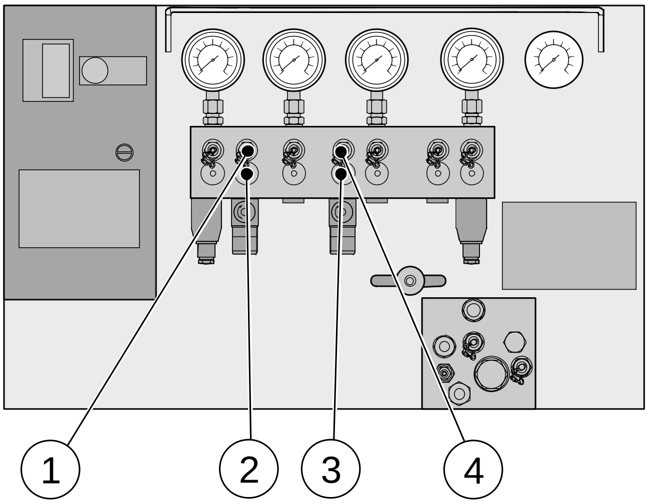

Figure 2 The control panel on the hydraulic power pack.

1. Test nipple TP1
2. Pressure switch PS1 shut-off valve PS1V
3. Pressure switch PS2 shut-off valve PS2V
4. Test nipple TP2

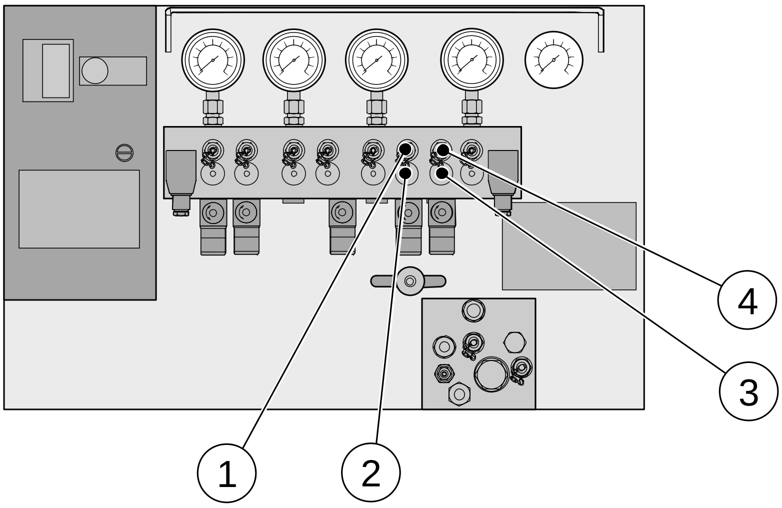

Figure 3 The control panel on the hydraulic power pack (with PTO-pump).

1. Test nipple TP10
2. Pressure switch PST1 shut-off valve PST1V
3. Pressure switch PST2 shut-off valve PST2V
4. Test nipple TP11

Warning: Turn off the hydraulic system before starting the replacement.

Caution: Turn off and make sure the incoming power is disconnected before dismantling.

Note: This task must be performed by an electrician.

Note: Make sure that the new pressure switch is preset from factory according to information stated on the Remote Supervision drawing.

Before starting this task

1. Turn off the hydraulic system.
2. Turn off the incoming power.

Remove the pressure switch

3. Locate the pressure switch (pos 4, figure 1) to be replaced on the hydraulic power pack.
4. Close the shut-off valve to the pressure switch to be replaced, see figure 1.
5. Remove the cable plug (pos 6, figure 1) connected to the pressure switch at the front of the control panel.
6. Connect a hose with test connection to the test nipple (pos 2, figure 1) to release the pressure. Take proper measures to collect the oil. Disconnect the hose when the pressure is released.
7. Loosen and remove the screws (pos 5, figure 1) on the pressure switch.
8. Remove the pressure switch.

Replace the pressure switch

9. Attach the new pressure switch.
10. Fit and tighten the screws (pos 5, figure 1).
11. Connect the cable plug to the new pressure switch.
12. Open the shut-off valve (pos 3, figure 1) gently and make sure that no oil is leaking.

Test the function

13. Turn on the incoming power.
14. Perform one of the following function tests depending on which pressure switch that has been replaced:

Inspect the automatic start of the pump unit P2

14.1. Make sure that only the pump unit P1 runs and that pump unit P2 is in stand-by position.

14.2. Close shut-off valve PS1V.

14.3. Connect a hose with test connection to the test nipple TP1 (see figure 2) and drain oil. Make sure that the pump unit P2 automatically start when the pump unit P1 fails to give pressure. Take proper measures to collect the oil. Disconnect the hose when the pressure is released.

14.4. Open shut-off valve PS1V.

Inspect the automatic start of the pump unit P1

14.5. Make sure that only the pump unit P2 runs and that pump unit P1 is in stand-by position.

14.6. Close shut-off valve PS2V.

14.7. Connect a hose with test connection to the test nipple TP2 (see figure 2) and drain oil. Make sure that the pump unit P1 automatically start when the pump unit P2 fails to give pressure. Take proper measures to collect the oil. Disconnect the hose when the pressure is released.

14.8. Open shut-off valve PS2V.

Inspect the automatic start of the pump units P1 and P2 (with PTO pump)

14.9. Make sure that only the PTO pump runs and that pump unit P1 and P2 are in stand-by position.

14.10. Close shut-off valve PST1V and PST2V (see figure 3).

14.11. Connect a hose with test connection to the test nipples TP10 and TP11 (see figure 3) and drain oil. Make sure that the pump unit P1 and P2 automatically start when the PTO pump fails to give pressure. Take proper measures to collect the oil. Disconnect the hose when the pressure is released. Dispose the collected oil according to local regulations.

14.12. Open shut-off valve PST1V and PST2V.

Finishing

15. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Transmitter PT2, PT3

Description

This task describes how to replace either one of the pressure transmitters.

Support Items

Spare Part Name	Qty
Pressure transmitter PT2	1
Pressure transmitter PT3	1

Special Tools and Test Equipment	Qty
Container to collect oil	As req.
Hose with test connection Minimess 16x2	1

Reference Documents
Hydraulic Diagram drawing
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

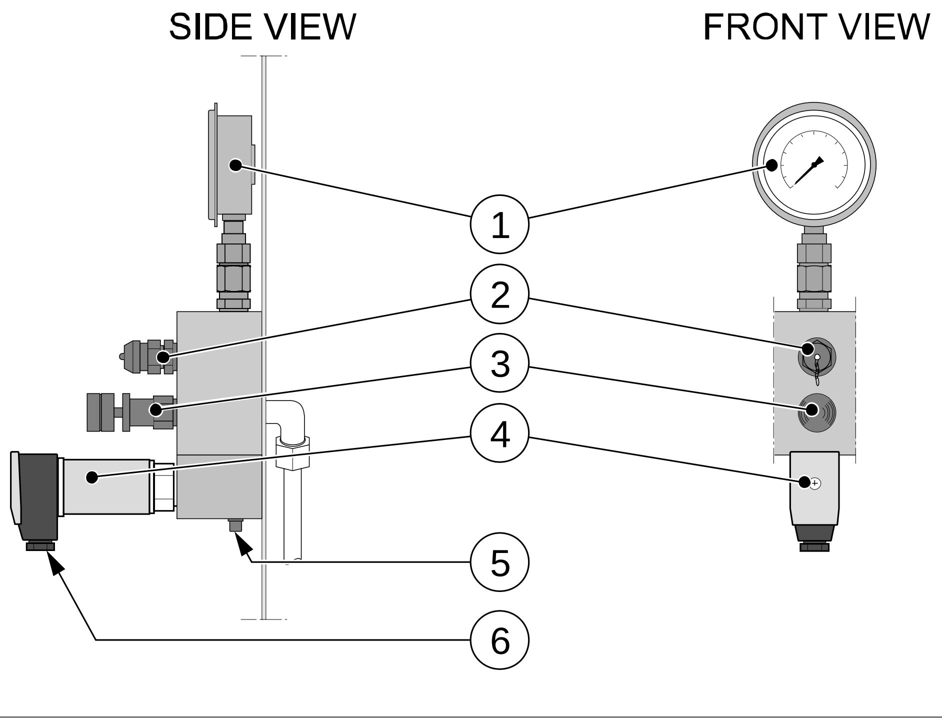

Figure 1 Front, side, and back view of a pressure transmitter.

1. Pressure gauge
2. Test nipple
3. Shut-off valve
4. Pressure transmitter
5. Screw
6. Cable plug

Warning: Turn off the hydraulic system before starting the replacement.

Caution: Turn off and make sure the incoming power is disconnected before dismantling.

Note: This task must be performed by an electrician.

Note: **The PT2 and PT3 pressure transmitters have different measuring ranges and must therefore not be mixed up.**

Before starting this task

1. Turn off the hydraulic system.
2. Turn off the incoming power.

Remove the pressure transmitter

3. Locate the pressure transmitter (pos 4, figure 1) to be replaced on the control panel of the hydraulic power pack.
4. Close the shut-off valve (pos 3, figure 1) to the pressure transmitter to be replaced.
5. Loosen the screw (pos 5, figure 1) and remove the plug from the pressure transmitter.
6. Connect a hose with test connection to the test nipple (pos 2, figure 1) to release the pressure. Take proper measures to collect the oil that flows. Disconnect the hose when the pressure is released. Dispose the collected oil according to local regulations.
7. Loosen and remove the pressure transmitter from the front of the control panel.

Replace the pressure transmitter

8. Replace and tighten the new pressure transmitter.
9. Connect the cable plug to the new pressure transmitter.
10. Tighten the screw at the centre of the cable plug.
11. Open the shut-off valve gently and make sure that no oil is leaking.

Test the function

12. Turn on the incoming power.
13. Perform one of the following function tests depending on which pressure transmitter that has been replaced:

    13.1. Test (PT2):
    Start either one of pump unit (P1) or (P2). Verify that the pressure gauge (G1) indicates normal pressure. The pressure indicated on (G1) should correspond to the pressure shown on the indicator on the bridge.

    13.2. Test (PT3):
    Start pump unit (P3). Verify that the pressure gauge (G5) indicates normal pressure. The pressure indicated on (G5) should correspond to the pressure shown on the indicator on the bridge.

Finishing

14. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Thermometer

Description

This task describes how to replace the thermometer, that is, the thermometer bulb and the temperature gauge in the hydraulic power pack tank.

Support Items

Spare Part Name	Qty
Temperature gauge and bulb	1

Special Tools and Test Equipment	Qty
Hot water: >65 ^{o}C	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

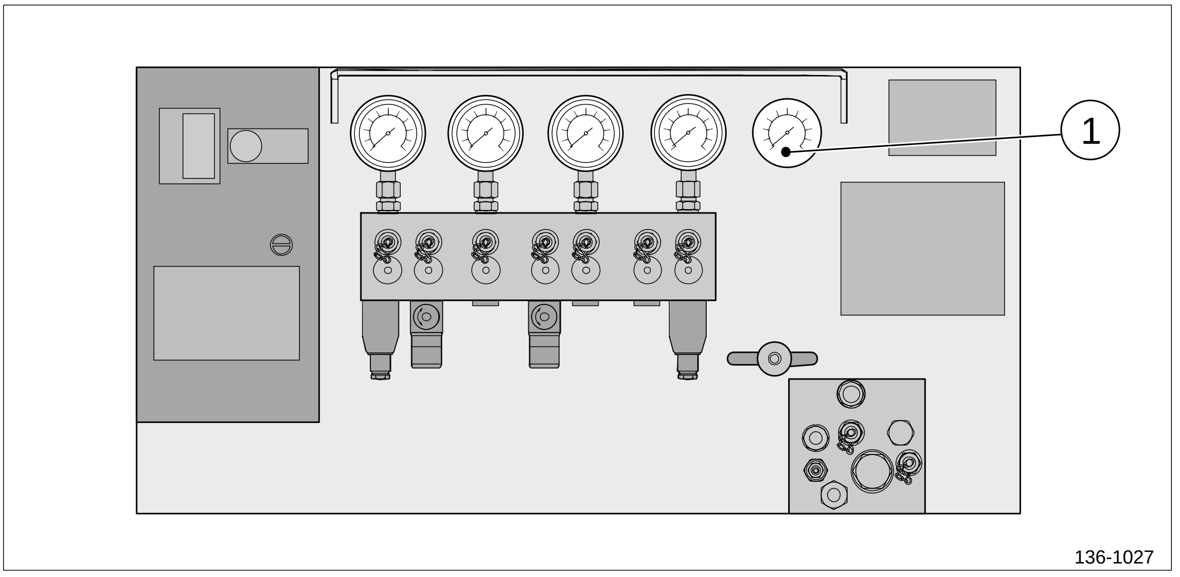

Figure 1 Control panel on the hydraulic power pack.

1. Temperature gauge for thermometer TH1

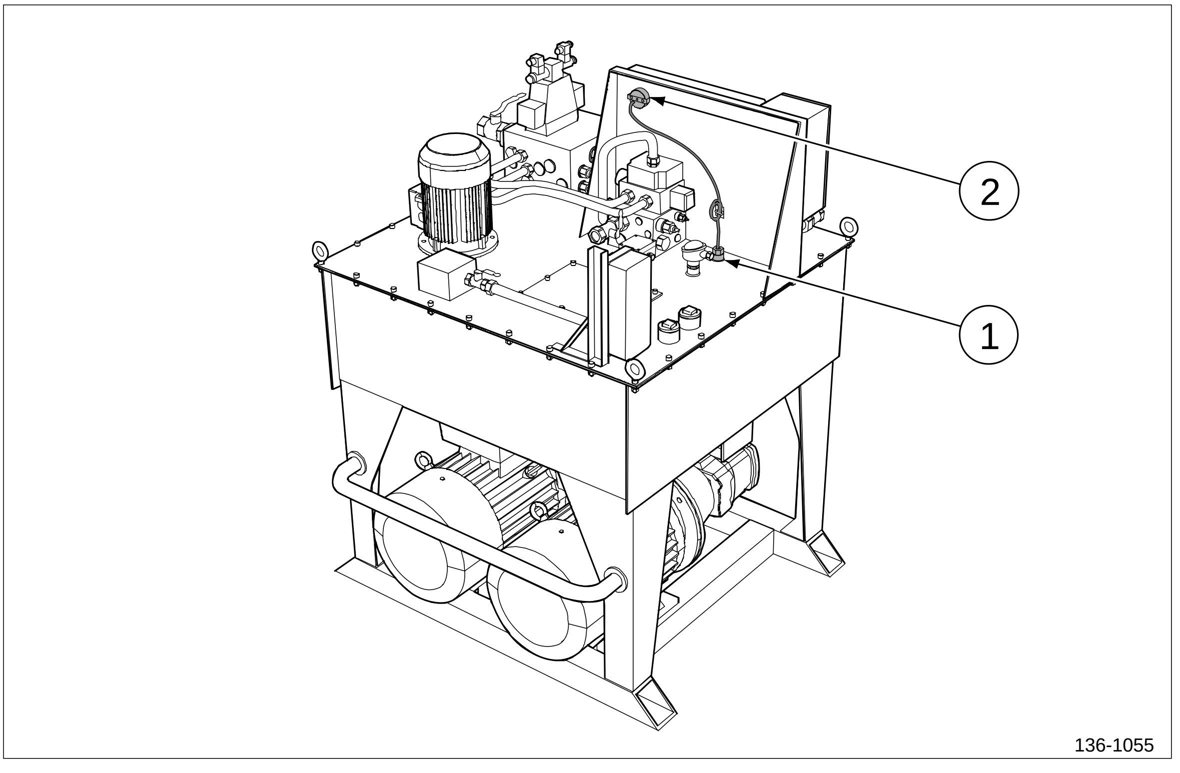

Figure 2 The thermometer parts on the hydraulic power pack.

1. Thermometer bulb
2. Temperature gauge (seen from behind)

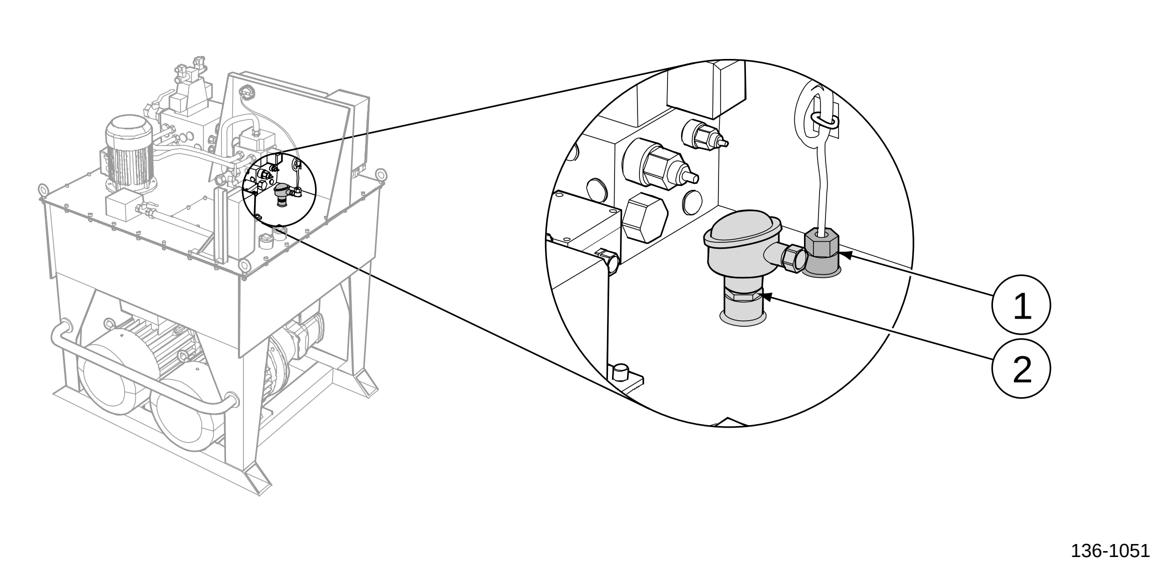

Figure 3 The back view of the hydraulic power pack.

1. Thermometer bulb
2. Temperature sensor TT1

Warning: Turn off the hydraulic system before starting the replacement.

Before starting this task

1. Make sure the hydraulic system is turned off.

Lift up the thermometer bulb

2. Locate the cap of the thermometer bulb on the back of the hydraulic power pack.
3. Unscrew the cap and lift up the bulb (pos 1, figure 2).

Remove the temperature gauge

4. Losen the screws and remove the temperature gauge (see figure 1) from the back of the hydraulic power pack panel.

Replace the temperature gauge and thermometer bulb

5. Fit the new temperature gauge and tighten the screws.
6. Test the function of the new temperature gauge and thermometer bulb by lowering the bottom part of the bulb into hot water (at least 65^{o}). Verify the temperature indication on the temperature gauge.
7. Wipe off the new bulb and make sure it is clean.
8. Lower the bulb into the hydraulic power pack tank and tighten its cap.
9. Use bundle straps to fasten the cable connecting the bulb to the gauge.
10. Turn on the hydraulic system.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Gauges

Description

This task describes how to replace either one of the following pressure gauges:

• G1 = system pressure

• G3 = A-port - astern working pressure

• G4 = B-port - ahead working pressure

• G5 = static pressure.

Support Items

Spare Part Name	Qty
Pressure gauge G1, G3, G4 (4 pieces)	As req.
Pressure gauge G5	1

Special Tools and Test Equipment	Qty
Container to collect oil	As req.
Hose with test connection Minimess 16x2	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

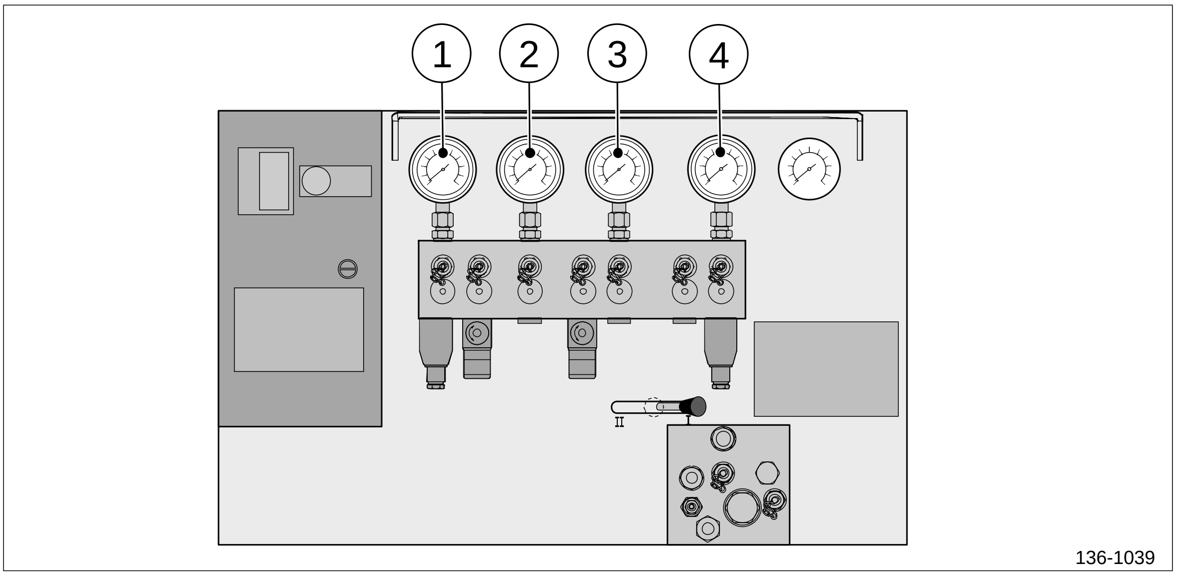

Figure 1 Control panel on the hydraulic power pack.

1. Gauge G1: system pressure
2. Gauge G3: A port - astern working pressure
3. Gauge G4: B port - ahead working pressure
4. Gauge G5: static pressure

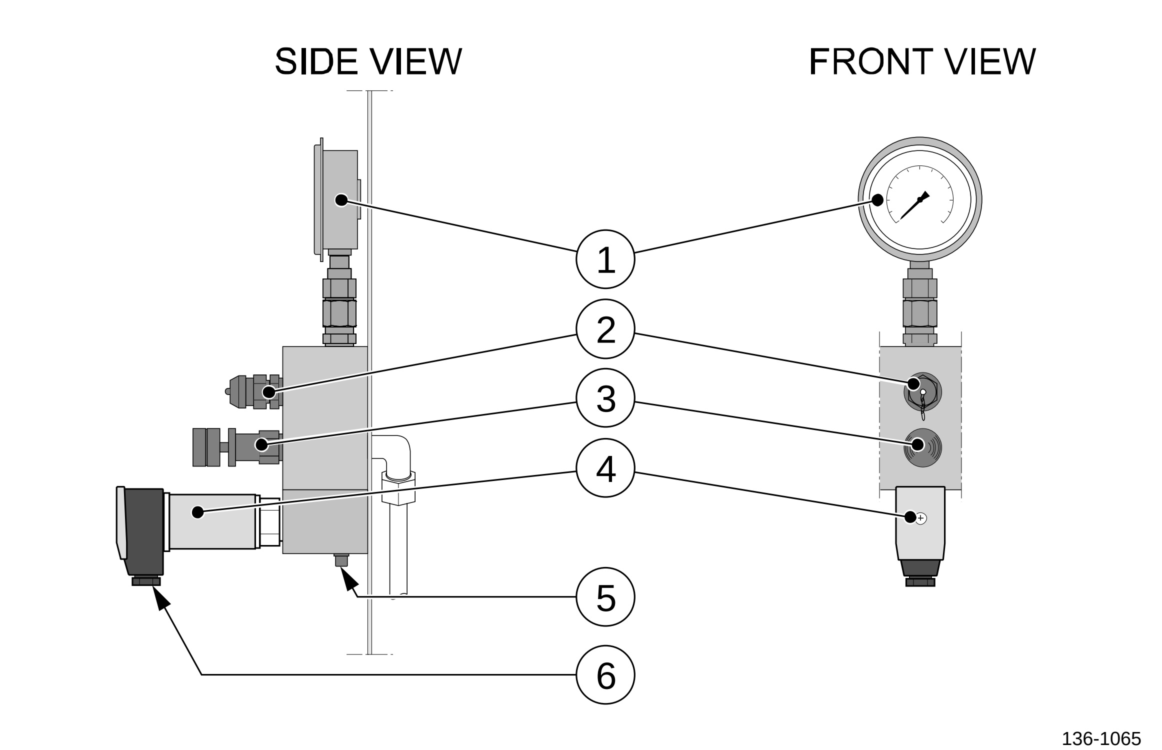

Figure 2 Front, side, and back view of a pressure transmitter.

1. Pressure gauge
2. Test nipple
3. Shut-off valve
4. Pressure transmitter
5. Screw
6. Cable plug

Warning: Turn off the hydraulic system before starting the replacement.

Caution: Turn off and make sure the incoming power is disconnected before dismantling.

Note: Pressure gauge G5 measures the static pressure and has a different measuring range with respect to that of the other pressure gauges. The gauges must therefore not be mixed up.

Depressurize and replace the gauge

1. Turn off the hydraulic pumps.
2. Close the shut-off valve of the pressure gauge to be replaced (see figure 2).
3. Connect a hose with test connection to the test nipple of the pressure gauge to be replaced (see figure 2). Note that when the hose is connected to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil. Dispose the oil according to local regulations.
4. Unscrew and remove the pressure gauge from the pipe connection.
5. Fit and tighten the new pressure gauge to the pipe connection.
6. Disconnect the hose from the test nipple.
7. Open the shut-off valve.
8. Test the function of the propulsion system in order to verify that the new gauge is in operation and is working properly.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Directional Control Valve V2 and V3

Description

This task describes how to replace either the directional control valve V2 or V3.

Support Items

Spare Part Name	Qty
Directional on/off control valve V2	1
Directional poportional control valve V3	1

Special Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

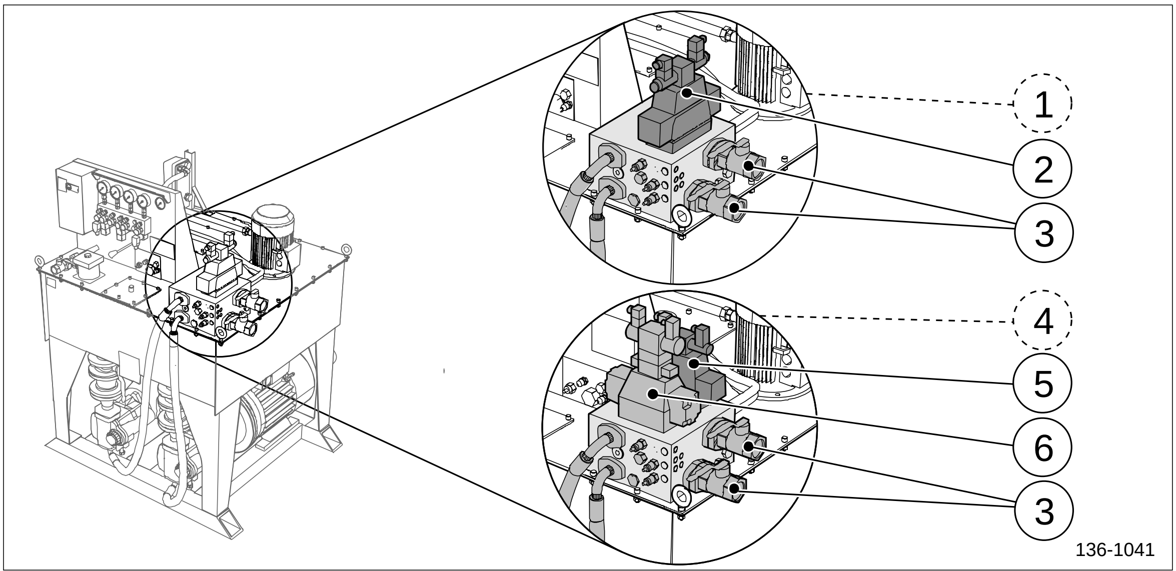

Figure 1 The valve manifold on the hydraulic power pack.

1. Valve manifold on power packs size 150-300 litres
2. Directional proportional valve V3
3. Shut-off valve V39 and V40
4. Valve manifold on power packs size 500-1000 litres
5. Directional proportional control valve V3
6. Directional on/off control valve V2

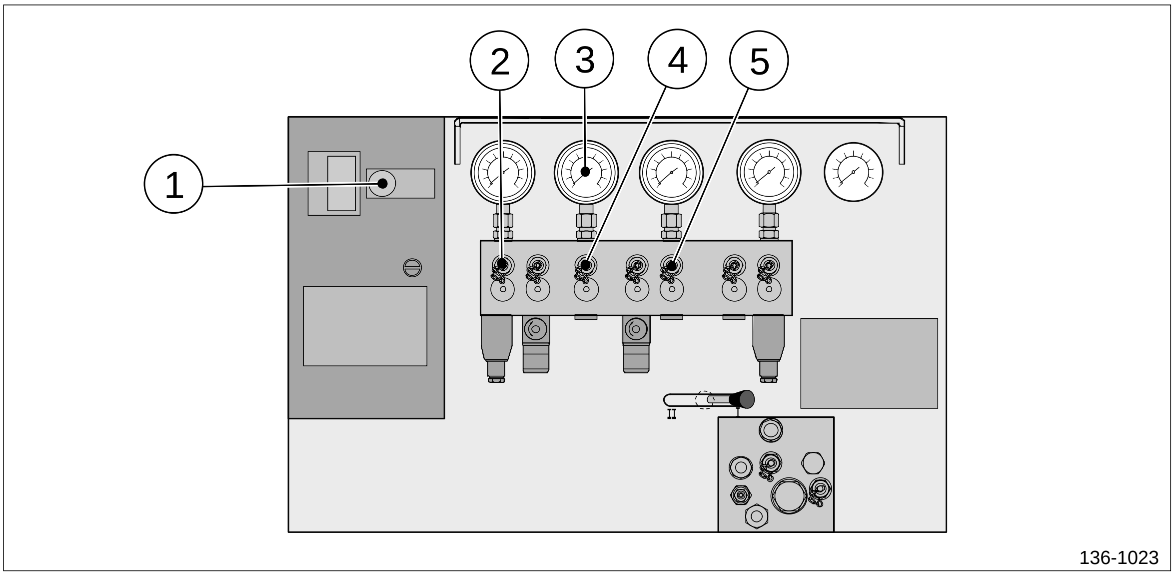

Figure 2 Control panel on the hydraulic power pack.

1. Local/remote switch
2. Test nipple TP3
3. Gauge G3
4. Test nipple TP4
5. Test nipple TP5

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Caution: Turn off and make sure the incoming power is disconnected before dismantling.

Note: This task must be performed by an electrician.

Note: **Replace one valve at a time to make sure the correct cables are connected to the correct valve.**

Note: **This task must be performed by an electrician.**

The valve to be replaced is located on the valve manifold. All valves on the valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the hydraulic system

1. Turn off the main engine(s) and lock the shaft.
2. Turn off the incoming power.
3. Set the pump units to local control.
4. Turn off all pump units.
5. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.
6. Close the shut-off valves V39 and V40.
7. Manoeuvre the directional proportional control valve V3 (see figure 1) by hand in both ahead and astern direction.
8. If applicable, manoeuvre directional on/off control valve V2 (see figure 1) by hand in both ahead and astern direction to depressurize the hydraulic system.
9. Connect a hose with test connection to test nipple TP3 (see figure 2). Note that when the hose is connected to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil.
10. Disconnect the hose.
11. Manoeuvre directional control valves V3 and V2 once again by hand in both the ahead and astern direction.
12. Connect a hose with test connection to the test nipple TP3. Note that oil will flow out and release the last pressure. Take proper measures to collect the oil. Disconnect the hose and repeat this procedure on the test nipples TP5 and TP4 (pos 4 and 5, figure 2) Dispose the oil according to local regulations.

Replace the valve

13. Clean the area around the valve to be replaced.
14. Disconnect the cables connected to the valve to be replaced.
15. Loosen and remove the screws which fasten the directional valve to the valve manifold.
16. Remove the valve to be replaced.
17. Install the new directional control valve on the valve manifold. Make sure that the seal is correctly fitted.
18. Refit the screws of the directional control valve.
19. Tighten the screws in a cross-pattern.
20. Connect the cables to the new directional control valve.
21. Make sure that the seal on the new directionalcontrol valve seals properly. If oil is leaking, make sure that the valve and the seal is correctly installed.

Test the Function of the New Valve

22. Turn on the incoming power.
23. Open the shut-off valves V39 and V40.
24. Test the function of the propulsion system in order to verify that the new directional control valve is in operation.
25. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
26. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Relief Valve V1

Description

This task describes how to replace the pressure relief valve V1 on the valve manifold.

Support Items

Spare Part Name	Qty
Pressure relief valve V1	1

Special Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

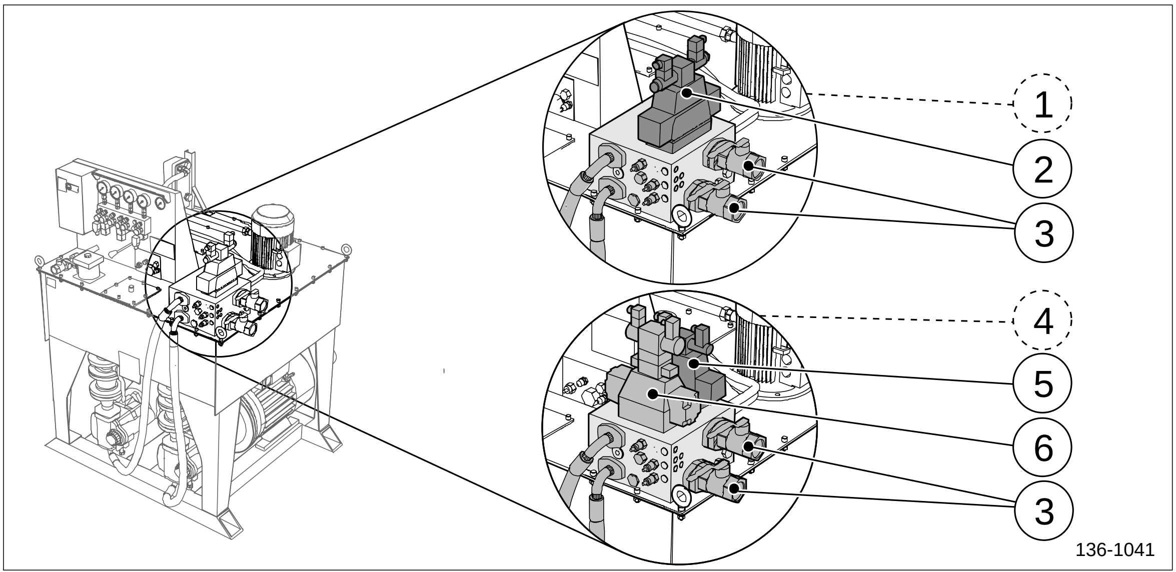

Figure 1 The valve manifold on the hydraulic power pack.

1. Valve manifold on power packs size 150-300 litres
2. Directional proportional control valve V3
3. Shut-off valve V39 and V40
4. Valve manifold on power packs size 500-1000 litres
5. Directional proportional control valve V3
6. Directional on/off cotrol valve V2

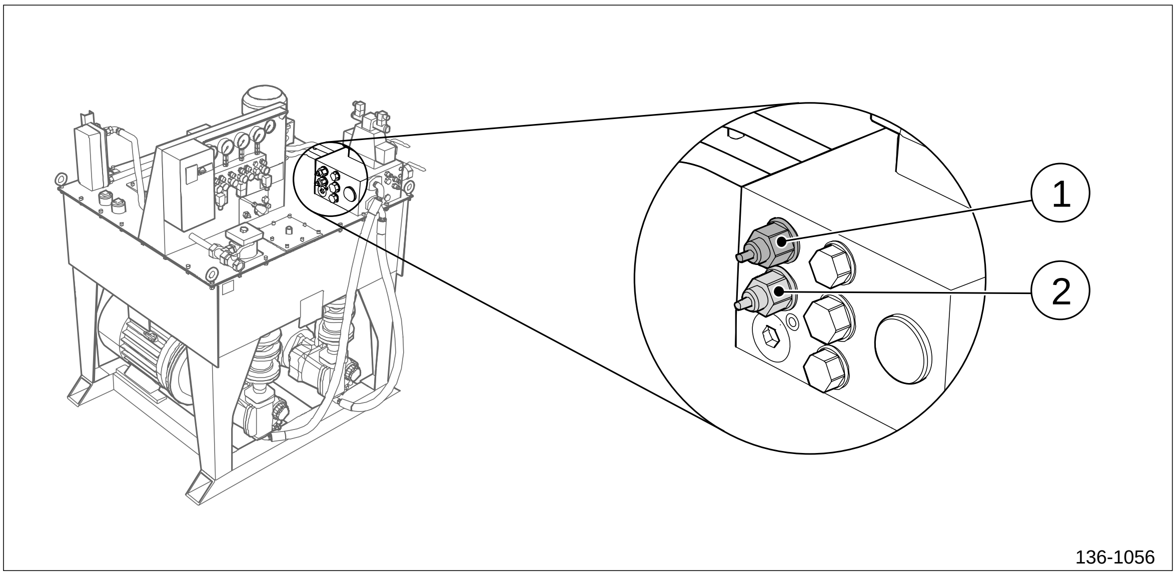

Figure 2 The hydraulic power pack unit.

1. Pressure relief valve V8
2. Pressure relief valve V1

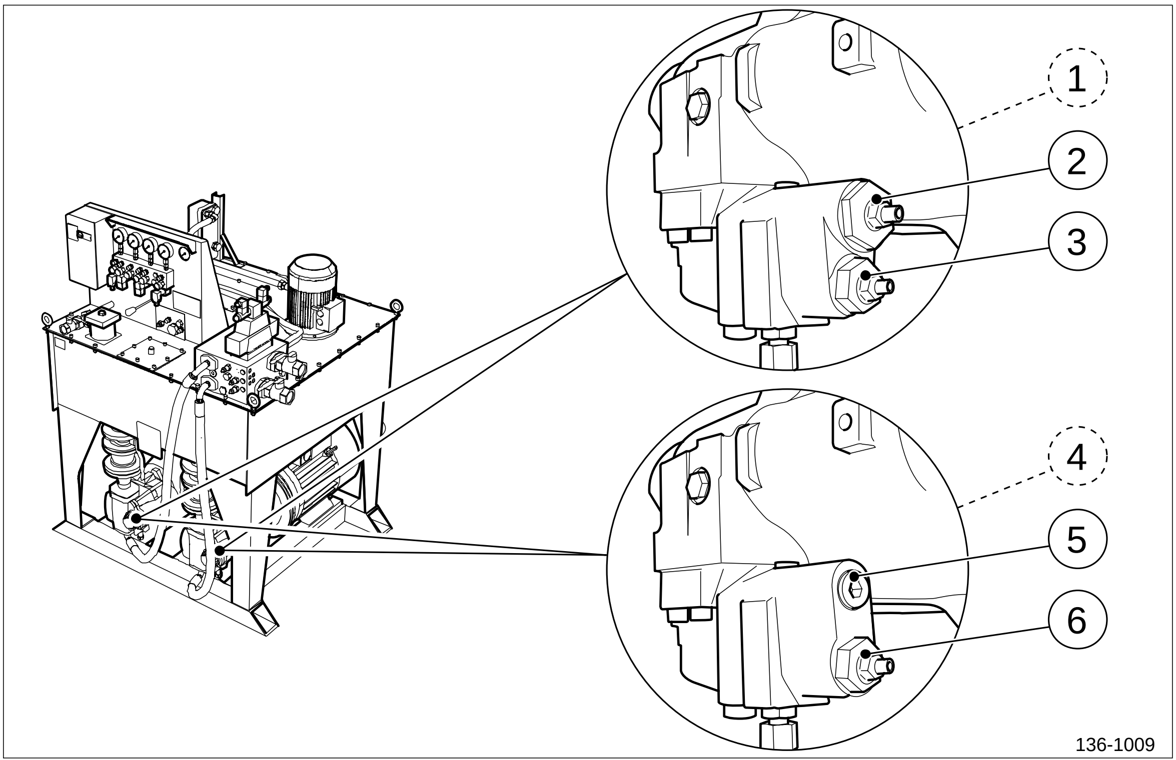

Figure 3 Hydraulic power pack.

1. For pumps: PVM057, 063, 074, 081, 098, 106, 131, 141
2. Pressure regulator
3. Load sensing regulator
4. For pumps: PVM018, 020, 045, 050
5. Load sensing regulator
6. Pressure regulator

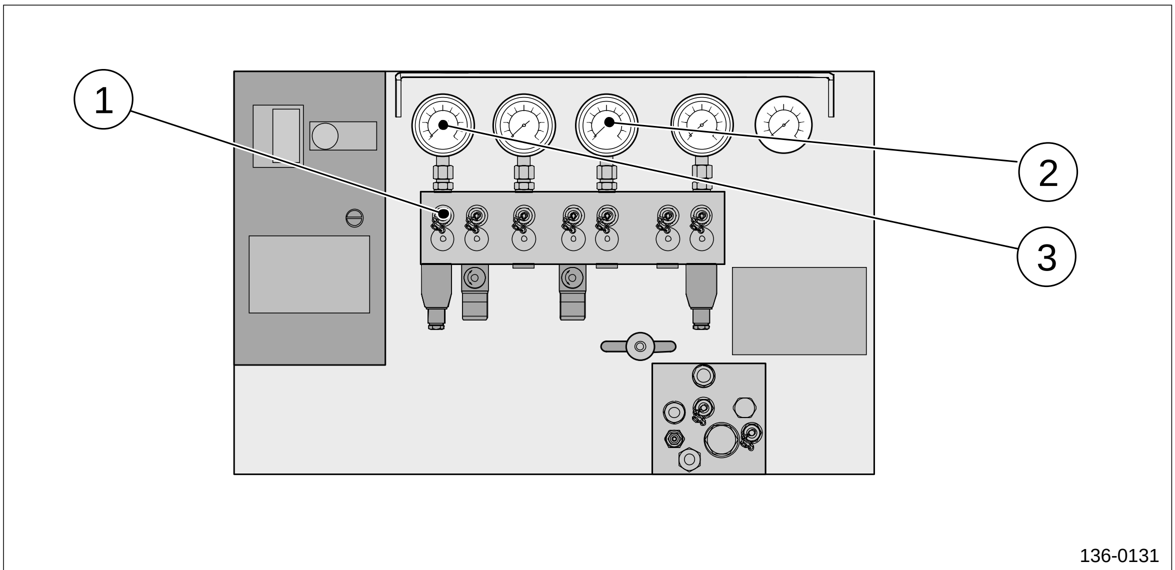

Figure 4 Oil pressure gauges located on the hydraulic power pack control panel.

1. Test nipple TP3
2. Gauge G4: B port - ahead working pressure
3. Gauge G1: system pressure

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

The valve to be replaced is located on the valve manifold. All valves on the valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the hydraulic system

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off all pump units except the static pressure pump unit P3.
4. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.
5. Close the shut-off valves V39 and V40 (see figure 1).
6. Manoeuvre the directional proportional control valve V3 (see figure 1) by hand in both ahead and astern direction.

7. If applicable, manoeuvre directionalon/off control valve V2 by hand in both ahead and astern direction to depressurize the hydraulic system.

8. Connect a hose with test connection to test nipple TP3 (pos 3, figure 4). Note that when the hose is connected to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil. Dispose the collected oil according to local regulations.

Replace the valve V1

9. Locate the relief valve V1 (pos 2, figure 1).

10. Clean the area around valve V1.

11. Loosen and remove valve V1.

12. Replace and fit the new valve V1.

Adjust and test the function of the new valve V1

13. Adjust and test the function of the new valve V1:

    13.1. Start one of the main pump units.

    13.2. Loosen the lock nut on the adjusting screw on valve V1 and set the pressure setting to a value which is lower than the pump output pressure.

    13.3. Manoeuvre the directional proportional control valve V3 by hand in ahead direction.

    13.4. Carefully increase the pressure by turning the pressure regulator (see figure 3) clockwise.

    13.5. Use the adjusting screw on valve V1 to set the pressure setting to the value stated on the Hydraulic Diagram drawing. Check pressure on gauge G1 (pos 2, figure 4).

    13.6. Decrease the pressure by turning the pressure regulator counter clockwise. Set the pressure according to the Hydraulic Diagram drawing.

    13.7. Manoeuvre directional proportional control valve V3 in ahead direction. Check the pressure on gauge G4 (pos 1, figure 4) and make sure that the value corresponds with the maximum pump pressure, stated on the Hydraulic Diagram drawing.

    13.8. Manoeuvre back to Zero pitch.

    13.9. Turn off the pump unit.

14. Open the shut-off valves V39 and V40.

15. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.

16. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Relief Valve V8

Description

This task describes how to replace the pressure relief valve V8 on the valve manifold.

Support Items

Spare Part Name	Qty
Pressure relief valve V8	1

Special Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

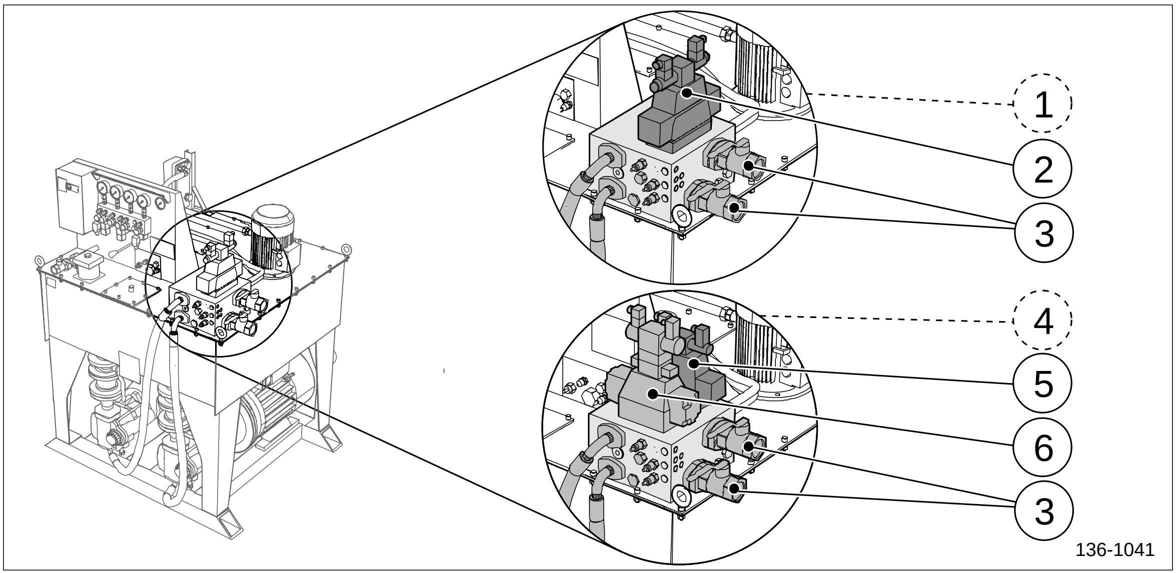

Figure 1 The valve manifold on the hydraulic power pack.

1. Valve manifold on power packs size 150-300 litres
2. Directional proportional control valve V3
3. Shut-off valve V39 and V40
4. Valve manifold on power packs size 500-1000 litres
5. Directional proportional control valve V3
6. Directional on/off control valve V2

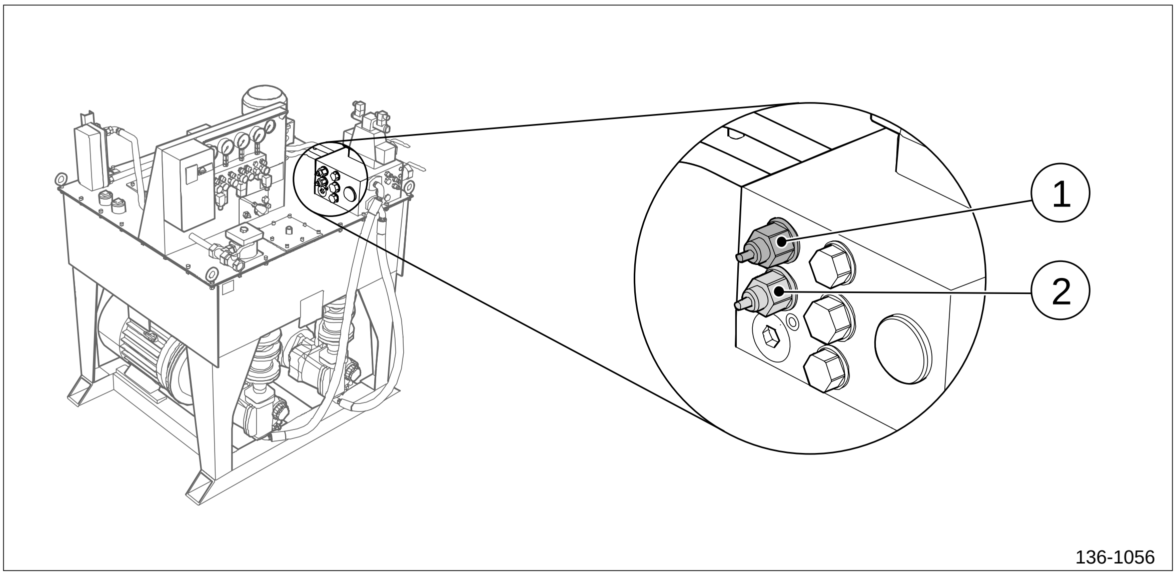

Figure 2 The hydraulic power pack unit.

1. Pressure relief valve V8
2. Pressure relief valve V1

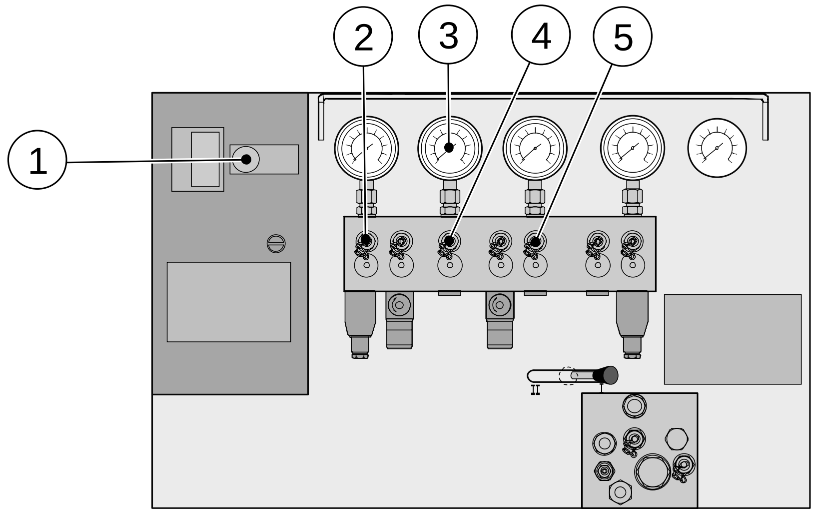

Figure 3 Control panel on the hydraulic power pack.

1. Local/remote switch
2. Test nipple TP3
3. Gauge G3
4. Test nipple TP4
5. Test nipple TP5

Warning: Turn off the main engine(s) before starting the procedure.

Warning: Turn off and secure the propulsion system before starting the procedure.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Take the necessary action to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

The valve to be replaced is located on the valve manifold. All valves on the valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the hydraulic system

1. Turn off the main engine(s).
2. Set the pump units to local mode.
3. Turn off all pump units except the static pressure pump unit P3.
4. Close shut-off valve V39 and V40 (see figure 1).
5. Set the local/remote switch (pos 1, figure 3) on the hydraulic power pack control panel to LOCAL CONTROL.
6. Manoeuvre the directional proportional control valve V3 (see figure 1) by hand in both ahead and astern direction.
7. If applicable, manoeuvre directional on/off control valve V2 by hand in both ahead and astern direction to depressurize the hydraulic system.
8. Connect a hose with test connection to test nipple TP5 (pos 5, figure 3). Note that when the hose is connected to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil.
9. Manoeuvre directional control valves V3 and V2 by hand in both the ahead and astern direction.
10. Connect a hose with test connection to the test nipple TP3 (pos 2, figure 3). Note that oil will flow out and release the last pressure. Disconnect the hose and repeat this procedure on the test nipples TP4 and TP5 (pos 4 and 5, figure 3). Dispose the collected oil according to local regulations.

Replace the valve

11. Locate prssure relief valve V8 (pos 1, figure 2) on the valve manifold.
12. Clean the area around valve V8.
13. Loosen and remove valve V8.
14. Replace and tighten the new valve V8.

Test function of pressure relief valve V8

15. Start the main pump unit.
16. Manoeuvre the directional proportional control valve V3 by hand in astern direction.
17. Check the pressure on the pressure gauge G3 (pos 3, figure 3). If the pressure is not in accordance with the pressure value stated for valve V8 on the Hydraulic

Diagram drawing, the valve V8 has to be adjusted.

Adjust the new valve V8

17.1. Start one of the main pump units.

17.2. Loosen the lock nut on the adjusting screw on valve V8 and set the pressure setting to a low value.

17.3. Manoeuvre the directional control valve V3 by hand in astern direction. If necessary, increase the pressure setting of valve V8.

17.4. Use the adjusting screw on valve V8 to set the pressure setting to the value stated in the hydraulic diagram drawing.

17.5. Lock the adjusting screw on valve V8 by tightening the locking nut.

18. Open shut-off valve V39 and V40.

19. Manoeuvre the directional control valve V3 until “Zero pitch” is reached and then back to mechanical end position astern once again.

20. Check the pressure on gauge G3 and make sure that the value is in accordance with the pressure value stated for valve V8 on in the hydraulic diagram drawing.

21. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.

22. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Relief Valve V14

Description

This task describes how to replace the pressure relief valve V14 on the emergency valve manifold.

The pressure relief valve V14 on the emergency valve manifold must be replaced if it is malfunctioning, to ensure the safety and functions of the hydraulic system.

Support Items

Spare Part Name	Qty
Pressure relief valve V14	1

Special/Additional Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.
Pressure test gauge (0-10 MPa) with Minimess connection 16x2	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

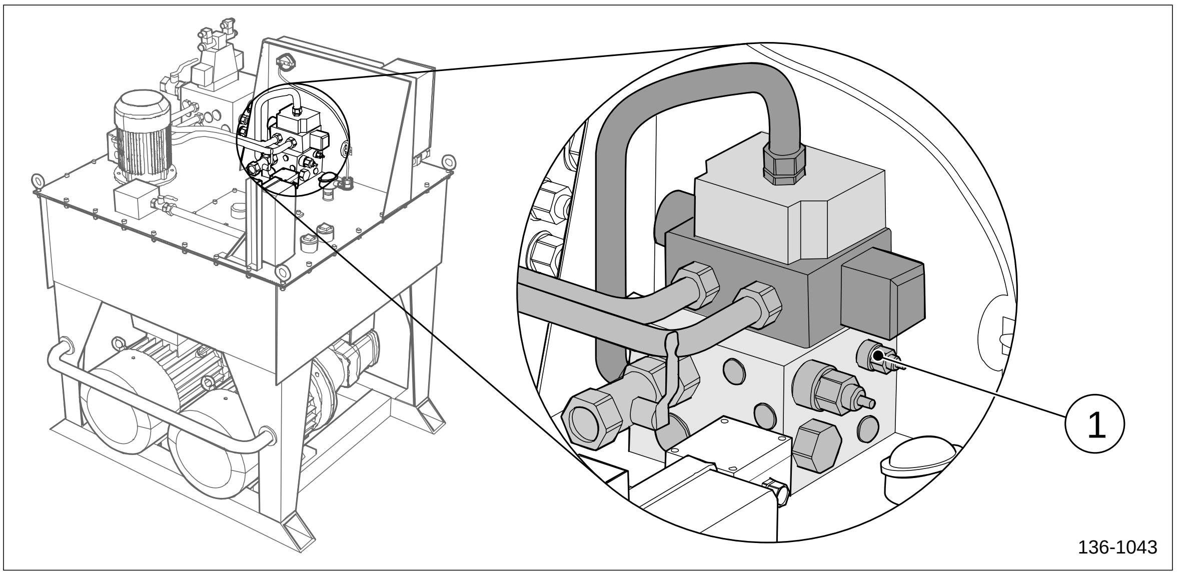

Figure 1 The emergency valve manifold is positioned on the back of the hydraulic power pack.

1. Pressure relief valve V14

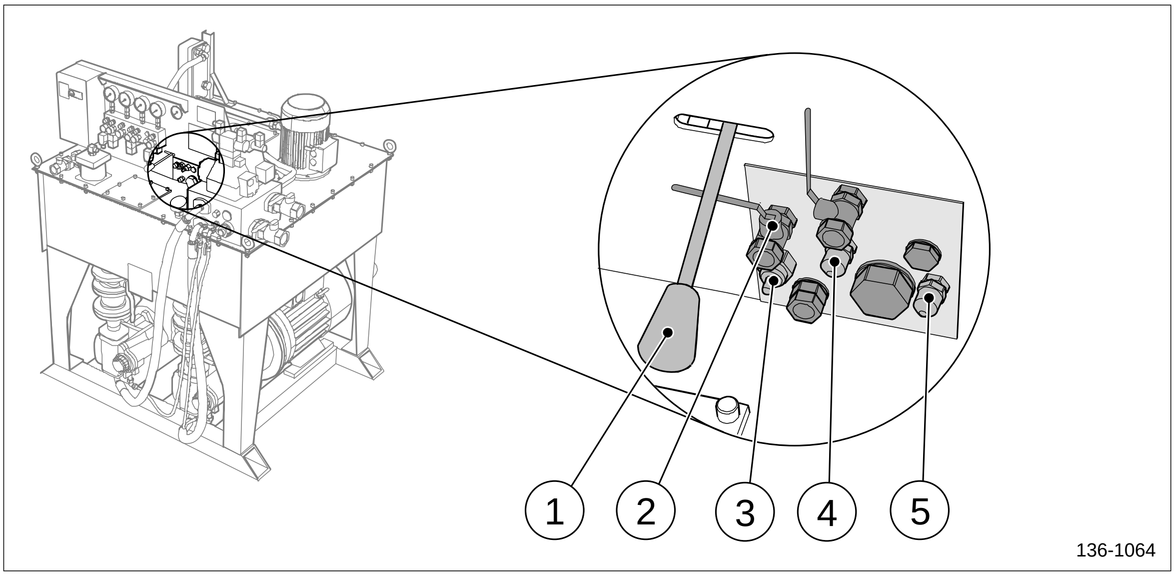

Figure 2 The emergency operating control panel on the hydraulic power pack unit.

1. Emergency control valve V12 lever
2. Shut-off valve V25
3. Needle valve V16
4. Test nipple P3T
5. Test nipple TP7

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

The valve to be replaced is located on the emergency valve manifold. All valves on the emergency valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the hydraulic system

1. Turn off the main engine(s) and lock the shaft.
2. Set the pump units to local control.
3. Turn off all pump units.
4. Close the shut-off valves V39 and V40.
5. Turn the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

6. Open, if the vessel is equipped with a gravity tank, the shut-off valve V25 (pos 2, figure 2) and drain the oil from the gravity tank into the hydraulic power pack tank. This will reduce the static pressure.
7. Turn the emergency control valve V12 lever (pos 1, figure 2) to emergency control I ahead and astern positions and then to emergency control II position and finally back to normal position.
8. Connect a hose with test connection to the test nipple TP7 and P3T (pos 5 and 4, figure 2). Note that when the hose is attached to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil. Dispose the collected oil according to local regulations.
9. Disconnect the hose from the test nipple.

Replace the valve V14

10. Locate relief valve V14 (pos 1, figure 1).
11. Loosen and remove valve V14.
12. Replace and tighten the new valve V14.
13. Close, if the vessel is equipped with a gravity tank, the shut-off valve V25.

Adjust and test function of the new valve

14. Start the hydraulic pumps.
15. Connect a pressure test gauge to the test nipple P3T.
16. Turn emergency control valve V12 lever to emergency control II position.
17. Loosen the lock nut on the adjusting screw on valve V14 and set the pressure setting to a low value.
18. Use the adjusting screw on valve V14 to set the pressure setting to the value stated on the hydraulic diagram drawing. Check the pressure on the pressure test gauge connected to P3T.
19. Lock the adjusting screw by tightening the lock nut.
20. Turn emergency control valve V12 lever to normal position.
21. Turn emergency control valve V12 lever to emergency control II position. Check the value on the pressure test gauge connected to P3T and compare it with the value stated for valve V14 on the Hydraulic Diagram drawing.
22. Turn emergency control valve V12 lever to normal position.
23. Open shut off valves V39 and V40.
24. Disconnect the pressure test gauge.
25. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
26. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Emergency Control Valve V12

Description

This task describes how to replace the emergency control valve V12.

Support Items

Spare Part Name	Qty
Emergency control valve V12	1

Special Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2.	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

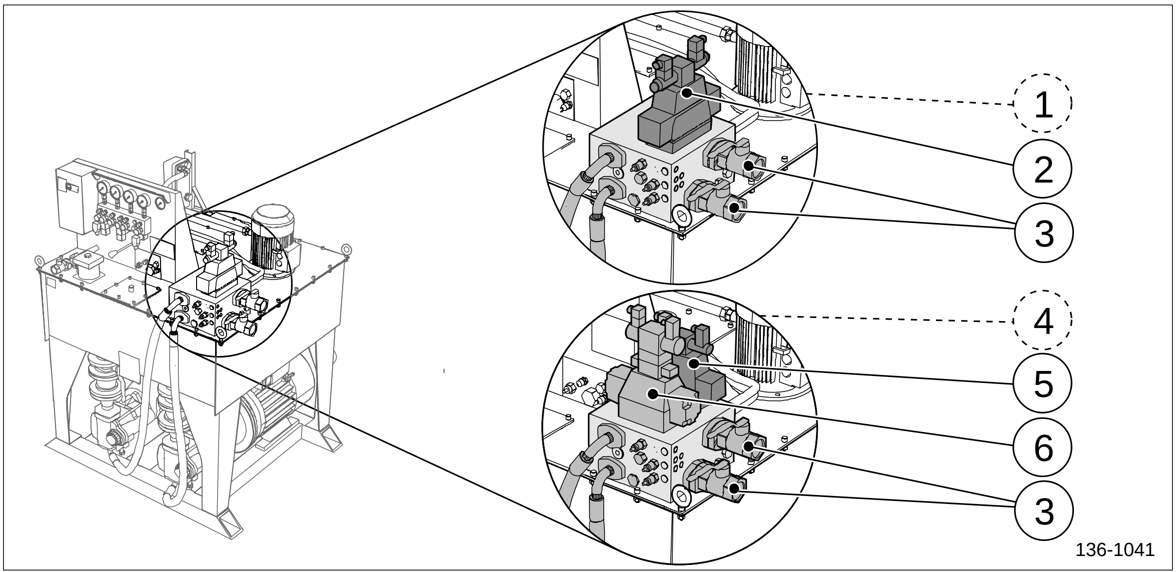

Figure 1 The valve manifold on the hydraulic power pack.

1. Valve manifold on power packs size 150-300 litres
2. Directional proportional control valve V3
3. Shut-off valve V39 and V40
4. Valve manifold on power packs size 500-1000 litres
5. Directional proportional control valve V3
6. Directional on/off control valve V2

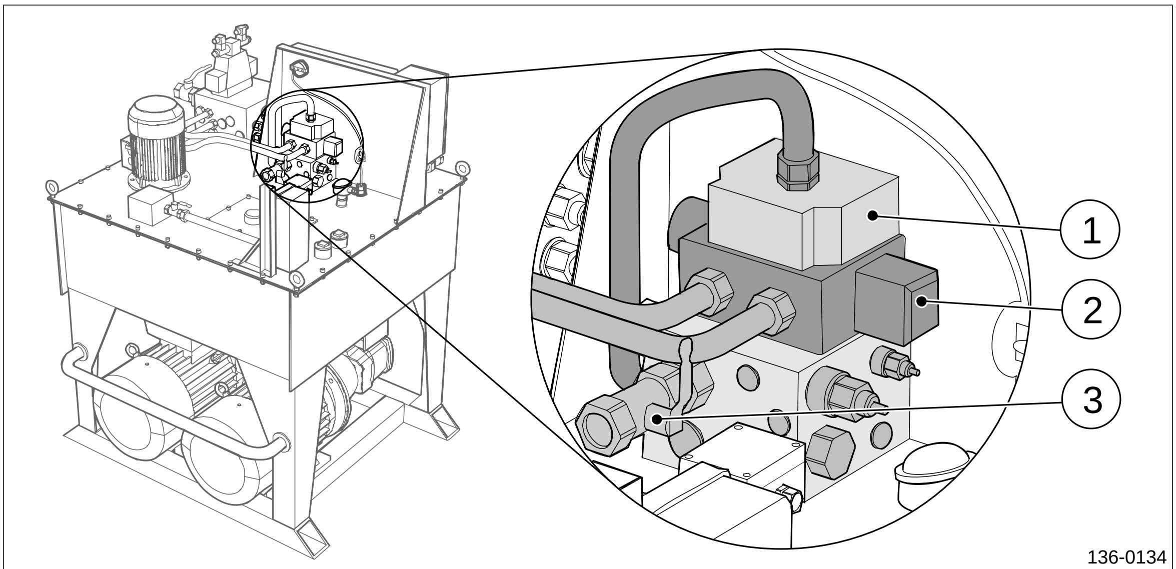

Figure 2 The rear of the emergency valve manifold on the hydraulic power pack unit.

1. Outlet cover emergency control valve V12
2. Emergency control valve V12
3. Shut-off valve V26

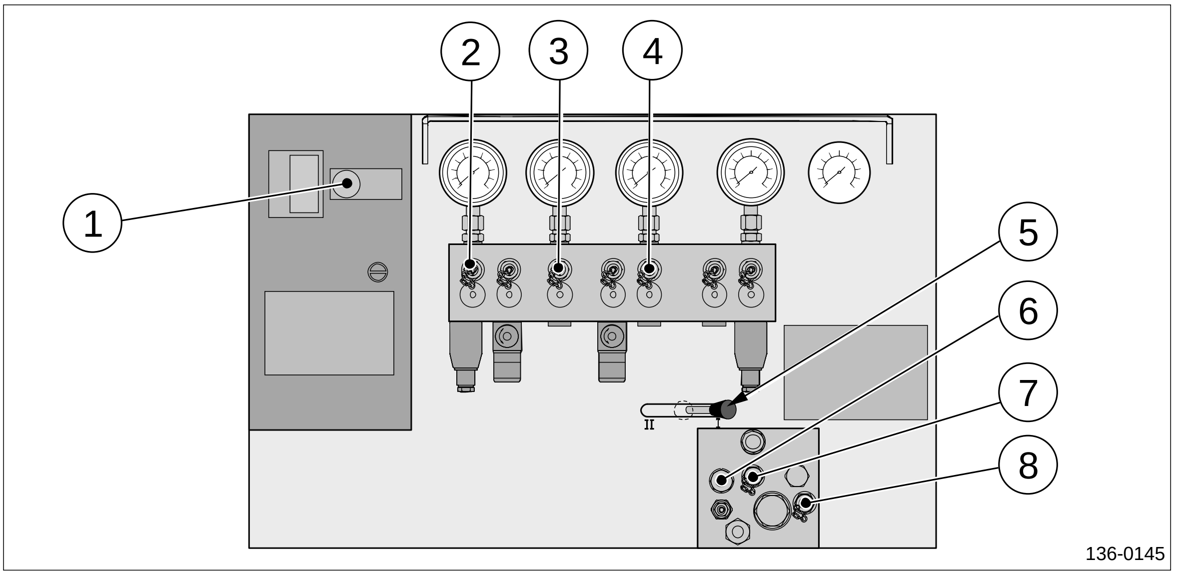

Figure 3 Hydraulic power pack control panel with the emergency manoeuvre panel.

1. Local/remote switch
2. Test nipple TP3
3. Test nipple TP4
4. Test nipple TP5
5. Emergency control valve V12 lever
6. Shut off valve V25
7. Test nipple P3T
8. Test nipple TP7

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure that the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

The valve to be replaced is located on the valve manifold. All valves on the valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the hydraulic system

1. Turn off the main engine(s) and lock the shaft.
2. Set the pump units to local control.
3. Turn off all pump units.
4. Set the local/remote switch on the hydraulic power pack control panel (see figure 3) to LOCAL CONTROL.
5. Close shut-off valves V39 and V40 (see figure 1).
6. Close shut-off valve V26 (see figure 2).
7. Open, if the vessel is equipped with a gravity tank, the shut-off valve V25 (see figure 3) on the hydraulic power pack and drain the oil in the gravity tank into the hydraulic power pack tank.
8. Manoeuvre the directional proportional control valve V3 (see figure 1) by hand in both ahead and astern direction.
9. Manoeuvre, if applicable, the directional on/off control valve V2 (see figure 1) by hand in both ahead and astern direction.
10. Connect a hose with test connection to test nipple TP3 (see figure 3). Note that when the hose is connected to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil.
11. Disconnect the hose and repeat this procedure on the test nipples TP4 and TP5 (see figure 3).
12. Manoeuvre the emergency control valve V12 lever (see figure 3) from normal position to Emergency Control I ahead and astern positions and then to Emergency Control II position and finally back to normal position again.
13. Connect a hose with test connection to the test nipple P3T (see figure 3). Note that oil will flow out and release the last pressure. Take proper measures to collect the oil.
14. Disconnect the hose and repeat this procedure on the test nipple TP7 (see figure 3). Dispose the collected oil according to local regulations.

Replace the emergency control valve V12

15. Locate the emergency control valve V12 (see figure 2).
16. Clean the area around the valve V12.
17. Loosen and remove the lever from the emergency control valve V12.
18. Disconnect the piping connected to the emergency control valve V12.
19. Remove the outlet cover (see figure 2) of the emergency control valve V12.
20. Loosen and remove the screws which fasten the emergency control valve to the valve manifold.
21. Remove the emergency control valve V12 from the emergency valve manifold.
22. Install the new emergency control valve V12 on the emergency valve manifold. Make sure that the seal is correctly fitted.
23. Refit the screws of the emergency control valve V12.
24. Tighten the screws in a cross-pattern.
25. Connect the lever to the new emergency control valve V12.
26. Install the outlet cover of emergency control valve V12.
27. Connect the piping to the emergency control valve V12.
28. Make sure that the seal on the new valve seals properly. If oil is leaking, make sure that the valve and the seal are correctly installed.

Test the function of the new emergency control valve V12

29. Close, if the vessel is equipped with a gravity tank, the shut off valves V25.
30. Open shut-off valve V26.
31. Open the shut-off valves V39 and V40.
32. Test the function of the new valve V12 according to instructions in Task: Test the Emergency Operating System.
33. Test the function of the propulsion system in order to verify that the new valve is in operation.
34. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
35. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Maintaining Valve V11

Description

This task describes how to replace the pressure maintaining valve V11 on the emergency valve manifold.

Support Items

Spare Part Name	Qty
Pressure maintaining valve 11	1

Special Tools and Test Equipment	Qty
Container to collect oil	As req.
Hose with test connection Minimess 16x2	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

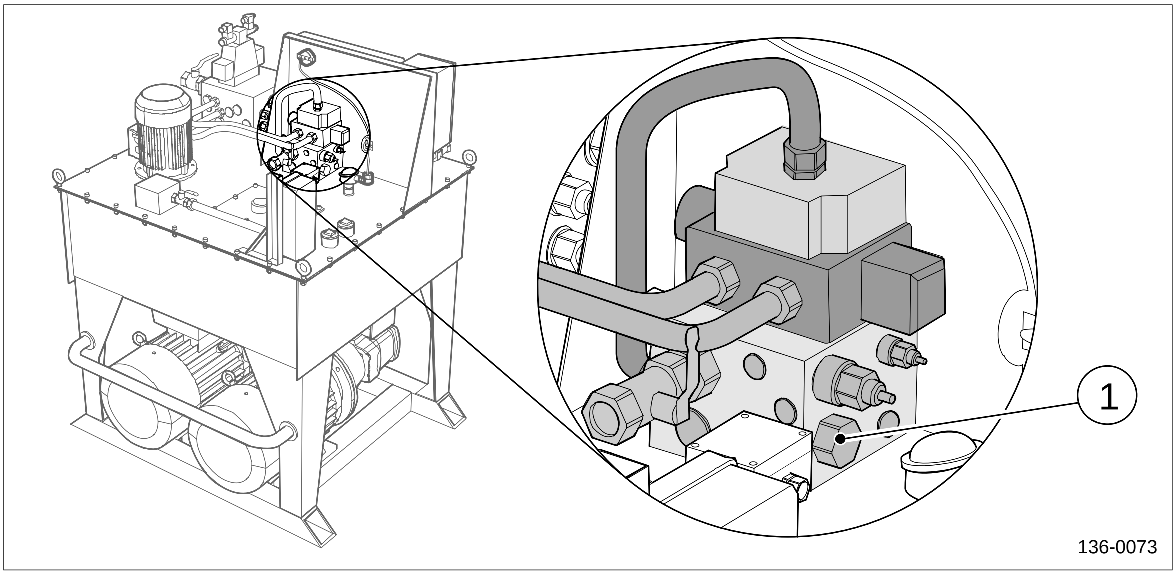

Figure 1 The emergency valve manifold is positioned on the hydraulic power pack.

1. Pressure maintaining valve V11

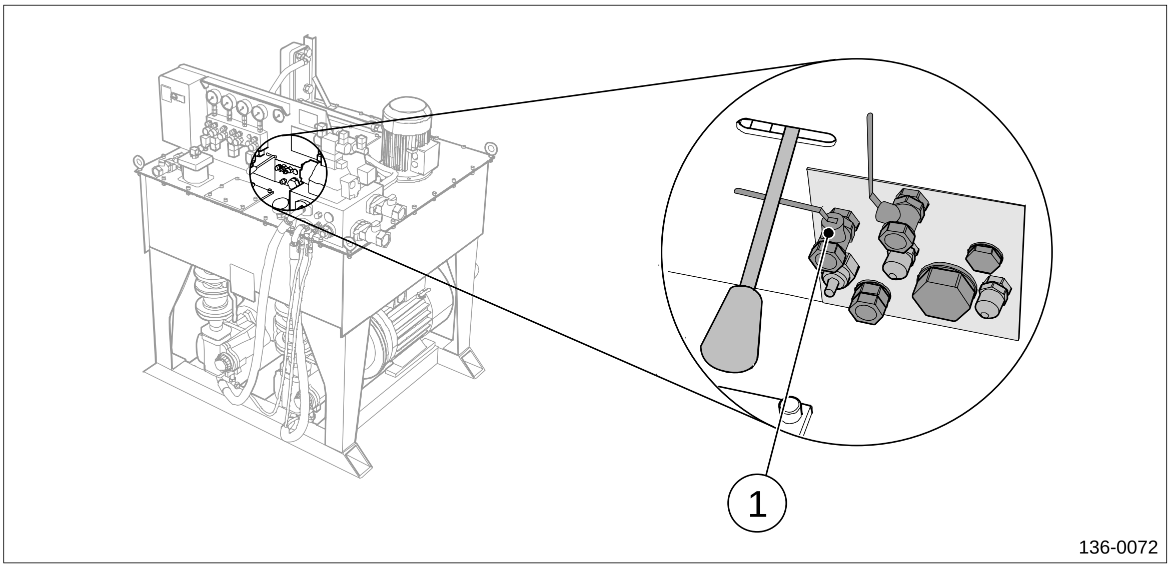

Figure 2 The emergency operating control panel on the hydraulic power pack unit.

1. Shut-off valve V25

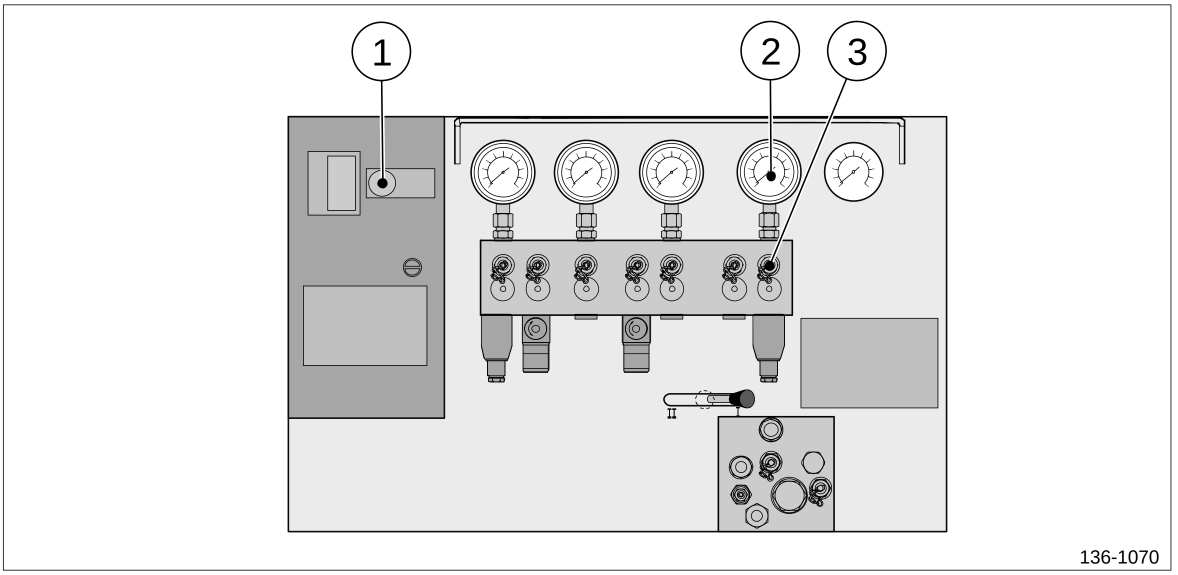

Figure 3 Control panel on the hydraulic power pack.

1. Local/remote switch
2. Gauge G5
3. Test nipple TP6

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure that the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

The valve to be replaced is located on the emergency valve manifold. All valves on the emergency valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the hydraulic system

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off all pump units.
4. Set the local/remote switch (pos 1, figure 3) on the hydraulic power pack control panel to LOCAL CONTROL.
5. Open, if the vessel is equipped with a gravity tank, the shut-off valve V25 (pos 1, figure 2) and drain the oil in the gravity tank into the hydraulic power pack tank. This will reduce the static pressure.
6. Connect a hose with test connection to the test nipple TP6 (pos 3, figure 3). Note that when the hose is attached to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil. Disconnect the hose when the pressure is released. Dispose the collected oil according to local regulations.

Replace the valve V11

7. Locate the valve V11 (pos 1, figure 1).
8. Loosen and the valve V11.
9. Fit and tighten the new valve V11.

Test the function of the new valve

10. Close, if the vessel is equipped with a gravity tank, the shut-off valve V25.
11. Test the function of the new valve V11:

    11.1. Start the static pressure pump unit P3.

    11.2. Inspect the pressure on gauge G5 (pos 2, figure 3) and make sure that the value corresponds with the value stated in the hydraulic diagram drawing.

12. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
13. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace By-pass Valve V17 and Check Valve V36

Description

This task describes how to replace the by-pass valve V17 and the check valve V36.

The valves on the return block must be replaced if they are malfunctioning, to ensure the safety and functions of the hydraulic system.

Support Items

Spare Part Name	Qty
By-pass valve V17/V36	1
Check valve V36	1

Special/Additional Tools and Test Equipment	Qty
Container to collect oil	As req.
Pressure test gauge (0-10 MPa) with Minimess connection 16x2	1

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

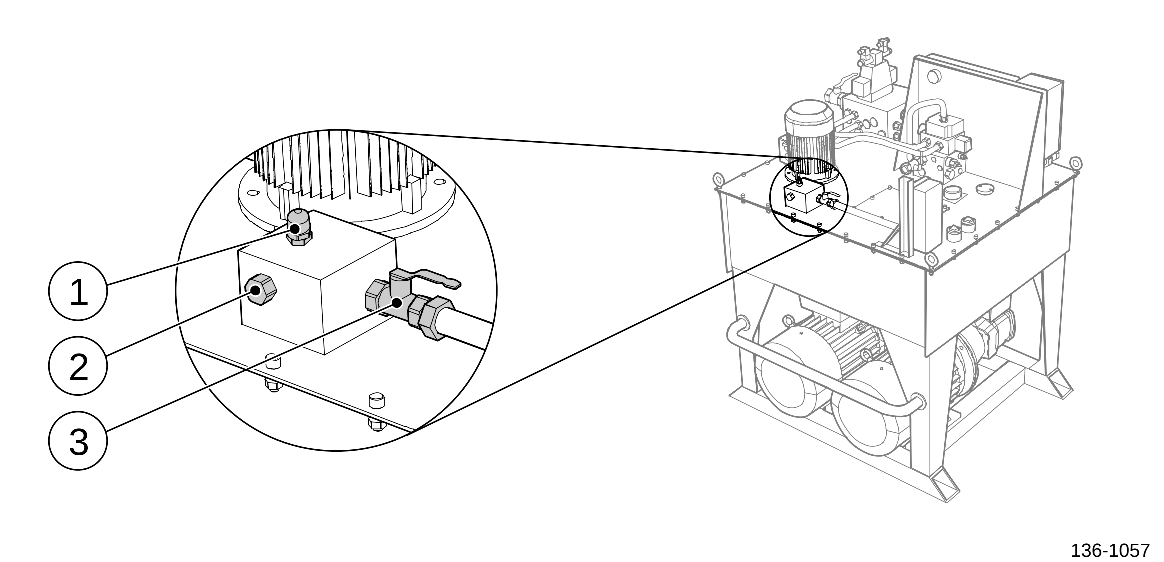

Figure 1 The back of the hydraulic power pack unit.

1. Test nipple TP8
2. Return block with the by-pass valve V17 and check valve V36
3. Shut-off valve V18

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Depressurize the hydraulic system

1. Set the pump units to local control.
2. Turn off all pump units.
3. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

Replace valve V17/V36

4. Locate the valve on the valve manifold (pos 2, figure 1).
5. Clean the area around the valve.
6. Loosen and remove the valve.
7. Replace and tighten the new valve.

Test function of valve V17

8. Start the static pressure circulation pump unit P3.
9. Close shut-off valve V18 (see figure 1).
10. Connect a pressure test gauge to test nipple TP8 (see figure 1) and compare the value on the gauge with the value stated for valve V17 on the hydraulic diagram drawing.
11. Disconnect the pressure test gauge.
12. Open shut-off valve V18.
13. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
14. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Screw-in Valves

Description

This task describes how to replace any of the following valves on the valve manifold on the hydraulic power pack unit:

• Check valve VS1

• Check valve VS2

• Check valve VSPTO (optional)

• Counter balance valve V5 (optional)

• Shuttle valve V6

• Counter balance valve V7

• Check valve VEA (optional)

• Check valve VEB (optional)

The valves on the valve manifold must be replaced if they are malfunctioning, to ensure the safety and functions of the hydraulic system.

Support Items

Spare Part Name	Qty.
Check valve VS1, VS2, and VSPTO	
Counter balance valve V5	
Shuttle valve V6	
Counter balance valve V7	
Check valve VEA, VEB	

Special/Additional Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

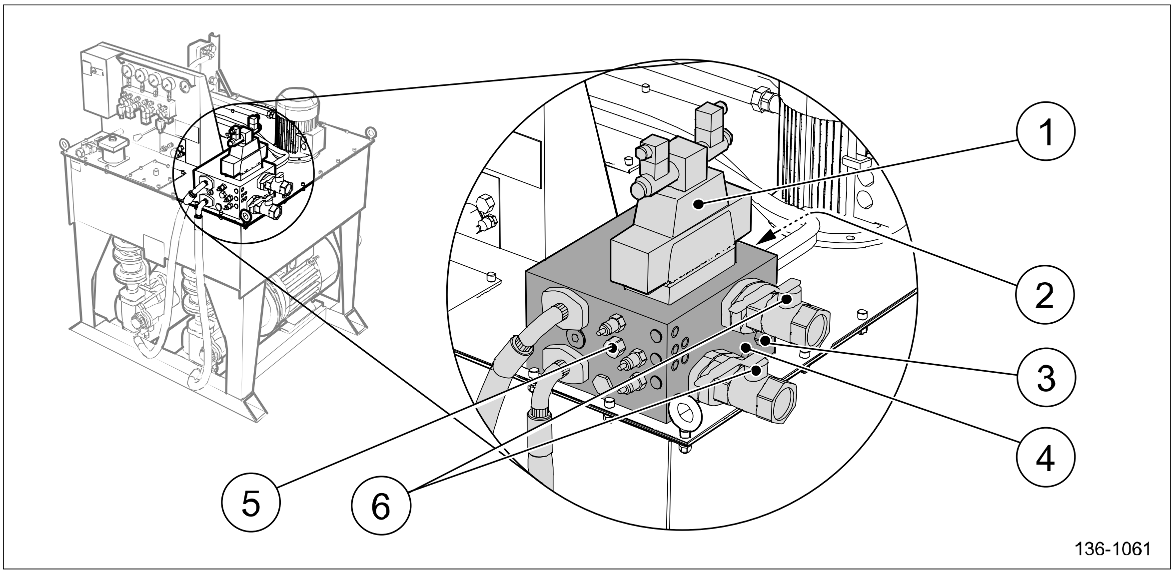

Figure 1 The valve manifold on the hydraulic power pack.

1. Directional proportional control valve V3
2. Counter balance valve V7
3. Check valve VEA
4. Check valve VEB
5. Shuttle valve V6
6. Shut-off valve V39 and V40

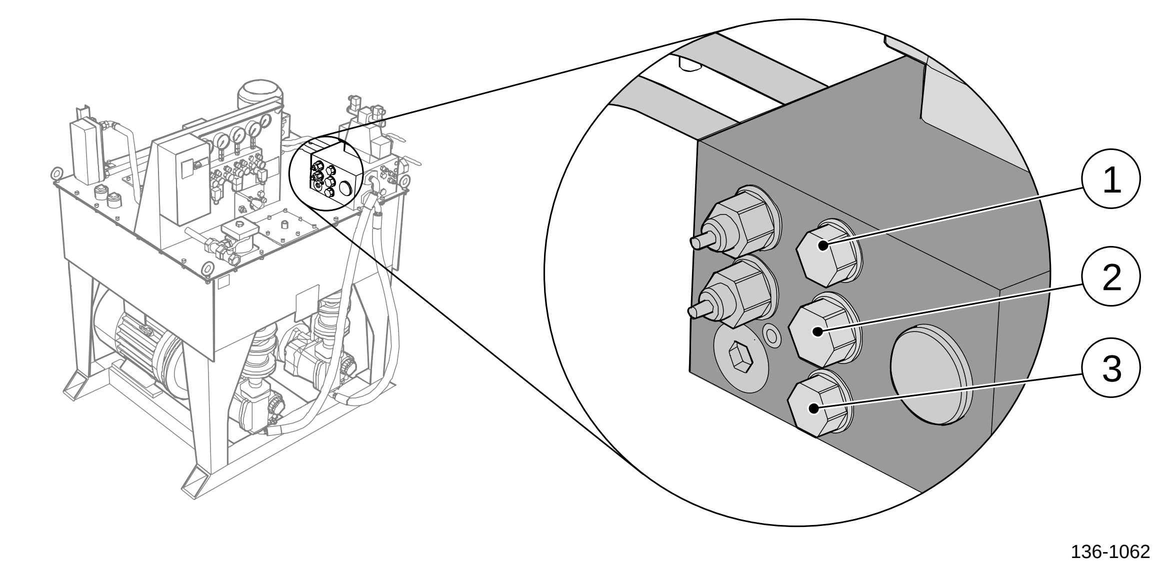

Figure 2 The hydraulic power pack unit.

1. Check valve VS2
2. Check valve VSPTO
3. Check valve VS1

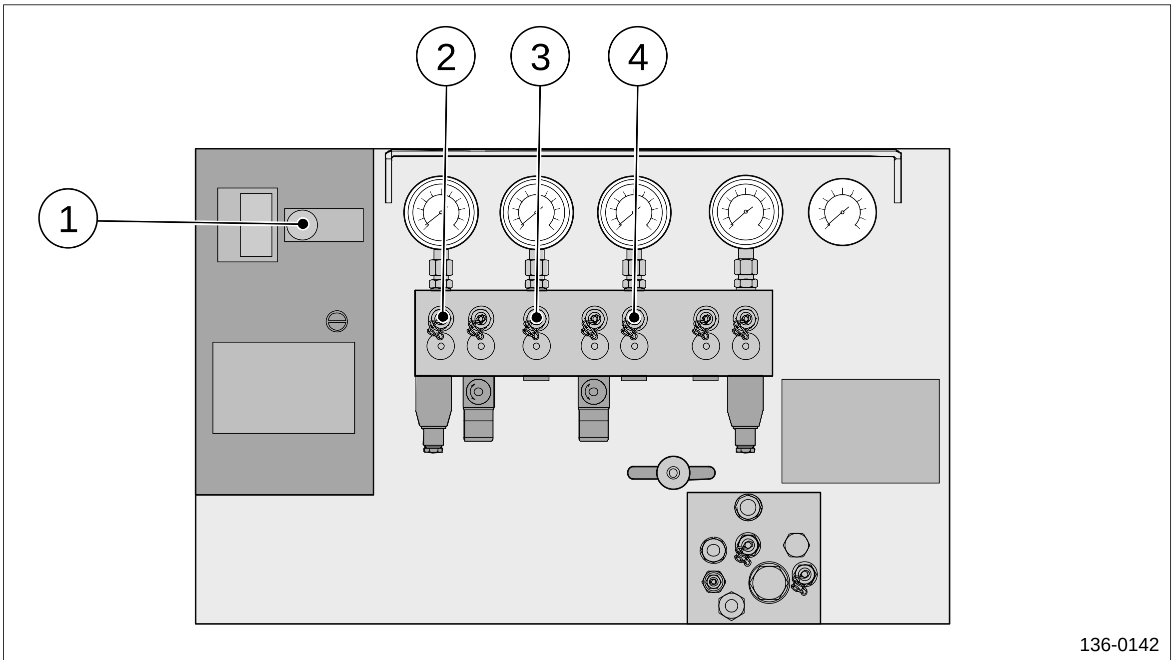

Figure 3 Control panel on the hydraulic power pack.

1. Local/remote switch
2. Test nipple TP3
3. Test nipple TP4
4. Test nipple TP5

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure that the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

The valve to be replaced is located on the valve manifold. All valves on the valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the Hydraulic System

1. Stop the vessel’s main engine(s).
2. Set the pump units to local control.
3. Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.
4. Manoeuvre directional proportional control valve V3 (see figure 1) by hand in both ahead and astern direction.
5. Manoeuvre, if applicable, directional on/off control valve V2 by hand in both ahead and astern direction to depressurize the hydraulic system.

6. Connect a hose with test connection to test nipple TP3 (pos 5, figure 3). Note that when the hose is attached to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil.
7. Disconnect the hose and repeat this procedure on the test nipples TP5 and TP4 (see figure 3). Dispose the collected oil according to local regulations.
8. Manoeuvre directional proportional control valve V3 (and V2 if applicable) once again by hand in both the ahead and astern direction.

Replace the valve

9. Locate the valve to be replaced.
10. Clean the area around the valve.
11. Loosen and remove the valve.
12. Replace and tighten the new valve.
13. Test the function of the propulsion system in order to verify that the new valve is in operation.
14. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
15. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Needle Valve V16

Description

This task describes how to replace the needle valve V16. If the vessel is equipped with a gravity tank, the new valve V16 has to be adjusted by a Rolls-Royce service expert.

The needle valve V16 on the emergency valve manifold must be replaced if it is malfunctioning, to ensure the safety and functions of the hydraulic system.

Support Items

Spare Part Name	Qty
Needle valve V16	1

Special/Additional Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

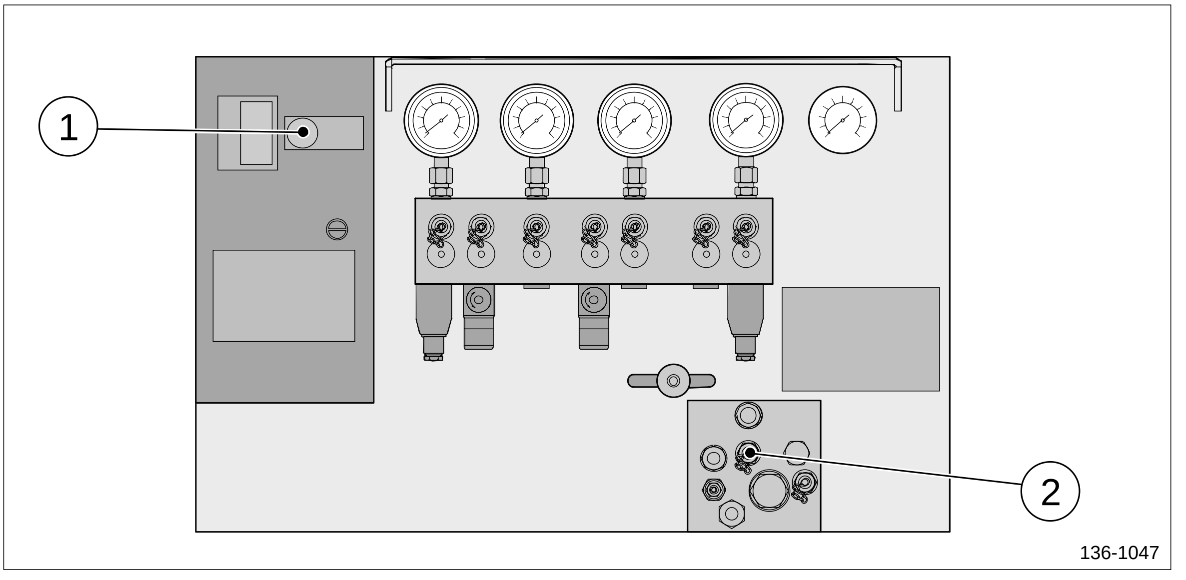

Figure 1 The control panel on the hydraulic power pack unit.

1. Local/remote switch
2. Test nipple P3T

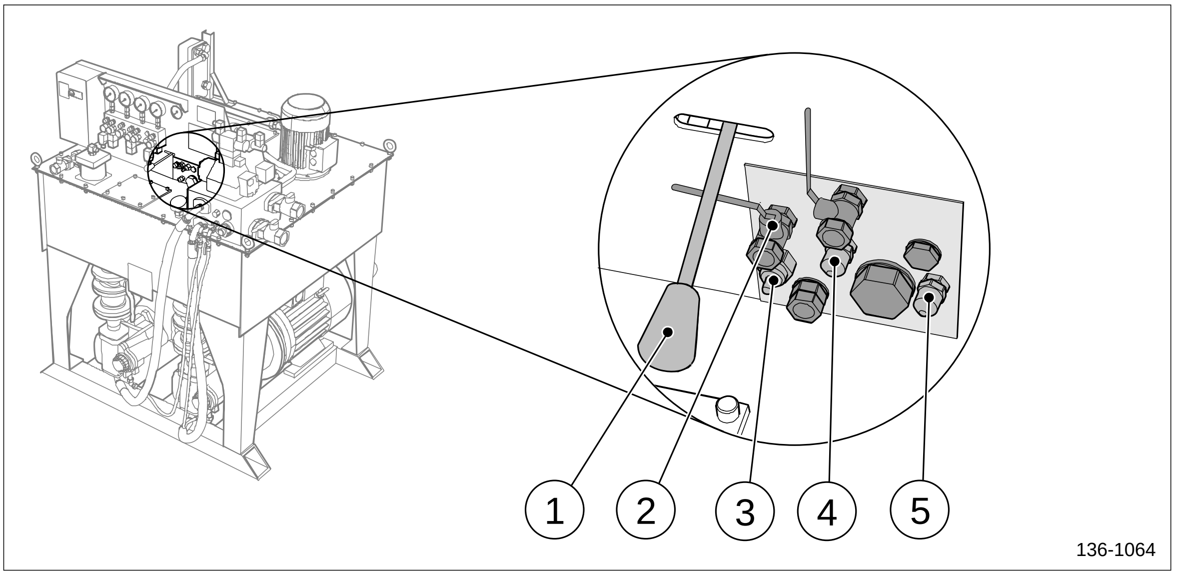

Figure 2 The emergency operating control panel on the hydraulic power pack unit.

1. Emergency control valve V12 lever
2. Shut-off valve V25
3. Needle valve V16
4. Test nipple P3T
5. Test nipple TP7

Warning: Turn off the main engine(s) before starting this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary actions to prevent the pump units from being started by accident.

Caution: Set the local/remote switch on the hydraulic power pack control panel to LOCAL CONTROL.

The valve to be replaced is located on the emergency valve manifold. All valves on the emergency valve manifold are marked by a name plate or the valve name is stamped directly on to the valve manifold.

Depressurize the hydraulic system

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn of all pump units.
4. Set the local/remote switch (pos 1, figure 1) on the hydraulic power pack control panel to LOCAL CONTROL.
5. Open, if the vessel is equipped with a gravity tank, the shut-off valve V25 (pos 2, figure 2) and drain the oil in the gravity tank into the hydraulic power pack tank. This will reduce the static pressure.

6. Turn the emergency control valve V12 lever (pos 1, figure 2) to Emergency Control I ahead and astern positions and then to Emergency Control II position and finally back to normal position.

7. Connect a hose with test connection to the test nipple TP7 and P3T (pos 5 and 4, figure 2). Note that when the hose is connected to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil.

8. Disconnect the hose from the test nipple. Dispose the oil according to local regulations.

Replace the valve V16

9. Locate needle valve V16 (pos 3, figure 2).

10. Unscrew and remove valve V16.

11. Fit and tighten the new valve V16.

12. Close valve V16 (if the vessel is equipped with a gravity tank the valve has to be adjusted by an Rolls-Royce service expert).

13. Close, if the vessel is equipped with a gravity tank, the shut-off valve V25.

Adjust the valve V16 (if the vessel is equipped with a gravity tank)

14. The new valve V16 must be adjusted by an Rolls-Royce service expert before starting up the hydraulic system. Contact Rolls-Royce.

Finishing

15. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.

16. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pressure Valve for By-Pass Cooler V20

Description

This task describes how to replace the pressure valve for the by-pass cooler V20, both during operation and with stopped pump units.

The valve V20 must be replaced if it is malfunctioning, to ensure the safety and functions of the hydraulic system.

Support Items

Spare Part Name	Qty
Pressure valve V20	1

Special/Additional Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.

Reference Documents
Hydraulic Diagram drawing

Consumables	Qty
Linen rags	As req.

Instruction

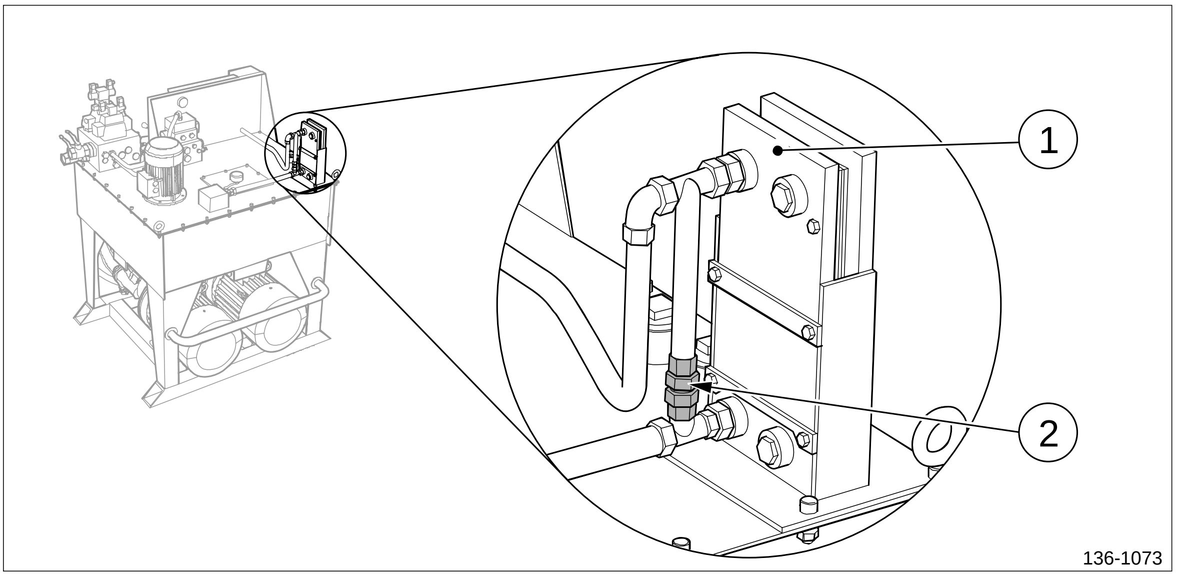

Figure 1 The back of the hydraulic power pack unit.

1. Oil cooler
2. Pressure valve for by-pass cooler V20

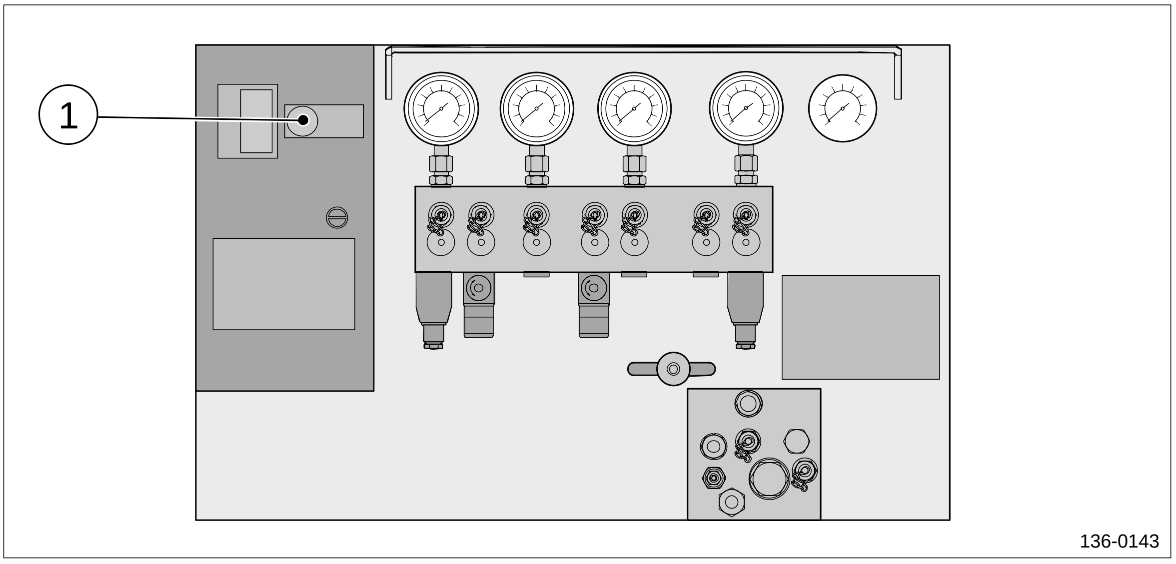

Figure 2 Control panel on the hydraulic power pack.

1. Local/remote switch

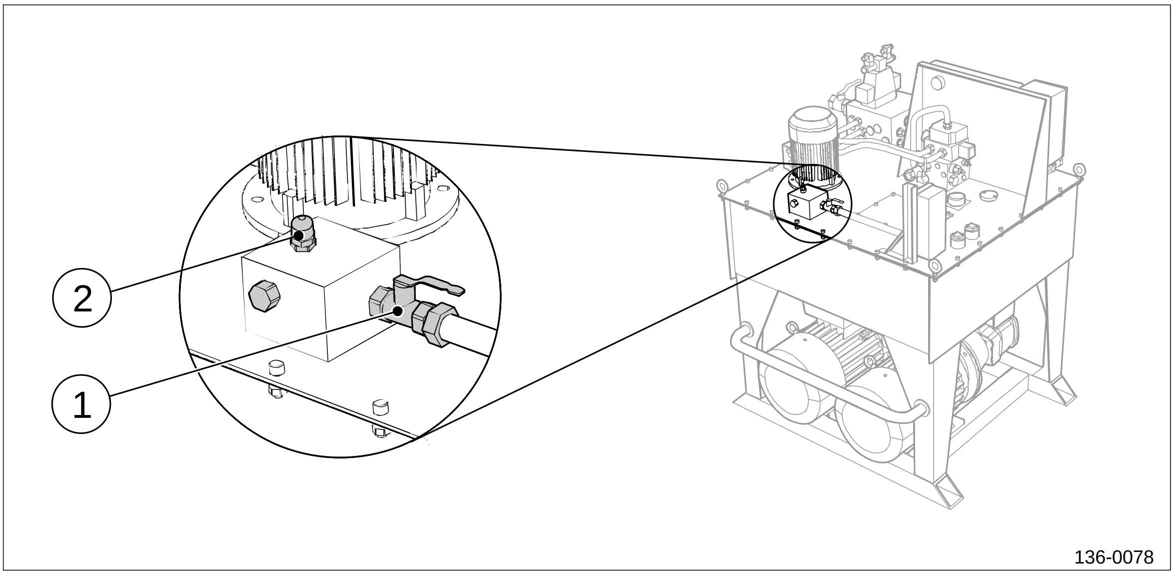

Figure 3 The rear of the hydraulic power pack.

1. Shut off valve V18
2. Test nipple TP8

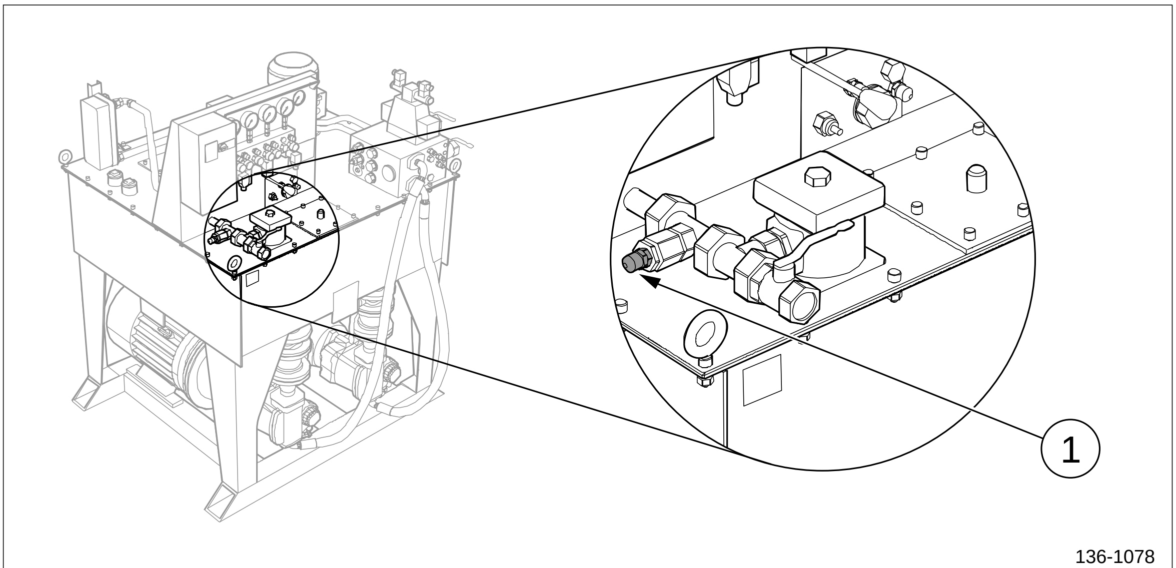

Figure 4 Front side of hydraulic power pack.

1. Test nipple TP9

Replace the Valve V20 with Stopped Pump Units

This procedure is recommended as the first hand choice when replacing the valve V20.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Depressurize the system

1. Set the pump units to local control.
2. Turn off all pump units.
3. Set the local/remote (pos 1, figure 2) switch on the hydraulic power pack control panel to LOCAL CONTROL.
4. Connect a hose with test connection to test nipple TP8 (pos 1, figure 2). Note that when the hose is attached to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil. Dispose the collected oil according to local regulations.

Replace the valve V20

5. Clean the area around valve V20.
6. Unscrew the pipe connections on each side of valve V20 (pos 2, figure 1).
7. Remove the valve V20.
8. Fit the new valve V20 and tighten the pipe connections.
9. Disconnect the hose from test nipple TP8.
10. Make sure that no oil is leaking from the new valve V20. If oil is leaking, make sure that the pipe connections are undamaged and correctly fitted.
11. Test the function of the valve in order to verify that the new valve is in operation.
12. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL
13. Set the pump units to remote control.

This task is now completed.

Replace the Valve V20 During Operation

This procedure is only to be used if it is not possible to change the valve with the hydraulic system shut off.

Warning: Replacing during operation is associated with great risks for personal safety due to rotating shaft.

Depressurize the system

1. Close shut-off valve V18 (see figure 3).
2. Connect a hose with test connection to test nipple TP9 (see figure 4). Note that when the hose is attached to the test nipple, oil will flow out and release the pressure. Take proper measures to collect the oil. Dispose the collected oil according to local regulations.

Replace the valve V20

3. Clean the area around valve V20.
4. Unscrew the pipe connections on each side of valve V20 (pos 2, figure 1).
5. Remove the valve V20.
6. Fit the new valve V20 and tighten the pipe connections.
7. Disconnect the hose from test nipple TP9.
8. Make sure that no oil is leaking from the new valve V20. If oil is leaking, make sure that the pipe connections are undamaged and correctly fitted.
9. Test the function of the valve in order to verify that the new valve is in operation.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pump Unit P1 or P2

Description

This task describes how to replace either one of the pump units P1 or P2.

Support Items

Spare Part Name	Qty
Pump unit P1, P2	1

Special Tools and Test Equipment	Qty
Lifting equipment	As req.
Rubber mallet	1
Hose with test connection Minimess 16x2	2
Container to collect oil	As req.
Pressure test gauge (0-25 MPa) with Minimess connection 16x2	1

Reference Documents
Hydraulic power pack assembly drawing
Hydraulic diagram

Consumables	Qty
Linen rags	As req.

Instruction

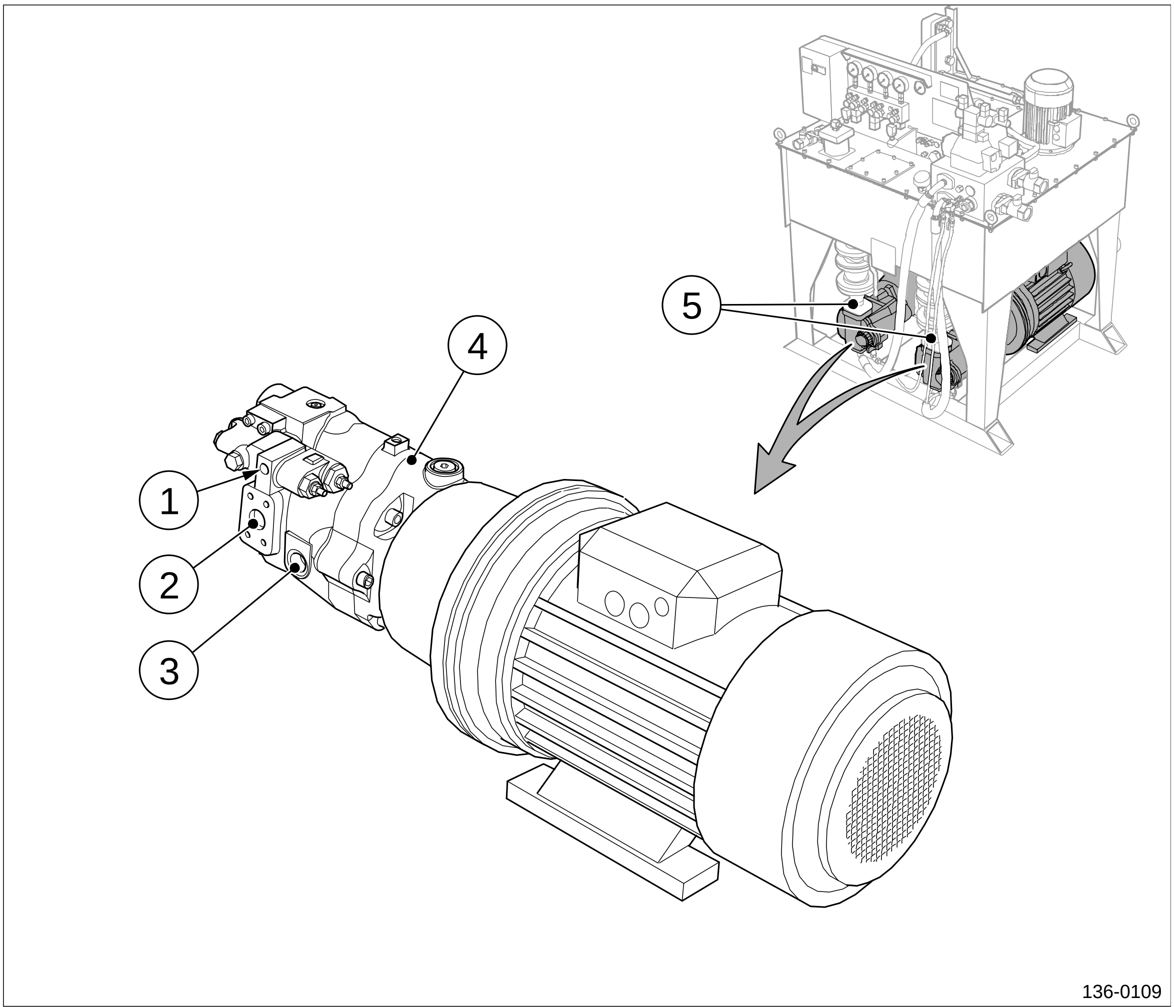

Figure 1 Pump unit.

1. Connection J, load sensing port
2. Outlet (pressure) port
3. Connection F, drain port
4. Pump unit
5. Inlet (suction) port

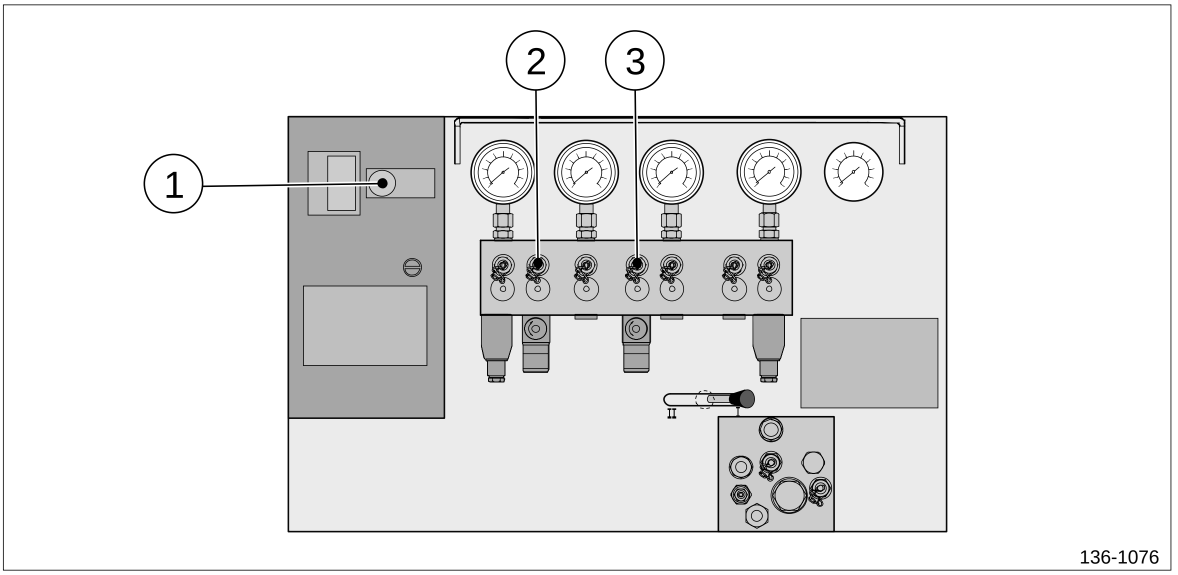

Figure 2 The control panel on the hydraulic power pack unit.

1. Remote/local switch
2. Test nipple TP1
3. Test nipple TP2

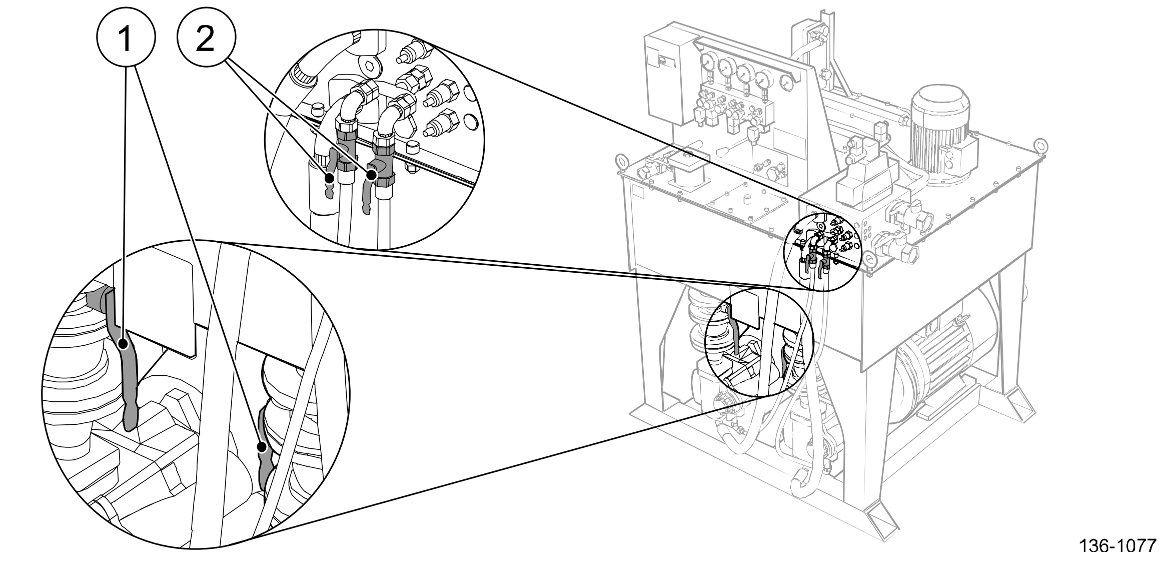

Figure 3 Hydraulic power pack.

1. Shut-off valves P1V and P2V
2. Shut-off valves LSV1 and LSV2

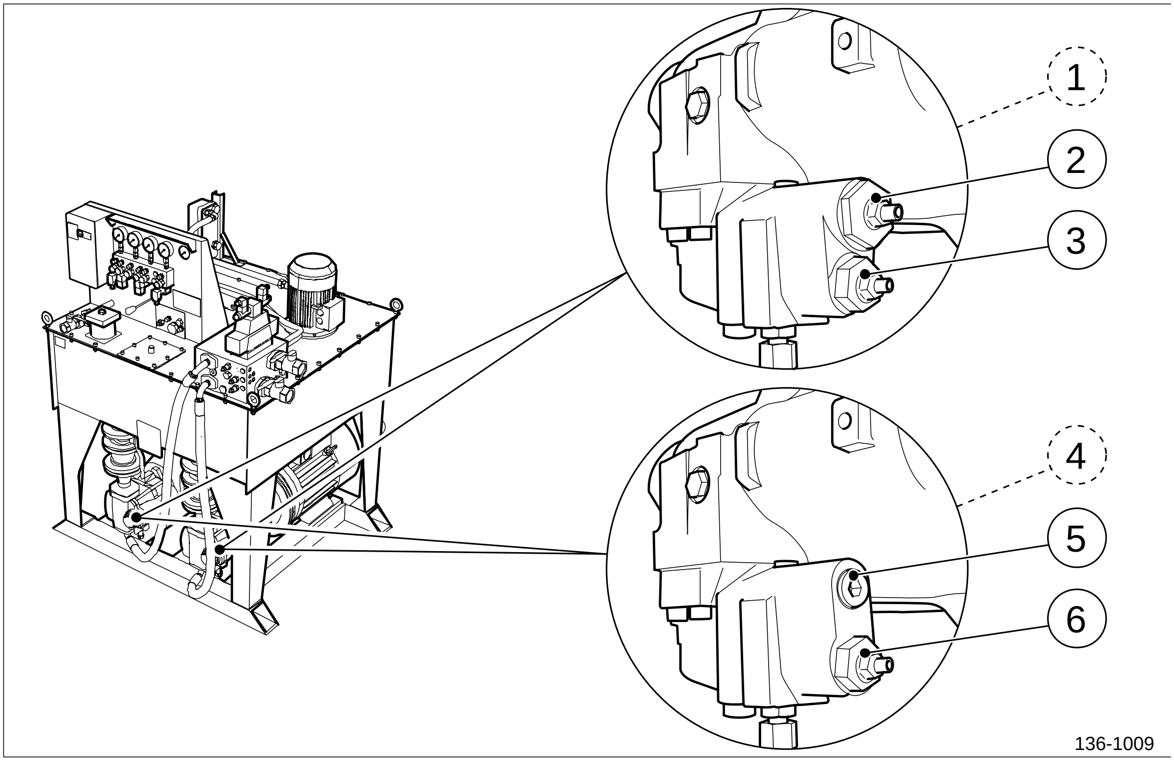

Figure 4 Hydraulic power pack.

1. For pumps: PVM057, 063, 074, 081, 098, 106, 131, 141
2. Pressure regulator
3. Load sensing regulator
4. For pumps: PVM018, 020, 045, 050
5. Load sensing regulator
6. Pressure regulator

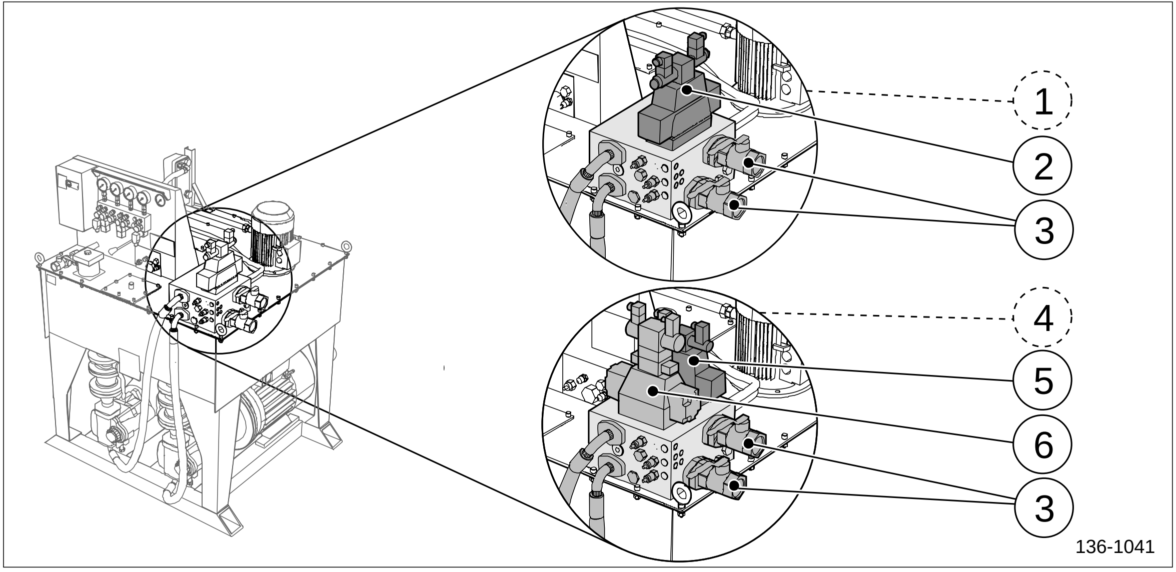

Figure 5 The valve manifold on the hydraulic power pack.

1. Valve manifold on power packs size 150-300 litres
2. Directional proportional control valve V3
3. Shut-off valve V39 and V40
4. Valve manifold on power packs size 500-1000 litres
5. Directional proportional control valve V3
6. Directional on/off control valve V2

Warning: The propulsion system must be turned off and secured the during this task.

Warning: Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.

Caution: Make sure the pump units are set to local control.

Caution: Take the necessary action to prevent the pump units from being started by accident.

Caution: Turn off and make sure the incoming power is disconnected before dismantling.

Caution: Make sure there is enough room to safely lift the pump unit.

Caution: Make sure the new pump is filled with oil before it is started. Otherwise it can seize.

Note: The oil must fulfil the requirements in section Oil Requirements in part Technical Data.

Note: **This task must be performed by a technical engineer.**

Before starting this task

1. Compare the label on the old and the new pump and make sure that the new pump comply with the old one.
2. Set the pump units to local control.
3. Turn off the pump units.
4. Turn off the incoming power.

Depressurize the hydraulic system

5. Close the shut-off valves V39 and V40 (pos 3, figure 5).
6. Manoeuvre directional proportional control valve V3 (see figure 5) by hand in both ahead and astern direction to depressurize the hydraulic system.
7. Connect a hose with test connection to the test nipple TP1 for pump P1 (test nipple TP2 for pump P2.), see figure 2. Oil will flow and release the pressure. Take proper measures to collect the oil.
8. Manoeuvre directional proportional control valve V3 once again by hand in both the ahead and astern direction.

Remove the pump unit

9. Close shut-off valve P1V for pump P1 (P2V for pump P2), see figure 3.
10. Close shut-off valve LSV1 for pump P1 (LSV2 for pump P2), see figure 3.
11. Prepare for collection of the oil which will flow out when the hoses are disconnected in the following steps. Place a suitable container under the pump.
12. Disconnect the hose at the drain port, connection F (pos 3, figure 1).
13. Disconnect the hose at the load sense port, connection J (pos 1, figure 1).
14. Disconnect the main oil pressure hose at the outlet port (pos 2, figure 1).
15. Disconnect the suction hose at the inlet port (pos 5, figure 1).
16. Disconnect the cables to the electric motor.
17. Loosen and remove the screws which hold the pump unit in place.
18. Carefully lift out the pump.

Install the new pump unit

19. Carefully lift the new pump unit into position on the hydraulic power pack.
20. Refit and tighten the screws which hold the pump in place.
21. Connect the cables to the electric motor.
22. Connect the suction hose to the inlet port (pos 5, figure 1).
23. Connect the main oil pressure hose to the outlet port (pos 2, figure 1).
24. Connect the hose to the load sense port, connection J (pos 1, figure 1).
25. Fill the pump with purified oil through the drain port. The oil must meet the recommendations in document Requirements for Lubricating Oil.
26. Connect the hose to the drain port, connection F (pos 3, figure 1).

Test function of the pump

27. Turn on incoming power.
28. Turn on the pump unit to be tested.
29. Open shut-off valve P1V for pump P1 (P2V for pump P2).
30. Open shut-off valve LSV1 for pump P1 (LSV2 for pump P2).
31. Manoeuvre directional proportional control valve V3 by hand in ahead direction.
32. Connect a pressure test gauge to test nipple TP1 and check that the pressure is in accordance with the pressure value stated on the Hydraulic Diagram drawing. If necessary adjust the pressure by adjusting the pressure regulator on the pump.
33. Manoeuvre the directional proportional control valve V3 by hand to neutral position (not actuated).
34. Open shut-off valves V39 and V40.
35. Disconnect the pressure test gauge.
36. Dispose the collected oil according to local regulations.

Adjust the pressure by adjusting the pressure regulator

1. Close shut-off valves V39 and V40.
2. Manoeuvre the directional proportional control valve V3 by hand in ahead direction. Keep the valve V3 actuated during the adjustment of the pressure regulator.
3. Adjust the pressure regulator (see figure 4) to desired value. Turn the pressure regulator counter clockwise to lower the pressure and clockwise to increase it.
4. Manoeuvre the directional proportional control valve V3 by hand to neutral position (not actuated).
5. Open shut-off valves V39 and V40.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Pump Unit P3

Description

This task describes how to replace the static pressure pump unit P3. Pump unit P3 is electric motor driven.

Support Items

Spare Part Name	Qty
Pump unit P3	1

Special Tools and Test Equipment	Qty
Hose with test connection Minimess 16x2	1
Container to collect oil	As req.
Lifting equipment	1

Reference Documents
Hydraulic Power Pack Assembly drawing

Consumables	Qty
Linen rags	As req.

Instruction

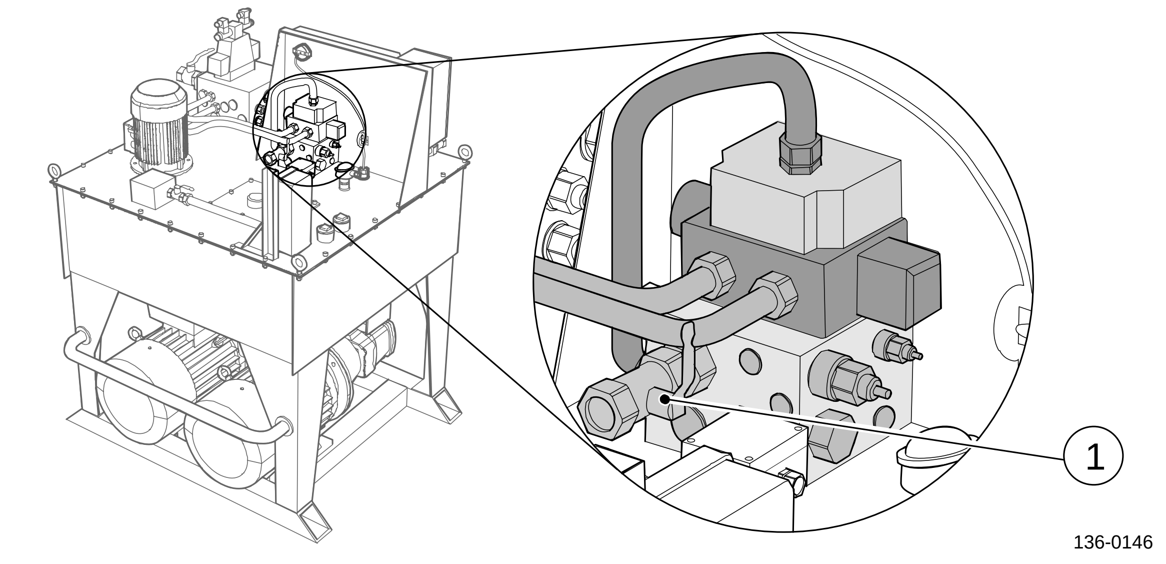

Figure 1 Back view of the hydraulic power pack.

1. Shut-off valve V26

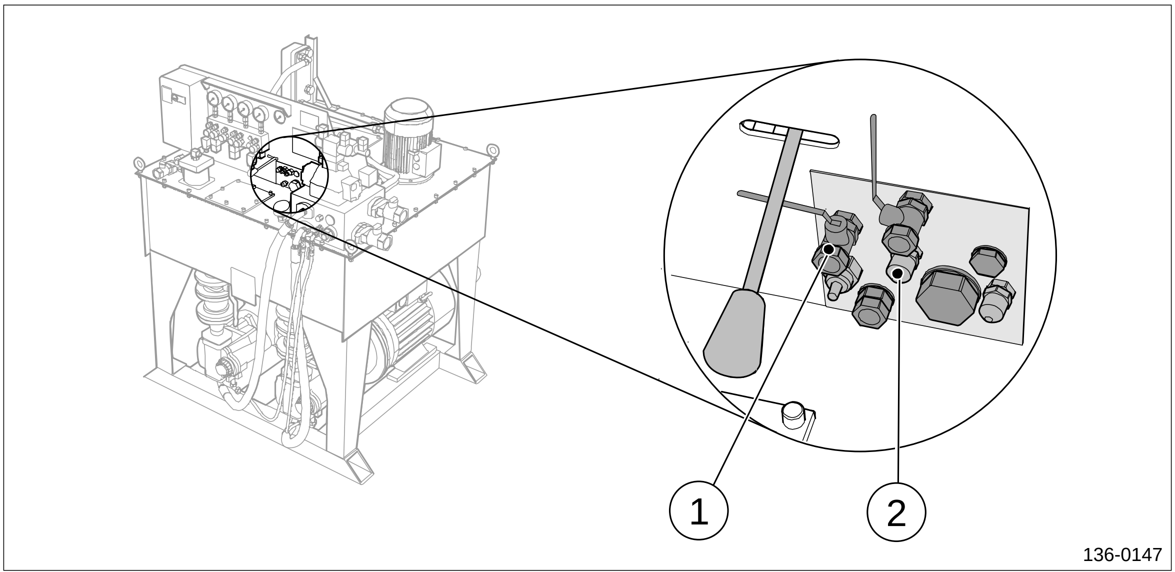

Figure 2 Control panel on the hydraulic power pack.

1. Shut-off valve V25
2. Test nipple P3T

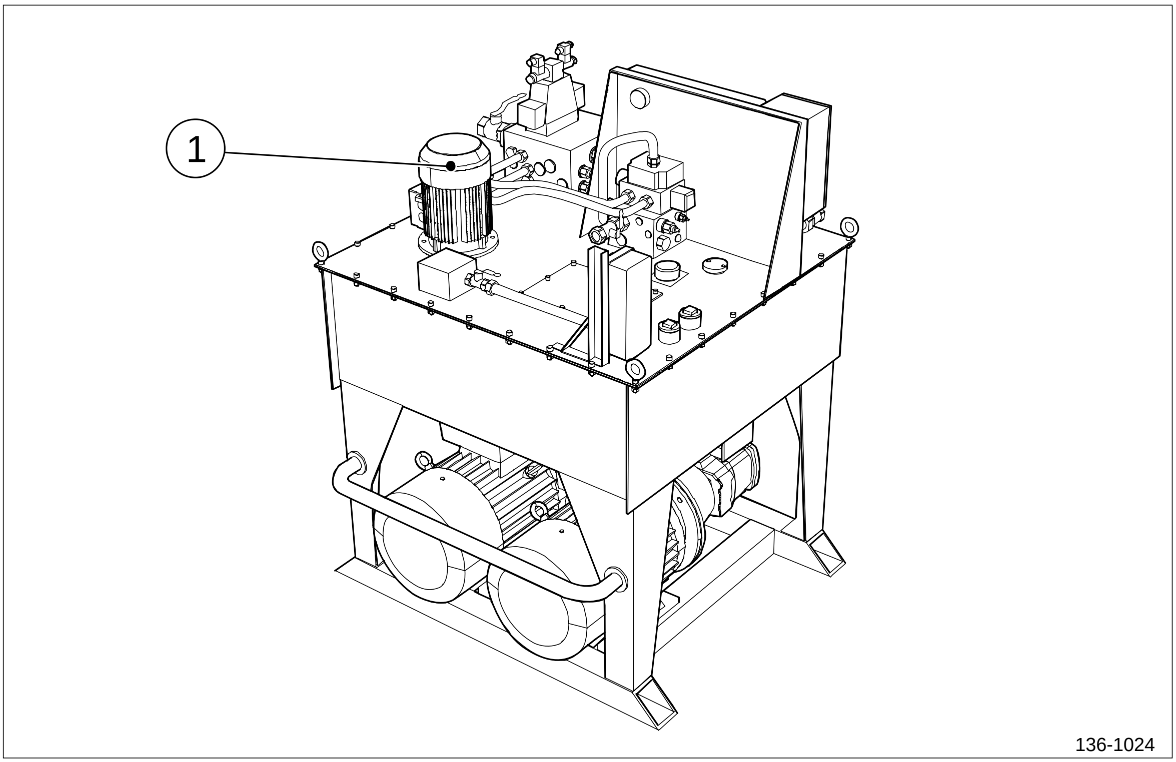

Figure 3 Back view of the hydraulic power pack.

1. Pump unit P3

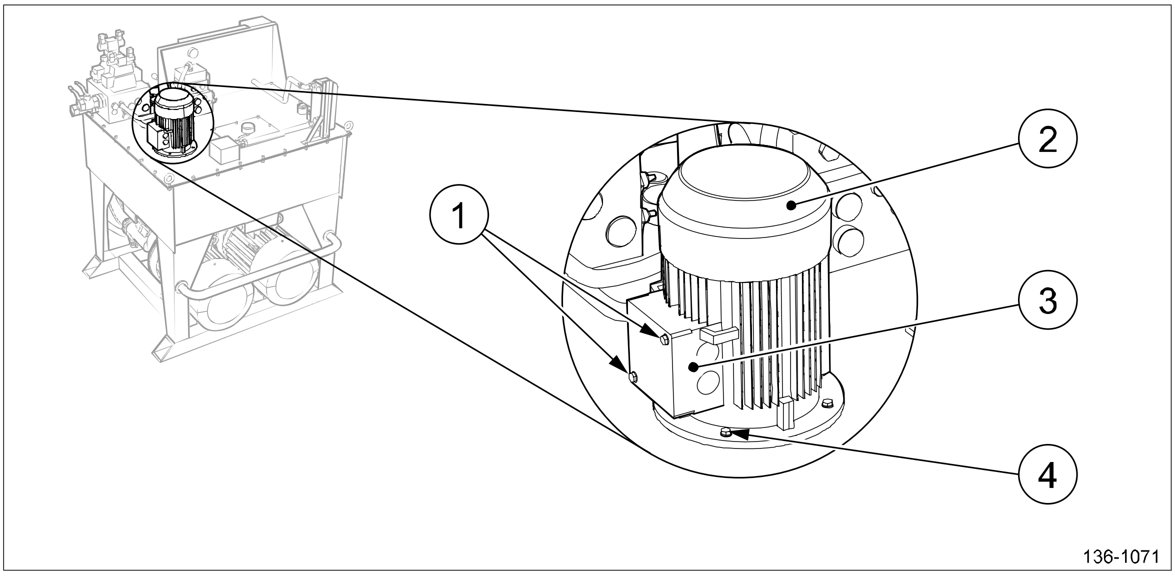

Figure 4 Pump unit P3.

1. Screws
2. Electric motor
3. Cable connection cover
4. Screws

Warning: **The propulsion system must be turned off and secured the during this task.**

Warning: **Dismantling hydraulic components without depressurizing the hydraulic system may cause serious personal injury.**

Caution: **Make sure the pump units are set to local control.**

Caution: **Take the necessary actions to prevent the pump units from being started by accident.**

Caution: **Turn off and make sure the incoming power is disconnected before dismantling.**

Caution: **Make sure that there is enough room to safely lift the pump unit.**

Note: **This task must be performed by both a technical engineer and an electrician.**

Depressurize the hydraulic system

1. Turn off all pump units.
2. Set the pump units to local control.
3. Turn off incoming power.
4. If the the vessel is equipped with a gravity tank, open the shut-off valve V25 (pos 1, figure 2).
5. Close the shut-off valve V26 (pos 1, figure 1).
6. Connect a hose with test connection to the test nipple P3T (pos 2, figure 2). Note that oil will flow out and release the pressure. Take proper measures to collect the oil. Disconnect the hose when the pressure is released. Dispose the collected oil according to local regulations.

Remove the pump unit

7. Remove the cable connection cover from the electric motor (pos 3, figure 4).
8. Disconnect the cables from the electric motor.
9. Disconnect the hydraulic pipes.
10. Loosen and remove the screws fastening the pump unit (pos 4, figure 4).
11. Lift the pump unit straight up using appropriate lifting device.

Replace the pump unit

12. Lift the new pump unit into position on the hydraulic power pack using appropriate lifting device.
13. Refit and tighten the screws that fasten the pump unit (pos 4, figure 4).
14. Connect the hydraulic pipes to the new pump unit.
15. Connect the electrical cables to the electric motor.
16. Install the cable connection cover and tighten the screws.

Switch on incoming power and test function

17. Turn on the incoming power for the new pump unit P3.
18. If the the vessel is equipped with a gravity tank, close the shut-off valve V25 (pos 1, figure 2).
19. Open the shut-off valve V26 (pos 1, figure 1).
20. Test the function of the pump unit to verify that the new pump unit is in operation and is running in correct direction. If the pressure gauge G5 indicate normal pressure, the pump unit is running in the correct direction.
21. Set the pump units to remote control.

This task is now completed.

Corrective Maintenance

Task: Repair Pump Motor Starter P1 and P2

Description

This task describes how to replace the contactor, relay, time relay and run indication light bulb on pump motor starter P1 or P2.

Support Items

Spare Part Name	Cross Ref. No.
Contactor K1	1041
Relay K2	1042
Time relay K3, K4	1043
Light bulb H1	1044

Special/Additional Tools and Test Equipment	Qty

Reference Documents
Pump Motor Starter Wiring Diagram drawing

Consumables	Qty

Instruction

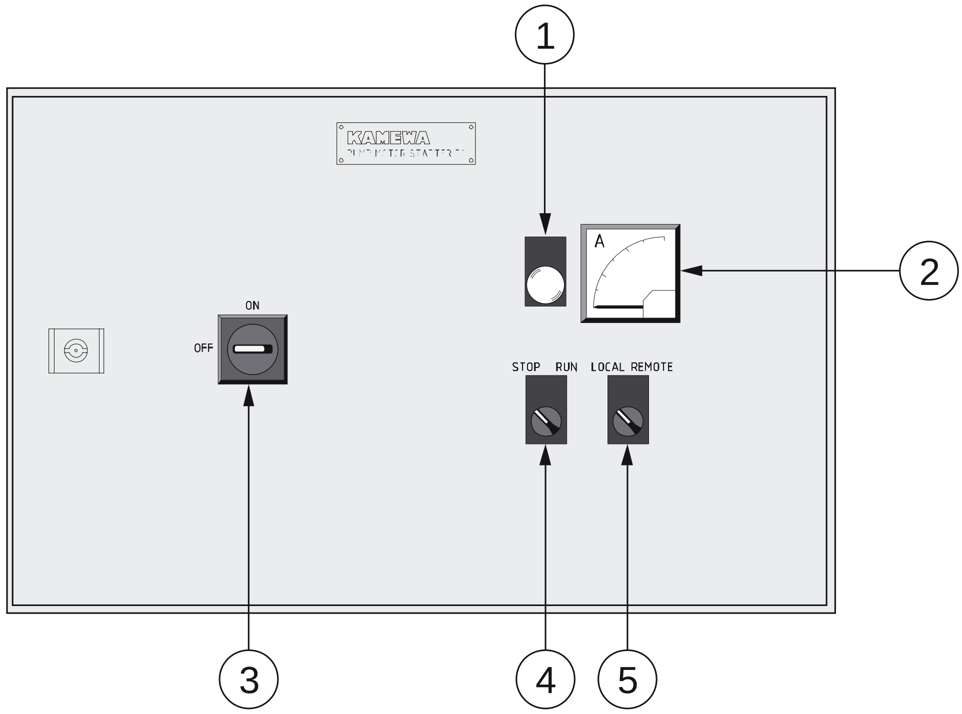

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Figure 1 Front view of pump motor starter P1 or P2.

1. Run indicator lamp
2. Ampere meter
3. Main switch
4. Stop/run switch
5. Local/remote switch

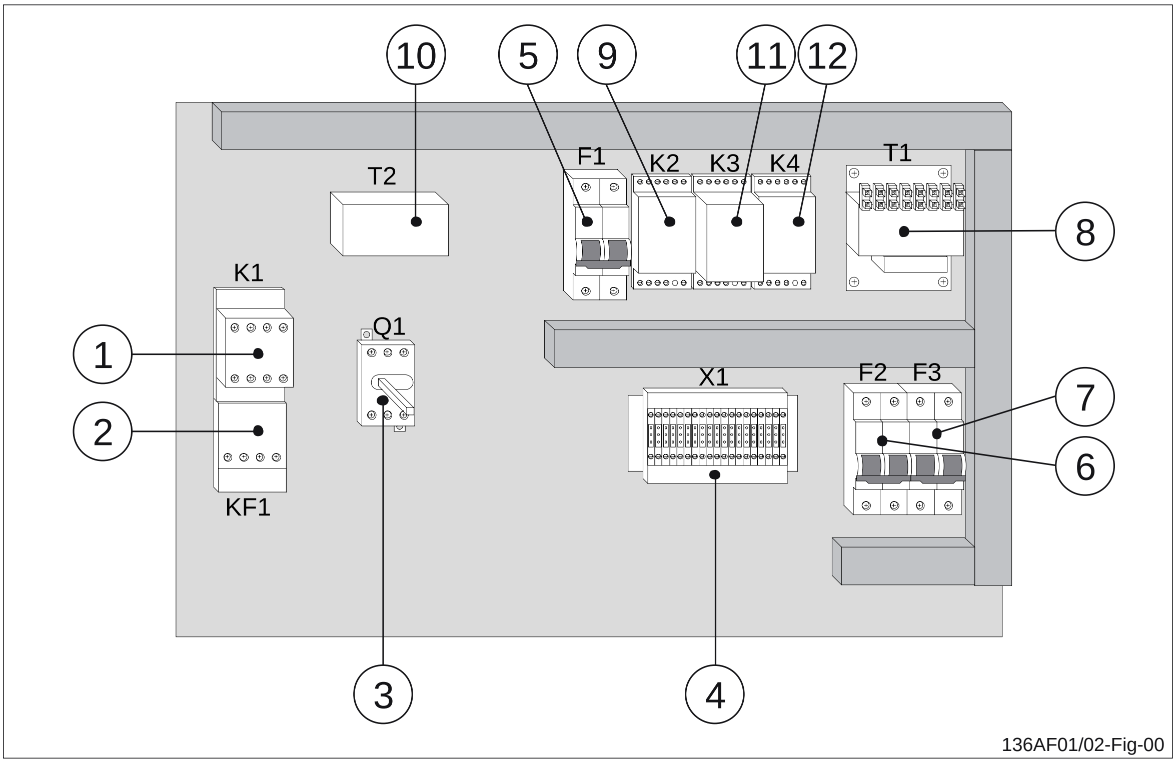

Figure 2 Internal equipment of pump motor starter P1 or P2.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal strip, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2
10. Current transformer, T2
11. Time relay, K3
12. Time relay, K4

Replace Contactor (K1)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the local/remote switch (see position 5 in figure 1) to LOCAL position.
2. Turn the stop/run switch (see position 4 in figure 1) to STOP position.
3. Turn the main switch (see position 3 in figure 1) to OFF position.
4. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
5. Disconnect the overcurrent relay KF1 (see position 2 in figure 2) from contactor

K1 (see position 1 in figure 2).

6. Disconnect the cables from connector K1. Make a note where the cables were connected.
7. Replace the contactor K1. Connect the cables to their correct positions.
8. Fit and connect the overcurrent relay KF1 to the contactor K1.
9. Close the cabinet using the key.
10. Turn the main switch to ON position.
11. Turn the stop/run switch to RUN position.
12. Turn the local/remote switch to REMOTE position.

This task is now completed.

Replace Relay (K2)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the local/remote switch (see position 5 in figure 1) to LOCAL position.
2. Turn the stop/run switch (see position 4 in figure 1) to STOP position.
3. Turn the main switch (see position 3 in figure 1) to OFF position.
4. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
5. Bring the support clamp on the relay (see position 9 in figure 2) down.
6. Loosen and remove the relay.
7. Fit the new relay and bring the support clamp up.
8. Close the cabinet using the key.
9. TurnTurn the main switch to ON position.
10. Turn the stop/run switch to RUN position.
11. Turn the local/remote switch to REMOTE position..

This task is now completed.

Replace Time Relay (K3 or K4)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the local/remote switch (see position 5 in figure 1) to LOCAL position.
2. Turn the stop/run switch (see position 4 in figure 1) to STOP position.
3. Turn the main switch (see position 3 in figure 1) to OFF position.
4. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
5. Note the time setting on the old time relay.
6. Loosen and pull out the time relay (see position 11 or 12 in figure 2).
7. Fit the new relay and adjust the time setting according to the value on the old time relay.
8. Close the cabinet.
9. Turn the main switch to ON position.
10. Turn the stop/run switch to RUN position.
11. Turn the local/remote switch to REMOTE position.

This task is now completed.

Replace Run Indication Light Bulb (H1)

Caution: This task must be performed by personnel which has at least fundamental knowledge of electricity.

The light bulb can be replaced in two ways:

Procedure 1

1. Turn the local/remote switch (see position 5 in figure 1) to LOCAL position.
2. Turn the stop/run switch (see position 4 in figure 1) to STOP position.
3. Turn the main switch (see position 3 in figure 1) to OFF position.
4. Unscrew the run indicating lens (see position 1 in figure 1) on the front of the pump motor starter cabinet.
5. Pull out the light bulb and replace it.
6. Refit the lens.
7. Turn the main switch to ON position.
8. Turn the stop/run switch to RUN position.
9. Turn the local/remote switch to REMOTE position.

This task is now completed.

Procedure 2

1. Turn the local/remote switch (see position 5 in figure 1) to LOCAL position.

2. Turn the stop/run switch (see position 4 in figure 1) to STOP position.
3. Turn the main switch (see position 3 in figure 1) to OFF position.
4. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
5. Loosen the screw underneath the light bulb socket.
6. Bring the locking pin up and pull out the light bulb.
7. Replace the light bulb.
8. Tighten the screw underneath the light bulb socket.
9. Close the cabinet using the key.
10. Turn the main switch to ON position.
11. Turn the stop/run switch to RUN position.
12. Turn the local/remote switch to REMOTE position.

This task is now completed.

Task: Repair Pump Motor Starter P3 (without Gravity Tank)

Description

This task describes how to replace the contactor, relay, time relay and run indication light bulb on pump motor starter P3.

Support Items

Spare Part Name	Cross Ref. No.
Contactor K1	1045
Relay K2	1046
Light bulb H1	1047

Special/Additional Tools and Test Equipment	Qty

Reference Documents
Pump Motor Starter Wiring Diagram drawing

Consumables	Qty

Instruction

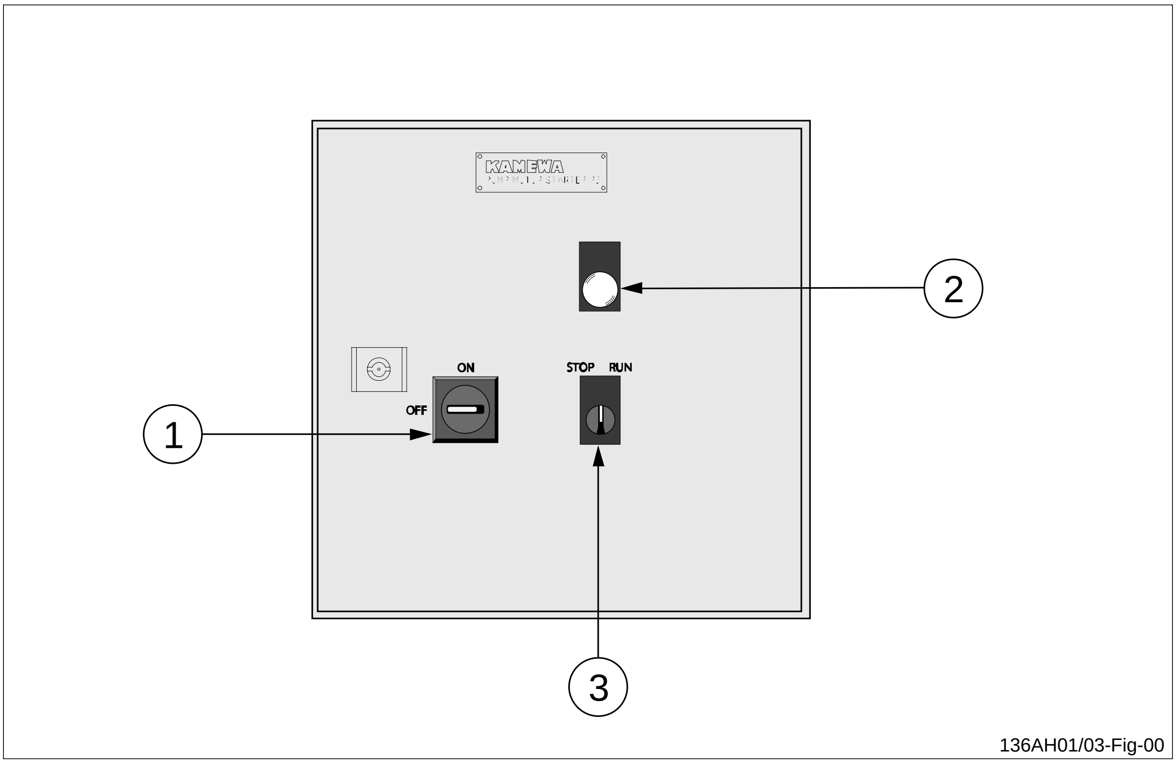

Figure 3 Front view of pump motor starter P3.

1. Main switch
2. Run indicator lamp
3. Stop/run switch

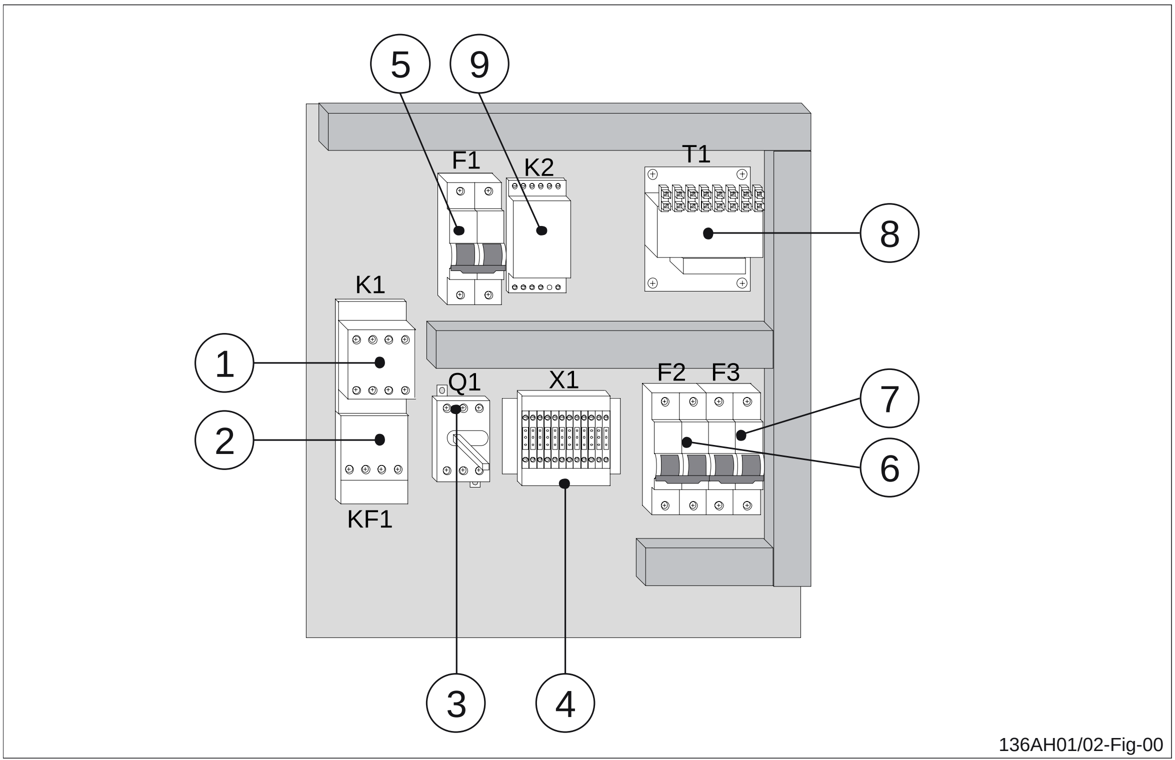

Figure 4 Internal equipment of pump motor starter P3.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal strip, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2

Replace Contactor (K1)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the stop/run switch (see position 3 in figure 127) to STOP position.
2. Turn the main switch (see position 1 in figure 127) to OFF position.
3. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
4. Disconnect the overcurrent relay KF1 (see position 2 in figure 128) from the contactor K1 (see position 1 in figure 2).
5. Disconnect the cables from connector K1. Make a note where the cables were connected.

6. Replace contactor K1. Connect the cables to their correct positions.
7. Fit and connect the overcurrent relay KF1 to contactor K1.
8. Close the cabinet using the key.
9. Turn the main switch to ON position.
10. Turn the stop/run switch to RUN position.

This task is now completed.

Replace Relay (K2)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the stop/run switch (see position 3 in figure 127) to STOP position.
2. Turn the main switch (see position 1 in figure 127) to OFF position.
3. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
4. Bring the support clamp on the relay (see position 9 in figure 128) down.
5. Loosen and remove the relay.
6. Fit the new relay and bring the support clamp up.
7. Close the cabinet using the key.
8. Turn the main switch to ON position.
9. Turn the stop/run switch to RUN position.

This task is now completed.

Replace the Run Indication Light Bulb (H1)

Caution: This task must be performed by personnel which has at least fundamental knowledge of electricity.

The light bulb can be replaced in two ways:

Procedure 1

1. Turn the stop/run switch (see position 3 in figure 127) to STOP position.
2. Turn the main switch (see position 1 in figure 127) to OFF position.
3. Unscrew the run indicating lens (see position 2 in figure 127) on the front of the pump motor starter cabinet.

4. Pull out the light bulb and replace it.
5. Refit the lens.
6. Turn the main switch to ON position.
7. Turn the stop/run switch to RUN position.

This task is now completed.

Procedure 2

1. Turn the stop/run switch (see position 3 in figure 127) to STOP position.
2. Turn the main switch (see position 1 in figure 127) to OFF position.
3. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
4. Loosen the screw underneath the light bulb socket.
5. Bring the locking pin up and pull out the light bulb.
6. Replace the light bulb.
7. Tighten the screw underneath the light bulb socket.
8. Close the cabinet using the key.
9. Turn the main switch to ON position.
10. Turn the stop/run switch to RUN position.

This task is now completed.

Task: Repair Pump Motor Starter P3 (with Gravity Tank)

Description

This task describes how to replace the contactor, relay, time relay and run indication light bulb on pump motor starter P3.

Support Items

Spare Part Name	Cross Ref. No.
Contactor K1	1045
Relay K2	1046
Light bulb H1	1047
Time relay K3	1053

Special Tools and Test Equipment	Qty

Reference Documents
Pump Motor Starter Wiring Diagram drawing

Consumables	Qty

Instruction

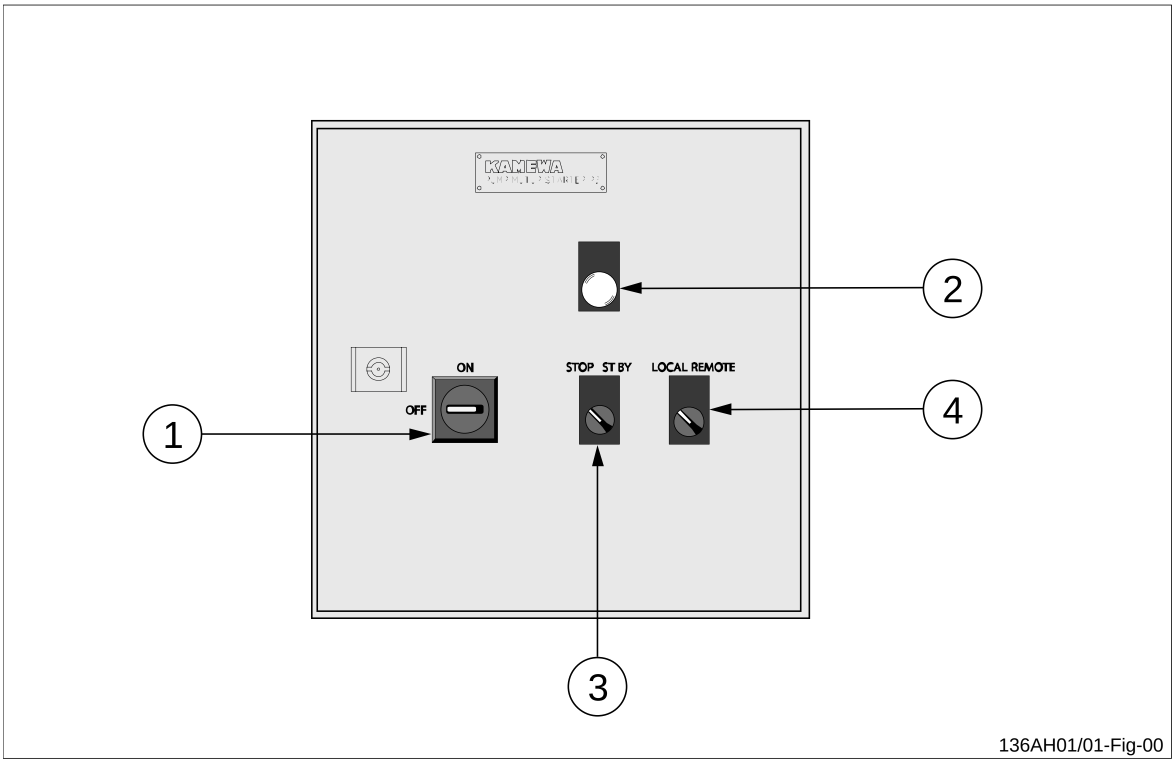

Figure 5 Front view of pump motor starter P3.

1. Main switch
2. Run indicator lamp
3. Stop/run switch
4. Local/Remote switch

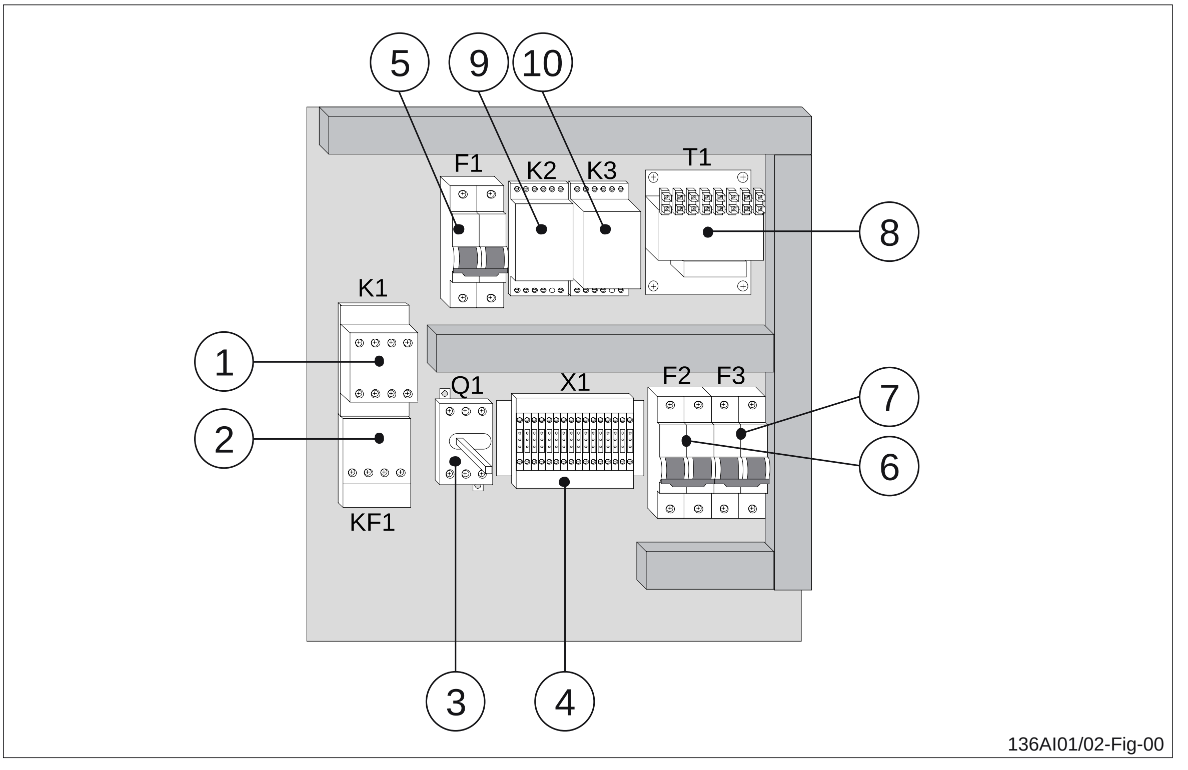

Figure 6 Internal equipment of pump motor starter P3.

1. Contactor, K1
2. Overcurrent relay, KF1
3. Main switch, Q1
4. Terminal strip, X1
5. Automatic fuse, F1
6. Automatic fuse, F2
7. Automatic fuse, F3
8. Transformer, T1
9. Relay, K2
10. Time relay, K3

Replace Contactor (K1)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the local/remote switch (see position 6 in figure 5) to LOCAL position.
2. Turn the stop/run switch (see position 3 in figure 5) to STOP position.
3. Turn the main switch (see position 1 in figure 5) to OFF position.
4. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
5. Disconnect the overcurrent relay KF1 (see position 2 in figure 6) from the contactor K1 (see position 1 in figure 6).

6. Disconnect the cables from connector K1. Make a note where the cables were connected.
7. Replace contactor K1. Connect the cables to their correct positions.
8. Fit and connect the overcurrent relay KF1 to contactor K1.
9. Close the cabinet using the key.
10. Turn the main switch to ON position.
11. Turn the stop/run switch to RUN position.
12. Turn the local/remote switch to REMOTE position.

This task is now completed.

Replace Relay (K2)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the local/remote switch (see position 6 in figure 79) to LOCAL position.
2. Turn the stop/run switch (see position 3 in figure 79) to STOP position.
3. Turn the main switch (see position 1 in figure 79) to OFF position.
4. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
5. Bring the support clamp on the relay (see position 9 in figure 80) down.
6. Loosen and remove the relay.
7. Fit the new relay and bring the support clamp up.
8. Close the cabinet using the key.
9. Turn the main switch to ON position.
10. Turn the stop/run switch to RUN position.
11. Turn the local/remote switch to REMOTE position.

This task is now completed.

Replace Time Relay (K3)

Caution: This task must be performed by an electrician. If the contactor is connected in a wrong way it will damage the whole pump motor starter.

1. Turn the local/remote switch (see position 6 in figure 79) to LOCAL position.

2. Turn the stop/run switch (see position 5 in figure 79) to STOP position.
3. Turn the main switch (see position 4 in figure 79) to OFF position.
4. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.
5. Note the time setting on the old time relay.
6. Loosen and pull out the time relay (see position 10 in figure 80).
7. Fit the new relay and adjust the time setting according to the value on the old time relay.
8. Close the cabinet.
9. Turn the main switch to ON position.
10. Turn the stop/run switch to RUN position.
11. Turn the local/remote switch to REMOTE position.

This task is now completed.

Replace the Run Indication Light Bulb (H1)

Caution: This task must be performed by personnel which has at least fundamental knowledge of electricity.

The light bulb can be replaced in two ways:

Procedure 1

1. Turn the stop/run switch (see position 3 in figure 79) to STOP position.
2. Turn the main switch (see position 1 in figure 79) to OFF position.
3. Unscrew the run indicating lens (see position 2 in figure 79) on the front of the pump motor starter cabinet.
4. Pull out the light bulb and replace it.
5. Refit the lens.
6. Turn the main switch to ON position.
7. Turn the stop/run switch to RUN position.

This task is now completed.

Procedure 2

1. Turn the stop/run switch (see position 3 in figure 79) to STOP position.
2. Turn the main switch (see position 1 in figure 79) to OFF position.
3. Open the pump motor starter cabinet with the key. Make sure that the power is switched off.

4. Loosen the screw underneath the light bulb socket.
5. Bring the locking pin up and pull out the light bulb.
6. Replace the light bulb.
7. Tighten the screw underneath the light bulb socket.
8. Close the cabinet using the key.
9. Turn the main switch to ON position.
10. Turn the stop/run switch to RUN position.

This task is now completed.

Corrective Maintenance, Hydraulic System

Task: Replace Hydraulic Hoses

Description

This instruction describes how to replace hydraulic hoses. It is recommended to replace the hydraulic hoses every fifth year due to wear and ageing.

Support Items

Spare Part Name	Qty
Adequate hoses	

Special/Additional Tools and Test Equipment	Qty
Container to collect the oil	As req.
Hose with test connection Minimess 16x2	1

Reference Documents

Consumables	Qty
Linen rags	As req.

Instruction

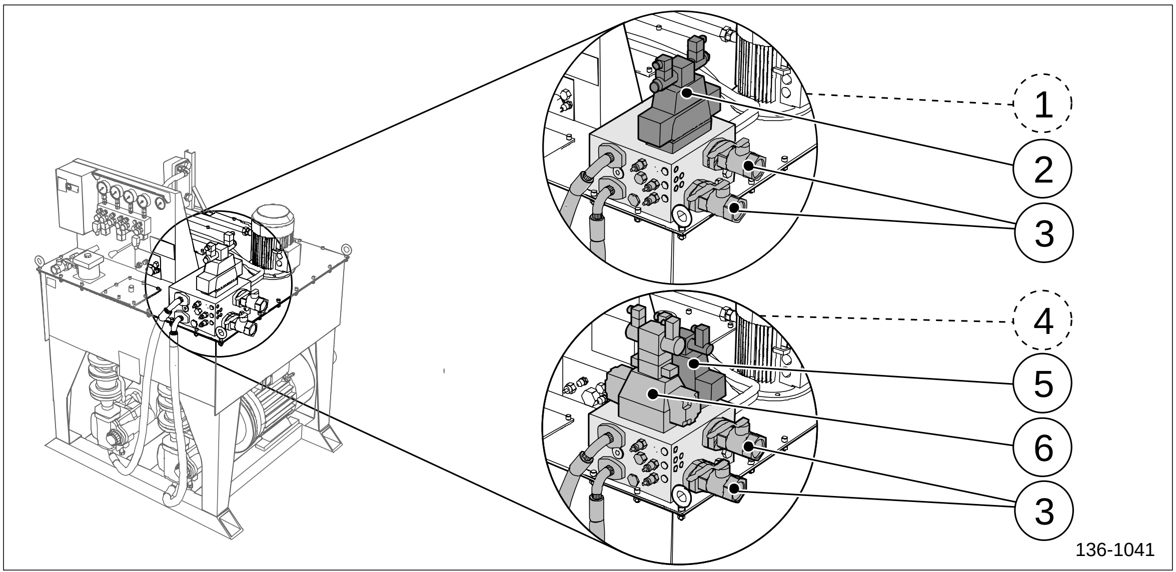

Figure 1 The valve manifold on the hydraulic power pack.

1. Valve manifold on power packs size 150-300 litres
2. Directional proportional control valve V3
3. Shut-off valve V39 and V40
4. Valve manifold on power packs size 500-1000 litres
5. Directional proportional control valve V3
6. Directional on/off control valve V2

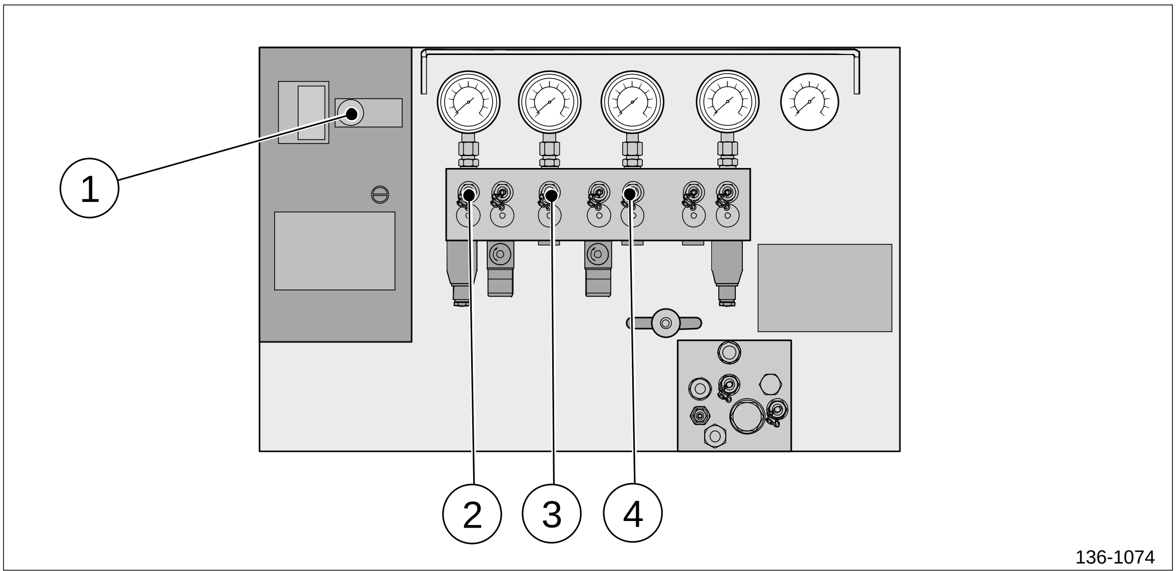

Figure 2 Control panel on the hydraulic power pack.

1. Local/remote switch
2. Test nipple TP3
3. Test nipple TP4
4. Test nipple TP5

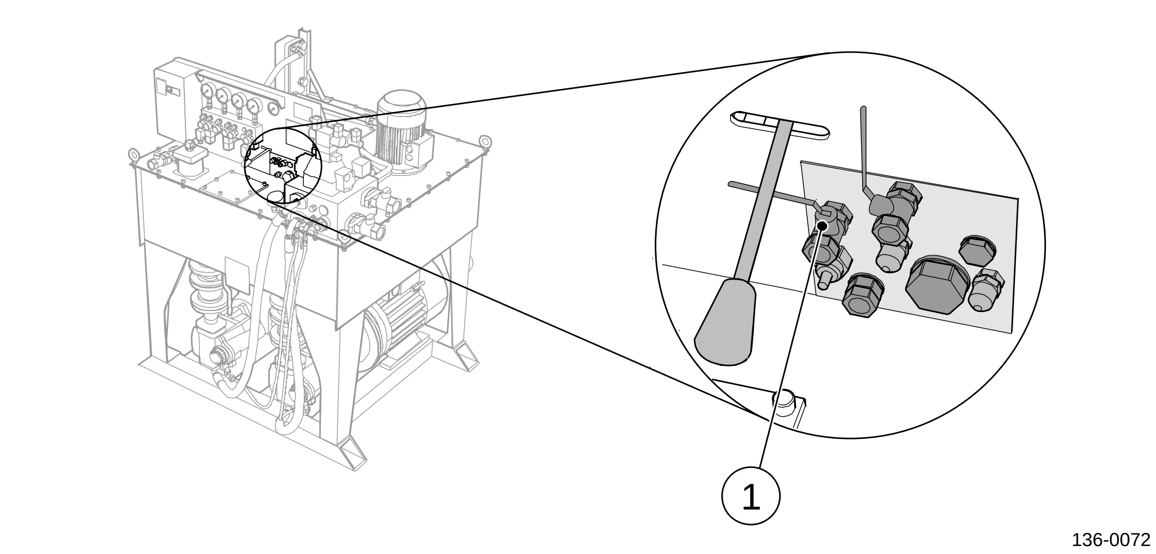

Figure 3 The emergency operating control panel on the hydraulic power pack unit.

1. Shut-off valve V25

Warning: Turn off the main engine(s) during this task.

Warning: Turn off and secure the propulsion system before starting this task.

Warning: The hydraulic system uses high pressurized oil for functioning. The pressure might be high even when the engine is not running. Depressurize the hydraulic system before starting this task.

Warning: The pressurized oil in the hydraulic system can be hot! Damage on hoses, pipes or couplings can lead to serious personal injuries.

Warning: Air mixed with oil may explode if the oil comes in contact with hot machine parts. There is also a risk of fire.

Caution: Always use protective gloves while handling hydraulic pipes and hoses.

Caution: It is highly important to prevent dirt and particles to enter the hydraulic system. Always use clean equipment when working with the hydraulic system. Clean the working area and the parts before assembly and disassembly.

Depressurize the hydraulic system

1. Turn off the main engine(s).
2. Set the pump units to local control.
3. Turn off all pump units.
4. Set the local/remote switch (see figure 2) on the hydraulic power pack control panel to LOCAL CONTROL.
5. Manoeuvre the directional proportional control valve V3 (see figure 1) by hand in both ahead and astern direction.
6. Manoeuvre, if applicable, the directional on/off control valve V2 by hand in both ahead and astern direction to depressurize the hydraulic system.
7. Connect a hose with test connection to the test nipple TP3 (see figure 2). Note that oil will flow out and release the last pressure. Take proper measures to collect the oil. Disconnect the hose and repeat this procedure on the test nipples TP4 and TP5 (see figure 2). Dispose the collected oil according to local regulations.
8. Manoeuvre directional proportional control valve V3 (and V2 if applicable) once again by hand in both the ahead and astern direction.
9. Open, if the vessel is equipped with a gravity tank, the shut-off valve V25 (see figure 3) and drain the oil from the gravity tank into the hydraulic power pack tank. This will reduce the static pressure.
10. Close the shut-off valves V39 and V40 (see figure 1).

Replace the hose

11. Locate the hose to be replaced.
12. Clean the hose connections before removing the hose.
13. Loosen and remove the hose connections. Note that the oil in the hose and piping will flow out. Take proper measures to collect the oil.
14. Fit and connect the new hose. If the hose is connected by flanges, make sure to fit flange O-rings properly.
15. Wipe the hose, the connections, and the area around the hose clean with linen rags.
16. Close, if the vessel is equipped with a gravity tank, the shut-off valve V25.
17. Open the shut-off valves V39 and V40.
18. Start, depending on which hose that has been replaced:

    #### Non-PTO hoses

    18.1. Start the main pump units.

    #### PTO hose

    18.2. Start the propulsion system.
19. Inspect the replaced hose and connections for leakage. If leakage occurs, make sure that the connections are clean, undamaged, and that the O-rings are fitted correctly.
20. Set the pump units to remote control.
21. Set the local/remote switch on the hydraulic power pack control panel to REMOTE CONTROL.
22. Run the hydraulic pumps for 30 minutes. Inspect the oil level in the hydraulic power pack and refill if necessary. Refill purified oil according to the instructions in Task: Refill Oil to the Hydraulic System.

This task is now completed.

Corrective Maintenance, Remote Control System

Task: Replace Filter Unit with Capacitor and Transorber

Description

This task describes how to replace a filter unit in a bridge unit cabinet, ECR unit cabinet, or in an HPP unit cabinet, in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
Filter	3001
Transorber	3002
Capacitors (x 2)	3003

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1
Soldering-iron	1

Reference Documents

Consumables	Qty
Cable with cable area 1.0 mm^2	As req.
Solder	As req.

Instruction

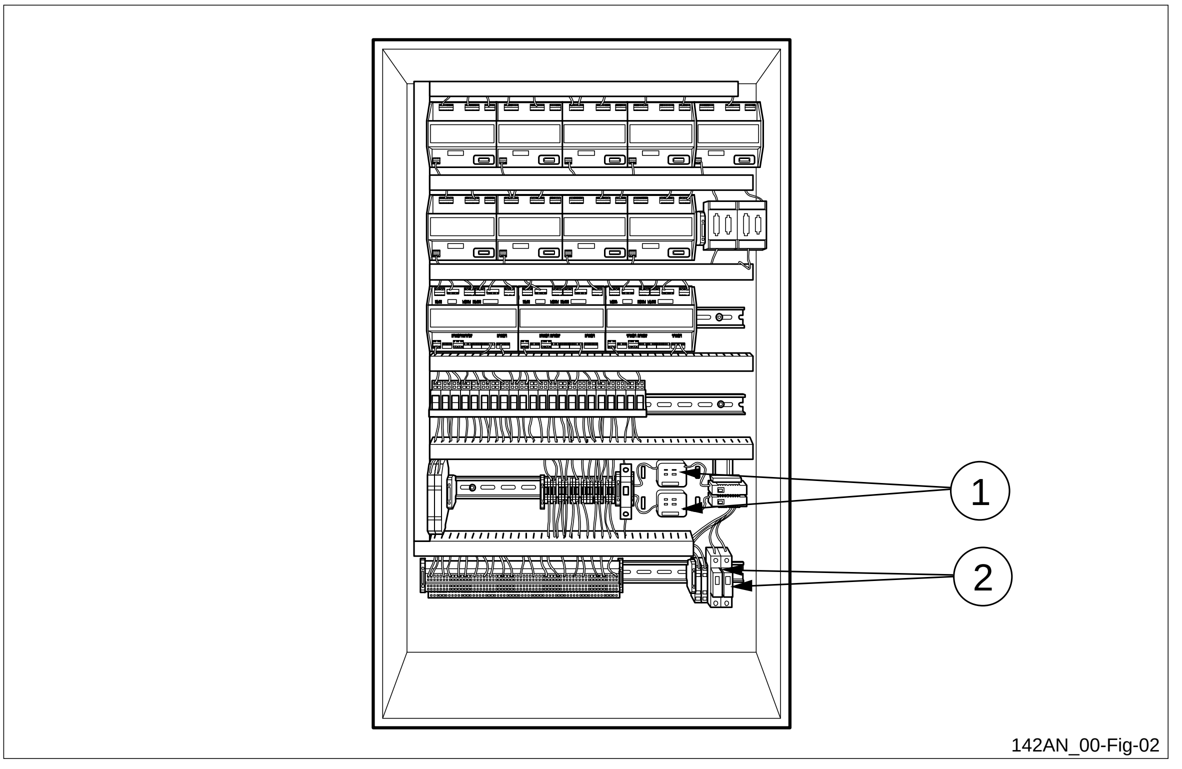

Figure 1 Filter units in a bridge unit cabinet.

1. Filter units
2. Automatic fuses

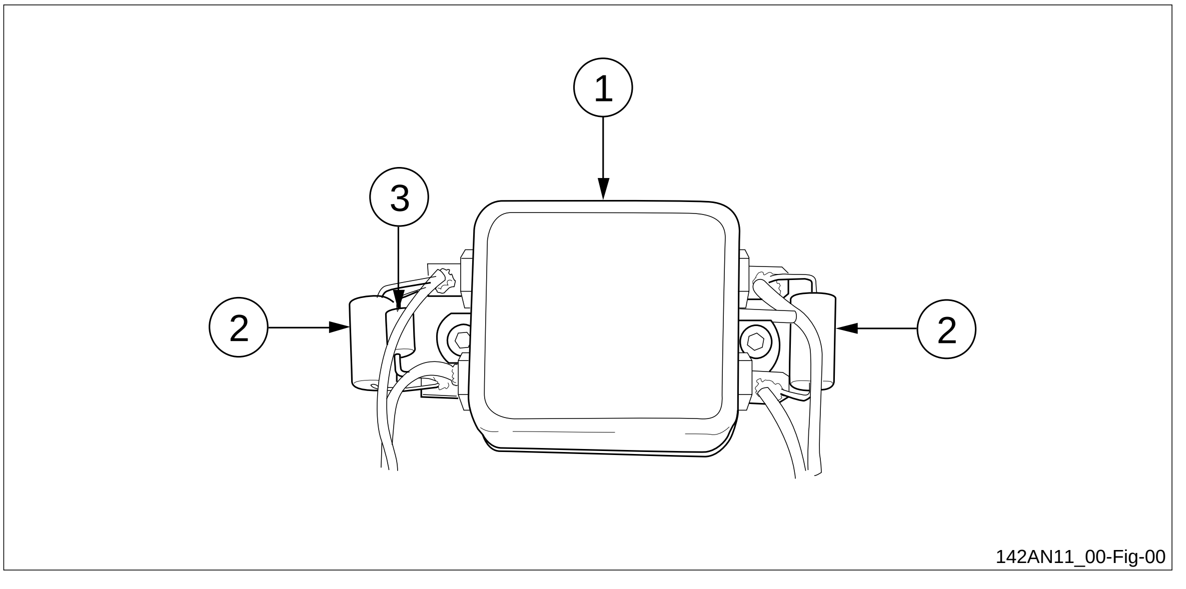

Figure 2 Filter unit details.

1. Filter
2. Capacitor
3. Transorber

Caution: The electronics cabinets contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these cabinets.

Note: This task must be performed by an electrician.

The filter unit includes two capacitors and a transorber. The capacitors and the transorber, as well as the filter unit connection cables, are soldered to the input and output terminals of the filter.

1. Open the cabinet and make sure the incoming power is interrupted by setting the automatic fuses (see position 2 in figure 1) to position OFF.
2. Disconnect the filter unit connection cables from the distribution terminals.
3. Unscrew the filter unit and remove it together with the transorber, capacitors and connection cables.
4. Detach the component to be replaced and replace it with a spare one.
5. Solder the filter, capacitors, transorber and connection cables back together. Replace cables if necessary.
6. Refit the removed items in the cabinet.
7. Turn on the incoming power. If applicable, reset the automatic fuses to position ON.
8. Close the cabinet.

This task is now completed.

Task: Replace Surge Filter SVI-01

Description

This task describes how to replace an SVI-01 surge filter in a bridge unit cabinet, ECR unit cabinet, or in an HPP unit cabinet, in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
Surge filter SVI-01	3004

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

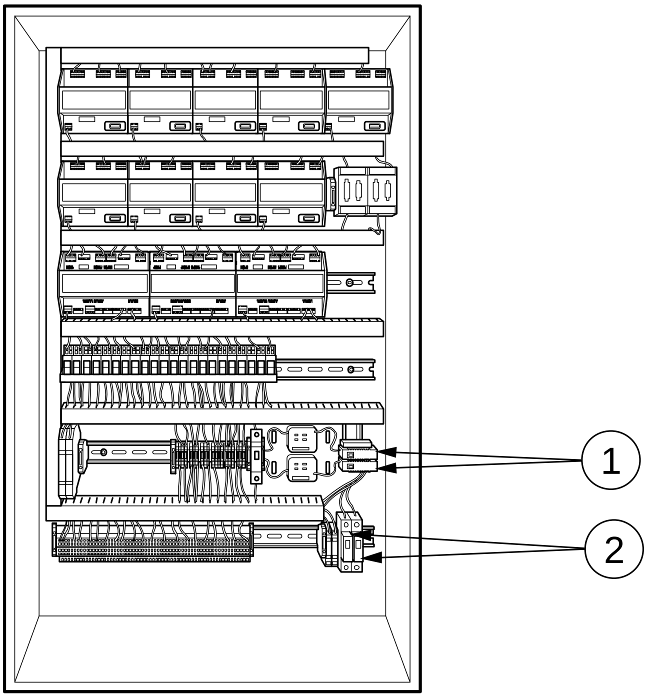

Figure 3 Surge filters in a bridge unit cabinet.

1. SVI-01 surge filters
2. Automatic fuses

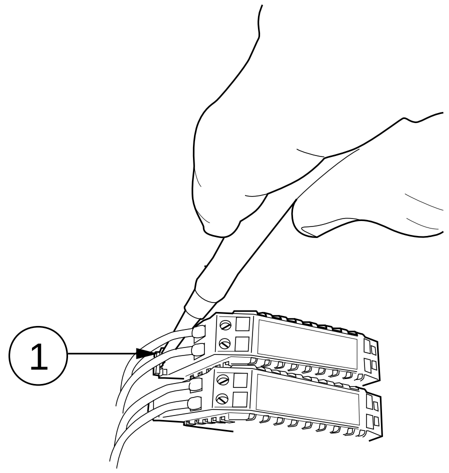

Figure 4 Unlocking the snap mechanism of SVI-01.

1. SVI-01 snap mechanism

Caution: The electronics cabinets contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these cabinets.

Note: This task must be performed by an electrician.

The SVI-01 surge filters are used by the power supply function.

1. Open the cabinet and make sure the incoming power is interrupted by setting the automatic fuses (see position 2 in figure 3) to position OFF.
2. Unscrew the connection cables to the surge filter.
3. Use a screwdriver to unlock the snap mechanism.
4. Remove the failing component and plug in a spare one.
5. Refit the connection cables.
6. Turn on the incoming power. If applicable, reset the automatic fuses to position ON.
7. Close the cabinet.

This task is now completed.

Task: Replace Isolator I/I

Description

This task describes how to replace an isolator I/I in an ECR unit cabinet, in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
Isolation amplifier I/I	3010

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

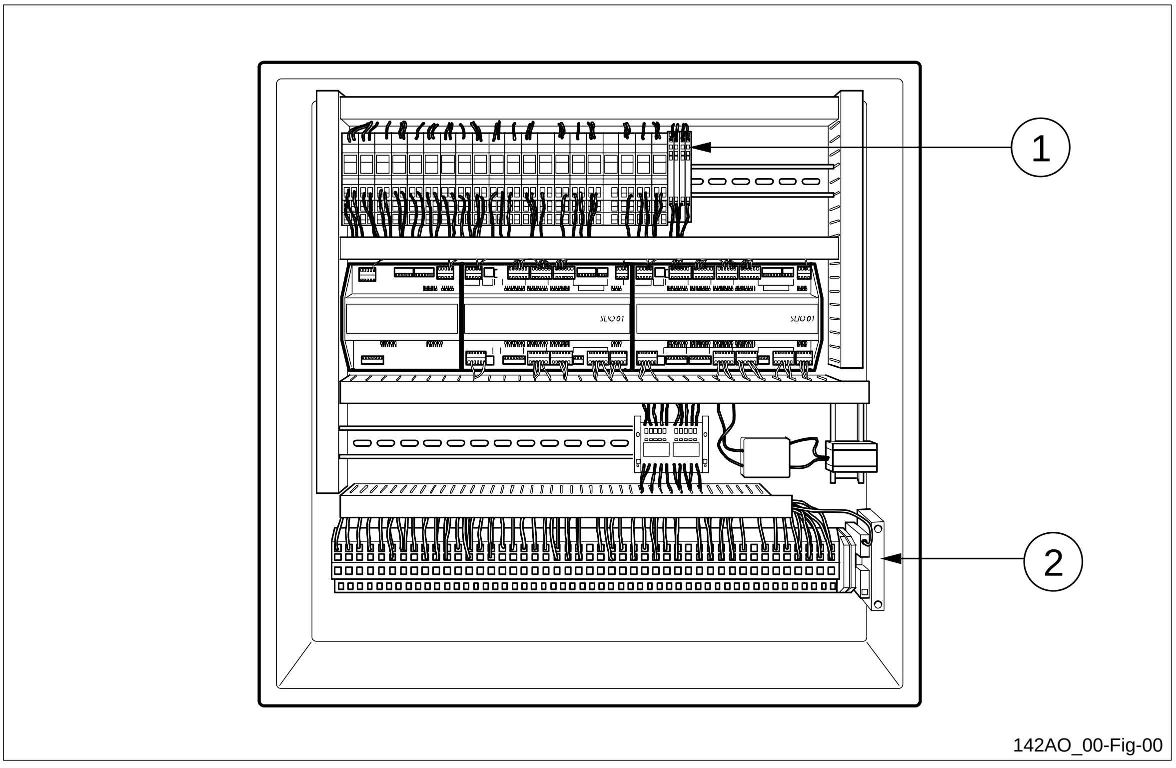

Figure 5 Isolation amplifier I/I in an ECR unit cabinet.

1. Isolator I/I
2. Automatic fuse

Caution: The electronics cabinets contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these cabinets.

Note: This task must be performed by an electrician.

1. Open the ECR unit cabinet and make sure the incoming power is interrupted, for example, by setting the automatic fuse (see position 2 in figure 5) to position OFF.
2. Unscrew the connection cables to the isolator.
3. Use a screwdriver to unlock the snap mechanism in the bottom side of the component.
4. Remove the failing component and plug in a spare one.
5. Refit the connection cables.
6. Turn on the incoming power. If applicable, reset the automatic fuse to position ON.
7. Close the cabinet.

This task is now completed.

Task: Replace SLIO 01 PC-board

Description

This task describes how to replace a SLIO 01 PC-board in a bridge station I/O cabinet, ECR station I/O cabinet, or in an ECR unit, in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
SLIO 01 PC-board	3005

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

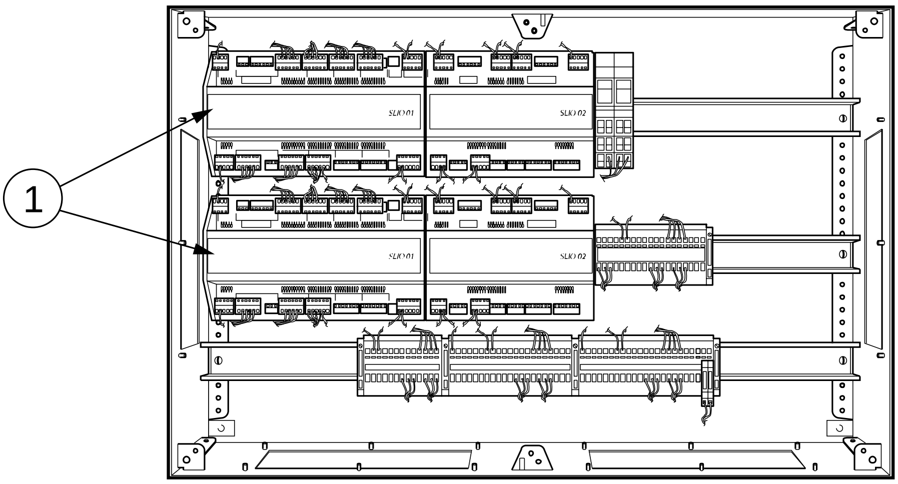

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Figure 6 SLIO 01 PC-boards in an ECR station I/O cabinet.

1. SLIO 01 PC-boards

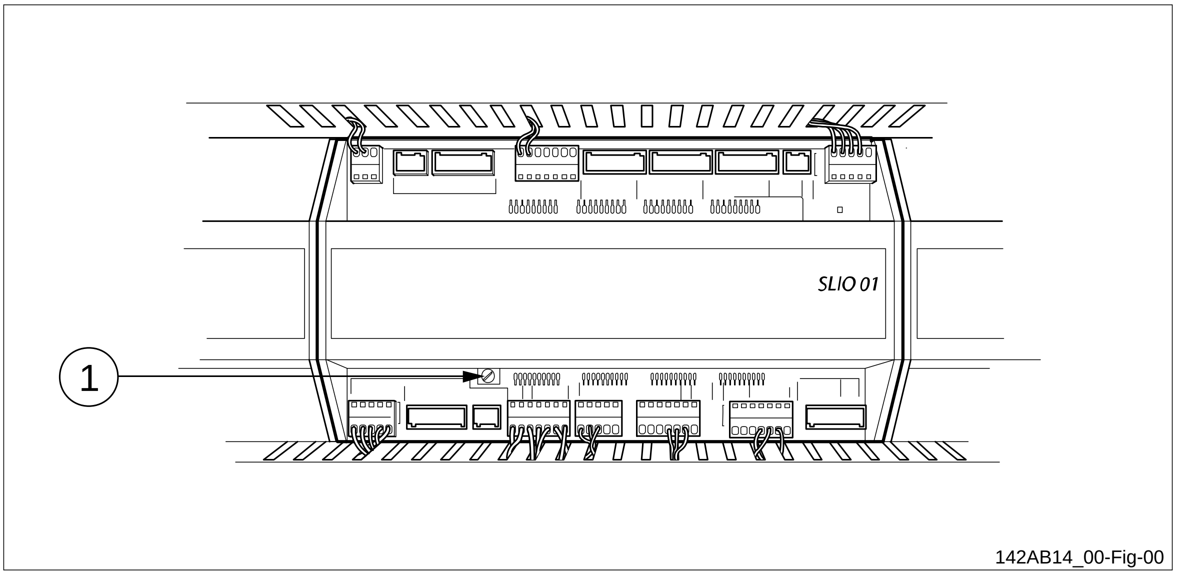

Figure 7 SLIO 01 PC-board.

1. SLIO 01 address switch

Caution: The electronics cabinets contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these cabinets.

Note: This task must be performed by an electrician.

1. Open the cabinet and make sure the incoming power is interrupted, for example, by setting the automatic fuses to position OFF. For work in an ECR station I/O cabinet, set the corresponding ECR unit cabinet automatic fuse to OFF. For work in a bridge station I/O cabinet, set the corresponding bridge unit cabinet automatic fuses to OFF.
2. Take note of the SLIO 01 address switch position. See figure 7.
3. Unplug the sockets that are connected to the SLIO 01 PC-board.
4. Use a screwdriver to unlock the snap mechanism on the bottom side of the PC-board holder and pull out the PC-board together with its holder.
5. Replace the PC-board unit, including holder, with a spare unit and refit the removed items.
6. Set the SLIO 01 address switch to the same position as the one on the old board and plug in the sockets.
7. Turn on the incoming power. If applicable, reset the automatic fuses to position ON.

8. Close the cabinet.

This task is now completed.

Task: Replace SLIO 02 PC-Board

Description

This task describes how to replace a SLIO 02 PC-board in an ECR station I/O cabinet, bridge unit cabinet, ECR unit cabinet, or in an HPP unit cabinet, in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
SLIO 02 PC-board	3006

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

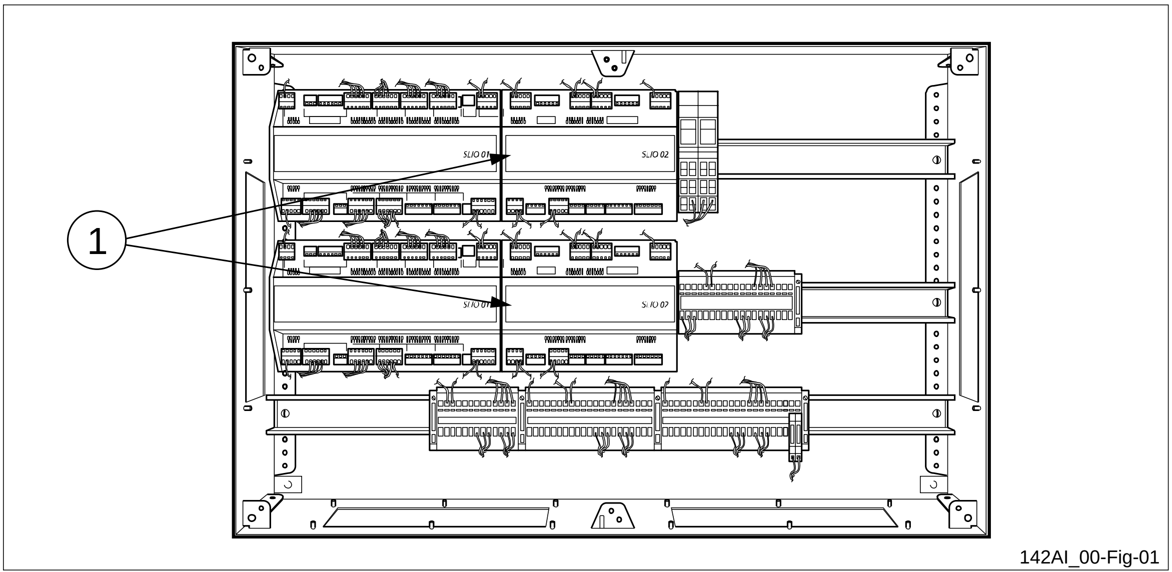

Figure 8 SLIO 02 PC-boards in an ECR station I/O cabinet.

1. SLIO 02 PC-boards

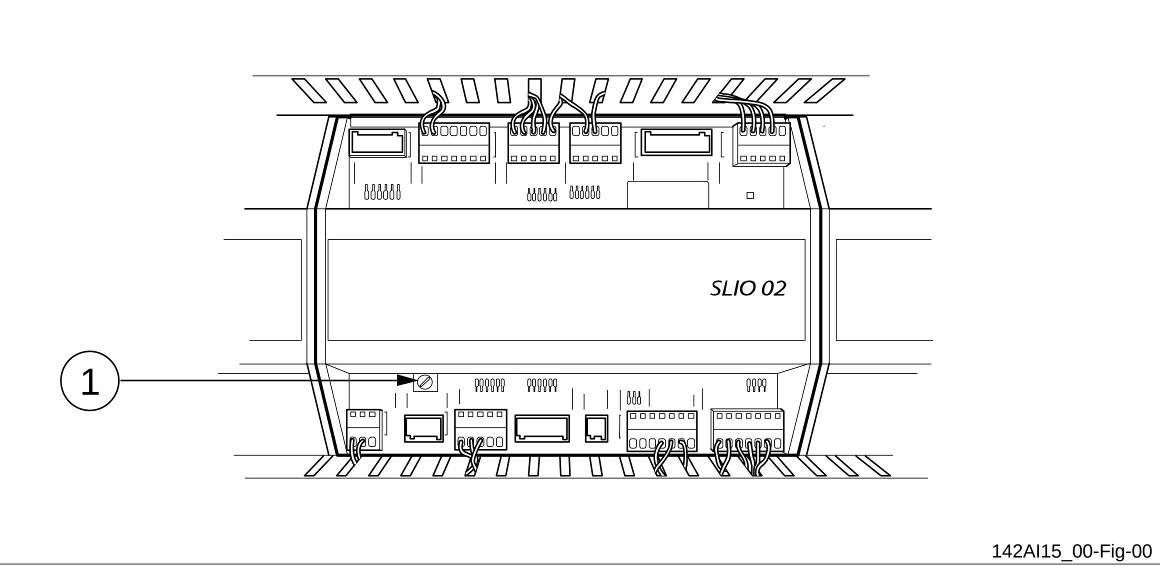

Figure 9 SLIO 02 PC-board.

1. SLIO 02 address switch

Caution: The electronics cabinets contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these cabinets.

Note: This task must be performed by an electrician.

The SLIO 02 PC-boards provide in and out channels.

1. Open the cabinet and make sure the incoming power is interrupted, for example, by setting the automatic fuses to position OFF. For work in the ECR station I/O cabinet, set the corresponding ECR unit cabinet automatic fuse to OFF.
2. Take note of the SLIO 02 address switch position. See figure 9.
3. Unplug the sockets that are connected to the SLIO 02 PC-board.
4. Use a screwdriver to unlock the snap mechanism on the bottom side of the PC-board holder and pull out the PC-board together with its holder.
5. Replace the PC-board unit, including holder, with a spare unit and refit the removed items.
6. Set the SLIO 02 address switch to the same position as the one on the old board and plug in the sockets.
7. Turn on the incoming power. If applicable, reset the automatic fuses to position ON.

8. Close the cabinet.

This task is now completed.

Task: Replace 2-pole Relay

Description

This task describes how to replace a 2-pole relay in a bridge control panel, bridge station I/O unit, ECR control panel, ECR station unit I/O, bridge unit, ECR unit, or in an HPP unit, in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
2-pole relay	3007

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

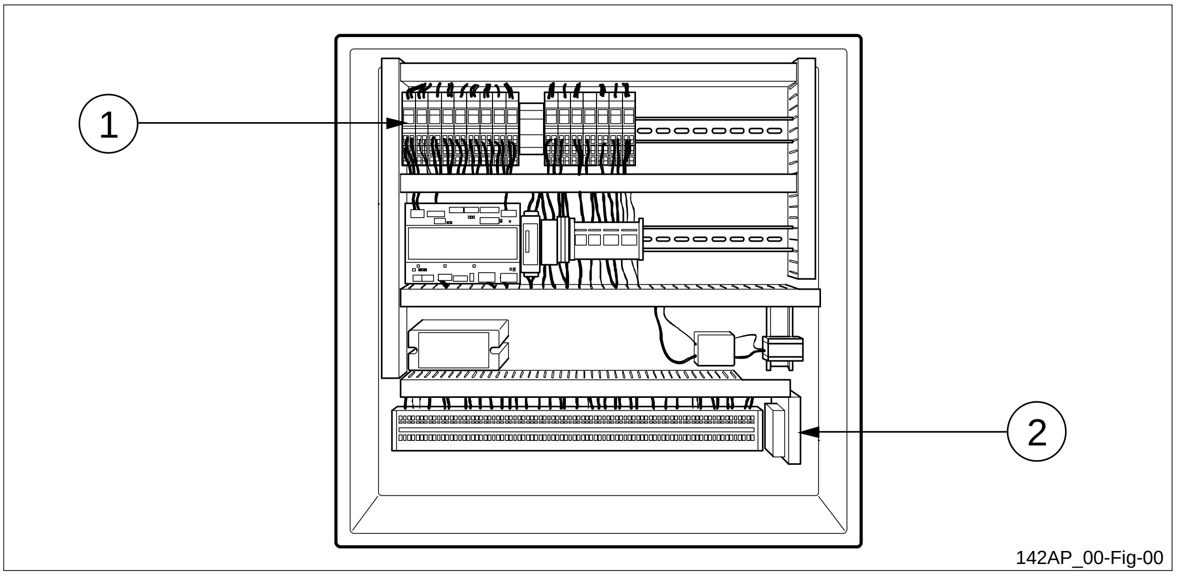

Figure 10 2-pole relays in an HPP unit cabinet.

1. 2-pole relay
2. Automatic fuse

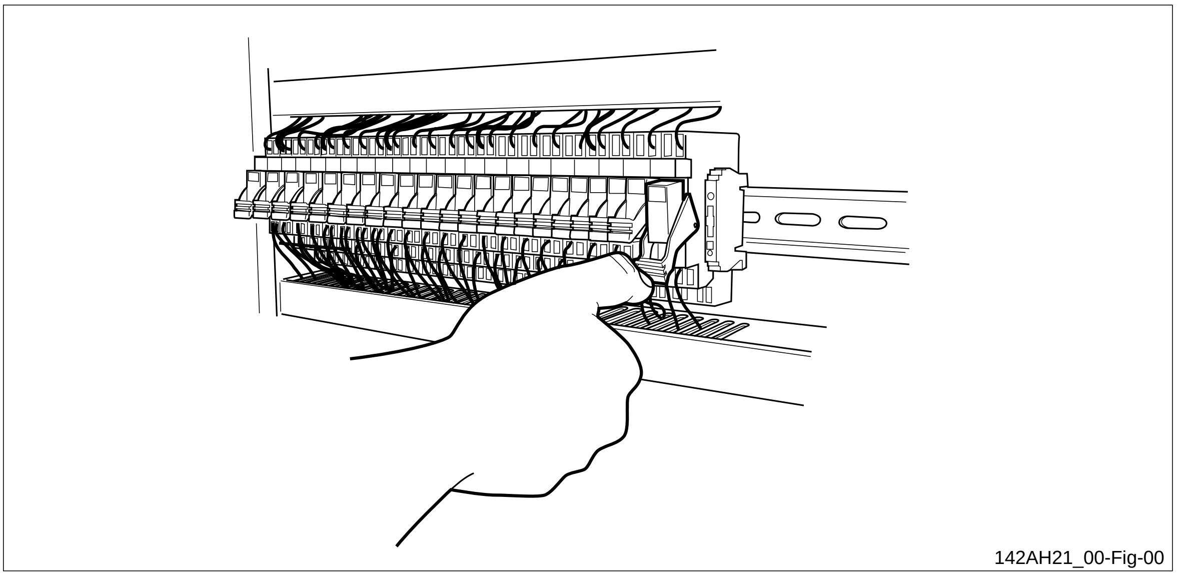

Figure 11 Unlocking a 2-pole relay.

Caution: The electronics cabinets contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these cabinets.

Note: This task must be performed by an electrician.

1. Open the cabinet and make sure the incoming power is interrupted, for example, by setting the automatic fuses (see position 2 in figure 10) to position OFF.
2. Push down the stirrup to unlock the locking mechanism for the relay to be replaced, as shown in figure 11.
3. Pull the failing relay out of the relay socket.
4. Carefully push a spare relay into the socket and push the locking mechanism back into position.
5. Turn on the incoming power. If applicable, reset the automatic fuses to position ON.
6. Close the cabinet.

This task is now completed.

Task: Replace Bistable Relay

Description

This task describes how to replace a bistable relay in the HPP unit cabinet, in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
Bistable relay	3008

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

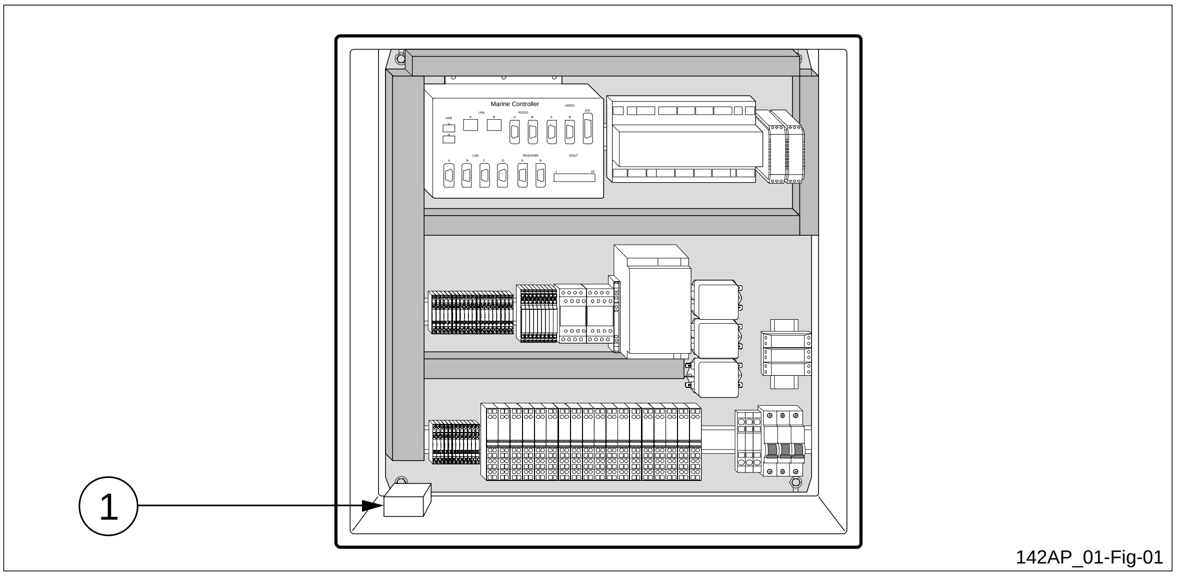

Figure 12 Bistable relay in an HPP unit cabinet.

1. Bistable relay
2. Automatic fuse

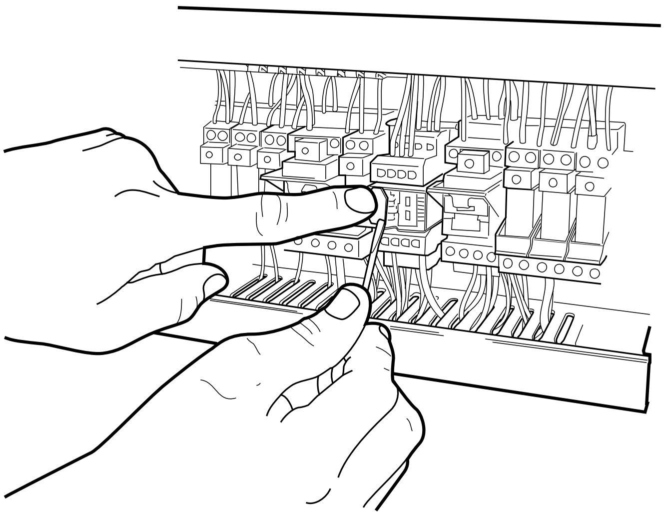

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Figure 13 Unlocking a bistable relay.

Caution: The electronics cabinets contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these cabinets.

Note: This task must be performed by an electrician.

1. Open the cabinet and make sure the incoming power is interrupted, for example, by setting the automatic fuse (see position 2 in figure 12) to position OFF.
2. Pull up the locking mechanism of the relay to be replaced with a screwdriver as shown in figure 13.
3. Pull the failing relay out of the relay socket.
4. Carefully push a spare relay into the socket and push the locking mechanism back into position.
5. Turn on the incoming power. If applicable, reset the automatic fuse to position ON.
6. Close the cabinet.

This task is now completed.

Task: Replace LED

Description

This task describes how to replace a LED in a bridge control panel, ECR control panel, separate RPM panel or in a load control panel, in case of failure.

LEDs can either be replaced from the front side of the panel using a special LED replacement tool, or from the backside of the panel.

Support Items

Spare Part Name	Cross Ref. No.
LED	3009

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1
Special tool for LED replacement (if available)	1

Reference Documents

Consumables	Qty

Instruction

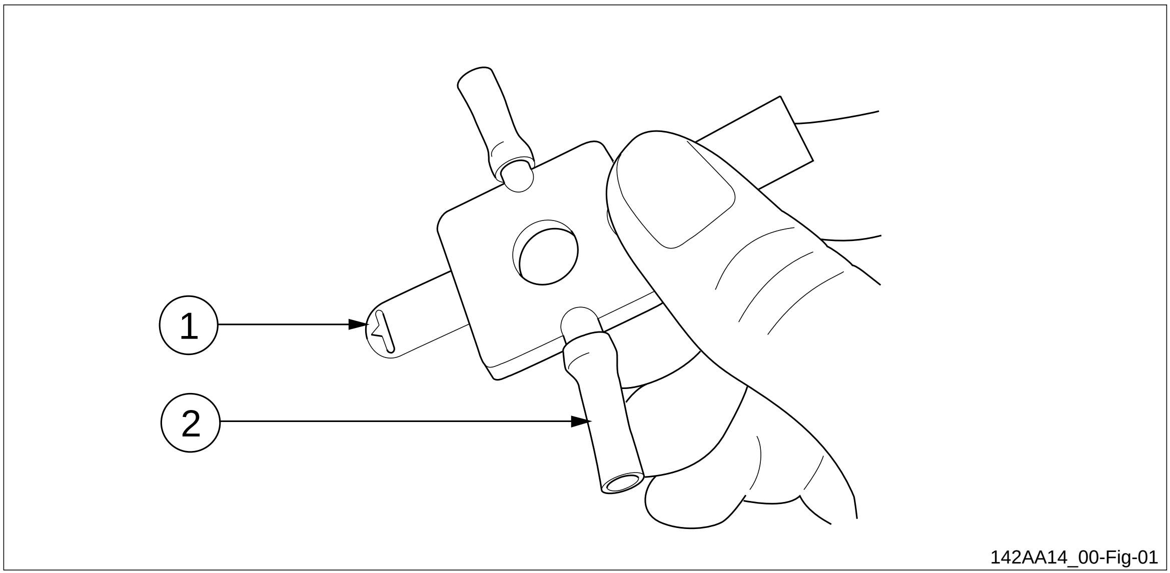

Figure 14 Special LED replacement tool.

1. Pry tool
2. Plastic tube

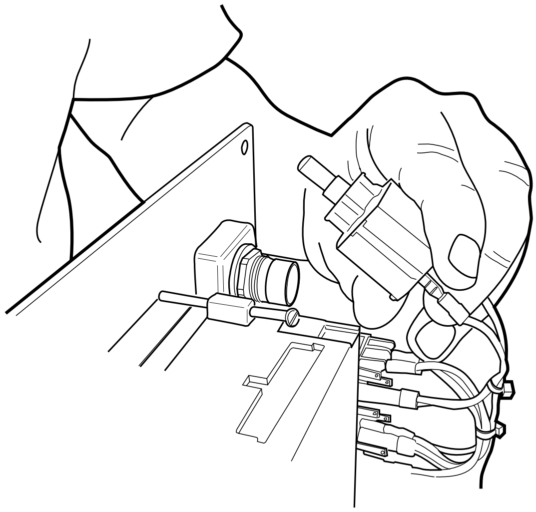

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Figure 15 Replacing a LED from the back side of a control panel.

Caution: The control panels contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work on these panels.

Note: This task must be performed by an electrician.

If the special LED replacement tool is available follow step 1-3 below to replace the failing LED from the front side of the panel.

1. Insert the pry side of the special tool, see figure 14, at the edge of the lamp cover to pry open the lamp and remove the cover.
2. Push the plastic tube that best fits over the LED and pull it out with the special tool.
3. Insert a new LED and push the lamp cover back into position.

If the special LED replacement tool is not available follow step 4-8 below to replace the failing LED from the back side of the panel.

4. Disassemble the protection plate behind the control panel to enable access to the control panel components.
5. Turn the holder of the LED to be replaced about 45 degrees and then pull it out the as shown in figure 15.
6. Pull the failing LED out of the LED holder and replace it with a new one.
7. Push and turn the LED holder back into position.
8. Assemble the control panel protection plate.

This task is now completed.

Task: Replace Pitch Indicator, RPM Indicator or FPS Indicator

Description

This task describes how to replace a pitch indicator, RPM indicator or FPS indicator in a bridge control panel, ECR control panel or in a separate RPM panel or FPS panel in case of failure.

Support Items

Spare Part Name	Cross Ref. No.
One of following:	
Pitch indicator	3011
RPM indicator	3012
FPS indicator	3013

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

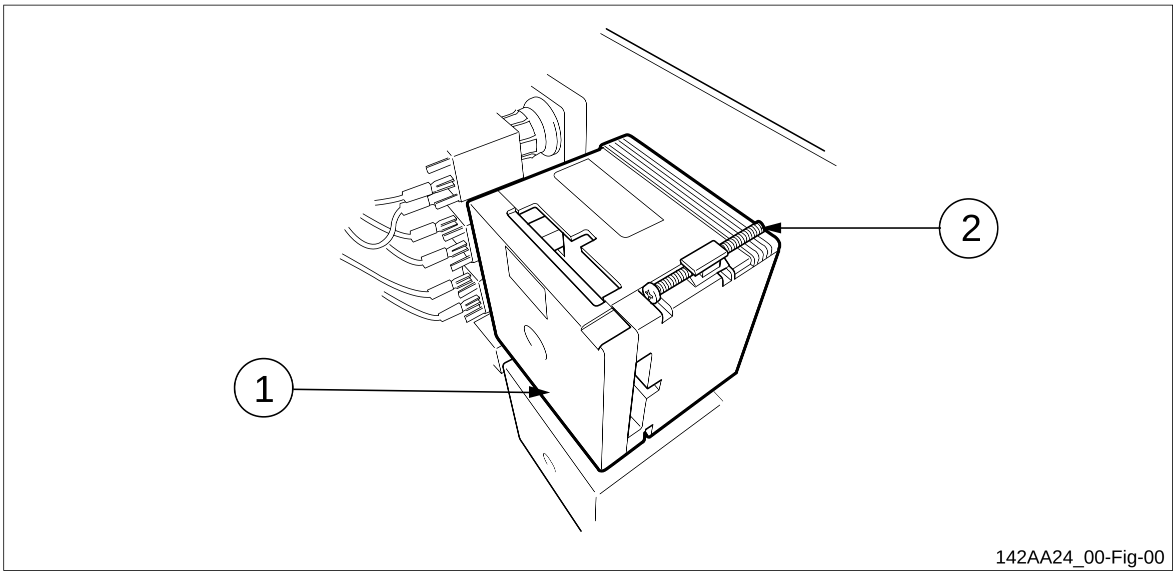


Figure 16 A pitch indicator in an ECR control panel.

1. Pitch indicator backside
2. Fixing screw

Caution: The control panels contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these panels.

Note: This task must be performed by an electrician.

Note: Replacement of an indicator implies adjustment of the instrument's deflection or mechanical zero point afterwards.

1. Make sure the incoming power to the control panel is interrupted, for example, by setting the automatic fuses in the corresponding unit cabinet to position OFF.
2. Disassemble the protection plate behind the control panel to enable access to the control panel components.
3. Disconnect the cables connected to the indicator to be replaced.
4. Remove the 4 fixing screws on the backside of the indicator.
5. Pull out the indicator.
6. Push a spare indicator together with a rubber gasket into place.
7. Tighten the fixing screws and reconnect the cables.
8. Assemble the control panel protection plate.
9. Turn on the incoming power. If applicable, reset the automatic fuses to position ON in the corresponding unit cabinet and close the cabinet.

This task is now completed.

See instruction Adjust Indicator Deflection and Mechanical Zero Point for instructions of how to calibrate the new indicator.

Task: Adjust Indicator Deflection and Mechanical Zero Point

Description

This task describes how to adjust the deflection of a pitch indicator, RPM indicator or FPS indicator in a bridge control panel, and the mechanical zero point in an ECR control panel, to fit the scaling of the indicator to the existing installation, in case the indicator has been replaced.

Support Items

Spare Part Name	Cross Ref. No.

Special/Additional Tools and Test Equipment	Qty
ESD bracelet	1

Reference Documents

Consumables	Qty

Instruction

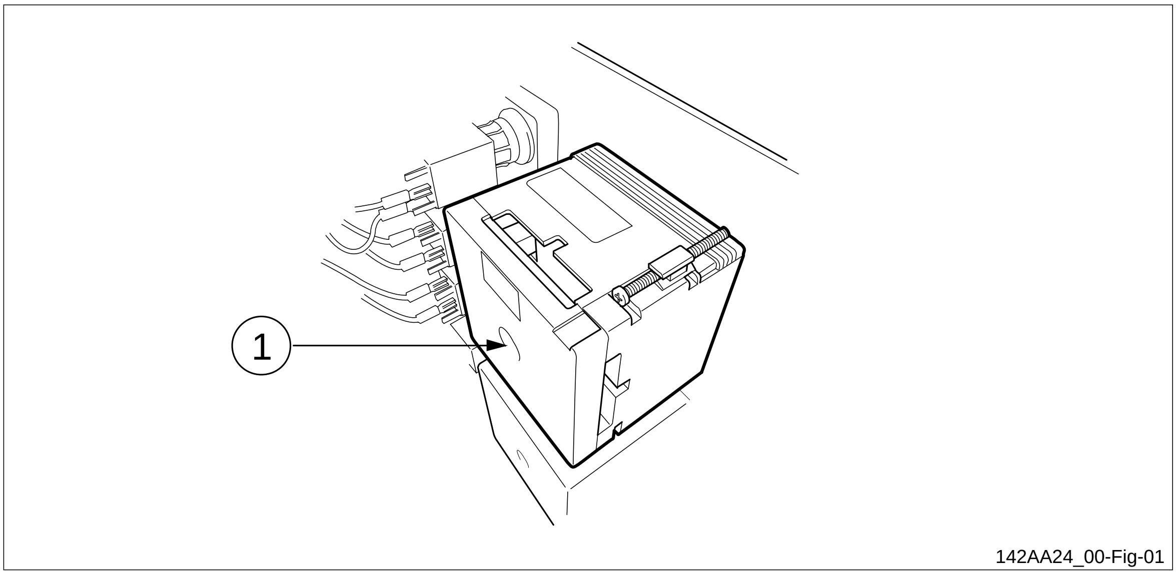


Figure 17 Pitch indicator backside in a bridge control panel.

1. Potentiometer marked “INSTR. ADJ.”

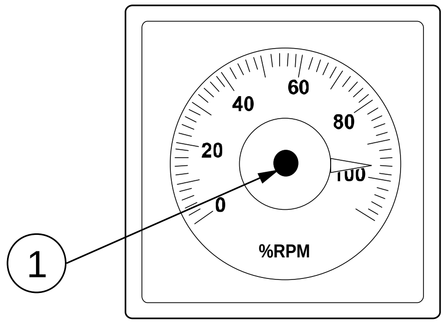


Figure 18 RPM indicator front side in an ECR control panel.

1. Adjustment screw

Caution: The control panels contain components that are sensitive to Electrostatic Discharges (ESD). To avoid damage to the equipment, always use a grounded ESD bracelet when carrying out work in these panels.

Note: This task must be performed by an electrician.

In case the indicator is part of a bridge control station, follow step 1 below to adjust its deflection.

1. By maximum input, or a known input, adjust the deflection of the instrument with the potentiometer on the indicator’s backside, indicated in figure 17. The deflection can be adjusted within +/-10% of full-scale.

In case the indicator is part of an ECR control station, follow step 2 below to adjust its mechanical zero point.

2. With no input signal to the instrument, adjust its zero indication with the adjustment screw on the front side, indicated in figure 18.

This task is now completed.

Handling and Preservation

Introduction

The Handling and Preservation contains information about the following:

Delivery Inspection

All parts of the propeller system must be immediately unpacked and inspected at delivery. For easy identification all of the propeller system parts are marked with a number. Store the parts in original wrap.

If the delivered goods have suffered any damage due to the transport, such as impact damage, scratches, cracks, and so on, it must be reported to the transport insurance company according to Incoterms 2000.

Storage Recommendations

Introduction

These storage recommendations apply to how to store the propeller system before installation, how to store spare parts, and to long time storage of the propeller system.

General Requirements

All parts must be adequately protected during transit and storage against mechanical damage, corrosion, and from long term exposure to aggressive atmospheric conditions.

Parts which are not protected against corrosion at delivery, such as fitting bolts and machine-finished surfaces, must be treated with an anti corrosive agent. Rolls-Royce recommend oil type such as Dinitrol 3641-E or similar.

The propeller system parts that are kept in storage before installation must be inspected weekly and stored spare parts must be inspected twice a year. Any damage found on the parts must be remedied at once.

All parts, such as the hydraulic power pack, OD-box, electronic control system, couplings, propeller blades, spare parts, tools and lifting tools are preferably kept in an indoor warehouse. However, spare parts such as propeller blades, can be stored onboard the vessel. The parts of the propeller system must be stored according to the following conditions:

• The temperature must be between +10 ^{o}C and +55 ^{o}C. Note that temperatures above +35^{o}C will accelerate aging of rubber materials.

• Storage conditions must be such that condensation does not occur.

• Until assembly, store the parts in original wrap in a dry and clean place, that protect parts from moisture, sunlight, mechanical damages, dust and dirt.

• Do not use storage areas with ozone generating equipment.

• Do not use forced circulated air in the storage area.

Specific Requirements

Hydraulic Power Pack

If the storage period exceeds three months, all connections on the hydraulic power pack must be sealed off and the pump units, valves etc. to be filled with oil. The oil must meet the recommendations in document Requirements for Lubricating Oil.

Propeller Hub

If a storage period exceeds three months special treatment of the propeller hub is necessary. The propeller hub, without blades, must be fully submerged in oil during storage. A suitable tank, which is not part of the Rolls-Royce delivery, must be provided by the customer.

The oil must meet the recommendations in section Requirements for Lubrication Oil. The container with the propeller hub is preferably stored in a warehouse.

Propeller Blade

The blades must be handled with care to prevent damage on the blade edges and the blade foot sealing surfaces.

If spare propeller blades are part of the delivery, the blades are preferably stored below deck, but they can be stored on deck, see figure 1 for attachment instruction.

Apply an anti corrosive agent on the blade. When the coating has dried it should be approximately 70-100µm. Secure the blades according to figure 1.

Make sure to inspect and apply new anti corrosive agent on the spare blade once a year. It is important to inspect the underside of the blade carefully since it is especially exposed to the weather conditions.

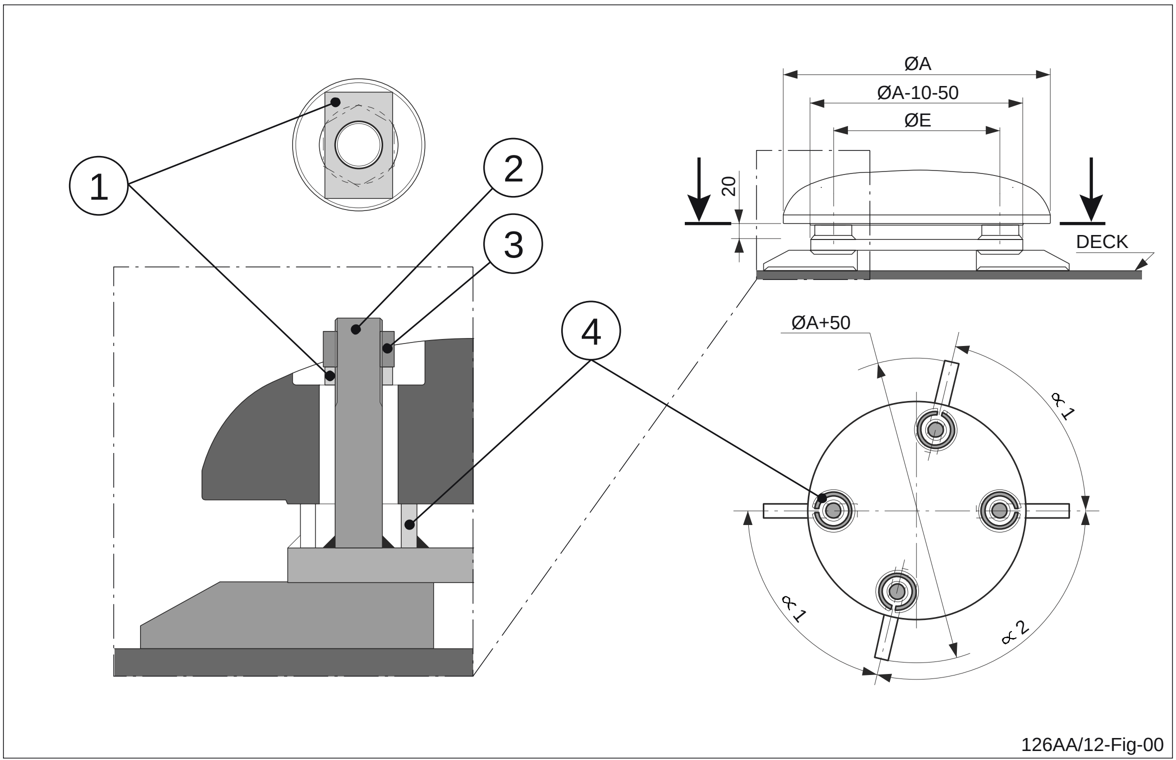


Figure 1 Storage of spare propeller blade.

1. Washer (Galvanized)
2. Stud Bolt (Stainless Steel)
3. Nut (Stainless Steel)
4. Supports (Mild Steel), groove for water drain

Shaft Line Components

Couplings must be stored and handled according to the instructions from the Sub Supplier, see Part Sub Supplier Manuals.

The shafts have been treated with an anti corrosion agent for transport only.

The shafts must be unpacked immediately upon arrival for inspection and treated with an anti corrosive agent. Rolls-Royce recommend an oil type such as Dinitrol 3641-E or similar with a minimum thickness of 120 micron. New anti corrosive agent must be applied at regular intervals according to the manufacturer specification. This is done to prevent corrosion until the time the shafts will be installed in the ship. All parts must be inspected weekly and any damage found must be remedied at once.

The shafts must be stored in a ventilated warehouse with a solid roof of sufficient extent and must be protected against moisture and dust. If an indoor storage is not possible an alternative outdoor storage as described in figure 2 is recommended.

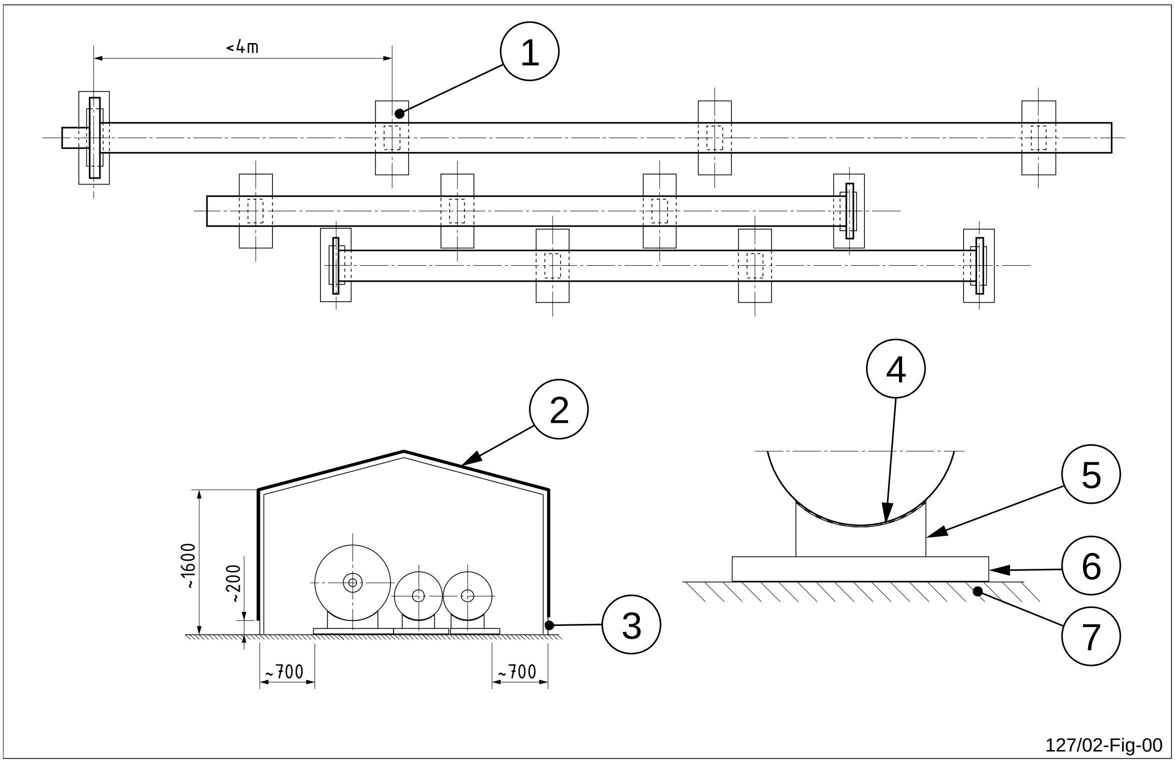


Figure 2 Example of weather-protected, ventilated outdoor storage.

1. Support. Avoid bearing journals and coupling surfaces
2. Tarpaulin or equal
3. Ventilation opening all around
4. Lead plate, thickness approx. 3 mm
5. Wood support
6. Beam
7. Stiff ground

The shafts must be placed on supports with maximum 4 metres distance in between. The support surface must be covered by a non-water absorbing material, for example a lead plate (see figure 2 for more information).

The shafts must be unwrapped and treated with an anti corrosive agent. The supports must be placed on a stiff ground and be well aligned, to ensure the straightness of the shafts.

The shafts must be lifted once a month to inspect the contact surface of the supports. It is possible to partially lift the shaft close to a support by means of a hydraulic jack. A pad must be placed between the hydraulic jack and the shaft when lifting the shaft to prevent it from getting damaged.

The oil tubes must be fitted into the shafts and the hollow boring must be filled with oil which meets the recommendations in document Requirements for Lubrication Oil. This procedure requires blanking flanges, which are not part of the Rolls-Royce delivery, see figure 3 for more information.

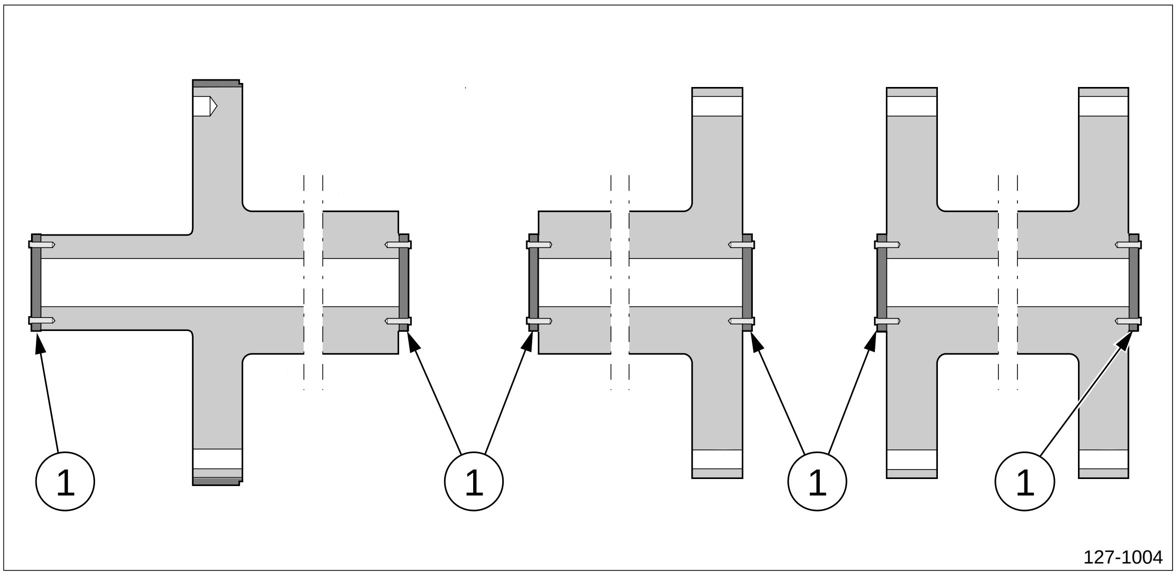


Figure 3 Examples of blanking flanges for propeller shafts and intermediate shafts.

1. Blanking flanges

Storage During Outfitting Time on Board

General Requirements

The general requirements stated in Section Storage Recommendations must be fulfilled.

All parts must be protected against damage from handling and outfitting work, such as grinding and welding spray, impact damage, rain and other weather conditions, long term exposure to aggressive atmospheric conditions, and so on.

During welding on board, the propeller and the shaft line must be carefully earthed to the hull, the contact in the stern tube is not sufficient. Furthermore, the hull must be carefully earthed to the quay. The earthing must be inspected daily during welding periods. It is most important to prevent leaking currents to go through the propeller and shaft line. Leaking current causes cathodic corrosion.

Before starting up, the Harbour Acceptance Test (HAT) must be completed. The underwater parts of the supply must be thoroughly inspected and remedied. Make sure that propeller blades, hub, and propeller shaft are free from marine growth and other foreign objects which can damage the equipment.

Specific Requirements

Propeller Hub

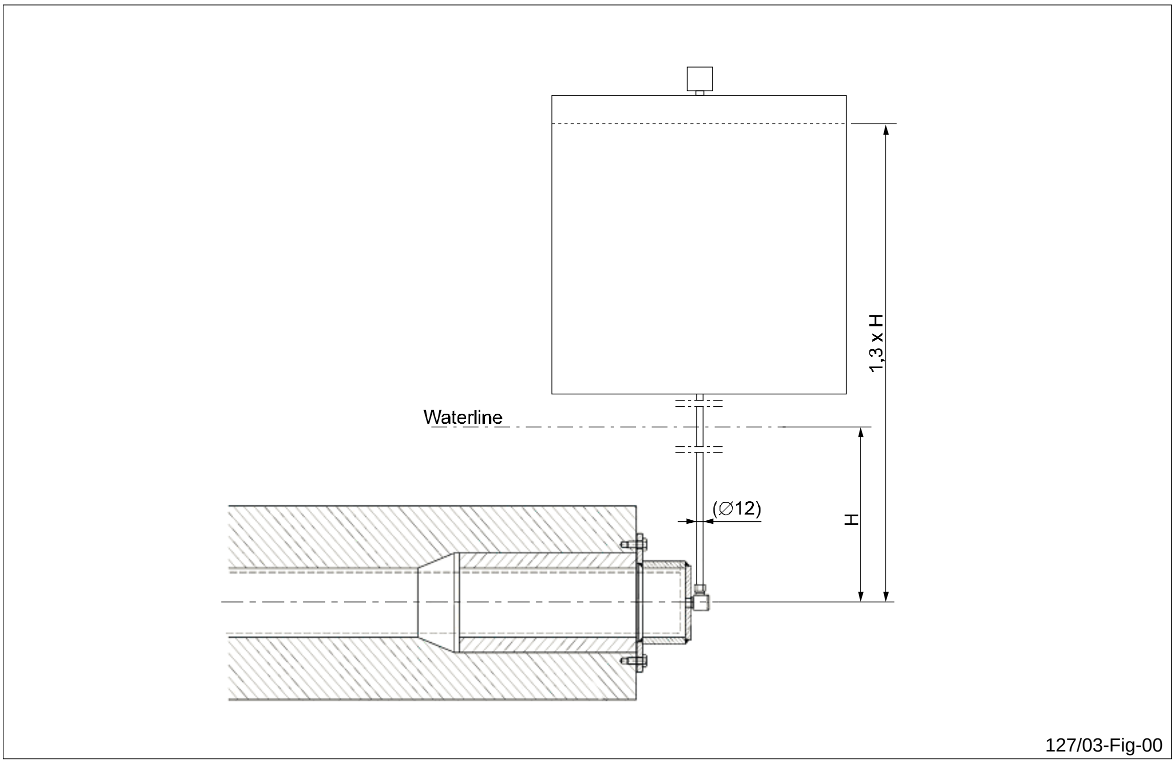


Figure 4 Example of a temporary oil tank.

For corrosion prevention by water entering into the internal parts of the hub it must be filled with oil before launch and a pressure test has to be performed, see part Installation Description. A static over pressure must be maintained during the whole outfitting period. If the hydraulic system cannot be connected, a temporarily tank must be arranged, which is not part of the Rolls-Royce delivery, see figure 4 for an example. The oil must meet the recommendations stated in the section Requirements for Lubrication Oil. As soon as the hydraulic power pack unit has been connected and set to work the pitch must be manoeuvred from full ahead to full astern weekly.

Propeller

Bronze Propellers

To prevent corrosion of sea water exposed parts of the hub and shafts, the following instructions must be followed regarding bronze propellers:

1. The propeller shaft must be earthed to the hull with a special earthing device, designed to be used during the whole life of the vessel. The earthing device function must be inspected weekly. The contact in the stern tube is not sufficient. If the permanent system is not installed, a temporary earthing device, which is not part of the Rolls-Royce delivery, must be arranged during the outfitting period.

2. During welding on board, the hull must be carefully earthed to the welding equipment. To prevent cathodic corrosion this must be inspected daily during periods that welding is in progress on board.

3. The cathodic protection system, zinc or aluminium anodes, must be inspected every second month.

Stainless Steel Propellers

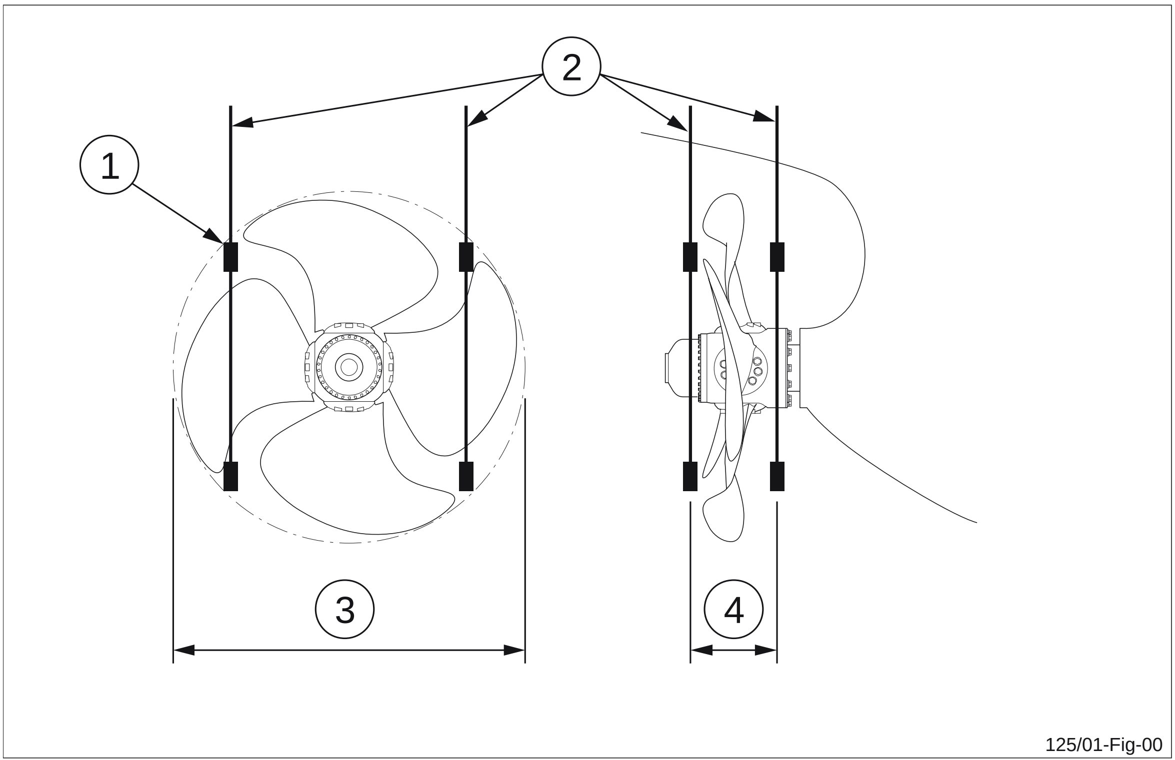


Figure 5 Placement of temporary zinc anodes after launching.

1. Zinc anodes
2. Insulated cables (15-20 mm^2) connected to the hull.
3. Propeller diameter
4. Length of hub body

To prevent corrosion on the parts of the hub and shafts that are exposed to sea water, the following instructions must be followed regarding stainless steel propellers:

1. The propeller shaft must be earthed to the hull with a special earthing device, designed to be used during the whole life of the vessel. The earthing device function must be checked weekly. The contact in the stern tube is not sufficient. If the permanent system is not installed, a temporary earthing device, which is not part of the Rolls-Royce delivery, must be arranged during the outfitting period.

2. During welding on board, the hull must be carefully earthed to the welding equipment. To prevent cathodic corrosion this must be checked daily during periods that welding is in progress on board.

3. After launching, eight zinc anodes must be placed around the propeller, see figure 5. The distances are adjusted according to figure 5. The cathodic protection system, zinc or aluminium anodes, must be inspected monthly. The anodes are to be suspended by insulated electrical cables that are earthed to the hull. It is recommended that warning signs are to be placed at the engine control stand informing that the anodes must be lifted before turning the propeller.

Cathodic Protection for Nozzle Propellers

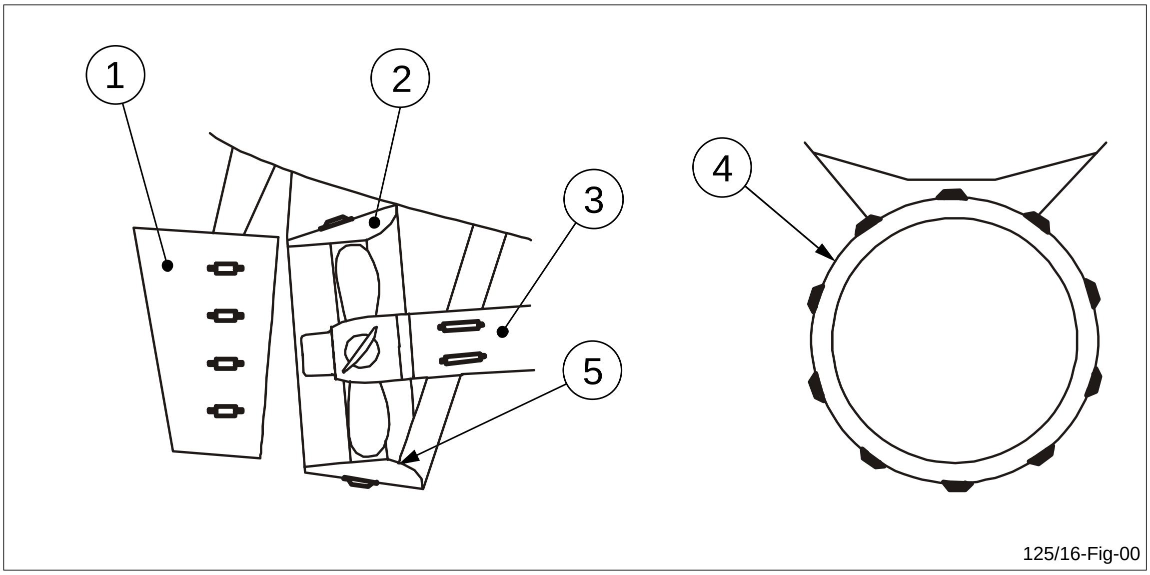


Figure 6 The positions of the sacrificial anodes on the rudder, nozzle, and shaft carrier.

1. Rudder with anodes
2. Nozzle (cut away view)
3. Shaft carrier with anodes
4. Nozzle with anodes
5. Stainless steel cladding

Sacrificial anodes installation

The sacrificial anodes should be made of zinc and may be of either tank type or oblong type. If the anodes are dimensioned to the recommended weight they are calculated to last for about three year.

All anti-corrosion painting should be finished before fitting the anodes. However, the anodes must be in place before launching of the vessel and be effective during the fitting-out period.

Anodes on the nozzle

Sacrificial anodes must be installed on the outside of the nozzle. The total weight of the anodes should be about 14 x D x D in kilograms. Where D is equal with the propeller diameter in meter. This formula is only valid for anodes made out of zinc.

Anodes on the rudder

Standard rudder anodes must be installed on the rudder. The total weight of the sacrificial anodes should be 1/3 of the weight of the anodes installed on the outside of the nozzle.

Anodes on the shaft carrier

Four sacrificial anodes must also be installed on the shaft carrier. The total weight of all four of the anodes should be 1/3 of the weight of the anodes installed on the outside of the nozzle.

Shaftline Components

After installation, open areas between bearings on inboard shafts, must be treated with an anti corrosive agent such as Dinitrol, Tectyl, painting, or similar protection.

The shafts must be inspected for corrosion and be rotated approximately a half turn at least once a month.

Pump Motor Starter Cabinets

The main switch on the pump motor starter cabinet must be turned to off during the outfitting period onboard.

The cables should be connected as late as possible and after that all welding work is finished.

The cabinets must be tight, that is, the doors must be closed and the flanges mounted to prevent moisture and dust to enter the unit.

When grinding work is carried out the starters must be protected against grinding flares and grinding dust.

The pump motor starter equipment should also be covered when painting work is performed near the control system.

Where there is a risk of mechanical damage, special protection equipment must be arranged to protect the pump motor starter parts.

After mounting the pump motor starter unit must be inspected and cleaned before start-up.

Control System

When the components are installed they should be disconnected electrically where possible until the system is to be started up, that is:

- The automatic fuses should be disconnected.
- The PC-boards should be disconnected.
- The terminals should be disconnected.
- The cable connections should be disjointed, etc.

The cables should be connected as late as possible and after that all welding work is finished.

The cabinets must be tight, that is, the doors must be closed and the flanges mounted to prevent moisture and dust to enter the unit.

When grinding work is carried out the control panels must be protected against grinding flares and grinding dust.

The control system equipment should also be covered when painting work is performed near the control system.

Where there is a risk of mechanical damage, special protection equipment must be arranged to protect the control system parts.

After mounting the control system units must be checked and cleaned before start-up.

Permanent Protection of the Propeller Against Corrosion

The propeller must be provided with an effective protection against corrosion. When designing the cathodic protection for the hull the current absorption of the propeller must also be considered.

For a cathodic protection system about 250 mA/m^2 propeller surface is needed. If sacrificing anodes are used the supplier of these must dimension the anodes so that required life span and current density is obtained.

If an impressed current system is used the supplier of this system must locate and dimension the anodes so that required current density is obtained. The system must always be connected even when the vessel is at quay.

Even if the hull is protected against corrosion by means of a modern painting system, for example two-component Epoxy, cathodic protection of the propeller is necessary. On vessels where such painting systems are used the current density (250 mA/m^2) must be increased by 25-50% as the hull cannot protect the propeller in the same way as when the hull is painted with standard paint.

The cathodic protection does not only protect the propeller but also the hull, which due to potential differences between hull and the propeller can be exposed to corrosion attacks if the hull plating is damaged.

Procedures during Long Period of Inactivity

Preparation of the Vessel

The following conditions must be fulfilled if the vessel is to be in harbour for a long period of time (idle in harbour for more then two weeks).

- The general requirements stated in Section Storage Recommendations must be fulfilled.
- The static pressure pump unit P3 must not be shut off. If the vessel is equipped with a gravity tank the pump unit P3 is started and stopped by a level switch in the gravity tank. If the vessel is not equipped with a gravity tank the pump unit P3 must be running constantly to prevent water from entering the hub.
- If the vessel is equipped with a propeller made of stainless steel, eight temporary zinc or aluminium anodes must be placed around the propeller, see figure 5. The anodes are suspended by insulated electrical cables that are earthed to the hull. It is recommended that warning signs are to be placed at the engine control stand informing that anodes must be lifted before turning the propeller.
- Switch off the remote control system by the switches in the central unit cabinets placed on the bridge, in the control room, and close to the hydraulic power pack unit.

Inspections and Procedures

Weekly Inspection

- Turn the shaft approximately 1.5 rotations once a week. Use the turning equipment on the gear if the vessel is equipped with such. The rotation of the shaft is necessary to prevent the shaft from being curved and to lubricate the contact surfaces in bearings and sealings.
- Start pump unit P1 and P2 and manoeuvre the pitch from full ahead to full astern and back to zero position. This manoeuvre must be done in order to lubricate the blade sealing rings under each blade foot. If the blade sealing ring is not lubricated they may get damaged during start-up. This procedure will also allow the valves in the hydraulic system to move, which prevents them from getting stuck.
- Inspect the propeller system. Make sure that there are no oil leakage, no signs of corrosion or other damage caused by for example noxious animals. If the coating of anti corrosive agent is damaged or if other damage is found it must be remedied immediately.

Every Second Month Inspection

- Inspect the cathodic protection system, zinc or aluminium anodes, every second month. Replace the anodes before they are consumed.

Before Start-up of the Vessel

- The propeller shaft, propeller hub, and blades must be cleaned from marine growth before start-up of the propeller system. Any other foreign objects, which may damage the propeller equipment during the start-up, must also be removed.
- If the vessel is equipped with a stainless steel propeller, lift the zinc anodes up prior to take off.

Lifting Instructions

General Information

If lifting tools are part of Rolls-Royce delivery these must be protected with an anti-corrosion agent after use.

Propeller Shaft

Warning: It is important that only qualified personnel perform the lifting.

Caution: Make sure to insert the shaft in a straight line so that pipes and other equipment in the stern tube do not get damaged.

Caution: The propeller shaft must be thoroughly cleaned from dust and dirt, otherwise it might get scratched during insertion. It must also be well lubricated to allow it to run smoothly through the stern tube bearings.

Caution: Protect the propeller system parts from dust and dirt during the lifting and installation procedure. Cover the parts in a proper way.

Caution: Use only clean soft slings when lifting to prevent damage on the propeller shafts.

The propeller shaft can be inserted into the stern tube either with or without the propeller hub mounted. If the propeller hub is to be mounted later, all fittings concerning the hub installation must be placed on the shaft before insertion into the stern tube.

Note the placement of the soft slings when lifting.

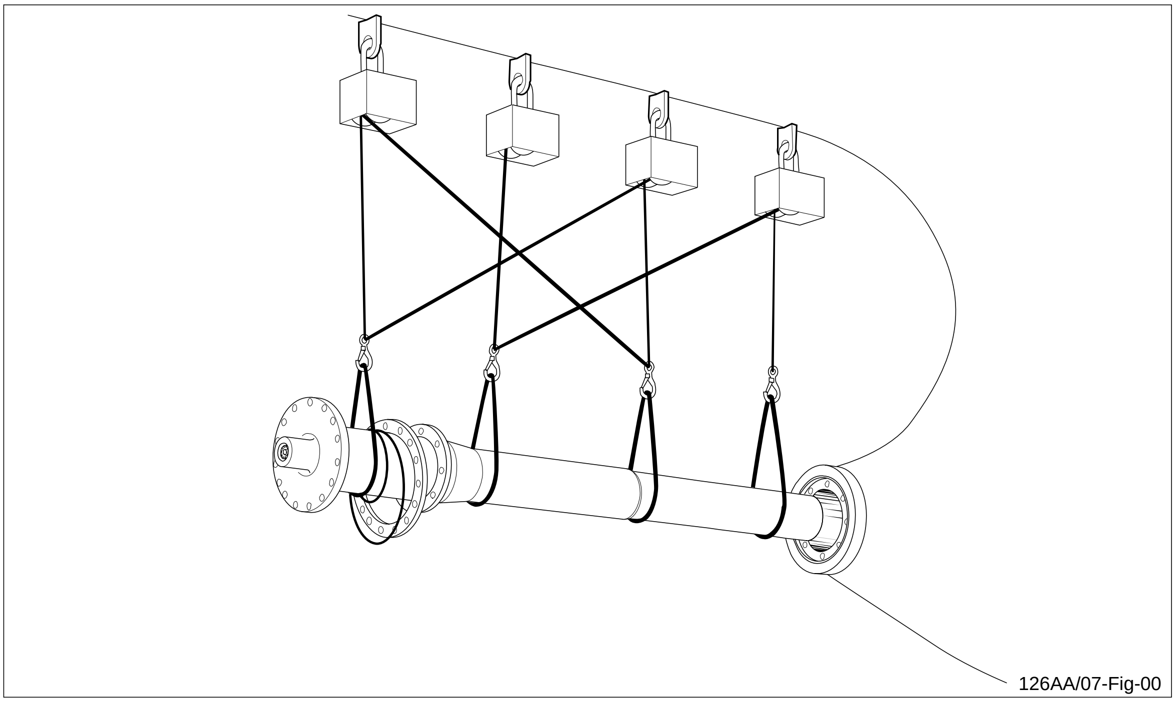


Figure 7 Lifting of propeller shaft with necessary hub mounting equipment.

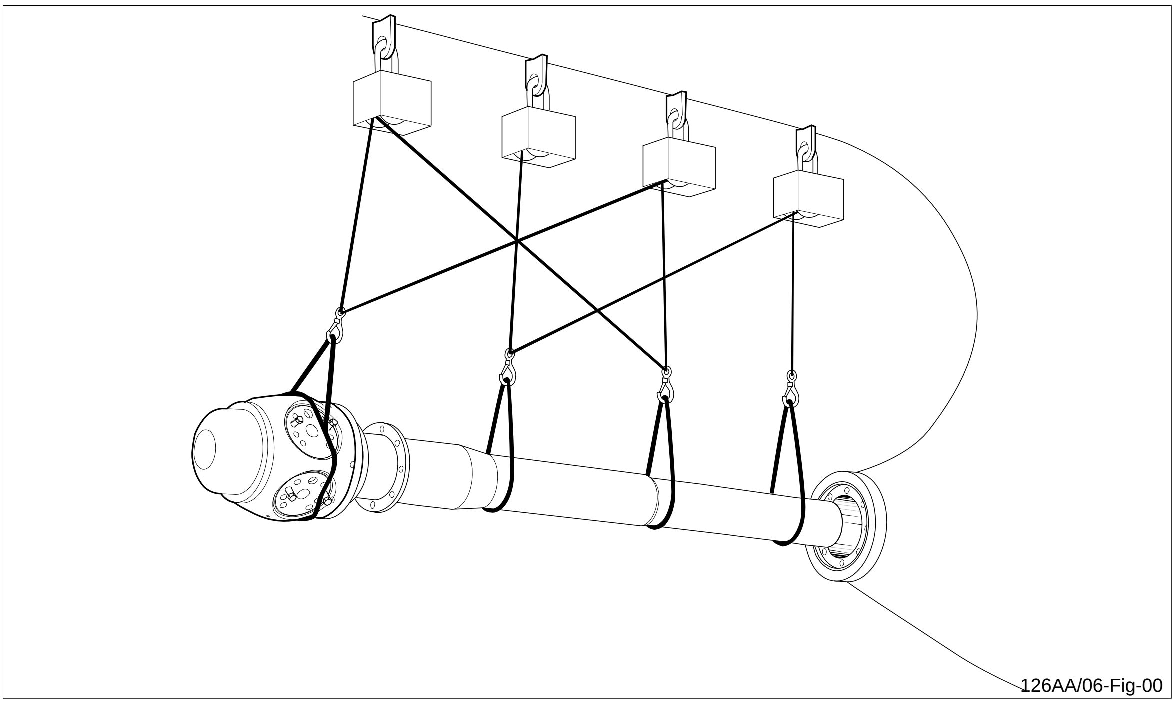


Figure 8 Lifting of propeller shaft with propeller hub mounted.

- Lift the propeller shaft in chain blocks just in front of the stern tube hole as shown in figure 7 and figure 8.
- Prepare for the stern tube sealing.

Twin/Single Tube

The twin/single tube is normally mounted in its respective shaft at delivery. This lifting instruction is applicable if the twin tube is delivered separately.

Warning: It is important that only qualified personnel perform the lifting.

Caution: Use only clean soft slings when lifting to prevent damage on the twin/ single tube.

Caution: Take care during the installation to prevent the twin/single tube from getting damaged. Support the twin tube in several places during installation.

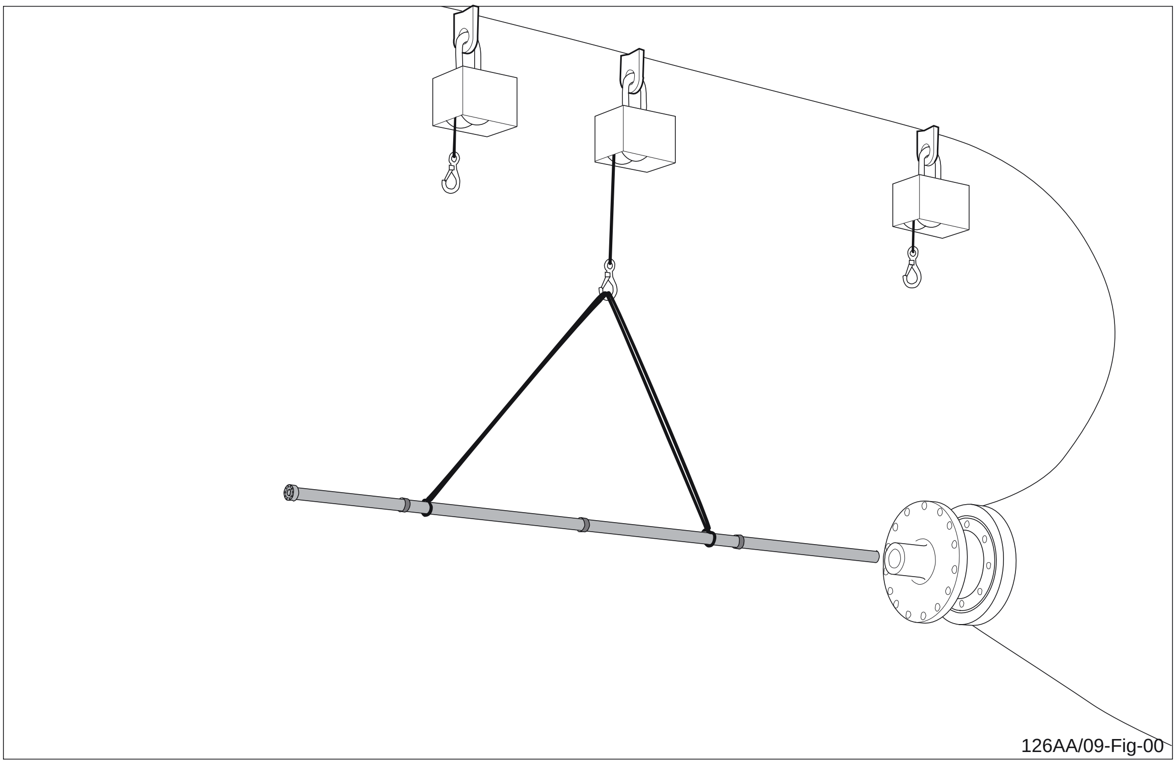


Figure 9 Lifting of the twin/single tube.

• Lift the twin tube assembly in front of the propeller shaft as shown in figure 9.

Propeller Hub

Warning: Never work alone when lifting heavy components. Most lifting operations require two persons, one who operates the lifting device and one who prevents the components from getting damaged.

Warning: It is important that only qualified personnel perform the lifting.

Caution: The lifting tools from Rolls-Royce is dimensioned to lift the weight of the propeller hub only. Do not use the lifting tools if the lift includes the propeller blades or if the hub is attached to the propeller shaft.

Caution: Protect the propeller system parts from dust and dirt during the lifting and installation procedure. Cover the parts in a proper way.

Caution: Use only clean soft slings when lifting to prevent damage on the propeller hub.

Lifting the propeller during installation can be performed by using one of the following methods depending on the size of the propeller hub:

- Using lifting yokes
- Slinging around the hub
- Slinging around the blades

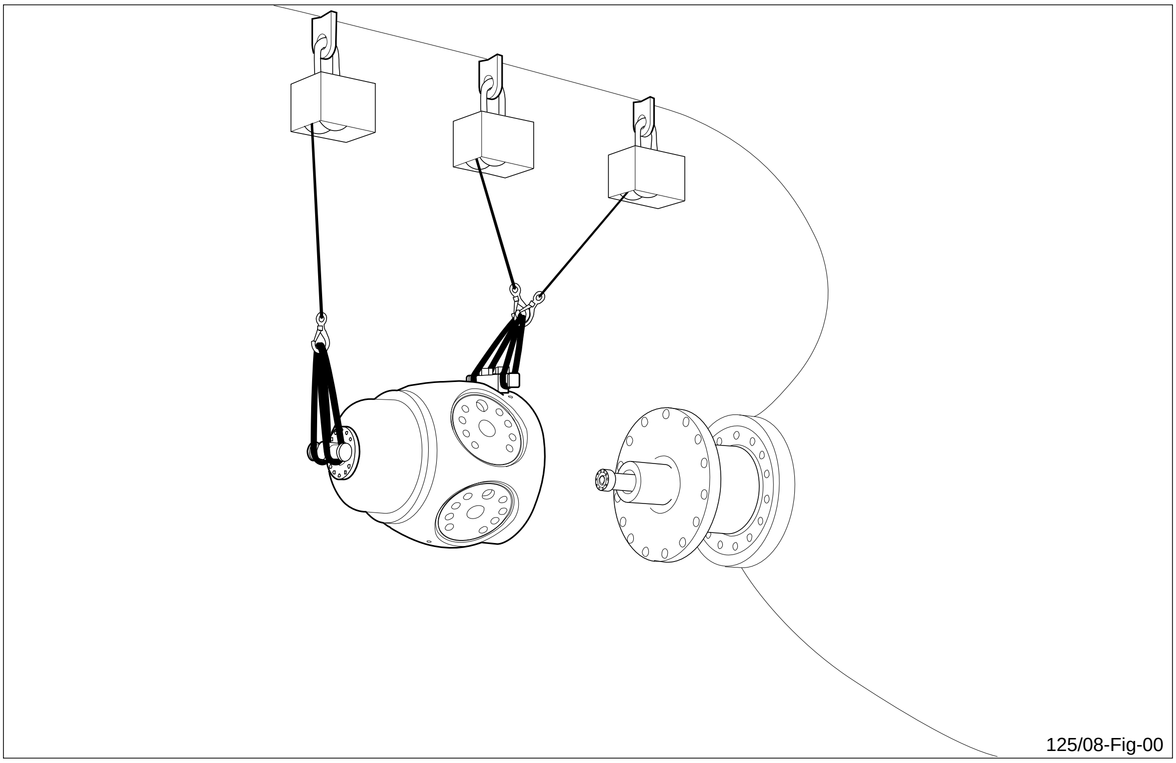


Figure 10 Lifting a large hub using lifting yokes.

Using Lifting Yokes

For propeller hubs size 102 and larger, lifting yokes are included in the delivery from Rolls-Royce. The lifting tools from Rolls-Royce are dimensioned to lift the weight of the propeller hub. Do not use the lifting tools if the lift includes the propeller blades or if the hub is attached to the propeller shaft.

Mount one of the yokes in the lifting holes on the hub cylinder and one in the lifting holes on the hub body. Fit soft slings according to figure 10.

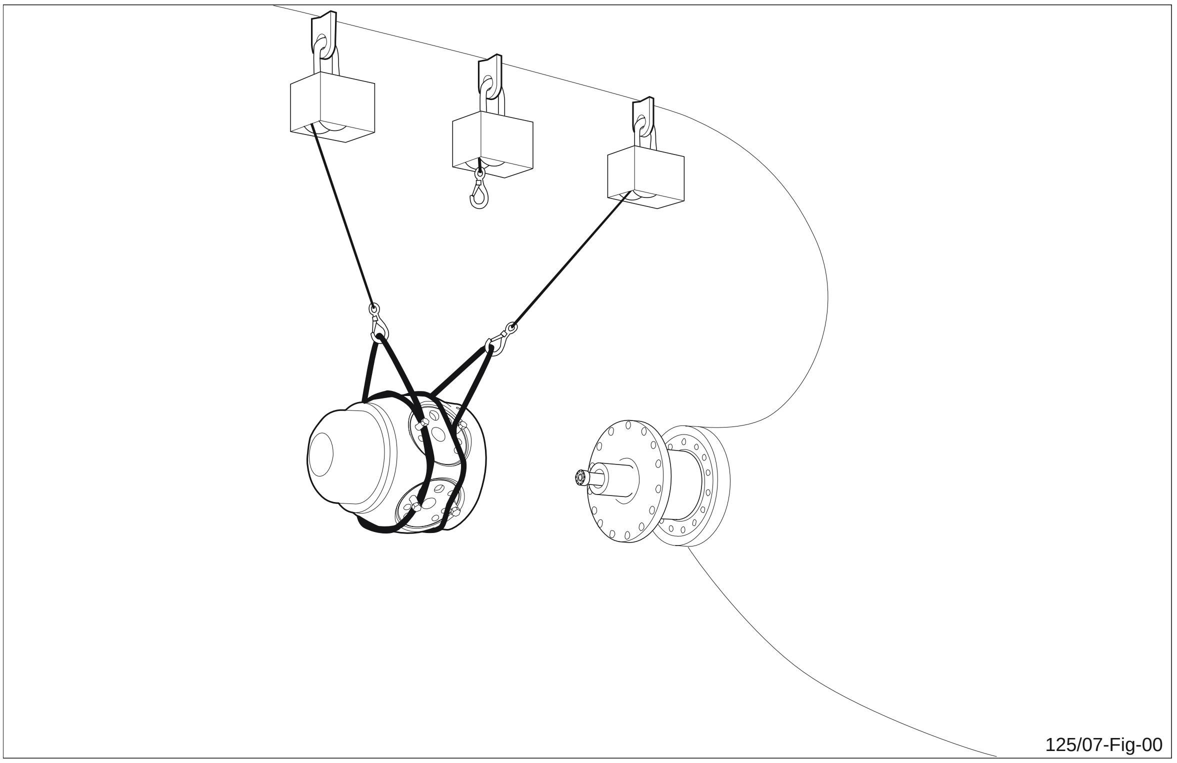


Figure 11 Lifting of propeller hub without blades.

Slinging around the hub

For medium sized propeller hubs, the hub can be lifted by slinging soft slings around the hub. To prevent the soft slings from sliding off the hub, a sufficient number of blade bolts are threaded into position, see figure 11.

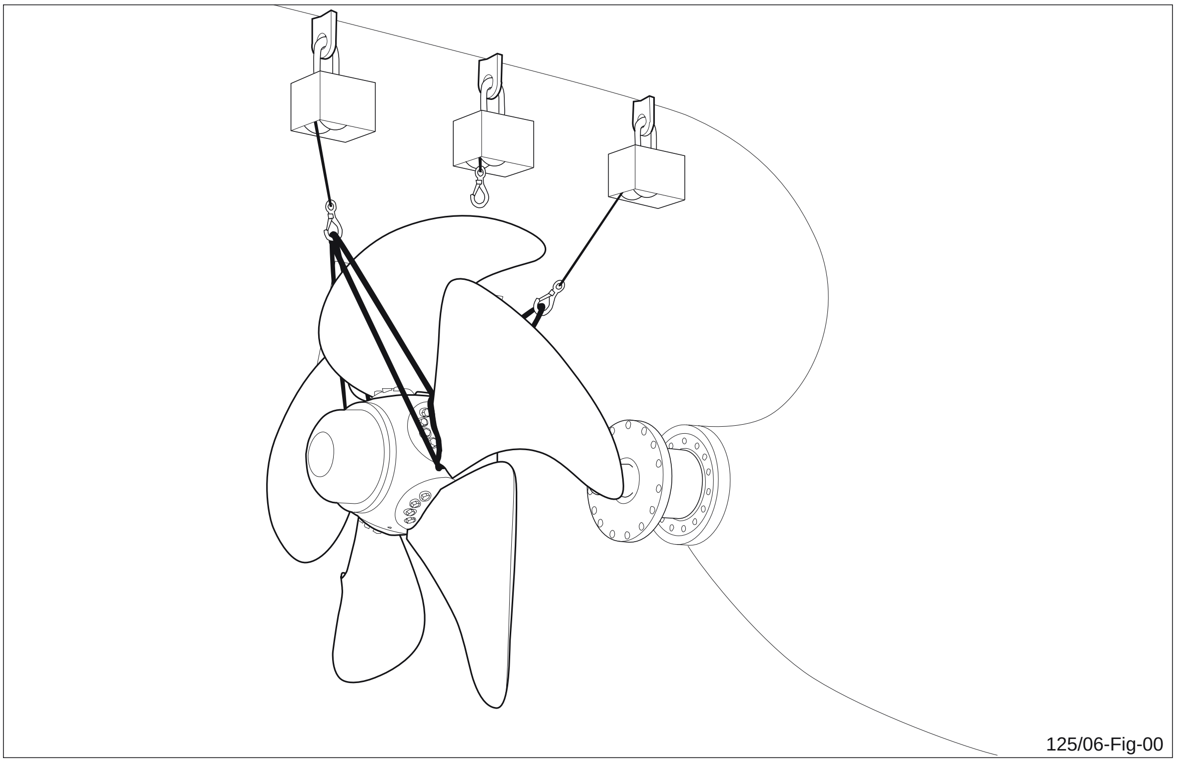

125/06-Fig-00

Figure 12 Lifting of propeller hub with mounted blades.

Slinging around the blades

For small sized propellers it is many times sufficient to lift and install them by slinging the propeller around the blades during the lifting and installation process, see figure 12. This method can be considered if the weight is below five tons.

Propeller Blade

Lifting Instruction using the Lifting Hole in the Propeller Blade

Description

This task describes how to lift the propeller blades using the lifting hole in the blade. To be able to use the lifting hole a plug must be removed and a protection sleeve fitted in the lifting hole. This instruction also describes how to reinstall the plug in the lifting hole.

Support Items

Spare Part Name	Cross Ref. No.
Crack bolt	4002

Special/Additional Tools and Test Equipment	Qty
Standard welding machine	1
Standard grinding machine	1
Standard lithe	1

Reference Documents
Hub Assembly drawing

Consumables	Qty
Grinding disks	As req.
Electrodes, ISO E 23.12.2	As req.
Kamewa bolt head sealing compound	As req.
Linen rags	As req.

Instruction

Remove Lifting Hole Plug and Lift the blade

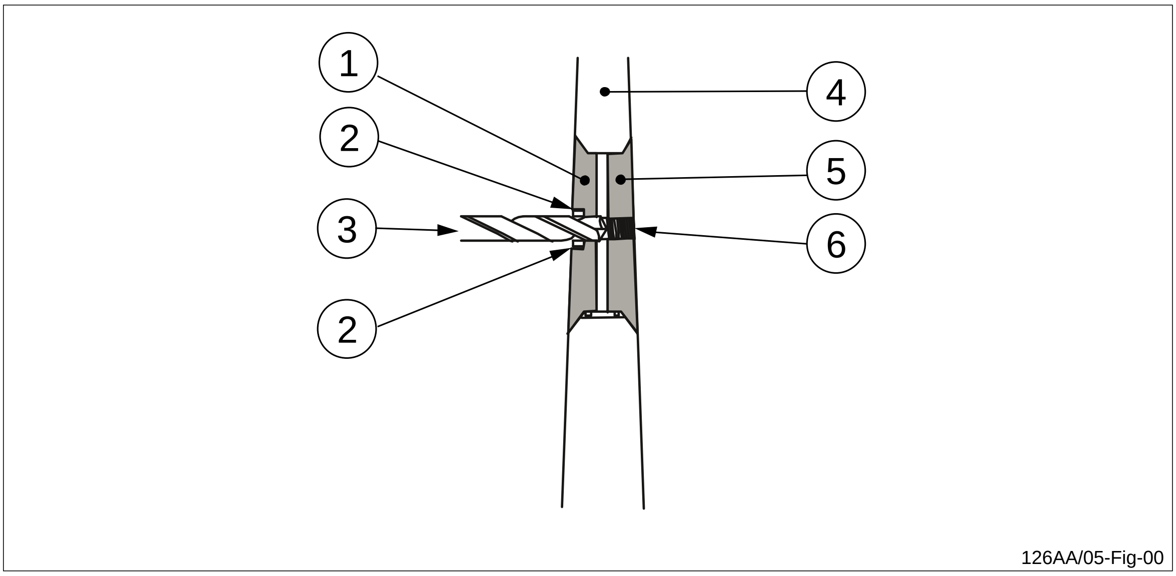


Figure 13 The crack bolt head must be drill out before removing the lifting hole plug.

1. Lifting hole plug half, pressure side
2. Spot welding
3. Drill
4. Propeller blade
5. Lifting hole plug half, suction side
6. Crack bolt

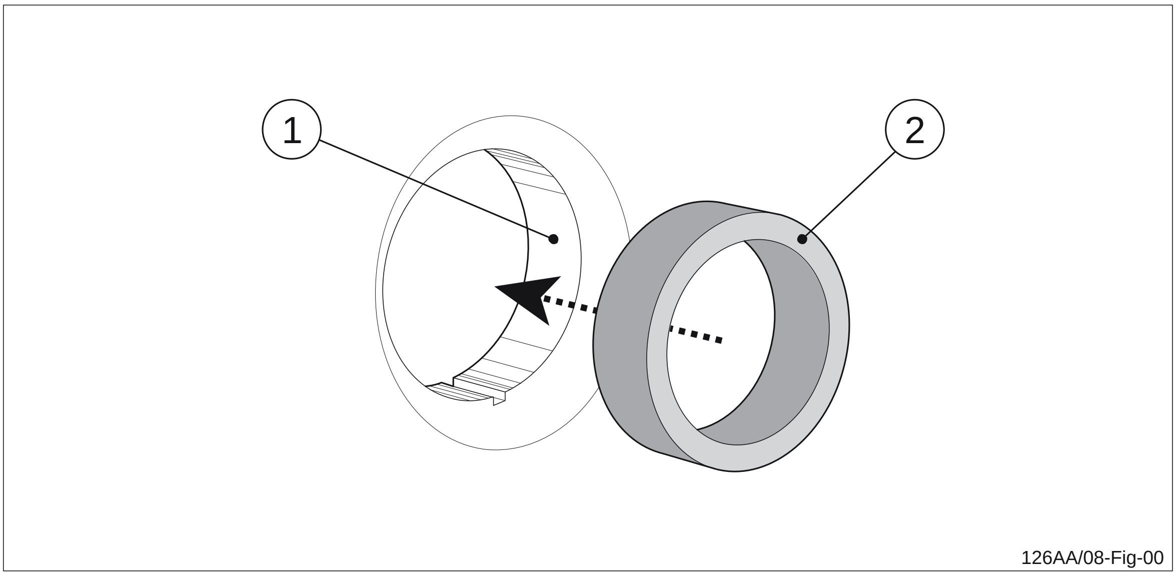


Figure 14 The protection sleeve for the blade lifting hole.

1. Lifting hole
2. Protection sleeve

Warning: Never work alone when lifting heavy components. Most lifting operations require two persons, one operate the lifting device and one ensure that the components do not get damaged.

Caution: It is important that only qualified personnel perform the lifting.

Caution: Use only clean soft slings when lifting to prevent damage on the blades.

Note: The plug halves have the same manufacturing number as its respective propeller blade.

Make sure that proper lifting equipment are available. Weld brackets onto the ships hull or use a mobile crane to lift the propeller blades.

The lifting hole plug is fasten with a crack bolt and the crack bolt head has to be drilled out before removing the plug.

Remove the lifting hole plug

1. Use a drill with a diameter of 6 mm to pre-drill a hole in the centre of the crack bolt head.
2. Use a drill with a diameter of 13.5 mm or 18 mm and drill, to a depth of approximately 10 mm, until the head loosens from the crack bolt (see figure 13). When the head has loosened do not drill any deeper.
3. Remove the plug half on the pressure side of the propeller blade.
4. Unthread the remaining part of the crack bolt and remove the plug on the suction side.

Fit protection sleeve and lift the blade

5. Attach clean soft slings to the propeller blade using the lifting hole. Use soft slings suitable to lift the weight of the propeller blade. Make sure that the lifting is performed by qualified personnel.
6. Unscrew and remove the blade bolts (for more information see Task: Remove Propeller Blade in part Maintenance).
7. Lift the propeller blade. The blade must be lifted straight upwards and be kept in horizontal position until the blade has come off the guide pins.

8. Place the blade with the blade flange down on a clean wooden foundation.

When the protection sleeve is not used it must be lubricated and treated with corrosive preventive agent. It must then be stored together with other lifting tools or spare parts.

This task is now completed.

Plug the Lifting Hole

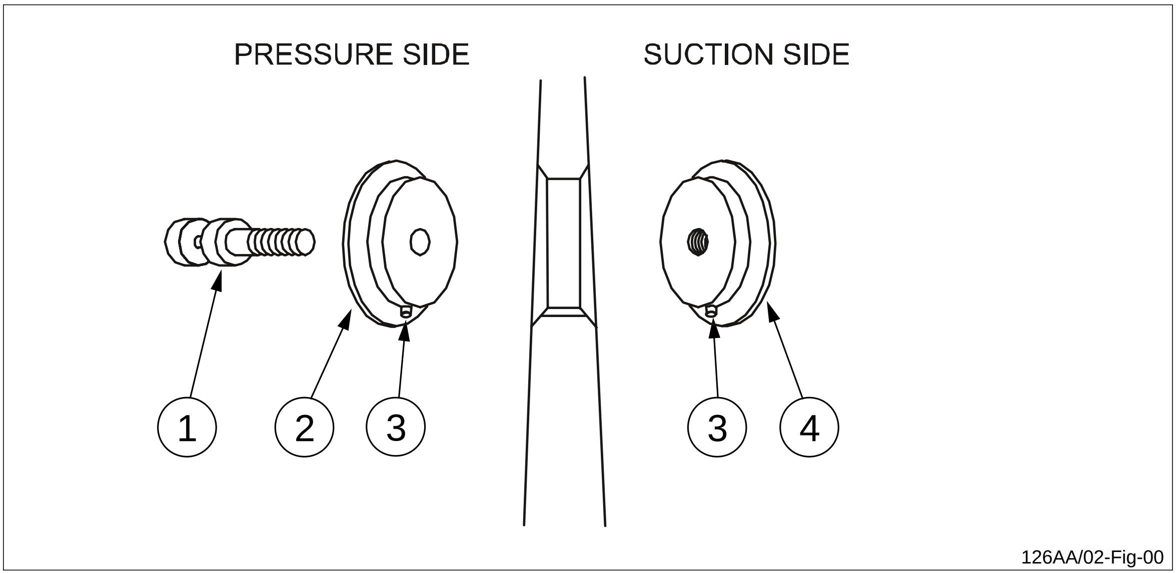


Figure 15 The two plug halves are pre-machined to fit in its propeller blade.

1. Crack bolt
2. Lifting hole plug half, pressure side
3. Position pin
4. Lifting hole plug half, suction side

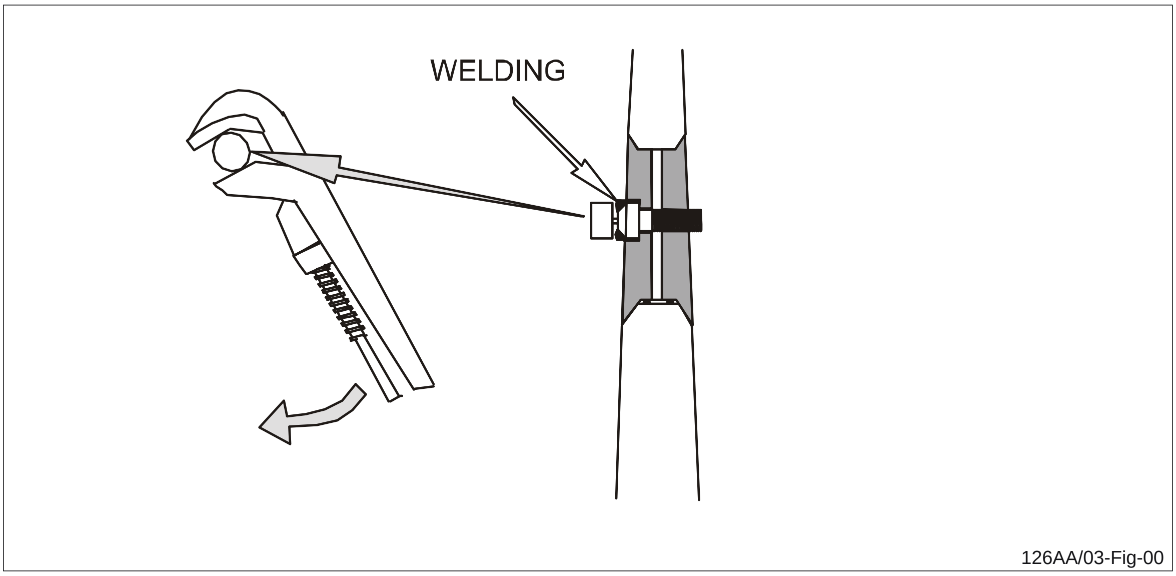


Figure 16 The crack bolt is secured by welding.

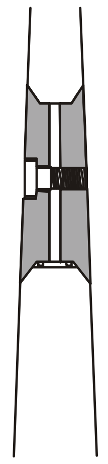


Figure 17 The installed plug in the lifting hole.

Caution: Do not grind on the propeller blade.

Note: The lifting hole plug halves have the same manufacturing number as its respective propeller blade.

The plug halves is pre-machined to fit the lifting hole perfectly. Make sure to fit the suction side plug half on the suction side of the propeller blade and vice versa. Each plug has to be fitted in the correct blade, note that the blade and the plug halves are marked with the same manufacturing number. The plug halves are marked on the inside.

Install the lifting hole plug

1. Use a lathe or a facing cutter to turn out the spot welds that fastens the remaining part of the crack bolt head to the plug (see position 2, in figure 13). Remove the crack bolt head.
2. Make sure that the existing plug halves are intact and can be reinstalled. The position pins (see figure 15 position 3) must be intact.
3. Lubricate the lifting hole and the plug with Kamewa sealing compound or similar corrosion protection before installing the plug.
4. Insert the plug halves in the lifting hole according to figure 17.
5. Use a new crack-bolt and tighten the crack-bolt until the crack bolt head breaks off (see figure 16).
6. Lock the crack-bolt by spot welding.

7. Grind down the crack-bolt on both sides of the blade until the bolt is levelled with the surface of the lifting plug. Do not to grind on the propeller blade.

For more detailed instructions on how to install the lifting hole plug, please contact Rolls-Royce Global Support Network.

Lifting Instruction for Blades without Lifting Hole

Warning: Never work alone when lifting heavy components. Most lifting operations require two persons, one operate the lifting device and one ensure that the components do not get damaged.

Caution: It is important that only qualified personnel perform the lifting.

Caution: Use only clean soft slings when lifting to prevent damage on the blades.

Make sure that proper lifting equipment are available. Weld brackets onto the ships hull or use a mobile crane to lift the propeller blades.

1. Fit clean soft slings around the blade and the blade foot. Use soft slings and lifting equipment that are suitable to lift the weight of the propeller blade. Note that the lifting of the propeller blade must be performed by qualified personnel.
2. Unscrew and remove the blade bolts (for more detailed information see Task: Remove Propeller Blade in part Maintenance).
3. Lift the propeller blade. The blade must be lifted straight upwards and be kept in horizontal position until the blade has come off its guide pins.
4. Place the blade with the blade flange down on a clean wooden foundation.

OD-box (FA)

Use soft slings as shown in figure 18 and figure 19.

Depending on the OD-box size there are two ways of lifting the OD-box, see figure 18 and figure 19.

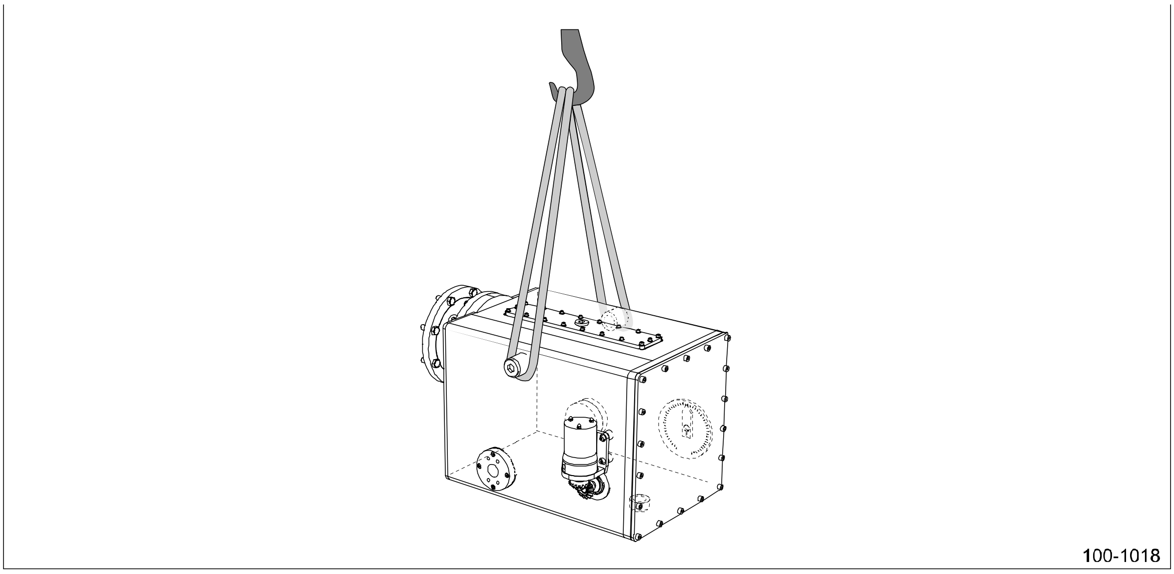


Figure 18 Lifting of OD-box (FA) size 70, 100 and 140.

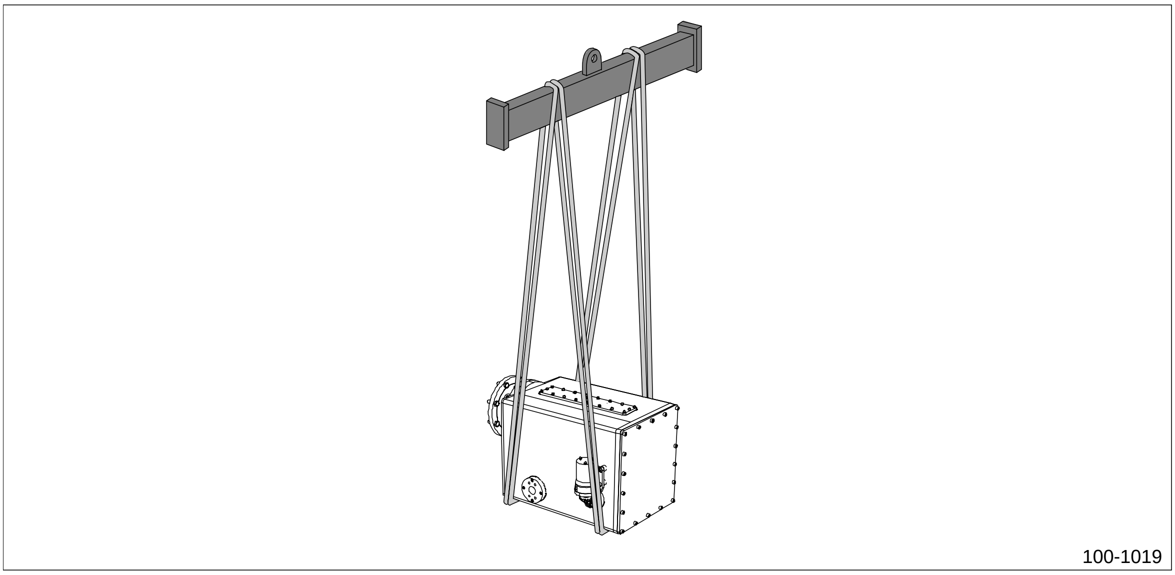


Figure 19 Lifting of OD-box (FA) size 35, 50 and 70.

OD-box (M0)

Caution: Use clean soft slings to prevent the OD-box from getting damaged.

Caution: Do not lift in box housing or feed back sleeve.

The lifting of the OD-box (M0), is performed as when lifting an intermediate shaft, but it is not permitted neither to lift in the box housing, nor in the feed back sleeve.

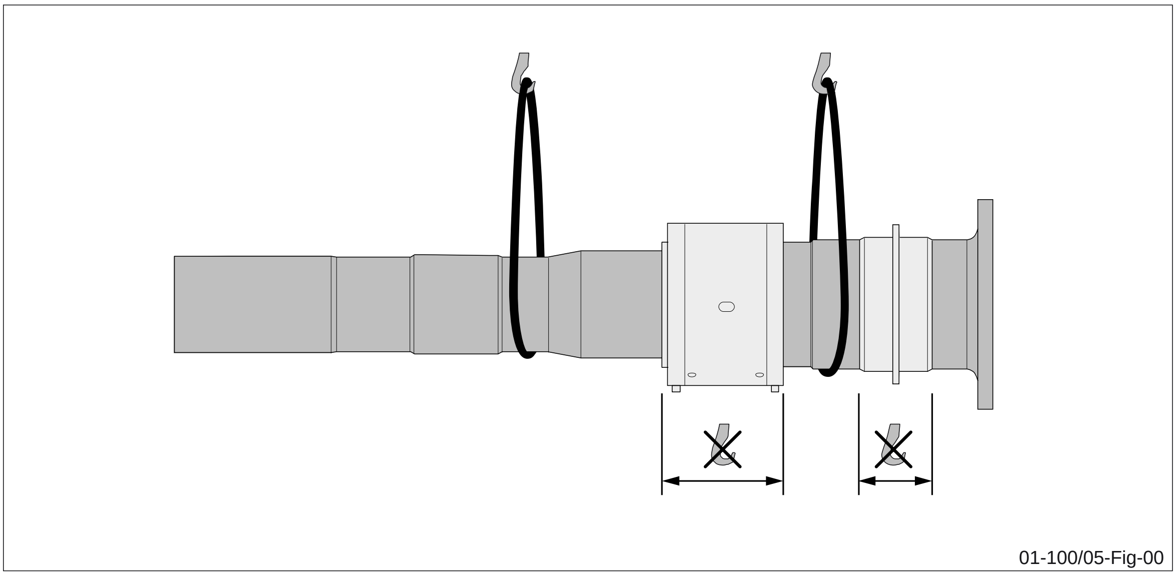


Figure 20 Lifting of OD-box (M0).

Hydraulic Power Pack

Use soft slings and a lifting device as shown in figure 21. The lifting device is not part of the Rolls-Royce delivery.

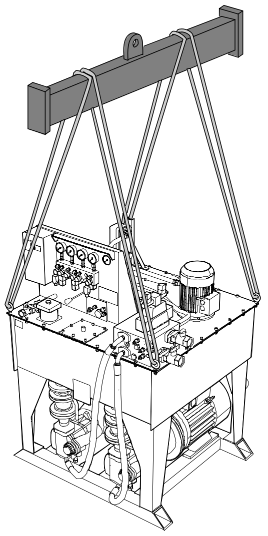


Figure 21 Lifting of hydraulic power pack.

Produced by: SS Approved by: Nna
Creation date: 2005-05-31

Revision: Sign:
Revision date:

Service Journal

Date	Service Engineer	Functional Disturbances	Measures Taken

Produced by: KK174 Approved by: Fnl Revision: Sign:
Creation date: 2008-05-06 Revision date:

Damage Report

Introduction

If damage is found on the propeller hub or blades, make a report including the following information and send it to the nearest Rolls-Royce Marine Global Support Network:

• Locate the damage

• Describe the extent and nature of the damage

• Analyze what caused the damage

• Make sketches or take photographs of the damage

One photograph should show the entire blade so that the location of the damage can be determined and another photo should be a close-up. Colour photographs are preferred.

Mark the photographs with shipyard number, hull number and the number of the blade.

Locate the Damage

The location of the damage must also be marked on the photographs.

• Is the damage located on the back or the face of the propeller?

____

____

• Where is the damage located in relation to the leading edge or the trailing edge?

____

____

• Does the damage occur at the same location on all the blades?

____

____

Describe Extent and Nature of the Damage

- Are both the starboard propeller and the port propeller damaged?

- What is the maximum depth of the damage?

- Does the damage occur to the same extent on all blades?

Has the blade colour changed?

- Are there hammerings on the blade surface?

- Has the blade surfaces got rough?

- Is the blade surface porous?

Analyze the Cause of the Damage

- If the leading edge is damaged, inspect what caused the damage. Is it caused by for example grounding or contact with wires or chains.

- If the surface of the propeller blade is uneven, inspect if the damage comes from repairs, protruding lifting hole plugs, or objects in front of the propeller. Objects in front of the propeller that may disturb the propeller flow are for example zinc anodes on the shaft barrels.

- Check in the logbook in the control room for how long the engine and propeller have been run and during which circumstances.

Produced by: KK174 Approved by: Nna
Creation date: 2005-05-31

Revision: a Sign: Nna
Revision date: 2007-12-12

Returning of Units

Complete and return this form at the same time as returning unit(s) for repair or service. The more information you can give, the greater is the possibility for less repair expenses.

Send the unit(s) to:
Rolls-Royce
Service Department
Box 1010
SE-681 29 KRISTINEHAMN
Sweden

Kamewa file number: ____

Yard and new building number______________________________________

Name of the vessel: ____

Unit and serial number of the unit: __________________________________

Sender/Contact person: ____

The unit is sent back to be:

° Inspected

° Repaired

° Replaced

° Other: ____

The problem occurs:

° Steadily

° Intermittently

° Other: ____

Description of the problem: ____
____
____
____
____
____
____
____
____
____
____

Is the unit replaced together with units caused by same problem?

° No.

° Yes, units are: ____

Troubleshooting

Ordering Service from Rolls-Royce

Introduction

Minor faults can be remedied by the engine room personnel but if major or more complicated faults occur it might be necessary to consult Rolls-Royce Marine Global Support Network, see part Contact List.

Before ordering service Rolls-Royce recommends that a troubleshooting procedure is performed. This will help locate the fault and it will save time and make it possible for Rolls-Royce to send necessary spare parts and personnel. Read the section Description of Logic at Failure and see the appended troubleshooting diagram to perform the troubleshooting.

Information to Give to Rolls-Royce

The faults are normally located in one of the following systems:

- Propeller mechanics including OD-box
- Hydraulic systems for pitch setting and static hub pressure
- Control system including load control system

Rolls-Royce recommends that the following information is stated when ordering service:

Oil Pressure (non rotating shaft):

- Servo
- Booster

Oil pressure (rotating shaft):

- Servo
- Booster

Temperature:

- Inspect the oil temperature in the hydraulic power pack
- Inspect the oil temperature in the box housing (only applicable if the vessel is equipped with a OD-box type M0)

Manoeuvring possibilities with:

- Main control system
- Back-up system

Pitch positions (to be read from the OD-box scale):

- Zero pitch
- Ahead maximum stroke at zero rpm
- Ahead position for full load with 100% rpm
- Astern maximum stroke at zero rpm

Deviations:

- Compare and see if there are any deviations between present set values and earlier set values

Description of Logic at Failure

Normal Operation

The pitch and the rpm are controlled by the levers on the control panels according to the combinator curve or linear pitch at constant rpm. The actual pitch can be observed on the OD-box scale.

If any of the faults mentioned in the following sections occur, an alarm will be activated on the control panel and in the main alarm system (external system).

In case of a failure in the main control system, the pitch will be blocked in actual position and the rpm will, if possible, be maintained, alternatively it will drop to idle speed.

In case of a failure in the main control system, the back-up system can be used. The pitch can be controlled by a manipulator in the main bridge control panel at a preset constant rpm. Actual pitch can be observed at pitch indicator on the control panel.

Failure in Both Main and Back-up System

If a failure occurs in both the main control system and in the back-up systems, the pitch can be set directly by push-buttons on the control valve on the hydraulic power pack. The actual pitch can be observed on an electrical pitch indicator on the power pack, alternatively on the OD-box scale.

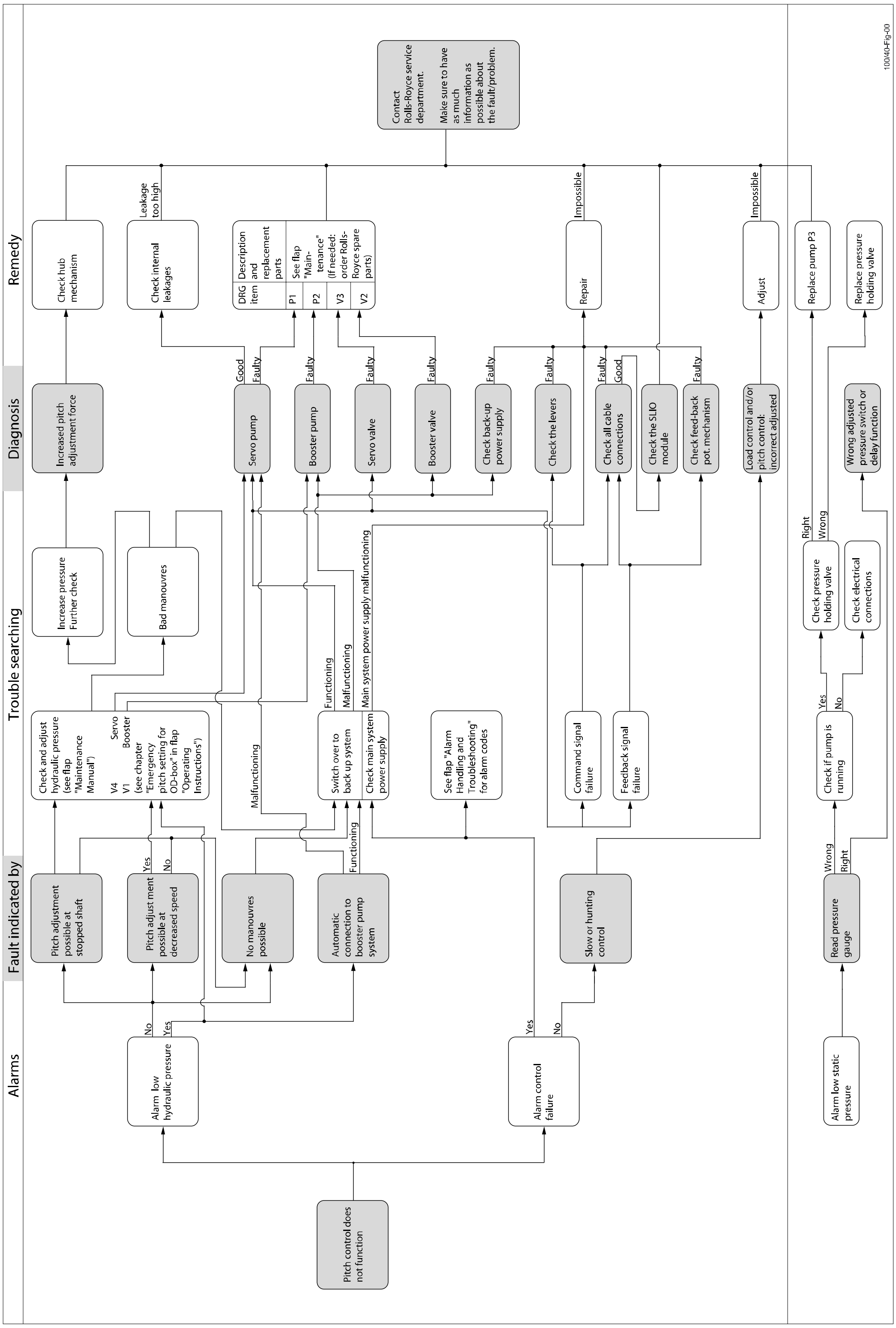
Failure in Hydraulic System and/or OD-box

In case of a failure in the hydraulic system and/or the OD-box, the pitch can be set according to separate instructions in section Emergency Operating in part Operating Instruction.

Oil Pressure Failure

In case of an oil pressure failure the pitch will act as follows:

- For pitch values equal to design pitch or higher, the pitch will normally remain in its position.
- For pitch values less than design pitch, it will slowly move to astern. The pitch changing velocity depends on the internal leakage in the system due to tolerances, sealings and so on.


Alarms
Fault indicated by
Trouble searching
Diagnosis
Remedy
Pitch control does not function
Alarm low hydraulic pressure
No
Yes
Alarm control failure
Yes
No
Alarm low static pressure
Pitch adjustment possible at stopped shaft
Pitch adjust ment possible at decreased speed
Yes
No
No manouvres possible
Automatic connection to booster pump system
Functioning
Slow or hunting control
Read pressure gauge
Wrong
Right
Check and adjust hydraulic pressure (see flap "Maintenance Manual")
V4 Servo
V1 Booster
(see chapter "Emergency pitch setting for OD-box" in flap "Operating Instructions")
Malfunctioning
Switch over to back up system
Check main system power supply
Functioning
Malfunctioning
Main system power supply malfunctioning
See flap "Alarm Handling and Troubleshooting" for alarm codes
Command signal failure
Feedback signal failure
Check if pump is running
Yes
No
Increase pressure Further check
Bad manouvres
Check pressure holding valve
Right
Wrong
Check electrical connections
Increased pitch adjustment force
Servo pump
Good
Faulty
Booster pump
Faulty
Servo valve
Faulty
Booster valve
Faulty
Check back-up power supply
Faulty
Check the levers
Faulty
Check all cable connections
Faulty
Good
Check the SLIO module
Check feed-back pot. mechanism
Faulty
Load control and/or pitch control: incorrect adjusted
Wrong adjusted pressure switch or delay function
Check hub mechanism
Check internal leakages
Leakage too high
DRG item
Description and replacement parts
P1
P2
V3
V2
See flap "Main-tenance" (If needed: order Rolls-Royce spare parts)
Repair
Impossible
Adjust
Impossible
Replace pump P3
Replace pressure holding valve
Contact Rolls-Royce service department.
Make sure to have as much information as possible about the fault/problem.
100/40-Fig-00

Diagnostic Description for System Failure Warning

1 Introduction

This document describes how to find the source to a failure at System warning failure.

All failure signals are collected in the STATUS node. To find out from where the failure originates, connect a terminal to the STATUS node. Select “signals” from the main menu followed by a list of the comprised processes. Select “FAILURE” and see which of the failure signals that are activated.

The failure signal names are listed in the appendix to this document. The failure signals are divided into three levels to make it easier/faster to search for the failure source. A prefix “***”, “**” or “*” in the signal name specifies the level, where “*” is the most detailed level (see the appendix).

- First look on the signals with the “***” level assignment, which tells you where in the system the failure is located. For example, on the Bridge, ECR (port or stbd) etc.
- When you know where in the system the failure is, look on the “**” level which tells you in which node the failure is located.
- At last when you know which node that has a failure, look on “*” level which tells you where in the node the failure is located.

Note: **When system warning failure occurs, more than one failure signal can be activated as a consequence to the first one.**

2 Diagnostic Procedure

When system failure is activated do as follows:

1. Connect the Hand Held Terminal (HHT) or a PC to the HHT connection (9 pin DSub) on the Status node. If a PC with a terminal program is used, the line settings shall be 9600 baud, 8 bits, one stop bit and no parity check.
2. Press <Backspace> to see “Password:” in the last row in the terminal.
3. Login by pressing <ENTER>. You will enter the main menu and see “> Exit” in the terminal.
4. Press <S> (use upper case letter) and you will see “> Signals” displayed in the terminal.

5. Press <ENTER> to select the Signal menu. You will see the name of the first process. Next process name will be listed if you press <SPACE>.
6. Press <F> (upper case letter) and <ENTER> , or just press <SPACE> a number of times, to see the process name “FAILURE” in the display.
7. Press <ENTER> to select the “FAILURE “ process. You will see the failure signals listed starting with the first system failure signal “***11-BRM”.
8. Press <Space> to see next signal in alphabetical order or type <signal name> (use upper case letters) and <ENTER> to see a specific signal. Follow the three levels described in the beginning of this document. In most cases the signal is ON if there is a failure, see appendix in this document for failure signal names and status.
9. When finished, press <Backspace> until you see “> Signals” in the terminal.

Then press <E> for exit (upper case letter) <ENTER> for exit and resume “Password:” displayed on the last row in the terminal.

Example:

For example at a failure only in the signal from the port lever thrust command at the main station in the bridge slave node.

1. Do step 1) to 7) in the “Diagnostic procedure“ and you will see the first system failure signal “***11.BRM”. The signal is OFF.
2. Press <Space> and you will see the next system failure signal “***12-BRS”. The signal will be ON. By this you will know that there is a failure in the bridge slave node.
3. Type <**12 > <ENTER> and you will see bridge slave node failure signal “**121-NODE”. This signal will be OFF.
4. Press <SPACE> and you will see bridge slave bus failure signal “**122-BUS”. This signal will be OFF.
5. Press <SPACE> and you will see bridge slave SLIO failure signal “**123-SLIO”. This signal will be OFF.
6. Press <SPACE> and you will see bridge slave transmitter failure signal“**124-TRM“. The signal will be ON. By this you will know that the failure is originating from (any of) the bridge slave transmitters.
7. Type <*124> <ENTER> and you will see the first transmitter failure signal “*124-MAPE” in bridge slave node. This signal will be OFF.
8. Press <Space> until you will see a failure signal with status ON. The signals are coming in alphabetical order. The first signal with status ON should be the signal “*124-MAPT” which means there is a failure in the signal from the port lever thrust command at the main station in the bridge slave node.

3 Appendix

Failure signals collected in the status node.

Signal Structure:

The failure status signals are divided in a numerical part and a character part.

- The first two digits in the beginning of the signal names are equal to the node id. Signal names with only two digits (top level) indicate in which node the failure is to be found. An exception from this is the display nodes, GATEWAY nodes and the FREESTYLE node which have a four digit id number. The display are only supervised in the top level signal structure (i.e. 1801 to 1803)
- The third digit (in the second and third level) indicates the failure type in the node, where:
  1 = node failure
  2 = Bus failure i.e. A, B or S bus failure
  3 = SLIO failure
  4 = Transmitter (analog) failure (connected to a SLIO)
  5 = Bus signal failure, internal failure signal or external serial input failure

The following letters are the node or transmitter names (normally abbreviated).

3.1.1 System Failures (Top Level)

All Nodes

Signal	Error Message
***11-BRM	Bridge master failure
***12-BRS	Bridge slave failure
***13-TBRM	Tunnel thruster bridge master failure
***14-TBRS	Tunnel thruster bridge slave failure
***15-JSTM	Joystick master failure
***16-JSTS	Joystick slave failure
***17-STSM	Status master failure
***18-STSS	Status slave failure
***1801-PD	Port bridge station display failure
***1802-SD	Stbd bridge station display failure
***1803-MD	Main bridge station display failure
***1804-AD	Auxilary bridge station display failure
***1850-GF	Gateway FREESTYLE failure
***1851-G1	Gateway 1 failure

***1852-G2	Gateway 2 failure
***1853TG1	Tunnel thruster gateway 1 failure
***1854TG2	Tunnel thruster gateway 2 failure
***20-VDR	VDR interface failure
***21-PECR	Port ECR failure
***24-SECR	Starboard ECR failure
***40-TTB1	Bow thruster 1 control node failure
***41-TTB2	Bow thruster 2 control node failure
***42-TTB3	Bow thruster 3 control node failure
***43-TTS1	Stern thruster 1 control node failure
***44-TTS2	Stern thruster 2 control node failure
***45-TTS3	Stern thruster 3 control node failure

3.1.2 Bridge Master Node Failures

It is possible to use two different bridge node applications, one for twin propellers and one for a single propeller. Therefore the following failures can have two different meanings that are marked with:

T = twin propellers application
S = single propeller application.

Node Failure (Second Level)

Signal	Error Message
**111-NODE	Node failure
**112-BUS	Bus failure
**113-SLIO	SLIO failure
**114-TRM	Transmitter failure

Bus Failure (Third Level)

Signal	Error Message
*112-A	A-bus failure
*112-B	B-bus failure
*112-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*113-SL1	SLIO no 1 failure Main station (T & S)
*113-SL2	SLIO no 2 failure Main station (T & S)
*113-SL3	SLIO no 3 failure Main station (T), Main station joystick (S)
*113-SL4	SLIO no 4 failure Main station joystick (T), Port annex (S)
*113-SL5	SLIO no 5 failure Port annex (T & S)
*113-SL6	SLIO no 6 failure Port annex (T), Port annex joystick (S)
*113-SL7	SLIO no 7 failure Port annex (T), Stbd annex (S)
*113-SL8	SLIO no 8 failure Port annex joystick (T), Stbd annex (S)
*113-SL9	SLIO no 9 failure Stbd annex (T), Stbd annex joystick (S)
*113-SL10	SLIO no 10 failure Stbd annex (T), Auxilary station (S)
*113-SL11	SLIO no 11 failure Stbd annex (T), Auxilary station (S)
*113-SL12	SLIO no 12 fail Stbd annex joystick (T), Aux station joystick (S)

Transmitter Failure Main Station (Third Level)

Signal	Error Message	SLIO no, ch
*114-MAJC	Main station Joystick lever cosine command failure	4 , 3 (T) , 3, 3 (S)
*114-MAJM	Main station Joystick moment command failure	4 , 5 (T) , 3, 5 (S)
*114-MAJS	Main station Joystick lever sine command failure	4 , 2 (T) , 3, 2 (S)
*114-MAJT	Main station Joystick lever thrust command failure	4 , 4 (T) , 3, 4 (S)
*114-MAPE	Main station Port emergency clutch out request input failure	2 , 0 (T) , 2, 0 (S)
*114-MAPT	Main station Port thrust command failure	2 , 2 (T) , 1, 2 (S)
*114-MASE	Main station Stbd emergency clutch out request input failure	1 , 0 (T)
*114-MAST	Main station Stbd thrust command failure	1, 2 (T)

Transmitter Failure Port Annex Station (Third Level)

Signal	Error Message	SLIO no, ch
*114-PTAJC	Port annex Joystick lever cosine command failure	8 , 3 (T) , 6, 3 (S)
*114-PTAJM	Port annex Joystick moment command failure	8 , 5 (T) , 6, 5 (S)
*114-PTAJS	Port annex Joystick lever sine command failure	8 , 2 (T) , 6, 2 (S)
*114-PTAJT	Port annex Joystick lever thrust command failure	8 , 4 (T) , 6, 4 (S)
*114-PTAPE	Port annex Port emergency clutch out request input failure	6 , 0 (T) , 5, 0 (S)
*114-PTAPT	Port annex Port thrust command failure	6 , 2 (T) , 4, 2 (S)
*114-PTASE	Port annex Stbd emergency clutch out request input failure	5 , 0 (T)
*114-PTAST	Port annex Stbd thrust command failure	5, 2 (T)

3.1.3 Bridge Master Node Failures Cont’d

Transmitter Failure Stbd Station (Third Level)

Signal	Error Message	SLIO no, ch
*114-SBAJC	Stbd annex Joystick lever cosine command failure	12, 3 (T), 9, 3 (S)
*114-SBAJM	Stbd annex Joystick moment command failure	12, 5 (T), 9, 5 (S)
*114-SBAJS	Stbd annex Joystick lever sine command failure	12, 2 (T), 9, 2 (S)
*114-SBAJT	Stbd annex Joystick lever thrust command failure	12, 4 (T), 9, 4 (S)
*114-SBAPE	Stbd annex Port emergency clutch out request input failure	10, 0 (T), 8, 0 (S)
*114-SBAPT	Stbd annex Port thrust command failure	10, 2 (T), 7, 2 (S)
*114-SBASE	Stbd annex Stbd emergency clutch out request input failure	9 , 0 (T)
*114-SBAST	Stbd annex Stbd thrust command failure	9, 2 (T)

Transmitter Failure Auxilary Station (Third Level)

Signal	Error Message	SLIO no, ch
*114-AUXJC	Auxilary station Joystick lever cosine command failure	12 , 3 (S)
*114-AUXJM	Auxilary station Joystick moment command failure	12 , 5 (S)
*114-AUXJS	Auxilary station Joystick lever sine command failure	12 , 2 (S)
*114-AUXJT	Auxilary station Joystick lever thrust command failure	12 , 4 (S)
*114-AUXPE	Auxilary station Port emergency clutch out request input fail	11 , 0 (S)
114-AUXPT	Auxilary station Port thrust command failure	10 , 2 (S)
*114-AUXSE	Auxilary station Stbd emergency clutch out request input fail	-
*114-AUXST	Auxilary station Stbd thrust command failure	-

Transmitter Failure at Signals in Command (Third Level)

Signal	Error Message	SLIO no, ch
*114-TRMIC	Transmitter failure of any bridge transmitter in command	-

3.1.4 Bridge Slave Node Failures

It is possible to use two different bridge node applications, one for twin propellers and one for a single propeller. Therefore the following failures can have two different meanings that are marked with:

T = twin propellers application

S = single propeller application.

Node Failure (Second Level)

Signal	Error Message
**121-NODE	Node failure
**122-BUS	Bus failure
**123-SLIO	SLIO failure
**124-TRM	Transmitter failure

Bus Failure (Third Level)

Signal	Error Message
*122-A	A-bus failure
*122-B	B-bus failure
*122-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*123-SL1	SLIO no 1 failure Main station (T & S)
*123-SL2	SLIO no 2 failure Main station (T & S)
*123-SL3	SLIO no 3 failure Main station (T), Main station joystick (S)
*123-SL4	SLIO no 4 failure Main station joystick (T), Port annex (S)
*123-SL5	SLIO no 5 failure Port annex (T & S)
*123-SL6	SLIO no 6 failure Port annex (T), Port annex joystick (S)
*123-SL7	SLIO no 7 failure Port annex (T), Stbd annex (S)
*123-SL8	SLIO no 8 failure Port annex joystick (T), Stbd annex (S)
*123-SL9	SLIO no 9 failure Stbd annex (T), Stbd annex joystick (S)
*123-SL10	SLIO no 10 failure Stbd annex (T), Auxilary station (S)
*123-SL11	SLIO no 11 failure Stbd annex (T), Auxilary station (S)
*123-SL12	SLIO no 12 fail Stbd annex joystick (T), Aux station joystick (S)

Transmitter failure main station (third level)

Signal	Error Message	SLIO no, ch
*124-MAJC	Main station Joystick lever cosine command failure	4 , 3 (T) , 3, 3 (S)
*124-MAJM	Main station Joystick moment command failure	4 , 5 (T) , 3, 5 (S)
*124-MAJS	Main station Joystick lever sine command failure	4 , 2 (T) , 3, 2 (S)
*124-MAJT	Main station Joystick lever thrust command failure	4 , 4 (T) , 3, 4 (S)
*124-MAPE	Main station Port emergency clutch out request input failure	2 , 0 (T) , 2, 0 (S)
*124-MAPT	Main station Port thrust command failure	2 , 2 (T) , 1, 2 (S)
*124-MASE	Main station Stbd emergency clutch out request input failure	1 , 0 (T)
*124-MAST	Main station Stbd thrust command failure	1, 2 (T)

Transmitter Failure Port Annex Station (Third Level)

Signal	Error Message	SLIO no, ch
*124-PTAJC	Port annex Joystick lever cosine command failure	8 , 3 (T) , 6, 3 (S)
*124-PTAJM	Port annex Joystick moment command failure	8 , 5 (T) , 6, 5 (S)
*124-PTAJS	Port annex Joystick lever sine command failure	8 , 2 (T) , 6, 2 (S)
*124-PTAJT	Port annex Joystick lever thrust command failure	8 , 4 (T) , 6, 4 (S)
*124-PTAPE	Port annex Port emergency clutch out request input failure	6 , 0 (T) , 5, 0 (S)
*124-PTAPT	Port annex Port thrust command failure	6 , 2 (T) , 4, 2 (S)
*124-PTASE	Port annex Stbd emergency clutch out request input failure	5 , 0 (T)
*124-PTAST	Port annex Stbd thrust command failure	5, 2 (T)

3.1.5 Bridge Slave Node Failures Cont'd

Transmitter Failure Stbd Station (Third Level)

Signal	Error Message	SLIO no, ch
*124-SBAJC	Stbd annex Joystick lever cosine command failure	12, 3 (T), 9, 3 (S)
*124-SBAJM	Stbd annex Joystick moment command failure	12, 5 (T), 9, 5 (S)
*124-SBAJS	Stbd annex Joystick lever sine command failure	12, 2 (T), 9, 2 (S)
*124-SBAJT	Stbd annex Joystick lever thrust command failure	12, 4 (T), 9, 4 (S)
*124-SBAPE	Stbd annex Port emergency clutch out request input failure	10, 0 (T), 8, 0 (S)
*124-SBAPT	Stbd annex Port thrust command failure	10, 2 (T), 7, 2 (S)
*124-SBASE	Stbd annex Stbd emergency clutch out request input failure	9 , 0 (T)
*124-SBAST	Stbd annex Stbd thrust command failure	9, 2 (T)

Transmitter Failure Auxilary Station (Third Level)

Signal	Error Message	SLIO no, ch
*124-AUXJC	Auxilary station Joystick lever cosine command failure	12 , 3 (S)
*124-AUXJM	Auxilary station Joystick moment command failure	12 , 5 (S)
*124-AUXJS	Auxilary station Joystick lever sine command failure	12 , 2 (S)
*124-AUXJT	Auxilary station Joystick lever thrust command failure	12 , 4 (S)
*124-AUXPE	Auxilary station Port emergency clutch out request input fail	11 , 0 (S)
*124-AUXPT	Auxilary station Port thrust command failure	10 , 2 (S)
*124-AUXSE	Auxilary station Stbd emergency clutch out request input fail	-
*124-AUXST	Auxilary station Stbd thrust command failure	-

Transmitter Failure at Signals in Command (Third Level)

Signal	Error Message	SLIO no, ch
*124-TRMIC	Transmitter failure of any bridge transmitter in command	-

3.1.6 Tunnel Thruster Bridge Master Node Failures

Node Failure (Second Level)

Signal	Error Message
**131-NODE	Node failure
**132-BUS	Bus failure
**133-SLIO	SLIO failure
**134-TRM	Transmitter failure

Bus Failure (Third Level)

Signal	Error Message
*132-A	A-bus failure
*132-B	B-bus failure
*132-S	S (slio)-bus failure

SLIO failure (third level)

Signal	Error Message
*133-SL0	Main station SLIO no 0 failure
*133-SL1	Main station SLIO no 1 failure
*133-SL2	Main station SLIO no 2 failure
*133-SL3	Main station SLIO no 3 failure
*133-SL4	Port annex SLIO no 4 failure
*133-SL5	Port annex SLIO no 5 failure
*133-SL6	Port annex SLIO no 6 failure
*133-SL7	Port annex SLIO no 7 failure
*133-SL8	Stbd annex SLIO no 8 failure
*133-SL9	Stbd annex SLIO no 9 failure
*133-SL10	Stbd annex SLIO no 10 failure
*133-SL11	Stbd annex SLIO no 11 failure
*133-SL12	Auxilary station SLIO no 12 failure
*133-SL13	Auxilary station SLIO no 13 failure
*133-SL14	Auxilary station SLIO no 14 failure
*133-SL15	Auxilary station SLIO no 15 failure

Transmitter Failure Main Station (Third Level)

Signal	Error Message	SLIO no, ch
*134-MB1-T	Main station bow thruster 1 lever command failure	0 , 0
*134-MB2-T	Main station bow thruster 2 lever command failure	1 , 0
*134-MB3-T	Main station bow thruster 3 lever command failure	1 , 4
*134-MS1-T	Main station stern thruster 1 lever command failure	2 , 0
*134-MS2-T	Main station stern thruster 2 lever command failure	3 , 0
*134-MS3-T	Main station stern thruster 3 lever command failure	3 , 4

Transmitter Failure Port Annex Station (Third Level)

Signal	Error Message	SLIO no, ch
*134-PB1-T	Port annex station bow thruster 1 lever command failure	4 , 0
*134-PB2-T	Port annex station bow thruster 2 lever command failure	5 , 0
*134-PB3-T	Port annex station bow thruster 3 lever command failure	5 , 4
*134-PS1-T	Port annex station stern thruster 1 lever command failure	6 , 0
*134-PS2-T	Port annex station stern thruster 2 lever command failure	7 , 0
*134-PS3-T	Port annex station stern thruster 3 lever command failure	7 , 4

Transmitter Failure Stbd Station (Third Level)

Signal	Error Message	SLIO no, ch
*134-SB1-T	Starboard annex station bow thruster 1 lever command failure	8 , 0
*134-SB2-T	Starboard annex station bow thruster 2 lever command failure	9 , 0
*134-SB3-T	Starboard annex station bow thruster 3 lever command failure	9 , 4
*134-SS1-T	Starboard annex station stern thruster 1 lever command failure	10 , 0
*134-SS2-T	Starboard annex station stern thruster 2 lever command failure	11 , 0
*134-SS3-T	Starboard annex station stern thruster 3 lever command failure	11 , 4

Transmitter failure auxilary station (third level)

Signal	Error Message	SLIO no, ch
*134-AB1-T	Auxilary station station bow thruster 1 lever command failure	12 , 0
*134-AB2-T	Auxilary station station bow thruster 2 lever command failure	13 , 0
*134-AB3-T	Auxilary station station bow thruster 3 lever command failure	13 , 4
*134-AS1-T	Auxilary station station stern thruster 1 lever command failure	14 , 0
*134-AS2-T	Auxilary station station stern thruster 2 lever command failure	15 , 0
*134-AS3-T	Auxilary station station stern thruster 3 lever command failure	15 , 4

3.1.7 Tunnel Thruster Bridge Slave Node Failures

Node Failure (Second Level)

Signal	Error Message
**141-NODE	Node failure
**142-BUS	Bus failure
**143-SLIO	SLIO failure
**144-TRM	Transmitter failure

Bus Failure (Third Level)

Signal	Error Message
*142-A	A-bus failure
*142-B	B-bus failure
*142-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*143-SL0	Main station SLIO no 0 failure
*143-SL1	Main station SLIO no 1 failure
*143-SL2	Main station SLIO no 2 failure
*143-SL3	Main station SLIO no 3 failure
*143-SL4	Port annex SLIO no 4 failure
*143-SL5	Port annex SLIO no 5 failure
*143-SL6	Port annex SLIO no 6 failure
*143-SL7	Port annex SLIO no 7 failure
*143-SL8	Stbd annex SLIO no 8 failure
*143-SL9	Stbd annex SLIO no 9 failure
*143-SL10	Stbd annex SLIO no 10 failure
*143-SL11	Stbd annex SLIO no 11 failure
*143-SL12	Auxilary station SLIO no 12 failure
*143-SL13	Auxilary station SLIO no 13 failure
*143-SL14	Auxilary station SLIO no 14 failure
*143-SL15	Auxilary station SLIO no 15 failure

Transmitter Failure Main Station (Third Level)

Signal	Error Message	SLIO no, ch
*144-MB1-T	Main station bow thruster 1 lever command failure	0 , 0
*144-MB2-T	Main station bow thruster 2 lever command failure	1 , 0
*144-MB3-T	Main station bow thruster 3 lever command failure	1 , 4
*144-MS1-T	Main station stern thruster 1 lever command failure	2 , 0
*144-MS2-T	Main station stern thruster 2 lever command failure	3 , 0
*144-MS3-T	Main station stern thruster 3 lever command failure	3 , 4

Transmitter Failure Port Annex Station (Third Level)

Signal	Error Message	SLIO no, ch
*144-PB1-T	Port annex station bow thruster 1 lever command failure	4 , 0
*144-PB2-T	Port annex station bow thruster 2 lever command failure	5 , 0
*144-PB3-T	Port annex station bow thruster 3 lever command failure	5 , 4
*144-PS1-T	Port annex station stern thruster 1 lever command failure	6 , 0
*144-PS2-T	Port annex station stern thruster 2 lever command failure	7 , 0
*144-PS3-T	Port annex station stern thruster 3 lever command failure	7 , 4

Transmitter Failure Stbd Station (Third Level)

Signal	Error Message	SLIO no, ch
*144-SB1-T	Starboard annex station bow thruster 1 lever command failure	8 , 0
*144-SB2-T	Starboard annex station bow thruster 2 lever command failure	9 , 0
*144-SB3-T	Starboard annex station bow thruster 3 lever command failure	9 , 4
*144-SS1-T	Starboard annex station stern thruster 1 lever command failure	10 , 0
*144-SS2-T	Starboard annex station stern thruster 2 lever command failure	11 , 0
*144-SS3-T	Starboard annex station stern thruster 3 lever command failure	11 , 4

3.1.8 Transmitter failure auxilary station (third level)

Signal	Error Message	SLIO no, ch
*144-AB1-T	Auxilary station station bow thruster 1 lever command failure	12 , 0
*144-AB2-T	Auxilary station station bow thruster 2 lever command failure	13 , 0
*144-AB3-T	Auxilary station station bow thruster 3 lever command failure	13 , 4
*144-AS1-T	Auxilary station station stern thruster 1 lever command failure	14 , 0
*144-AS2-T	Auxilary station station stern thruster 2 lever command failure	15 , 0
*144-AS3-T	Auxilary station station stern thruster 3 lever command failure	15 , 4

3.1.9 Joystick Master Node Failures

Node Failure (Second Level)

Signal	Error Message
**151-NODE	Node failure
**152-BUS	Bus failure
**155-SIG	Bus signal failure

Bus Failure (Third Level)

Signal	Error Message
*152-A	A-bus failure
*152-B	B-bus failure
**155-SIG	Bus signal failure

Bus Signal Input Failure (Third Level)

Signal	Error Message
*155-GYRO	Gyro heading input failure

3.1.10 Joystick Slave Node Failures

Node Failure (Second Level)

Signal	Error Message
**161-NODE	Node failure
**162-BUS	Bus failure
**165-SIG	Bus signal failure

Bus Failure (Third Level)

Signal	Error Message
*162-A	A-bus failure
*162-B	B-bus failure

Bus Signal Input Failure (Third Level)

Signal	Error Message
*165-GYRO	Gyro heading input failure

3.1.11 Status Master Node Failures

Node Failure (Second Level)

Signal	Error Message
**171-NODE	Node failure
**172-BUS	Bus failure
**173-SLIO	SLIO failure
**174-TRM	Transmitter failure

Bus Failure (Third Level)

Signal	Error Message
*172-A	A-bus failure
*172-B	B-bus failure
*172-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*173-SL1	SLIO no 1 failure
*173-SL2	SLIO no 2 failure
*173-SL3	SLIO no 3 failure
*173-SL4	SLIO no 4 failure
*173-SL5	SLIO no 5 failure
*173-SL6	SLIO no 6 failure
*173-SL7	SLIO no 7 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*174-DP-B1	DP bow thruster 1 command failure	4 , 2
*174-DP-B2	DP bow thruster 2 command failure	4 , 3
*174-DP-B3	DP bow thruster 3 command failure	4 , 4
*174-DP-PT	DP port main propeller command failure	4 , 0
*174-DP-S1	DP stern thruster 1 command failure	4 , 5
*174-DP-S2	DP stern thruster 2 command failure	4 , 6
*174-DP-S3	DP stern thruster 3 command failure	4 , 7
*174-DP-SB	DP stbd main propeller command failure	4 , 1
*174-GYRO	Gyro interface input failure (serial or analog sin/cos interface)	Serial / 2, 6 & 2, 7
*174-SP-PT	Speed pilot port main propeller command failure	2 , 2
*174-SP-SB	Speed pilot stbd main propeller command failure	2 , 3

Transmitter Failure at Signals in Command (Third Level)

Signal	Error Message	SLIO no, ch
*174-TRMIC	Transmitter failure of status node input in command	-

3.1.12 Status Slave Node Failures

Node Failure (Second Level)

Signal	Error Message
**181-NODE	Node failure
**182-BUS	Bus failure
**183-SLIO	SLIO failure
**184-TRM	Transmitter failure

Bus Failure (Third Level)

Signal	Error Message
*182-A	A-bus failure
*182-B	B-bus failure
*182-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*183-SL1	SLIO no 1 failure
*183-SL2	SLIO no 2 failure
*183-SL3	SLIO no 3 failure
*183-SL4	SLIO no 4 failure
*183-SL5	SLIO no 5 failure
*183-SL6	SLIO no 6 failure
*183-SL7	SLIO no 7 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*184-DP-B1	DP bow thruster 1 command failure	4 , 2
*184-DP-B2	DP bow thruster 2 command failure	4 , 3
*184-DP-B3	DP bow thruster 3 command failure	4 , 4
*184-DP-PT	DP port main propeller command failure	4 , 0
*184-DP-S1	DP stern thruster 1 command failure	4 , 5
*184-DP-S2	DP stern thruster 2 command failure	4 , 6
*184-DP-S3	DP stern thruster 3 command failure	4 , 7
*184-DP-SB	DP stbd main propeller command failure	4 , 1
*184-GYRO	Gyro interface input failure (serial or analog sin/cos interface)	Serial / 2, 6 & 2, 7
*184-SP-PT	Speed pilot port main propeller command failure	2 , 2
*184-SP-SB	Speed pilot stbd main propeller command failure	2 , 3

Transmitter Failure at Signals in Command (Third Level)

Signal	Error Message	SLIO no, ch
*184-TRMIC	Transmitter failure of status node input in command	-

3.1.13 Gateway FREESTYLE Node Failures

Bus Failure (Third Level)

Signal	Error Message
*18502-A	A-bus failure
*18502-B	B-bus failure
18502-S	S-bus failure

3.1.14 Gateway 1 Node Failures

Bus Failure (Third Level)

Signal	Error Message
*18512-A	A-bus failure
*18512-B	B-bus failure
*18512-S	S-bus failure

3.1.15 Gateway 2 Node Failures

Bus Failure (Third Level)

Signal	Error Message
*18522-A	A-bus failure
*18522-B	B-bus failure
*18522-S	S-bus failure

3.1.16 Tunnel Thruster Gateway 1 Node Failures

Bus Failure (Third Level)

Signal	Error Message
*18532-A	A-bus failure
*18532-B	B-bus failure
*18532-S	S-bus failure

3.1.17 Tunnel Thruster Gateway 2 Node Nailures

Bus Failure (Third Level)

Signal	Error Message
*18542-A	A-bus failure
*18542-B	B-bus failure
*18542-S	S-bus failure

3.1.18 Port ECR Node Failures

Node Failure (Second Level)

Signal	Error Message
**211-NODE	Node failure
**212-BUS	Bus failure
**213-SLIO	SLIO failure
**214-TRM	Transmitter failure
**215-SIG	Bus signal or control failure

Bus Failure (Third Level)

Signal	Error Message
*212-A	A-bus failure
*212-B	B-bus failure
*212-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*213-SL1	Central unit SLIO no 1 failure
*213-SL2	Central unit SLIO no 2 failure
*213-SL3	ECR station SLIO no 3 failure
*213-SL4	ECR station SLIO no 4 failure
*213-SL5	HPP unit SLIO no 5 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*214-CFINE	Constant rpm fine adjustment failure	4 , 5
*214-ECRTH	ECR thrust command failure	3 , 2
*214-EMO-P	Emergency clutch out request input failure	4 , 4
*214-FPS-P	Port main engine fuel pump setting transmitter failure	1 , 0
*214-FPS-S	Stbd main engine fuel pump setting transmitter failure	1 , 4
*214-GOVCP	Port main engine rpm governor command failure	1 , 2
*214-GOVCS	Stbd main engine rpm governor command failure	1 , 6
*214-LLS	Load limit setting failure	4 , 0
*214-LSBAL	Load sharing balance command failure	4 , 1
*214-PDRSP	Pitch response transmitter failure	5 , 0
*214-RPMR	Rpm response transmitter failure	5 , rpm channel
*214-SCAVP	Port main engine scavenging air transmitter failure	1 , 1
*214-SCAVS	Stbd main engine scavenging air transmitter failure	1 , 5
*214-SEPCP	Port main engine separate rpm transmitter failure	3 , 3
*214-SEPCS	Stbd main engine separate rpm transmitter failure	3 , 4
*214-U/8	Supply voltage supervision failure	5 , 1

Signal Failure (Third Level)

Signal	Error Message	SLIO no, ch
*215- PCFAI	Pitch control loop failure	-

3.1.19 Stbd ECR Node Failures

Node Failure (Second Level)

Signal	Error Message
**241-NODE	Node failure
**242-BUS	Bus failure
**243-SLIO	SLIO failure
**244-TRM	Transmitter failure
**245-SIG	Bus signal or control failure

Bus failure (Third Level)

Signal	Error Message
*242-A	A-bus failure
*242-B	B-bus failure
*242-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*243-SL1	Central unit SLIO no 1 failure
*243-SL2	Central unit SLIO no 2 failure
*243-SL3	ECR station SLIO no 3 failure
*243-SL4	ECR station SLIO no 4 failure
*243-SL5	HPP unit SLIO no 5 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*244-CFINE	Constant rpm fine adjustment failure	4 , 5
*244-ECRTH	ECR thrust command failure	3 , 2
*244-EMO-P	Emergency clutch out request input failure	4 , 4
*244-FPS-P	Port main engine fuel pump setting transmitter failure	1 , 0
*244-FPS-S	Stbd main engine fuel pump setting transmitter failure	1 , 4
*244-GOVCP	Port main engine rpm governor command failure	1 , 2
*244-GOVCS	Stbd main engine rpm governor command failure	1 , 6
*244-LLS	Load limit setting failure	4 , 0
*244-LSBAL	Load sharing balance command failure	4 , 1
*244-PDRSP	Pitch response transmitter failure	5 , 0
*244-RPMR	Rpm response transmitter failure	5 , rpm channel
*244-SCAVP	Port main engine scavenging air transmitter failure	1 , 1
*244-SCAVS	Stbd main engine scavenging air transmitter failure	1 , 5
*244-SEPCP	Port main engine separate rpm transmitter failure	3 , 3
*244-SEPCS	Stbd main engine separate rpm transmitter failure	3 , 4
*244-U/8	Supply voltage supervision failure	5 , 1

Signal Failure (Third Level)

Signal	Error Message	SLIO no, ch
*245- PCFAI	Pitch control loop failure	-

3.1.20 Bow Thruster 1 Control Node Failures

Node Failure (Second Level)

Signal	Error Message
**401-NODE	Node failure
**402-BUS	Bus failure
**403-SLIO	SLIO failure
**404-TRM	Transmitter failure
**405-SIG	Bus signal or control failure

Bus Failure (Third Level)

Signal	Error Message
*402-A	A-bus failure
*402-B	B-bus failure
*402-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*402-S	SLIO no 1 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*404-CURR	Drive motor current response failure	1 , 2
*404-PDRSP	Pitch response failure	1 , 0
*404-THRED	Thrust reduction failure	1 , 3
*404-VOLT	Drive motor volt response failure	1 , 1

Signal Failure (Third Level)

Signal	Error Message
*405- PCFAI	Pitch control failure

3.1.21 Bow Thruster 2 Control Node Failures

Node Failure (Second Level)

Signal	Error Message
**411-NODE	Node failure
**412-BUS	Bus failure
**413-SLIO	SLIO failure
**414-TRM	Transmitter failure
**415-SIG	Bus signal or control failure

Bus Failure (Third Level)

Signal	Error Message
*412-A	A-bus failure
*412-B	B-bus failure
*412-S S	(slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*412-S	SLIO no 1 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*414-CURR	Drive motor current response failure	1 , 2
*414-PDRSP	Pitch response failure	1 , 0
*414-THRED	Thrust reduction failure	1 , 3
*414-VOLT	Drive motor volt response failure	1 , 1

Signal Failure (Third Level)

Signal	Error Message
*415- PCFAI	Pitch control failure

3.1.22 Bow Thruster 3 Control Node Failures

Node Failure (Second Level)

Signal	Error Message
**421-NODE	Node failure
**422-BUS	Bus failure
**423-SLIO	SLIO failure
**424-TRM	Transmitter failure
**425-SIG	Bus signal or control failure

Bus Failure (Third Level)

Signal	Error Message
*422-A	A-bus failure
*422-B	B-bus failure
*422-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*422-S	SLIO no 1 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*424-CURR	Drive motor current response failure	1 , 2
*424-PDRSP	Pitch response failure	1 , 0
*424-THRED	Thrust reduction failure	1 , 3
*424-VOLT	Drive motor volt response failure	1 , 1

Signal Failure (Third Level)

Signal	Error Message
*425- PCFAI	Pitch control failure

3.1.23 Stern Thruster 1 Control Node Failures

Node Failure (Second Level)

Signal	Error Message
**431-NODE	Node failure
**432-BUS	Bus failure
**433-SLIO	SLIO failure
**434-TRM	Transmitter failure
**435-SIG	Bus signal or control failure

Bus Failure (Third Level)

Signal	Error Message
*432-A	A-bus failure
*432-B	B-bus failure
*432-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*432-S	SLIO no 1 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*434-CURR	Drive motor current response failure	1 , 2
*434-PDRSP	Pitch response failure	1 , 0
*434-THRED	Thrust reduction failure	1 , 3
*434-VOLT	Drive motor volt response failure	1 , 1

Signal Failure (Third Level)

Signal	Error Message
*435- PCFAI	Pitch control failure

3.1.24 Stern Thruster 2 Control Node Failures

Node Failure (Second Level)

Signal	Error Message
**441-NODE	Node failure
**442-BUS	Bus failure
**443-SLIO	SLIO failure
**444-TRM	Transmitter failure
**445-SIG	Bus signal or control failure

Bus Failure (Third Level)

Signal	Error Message
*442-A	A-bus failure
*442-B	B-bus failure
*442-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*442-S	SLIO no 1 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*444-CURR	Drive motor current response failure	1 , 2
*444-PDRSP	Pitch response failure	1 , 0
*444-THRED	Thrust reduction failure	1 , 3
*444-VOLT	Drive motor volt response failure	1 , 1

Signal Failure (Third Level)

Signal	Error Message
*445- PCFAI	Pitch control failure

3.1.25 Stern Thruster 3 Control Node Failures

Node Failure (Second Level)

Signal	Error Message
**451-NODE	Node failure
**452-BUS	Bus failure
**453-SLIO	SLIO failure
**454-TRM	Transmitter failure
**455-SIG	Bus signal or control failure

Bus Failure (Third Level)

Signal	Error Message
*452-A	A-bus failure
*452-B	B-bus failure
*452-S	S (slio)-bus failure

SLIO Failure (Third Level)

Signal	Error Message
*452-S	SLIO no 1 failure

Transmitter Failure (Third Level)

Signal	Error Message	SLIO no, ch
*454-CURR	Drive motor current response failure	1 , 2
*454-PDRSP	Pitch response failure	1 , 0
*454-THRED	Thrust reduction failure	1 , 3
*454-VOLT	Drive motor volt response failure	1 , 1

Signal Failure (Third Level)

Signal	Error Message
*455- PCFAI	Pitch control failure

HHT Guide

Calibration and Adjustment

General

Calibration of analog and digital input/outputs, modification of system parameters and display of system messages are all performed by means of a hand held terminal (HHT). Any standard ASC II can be used, but following description refers to Termiflex ST/2000. The terminal may also be used to monitor and debug the internal operation of the application software. When the terminal is connected and the CanMan System is started (power on / reset) the terminal will display some progress information. The name KAMEWA will slowly appear. Each character in the name indicates a successfully completed phase of the start up procedure. Normally software configuration is now given as:

- Checksum
- Node name
- Node ID
- Base system version.
- Application name (number) & revision.

Display

The display is scrolled upwards which means that only the last row is updated with valid information.

Keyboard

ENTER
Enters the menu or function that is currently displayed

SPACE
Scrolls within the current menu to the next item

BKSP
Exits the current menu and goes back to the previous menu

ESC
Exits the current menu and goes back to the previous menu

SHIFT

Selects upper or lower cases of the keys. A Shift Lock function is achieved if the SHIFT is pressed twice.

Passwords

VIEW
Only possible to view information — only ENTER is required

CALIBR.
VIEW + calibration of I/O — ………………………..

PARAM.
CALIBRATE + modification of parameters — ………………………..

RESTORE
Default calibration and parameters are restored — ………………………..

Main Menu

EXIT

The terminal session is terminated and possible simulations removed.

EXIT REMOTE

Return to local node in remote operation.

FREE

Numbers in percent are given for free CPU-time and memory spaces.

WATCH

The watch menu enables 2 signals to be continuously updated on the HHT.
(7 signals with an 80 character terminal).

Procedure for WATCH:

- Select process
- Select signal
- Press – ENTER
- Repeat

The system stores the last signals watched, therefore it is possible to press ENTER to specify processes and signals when re-entering the WATCH menu.

DUMP

Dumps calibration on the serial line.

I/O

All I/O values can be viewed. If the CALIBRATION or PARAMETER password has previously been given, calibration is also possible.

Calibration, View

- Select SLIO number by SPACE-key or type its number, press - ENTER
- Select type of I/O (Analog In, Analog Out, Digital In, Digital Out)
- Select channel number by SPACE or type its number. The display shows (second character) if the channel is an input or an output (I or O). If an E appears in this position the signal has an error status. The next displayed items are the name of the signal and its value, normally in the range +/-1.00 or 0-1.00 for analog signals and On or Off for digital.

Calibration of an Analog Input Channel

- Select a channel, according to VIEW above, press -ENTER.
- The first calibration item is the signal type. This shall not be changed unless transmitter type has been changed. In that case press -ENTER (Parameter password required) and select the correct type by scrolling through the list by the SPACE-key. Press ENTER. For normal calibration, ignore this point by pressing - SPACE.
- The CANMAN calibration procedure requires that the input signal is changed to values which correspond to displayed process values. Normally, High: 1.0 is the first calibration point (the default value, 1.0, can be changed by using the numeric keys). When the input has been given the value which corresponds to process value High, press -ENTER.
- Repeat the procedure for the Low calibration point. If the process value is or has been changed from normally a negative value to 0 or a positive value the next step will be ignored, otherwise:
- Repeat the procedure for the 0 calibration point. 0-value is not possible to change.

Calibration of an Analog Output Signal

- Select a channel, according to VIEW above, press - ENTER.
- The first calibration item is the signal Type. This shall not be changed unless output load type has been changed. In that case press -ENTER (Parameter password required) and select the correct type by scrolling through the list by the SPACE-key. Press -ENTER. For normal calibration, ignore this point by pressing -SPACE.
- The CANMAN calibration procedure requires that the output signal is changed to values which correspond to displayed process values. High, normally set to 1.0 is the first calibration point (the value, 1.0, can be changed by using the numeric keys). When the -ENTER key is pressed, the output signal will directly be given a value which corresponds to the process value for the High calibration point.

- The output signal can now be changed by +/- keys for increase/decrease. If a faster rate is desired, use I/D keys (lower case keys). When desired output signal has been reached, press - ENTER.
- Accept or change process value for the Low calibration point, then press – ENTER.
- Change the output signal to desired value, then press - ENTER.
- Accept or change process value for the 0 calibration point. If the process value for the Low calibration point was positive or 0, the 0 calibration point will never appear. Otherwise press - ENTER.
- Change the output signal to desired value, then press - ENTER.

Calibration of a Digital I/O-Channel

- Select a channel, according to VIEW above, press – ENTER.
- Signal polarity can be changed Pos/Neg and the signal can also be permanently set to On or Off. Select one of the possibilities by the SPACE-key.
- Press - ENTER. Calibration is now done.
- Return to MAIN menu by pressing - BKSP (or - ESC) repeatedly.

Creation of a Temporary Analog Output Channel

Unused analog channels may temporarily be used for test purposes. The temporary creation means that it is terminated by reset (power on).

- Select an unused channel, according to VIEW above, press - ENTER twice.
- Select a process (see SIGNALS menu).
- Select a real signal within the selected process.
- Calibrate the analog output in the ordinary way.

NUM. I/O

The numeric calibration assigns values for the 3 (2) calibration points of each analog channel and the function of a digital channel. Default/delivery/commissioning values are specified in the plant dependent document: Specification/calibration. Values from further calibration shall also be documented. By means of these values it is always possible to recreate a lost calibration.

Numeric Calibration of a Digital I/O-Channel

- Select card number. Press – ENTER
- Select channel number. Press - ENTER
- Select or document Pos/Neg/On/Off. Press - ENTER if changed. Otherwise –
- SPACE

Numeric Calibration of an Analog I/O-Channel

- Select card number. Press –ENTER
- Select channel number. Press -ENTER
- Change or document the values for: Type, High, Low, 0. If changed, press - ENTER, otherwise press -SPACE.

LOG

The system maintains a log file over the last 50 messages. The last message is displayed when entering LOG. Pressing - SPACE will scroll the list backwards. Every message is time stamped. The time is displayed in either uptime since start, or in date-time format. If uptime is displayed, the date-time format will be obtained by entering present date and time in the TIME menu.

TIME

The time menu displays the current uptime continuously. Procedure to change to date-time format:

- Press - ENTER when uptime is displayed
- Input actual data in format: YYYYMMDDHHMMSS

PARAM

The parameter menu works in the same way as the signals menu, but only parameters and function curves in the selected process are displayed.

SIGNALS

This menu is used to view and modify Signals, Parameters and Function-curves.

Select Process/Signal, View

- Select appropriate process by scrolling (SPACE-key) or typing the unique characters of its name. Pressing the SPACE key when specifying a process name will display the next character within the current name. Information given for each process: R - running, H - halted, E - delayed and running time in seconds. Press - ENTER.
- Select a signal in the same way. Information given for each signal: P - parameter, F - function curve = table, T - test point = ordinary signal, S - simulated signal (flashing), C - constant, E -error indication (flashing). The second field contains the name of the signal/parameter/function-curve. The third field holds the current value of the signal or parameter and the size of the function curve. The information on the last line is updated 5 times per second.

Simulation

- Signals may be simulated by assigning constant values, these signals will not be updated by the application software. Procedure:

  Continue from View. Press – ENTER
  - Digital signals are toggled ON/OFF with the SPACE key
  - Analog signals are simulated by typing a numerical value.

  Press - ENTER.

Removing of a simulation for a single signal is done by pressing - ENTER, immediately followed by - BKSP (or - ESC).

Removing of all simulations is done by selecting EXIT in the MAIN menu, followed by pressing - ENTER. All simulations are also automatically removed if the HHT has not been used for 1 hour, or if the system has been switched OFF.

Updating Parameters

- Parameters may be permanently changed with the same procedure as for SIMULATION of signals.

Updating Tables (Function Curves and Ramp Delays)

A function curve is used for generation of a direct relationship between an output and an input signal with a function generator (FUNG) block. The breakpoints of the curve are defined as X (n) - Y (n) pairs. The (n) is the number of the breakpoint. When the input value is between two breakpoints, a straight line interpolation is used to calculate the output. Figure 1 shows examples of two curves and the table below gives the corresponding X - Y pairs.

A ramp delay is used for generation of a time delay between an output and an input signal with a RAMP block. The delay is achieved by limitation of the rate of change by which the output moves towards the input. Two tables must be defined for each RAMP block, one for increasing and one for decreasing output. The delay curves are given as X (n) - Y (n) pairs, where the X value is time in seconds and Y is the output from the RAMP block. Figure 2 shows an example of an increasing and a decreasing curve. Note carefully how the curves are defined, always starting with X (0) = 0.

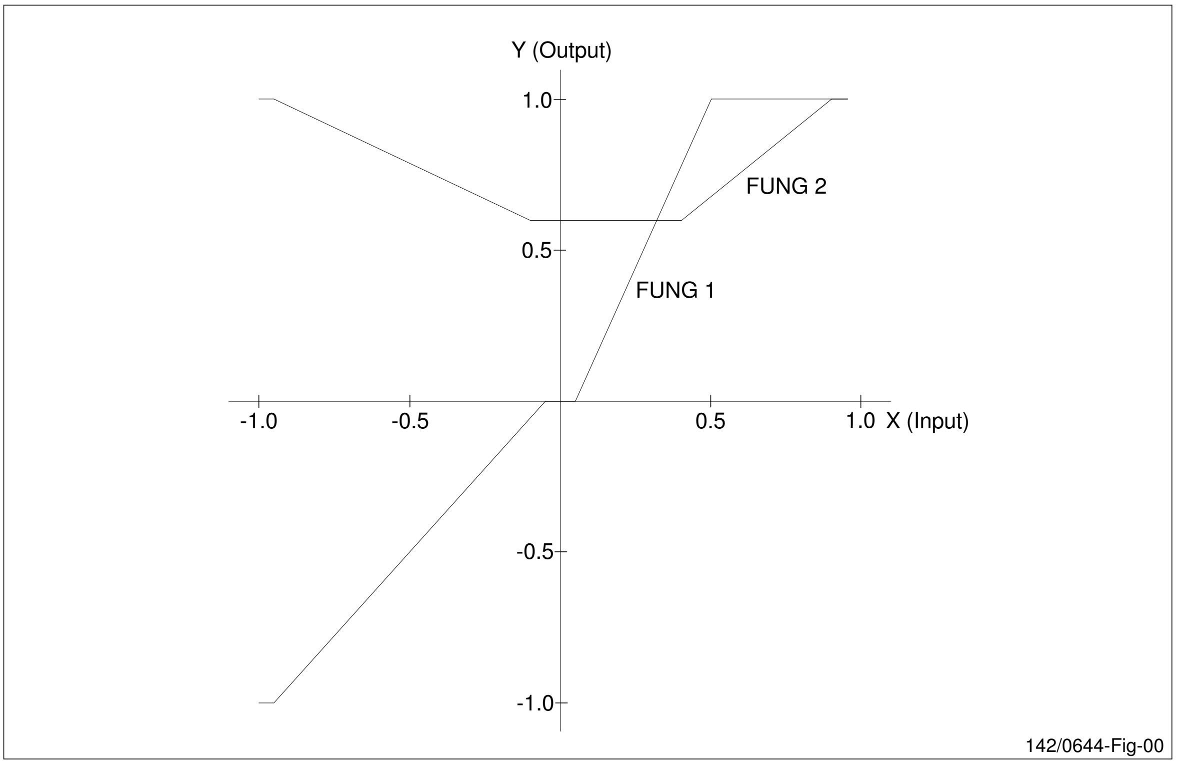
Procedure for Updating a Table:

- Press ENTER in the SIGNALS menu. The X(n) - Y(n) pair may be displayed, without updating, by pressing SPACE a number of times or typing it's index.

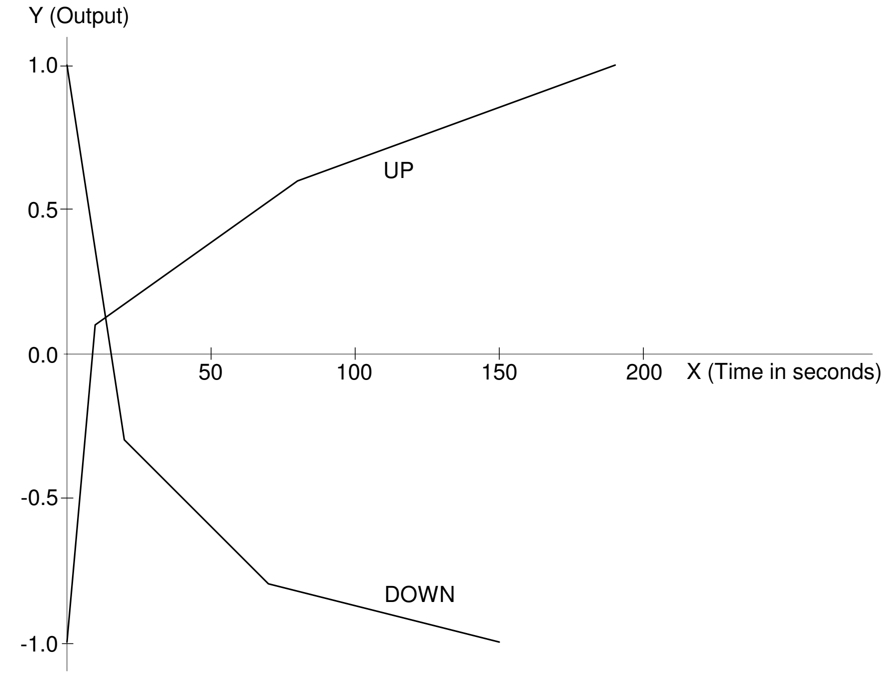
For updating proceed by:

- Select the element
- Press - ENTER
- Type the new value
- Press - ENTER
- Select the next element – etc.
- Press - U after any element or -SPACE after the last element to update the table.

It is possible to abort the parameter update at any point by pressing -BKSP (or -ESC). The original function curve will then be maintained.



n	FUNG 1		FUNG 2	
	X	Y	X	Y
0	-1.0	-1.0	-1.0	1.0
1	-0.95	-1.0	-0.95	1.0
2	-0.05	0.0	-0.1	0.6
3	0.05	0.0	0.4	0.6
4	0.5	1.0	0.95	1.0
5	1.0	1.0	1.0	1.0



142/0645-Fig-00

n	UP		DOWN	
	X	Y	X	Y
0	0.0	-1.0	0.0	1.0
1	10	0.1	20	-0.3
2	80	0.6	70	-0.8
3	190	1.0	150	-1.0

CONFIG

This menu is used to set Node name, Node id (number), SLIO maximum update period, CAN bus bite rate and SLIO bus bit rate. <SPACE> displays next line, <ENTER> let's the user change current setting. <DELETE> is used to erase previous character in edit-mode; otherwise it's used to exit the bus signal submenu.

Switch the power Off and On after the Node id has been changed.

Node Configuration Menu:

Node: Old name	SPACE
Node id: 12	SPACE
SLIO delay: 0.100s	SPACE
CAN BTR0: 345	SPACE
CAN BTR1: 345	SPACE
SLIO BTR0: 678	SPACE
SLIO BTR1: 678	SPACE

Node: Old name	ENTER
Name:	NODE_A ENTER
Node: NODE_A	SPACE
Node id: 12	ENTER
New id: 12	43 ENTER
Node id: 43	SPACE
SLIO delay: 0.100s	SPACE
CAN BTR0: 345	ENTER
New value: 345	222 ENTER
CAN BTR0: 222	DELETE

BUS SIGNALS

This menu is used to connect signal name to signal id, i.e. the message id number used for the signal on the CAN bus. The signal is presented with name and id number. <SPACE> displays next signal, <ENTER> let's the user change signal id. <DELETE> is used to erase previous character in edit-mode; otherwise it's used to exit the bus signal submenu.

Select Bus Signal, View

- Select appropriate BUS signal by scrolling (SPACE-key) or typing the unique characters of its name. Press - ENTER.

Updating Bus Signal ID

- BUS signal ID's are altered by typing the numerical value for the ID.
- Press - ENTER

REMOTE

This menu is used to make remote HHT connections. A list of selectable nodes is presented to the user. <SPACE> is used to step through the list, <ENTER> is a request for a remote connection, <DELETE> is used to exit the bus signal submenu.

Remote HHT Menu:

31	SPACE
43	SPACE
50	SPACE
60	ENTER

Software configuration for the remote node is now given and the remote node can be accessed as if the HHT was connected locally.

Troubleshooting, Remote Control System

Alarm Handling Main Propeller System

The propulsion system is equipped with an alarm monitoring system that in case of errors can give the user information about where in the system errors has occurred.

Alarms are indicated by an alarm buzzer and flashing status lamps on the control panels. Alarms and warnings are also sent to the alarm monitoring system of the ship.

This chapter includes description of optional features, which may not be found in your application. For example the Clutch Control. All these options are marked in the text.

In case of errors the main propeller control system activate the following alarms and warnings:

• Control failure alarm

• Load control failure alarm

• Clutch control alarms (if the application includes clutch control)

• System warning

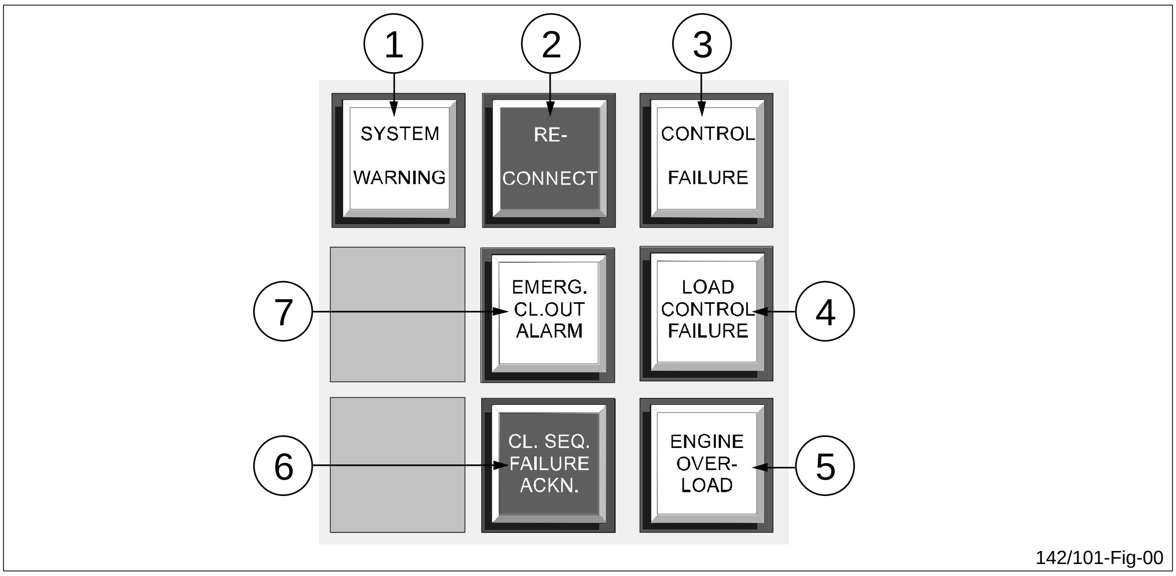


Figure 1 Alarm and warning indication lamps and reset buttons at the bridge panels. Except for SYSTEM WARNING, the same indications and buttons are found on the panel in

the engine control room, which also includes reset of emergency clutch out.

1. SYSTEM WARNING - system warning indication lamp (only at the bridge stations)
2. RECONNECT - button for reconnecting the control system after recovery from control failure
3. CONTROL FAILURE - lamp indicating control failure alarm
4. LOAD CONTROL FAILURE - lamp indicating load control failure alarm
5. ENGINE OVERLOAD - lamp indicating engine overload
6. CL. SEQ. FAILURE ACKN. - clutch sequence failure alarm indication and reset button (present only when clutch control is included)
7. EMERG. CL. OUT ALARM - emergency clutch out alarm indication on bridge, combined alarm indication and reset button in ECR (present only when clutch control is included)

The time during which the buzzer sounds and the indication lamps flash for different types of alarms depends on editable parameters in the software configuration. The time statements in the following descriptions are default values.

The buzzer sounds also in other situations which require the operator's attention, for instance, at transfer of manoeuvre responsibility.

Control Failure Alarm

Alarm Indications

When the lamp CONTROL FAILURE (see figure 1) starts to flash while the buzzer sounds, a control failure has occurred in the propeller control system. The lamp flashes and the buzzer sounds for six seconds (default). After that, the buzzer is silenced and the lamp gets a steady light.

When a control failure is detected, the propeller pitch is frozen in the position it had when the failure occurred (the hydraulic pitch control valve(s) of the propeller are disconnected). The pitch of the propeller can no longer be changed with the control lever, only with the back-up system.

Provided that the alarm was not caused by a failure in the lever in command, the RPM can still be controlled by the lever in command. If the alarm was caused by the lever in command, the RPM is frozen on the level it had at the occurrence of the failure.

At the occurrence of a control failure, a system warning is also always indicated (see section System Warning). At failures originating from non-active or redundant equipment, no alarm is activated, only a system warning (see section System Warning).

Possible Alarm Causes

The cause for a control failure alarm may be:

• Pitch control loop failure. Pitch control failure occur if there is a deviation between ordered and resulting pitch and the pitch is changing too slowly, or it is changing in the wrong direction. When a pitch control failure is detected, the hydraulic pitch control valves are disconnected (blocked). The pitch is frozen in its present position and is no longer controllable with the control system. The RPM, though, is still controllable with the lever in command.

• Pitch response error (failure status on the pitch response signal due to an error in the pitch response transmitter). The pitch is frozen in its present position, but the RPM can be controlled with the lever in command.

• Command error (failure status on the lever in command). Both the pitch and the RPM are maintained as they were at the detection of the failure.

Actions to take at Control Failure Alarm

Try to move the manoeuvre responsibility to another station and reconnect the system as described below. If this is not possible, or if the alarm remains, shift over to back-up operation of the propeller (see “Operating Instructions”). Have the system repaired.

Restoring the System

To reconnect the control system after recovery follow these steps:

1. Set the control lever in a position roughly corresponding to the actual pitch
2. Press the RECONNECT button (see figure 1)

The button is enabled (lit) as soon as the system has recovered. After system reconnect the system will return to normal operation.

If the control failure alarm was caused by a pitch control loop failure, the RECONNECT button (see figure 1) will be enabled directly without corrective actions. If the failure remains, a new control failure alarm will be activated after a few seconds.

Load Control Failure Alarm

When the lamp LOAD CONTROL FAILURE (see figure 1), is lit, a failure has occurred in the load control system. The load control is out of function or unreliable.

A load control failure may be caused by:

• Error in the fuel pump setting response transmitter

• Error in the charge air pressure signal

• Error in the RPM response transmitter

• Error in the load limit setting signal

When a load control failure is detected, the system is automatically set to overload protection mode. In this mode, the overload contact from the engine safety system (the fuel rack overload switch) is used to reduce the pitch automatically when overload occurs.

At an error in the RPM response transmitter or in the load limit setting, the load control will still be in operation in parallel with the activated overload protection function. In case of an error in the RPM response transmitter, the ordered RPM taken from the combinator curve will be used instead of the measured RPM. In case of an error in the load limit setting, a fixed load limit will be used (default = 100%).

When the LOAD CONTROL FAILURE lamp is lit (see figure 1) an error has occurred in the load control system, watch out for the ENGINE OVERLOAD lamp (see figure 1) on the control panel, and reduce the load if it is lit. The ENGINE OVERLOAD lamp (see figure 1) is activated by the fuel rack overload switch of the engine.

Clutch Control Alarms

This feature is optional, which means that it may not be found in your application.

Emergency Clutch Out Alarm

An emergency clutch out alarm is activated at a manual or automatic emergency clutch out. An automatic emergency clutch out takes place at the following events in an engaged engine:

• At an emergency clutch out command from the engine control system

• At low oil pressure in the clutch control hydraulics

• At low engine RPM

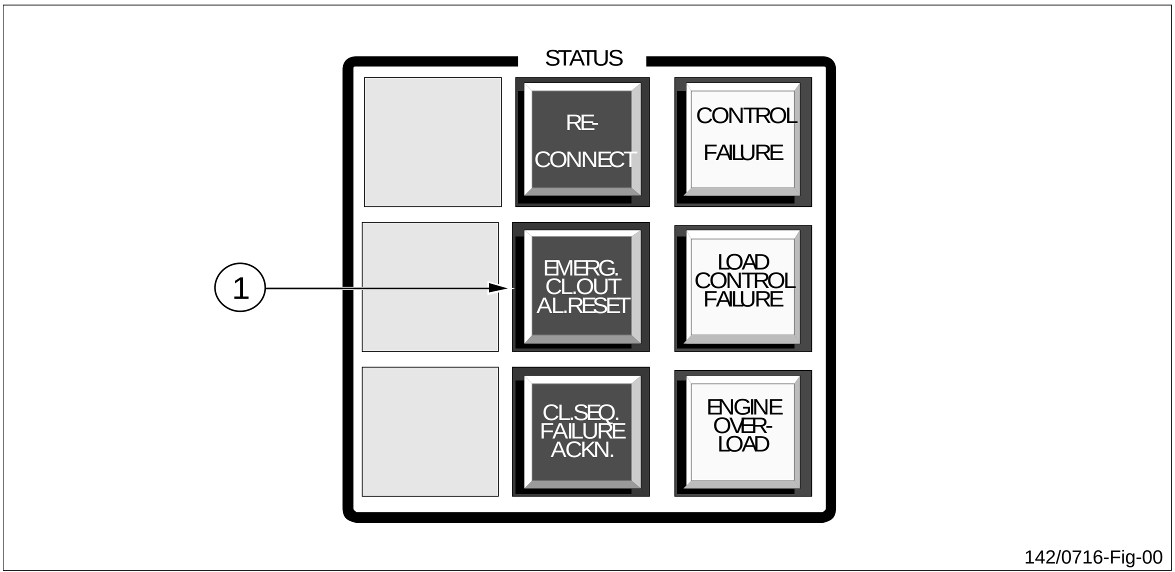


Figure 2 Alarm and indication lamps and reset buttons at the engine control room panel. Valid only for single propeller.

1. EMERG. CL. OUT AL. RESET - reset button for the emergency clutch out alarm

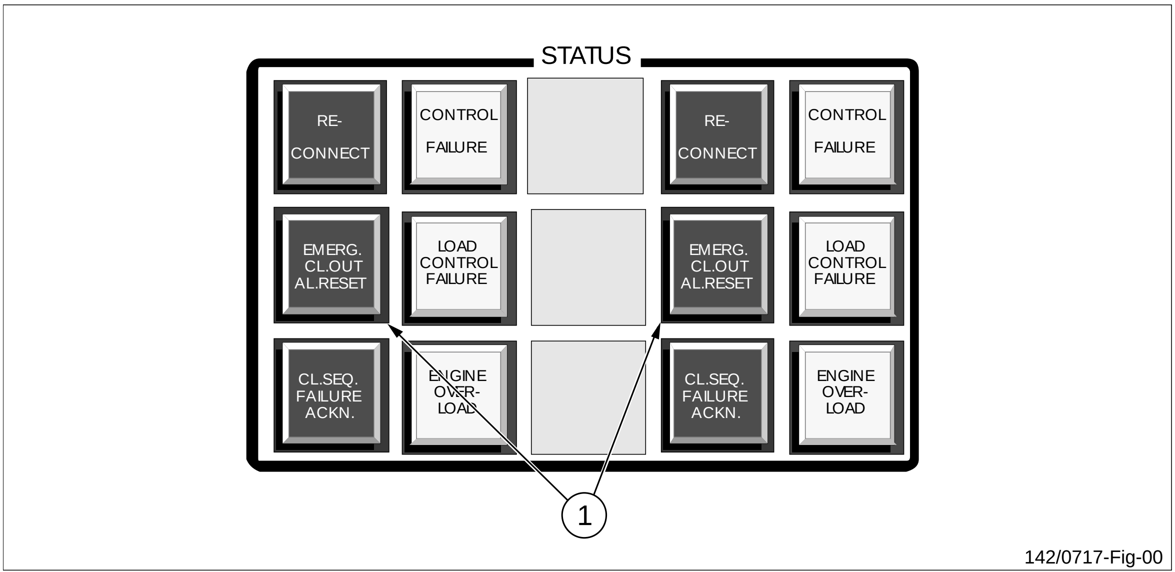


Figure 3 Alarm and indication lamps and reset buttons at the engine control room panel. Valid only for twin propellers.

1. EMERG. CL. OUT AL. RESET - reset buttons for the emergency clutch out alarm

At an emergency clutch out, the buzzer sounds and the EMERG. CL. OUT ALARM lamp is lit (see figure 1) at the bridge stations and the EMERG. CL. OUT AL. RESET button (see figure 2 if equiped with single propeller and figure 3 if equiped with twin propellers) in the engine control room. To acknowledge the clutch out alarm, press the EMERG. CL. OUT AL. RESET button (see figure 2 if equiped with single propeller and figure 3 if equiped with twin propellers) in the engine control room.

Sequence Failure Alarm

If an engagement or disengagement of a clutch did not succeed, a sequence failure alarm is activated. The alarm buzzer starts to sound and the CL. SEQ. FAILURE ACKN. lamp (see figure 1) flashes. The clutch remains in its previous engagement status.

The reason for a sequence failure alarm is that the engagement status was not achieved within a stipulated period of time (default 20 seconds). Check the clutch status feedback signals and the clutch hydraulics.

Reset the alarm by pressing the CL. SEQ. FAILURE ACKN. button (see figure 1). Then you can make a new attempt to engage or disengage the clutch.

System Warning

Caution: Avoid changing operating mode or moving the manoeuvre responsibility until the fault has been located and repaired.

The SYSTEM WARNING lamp (see figure 1) on the control panel indicates a non-critical fault in the control system. The cause for a system warning may be:

- A master control unit, SLIO unit or SLIO bus has become faulty, and the slave system has taken over (only valid when equipped with twin propellers).
- One of the two redundant CAN buses is faulty.
- An error is detected on a non-active device, for instance, a lever transmitter on a station that is not in command.
- A failure has been detected in the FPS transmitter of a disengaged engine.
- A system warning has been activated in the tunnel thruster control system (if the application includes a tunnel thruster control system delivered by Rolls-Royce).
- A wire break has occurred in an EMERG. CL. OUT ALARM button (see figure 1) (if emergency clutch out is included). The button, which is normally always lit, is switched off.

When a system warning has occurred, the control system continues to operate without disruption. However, another fault, or, for instance, a change of station in command may activate a control failure. It is therefore important at a system warning to take measures to locate and repair the faulty devices as soon as possible.

Produced by: BI Approved by: Jnj Revision: b Sign: Mnm
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Rolls-Royce Marine New Zealand	+64-3-962-1230	+64-3-962-1231	
P.O. Box 12-169			
8002 Christchrurch			
New Zealand			

America

United States of America

Address	Phone	Fax	Mobile
Rolls-Royce Marine Inc.	+1 504 464 4561	+1 504 464 4565	1 866-464-4561
200 James Drive West			
St. Rose, LA 70087			
USA			

Address	Phone	Fax	Mobile
Rolls-Royce Commercial Marine	+1 954 436 7100	+1 954 436 7101	
11550 Interchange Circle North			
Miramar, Florida 33025	E-mails: parts.florida@rolls-royce.com		
USA	service.florida@rolls-royce.com		

Address	Phone	Fax	Mobile
Rolls-Royce Marine Seattle 4451 - 14th Avenue NW Seattle, WA 98107-4696 USA	+1-206-782-9190	+1-206-782-0176	

Canada

Address	Phone	Fax	Mobile
Rolls-Royce Canada Ltd. Halifax Office 196 Joseph Zatzman Drive, Unit 9 Dartmouth, Nova Scotia Canada B3B 1N4	+1 902 468 2883	+1 905 468 2759	

Address	Phone	Fax	Mobile
Rolls-Royce Canada Ltd. 96 North Bend Street Coquitlam B.C. Canada V3K 6H1	+1 604 942 1100	+1 604 942 1125	

South America

Address	Phone	Fax	Mobile
Rolls-Royce Marine Brasil Ltda. Rua General Jose, Cristino, 31 20921-400 Rio de Janeiro - RJ Brazil	+55 21 3860 8787	+55 21 3860 4410	

Asia

China

Address	Phone	Fax	Mobile
Rolls-Royce Marine Shanghai Ltd.	+86 21 638 78808	+86 21 538 25793	86 13 6016 32525
RM 909-915, Lippo Plaza			86 13 6019 26680
222, Huaihai Road			
200021 Shanghai			
China			

Hong Kong

Address	Phone	Fax	Mobile
Rolls-Royce Marine Hong Kong Ltd.	+852 2526 6937	+852 2868 5344	
Room 1008B, Shui on Centre			
6-8 Harbour Road, Wanchai			
Hong Kong			

India

Address	Phone	Fax	Mobile
Rolls-Royce Marine India Pvt Ltd.	+91 22 5640 3838	+91 22 5640 3819	
617-620/B Bonanza, Sahar Plaza			
MV Road, Andheri East			
Mumbai 400 059			
India			

Japan

Address	Phone	Fax	Mobile
Rolls-Royce Marine Japan K.K.	+81 3 3237 6861	+81 3 3237 6846	81 9032 2735 68
Tobunsha Bldg. 4F			
2-5-1, Kudan-Minami			
Chiyoda-ku Tokyo 102-0074			
Japan			

Korea

Address	Phone	Fax	Mobile
Rolls-Royce Marine Korea Ltd.	+82 51 831-4100	+82 51 831-4101	82 11 554 4171
Noksan State Industrial Complex 18B-2L			
1578-1, Songjeong-dong, Gangseo-gu			
Busan 618-270			
Korea			

Singapore

Address	Phone	Fax	Mobile
Rolls-Royce Marine Singapore Pte Ltd.	+65 6862 1901	+65 6863 0287	65 9297 2868
No. 6 Tuas Drive 1, Jurong		(Service)	
Singapore 638673		+65 6863 2381	
		(Spares)	

United Arab Emirates

Address	Phone	Fax	Mobile
Rolls-Royce Marine Middle East	+971 4.883 3881	+971 4.883 3882	
P.O. Box 261103			
Jebel Ali Free Zone			
Dubai			
United Arab Emirates			

Produced by: SS Approved by: Nna Revision: a Sign: Nna
Creation date: 2005-05-31 Revision date: 2008-06-03

Introduction, Spare Parts

How to Order Spare Parts using Drawings

To order spare parts, please contact your nearest Rolls-Royce Marine Global Support Network, see part 9 Contact List.

Use the appended design drawings in part 12 Design Drawings to locate the spare parts you would like to order. Present the drawing number and the position number of the spare parts to Rolls-Royce and be prepared to state the following information about the vessel.

- Building yard
- New building number
- Rolls-Royce manufacturing number
- Rolls-Royce file number

The information about the vessel is found in part 5 Technical Data.

Nr. No.	Benämning Description	Dimension Dimension	Material Material	Ant. No of	Märkning Marking: Ritning Drawing	Märkning Marking: Det. Item	Placering Location
1	O-RING O-RING	298x9,7	GUMMI RUBBER	1	RRM200011922	1	BLADFLÄNS BLADE FLANGE
2	LÅSPINNE LOCKING PIN	Ø8x25 915980V	2343-02	6	RRM200011922	2	BLADFLÄNS BLADE FLANGE
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

KAMEWA
A Vickers P.L.C. company

NAV
HUB 55A/4, XF5/4, P1/4
INSTALLATIONSSATS
INSTALLATION SPARE KIT 11

Uppgj. KO	Kontr. KK186	Godk. KK583	
Datum 101025	Föreg. ritn. 154063	Skala -	A4
RRM200011922			A

Item no.	No. of	Description	Reference	Art. no.	Remark	Position	Note
1	4	Filter insert	0160 R 010 BN4HC	K162560	HYDAC	F3	2 pcs. for start up and 2 pcs. for spare
2	1	Pump unit P3	See hydraulic diagram dwg.	K162561	Pump/elmotor	P3	
3	1	Pump unit P1	See hydraulic diagram dwg.	RRM200011110	Pump/elmotor	P1	
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Spare parts hydraulic
Main propeller
Reservdelar hydraulik

Checked: Har	Previous Drg:			
Approved: Mnmn	Weight kg:			
Origin. / Date: Jnla 2010-04-27	Scale:	Format: A3	Sheet: 1 of 1	
Drawing no: RRM200007040			Revision: B	

Rolls-Royce

Rolls-Royce AB
Propulsion Kristinehamn

Acess List

RR AB'S Info. Class: LIMITED

Nr. No.	Benämning Description	Dimension Dimension	Material Material	Ant. No of	Märkning Marking Ritning Drawing	Märkning Marking Det. Item	Placering Location
1	SIMMERING BAUMX7 SEALING RING	45-62-8	75FPM585	1	214017	1	Anslutningsfläns Connection flange
2	SIMMERING BABSL SEALING RING	45-62-7	75FPM585	1	214017	2	Anslutningsfläns Connection flange
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							

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T.O.-BOX
O.D.-BOX 35 FA _

RESERVDELAR
SPARE PARTS

Uppgj.	Kontr.	Godk.	
Gök	KO	Ekk	
Datum 060118	Föreg.ritn. _	Skala –	A4
214017			_

Item.	Quant.	Description	Type	Manufacturer	Note
K1	1	CONTACTOR 18A 24VDC	LC1D18BD	TELEMECANIQUE	FOR STARTER DWG. NO. RRM200007038 (P1/P2)
K2	1	RELAY 3-POLE 24VDC	C3A30D24D	RELECO	FOR STARTER DWG. NO. RRM200007038 (P1/P2)
K3,K4	1	MULTIFUNCTIONAL TIME RELAY	PU2R3	CROUZET	FOR STARTER DWG. NO. RRM200007038 (P1/P2)
H1	1	NEON-LIGHT BA9S 24V			FOR STARTER DWG. NO. RRM200007038 (P1/P2)
K1	1	CONTACTOR 9A 230VAC	LC1D09BD	TELEMECANIQUE	FOR STARTER DWG. NO. RRM200007039 (P3)
K2	1	RELAY 3-POLE 230VAC	C3A30D24D	RELECO	FOR STARTER DWG. NO. RRM200007039 (P3)
H1	1	NEON-LIGHT BA9S 24V			FOR STARTER DWG. NO. RRM200007039 (P3)

ELEKTROMONTAGE

Revis.	Revision comprises	Date	Made by	Checked	Approved

HYDRAULIC SYSTEM
MAIN PROPELLER
SPARE PARTS STARTERS

Checked: SGR
Approved: LBE
Previous Drg:
Weight kg:

Rolls-Royce

Rolls-Royce AB
Propulsion Kristinehamn

Origin. / Date: MLI / 10.05.05
Scale:
Format: A3
Sheet: 1 of 1
Drawing no: RRM200007041
Revision: A

Acess List

RR AB´S Info. Class: LIMITED

Tools

Introduction

Every task in the installation and maintenance parts includes a section with recommended equipment called Support Items. The Special Tool and Test Equipment table in the Support Items section covers the special tools and additional tools needed to perform the task, it does not include standard tools. Rolls-Royce presumes that standard tools are available on board the vessel, see section Standard Tools for recommended standard tools.

Standard Tools

Rolls-Royce presumes that standard tools are available on board the vessel. Rolls-Royce recommends that at least the following standard tools are available (note that the illustrations may not be an exact copy of the tools on board the vessel):

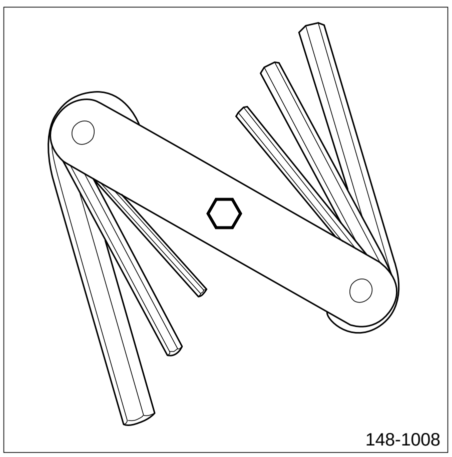


Figure 1 Allen key kit.

Figure 2 Socket wrench kit (including ratchet wrench, ratchet wrench extension and sockets).

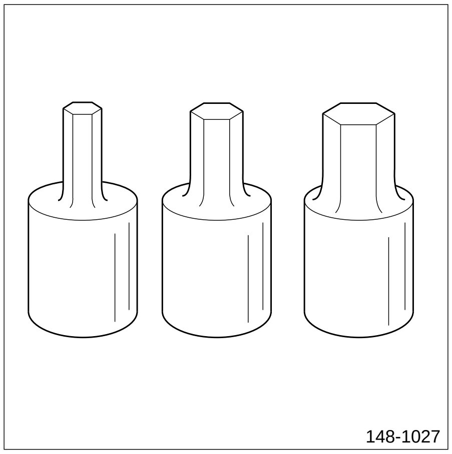


Figure 3 Hexagon wrench kit fitting ratchett wrench .

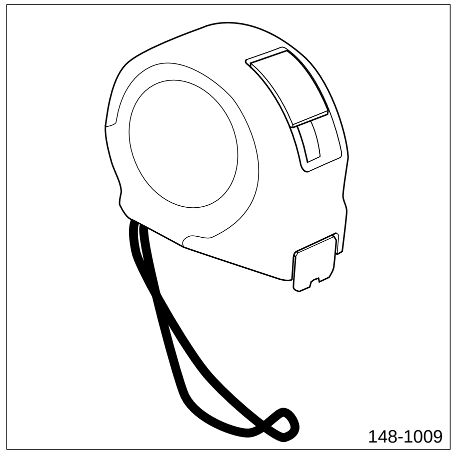


Figure 4 Measure tape.

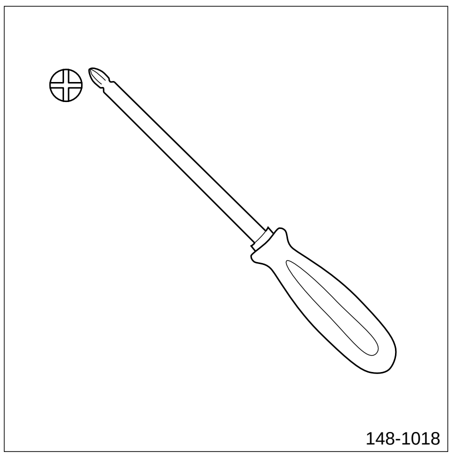


Figure 5 Screw driver (Philips type).

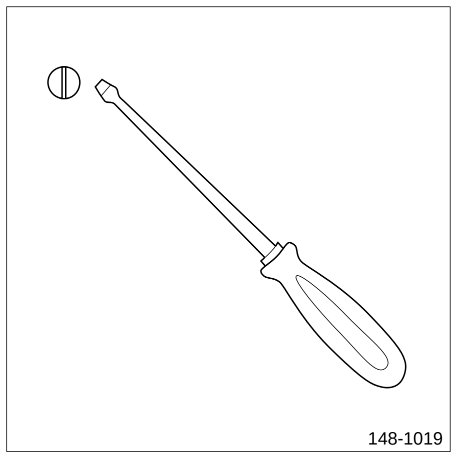


Figure 6 Screw driver (slotted).

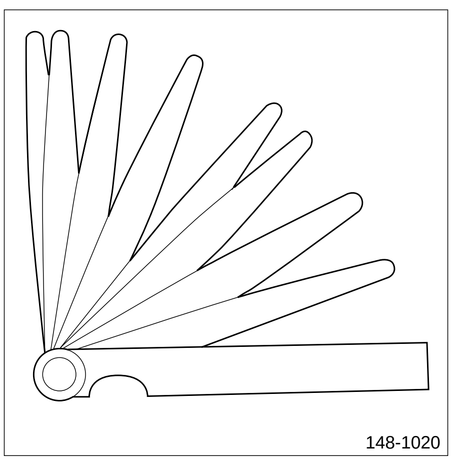


Figure 7 Feeler gauge.

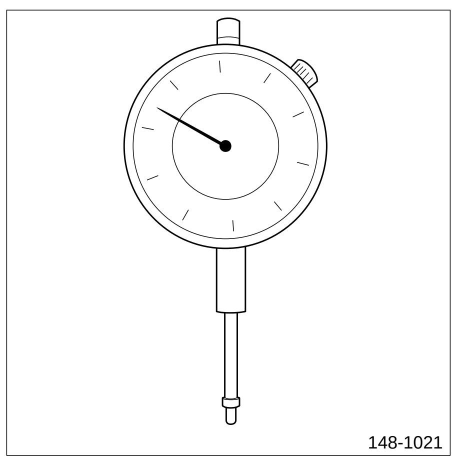


Figure 8 Dial indicator.

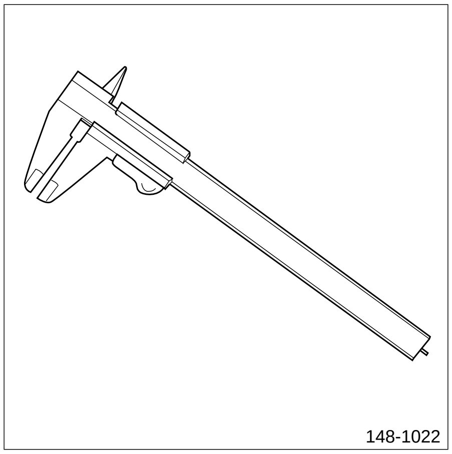


Figure 9 Sliding caliper.

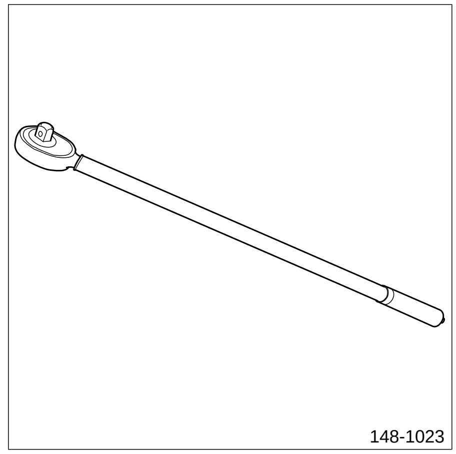


Figure 10 Torque wrench.

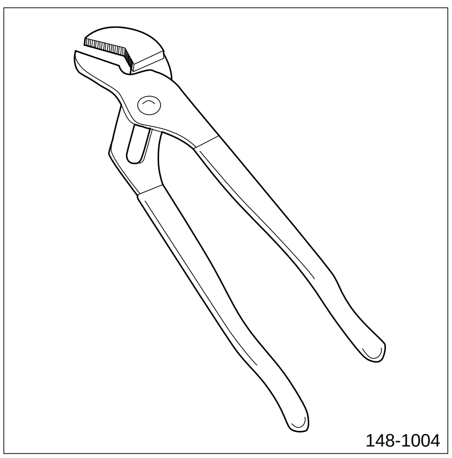


Figure 11 Universal plier.

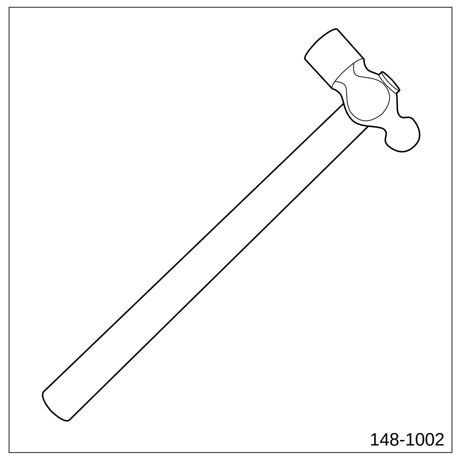


Figure 12 Ball hammer.

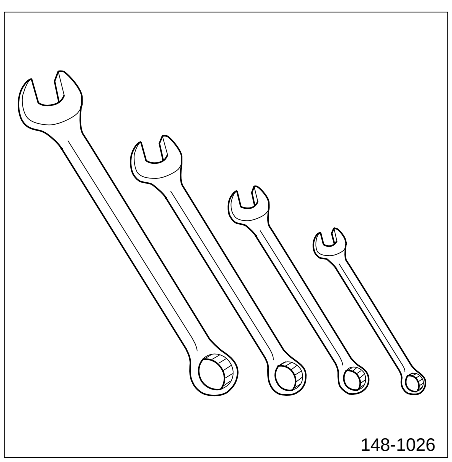


Figure 13 Spanner kit.

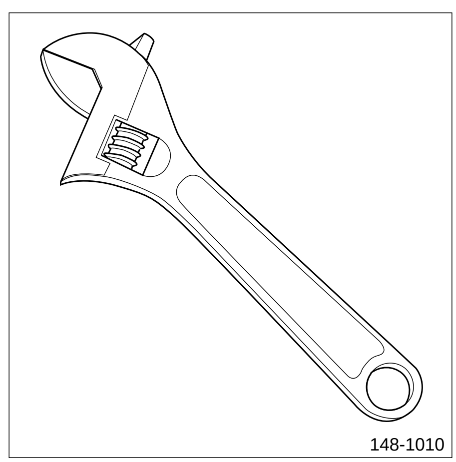


Figure 14 Adjustable wrench.

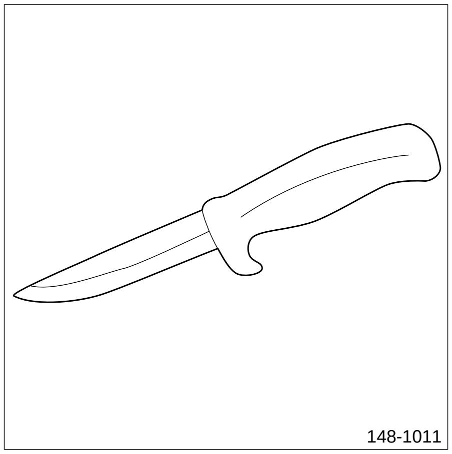


Figure 15 Knife.

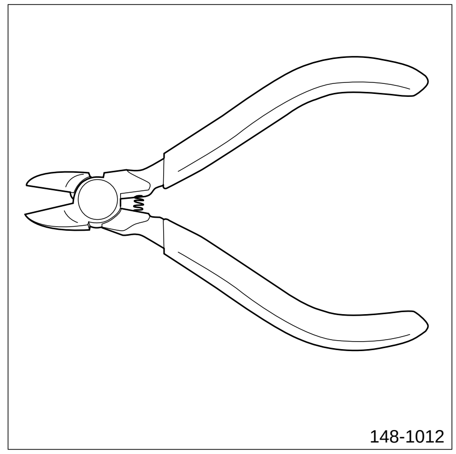


Figure 16 Side cutting plier.

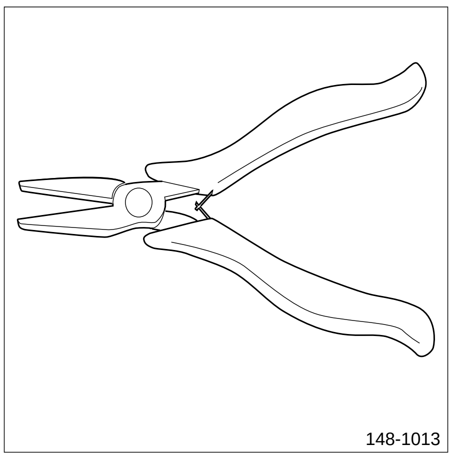


Figure 17 Flat plier.

Lifting Tools

All Rolls-Royce lifting tools are tested and approved according to 2A 98/37/EG Machinery Directive. For more information see the appended user manual for lifting tools in part Tools.

Special Tools

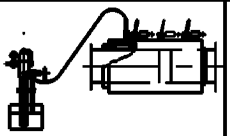
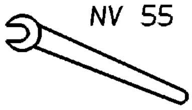
If special tools are part of the Rolls-Royce delivery they are listed in part Design Drawings. The special tools are tools that are manufactured by Rolls-Royce and included in the delivery of the propulsion system. To order special tools, please contact nearest Rolls-Royce Marine Global Support Network.

Additional Tools

Additional tools are not part of the Rolls-Royce delivery but are mentioned in the support items table to facilitate the maintenance of the propulsion system.

.

B

Nr. No.	Benämning Description	Skiss Sketch	Material Material	Ant. No of	Märkning Marking: Ritning Drawing	Märkning Marking: Det. Item	Placering Location
1	MONTAGEVERKTYG MOUNTING TOOLS			1	943587□	1-2	SKF KOPPLING SKF COUPLING
2	U-NYCKEL U-SPANNER	NV 55  STAHLVILLE 4004-55	STÅL STEEL	2	-	2	DUBBELRÖR TWIN TUBE
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

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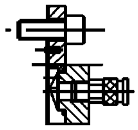
AXELLEDN. HÅLBORRN. Ø65
SHAFTING (60-66XF5/4)
VERKTYG
TOOLS

Uppgj.	Kontr.	Godk.	
Sdb	Lnr	JÅN	
Datum 970715	Föreg. ritn. _	Skala -	A4

104500

B

Nr. No.	Benämning Description	Skiss Sketch	Material Material	Ant. No of	Märkning Marking: Ritning Drawing	Märkning Marking: Det. Item	Placering Location
1	NÖDMANÖVER-PLUNGE EMERGENCY-PLUNGER		STÅL STEEL	1	948427	1-7	OLJEINFÖRNINGS-RÖR OIL DISTRIBUTION PIPE
2	NÖDMANÖVER-SLANG EMERGENCY-HOSE	7m	GUMMI RUBBER	1	961214	1-6	PLUNGE PLUNGER
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

KAMEWA
A Vickers P.L.C. company

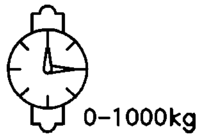
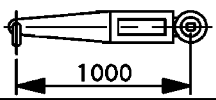
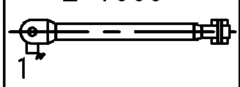
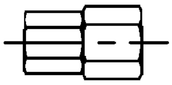
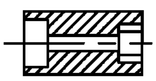
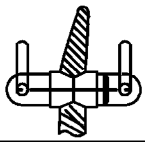
VERKTYG NÖDMANÖVER
TOOLS EMERGENCY CONTROL

TO-BOX
OD-BOX ⌀35

Uppgj.	Kontr.	Godk.	
JA	Lnr	Nna	
Datum 920115	Föreg. ritn. –	Skala –	A4

940832

B

NR NO	BENÄMNING DESCRIPTION	SKISS SKETCH	MATERIAL MATERIAL	ANT. NO OF	MÄRKNING MARKING RITNING DRAWING	MÄRKNING MARKING DET ITEM	PLACERING LOCATION
1	DYNAMOMETER TENSION TESTER		STÅL STEEL	1	RRM200010894	1	BLADFLÄNS AXELFLÄNS BLADE FLANGE SHAFT FLANGE
2	MOMENTVERKTYG DYNAMOMETRIC WRENCH		STÅL STEEL	1	R935753A	1-4	BLADFLÄNS AXELFLÄNS BLADE FLANGE SHAFT FLANGE
3	LEDHANDTAG WRENCH HANDLE		STÅL STEEL	1	R903096A	1-2	NAVCYLINDER KOLV HUB CYLINDER PISTON
4	INSATSMEJSEL CHISEL		STÅL STEEL	1	RRM200010894	4	NAVCYLINDER KOLV HUB CYLINDER PISTON
5	HÅLLARE HOLDER		STÅL STEEL	1	RRM200010894	5	NAVCYLINDER KOLV HUB CYLINDER PISTON
6	SLANG SMST HOSE ASSEMBLY	-		1	RRM200008411	1-4	FLUSHING HUB FLUSHING
7	SLANG SMST HOSE ASSEMBLY	-		1	RRM200012768	1-11	BLAD BLADE
8	FLUSHNINGSPUMP FLUSHNING PUMP	-		1	RRM200012787	9	BLAD BLADE
9	LIFTING TOOL LYFTVERKTYG		STÅL STEEL	1	RRM200010918	1-5	BLAD BLADE
10	- -	-		-	-	-	- -
11	- -	-		-	-	-	- -
12	- -	-		-	-	-	- -

Rolls-Royce	NAV HUB 2x55A/4 G VERKTYG TOOLS 1 2	Uppgj. JH	Kontr. Har	Godk. mnmn	
		Datum 100922	Föreg. ritn. 154735	Skala -	A4
		RRM200010894			C

B

NR NO	BENÄMNING DESCRIPTION	SKISS SKETCH	MATERIAL MATERIAL	ANT. NO OF	MÄRKNING MARKING RITNING DRAWING	 DET ITEM	PLACERING LOCATION
13	PTFE-FETT PTFE-COMPOUND	67665-ST		6	RRM200010894	13	BLADTÄTNING BLADE SEAL
14	TÄTNINGSMASSA SEALING COMPOUND	-		4	RRM200010894	14	SKRUV SCREW
15	MOLYCOTE MOLYCOTE	-		2	RRM200010894	15	SKRUV SCREW
16	FETT GREASE	STATOIL GREASEWAY CAH92		5,6Kg	RRM200010894	16	BLAD BLADE
17	OLJA OIL	STATOIL SL07-201		80L	RRM200012858	1	BLAD BLADE
18							
19							
20							

Rolls-Royce

NAV
HUB 2x55A/4 G
VERKTYG
TOOLS

Uppgj.	Kontr.	Godk.	
JH	Har	mnmn	
Datum 100922	Föreg. ritn. 154735	Skala –	A4
RRM200010894			C

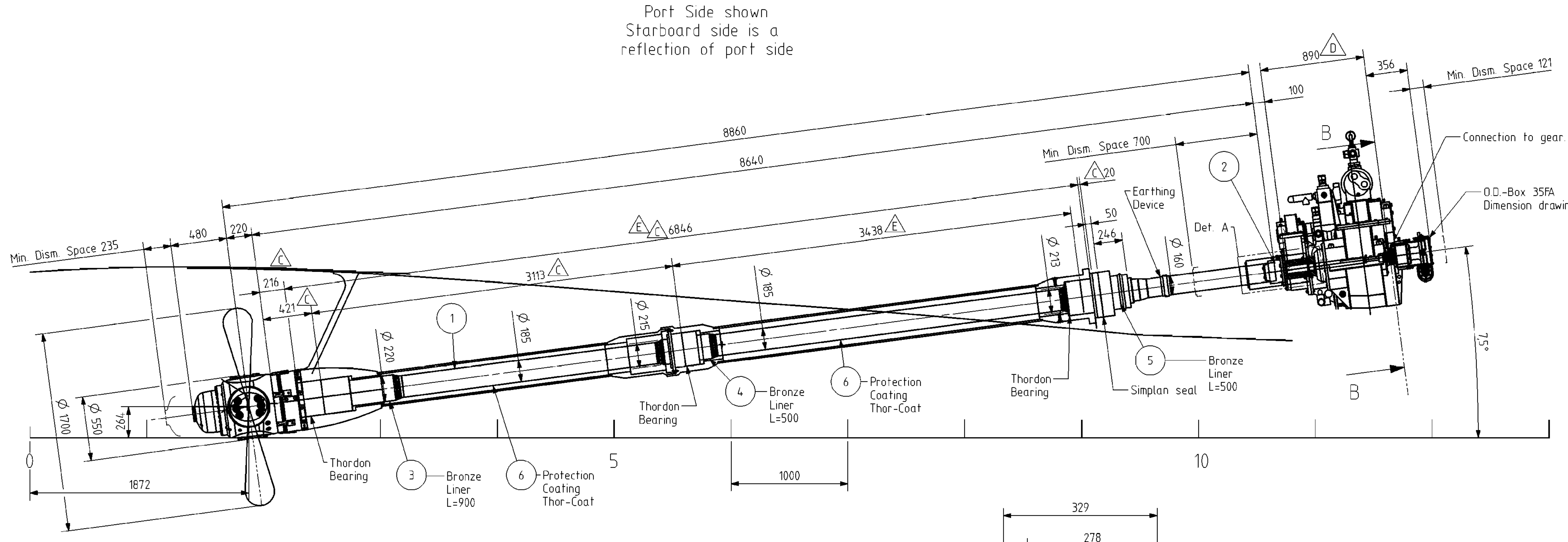
2 2

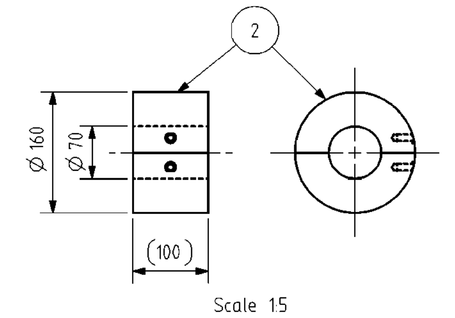
Design Drawings

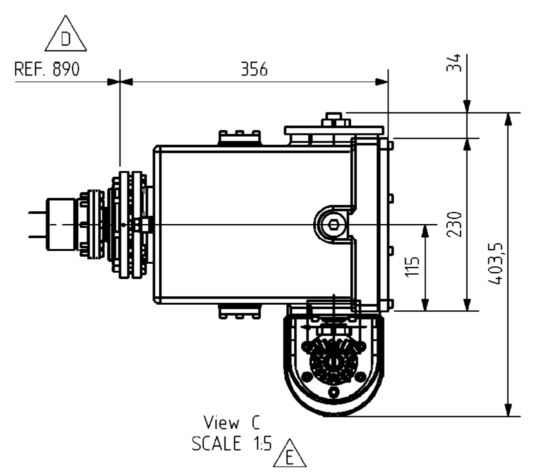
1.1 Mechanical and Hydraulic Drawings

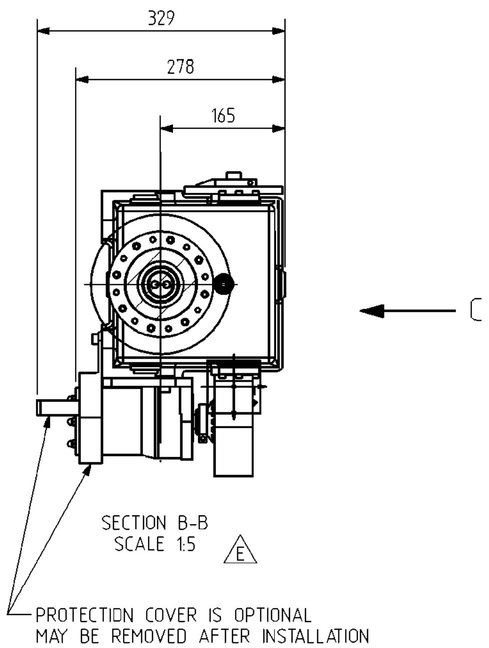
Drawing Title	Drawing Number	Design
Shafting		
Shafting Arrangement	DMN200000864 rev E	
Main Assembly and Marking Drawing	DMN200001313 rev A	
Propeller Shaft Assembly	RRM200005966 rev B	
Twin tube	RRM200008623 rev A	
Stern Tube Assembly	RRM200006467 rev A	
Stern Tube Aft Bearing	RRM200006474 rev C	
Stern Tube Intermediate Bearing	RRM200006475 rev C	
Stern Tube forward Bearing	RRM200006476 rev C	
B+V Simplan Seal	RRM200006480 rev A	
SKF Coupling	RRM200005975 rev B	
PDn Diagram	10S000239/42061-O	
Propeller Hub		
Hub Assembly Right	RRM200009225 rev A	
Hub Assembly Left	RRM200009345 rev A	
Blade Outline	10S000239/R185033-O	
Tightening and Locking of Screws		
Instruction for Tightening of Screws	586431 rev G	
Instruction for Locking of Screws	998174 rev A	
Plug for Lifting Hole Assembly	144 112 rev –	
Oil Distribution Box		
OD-box Assembly	214 000 rev A	
OD-box Dimension	154 903 rev –	
OD-box Connection to Gear	214740 rev –	
Feed Back Box Assembly (F0/FA)	RRM200000128 rev C	

Drawing Title	Drawing Number	Design
Hydraulic System		
Hydraulic Diagram	DMN200000689 rev D	
Hydraulic System Assembly	RRM200007036 rev B	
Gravity Tank	RRM200011521 rev A	
Hydraulic Power Pack	RRM200007037 rev D	
Connection Diagram	DMN200000981 rev B	
Pump Motor Starter P1/P2	RRM200007038 rev A	
Pump Motor Starter P3	RRM200007039 rev B	
Cable Drawing	DMN200000983 rev B	
Cable Connection Drawing	DMN200000984 rev B	
Remote Supervision	DMN200000982 rev B	









HOLE DIAMETER Ø 65

DATA OF PROPELLER

Diameter:	1700	mm
Weight:	932	kg
Mass moment of inertia at MCR condition, J:	184	kgm^2 in water
Mass moment of inertia, J:	111	kgm^2 in air
Material:	NiAl Bronze	
Direction of rotation, seen from aft:	Outwards over the top	
Propeller speed:	491.9	r/min
Numbers of blades:	4	

DATA OF MAIN ENGINE PER SHAFT

Number: 1	Type:	MTU 12V4000M93L
Cycles: _	No of cyl: _	
Brake power, P_B at mox.cont. rating:	2500	kW
Engine speed:	2100	r/min
Make and type of engine coupling:	_	
Make and type of reduction gear:	_	

CLASSIFICATION SOCIETY

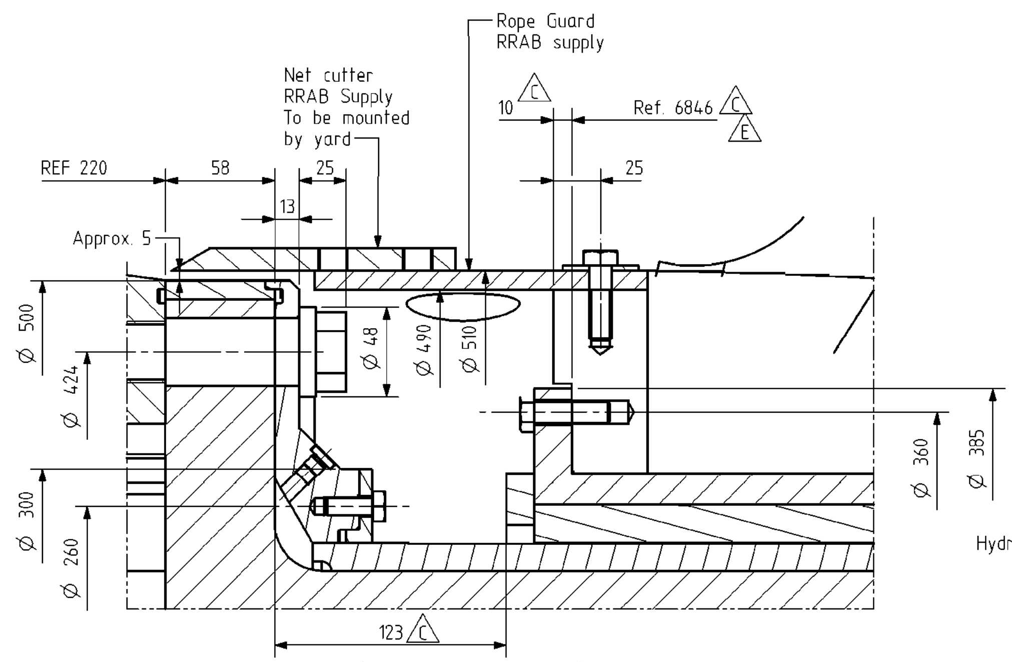
LRS

Ice class: No ICE

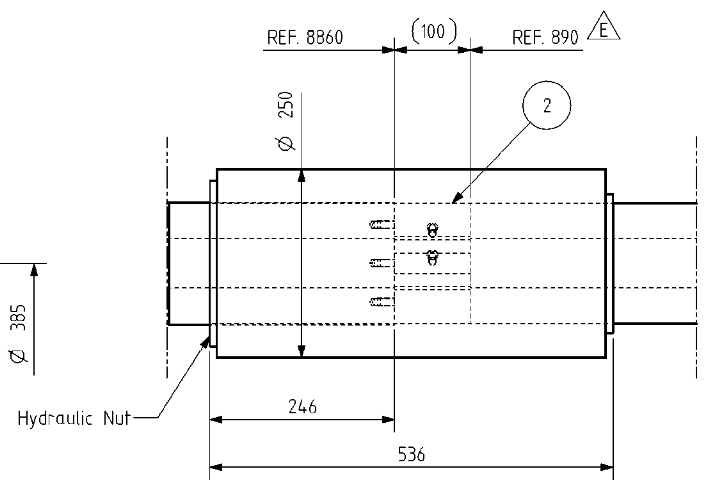
TVC SCHEME DRAWING: DMN200000945

MATERIAL PROPERTIES

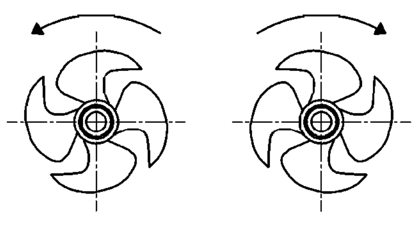
Item	Min tens.strenght N/mm	Min yield point N/mm	Min elongation % on $5.65*\sqrt{So}$	Impact test, min. KV (J) at -10°C	Weight kg
1	600	300	18	_	1630
2	_	315	_	_	13
3	270	130	16	_	74
4	270	130	16	_	31
5	270	130	16	_	42
6	Protection Coating				



Section of propeller shaft flange
SCALE 1:2



Det. A
Scale 1:5



SEEN FROM AFT

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	_

Drawing, Arrangement
2x 55A/4D-B-G - 35FA
Axelarrangemang K-200

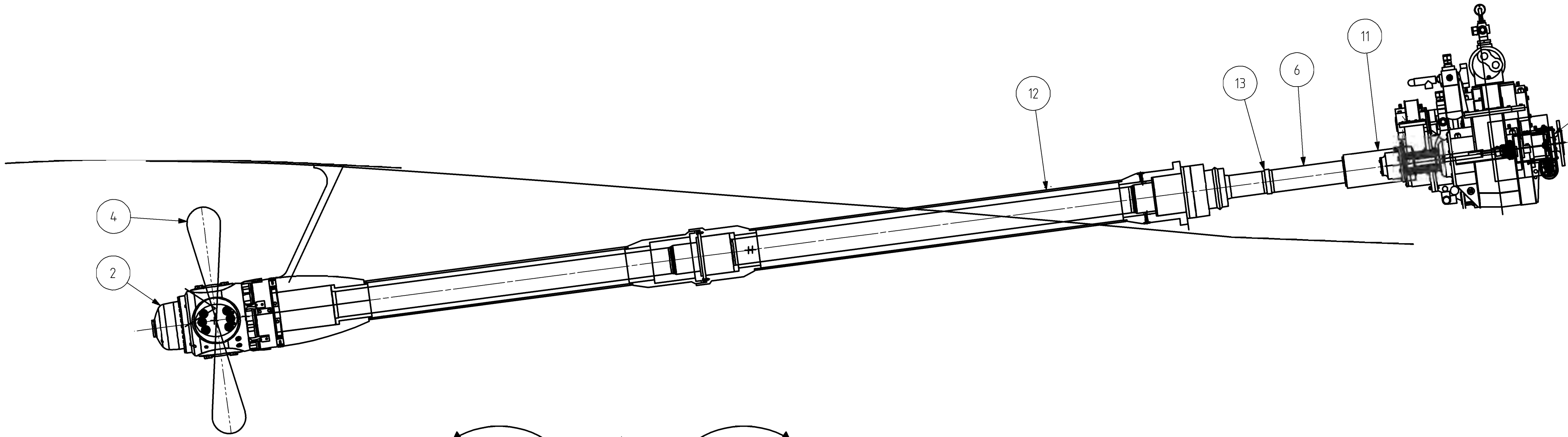
Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

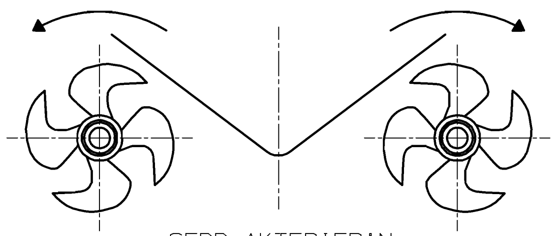
Origin/Date:	Scale:	Format:	Sheet:
JH 2010.03.23	1:20	A1	1 of 1

Drawing no: DMN200000864
Revision: E

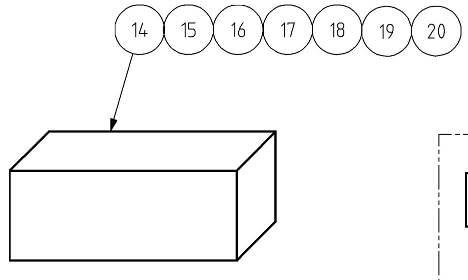
Access List:

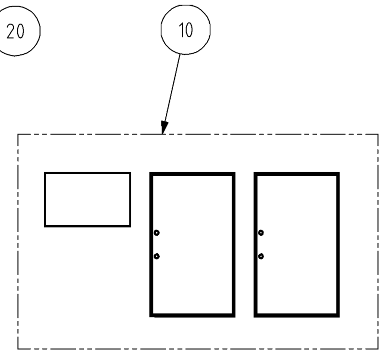
PORT SIDE SHOWN

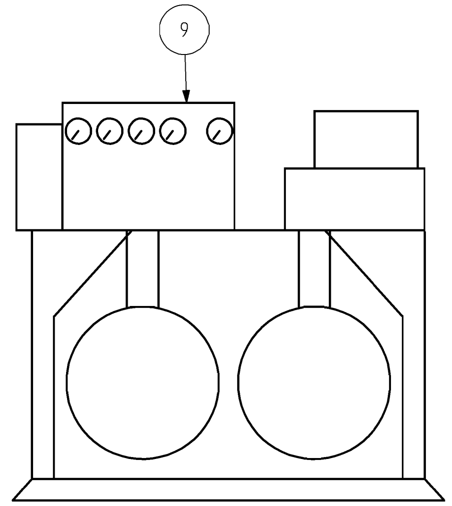




SEDD AKTERIFRAN
SEEN FROM AFT







MÄRKNING AV DETALJER

DETAILS TO BE MARKED

		BABORD PORT	STYRBORD STARBOARD
		VÄNSTER-ROTERANDE LEFT HAND TURNING	HÖGER-ROTERANDE RIGHT HAND TURNING
ORDER NO.	NYB. NR. YARD NO.	RR MÄRKNING RR MARKING	RR MÄRKNING RR MARKING
10S000239	K-200-1	16514	16515
10S000240	K-200-2	16516	16517
10S000241	K-200-3	16518	16519
10S000242	K-200-4	16520	16521
10S000243	K-200-5	16522	16523
10S000244	K-200-6	16524	16525
10S000245	K-200-7	16526	16527
10S000246	K-200-8	16528	16529
10S000247	K-200-9	16530	16531

HYDRAULIC SYSTEM	9	1	HYDRAULIKSYSTEM	RRM200007036	---	---
O.D.-BOX ASSY LEFT	7	1	T.O.-BOX SMST VÄNSTER	RRM200009766	---	Note 1
PROPELLER SHAFT ASSY.	6	1	PROPELLERAXEL SMST	RRM200005966	---	Note 1
PROPELLER BLADE	4	4	PROPELLERBLAD, VÄNSTER	RRM200005946	---	---
PROPELLER HUB	2	1	PROPELLERNAV, VÄNSTER	RRM200009345	---	---
	Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark

Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark
9	1	HYDRAULIKSYSTEM	RRM200007036	---	---
8	1	T.O.-BOX SMST HÖGER	RRM200005985	---	Note 1
6	1	PROPELLERAXEL SMST	RRM200005966	---	Note 1
5	4	PROPELLERBLAD, HÖGER	RRM200005943	---	---
3	1	PROPELLERNAV, HÖGER	RRM200009225	---	---

Note 1: Shaft and O.D.-BOX assemblies includes the twin tube

DESCRIPTION	ITEM NO.	NO. OF	SWEDISH DESCRIPTION	REFERENCE
TOOLS EMERGENCY CONTROL	20	1	VERKTYG NÖDMANÖVER	940832A
TOOLS SHAFTING	19	1	VERKTYG AXELLEDNING	104500A
TOOLS HUB	18	1	VERKTYG NAV	---
SPARE PARTS STARTERS	17	1	RESERVDELAR STARTERS	RRM200007041
SPARE PARTS HYDRAULIC	16	1	RESERVDELAR HYDRAULIK	RRM200007040
SPARE PARTS O.D.-BOX	15	1	RESERVDELAR T.O.-BOX	214017A
INSTALLATION SPARE KIT HUB	14	1	INSTALLATIONSSATS NAV	---
EARTHING DEVICE	13	2	JORDNINGSUTRUSTNING	RRM200005977
STERNTUBE ASSY	12	2	AXELHYLSA SMST	RRM200006467
SHAFT COUPLING	11	2	KOPPLING	RRM200005975
CONTROL SYSTEM ASSY	10	1	MANÖVERSYSTEM SMST	RRM200005995
SHAFTING ARRANGEMENT	1	1	AXELARRANGEMANG	DMN200000864

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	-

Drawing, Assembly
55A/4D -35FA
Main assy & Mark drawing

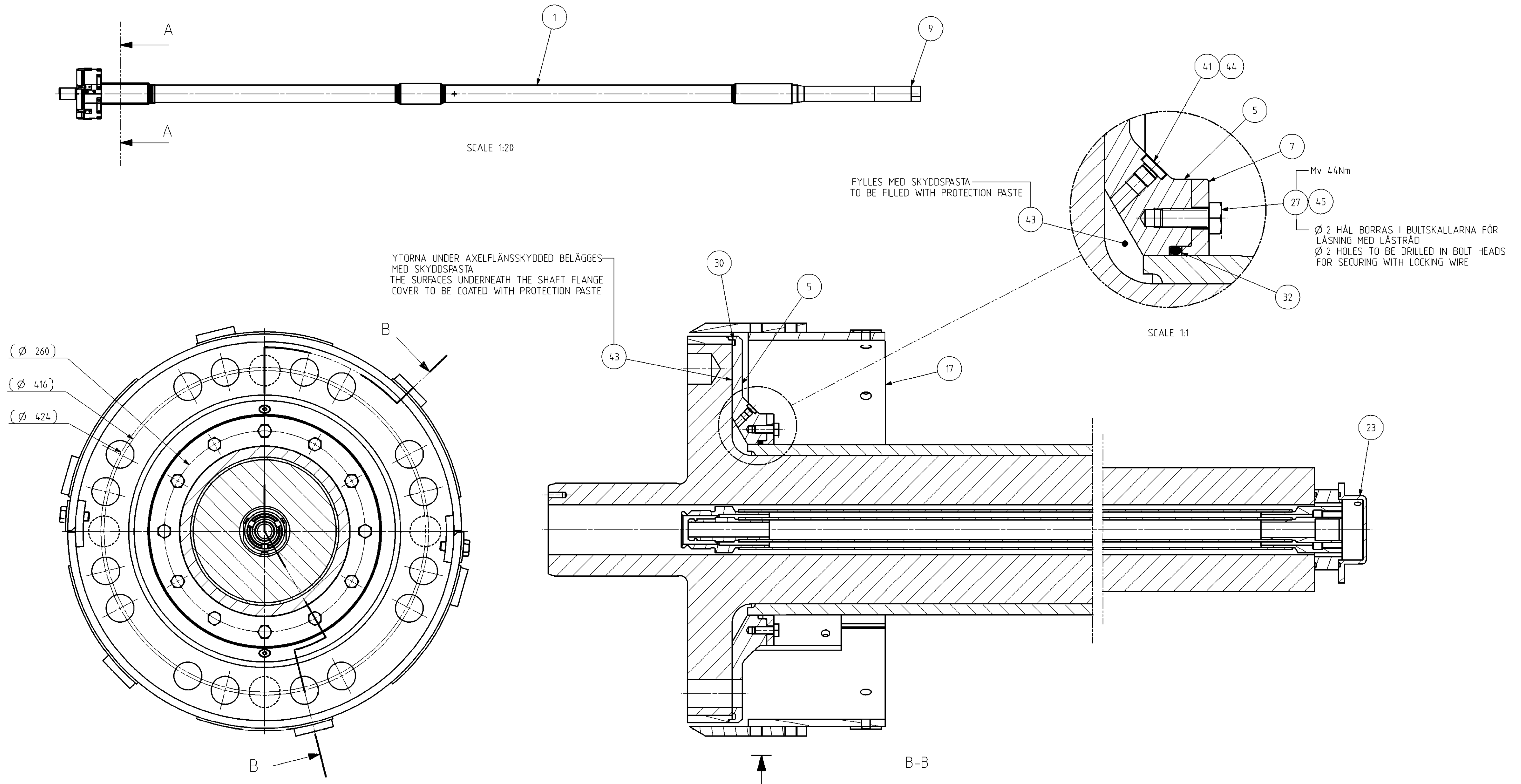
Rolls-Royce

Rolls-Royce AB
S-681 29 KRISTINEHAMN

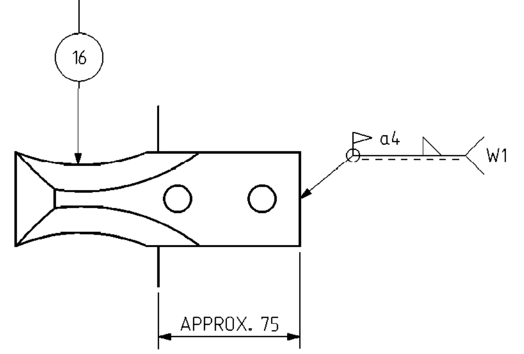
Origin./Date:	Scale:	Format:	Sheet:
Wkg 2010.07.15	1:20	A1	1 of 1
Drawing no: DMN200001313			Revision: A

Access List:

RR AB's Info class:



A-A
SKALA / SCALE 2:5



VY / VIEW C
SCALE 1:2

SVETSBESTÄMMELSER / WELDING RULES	SVETSSTANDARD FÖR ROLLS-ROYCE AB / WELDING STANDARD FOR ROLLS-ROYCE AB
GRUNDMATERIAL / PARENT METAL	—
AVSPÄNNINGSGLÖDGNINGSTEMPERATUR / STRESS-RELIEVING HEAT TREATMENT AT	SE SVETSDATABLAD / SEE WELDING PROCEDURE SPECIFICATION (WPS)
SVETSPLAN / SEQUENCE OF WELDING	SE SVETSDATABLAD / SEE WELDING PROCEDURE SPECIFICATION (WPS)
TÄTHETSKRAV / SEALING REQUIREMENTS	— / —
SVETSTOLERANS / WELDING TOLERANCE	EN ISO 13920-BE

			PROVNINGSOMFATTNING / EXTENT OF EXAMINATION				
SVETS NR / WELD NO	SVETSKLASS / WELDING CLASS	SVETSMETOD / WELDING PROCESS	RÖNTGEN UNDERSÖKNING / RADIOGRAPHIC EXAMINATION	ULTRALJUD UNDERSÖKNING / ULTRASONIC EXAMINATION	MAGNETPULVER UNDERSÖKNING / MAGNETIC PARTICLE EXAMINATION	PENETRANT UNDERSÖKNING / LIQUID PENETRANT EXAMINATION	ANMÄRKNING / REMARK
W1	C	_	_%	_%	_%	_%	

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	1850

Propeller Shaft
55A/4-DBG
PROPELLER SHAFT ASSY

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

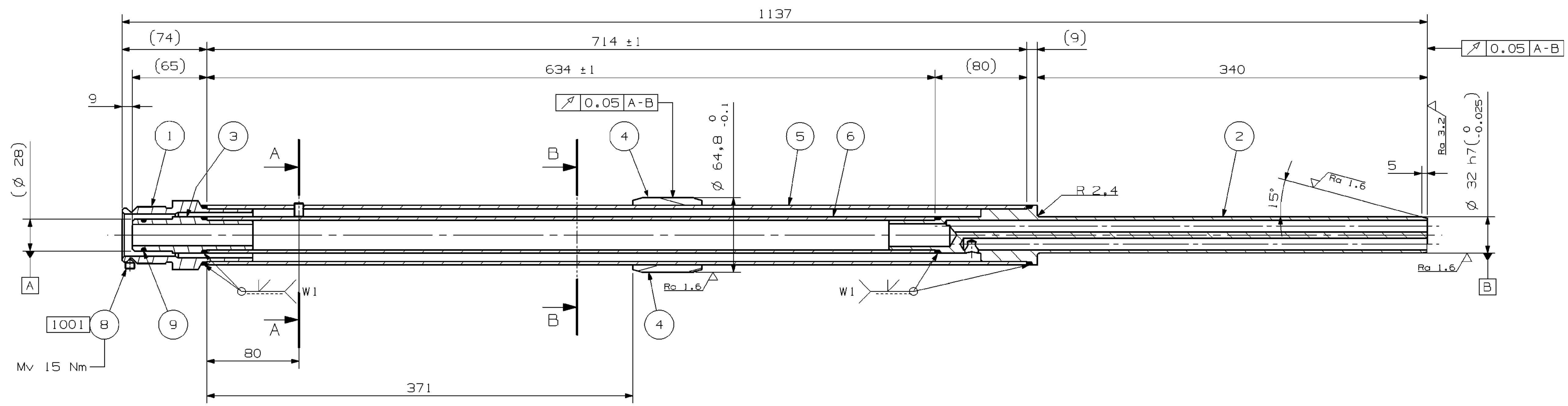
Origin./Date:		Scale:	Format:	Sheet:
Wkg	2010.06.10	1:2.5	A1	1 of 1
Drawing no: RRM200005966				Revision: B

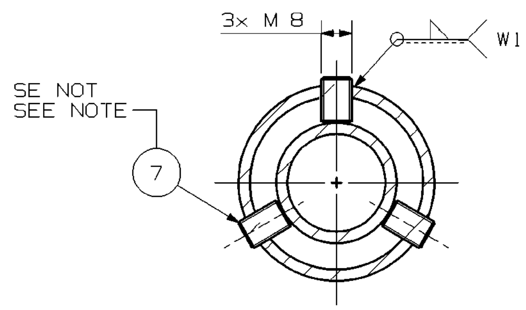
Access List:

External Bom Report

Item ID/Rev	Name	Item State	Size
RRM200005966/B	Propeller Shaft	Assembly	55A/4-DBG

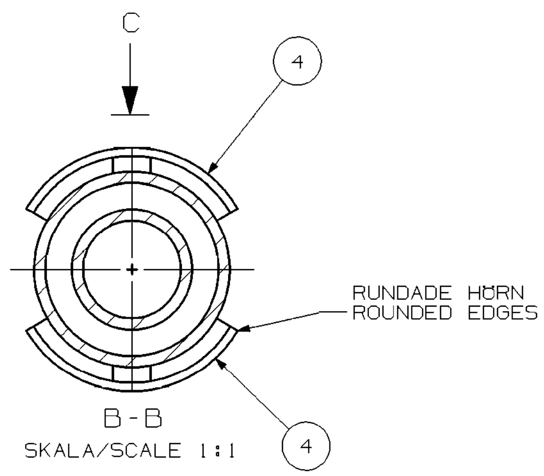
Sub-Assembly/Part				
Seq No	**Qty**	**Item ID/Rev**	**Name**	**Item State**
1	1	RRM200005965/A	Propeller Shaft	Assembly
5	1	RRM200005967/A	Shaft Flange Protection	Detail
7	1	RRM200005968/B	Gland	Detail
9	1	R125146B/C	Distance Ring	Detail
16	6	R124124A/_	Rope Knife	Detail
17	1	RRM200005969/B	Rope Guard	Detail
23	1	R215025A/_	Cover	Assembly
27	12	F019414/_	Hexagon Head Screw	Detail
30	1	F088499/_	O-Ring	Detail
32	1	F088357/_	O-Ring	Detail
41	2	F062832/_	Plug	Detail
43	2	F067211/_	Sealing Compound	Detail
44	1	F067206/_	Locking Compound	Detail
45	1	K112905/_	Lock Wire	Detail





A-A

SKALA/SCALE 1:1



B-B

SKALA/SCALE 1:1

FÖR VERKSTAD

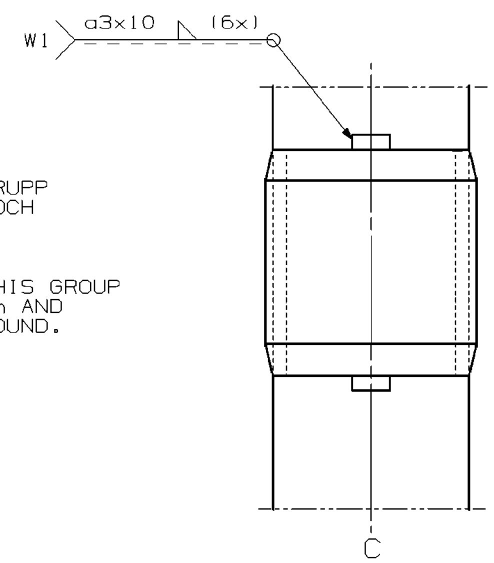
DUBBELRÖREN RENGÖRES NOGGRANT IN OCH UTVÄNDIGT FÖRE MONTAGE.

VARJE KOMPLETT DUBBELRÖRSDEL MÄRKES MED RÖRETS RITNIGNSNUMMER SAMT TILLV.NR. ENLIGT HUVUDSMST OCH MÄRKRITNING.

FOR WORKSHOP

BEFORE MOUNTING, THE TWIN TUBES ARE TO BE CLEANED CAREFULLY IN AND OUTWARDS.

EACH COMPLETE PART OF THE TWIN TUBE TO BE MARKED WITH DRAWING NO. AND MANUFACTURING NO. ACC. TO MAIN ASSY AND MARK DRAWING.



C

SKALA/SCALE 1:1

NOT
SKRUVARNA I DENNA GRUPP ANSÄTTES MED 10 Nm OCH TÄTSVETSAS RUNTOM.

NOTE
THE SET SCREWS IN THIS GROUP TO BE SET WITH 10 Nm AND WELDED TIGHT ALL AROUND.

1001 LOCTITE 243

SVETSBESTÄMMELSER WELDING RULES	SVETSSTANDARD FÖR ROLLS-ROYCE AB WELDING STANDARD FOR ROLLS-ROYCE AB
GRUNDMATERIAL PARENT METAL	St35BK, EN5355JR
AVSPÄNNINGSGLÖDGNINGSTEMPERATUR STRESS-RELIEVING HEAT TREATMENT AT	SE SVETSDATABLAD SEE WELDING PROCEOURE SPECIFICATION (WPS)
SVETSPLAN SEQUENCE OF WELDING	SE SVETSDATABLAD SEE WELDING PROCEDURE SPECIFICATION (WPS)
TÄTHETSKRAV SEALING REQUIREMENTS	SE TÄTHETSPROV SEE PREASURE TEST
SVETSTOLERANS WELDING TOLERANCE	EN ISO 13920-BE

			PRÖVNINGSOMFATTNING EXTENT OF EXAMINATION				
SVETS NR WELD NO	SVETSKLASS WELDING CLASS	SVETSMETOD WELDING PROCESS	RÖNTGEN UNDERSÖKNING RADIOGRAPHIC EXAMINATION	ULTRALJUD UNDERSÖKNING ULTRASONIC EXAMINATION	MAGNETPULVER UNDERSÖKNING MAGNETIC PARTICLE EXAMINATION	PENETRANT UNDERSÖKNING LIQUID PENETRANT EXAMINATION	ANMÄRKNING REMARK
W1	C	_	_%	_%	_%	_%	

TÄTHETSPROV PRESSURE TEST

☐ Före bearbetning
Before machining

☒ Efter bearbetning
After machining

Kontrollmedium
Test medium .... PROVTR. VÄTSKA
PRESSURE TEST LIQUID

Kontrolltryck
Test pressure .... 135 .... bar

Kontrolltryck i pilens-T→riktning
Test pressure applied in directio. of →

Tid
Time .... 10 min. ....

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	8

Twin Tube
55A/4D-B -35FA
DUBBELRÖR; FÖRLIG DEL

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

Origin./Date:		Scale:	Format:	Sheet:
Wkg	2010.07.08	1:2	A1	1 of 1

Drawing no: RRM200008623
Revision: A

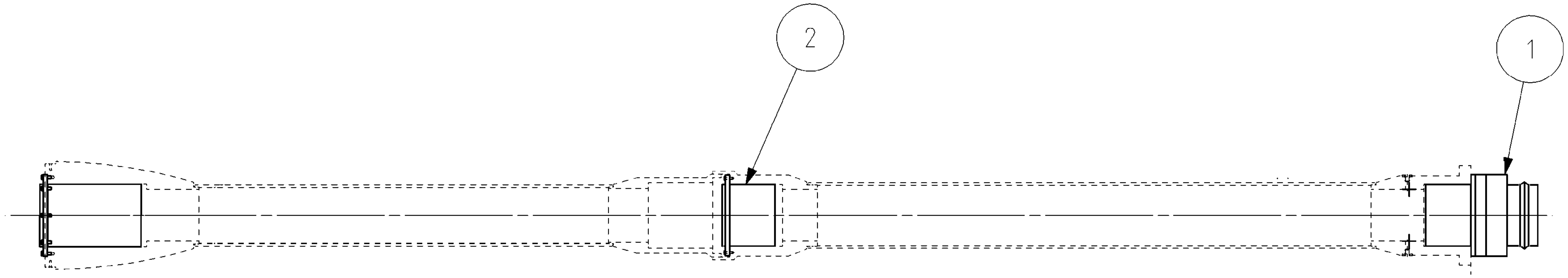
Access Unit:

External Bom Report

Item ID/Rev	Name	Item State	Size
RRM200008623/A	Twin Tube	Assembly	55A/4D-B -35FA

Sub-Assembly/Part

Seq No	Qty	Item ID/Rev	Name	Item State
1	1	R154350A/_	Muff	Detail
2	1	R154354A/A	Oil Distribution Pipe	Detail
3	1	R154355A/_	Pipe Sleeve	Detail
4	2	R154360A/_	Pipe Support	Detail
5	1	RRM200009296/A	Cylinder Pipe	Detail
6	1	RRM200009295/A	Cylinder Pipe	Detail
7	3	K162916/_	Set Screw	Detail
8	1	K164318/_	Set Screw	Detail
9	1	F088072/_	O-Ring	Detail



General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	201

Stern Tube
55A/4-DBG
AXELHYLSA

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

Origin./Date:	Scale:	Format:	Sheet:
Wkg 2010.07.12	1:1	A3	1 of 1

Drawing no:	Revision:
RRM200006467	A

Acess List:

External Bom Report

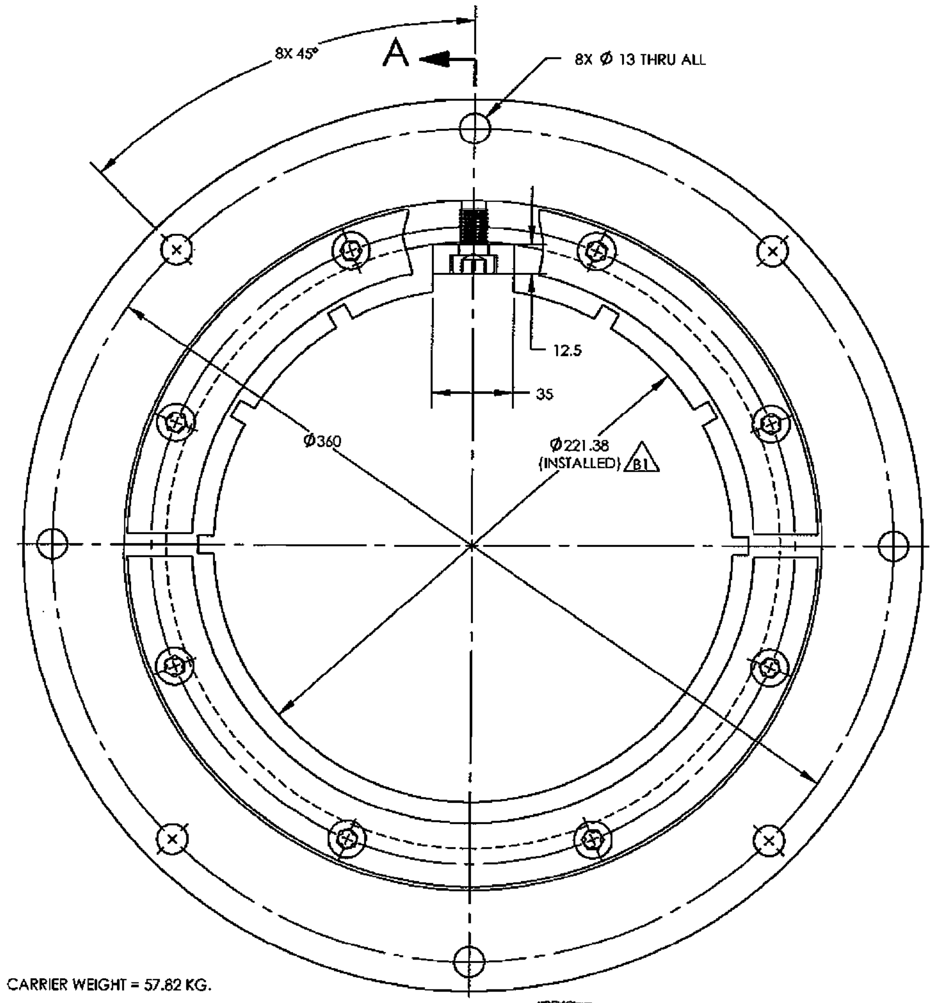
Item ID/Rev	Name	Item State	Size
RRM200006467/A	Stern Tube	Assembly	55A/4-DBG

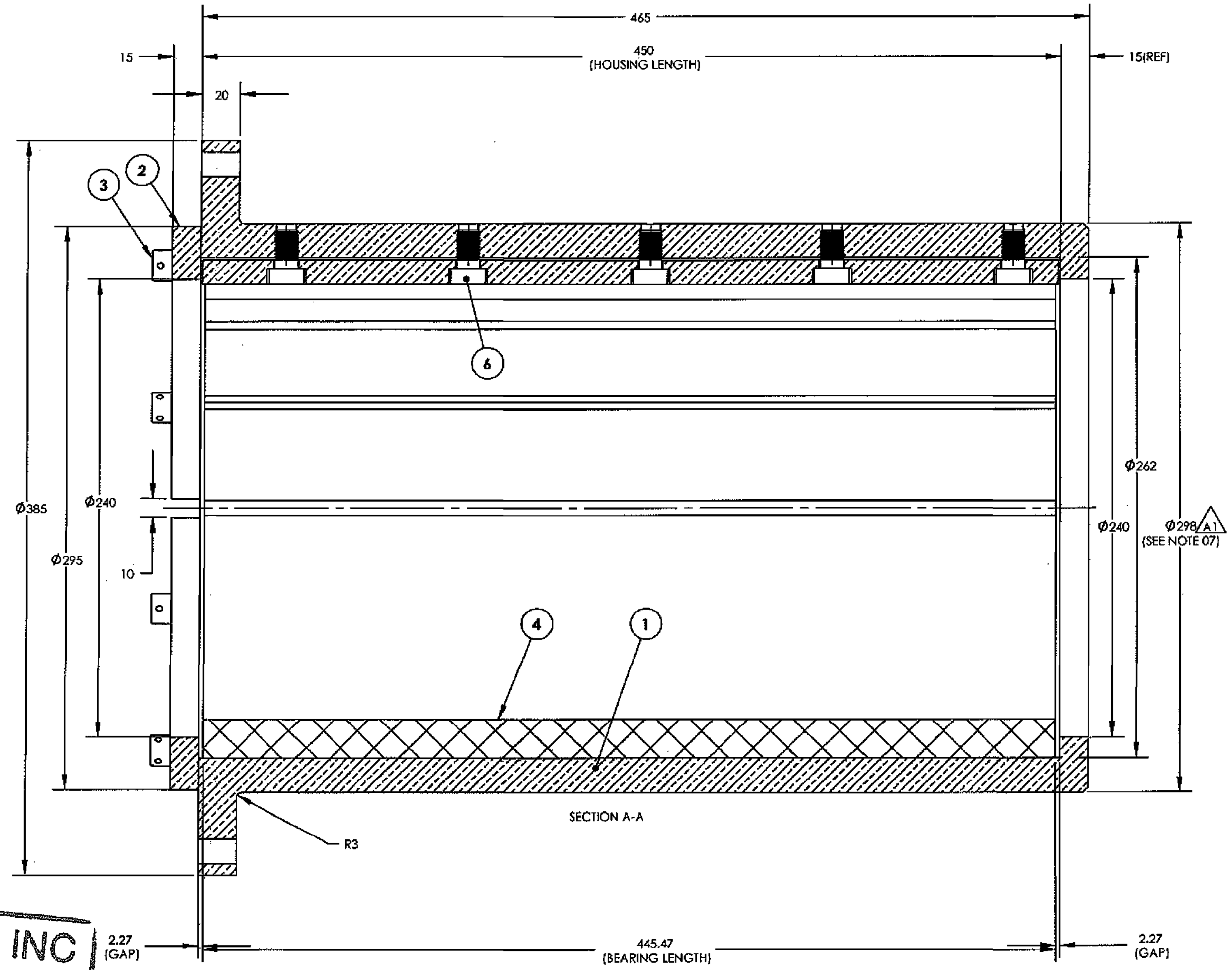
Sub-Assembly/Part

Seq No	Qty	Item ID/Rev	Name	Item State
1	1	RRM200006480/A	Stern Tube Seal	Detail
2	1	RRM200006473/B	Stern Tube	Assembly

ALL DIMENSIONAL INFORMATION IS BASED ON A MACHINING TEMPERATURE OF 21 °C, UNLESS STATED OTHERWISE. MACHINE GROOVES ONLY WHERE SHOWN

ITEM NO.	QTY.	PARTNO	DESCRIPTION	Material	REMARKS	DRAWING NUMBER
1	1	F_______	COMPAC BEARING	THORDON COMPAC		TG-21126
2	1	F_______	RETAINING RING	BRONZE	SPLIT	TG-21128
3	1	F_______	KEY	BRONZE		TG-21129
4	5	F_______	CAPSCREW, LOW PROFILE HEX SOCKET HEAD	BRONZE C95400	DIN 6912-M12X20	TG-21130
5	8	F_______	CAPSCREW, HEX SOCKET HEAD	AISI 316 ST. STEEL	DIN 912-M10 X 30	PURCHASE
6	1	F_______	CARRIER	BRONZE		TG-21127





SECTION A-A

CARRIER WEIGHT = 57.82 KG.
BEARING WEIGHT = 7.42 KG.
MINIMUM INSTALLED CLEARANCE: 1.38
RUNNING CLEARANCE: 0.88
THERMAL EXPANSION ALLOWANCE: 0.19
WATER SWELL ALLOWANCE: 0.31
TEMPERATURE RANGE: -2°C TO 45 °C
SHAFT DIA.: = 220
HOUSING DIA.: = 262
HOUSING LENGTH = 450

THORDON BEARINGS INC
APPROVED
FOR
PRODUCTION
GL 29 Oct 2010
APPROVED BY

GENERAL NOTES:

01. MATERIAL: SEE PARTS LIST
02. DIMENSIONS ARE EXPRESSED IN MM UNLESS NOTED OTHERWISE.
03. DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED.
04. TOLERANCES FOR ALL DIMENSIONS SHALL BE NONCUMULATIVE.
05. BREAK ALL CORNERS AND DEBURR ALL SHARP EDGES.
06. ALL FILLET AND RADII DIMENSIONS ARE NOMINAL UNLESS NOTED OTHERWISE.
A1 07. SHIPSETS #1 THRU 4 SUPPLIED AT Ø295

Rolls-Royce	Date: 2010-11-10	Approved: JH
Sheet: 1 of: 1	Drawing no: RRM 200 006 474	Revision: C

DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED

UNLESS SHOWN OTHERWISE, MACHINING TOLERANCES ARE:
LINEAR UP TO 1m(40") +/-0.5 mm(±0.020")
OVER 1m(40") +/-1.0 mm(±0.040")
ANGULAR +/-0.25°
SURFACE FINISH 3.2μmRa (125μinch)
THORDON MATERIAL SURFACE FINISH TO BE DETERMINED ONLY BY USE OF COMPARATOR

REV.	DESCRIPTION	DATE	DWN	CKD	APPV
B1	ADDED DIMENSION	10/29/2010	GL	GA	GA
A1	WAS Ø295 & ADDED NOTE 07	10/18/2010	GL	GA	GA

THORDON BEARINGS INC.
BURLINGTON, ONTARIO, CANADA

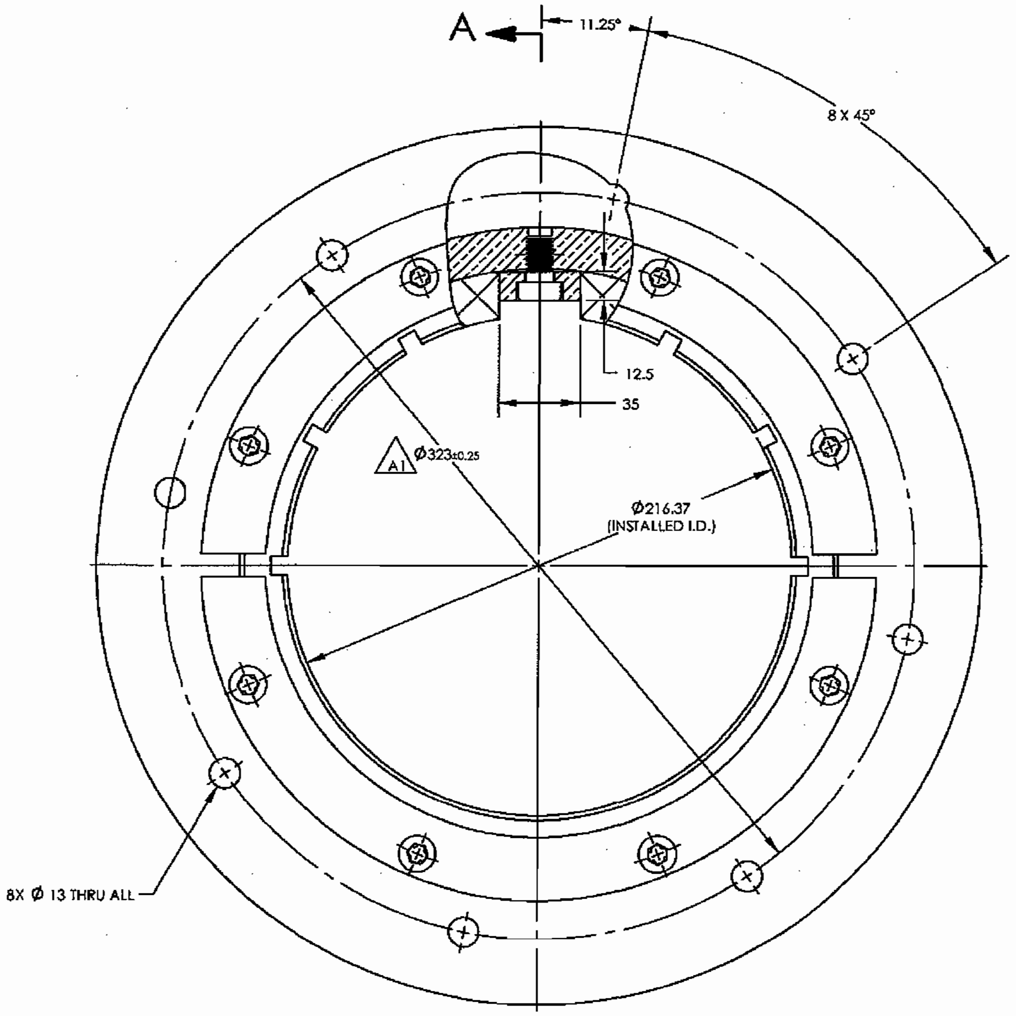
DWN/DESS	SIGN.	CKD/VER	SIGN	APPVL/APP	SIGN.
C.PREDOI		G.AUGER		G.AUGER	

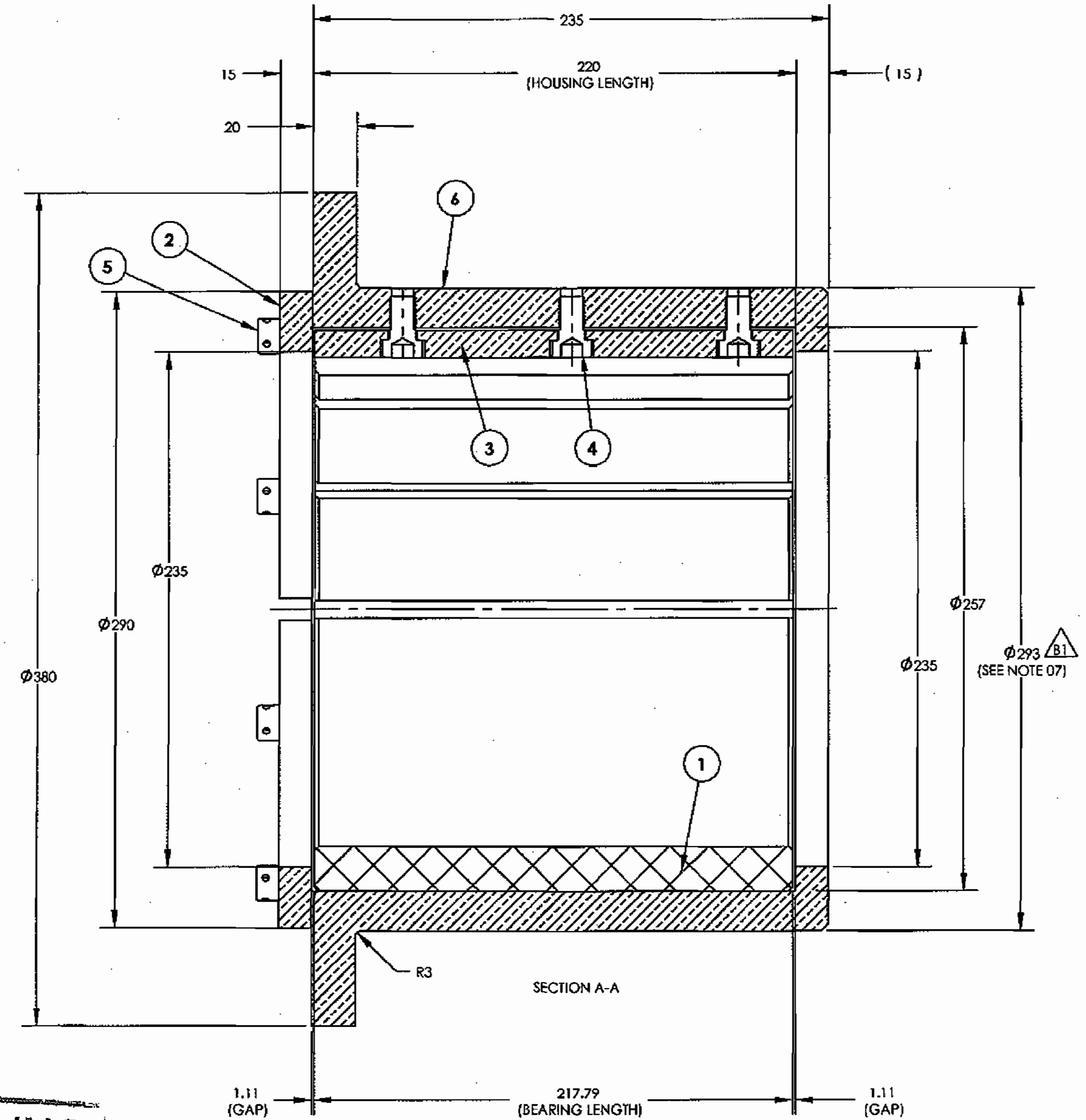
CUSTOMER/CLIENT	DRAWING DATE / DATE DU DESSIN	MRP NO.	SIZE
DUWEL TECNO ROLLS ROYCE	04-08-2010	F9775033	C

TITLE/TITRE	DRAWING NO. DU DESSIN	REV.
THORDON COMPAC AFT. BEARING ASSEMBLY	TG-20843	B
	SHEET/FEUILLE 1 OF/DE 1	

ALL DIMENSIONAL INFORMATION IS BASED ON A MACHINING TEMPERATURE OF 21 °C, UNLESS STATED OTHERWISE. MACHINE GROOVES ONLY WHERE SHOWN

ITEM NO.	QTY.	PARTNO	DESCRIPTION	Material	REMARKS	DRAWING NUMBER
1	1	F_____	BEARING	THORDON COMPAC		TG-21133
2	1	F_____	RETAINING RING	BRONZE		TG-21135
3	1	F_____	KEY	BRONZE		TG-21136
4	3	F_____	CAPSCREW, LOW PROFILE HEX SOCKET HEAD	BRONZE C95400	DIN 6912-M12X20	TG-21130
5	8	F_____	CAPSCREW, HEX SOCKET HEAD	AISI 316 ST. STEEL	DIN 912-M10 X 30	PURCHASE
6	1	F_____	CARRIER	BRONZE		TG-21134





CARRIER WEIGHT = 32.5 KG.
BEARING WEIGHT = 3.5 KG.
MINIMUM INSTALLED CLEARANCE: 1.37
RUNNING CLEARANCE: 0.87
THERMAL EXPANSION ALLOWANCE: 0.19
WATER SWELL ALLOWANCE: 0.31
TEMPERATURE RANGE: -2°C TO 45 °C
SHAFT DIA.: = 215
HOUSING DIA.: = 257
HOUSING LENGTH = 220

THORDON BEARINGS INC
APPROVED
FOR
PRODUCTION
G 18Oct 2010
APPROVED BY

GENERAL NOTES:

01. MATERIAL: SEE PARTS LIST
02. DIMENSIONS ARE EXPRESSED IN MM UNLESS NOTED OTHERWISE.
03. DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED.
04. TOLERANCES FOR ALL DIMENSIONS SHALL BE NONCUMULATIVE.
05. BREAK ALL CORNERS AND DEBURR ALL SHARP EDGES.
06. ALL FILLET AND RADII DIMENSIONS ARE NOMINAL UNLESS NOTED OTHERWISE.
B1 07. SHIPSETS #1 THRU 4 SUPPLIED AT Ø290

Rolls-Royce	Date: 2010-11-10	Approved: JH
Sheet: 1 of: 1	Drawing no: RRM 200 006 475	Revision: C

DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED

UNLESS SHOWN OTHERWISE, MACHINING TOLERANCES ARE:
LINEAR UP TO 1m(40") +/-0.5 mm(±0.020")
OVER 1m(40") +/-1.0 mm(±0.040")
ANGULAR +/-0.25°
SURFACE FINISH 3.2μmRa (125μinch)
THORDON MATERIAL SURFACE FINISH TO BE DETERMINED ONLY BY USE OF COMPARATOR

REV.	DESCRIPTION	DATE	DWN	CKD	APPV
B1	WAS Ø290 & ADDED NOTE 07	10/18/2010	GL	GA	GA
A1	B.C. WAS Ø350	10/5/2010	CP	GA	GA

THORDON BEARINGS INC.
BURLINGTON, ONTARIO, CANADA

DWN/DESS	CKD/VER	APPVL/APP
C.PREDOI	G.AUGER	G.AUGER

CUSTOMER/CLIENT: ROLLS ROYCE DUWEL TECHNO
DRAWING DATE / DATE DU DESSIN: 06-AUG-2010
MRP NO.: F_____
SIZE: C
TITLE/TITRE: THORDON COMPAC INTERMEDIATE BEARING ASSEMBLY
DRAWING NO. DU DESSIN: TG-20844
REV.: B
SHEET / FEUILLE 1 OF / DE 1

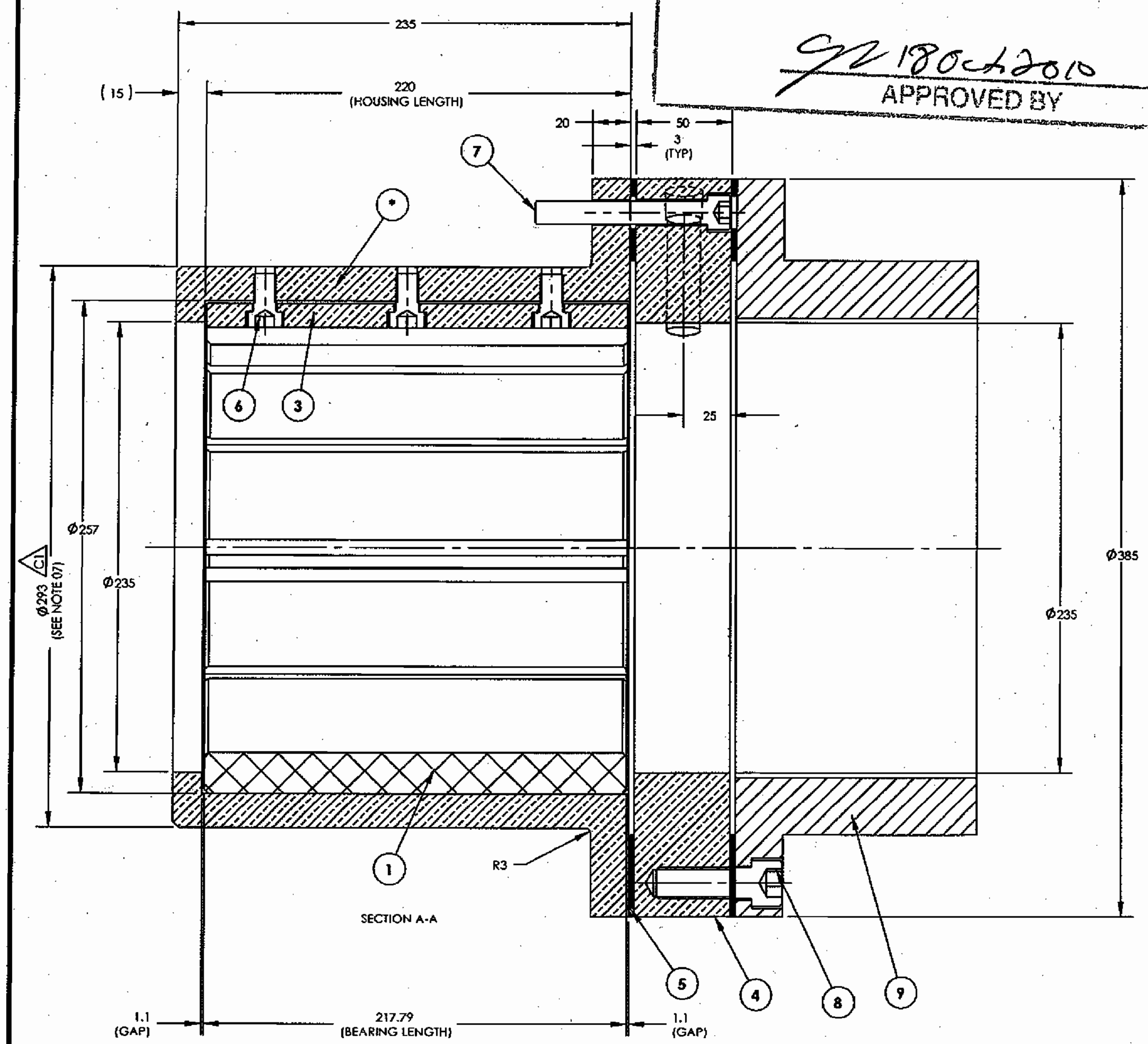
F19775033|

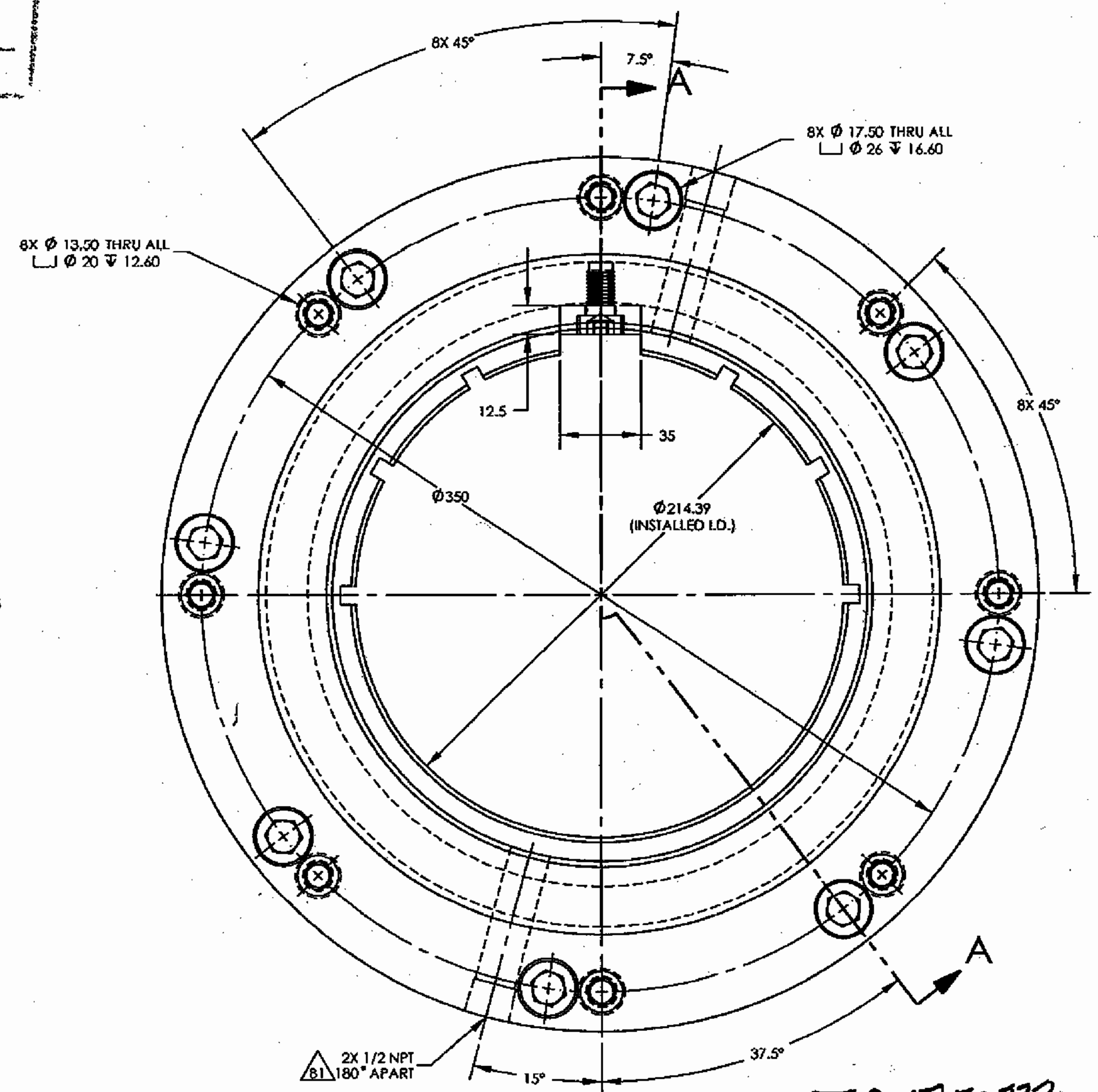
ALL DIMENSIONAL INFORMATION IS BASED ON A MACHINING TEMPERATURE OF 21 °C, UNLESS STATED OTHERWISE. MACHINE GROOVES ONLY WHERE SHOWN

THORDON BEARINGS INC
APPROVED
FOR
PRODUCTION

GL 18Oct2010
APPROVED BY

ITEM NO.	QTY.	PARTNO	Description	Material	REMARKS	DRAWING NUMBER
1	1	F_____	BEARING	THORDON COMPAC		TG-21140
2	1	F_____	CARRIER	BRONZE		TG-21141 ✓
3	1	F_____	KEY	BRONZE		TG-21142
4	1	F_____	RING	BRONZE		TG-21144 ✓
5	2	F_____	GASKET	GARLOK		TG-21145
6	3	F_____	CAPSCREW, LOW PROFILE HEX SOCKET HEAD	BRONZE C95400	DIN 6912-M12X20	TG-21130
7	8	F_____	CAPSCREW, HEX SOCKET HEAD	316 ST. STEEL	DIN 912-M12X90	PURCHASE
A1 8	8		CAPSCREW, HEX SOCKET HEAD	AISI 316 ST. STEEL	DIN 912- M16X50 LG	BY CUSTOMER
9	1		MECHANICAL SEAL			BY CUSTOMER





F19775O332

CARRIER WEIGHT = 33.05KG.
BEARING WEIGHT = 3.7KG
MINIMUM INSTALLED CLEARANCE: 1.39
RUNNING CLEARANCE: 0.87
THERMAL EXPANSION ALLOWANCE: 0.20
WATER SWELL ALLOWANCE: 0.32
TEMPERATURE RANGE: -2 °C TO 45 °C
SHAFT DIA.: = 213
HOUSING DIA.: = 257
HOUSING LENGTH = 220

GENERAL NOTES:

01. MATERIAL: SEE PARTS LIST
02. DIMENSIONS ARE EXPRESSED IN MM UNLESS NOTED OTHERWISE.
03. DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED.
04. TOLERANCES FOR ALL DIMENSIONS SHALL BE NONCUMULATIVE.
05. BREAK ALL CORNERS AND DEBURR ALL SHARP EDGES.
06. ALL FILLET AND RADII DIMENSIONS ARE NOMINAL UNLESS NOTED OTHERWISE.
C1 07. SHIPSETS #1 THRU 4 SUPPLIED AT ø290

Rolls-Royce	Date: 2010-11-10	Approved: JH
Sheet: 1 of: 1	Drawing no: RRM 200 006 476	Revision: C

DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED

UNLESS SHOWN OTHERWISE, MACHINING TOLERANCES ARE:

LINEAR UP TO 1m(40") +/-0.5 mm(±0.020")
OVER 1m(40") +/-1.0 mm(±0.040")
ANGULAR ±0.25°
SURFACE FINISH 3.2μmRa (125μinch)
THORDON MATERIAL SURFACE FINISH TO BE DETERMINED ONLY BY USE OF COMPARATOR

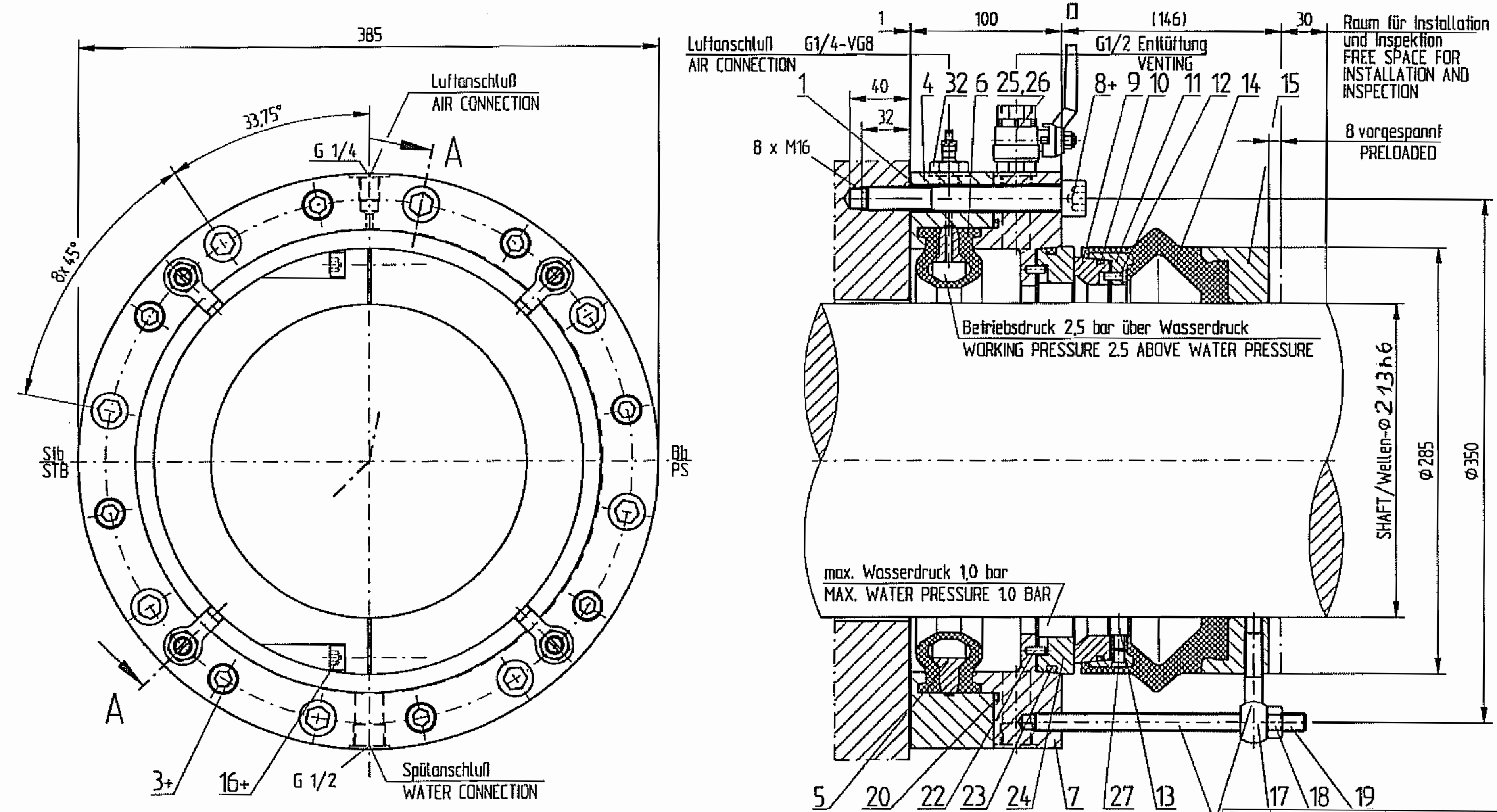
REV.	DESCRIPTION	DATE	DWN	CKD	APPV
C1	WAS ø290 & ADDED NOTE. 07	10/18/2010	GL	GA	GA
B1	ADDED NPT	9/22/2010	GL	GA	GA
A1	BOLT MATERIAL WAS BRONZE	8/18/2010	CP	GA	GA

THORDON BEARINGS INC.
BURLINGTON, ONTARIO, CANADA

DWN/DESS	CKD/VER	APPVL/APP
C.PREDOI	G.AUGER	G.AUGER

CUSTOMER/CLIENT	DRAWING DATE / DATE DU DESSIN	MRP NO.	SIZE
ROLLS ROYCE DUWEL TECHNO	06-AUG-2010	F197750332	C

TITLE/TITRE	DRAWING NO DU DESSIN	REV
THORDON COMPAC FWD. BEARING ASSEMBLY	TG-20845	C
	SHEET / FEUILLE 1 OF / DE 1	



Vor Inbetriebnahme Spannwerkzeug entfernen !
REMOVE INSTALLATION TOOLS BEFORE OPERATION !

erforderliche Wassermenge für die Abdichtung
im Normalbetrieb 1l/h pro 1mm Wellendurchmesser
WATER QUANTITY REQUIRED FOR SEAL AT STANDARD
OPERATION 1l./h PER 1mm SHAFT DIAMETER

Zulässige Wellenbewegung im Betrieb
ALLOWABLE SHAFT DEFLECTION DURING OPERATION
radial ± 3mm
axial ± 3mm

+: Schrauben mit LOCTITE 243/245 gesichert
SCREWS SECURED WITH LOCTITE 243/245

Anzugsmoment fuer / TIGHTENING TORQUE FOR

Pos. / POS	Gr. / SIZE	Nm
	M 8	14
16	M 10	30
3	M 12	50
8	M 16	120

Rolls-Royce

Date:	Approved	Sheet	of.	Drawing no.	Revision.
2010-05-05	JH	1	3	RRM 200 006 480	A

SHAFT-/Wellen-Ø 210 - 224

Projektion

Maßstab % | WEIGHT: 63,0 kg

SIMPLAN SEAL TYP: SIC-P

	Datum	Name
Bearb.	03.02.2003	Velterna
Gepr.	26.02.08	
Norm		
CAD: G:\EE9990A.SZA		MS22

Blohm + Voss Industries GmbH

Vordere Abdichtung, Gr.210
FWD SEAL, SIZE 210

SGC: 3-217-0008-000.1 -

Blatt

Zust.	Änderung	Datum	Name	Urspr.	Ers. f.:	Ers. d.:
1	Anzugsmomente neu -	22.02.2008	Old			

22. 02. 2008

Einzelteilliste / PARTS LIST

Thyssen B+V Industrietechnik

SIMPLAN Abdichtung / SIMPLAN SEAL vorn / FORWARD Größe / SIZE: **210 SiC-P**	Zeichnungs-Nr./ DRAWING-No. SGC:3-217-0008-000.1 -	Seite/ PAGE 1 von / of 2

Pos. POS.	Anzahl No.	Bennenung NAME		Zeichnungs-Nr. DRAWING-No.	Werkstoff MATERIAL
1	1	Flachdichtung GASKET		SGC:4-217-0001-001.	AFM 34
3	8	Zylinderschraube HEXAGON SOCKET HEAD CAP SCREW	M12 x 50	DIN 912	A4 - 70 STAINLESS STEEL
4	1	Gehäusering CASING RING		SGC:3-217-0005-004.	Bronze BRONZE
5	1	Einlegering NECK RING		SGC:4-217-0003-005.	Bronze BRONZE
6	1	Pneumostop PNEUMOSTOP		SGC:4-217-0003-006.	Neopren NEOPRENE
7	1	Gehäusering CASING RING		SGC:3-217-0006-007.	Bronze BRONZE
8	8	Zylinderschraube HEXAGON SOCKET HEAD CAP SCREW	M16 x 130	DIN 912	A4 - 70 STAINLESS STEEL
9	1	Gleitring SEALING RING		SGC:4-217-0006-009.	SiC-3
10	1	O-Ring O-RING	ø 255 x 3,5	DIN 3771	Viton VITON
11	1	Einlegering NECK RING		SGC:3-217-0001-011.	Bronze BRONZE
12	2	Stopfen PLUG		SGC:4-216-0001-012.	Bronze BRONZE
13	8	Zentrierstift CENTERING PIN		SGC:4-216-0002-013.	Bronze BRONZE
14	1	Gummibalg CONSTANT-PRESSURE SEAL BODY		SGC:2-217-0001-014.	Neopren NEOPRENE
15	1	Klemmring, geteilt CLAMP RING, SPLIT		SGC:3-217-0001-015.	Bronze BRONZE
16	2	Zylinderschraube HEXAGON SOCKET HEAD CAP SCREW	M10 x 35	DIN 912	A4 - 70 STAINLESS STEEL
17	4	Augenschraube EYE BOLT	M12 x 60		St STEEL
18	4	Sechskantmutter HEXAGON NUT	M12	DIN 555	St STEEL
19	4	Gewindebolzen THREADED BOLT	M12 x 180	SGC:4-216-0001-019.	St STEEL
20	1	O-Ring O-RING	ø 315 x 4	DIN 3771	Perbunan PERBUNAN

*217_0008

Approved: JH Revision: A
Date: 2010-05-05 Drawing no. RRM 200 006 480
Rolls-Royce Sheet: 3 of: 3

Einzelteilliste / PARTS LIST

Thyssen B+V Industrietechnik

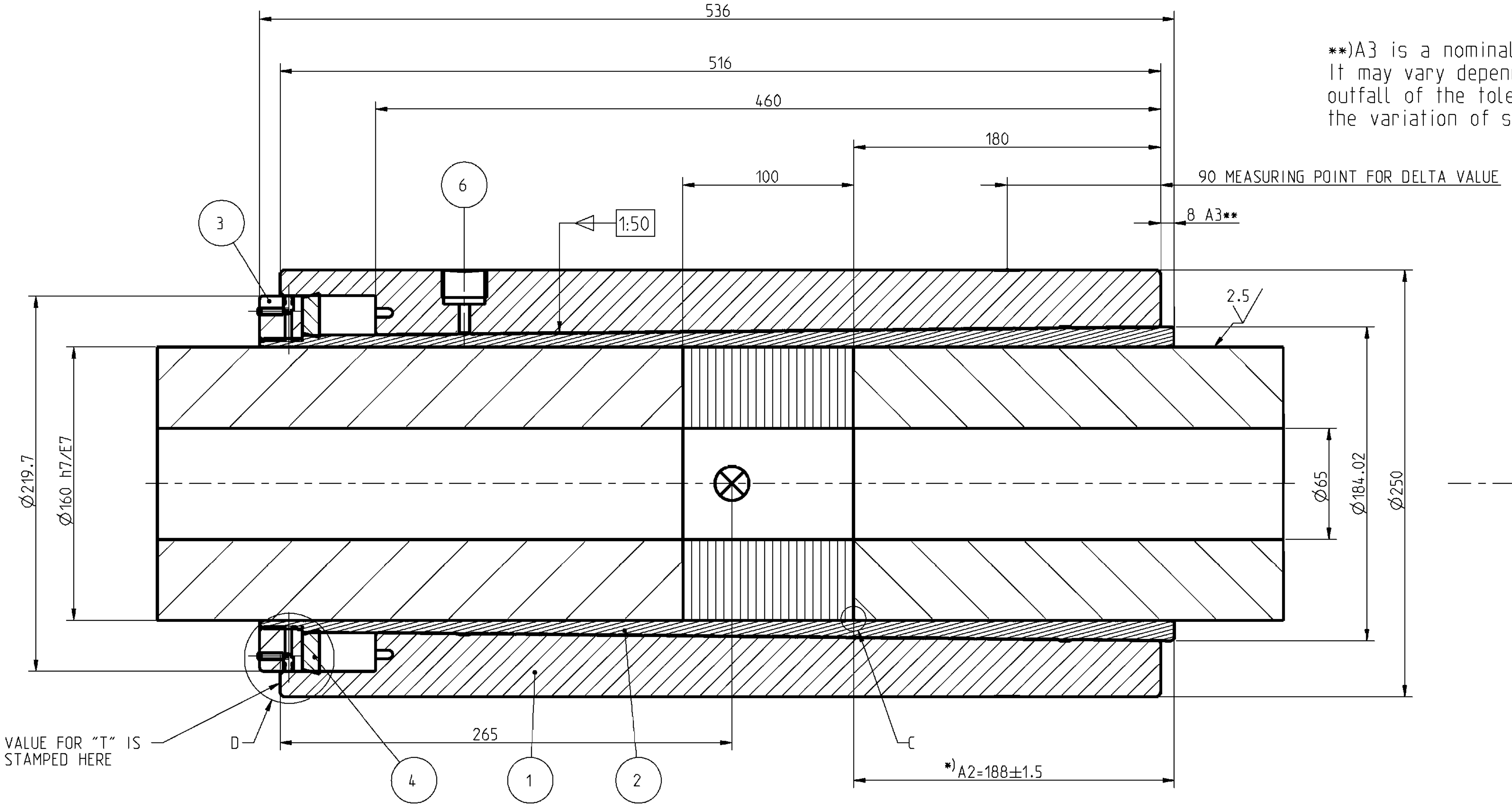
SIMPLAN Abdichtung / SIMPLAN SEAL vorn / FORWARD Größe / SIZE: **210 SiC-P**	Zeichnungs-Nr./ DRAWING-No. SGC:3-217-0008-000.1	Seite/ PAGE 2 von / of 2

Pos. POS.	Anzahl No.	Bennenung NAME		Zeichnungs-Nr. DRAWING-No.	Werkstoff MATERIAL
22	2	Paßkerbstift GROOVER PINS	5 x 12	DIN 1472	Chromstahl STAINLESS STEEL
23	1	O-Ring O-RING	ø 270 x 5	DIN 3771	Viton VITON
24	1	Gegenring COUNTER RING		SGC:4-217-0003-024.	SiC-2
25	1	Kugelhahn BALL COCK	G 1/2 i/a	03-117 201/12	MS/Ni
26	1	Dichtband SEALING TAPE			PTFE
27	8	Stopfen PLUG		SGC:4-216-0001-027.	Bronze BRONZE
32	1	Pneumostop Ventil PNEUMOSTOP VALVE	G 1/4 – VG8	18-080-041.1	Ms BRASS

*217_0008

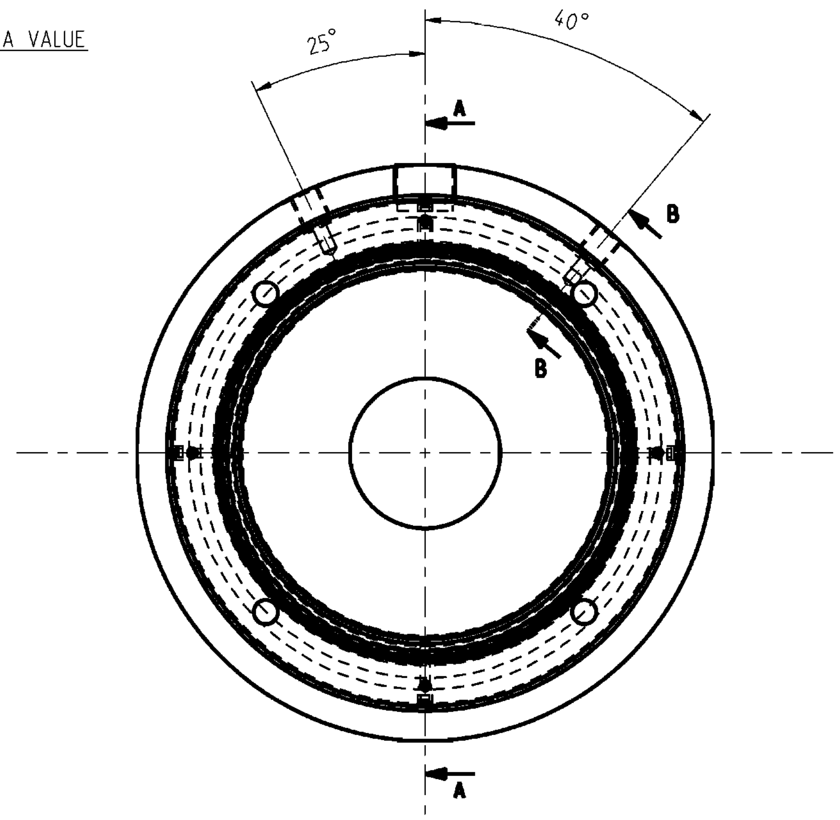
Permissible machining variations in dimensions without tolerance indications: SS-ISO 2768-m.

ORIGINAL SIZE: A2



A-A

**)A3 is a nominal dimension. It may vary depending on the outfall of the tolerances and the variation of shaft hole

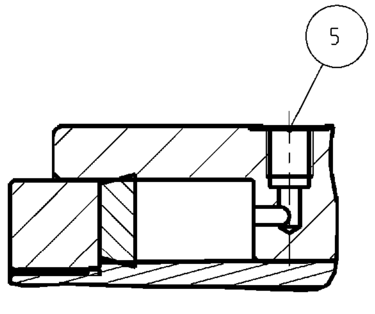


Rolls-Royce	Date: 2011-01-25	Approved: JH
Sheet: 1 of: 1	Drawing no: RRM 200 005 975	Revision: B

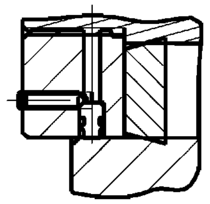
MAX TORQUE CAPACITY= 121 kNm

TOTAL WEIGHT= 115 KG

INERTIA WITH RESPECT TO CENTER AXIS= 1.3 kgm^2



B-B



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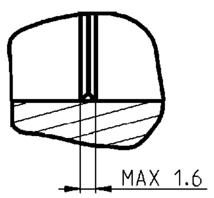


C

INCREASE OF COUPLING OUTER DIAMETER

△ = 0.24mm

*) FINAL POSITIONING OF THE SHAFT (A2):
A2= 180.0+T-27.3
NOTE: VALUE FOR "T" IS STAMPED ON THE COUPLING

Qty.	Item	Name	Material	Weight	PartNo.
1	6	PLUG BSP 3/4"			415182
2	5	PLUG BSP 1/4"			405024
1	4	SEALING	MSC001-60	0.3	38876-160
1	3	NUT	MSC001-30	3.0	38875-160
1	2	INNERSLEEVE	MSC001-44	20.7	3001670
1	1	OUTERSLEEVE	MSC001-11	91.0	28533

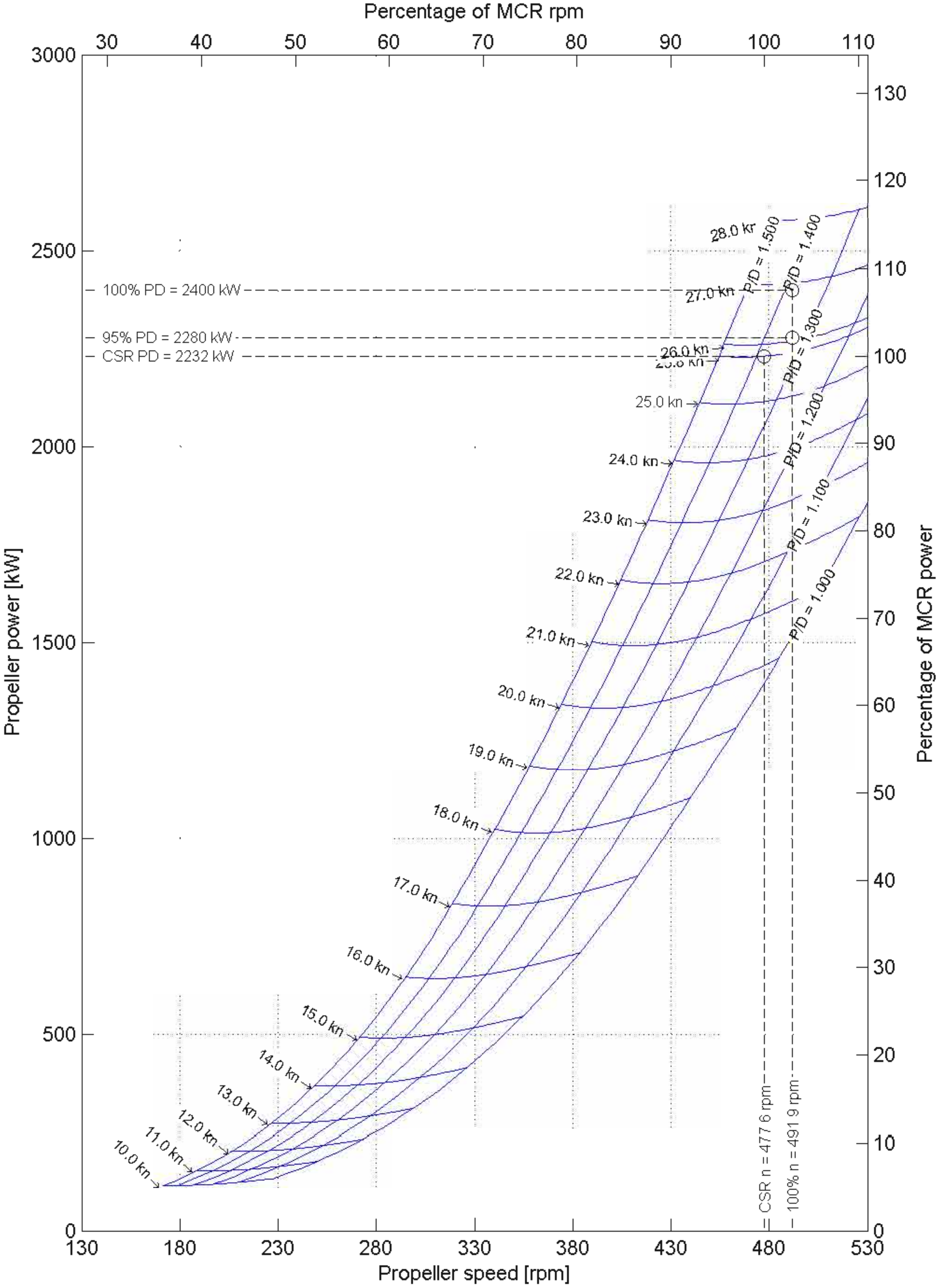
SKF PRODUCTS	Date 100430	Scale
OK COUPLING	Issued SS	Checked AR
ASSEMBLY DRAWING	Project no. 90406	
OKCAX 160/28436	Drawing no. 28436	Revision 2
Rolls-Royce		

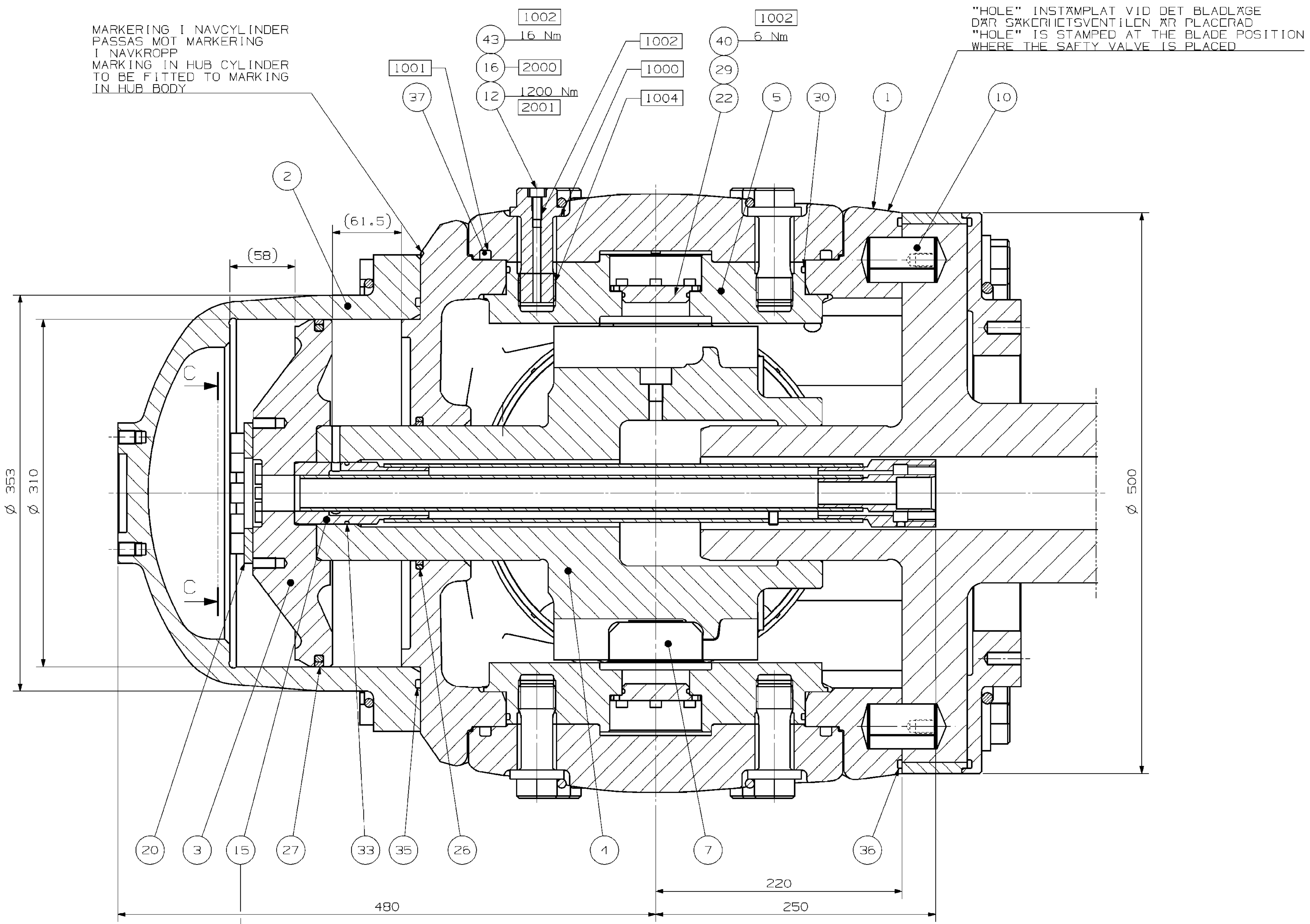
SKF COUPLING SYSTEMS AB

Rev. No.	Revision Note	Date	Issued	Approved
2	Torque and delta value changed	100920	MM	ME

Rolls-Royce HYDRODYNAMIC RESEARCH CENTRE	Pd-n Diagram	PD-n No	42061
	Halifax Shipyard	Combinator No	-
		Date	2010-06-04
	Pe at 25.8 given,prop.factor.given,Curve est.	Sign	Fgr

RRAB Info Class: Limited





B-B

NOT: SKARVSTYCKET MONTERAS SÅ ATT RADIELLA HÅL
I NAVMUFFEN HAMNAR MITT FÖR RADIELLA HÅL I KOLVSTÅNGEN

NOTE: THE CONNECTION PIECE IS TO BE MOUNTED IN SUCH WAY
THAT THE RADIAL HOLES IN HUB MUFF CORRESPOND TO RADIAL
HOLES IN PISTON ROD

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	-

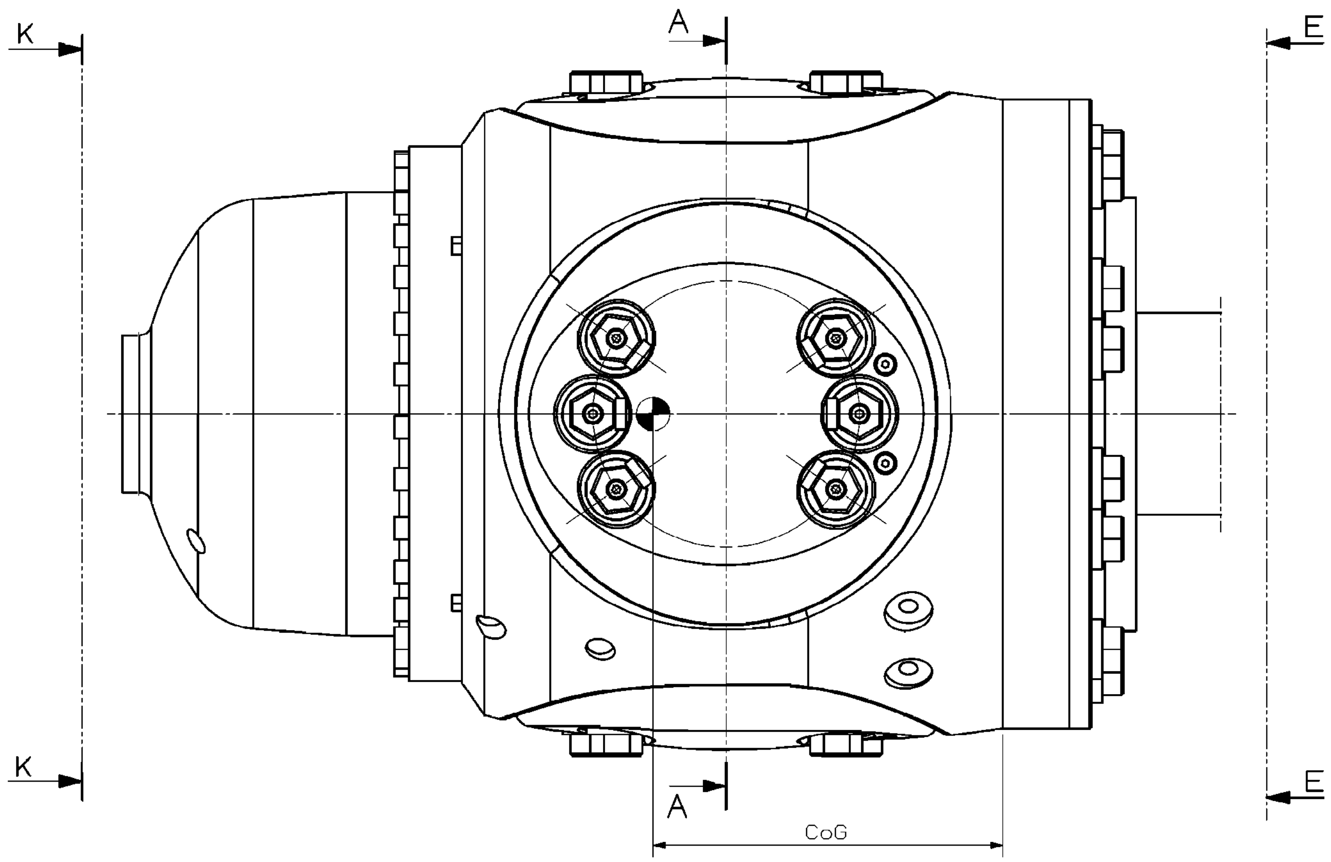
Propeller Hub
55A/4D-B Right
Ahead 32° (61.5mm) Astern 30° (58mm)

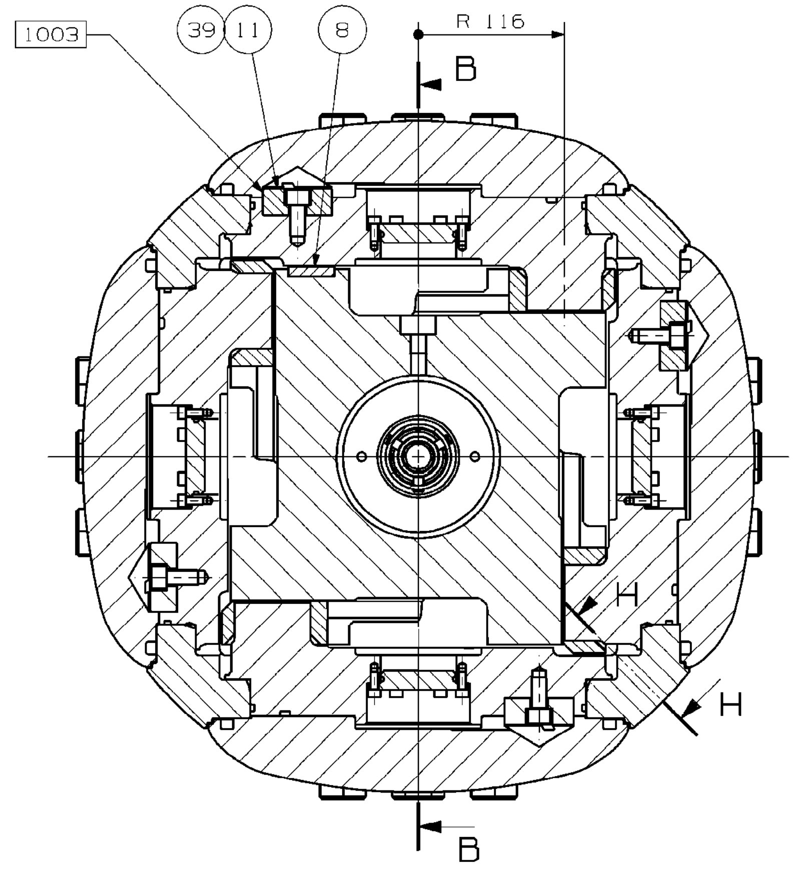
Rolls-Royce

Rolls-Royce AB
S-681 29 KRISTINEHAMN

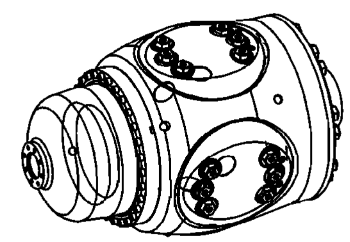
Origin/Date:	Scale:	Format:	Sheet:
Wkg 2010.07.09	1:2	A1	2 of 3
Drawing no: RRM200009225			Revision: A

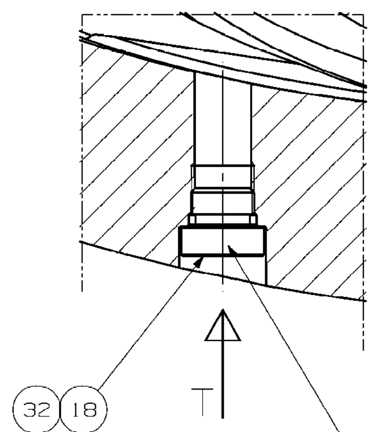
Access List:





A - A





H-H
1:1

PLUGGEN LASES MED PUNKTSVETS
EFTER ATT AXELN ÄR INSTALLERAD
SYSTEMET OLJEFYLLT OCH LUFTAT

THE PLUG TO BE LOCKED BY SPOT WELD
AFTER SHAFT IS INSTALLED
THE SYSTEM IS OILFILLED AND VENTED

TÄTHETSPROV	PRESSURE TEST	
FÖRE BEARBETNING BEFORE MACHINING		
EFTER BEARBETNING AFTER MACHINING	X	
KONTROLLMEDIUM TEST MEDIUM	OLJA OIL	
KONTROLLTRYCK TEST PRESSURE	3 bar	
KONTROLLTRYCK I PILENS-T RIKTNING TEST PRESSURE APPLIED IN DIRECTION OF		
TID TIME	5 h	

Centre of gravity
256-300mm

1000	KAMEWA SEALING COMPOUND
1001	TEFLON GREASE
1002	LOCTITE 243
1003	LOCTITE 648
1004	MOLYCOTE G RAPID

2000	INSTRUCTION FOR LOCKING R154090
2001	INSTRUCTION FOR TIGHTENING R586431

PREVIOUS DRAWING RRM200006185

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	498

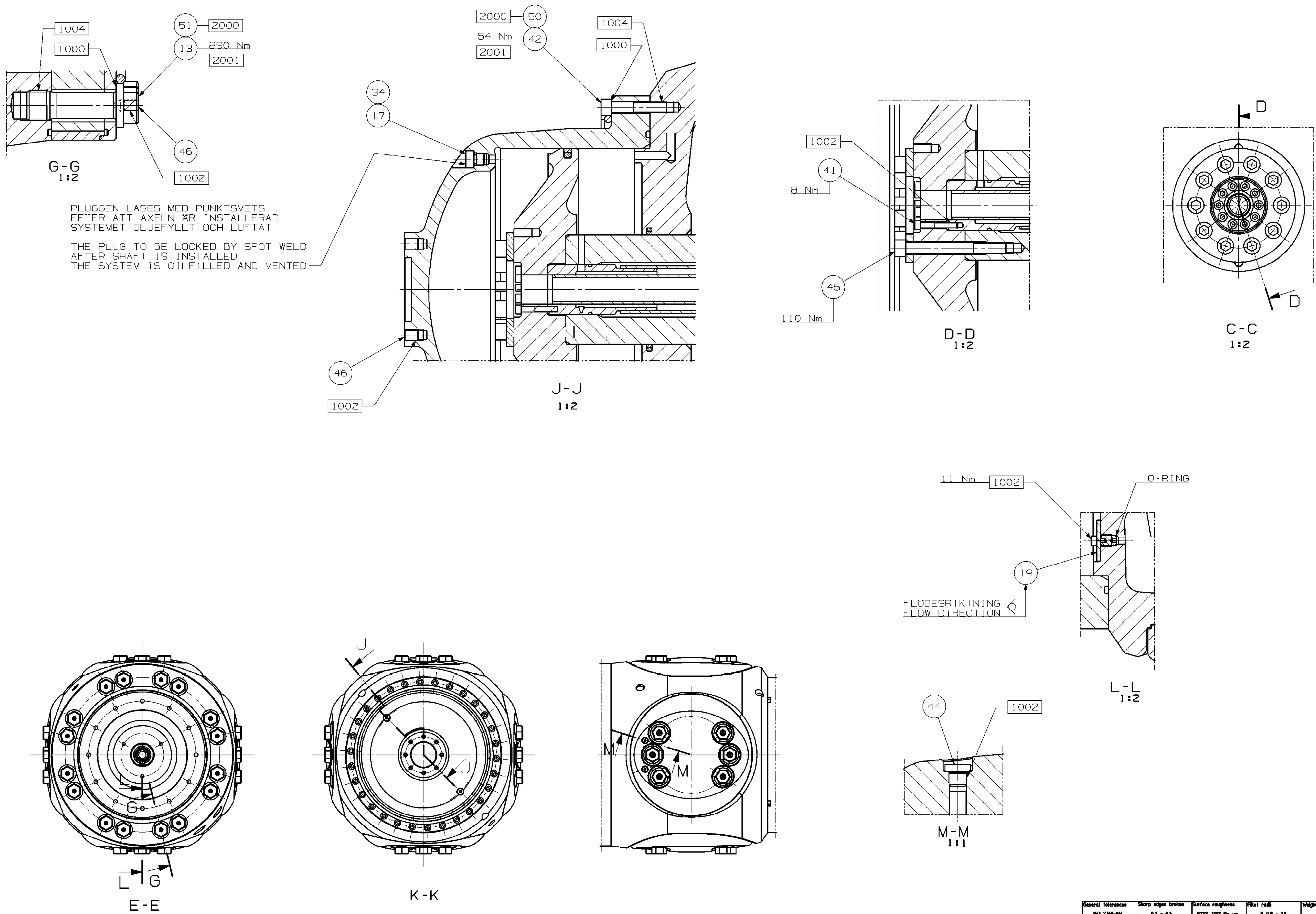
Propeller Hub
55A/4D-B Right
Ahead 32° (61.5mm) Astern 30° (58mm)

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

Origin/Date:		Scale:	Format:	Sheet:
Wkg	2010.07.09	1:3	A1	1 of 3

Drawing no: RRM200009225
Revision: A

Access List:
RR AB's Info class: Limited



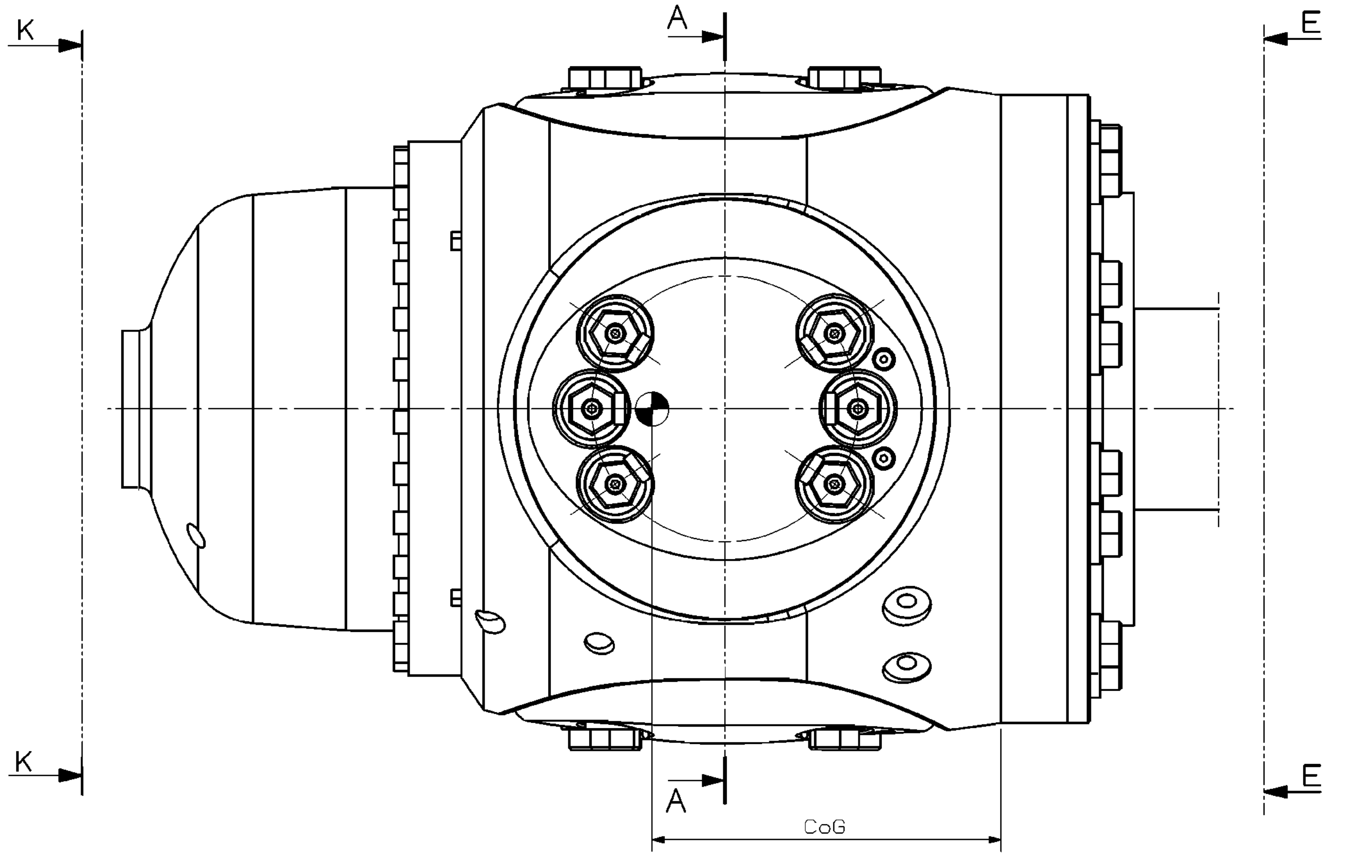
General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	-

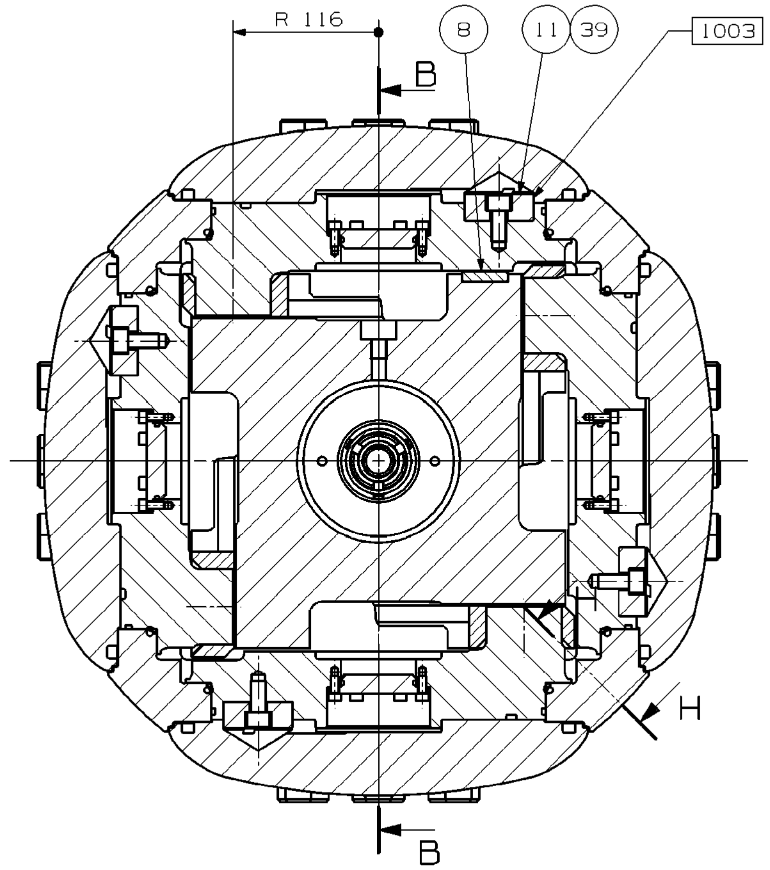
Propeller Hub
55A/4D-B Right
Ahead 32° (61.5mm) Astern 30° (58mm)

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

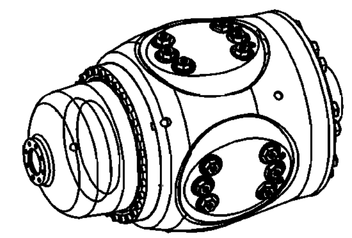
Origin/Date:		Scale:	Format:	Sheet:
Wkg	2010.07.09	1:5	A1	3 of 3

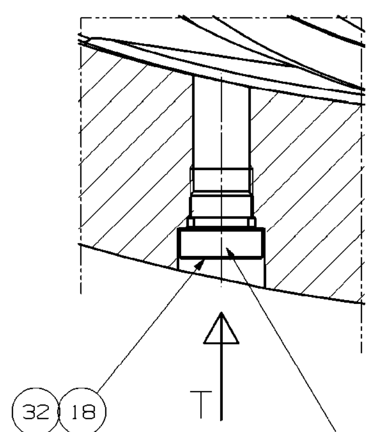
Drawing no: RRM200009225
Revision: A





A - A





H-H
1:1

PLUGGEN LASES MED PUNKTSVETS
EFTER ATT AXELN ÄR INSTALLERAD
SYSTEMET OLJEFYLLT OCH LUFTAT

THE PLUG TO BE LOCKED BY SPOT WELD
AFTER SHAFT IS INSTALLED
THE SYSTEM IS OILFILLED AND VENTED

TÄTHETSPROV	PRESSURE TEST	
FÖRE BEARBETNING BEFORE MACHINING	-	
EFTER BEARBETNING AFTER MACHINING	X	
KONTROLLMEDIUM TEST MEDIUM	OLJA OIL	
KONTROLLTRYCK TEST PRESSURE	3 bar	
KONTROLLTRYCK I PILENS-T RIKTNING TEST PRESSURE APPLIED IN DIRECTION OF		
TID TIME	5 h	

Centre of gravity
256-300mm

1000 KAMEWA SEALING COMPOUND
1001 TEFLON GREASE
1002 LOCTITE 243
1003 LOCTITE 648
1004 MOLYCOTE G-RAPID

2000 INSTRUCTION FOR LOCKING 998174A
2001 INSTRUCTION FOR TIGHTENING 586431A

PREVIOUS DRAWING RRM200006186

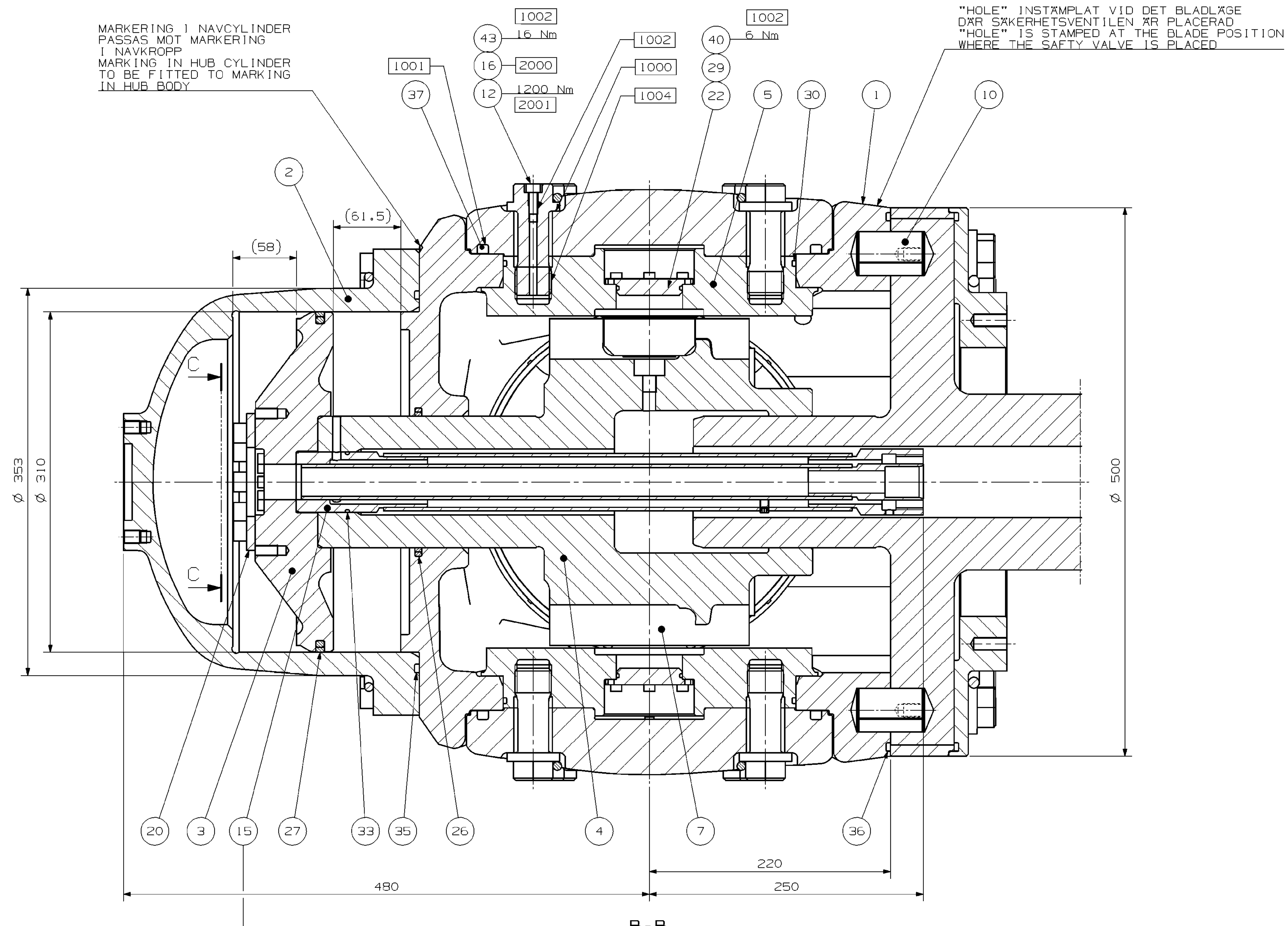
General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	498

Propeller Hub
55A/4D-B Left
AHEAD 32° (61.5mm) ASTERN -30° (58mm)

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

Origin./Date:		Scale:	Format:	Sheet:
Wkg	2010.07.09	1:3	A1	1 of 3

Drawing no: RRM200009345
Revision: A



B-B

NOT: SKARVSTYCKET MONTERAS SA ATT RADIELLA HAL I NAVMUFFEN HAMNAR MITT FÖR RADIELLA HAL I KOLVSTANGEN

NOTE: THE CONNECTION PIECE IS TO BE MOUNTED IN SUCH WAY THAT THE RADIAL HOLES IN HUB MUFF CORRESPOND TO RADIAL HOLES IN PISTON ROD

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	-

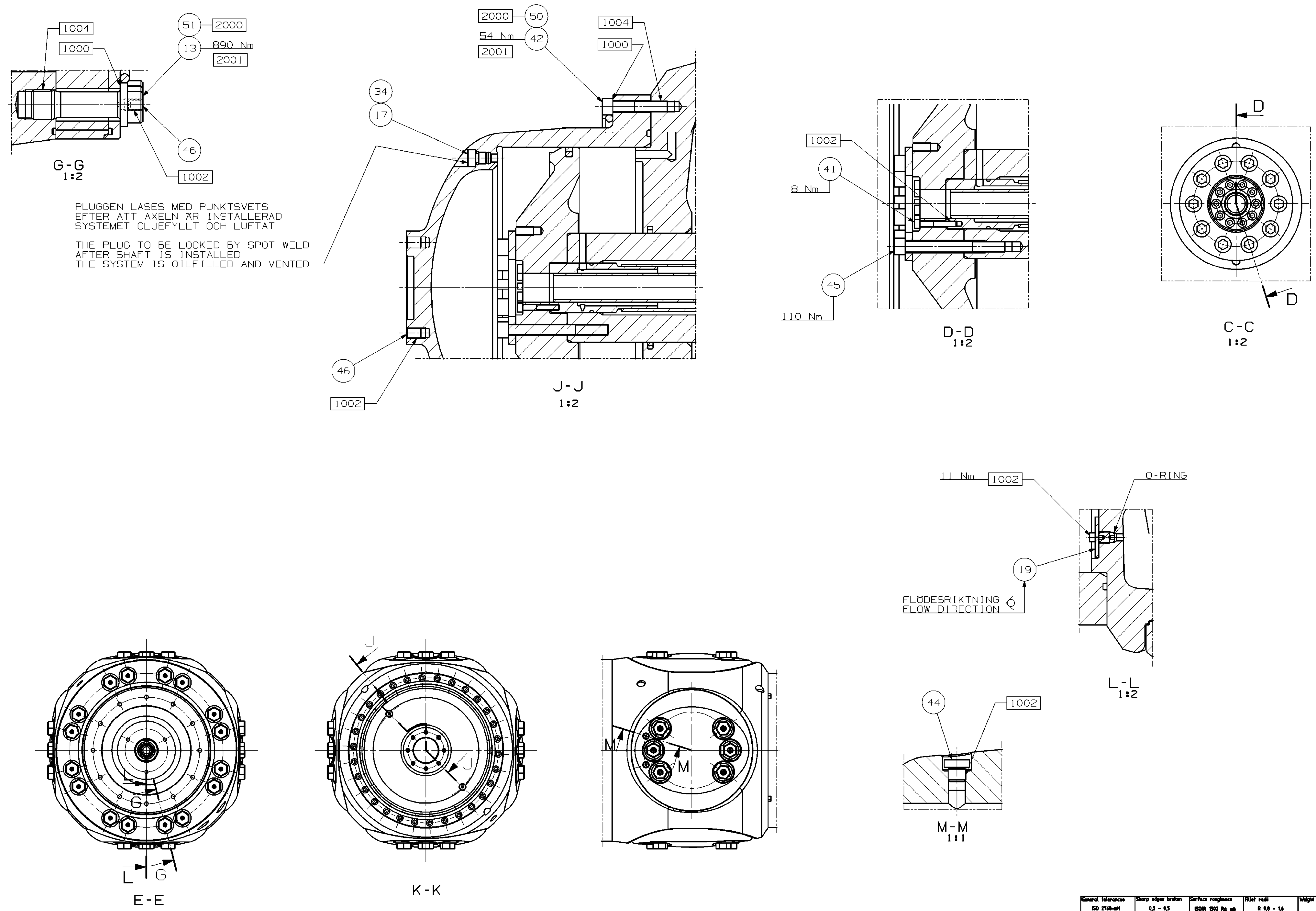
Propeller Hub
55A/4D-B Left
AHEAD 32° (61.5mm) ASTERN -30° (58mm)

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

Origin./Date:		Scale:	Format:	Sheet:
Wkg	2010.07.09	1:2	A1	2 of 3

Drawing no: RRM200009345 — Revision: A

Access List:



General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	-

Propeller Hub
55A/4D-B Left
AHEAD 32° (61.5mm) ASTERN -30° (58mm)

Rolls-Royce

Rolls-Royce AB
S-681 29 KRISTINEHAMN

Origin./Date:		Scale:	Format:	Sheet:
Wkg	2010.07.09	1:5	A1	3 of 3

Drawing no: RRM200009345

Revision: A

Access List:

RR AB's Info class: Limited

External Bom Report

Item ID/Rev	Name	Item State	Size
RRM200009345/A	Propeller Hub	Assembly	55A/4D-B Left

Sub-Assembly/Part

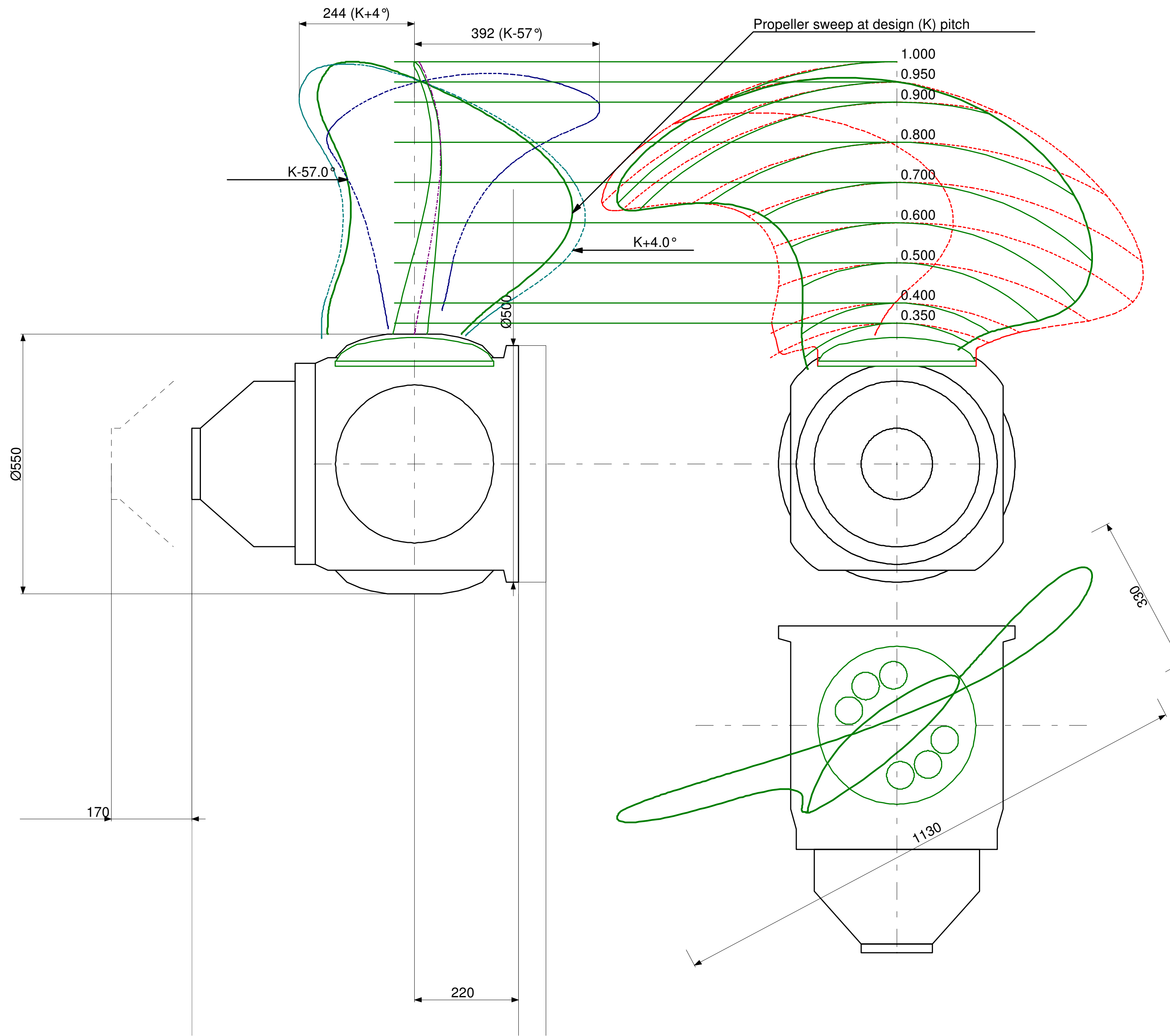
Seq No	Qty	Item ID/Rev	Name	Item State
1	1	RRM200006126/B	Propeller Hub Body	Detail
2	1	RRM200006747/B	Propeller Hub Cylinder	Detail
3	1	RRM200009226/A	Piston	Detail
4	1	RRM200006469/A	Propeller Piston Rod	Detail
5	4	RRM200009344/C	Crank Pin Ring	Detail
7	4	R214887A/_	Sliding Shoe	Detail
8	1	R986364A/B	Sliding Bar	Detail
10	4	R214897A/_	Dowel Pin	Detail
11	4	R950029A/A	Dowel Pin	Detail
12	24	RRM200008068/A	Screw	Detail
13	16	RRM200007706/A	Screw	Detail
15	1	RRM200007749/B	Pipe Connection Arrangement	Detail
16	24	R915980V/H	Lock Pin	Detail
17	2	RRM200003867/A	Plug	Detail
18	4	R954022A/A	Plug	Detail
19	1	RRM200003228/A	Check Valve	Assembly
20	1	RRM200007053/A	Ring	Detail
22	4	RRM200007685/A	Flange	Detail
26	1	F083440/_	Piston Seal	Detail
27	1	K163143/_	Piston Seal	Detail
29	4	F088149/_	O-Ring	Detail
30	4	RRM200008574/A	O-Ring	Detail
32	4	F082890/_	O-Ring	Detail
33	1	F088138/_	O-Ring	Detail
34	2	RRM200003876/A	O-Ring	Detail
35	1	K163144/_	O-Ring	Detail
36	1	F088499/_	O-Ring	Detail
37	4	F088423/_	O-Ring	Detail

39	4	K171223/_	Socket Head Screw	Detail
40	24	RRM200008569/A	Socket Head Screw	Detail
41	10	K163145/_	Socket Head Screw	Detail
42	30	F019781/_	Socket Head Screw	Detail
43	24	RRM200008570/A	Socket Head Screw	Detail
44	8	F083053/_	Plug	Detail
45	10	RRM200007070/A	Socket Head Screw	Detail
46	24	RRM200005759/A	Set Screw	Detail
50	1	RRM200008249/A	Locking Device	Detail
51	1	RRM200008235/A	Locking Device	Detail

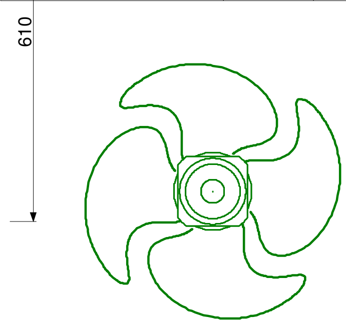
Rolls-Royce

Blade Outline
Ref:30-09-0920 10S000239-4/DESIGN

Date 2010-06-01 Time 10:26:03
Issued by Rolf Fagerberg



r/R		0.35	0.6	0.95
Radius	mm	297.5	510	807.5
L	mm	481	805	698
LF	mm	206	522	2
LA	mm	275	283	696
Pitch	mm	1537	2281	1650
Max thickn.	mm	70	35	11.8



Propeller Data

Propeller diameter	(D)	*1700*	mm
Hub diameter	(d)	*550*	mm
Number of blades	(Z)	*4*	
Expanded blade area ratio	(AE/A0)	*0.757*	
Pitch ratio at 0.7R	(P0.7/D)	*1.347*	

Data for One Blade

Expanded area	*0.430*	m²
Weight	*102*	kg

K-200	
55A/4D-B-G	R-185033--O

Bild-kort	Utf. Design
_	A
	B
	C
	D
	E
	F
	G
	H
	K

Bild-kort	Ändr. Revis	Zon Zone	Ändringen omfattar Revision comprises	Datum Date	Uppgj. Drawn	Godk. Approved
_	a	_	Texten kompletterad	801010	Deb	_
_	b	_	KaMeWa-propeller utgick	860428	BLöw	_
B	c	_	Text ändrad + omritad i CAD	920613	Alg	JnH
B	d	_	Mått 1000 var felaktigt måttsatt	940829	Alg	JnH
B	e	_	Text ändrad	950228	Alg	JnH
_	f	_	Removed swedish text	000719	BEK	DB
_	g	_	Svensk text tillkom	030916	Alg	KO

Tillåtna måttavvikelser när tolerans ej direkt utsatts på bearbetade detaljer SMS 715 Medel enligt tabell nedan. För rundningsradier, faser och vinkelmått följs SMS 715 Medel enligt separat standardblad.

Machining tolerances for linear dimensions unless otherwise specified. For radii and curvatures, bevels and angle measurements, SMS 715 Average according to separate standard sheets must be followed.

Basmått Basic size	Måttavvikelser Tolerances	Basmått Basic size	Måttavvikelser Tolerances
- 3	±0,1	(1000) - 2000	±1,2
(3) - 6	±0,1	(2000) - 4000	±2
(6) - 30	±0,2	(4000) - 8000	±3
(30) - 120	±0,3	(8000) - 12000	±4
(120) - 315	±0,5	(12000) - 16000	±5
(315) - 1000	±0,8	(16000) - 20000	±6

Modif. Modif.	Modifikationen omfattar Modification comprises			
	_			
Bild-kort	Zon Zone	Datum Date	Uppgj. Drawn	Godk. Approved
	_			

Användning av momentdragningsverktyg

Momentdragningsverktyg användes för förspänning av blad-, axelfläns- och navcylinderskruv.

Vid förspänning skall smörjmedel påföras på skruvens gänga och tätningsmassa påföras under skruvskallen (se Nav smst).
Skruvarna skall förspännas två gånger.

1. Kontrollera att skruven löper lätt i gängan.
   Ansätt samtliga skruvar med handverktyget.
   OBS! Mutterdragare (pneumatisk, hydraulisk eller elektrisk) får ej användas!
   Montera verktygen för momentdragning enligt förebild.

2. Förspänn skruvarna korsvis och avläs på dynamometern det på ritning Nav smst angivna momentet.

3. Vänta i 15 minuter
   Börja sedan med att lossa den först förspända och förspänn denna ånyo till på Nav smst angivet moment varefter samtliga skruvar lossas och förspännes en efter en enligt ovan

Use of tools for torque tightening

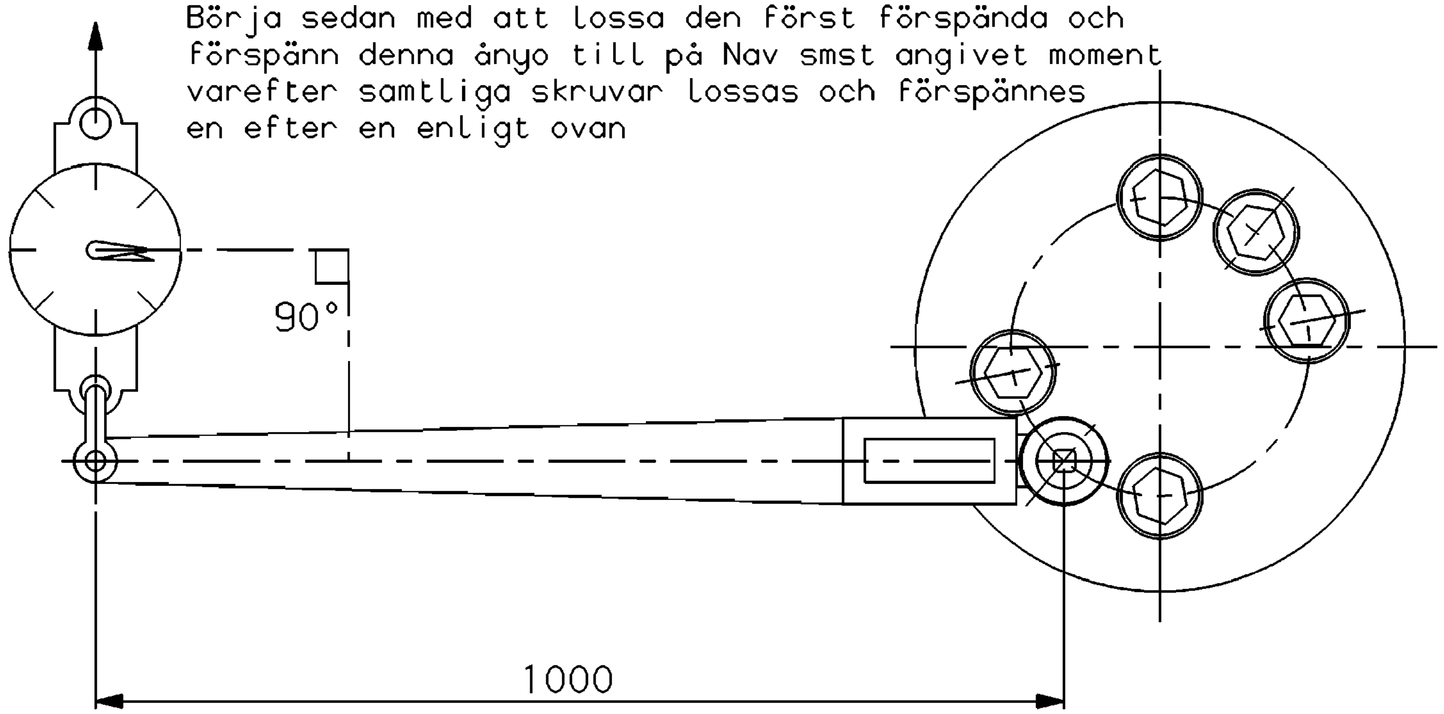
Tools for torque tightening are to be used pre-stressing of blade-, shaft flange- and hub cylinder screws.

Lubricant is to be used on the threads of the screw and sealing compound under the screw head when pre-stressing (see hub assembly drawing).
The screws are to be pre-stressed twice.

1. Check that the screw runs easily in the thread.
   Thighten all the screws with a hand tool.
   Note! Wrench (pneumatic, hydraulic or electric) may not be used!
   torque tightening according to instructions.

2. Pre-stress the screws crosswise and read on the dynamometer the torque stated on the hub assembly drawing.

3. Wait in 15 minutes
   Then begin untightening the screw first pre-stressed and pre-stress this again to the torque stated on the hub assembly drawing and then untighten all screws and pre-stress again one after each other according to above.



Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark

Anläggning Plant	Best. nr/Prod.gr. nr. Order No./Prod.gr. No.	Tot. vikt Tot.weight kg
_	_	_

Uppgj. Drawn	Kontr. Checked	Godk. Approved	Ytjämnhet enligt SMS 672 Ra µm / Surface texture ISO/R 1302 Ra µm
Deb	IP	Lös	

KaMeWa
A Vickers P.L.C. company
KRISTINEHAMN
SWEDEN

PROPELLERNAV
PROPELLER HUB
INSTR. FÖR DRAGNING AV SKRUV
INSTR. FOR TIGHTENING OF SCREW

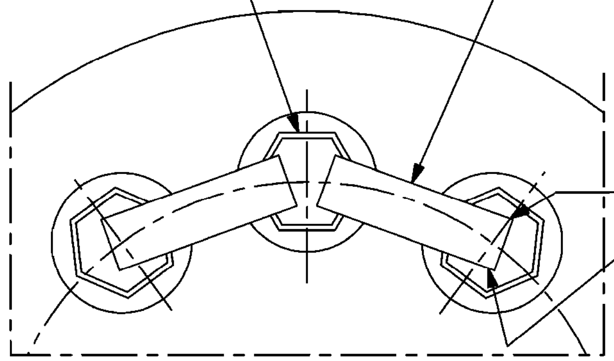
Skala Scale		Datum Date
_	A3	800312

Blad Sheet	av of	Föreg. ritn. Previous drg.
1	1	577077

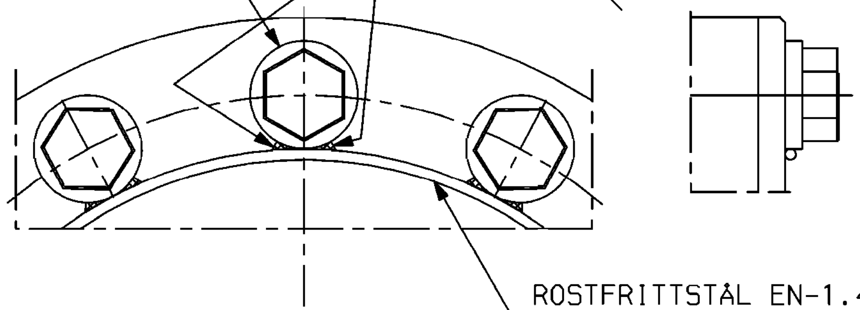
	Utf. Design	Ändr. Revis.
586431		g

REV.	ZONE	REVISION COMPRISES	DATE	MADE BY	CHECKED	APPROVED
a	_	WELDING INFORMATION ADJUSTED	051026	Har	KO	Gök

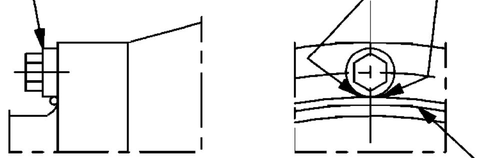
DESIGN
A
B
C
D
E



SKRUV, BLADFLÄNS
SCREW, BLADE FLANGE



SKRUV, AXELFLÄNS
SCREW, SHAFT FLANGE



SKRUV, NAVCYLINDER
SCREW, HUB CYLINDER

Svetsbestämmelser / Welding rules	Svetsstandard för Rolls-Royce AB / Welding standard for Rolls-Royce AB
Grundmaterial / Parent metal	_
Avspänningsglödgningstemperatur / Stress-relieving heat treatment at	_
Svetsplan / Sequence of welding	Se SVETSDATABLAD / See WELDING PROCEDURE SPECIFICATION (WPS)
Täthetskrav / Sealing requirements	_
Svetstolerans / Welding tolerance	EN ISO 13920-BE

Svets nr / Weld No	Svetsklass / Welding class	Svetsmetod / Welding process	Provningsomfattning / Extent of Examination: Röntgenundersökning / Radiographic Examination	Ultraljudundersökning / Ultrasonic Examination	Magnetpulverundersökning / Magnetic Particle Examination	Penetrantundersökning / Liquid Penetrant Examination	Anmärkning / Remark
W1	D	_	_%	_%	_%	_%	_
W2	D	_	_%	_%	_%	_%	_
W3	D	_	_%	_%	_%	_%	_

GENERAL TOLERANCE	SHARP EDGES BROKEN	PLANT	
SS-ISO 2768-mH	0.2-0.5	_	
SURFACE ROUGHNESS: SS-ISO 1302 Ra µm	FILLET RADII: R 0.8-1.6	PREVIOUS DRG.: 998334	CODE: _

NAV 50-121XF5 HUB INSTRUKTION FÖR LÅSNING AV SKRUV INSTRUCTION FOR LOCKING OF SDREW	WEIGHT kg: _	DATE: 960430
	SCALE: DO NOT SCALE	MADE BY: KO
	CHECKED: ALg	APPROVED: JnH
Rolls-Royce ROLLS-ROYCE AB KRISTINEHAMN SWEDEN	SHEET 1 OF 1	A2
	998174	DESIGN REV. a

Bild-kort	Utf. Design	Det. nr	Gr.nr	Antal
_	A	Det01-05	126	1 sats/blad
	B			
	C			
	D			
	E			
	F			
	G			
	_			
	_			

Bild-kort	Ändr. Revis	Zon Zone	Ändringen omfattar Revision comprises	Datum Date	Uppgj. Drawn	Godk. Approved
_	_	_	_	_	_	_

Tillåtna måttavvikelser när tolerans ej direkt utsatts på bearbetade detaljer SMS 715 Medel enligt tabell nedan. För rundningsradier, faser och vinkelmått följs SMS 715 Medel enligt separat standardblad.

Machining tolerances for linear dimensions unless otherwise specified. For radii and curvatures, bevels and angle measurements, SMS 715 Average according to separate standard sheets must be followed.

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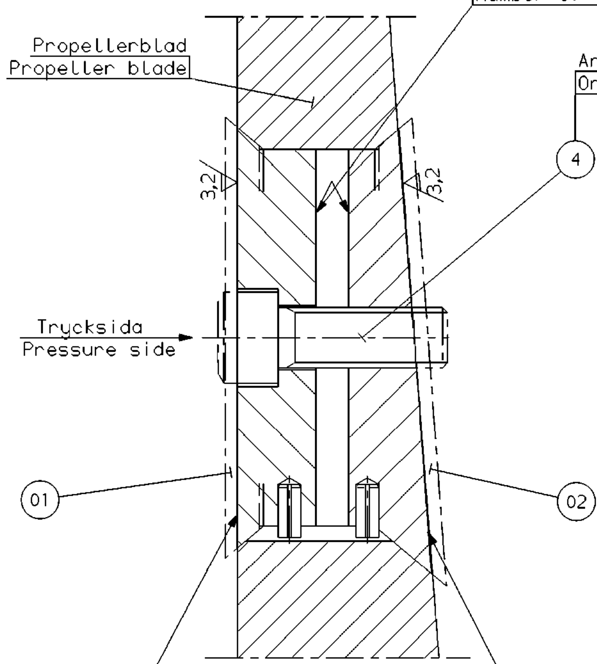
(3) - 6	±0,1	(2000) - 4000	±2
(6) - 30	±0,2	(4000) - 8000	±3
(30) - 120	±0,3	(8000) - 12000	±4
(120) - 315	±0,5	(12000) - 16000	±5
(315) - 1000	±0,8	(16000) - 20000	±6

Bild-kort	Modif. Modif.	Zon Zone	Modifikationen omfattar Modification comprises	Datum Date	Uppgj. Drawn	Godk. Approved
		_	_			

1. Avslipning av plugg utföres vid verkstad (KaMeWa, Kristinehamn).
Grinding of plug to be carried out at the workshop.

Pluggarna märkes med propellerbladets klassnummer på insidan.
To be marked with identification number of the propeller blade.

Användes endast vid avslipning
Only to be used when grinding

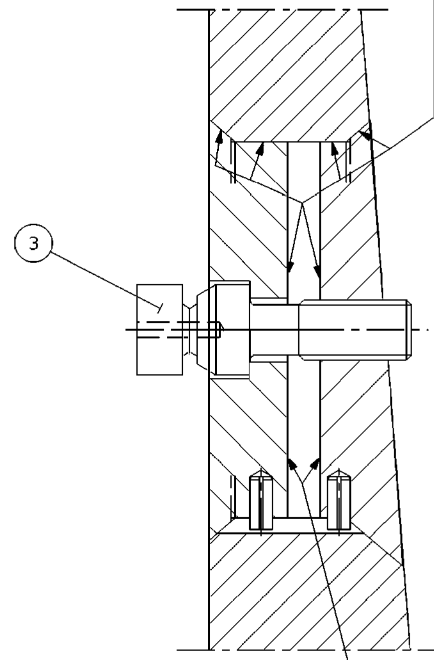


Avslipas jäms med bladytan
Flush to blade surface

2a,b,c. Fastsättning av plugg utföres vid varv.
Fastening of plug to be carried out at the shipyard.

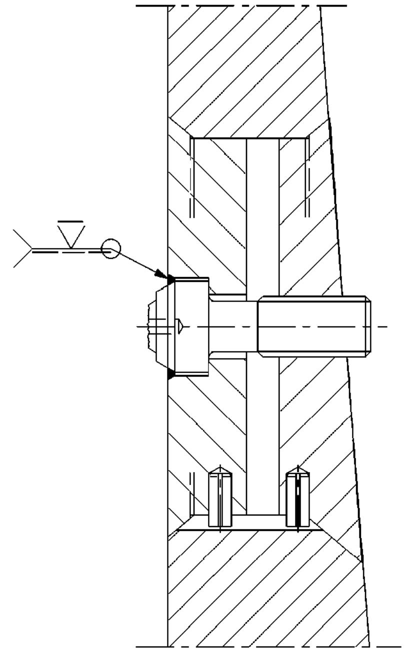
2a. Montering av pluggdetaljer.
Mounting of plug details.

Insmörjes med KaMeWa Bolthead Sealing Compound eller någon rostskyddsolja före montage.
To be greased with KaMeWa Bolthead Sealing Compound or some corrosion protecting oil before fitting.

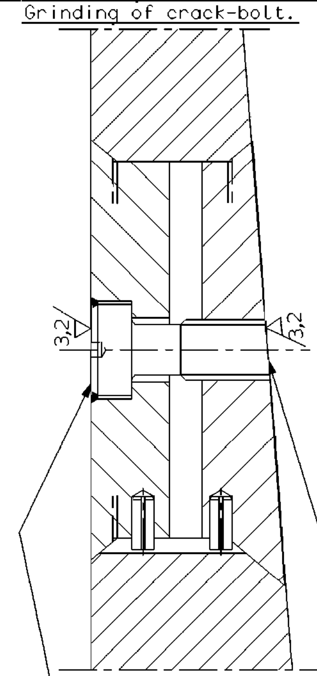


OBS! Propellerbladets klassnummer på insidan
Observe the identification number of the propeller blade.

2b. Avdragning av brottskruv och svetslåsning av skruvskalle.
Cracking and locking of crack-bolt.



2c. Avslipning av brottskruv.
Grinding of crack-bolt.

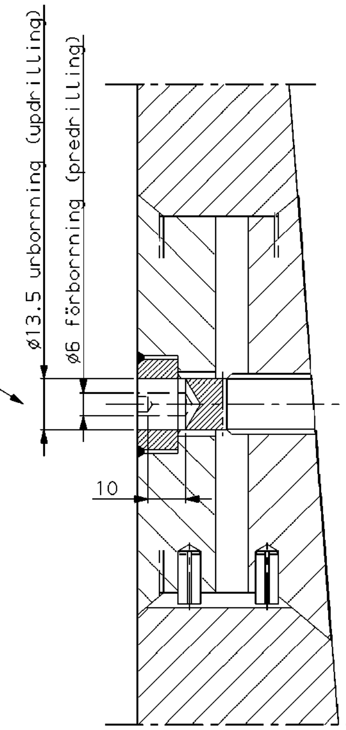


Avslipas jäms med pluggytan.
Flush to plug surface.

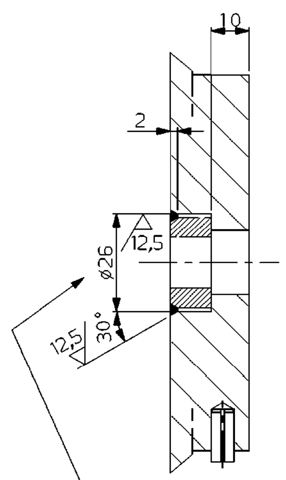
3a,b,c. Borttagning av plug.
Removal of plug.

3a. Urborrning av brottskruv.
Updrilling of crack-bolt.

Obs! Det lilla centreringshålet i skruvskallens centrum. Tillse att borret går rakt och att borrdjupet innehålles.
When drilling, observe the centre-hole and drilling depth.

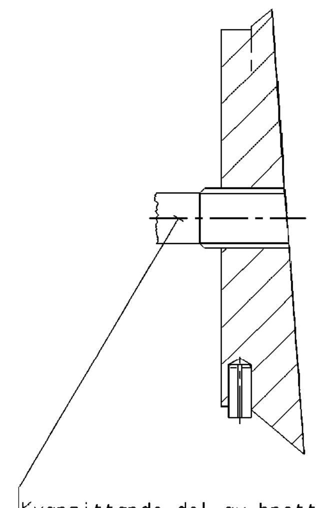


3b. Bortsvarvning av skruvskalle.
Upturning of crack-bolt head.



Svarva inte djupare än att skruvskallen lossnar.
Don´t turn deeper than loosening crack-bolt head.

3c. Borttagning av gängad skruvdel.
Removal of threaded screw part.



Kvarsittande del av brottskruv urgängas.
Threaded screw part to be removed.

4. Återinsättning av plugg.
Refitting plugs.

Vid återinsättning av demonterade pluggar tillses att de ligger jäms med bladytan.
Nya brottskruvar, det nr 3, som skall finnas som reserv ombord på fartyget, användes.

Det. nr 4 är inte reservdel.

F.ö. förfares enl. anvisning 2a,b,c.
"Fastsättning av plugg utföres vid varv."

When refitting dismounted plugs check that the plugs are flush to blade surface.
Use new crack-bolts, item no 3, to be kept onboard the vessel as spare part.

Item no 4 is not spare part.

Otherwise to be made according to 2a,b,c.
"Fastening of plug to be carried out at the shipyard."

Max. bladtjocklek: 130
Max. blade thickness: 130

	Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark
Drilling of liftinghole			Borrn. av lyfthål och	_	_	_
Protecting sleeve	05	1	Skyddshylsa	144113A	_	_
Screw	4	1	6K.HÅLSKR. M16x130-8.8	IS04762	_	_
Crack-bolt	3	1	Brottskruv	518926B	Avesta	248 SV
Plug	02	1	Lyfthålsplugg	144116A	Avesta	248 SV
Plug	01	1	Lyfthålsplugg	144115A	Avesta	248 SV

Anläggning Plant: _ | Best. nr/Prod.gr. nr. Order No./Prod.gr. No.: _ | Tot. vikt Tot.weight kg: _

Uppgj. Drawn: TWD | Kontr. Checked: Gök | Godk. Approved: JÅN | Ytjämnhet enligt SMS 672 Ro µm Surface texture ISO/R 1302 Ro µm

KaMeWa A Vickers P.L.C. company KRISTINEHAMN SWEDEN

KaMeWa propeller
Propellerblad
Plugg för lyfthål Smst
Plug for lifting hole Assy

Skala Scale: 1:1 | A1 | Datum Date: 010515
Blad Sheet: 1 av of: _ | Föreg. ritn. Previous drg.: 518923
144112 | Utf. Design | Ändr. Revis.: _

Bild-kort	Utf. Design		REF.DET.17/ITEM 17	MÅLNINGSINSTR.
_	A	TO-BOX HÖGER/OD-BOX RIGHT HAND	214012A	214016
_	B	TO-BOX VÄNSTER/OD-BOX LEFT HAND	214012B	214016
	C	TO-BOX HÖGER/OD-BOX RIGHT HAND	214012A	ORDER SPEC.
	D	TO-BOX VÄNSTER/OD-BOX LEFT HAND	214012B	ORDER SPEC.
	E			
	F			
	G			
	H			
	K			

Tillåtna måttavvikelser när tolerans ej direkt utsatts på bearbetade detaljer SMS 715 Medel enligt tabell nedan. För rundningsradier, faser och vinkelmått följs SMS 715 Medel enligt separat standardblad.

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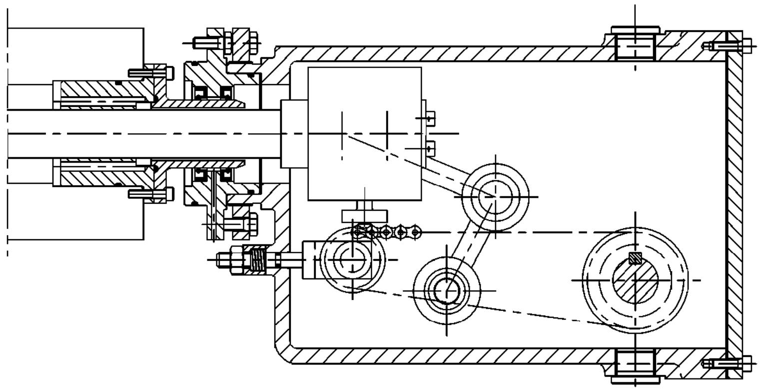
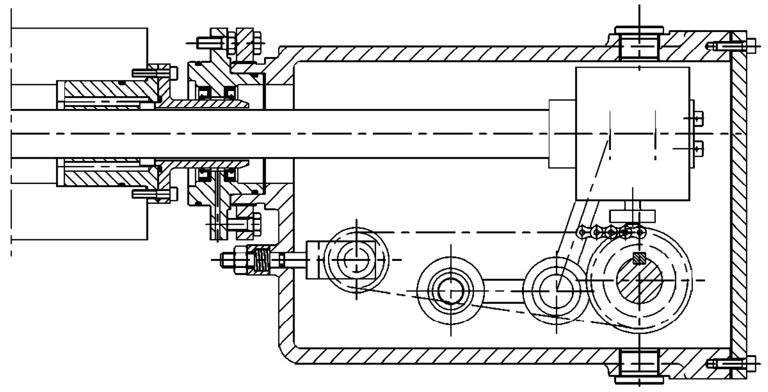
(6) - 30	±0,2	(4000) - 8000	±3
(30) - 120	±0,3	(8000) -12000	±4
(120) - 315	±0,5	(12000) -16000	±5
(315) -1000	±0,8	(16000) -20000	±6

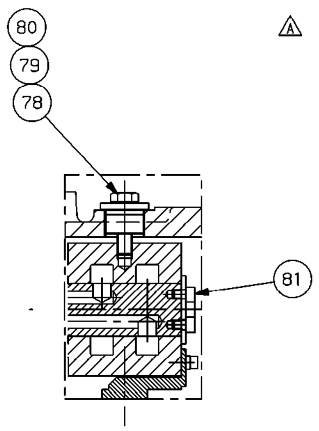
Bild-kort	Modif. Modif.	Zon Zone	Modifikationen omfattar Modification comprises	Datum Date	Uppgj. Drawn	Godk. Approved
		_	_			

BACK
ASTERN



FRAM
AHEAD





⚠ ENDAST FÖR TRANSPORT
ONLY FOR TRANSPORTATION

	Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark
SOCKET SCREW	81	2	6K.HÅLSKR. M6x8-8.8	ISO4762	_	_
SEALING WASHER	80	1	TÄTN.BRICKA 10.7x16	KS1147	_	_
HEXAGON HEAD SCREW	79	1	6k.SKRUV M10x35	ISO4014	_	_
REDUCTION NIPPEL	78	1	REDUCERINGSNIPPEL	R13/4-1/4		
SPARES	77	_	RESERVDELAR	214017A	_	_
TOOLS	76	_	VERKTYG	940832A	_	_
DIMENSION DRAWING	75	_	DIMENSIONSRITNING	154903A	_	_
LOCTITE	74	_	LOCTITE 243	_	_	_
SOCKET SCREW	73	4	6K.HÅLSKR.M5x12-8.8	ISO4762	_	_
_	72	_	_	_	_	_
CHAIN LOCK	71	1	KEDJELÅS 455 / 11	KEDJETEKNIK	_	_
CONNECTION LINK	70	2	BEFÄSTNINGSLÄNK 455/B7	KEDJETEKNIK	_	_
⚠ CHAIN	69	1	KEDJA NR.455 56 LÄNKAR	KEDJETEKNIK	_	_
CHAIN WHEEL	68	1	KEDJEHJUL 12/455,HÅLØ10H7	KEDJETEKNIK	_	_
CHAIN WHEEL	67	1	KEDJEHJUL 21/455,HÅLØ30H7	KEDJETEKNIK	KILSPÅR B=8, HÅL M6	
SPRING	66	1	TRYCKFJÄDER NR.12450	STECE-BARNES	_	135N VID L=10
KEY	65	1	PLATTKIL 8x7x28	SMS2306	_	RUNDA ÄNDAR
SOCKET SCREW	64	4	6K.HÅLSKR. M3x8-12.9	ISO4762	_	_
SEALING RING	63	1	SIMMERRING BABSL	SIMRIT	75FPM595	45-62-7
SEALING RING	62	1	SIMMERRRING BAUMX7	SIMRIT	75FPM585	45-62-8
CONICAL TOOTH WHEEL	61	2	KONISKA KUGGHJUL	214558A	_	
⚠ DISTANCE	60	1	DISTANS Ø20/Ø11x6	_	St52	_
LOCKING WASHER	59	2	LÅSBRICKA 5.2X9	_	_	NORDLOCK
PACKING	58	1	PACKNING 1x230x230	_	KLINGERSIL	_
PLUG	57	4	PROPP VSTI R3/4-ED	TEMETO	_	_
PLUG	56	2	PROPP VSTI R3/8-ED	TEMETO	_	_
HEXAGON HEAD SCREW	55	8	6K.SKRUV M8x25-8.8	ISO4014	_	_
HEXAGON HEAD SCREW	54	8	6K.SKRUV M8x20-8.8	ISO4014	_	_
SOCKET SCREW	53	8	6K.HÅLSKR. M5x25-8.8	ISO4762	_	_
SOCKET SCREW	52	3	6K.HÅLSKR. M6x30-8.8	ISO4762	_	_
LOCKING NUT	51	1	6K.LÅSMUTTER M10-8	ISO4032	_	_
SET SCREW	50	2	STOPPSKRUV MSK6SS 8x12	ISO4029	_	_
SOCKET SCREW	49	10	6K.HÅLSKR. M5x16-8.8	ISO4762	_	_
SOCKET SCREW	48	12	6K.HÅLSKR. M6x20-8.8	ISO4762	_	_
SOCKET SCREW	47	3	6K.HÅLSKR. M8x22-8.8	ISO4762	_	_
SOCKET SCREW	46	2	6K.HÅLSKR. M8x16-8.8	ISO4762	_	_
_	45	_	_	_	_	_
O-RING	44	1	O-RING 5.3x2.4	SMS1586	_	_
O-RING	43	1	O-RING 74.5x3	SMS1586	_	_
PARALLEL PIN	42	1	CP 2m6x8	ISO2338	_	_
RETAINING RING	41	2	SPÅRRING SgA 30	SMS1581	_	_
RETAINING RING	40	1	SPÅRRING SgA 10	SMS1581	_	_
RETAINING RING	39	6	SPÅRRING SgA 17	SMS1581	_	_
_	38	_	_	_	_	_

TO-BOX DATA
TOT.SLAG=175mm
VIKT=50kg
MAX OLJEFLÖDE=50l/min

OD-BOX DATA
STROKE=175mm
WEIGHT=50kg
MAX OIL FLOW=50l/min

PROVNING ENLIGT QI-02-133-20
TESTING ACCORDING TO QI-02-133-20

	Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark
_	37	_	_	_	_	_
O-RING	36	2	O-RING 26.2x3-704	SMS1586	_	_
O-RING	35	2	O-RING 10.1x1.6-704	SMS1586	_	_
O-RING	34	2	O-RING 24.2x3-704	SMS1586	_	_
O-RING	33	1	O-RING 44.2x3-704	SMS1586	_	_
O-RING	32	1	O-RING 59.5x3-704	SMS1586	_	_
O-RING	31	1	O-RING 89.5x3-704	SMS1586	_	_
FOOT GUARDE	30	1	TRAMPSKYDD	214798A	_	_
CHAIN ATTACHEMENT	29	1	KEDJEFÄSTE	214799A	_	_
PISTON GUIDE	28	2	KOLVSTYRRING PWR/S 30/24x10		_	SEALPOOL
SEALING	27	16	KOLVSTÅNGSTÄTN.GHH/SS-22/33x4.2-292/N70			SEALPOOL
PROTECTION SHIELD	26	1	KLÄMSKYDD	214367A	_	_
CLAMP	25	2	KLÄMMA	214277A		_
CAGE	24	1	HYLSA	154986A	_	_
PIN	23	1	TAPP	214015A	_	_
WASHER	22	2	BRICKA	934218A	_	_
YOKE	21	1	GAFFEL	214014A	_	_
SLEEVE	20	1	HYLSA	214013A	_	_
BUSHING	19	1	BUSSNING	986661A	_	_
POINTER	18	1	VISARE	154924A	_	_
SCALE	17	1	SKALA	SE UTF./SEE DESIGN		
SOCKET SCREW	16	2	SKRUV	948635A	_	_
WASHER	15	6	BRICKA	934219A	_	_
WASHER	14	1	BRICKA	948639A	_	_
STUB SHAFT	13	1	STUBBAXEL	214011A	_	_
_	12	_	_	_	_	_
SWIVEL, ASSY.	11	2	SVIVEL, SMST.	214009A	_	_
SWIVEL, ASSY.	10	2	SVIVEL, SMST.	937863A	_	_
BOLT	9	2	BULT	937867A	_	_
BOLT	8	2	BULT	987099A	_	_
CONNECTION PIPE	7	2	ANSLUTNINGSRÖR	214008A	_	_
COVER	6	1	LOCK	214007A	_	_
FLANGE NUT	5	1	FLÄNSMUTTER	214006A	_	_
CONNECTION FLANGE	4	1	ANSLUTNINGSFLÄNS	214005A	_	_
SHAFT	3	1	AXEL	214004A	_	_
OD-BOX RING	2	1	TO-BOXRING	214749A	_	_
BOX-HOUSING	1	1	BOXHUS	214001A	_	_

Anläggning Plant	Best. nr/Prod.gr. nr. Order No./Prod.gr. No.	Tot. vikt Tot.weight kg
_	_	48

Uppgj. Drawn	Kontr. Checked	Godk. Approved	Ytjämnhet enligt SMS 672 Ra µm / Surface texture ISO/R 1302 Ra µm
Gök	KO	Lly	

KAMEWA
A Vickers P.L.C. company
KRISTINEHAMN
SWEDEN

TO BOX 35 FA -
OD-BOX 35 FA

SAMMANSTÄLLNING
ASSEMBLY

Skala Scale		Datum Date	Blad Sheet	av of	Föreg. ritn. Previous drg.		Ändr. Revis.
1:2.5	A1	100331	1	3	_	214000	A

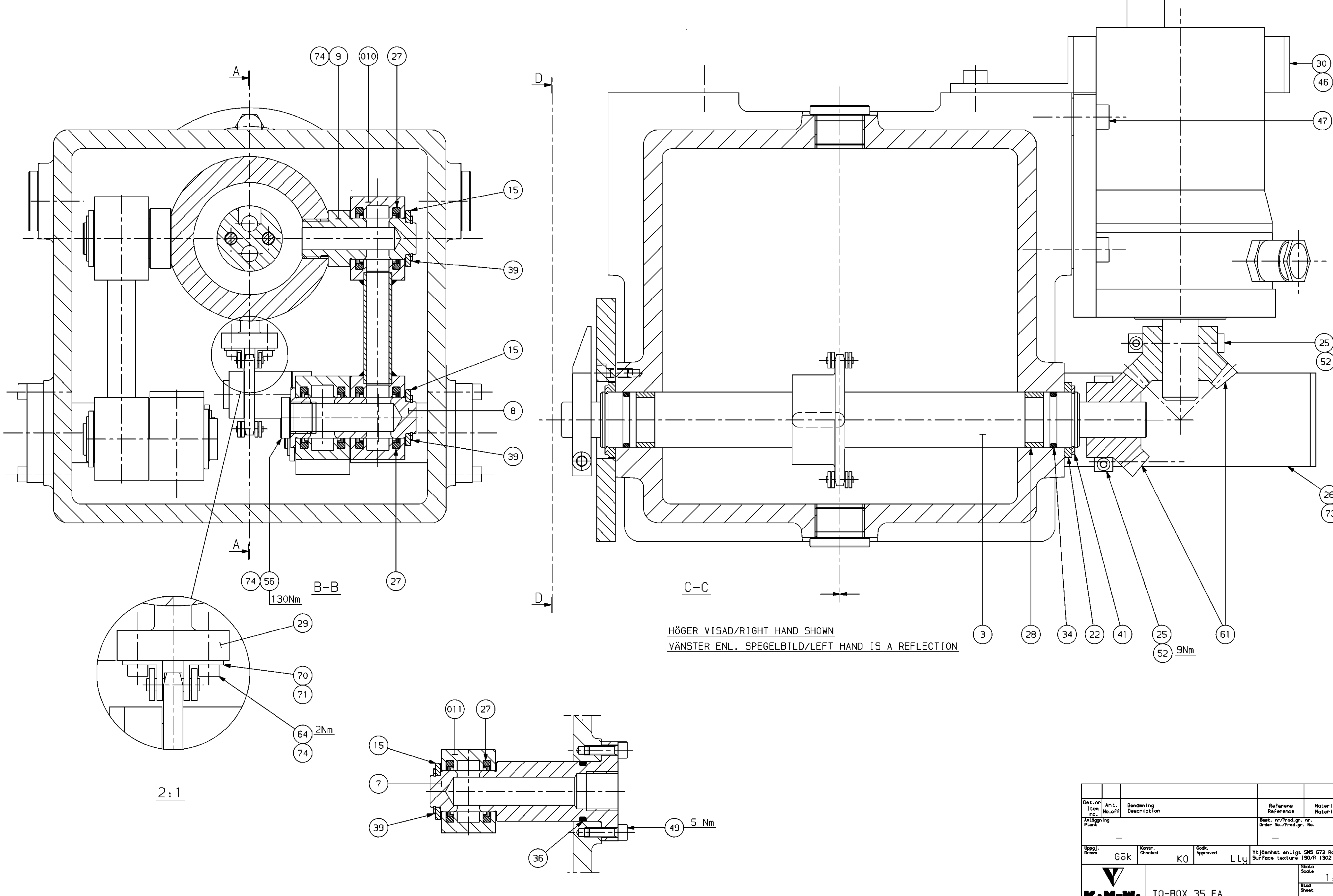
Bild-kort	Utf. Design
–	A
	B
	C
	D
	E
	F
	G
	H
	K

Tillåtna måttavvikelser när tolerans ej direkt utsatts på bearbetade detaljer SMS 715 Medel enligt tabell nedan. För rundningsradier, faser och vinkelmått följs SMS 715 Medel enligt separat standardblad.

Machining tolerances for linear dimensions unless otherwise specified. For radii and curvatures, bevels and angle measurements, SMS 715 Average according to separate standard sheets must be followed.

Basmått Basic size	Måttavvikelser Tolerances	Basmått Basic size	Måttavvikelser Tolerances
- 3	±0,1	(1000) - 2000	±1,2
(3) - 6	±0,1	(2000) - 4000	±2
(6) - 30	±0,2	(4000) - 8000	±3
(30) - 120	±0,3	(8000) - 12000	±4
(120) - 315	±0,5	(12000) - 16000	±5
(315) - 1000	±0,8	(16000) - 20000	±6

Bild-kort	Modif. Modif.	Zon Zone	Modifikationen omfattar Modification comprises	Datum Date	Uppgj. Drawn	Godk. Approved
		–	–			



Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark

Anläggning Plant: –

Best. nr/Prod.gr. nr. Order No./Prod.gr. No.: –

Tot. vikt Tot.weight kg: –

Uppgj. Drawn: Gök | Kontr. Checked: KO | Godk. Approved: Lly

Ytjämnhet enligt SMS 672 Ra µm
Surface texture ISO/R 1302 Ra µm

KAMEWA
A Vickers P.L.C. company
KRISTINEHAMN
SWEDEN

TO-BOX 35 FA
OD-BOX 35 FA
SAMMANSTÄLLNING
ASSEMBLY

Skala Scale: 1:1 | A1 | Datum Date: 100331

Blad Sheet: 2 av of 3 | Föreg. ritn. Previous drg.: –

214000 | Ändr. Revis.: A

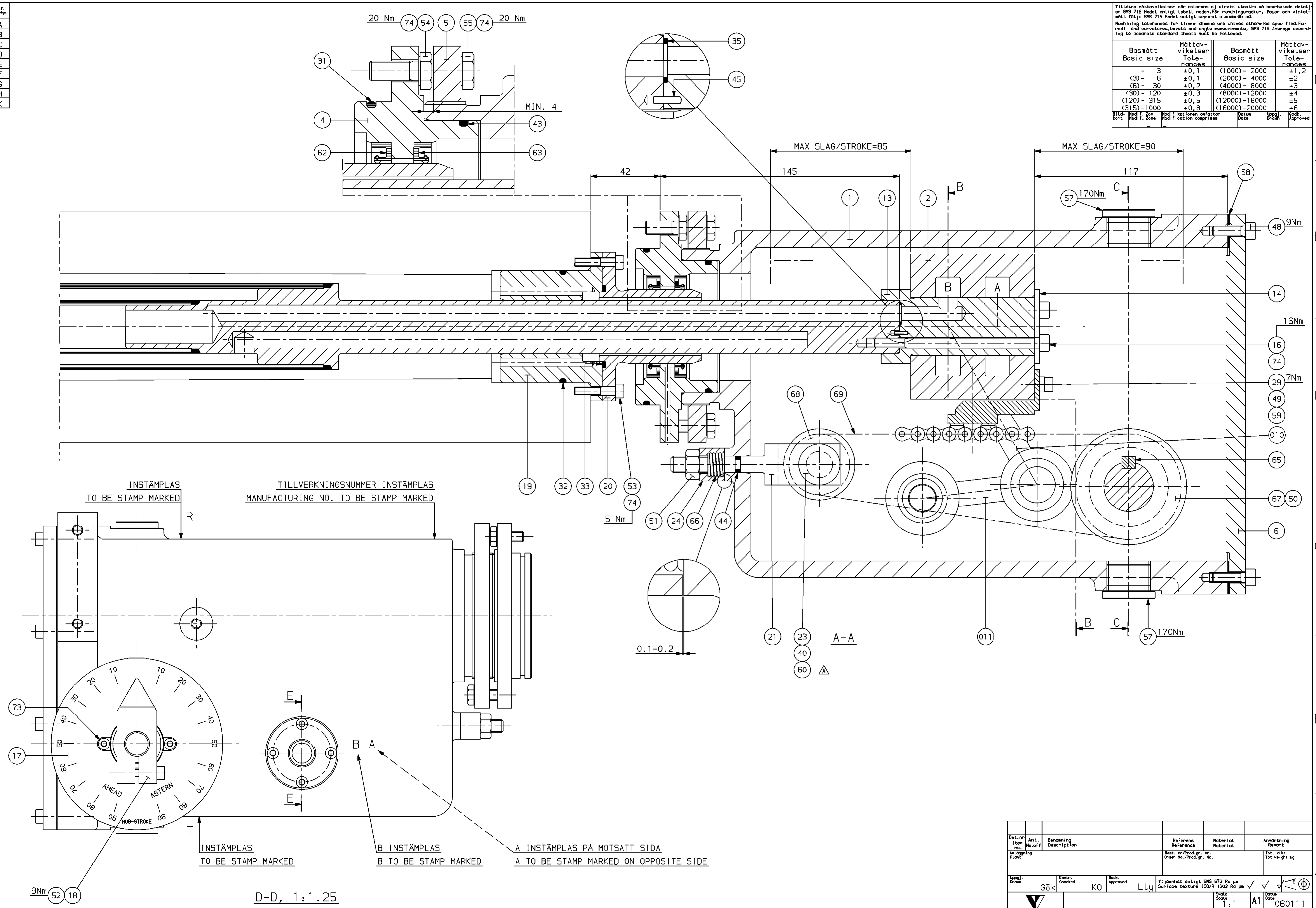


Bild-kort	Utf. Design
B	A
	B
	C
	D
	E
	F
	G
	H
	K

Tillåtna måttavvikelser när tolerans ej direkt utsatts på bearbetade detaljer SMS 715 Medel enligt tabell nedan. För rundningsradier, faser och vinkelmått följs SMS 715 Medel enligt separat standardblad.

Machining tolerances for linear dimensions unless otherwise specified. For radii and curvatures, bevels and angle measurements, SMS 715 Average according to separate standard sheets must be followed.

Basmått Basic size	Måttavvikelser Tolerances	Basmått Basic size	Måttavvikelser Tolerances
- 3	±0,1	(1000)- 2000	±1,2
(3)- 6	±0,1	(2000)- 4000	±2
(6)- 30	±0,2	(4000)- 8000	±3
(30)- 120	±0,3	(8000)-12000	±4
(120)- 315	±0,5	(12000)-16000	±5
(315)-1000	±0,8	(16000)-20000	±6

Bild-kort	Modif. Modif.	Zon Zone	Modifikationen omfattar Modification comprises	Datum Date	Uppgj. Drawn	Godk. Approved
		–	–			

Det.nr Item no.	Ant. No.off	Benämning Description	Referens Reference	Material Material	Anmärkning Remark

Anläggning Plant: –
Best. nr/Prod.gr. nr. Order No./Prod.gr. No.: –
Tot. vikt Tot.weight kg: –

Uppgj. Drawn: Gök | Kontr. Checked: KO | Godk. Approved: Lly

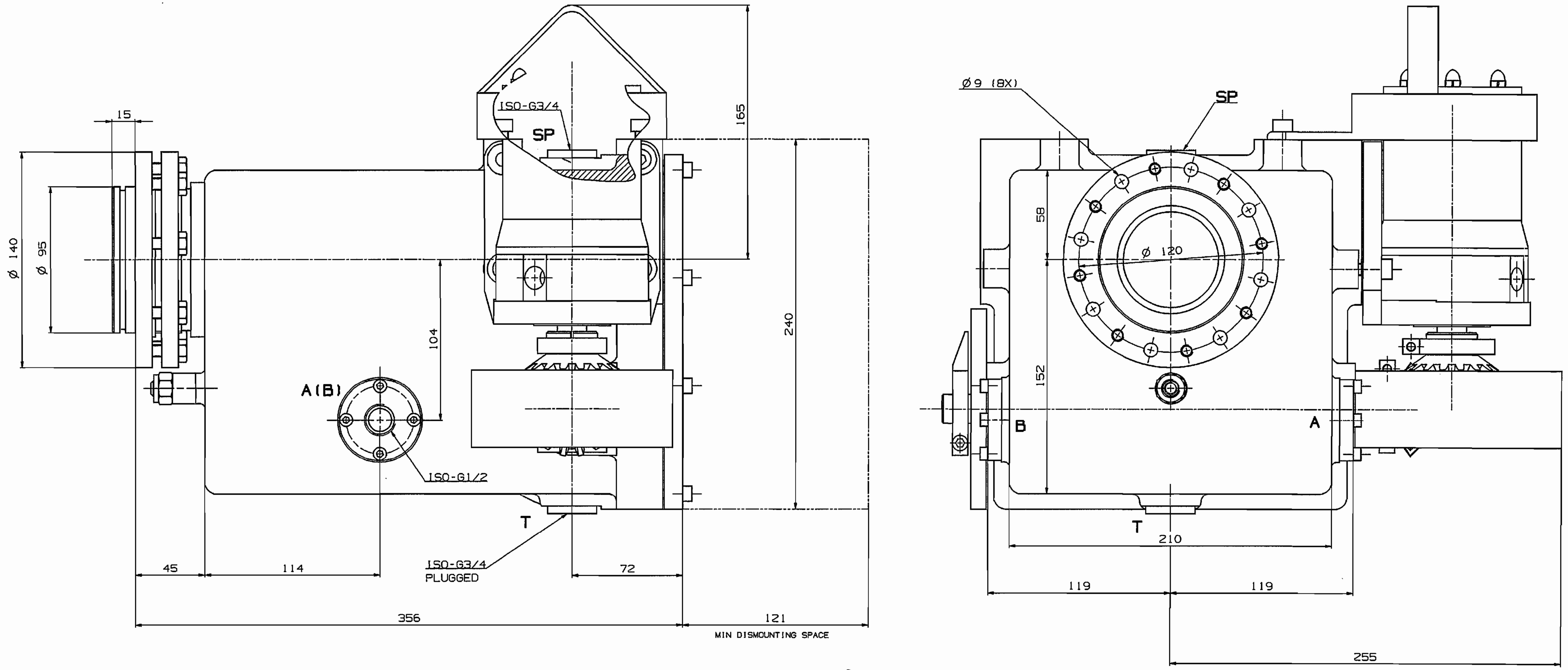
Ytjämnhet enligt SMS 672 Ra µm
Surface texture ISO/R 1302 Ra µm

KAMEWA
A Vickers P.L.C. company
KRISTINEHAMN
SWEDEN

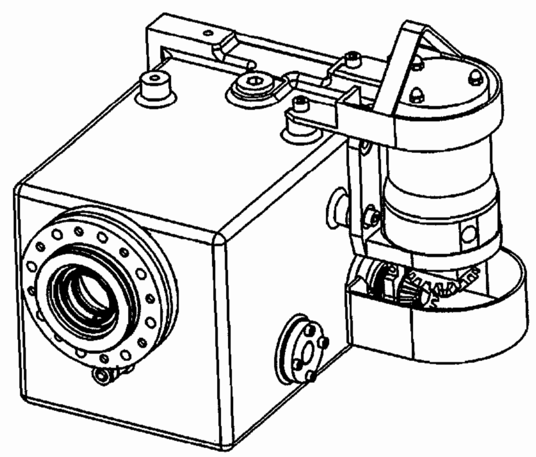
TO-BOX Ø35 FO
OD-BOX Ø35 FO
SAMMANSTÄLLNING
ASSEMBLY

Skala Scale: 1:1 | A1 | Datum Date: 060111
Blad Sheet: 3 av of 3 | Föreg. ritn. Previous drg.: –
214000 | Ändr. Revis.: A

REV.	ZONE	REVISION COMPRISES	DATE	MADE BY	CHECKED	APPROVED
—	—	—	—	—	—	—



DRY WEIGHT APPROX. 63 KG



DESCRIPTION	ITEM NO.	NO. OF	SWEDISH DESCRIPTION	REFERENCE	MATERIAL/REMARK

GENERAL TOLERANCES SS-ISO 2768 mH
SHARP EDGES BROKEN 0.2-0.5
PLANT
SURFACE ROUGHNESS SS-ISO 1302 Ra µm
FILLET RADII R 0.8-1.6
PREVIOUS DRG. —
CODE

T.O.- BOX Ø 35 FA
O.D.- BOX
DIMENSIONSRITNING
DIMENSION DRAWING

WEIGHT kg ---
DATE 080714
SCALE 1:1.3
MADE BY QRT
CHECKED EKK--
APPROVED
SHEET 1 OF 1
A1

Rolls-Royce
ROLLS-ROYCE AB KRISTINEHAMN SWEDEN

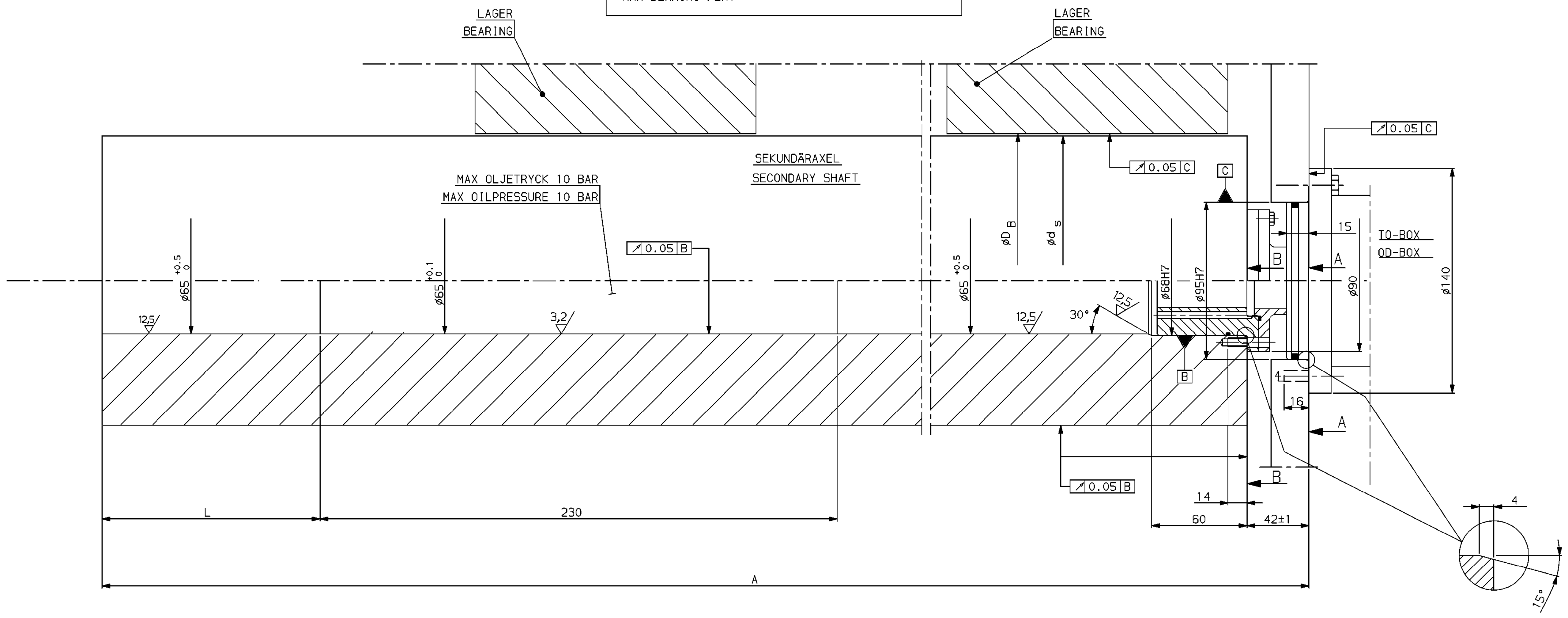
154903
DESIGN REV. -

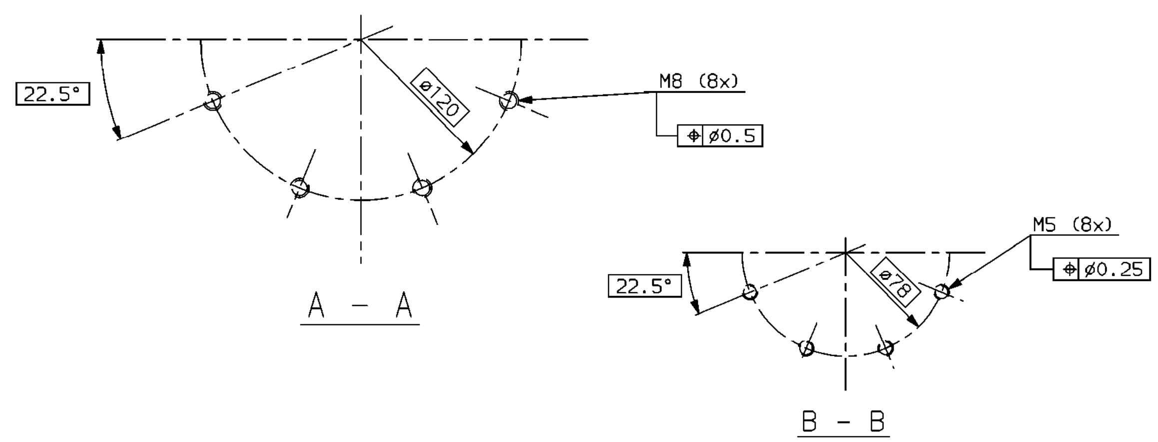
R-R AB'S INFO CLASS LIMITED
ACCESS LIST R-R AB

REV.	ZONE	REVISION COMPRISES	DATE	MADE BY	CHECKED	APPROVED
	–	–				

DESIGN
A
B
C
D
E

MAX LAGERSPEL
MAX BEARING PLAY $(\varnothing D_B - \varnothing d_s) = 0.60\text{mm}$





GIVEN BY GEAR MAKER

A=_ _ _ _ _mm

Material data for
gear output shaft:

Tensile strenght=_ _ _ _ _N/mm²

Yield point=_ _ _ _ _N/mm²

SKF-KOPPLING SKF-COUPLING	L
OKCX 180	258
–	–
–	–
–	–

3,2 DÄR EJ ANNAT ANGES
IF NOTHING ELSE IS MENTIONED

DESCRIPTION	ITEM NO.	NO. OF	SWEDISH DESCRIPTION	REFERENCE	MATERIAL	REMARK

GENERAL TOLERANCE SS-ISO 2768-mH
SHARP EDGES BROKEN 0.2-0.5
PLANT –
SURFACE ROUGHNESS SS-ISO 1302 Ra µm
FILLET RADII R 0.8-1.6
PREVIOUS DRG. 986469
CODE –

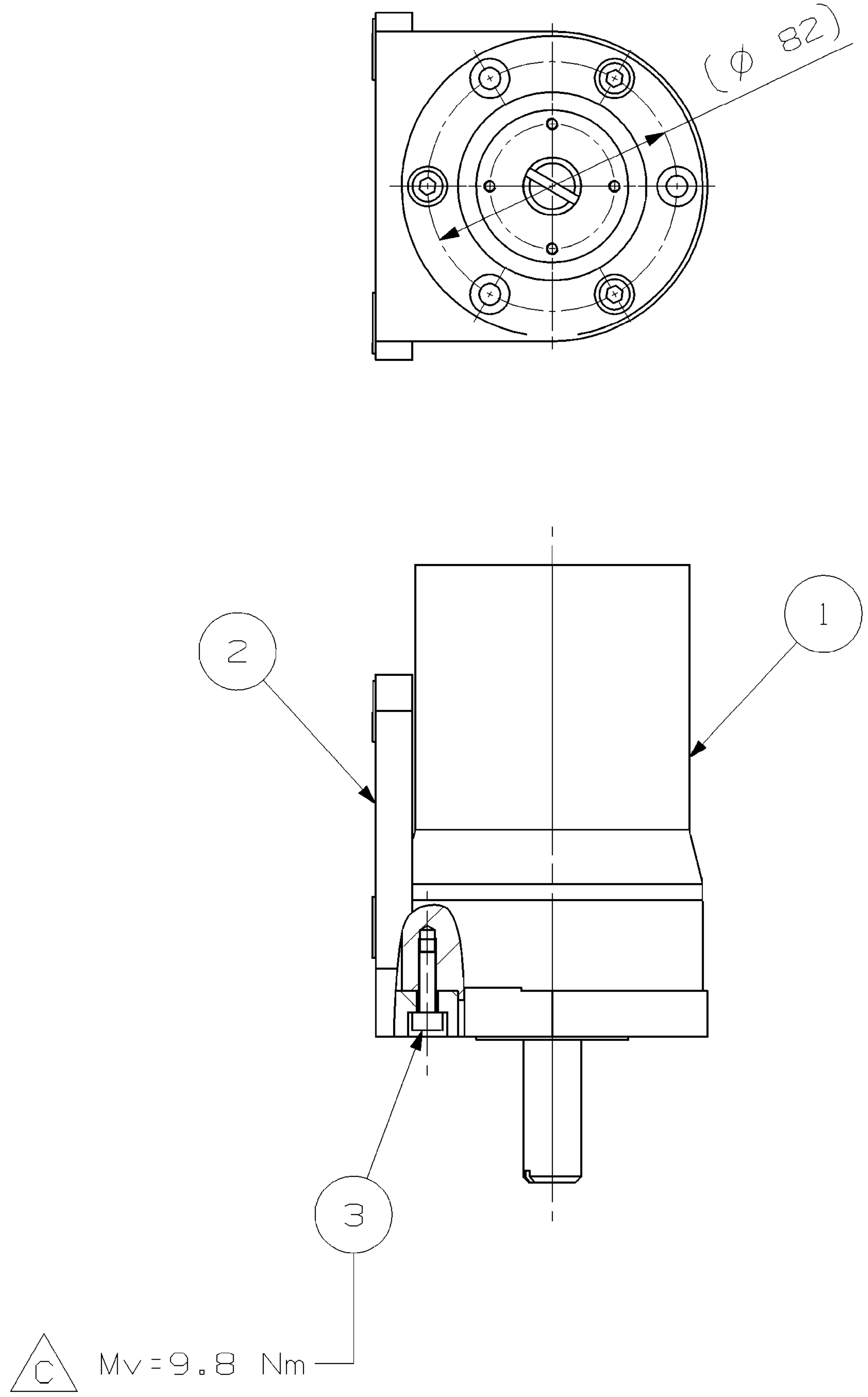
T.O.-BOX 35 FA (ø65)
O.D.-BOX 35 FA (ø65)
ANSLUTNING TILL VÄXEL
CONNECTION TO GEAR

WEIGHT kg –
DATE 080717
SCALE 1:1
MADE BY QRT
CHECKED KK216
APPROVED NNNS
SHEET 1 OF 1
A1
DESIGN REV. –

Rolls-Royce
ROLLS-ROYCE AB KRISTINEHAMN SWEDEN

214740

RR AB'S INFO CLASS
RESTRICTED
ACCESS LIST
RRAB



General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	5.5

Transmitter

ENCODER SMST

Rolls-Royce

Origin./Date:		Scale:	Format:	Sheet:
mnmn	2010.07.05	1:2	A3	1 of 1
Drawing no:				Revision:
RRM200000128				C

Rolls-Royce AB
S-681 29 KRISTINEHAMN

Access List:

Rolls-Royce

External Bom Report

Item ID/Rev	Name	Item State	Size
RRM200000128/C	Transmitter	Assembly	

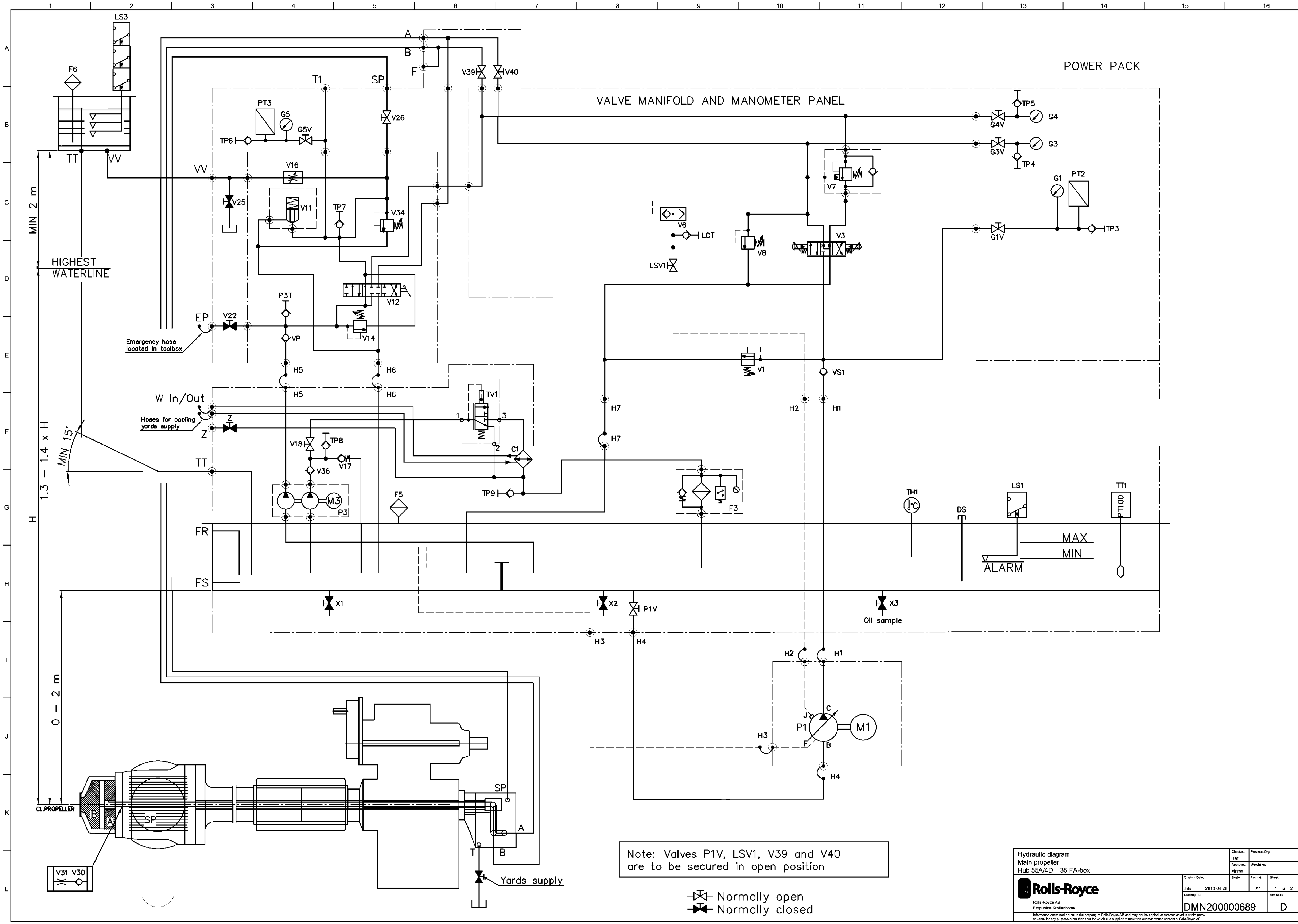
Sub-Assembly/Part

Seq No	Qty	Item ID/Rev	Name	Item State
1	1	R162407A/D	Transmitter	Assembly
2	1	R582003A/E	Holder	Detail
3	3	F500016/_	Socket Head Screw	Detail

External Bom Report

Item ID/Rev	Name	Item State	Size
RRM200000128/C	Transmitter	Assembly	

Sub-Assembly/Part				
Seq No	**Qty**	**Item ID/Rev**	**Name**	**Item State**
1	1	R162407A/D	Transmitter	Assembly
2	1	R582003A/E	Holder	Detail
3	3	F500016/_	Socket Head Screw	Detail



Note: Valves P1V, LSV1, V39 and V40 are to be secured in open position

Hydraulic diagram
Main propeller
Hub 55A/4D 35 FA-box

Checked: Har	Previous Drg:		
Approved: Mnmn	Weight kg:		
Origin. / Date: Jnla 2010-04-26	Scale:	Format: A1	Sheet: 1 of 2
Drawing no: DMN200000689			Revision: D

Rolls-Royce
Rolls-Royce AB
Propulsion Kristinehamn

Acess List
RR AB'S Info. Class: LIMITED

List of components

C1	Cooler
DS	Dip stick
F3	Oil circulation filter
F5	Air breather filter main tank
F6	Air breather filter gravity tank
G1	Pressure gauge system pressure
G1V	Shut off valve
G3	Pressure gauge conn A astern pitch
G3V	Shut off valve
G4	Pressure gauge conn B ahead pitch
G4V	Shut off valve
G5	Pressure gauge static pressure
G5V	Shut off valve
LCT	Test point
LS1	Level switch main tank
LS3	Level switch gravity tank
LSV1	Shut off valve, load sensing line pump P1
P1	Pump unit 1
P1V	Shut off valve, suction line pump P1
P3	Static pressure / cooling filtration pump
P3T	Test point
PT2	Pressure transmitter system pressure
PT3	Pressure transmitter static pressure
TH1	Thermometer main tank
TP3–TP9	Test point
TT1	Temperature sensor main tank
TV1	Temperature control valve
V1	Safety valve
V3	Proportional control valve
V6	Shuttle valve
V7	Counter balance valve
V8	Pressure relief valve (astern manoeuvre)
V11	Pressure valve for static pressure
V12	Selector valve for emergency control
V14	Pressure relief valve for emergency control
V16	Throttle valve
V17	Pressure valve for by-pass filter
V18	Shut off valve
V22	Shut off valve
V25	Shut off valve
V26	Shut off valve
V30	Check valve
V31	Nozzle
V34	Pressure relief valve
V36	Check valve
V39	Shut off valve
V40	Shut off valve
VS1	Check valve
VP	Check valve
X1	Shut off valve
X2	Shut off valve
X3	Shut off valve (oil sample)
Z	Shut off valve

Pressure valves setting values (MPa)

V1	13	(Safety valve)
PR	12	(Pressure regulator, pump)
LSR	2	(Load sensing regulator, pump)
V7	15,5	(Counter balance valve)
V8	6	
V11	0,15	
V14	6	
V17	0,5	
V34	0,4	

OD–Box connections

A	ISO G1/2"
B	ISO G1/2"
SP	ISO G3/4"
T	ISO G3/4"

External hoses (Yard supply)

Location	Inner dia. min	Design press. (MPa)
H1 to H1	3/4"	13
H2 to H2	1/4"	13
H3 to H3	1/2"	0,6
H4 to H4	1 1/4"	0,6
H5 to H5	1/2"	6
H6 to H6	1"	0,6
H7 to H7	1"	0,6

External tube (yard supply)

Location	Material	Inner dia. min (mm)	Thickness min (mm)	Design press. (MPa)
A to A	Steel	25	2	13
B to B	Steel	25	2	13
SP to SP	Steel	20	2	0,6
T	Steel	20	2	0,6
VV to VV	Steel	16	1,8	0,6
TT to TT	Steel	40	2	0,6
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–

Max tube length=10m, if longer please contact RR
Recomended tube material quality acc. to St 37.4
acc. to DIN 2391 C and DIN 1630
Min. tubewall thickness
acc. to LRS regulations part 5 chapt. 12 table 12.2.4

NOTE: THERE SHOULD ALWAYS BE FLEXIBLE HOSES ATTACHED TO THE COOLER

NOTE: OIL ALWAYS TO BE FILLED BY USING CONNECTION Z

Hydraulic system

Main data:
Max working pressure 13 MPa (pitch setting system) (Design pressure)
Max oil flow 35 lit/min, Total oil volume 160 lit
Calculated pitch setting time 14 sec. with one pumpunit in service

Hydraulic power pack

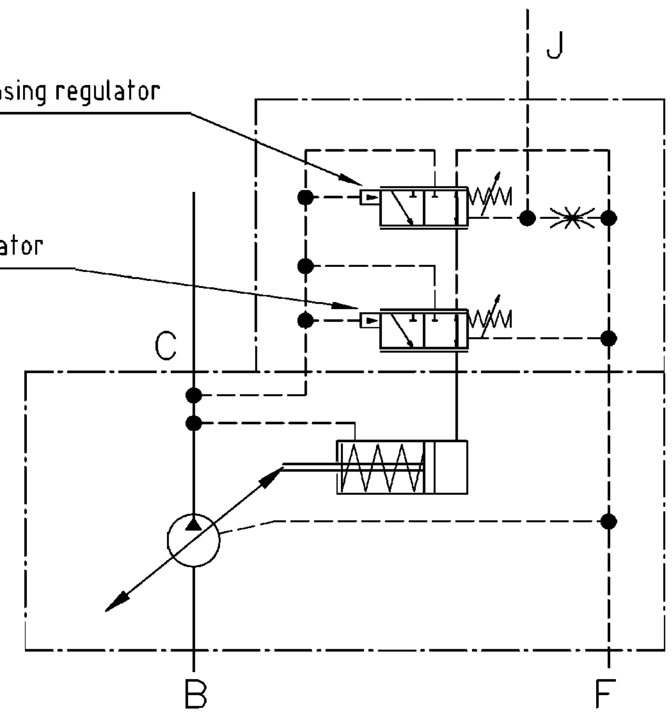
Pump unit P1
Load sensing variable piston pump, Vickers type PVM020
Capacity 35 lit/min at 1750 RPM

El–motor P1
Mez type 7BA132M04, 8,6kW at 1750 RPM, 600V, 60Hz, 3 Phases
Full load current 10,1 A, Starting current 68 A,

Pump unit P3
Gero double pump, Settima DG33 010 + 006
Capacity 17 + 10 lit/min at 1720 RPM

El–motor P3
Mez type 7AA90L04, 1,8 kW at 1720 RPM, 600V, 60Hz, 3 Phases
Full load current 2,3 A, Starting current 12 A,

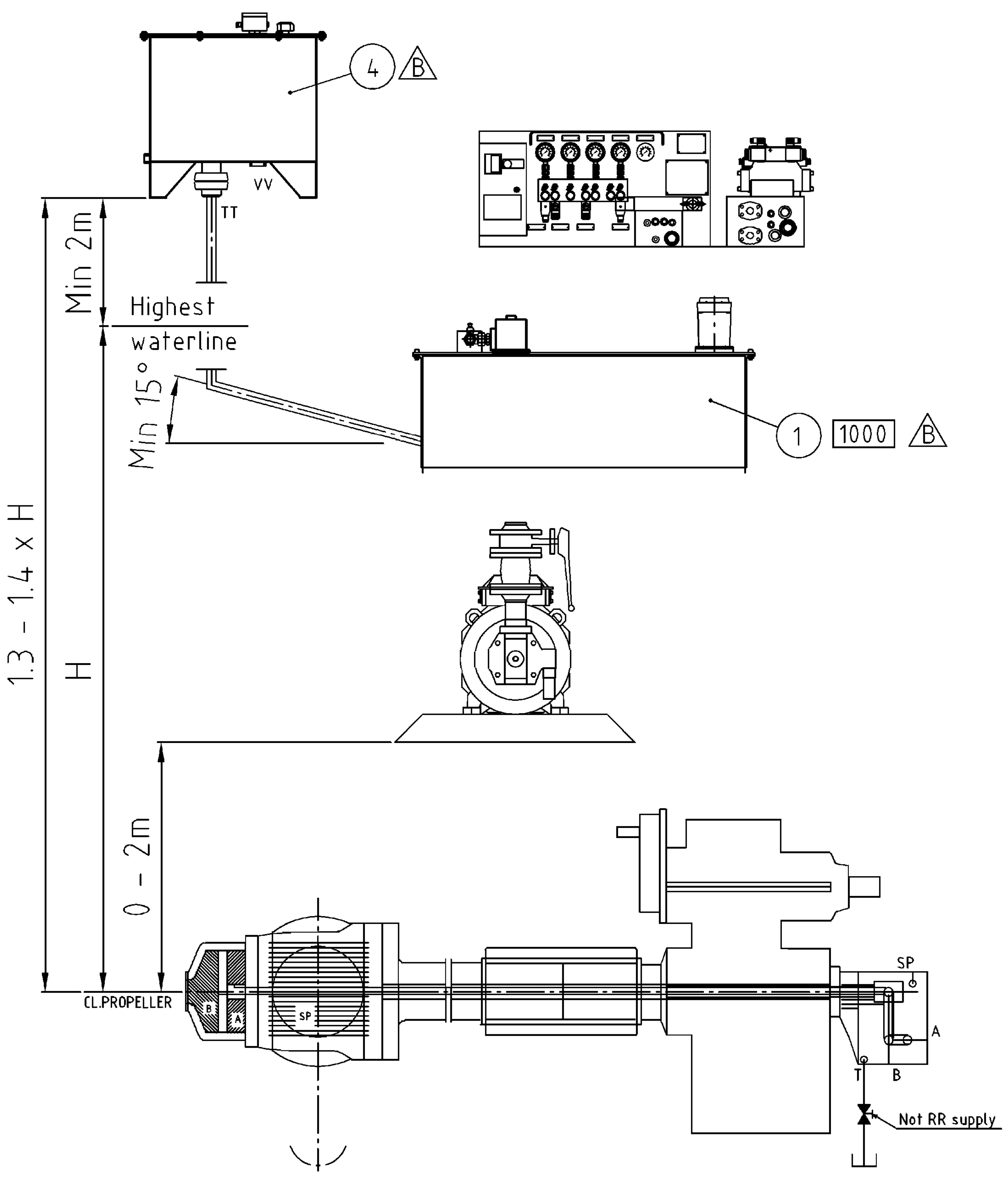
Cooler C1
Type H8A–IG16–9, Cooling capacity 3 kW, Cooling water req. 0.6 m3/h
Sea water of max 32 °C, dp water 5 kPa



LOAD SENSING VARIABLE DISPLACEMENT PISTON PUMP

Hydraulic diagram Main propeller Hub 55A/4D 35 FA-box	Checked: Har	Previous Drg:	
	Approved: Mnmn	Weight kg:	
Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date: Jnla 2010-04-26	Scale:	Format: A1 / Sheet: 2 of 2
	Drawing no: DMN200000689		Revision: D

Colour	
Hydraulic power pack	RAL 5024
Gravity oil tank	RAL 5024
Pump motor starter	RAL 7035



1001 Spare parts starter, see drawing RRM200007041

1000 Spare parts hydraulic, see drawing RRM200007040

Plant	Order No./Prod.gr. No.	Tot. Weight kg
		Surface texture ISO/R 1302 Ra um

Hydraulic system assembly
Main propeller
Hub 55 A/4D - 35FA

Checked: Har	Previous Drg:
Approved: Mnmn	Weight kg:

Rolls-Royce

Rolls-Royce AB
Propulsion Kristinehamn

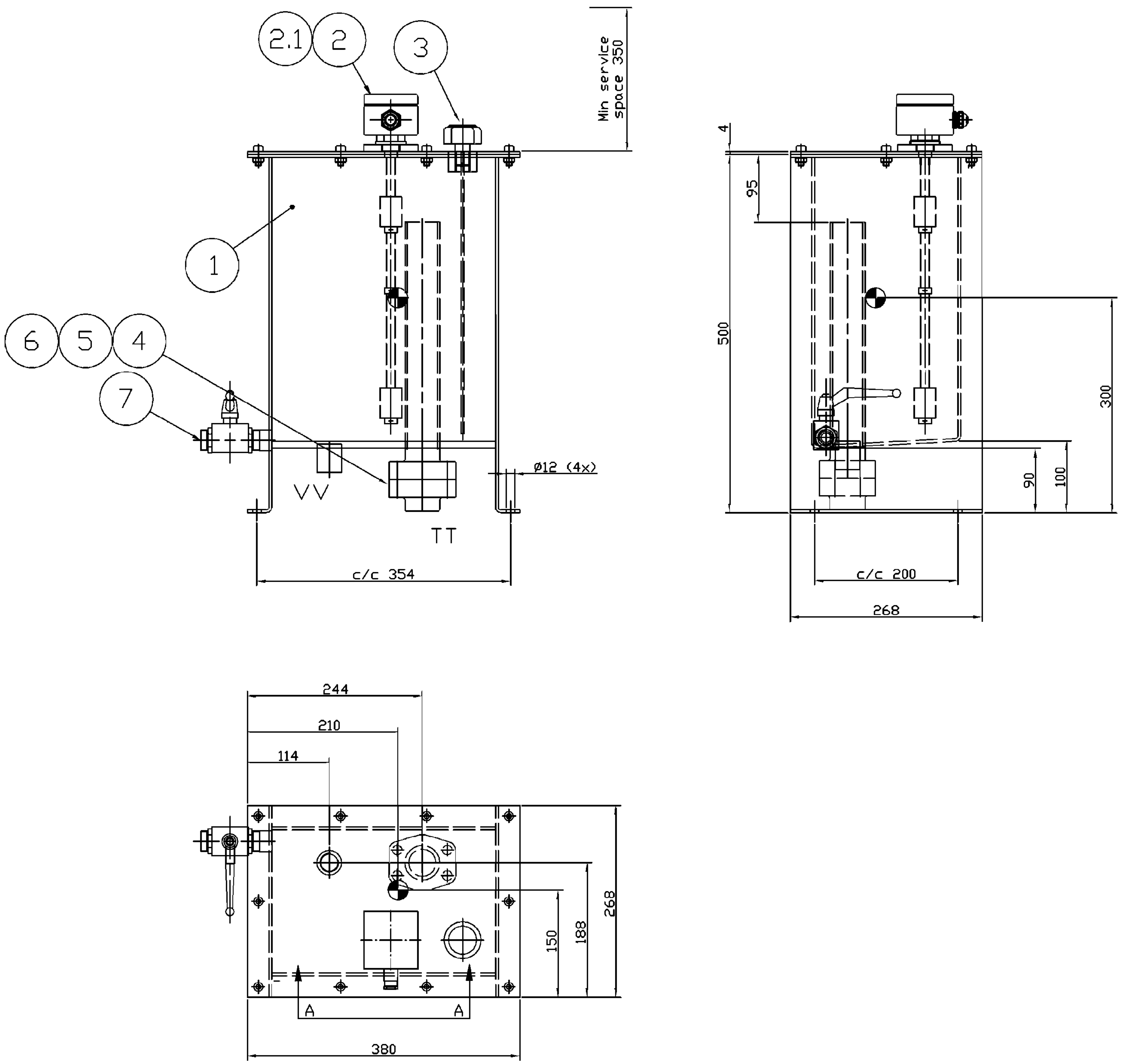
Origin. / Date:	Scale:	Format:	Sheet:
Jnla 2010-04-27		A2	1 of 1
Drawing no: RRM200007036			Revision: B

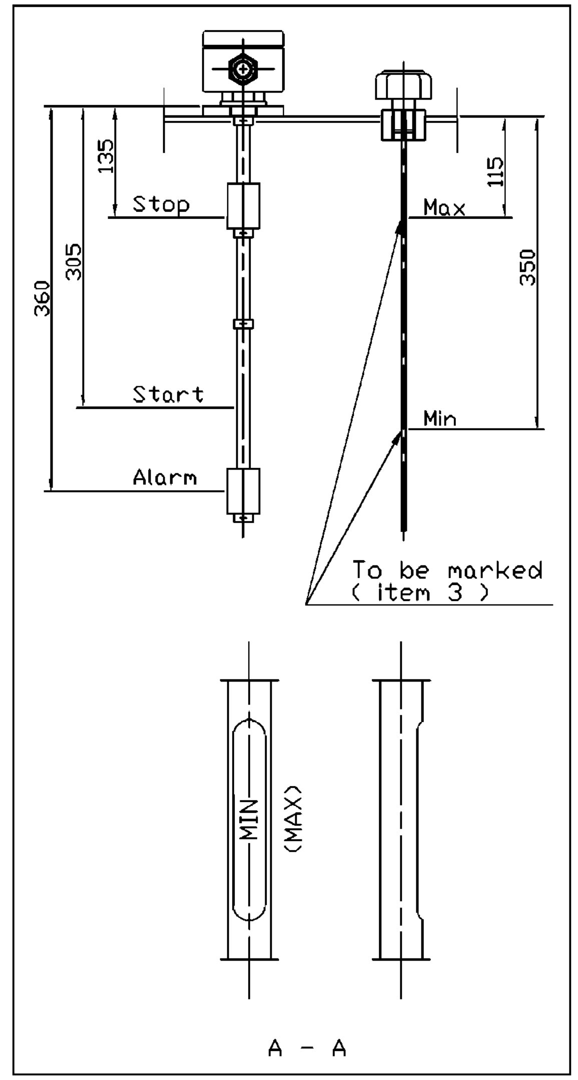
Access List

RR AB'S Info. Class: LIMITED

External Bom Report

Item ID/Rev	Name	Item State	Size	
RRM200007036/B	Hydraulic System	Unit	55A/4D-35FA	
Sub-Assembly/Part				
Seq No	**Qty**	**Item ID/Rev**	**Name**	**Item State**
1	1	RRM200007037/D	Hydraulic Power Pack	Assembly
2	1	RRM200007038/A	Starter	Detail
3	1	RRM200007039/B	Starter	Detail
4	1	RRM200011521/A	Gravity Tank	Assembly





Note:
Total weight incl. oil about 42 kg.
Total weight excl. oil about 25 kg.
"VV" gravity tank pressure ISO G 3/4.
"TT" overflow tube SAE 1 1/2".

Item	Qty	Description	Reference	Material	Remark
8	-	Colour			See hydraulic diagram
7	1	Shut-off valve 1/2"	8090-08-08 DN15		Specma
6	1	O-ring	47,22x3,53		Specma
5	4	Hex. socket cap screw	M12x45	12,9	ISO 4762
4	1	Flange for welding	AFS-106ST	48,5x38	Specma
3	1	Air breather whit dip stick	SES2-M-500		Parker
2.1	1	Adapter	G8113		Specma
2	1	Level switch	UNS2000-S-VA/T1-KLS2-BN30-L3/3		Barksdale
1	1	Oil tank 20 lit.	G09179		Specma

General tolerances	Sharp edges broken	Surface roughness	Fillet radii	Weight (kg)
ISO 2768-mH	0,2 - 0,5	ISO/R 1302 Ra µm	R 0,8 - 1,6	-

Acess List

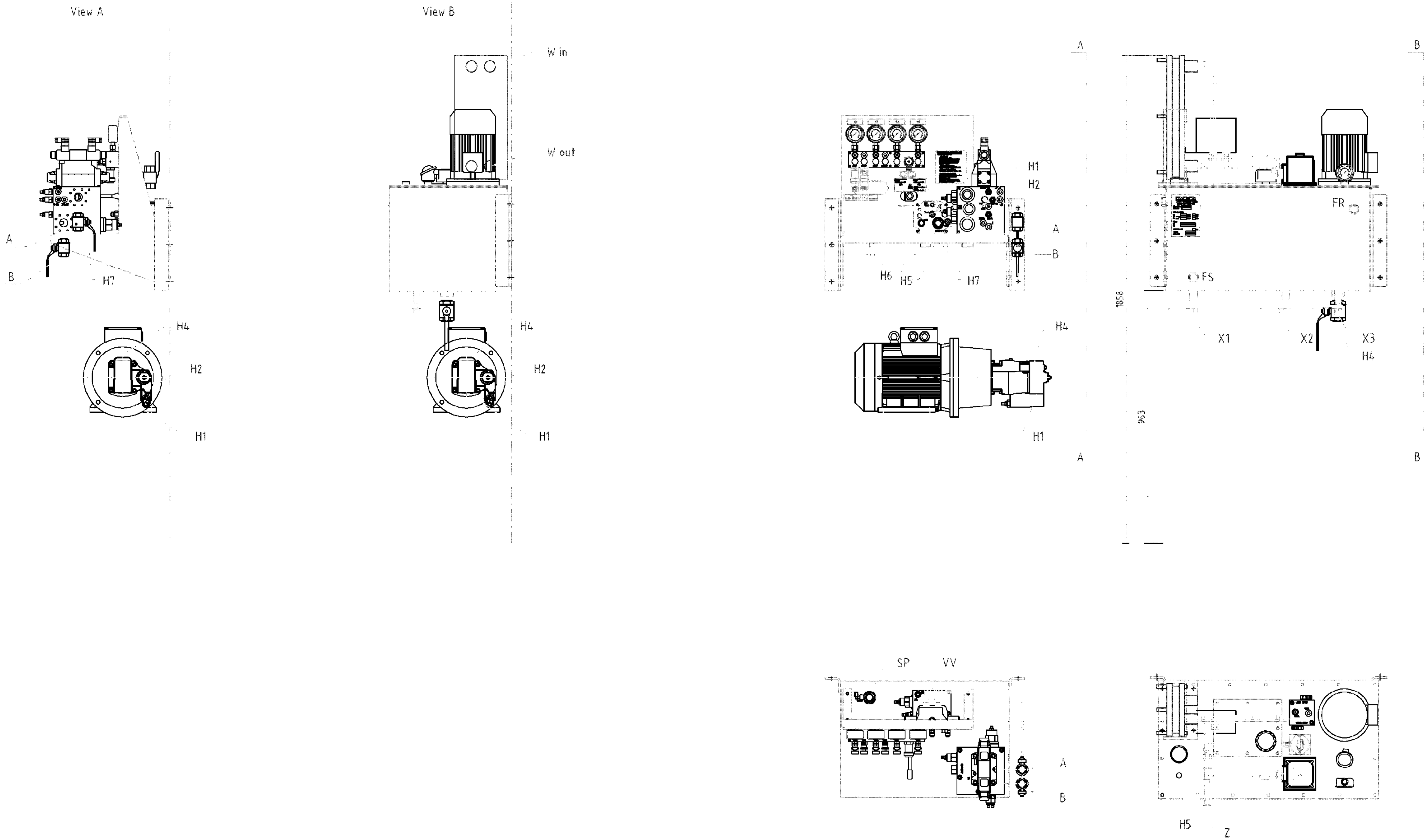
Hydraulic System
Main propeller
Gravity tank 20 lit.

Rolls-Royce
Rolls-Royce AB
S-681 29 KRISTINEHAMN

Origin. / Date:	Scale:	Format:	Sheet:
TAN 2010-10-12	1:5	A2	1 of 1

Drawing no:	Revision:
RRM200011521	A

RR AB'S Info. Class: LIMITED

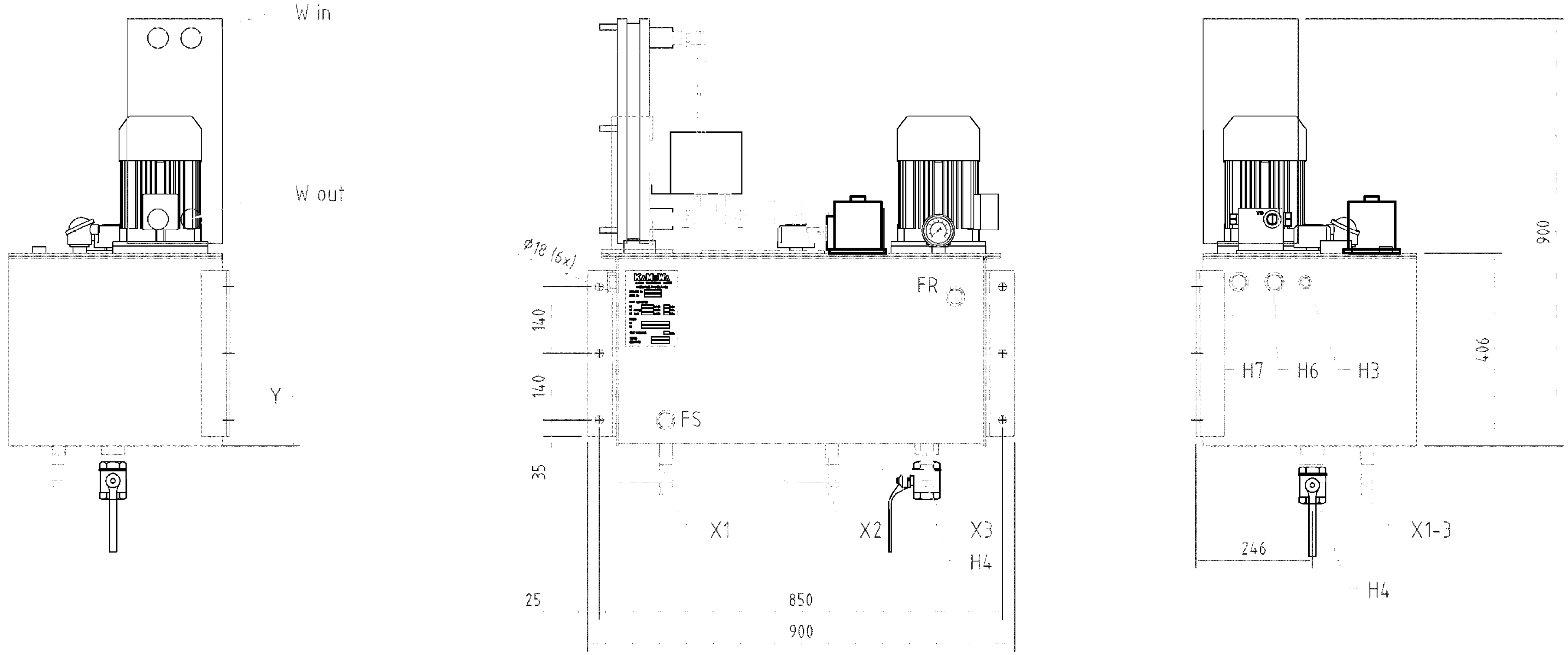


Hydraulic System
Main Propulsion
Powerpack

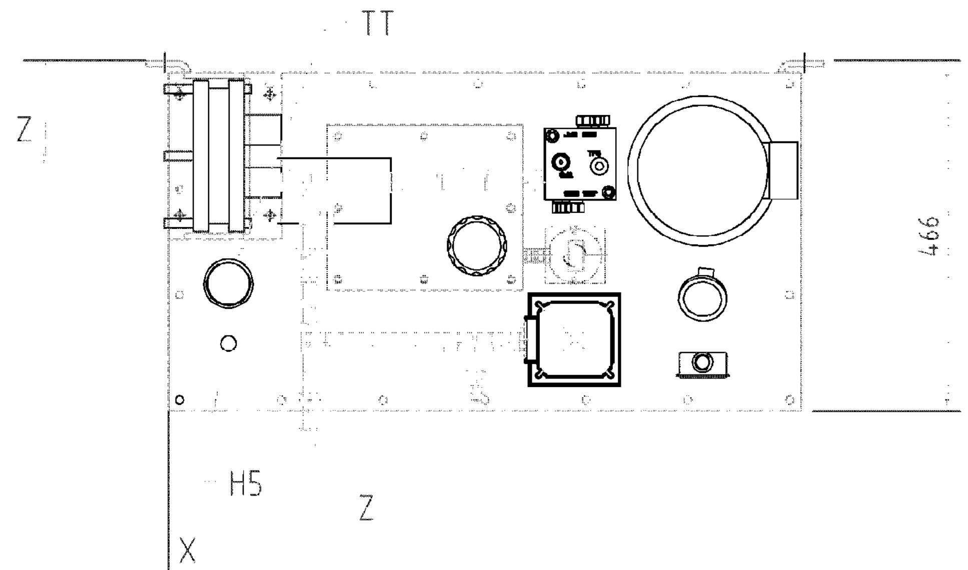
Rolls-Royce

RRM200007037

d



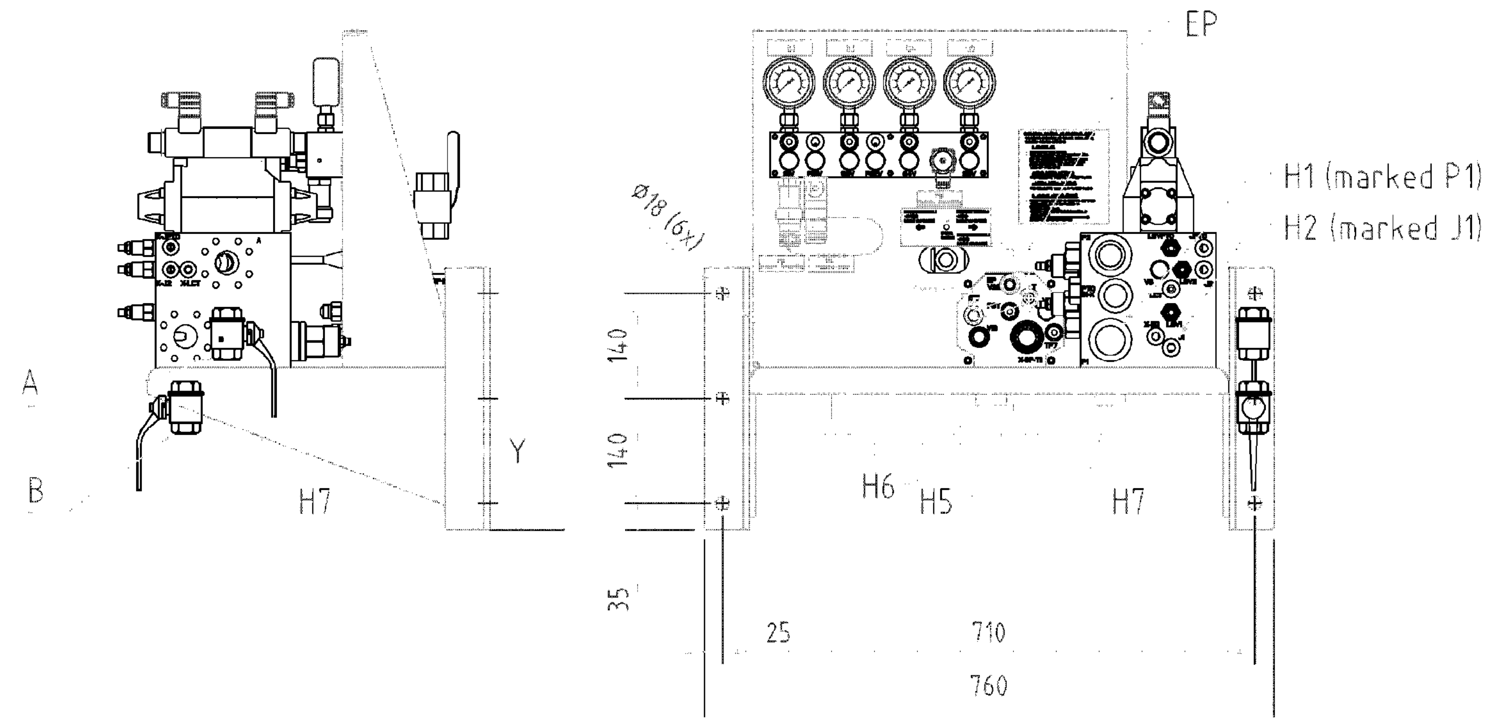
Connection	Size	X	Y	Z
TT	G 2"	80	435	295
C1, Water In	G 3/4"	150	860	90
C1, Water Out	G 3/4"	150	480	90
Z	G 3/4"	190	435	490
X1	G 1/2"	135	-100	360
X2	G 1/2"	485	-100	360
X3	G 1/2"	685	-100	360
FS	G 1"	135	55	100
FR	G 1"	745	315	335
H3	G 1/2"	15	345	230
H4	G 1 1/4"	685	-120	245
H5	G 1/2"	80	435	375
H6	G 1"	15	345	165
H7	G 1"	15	345	90

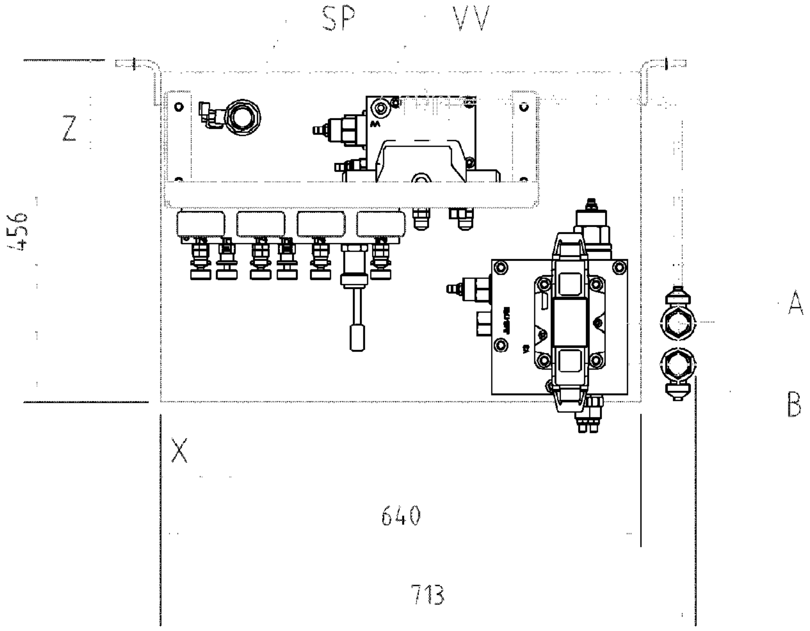


Hydraulic System
Power pack

Rolls-Royce

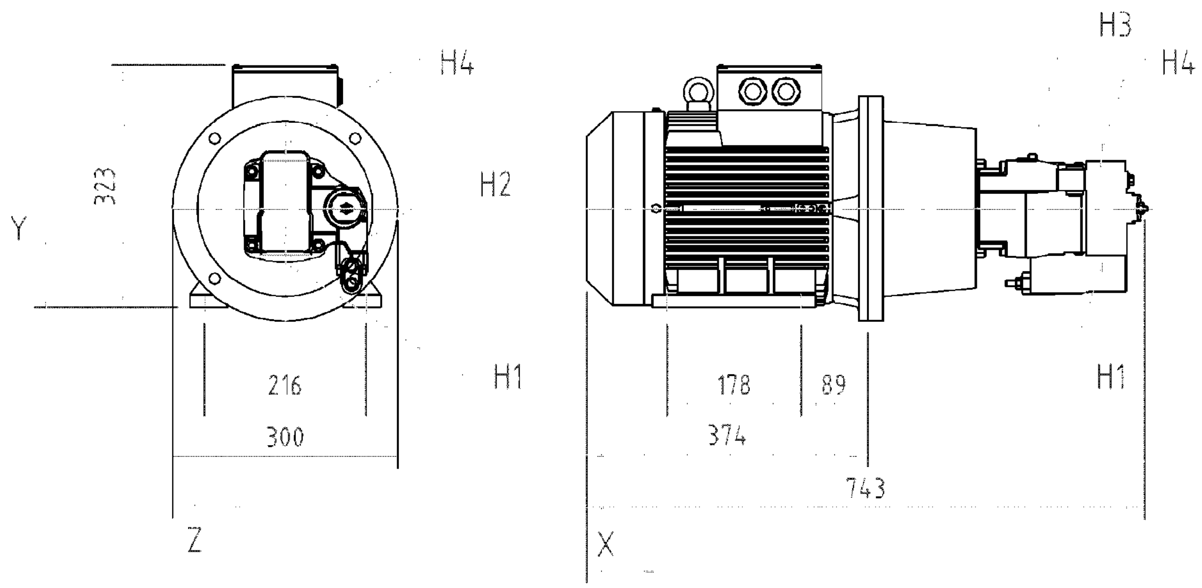
RRM200007037
d





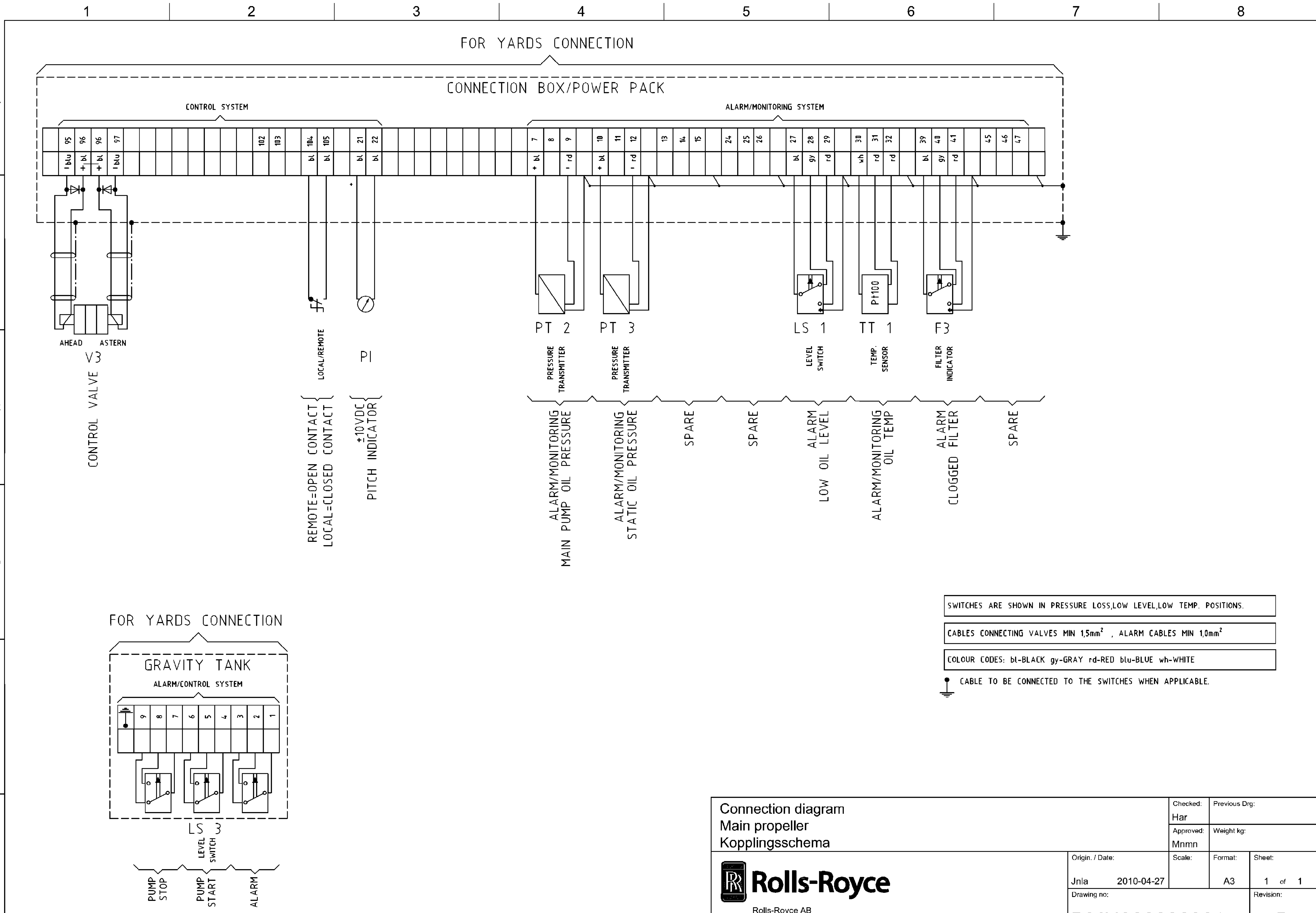
Connection	Size	X	Y	Z
A	G 1"	690	225	350
B	G 1"	690	180	405
SP	G 1"	110	475	75
VV	G 3/8"	295	340	65
EP	G 3/8"	350	325	265
H1	G 3/4"	480	255	445
H2	G 1/4"	565	245	445
H5	G 1/2"	395	165	120
H6	G 1"	325	165	120
H7	G 1"	480	165	305

Connection	Size	X	Y	Z
H1	G 3/4"	690	70	150
H2	G 1/4"	690	90	260
H3	G 1/2"	570	200	150
H4	SAE 1 1/4"	490	195	150



Rolls-Royce

RRM200007037



SWITCHES ARE SHOWN IN PRESSURE LOSS,LOW LEVEL,LOW TEMP. POSITIONS.

CABLES CONNECTING VALVES MIN 1,5mm², ALARM CABLES MIN 1,0mm²

COLOUR CODES: bl-BLACK gy-GRAY rd-RED blu-BLUE wh-WHITE

CABLE TO BE CONNECTED TO THE SWITCHES WHEN APPLICABLE.

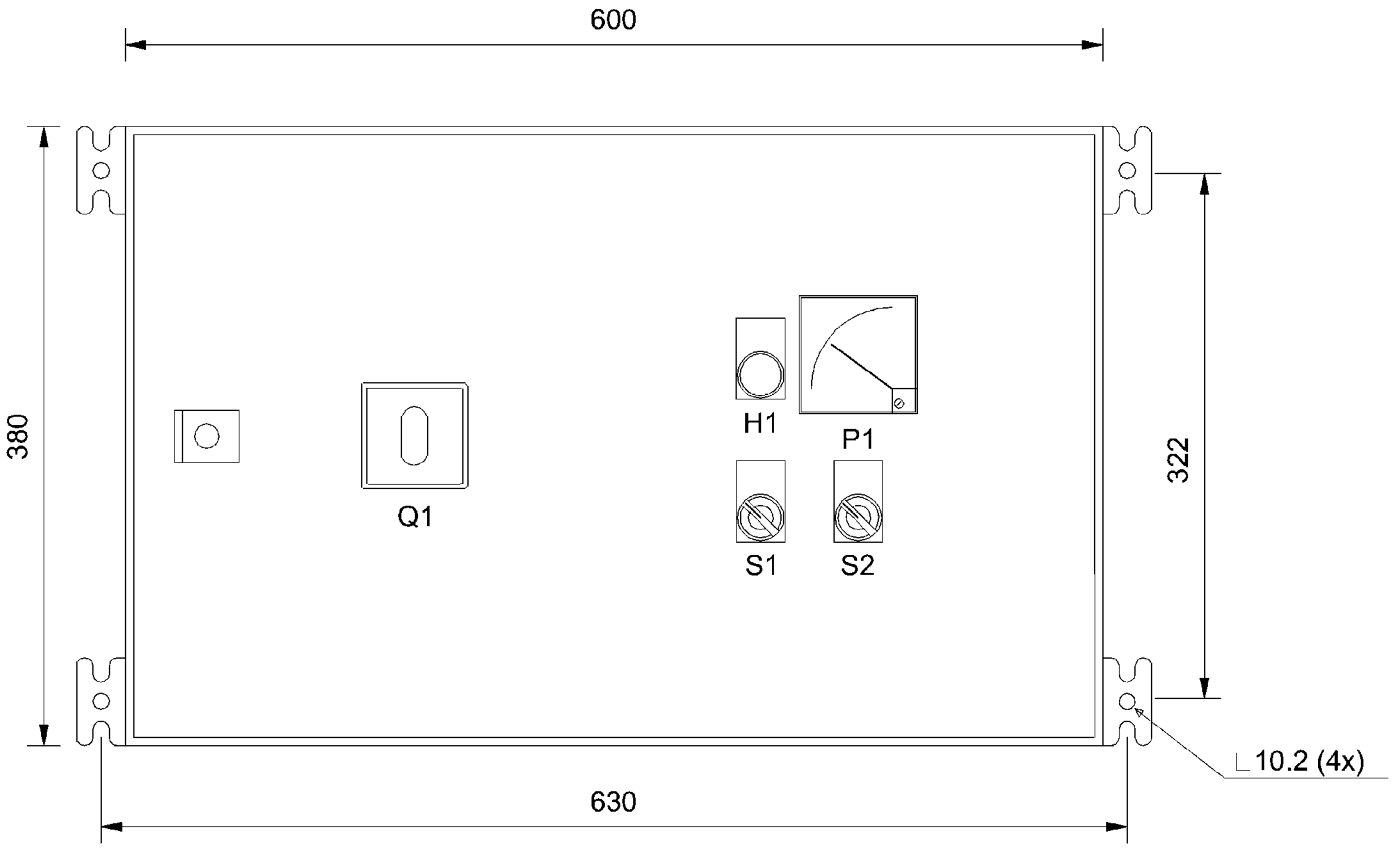
Connection diagram Main propeller Kopplingsschema		Checked: Har	Previous Drg:	
		Approved: Mnmn	Weight kg:	
Rolls-Royce Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date: Jnla 2010-04-27	Scale:	Format: A3	Sheet: 1 of 1
	Drawing no: DMN200000981			Revision: B

Acess List

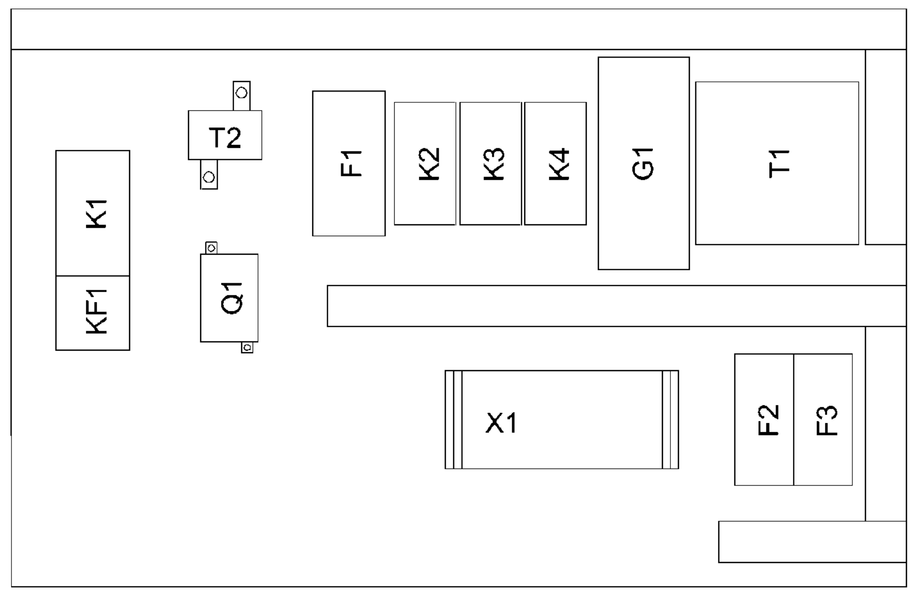
RR AB'S Info. Class: LIMITED

1 2 3 4 5 6 7 8

A B C D E F



DEPTH: 210mm



ELEKTROMONTAGE

Revis.	Revision comprises	Date	Made by	Checked	Approved

HYDRAULIC SYSTEM
MAIN PROPELLER
PUMP MOTOR STARTER P1/P2

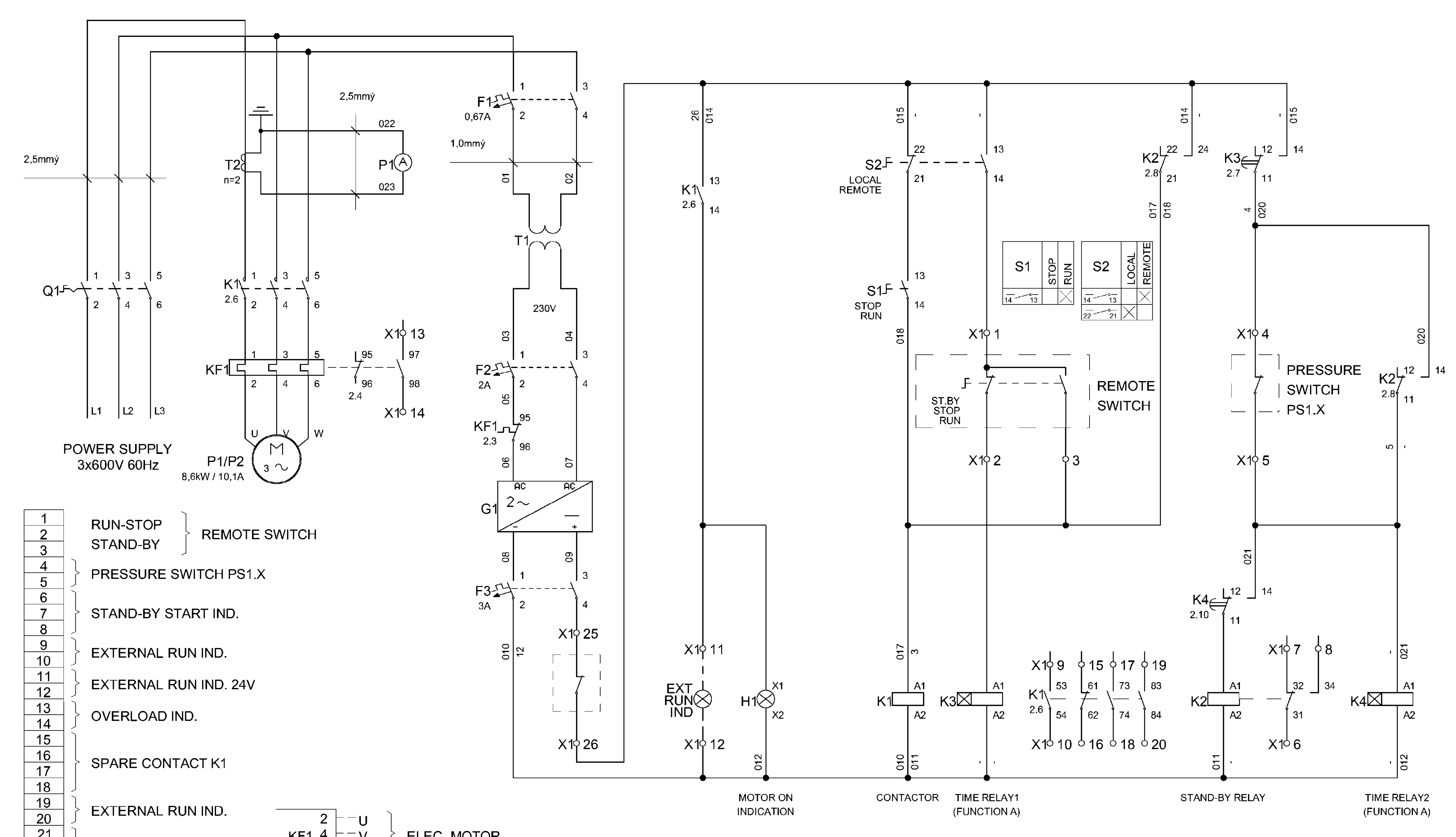
Checked: SGR	Previous Drg:	
Approved: LBE	Weight kg: ~25 Kg	
Origin. / Date: MLI / 10.05.05	Scale:	Format: A3
Sheet: 1 of 4		
Drawing no: RRM200007038	Revision: A	

Rolls-Royce

Rolls-Royce AB
Propulsion Kristinehamn

Acess List

RR AB'S info. Class: LIMITED



1	RUN-STOP
2	STAND-BY
3	(1–3: REMOTE SWITCH)
4	PRESSURE SWITCH PS1.X
5	
6	STAND-BY START IND.
7	
8	
9	EXTERNAL RUN IND.
10	
11	EXTERNAL RUN IND. 24V
12	
13	OVERLOAD IND.
14	
15	SPARE CONTACT K1
16	
17	
18	
19	EXTERNAL RUN IND.
20	
21	SPARE TERMINALS
22	
23	
24	
25	EMERGENCY STOP
26	

KF1	2	U	ELEC. MOTOR
	4	V	
	6	W	
Q1	2	L1	POWER SUPPLY
	4	L2	
	6	L3	

H.ONo:

ELEKTROMONTAGE

HYDRAULIC SYSTEM
MAIN PROPELLER
PUMP MOTOR STARTER P1/P2

Checked:	Previous Drg.		
SGR			
Approved: LBE	Weight kg: ~25 Kg		
Origin. / Date: MLI / 10.05.05	Scale:	Format: A3	Sheet: 2 of 4
Drawing no: RRM200007038			Revision: A

Rolls-Royce
Rolls-Royce AB
Propulsion Kristinehamn

Revis.	Revision comprises	Date	Made by	Checked	Approved

Acess List

RR AB'S Info. Class: LIMITED

Item.	Quant.	Description	Type	Manufacturer	Note
	1	CABINET 600X380X210	AE1039.500	RITTAL	
	4	WALL BRACKETS	SZ2508/4	RITTAL	
F1	1	MOTOR CIRCUIT BR. 0,63-1A	GV2RT05	TELEMECANIQUE	
F2	1	MINIATURE CIRCUIT BREAKER	C60N 2P C2A	MERLIN GERIN	
F3	1	MINIATURE CIRCUIT BREKAER	C32H DC 2P C3A	MERLIN GERIN	
G1	1	POWER SUPPLY 230/24V 3A	CP SNT 70W 24V 3A	WEIDMšLLER	
H1	1	LENSE YELLOW LED	ZB4BV053	TELEMECANIQUE	
H1	1	YELLOW LED PILOT LIGHT BODY	ZB4BVB5	TELEMECANIQUE	
K1	1	CONTACTOR 18A 24VDC	LC1D18BD	TELEMECANIQUE	
K1	1	AUX. CONTACT BLOCK 3NO+1NC	LADN31	TELEMECANIQUE	
K2	1	RELAY 3-POLE 24VDC	C3A30D24D	RELECO	
K2	1	SOCKET FOR 11-PIN RELAY	S3MP	RELECO	
K3	1	MULTIFUNCTIONAL TIME RELAY	PU2R3	CROUZET	
K3	1	SOCKET FOR 11-PIN RELAY	S3MP	RELECO	
K4	1	MULTIFUNCTIONAL TIME RELAY	PU2R3	CROUZET	
K4	1	SOCKET FOR 11-PIN RELAY	S3MP	RELECO	
KF1	1	OVERCURRENT RELAY 12-18A	LRD21	TELEMECANIQUE	
P1	1	AMMETER	IQ72 25/5A	CEWE INSTRUMENT	
Q1	1	LOAD BREAK SWITCH 40A 3P	OT 40 F3	ABB CONTROL	
Q1	1	HANDLE	OHBS2AJ	ABB CONTROL	
Q1	1	EXTENDED SHAFT 330mm	OXS6X330	ABB CONTROL	
S1	1	HANDLE 2-POS, BLACK	ZB4BD2	TELEMECANIQUE	
S1	1	CONTACT BODY 1NO	ZB4BZ101	TELEMECANIQUE	
S2	1	HANDLE 2-POS, BLACK	ZB4BD2	TELEMECANIQUE	
S2	1	CONTACT BODY 1NO	ZB4BZ101	TELEMECANIQUE	
S2	2	COMPLEMENTARY BLOCK 1NC	ZBE102	TELEMECANIQUE	

ELEKTROMONTAGE

Revis.	Revision comprises	Date	Made by	Checked	Approved

HYDRAULIC SYSTEM
MAIN PROPELLER
PUMP MOTOR STARTER P1/P2

Checked: SGR
Previous Drg.
Approved: LBE
Weight kg: ~25 Kg

Rolls-Royce
Rolls-Royce AB
Propulsion Kristinehamn

Origin. / Date: MLI / 10.05.05
Scale:
Format: A3
Sheet: 3 of 4
Drawing no: RRM200007038
Revision: A

Acess List
RR AB'S Info. Class: LIMITED

Item.	Quant.	Description	Type	Manufacturer	Note
T1	1	TRANSFORMER 690/230,24V	SUS120B 375+25VA	NORATEL	
T2	1	CURRENT TRANSFORMER	MAK 50/5A 45/14	CEWE INSTRUMENT	
X1	26	TERMINAL 2,5mm	WDU 2,5	WEIDMšLLER	

ELEKTROMONTAGE

HYDRAULIC SYSTEM
MAIN PROPELLER
PUMP MOTOR STARTER P1/P2

Rolls-Royce

Rolls-Royce AB
Propulsion Kristinehamn

Checked: SGR	Previous Drg.
Approved: LBE	Weight kg: ~25 Kg

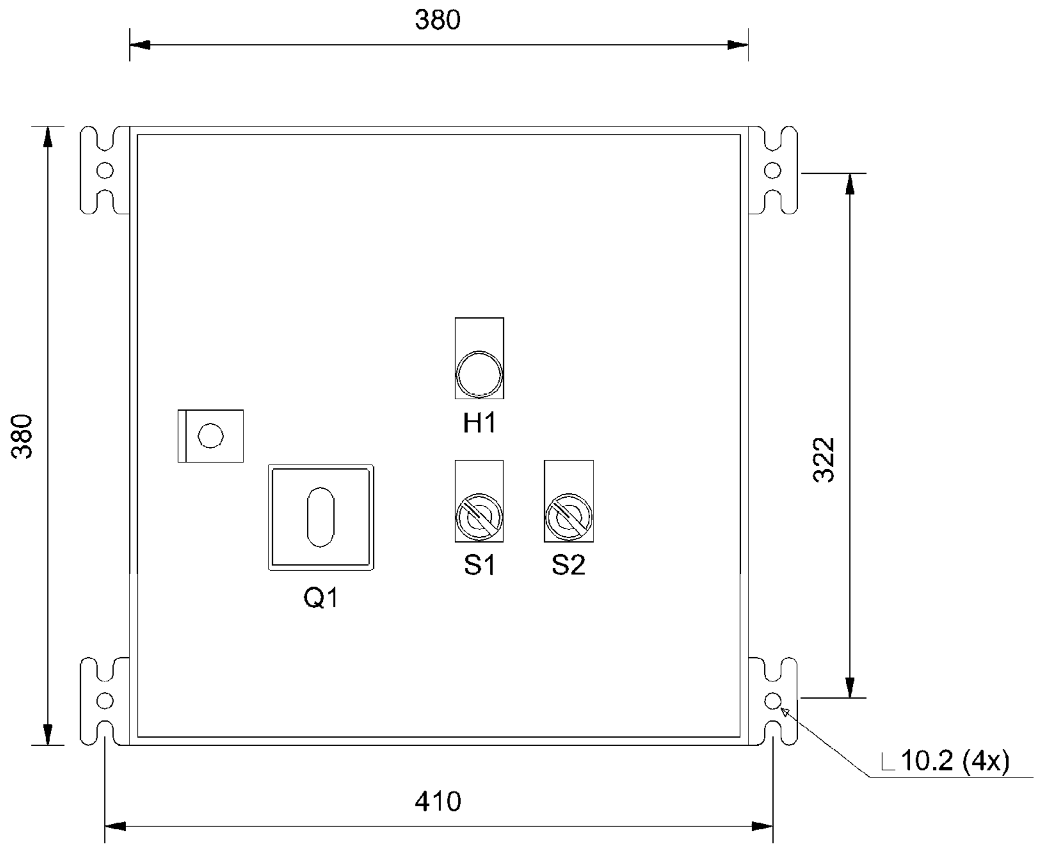
Origin. / Date:	Scale:	Format:	Sheet:
MLI / 10.05.05		A3	4 of 4

Drawing no:	Revision:
RRM200007038	A

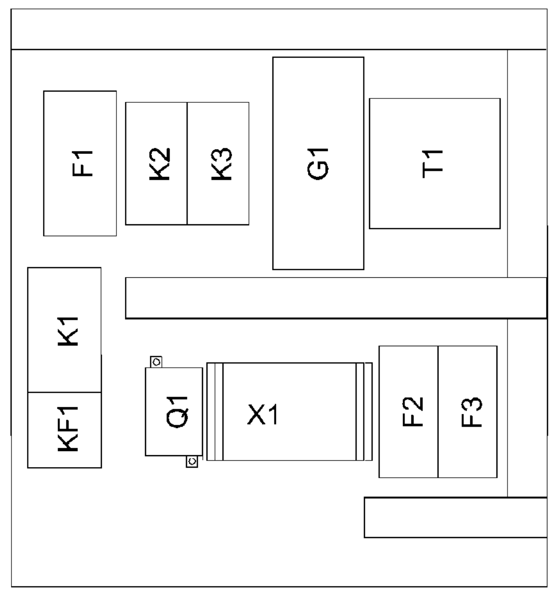
Revis.	Revision comprises	Date	Made by	Checked	Approved

Acess List

RR AB'S Info. Class: LIMITED



DEPTH: 210mm



ELEKTROMONTAGE

Revis.	Revision comprises	Date	Made by	Checked	Approved
B	Gravity tank added	10.10.19	Mikael Lindvall	Leif Bengtsson	Stefan Gr"nlund

HYDRAULIC SYSTEM
MAIN PROPELLER
PUMP MOTOR STARTER P3

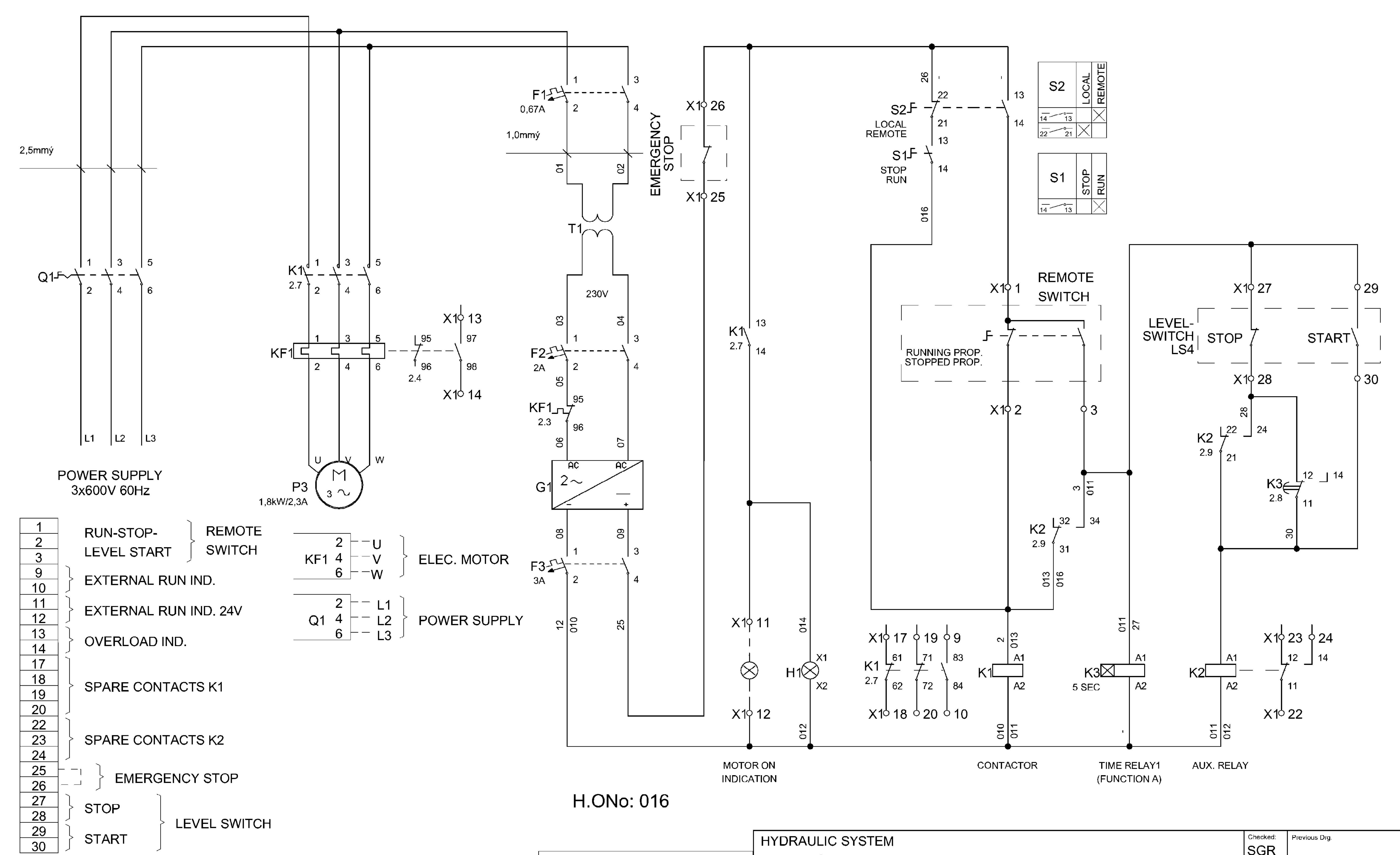
Checked: SGR	Previous Drg:			
Approved: LBE	Weight kg: ~17 Kg			
Origin. / Date: MLI / 10.05.05	Scale:	Format: A3	Sheet: 1 of 3	
Drawing no: RRM200007039			Revision: B	

Rolls-Royce

Rolls-Royce AB
Propulsion Kristinehamn

Acess List

RR AB'S info. Class: LIMITED



H.ONo: 016

NOTE: IF EMERGENCY STOP
NOT IS USED, CONNECT
25 TO 26

ELEKTROMONTAGE

Revis.	Revision comprises	Date	Made by	Checked	Approved

HYDRAULIC SYSTEM
MAIN PROPELLER
PUMP MOTOR STARTER P3

Checked: SGR | Previous Drg:
Approved: LBE | Weight kg: ~17 Kg

Rolls-Royce

Rolls-Royce AB
Propulsion Kristinehamn

Origin. / Date: MLI / 10.05.05 | Scale: | Format: A3 | Sheet: 2 of 3

Drawing no: RRM200007039 | Revision: B

Acess List

RR AB'S info. Class: LIMITED

Item.	Quant.	Description	Type	Manufacturer	Note
	1	CABINET 380x380x210	AE1380.500	RITTAL	
	4	WALL BRACKETS	SZ2508/4	RITTAL	
F1	1	MOTOR CIRCUIT BR. 0,63-1A	GV2RT05	TELEMECANIQUE	
F2	1	MINIATURE CIRCUIT BREAKER	C60N 2P C2A	MERLIN GERIN	
F3	1	MINIATURE CIRCUIT BREKAER	C60H DC 2P C3A	MERLIN GERIN	
G1	1	POWER SUPPLY 230/24V 3A	CP SNT 70W 24V 3A	WEIDMšLLER	
H1	1	LENSE YELLOW LED	ZB4BV053	TELEMECANIQUE	
H1	1	YELLOW LED PILOT LIGHT BODY	ZB4BVB5	TELEMECANIQUE	
K1	1	CONTACTOR 9A 24VDC	LC1D09BD	TELEMECANIQUE	
K1	1	AUX. CONTACT BLOCK 2NO+2NC	LADN22	TELEMECANIQUE	
K2	1	RELAY 3-POLE 24VDC	C3A30D24D	RELECO	
K2	1	SOCKET FOR 11-PIN RELAY	S3MP	RELECO	
K3	1	MULTIFUNCTIONAL TIME RELAY	PU2R3	CROUZET	
K3	1	SOCKET FOR 11-PIN RELAY	S3MP	RELECO	
KF1	1	OVERCURRENT RELAY 1,6-2,5A	LRD07	TELEMECANIQUE	
Q1	1	LOAD BREAK SWITCH 16A 3P	OT16F3	ABB CONTROL	
Q1	1	HANDLE	OHBS2AJ	ABB CONTROL	
Q1	1	EXTENDED SHAFT 330mm	OXS6X330	ABB CONTROL	
S1	1	HANDLE 2-POS, BLACK	ZB4BD2	TELEMECANIQUE	
S1	1	CONTACT BODY 1NO	ZB4BZ101	TELEMECANIQUE	
S2	1	HANDLE 2-POS, BLACK	ZB4BD2	TELEMECANIQUE	
S2	1	CONTACT BODY 1NO	ZB4BZ101	TELEMECANIQUE	
S2	1	COMPLEMENTARY BLOCK 1NC	ZBE102	TELEMECANIQUE	
T1	1	TRANSFORMER 690/230,24V	SUS120B 375+25VA	NORATEL	
X1	22	TERMINAL 2,5mm	WDU 2,5	WEIDMšLLER	

ELEKTROMONTAGE

Revis.	Revision comprises	Date	Made by	Checked	Approved

HYDRAULIC SYSTEM
MAIN PROPELLER
PUMP MOTOR STARTER P3

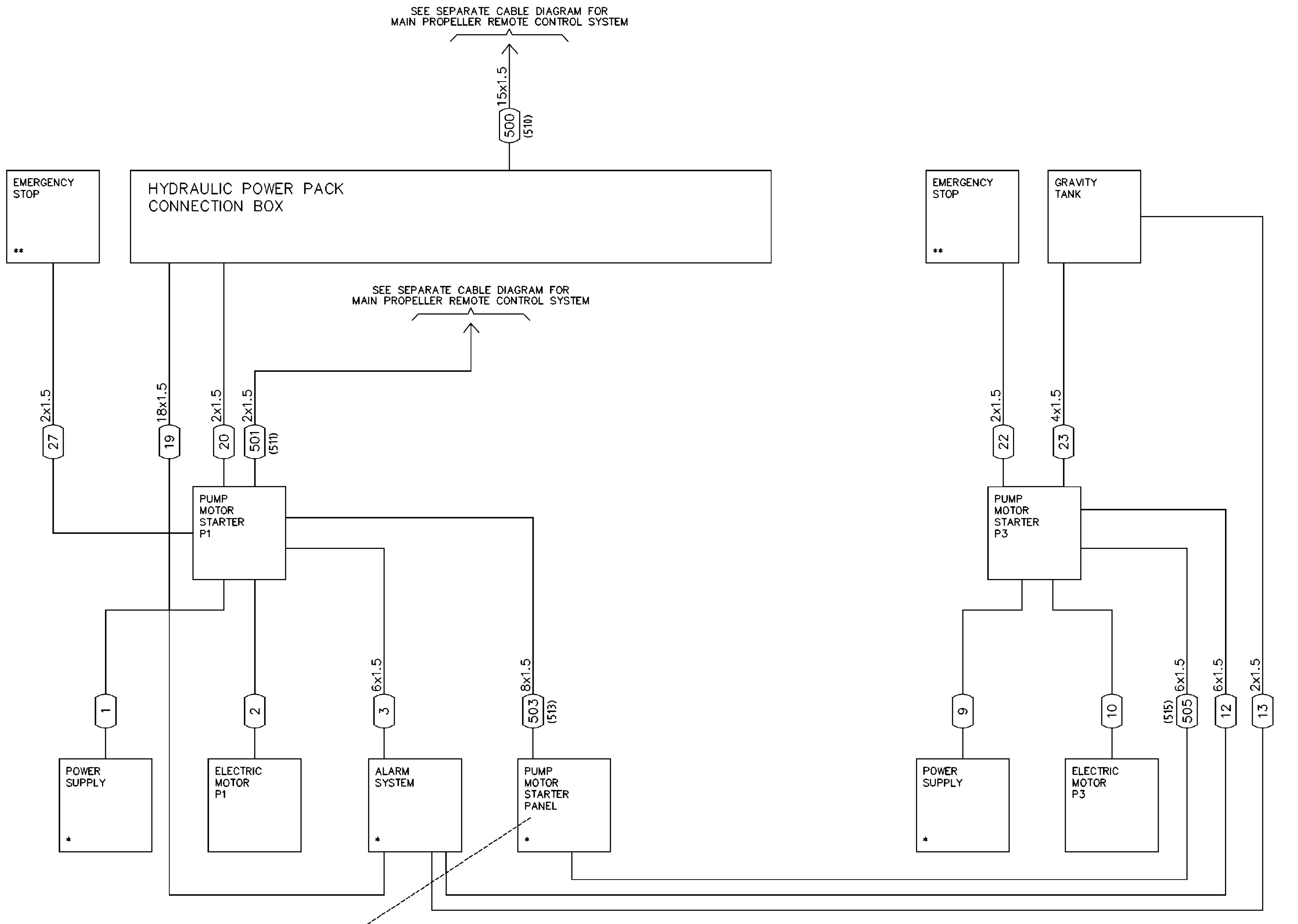
Checked: SGR
Previous Drg.
Approved: LBE
Weight kg: ~17 Kg

Rolls-Royce
Rolls-Royce AB
Propulsion Kristinehamn

Origin. / Date: MLI / 10.05.05
Scale:
Format: A3
Sheet: 3 of 3
Drawing no: RRM200007039
Revision: B

Acess List

RR AB'S Info. Class: LIMITED



NOTE! PANEL CAN BE SUPPLIED BY ROLLS-ROYCE
THEN THE CABLES WILL REFERED TO CABLE DIAGRAM
FOR MAIN PROPELLER REMOTE CONTROL SYSTEM

** = DEPENDING ON CLASSIFICATION SOCIETY THE EMERGENCY STOP IS NOT NEEDED

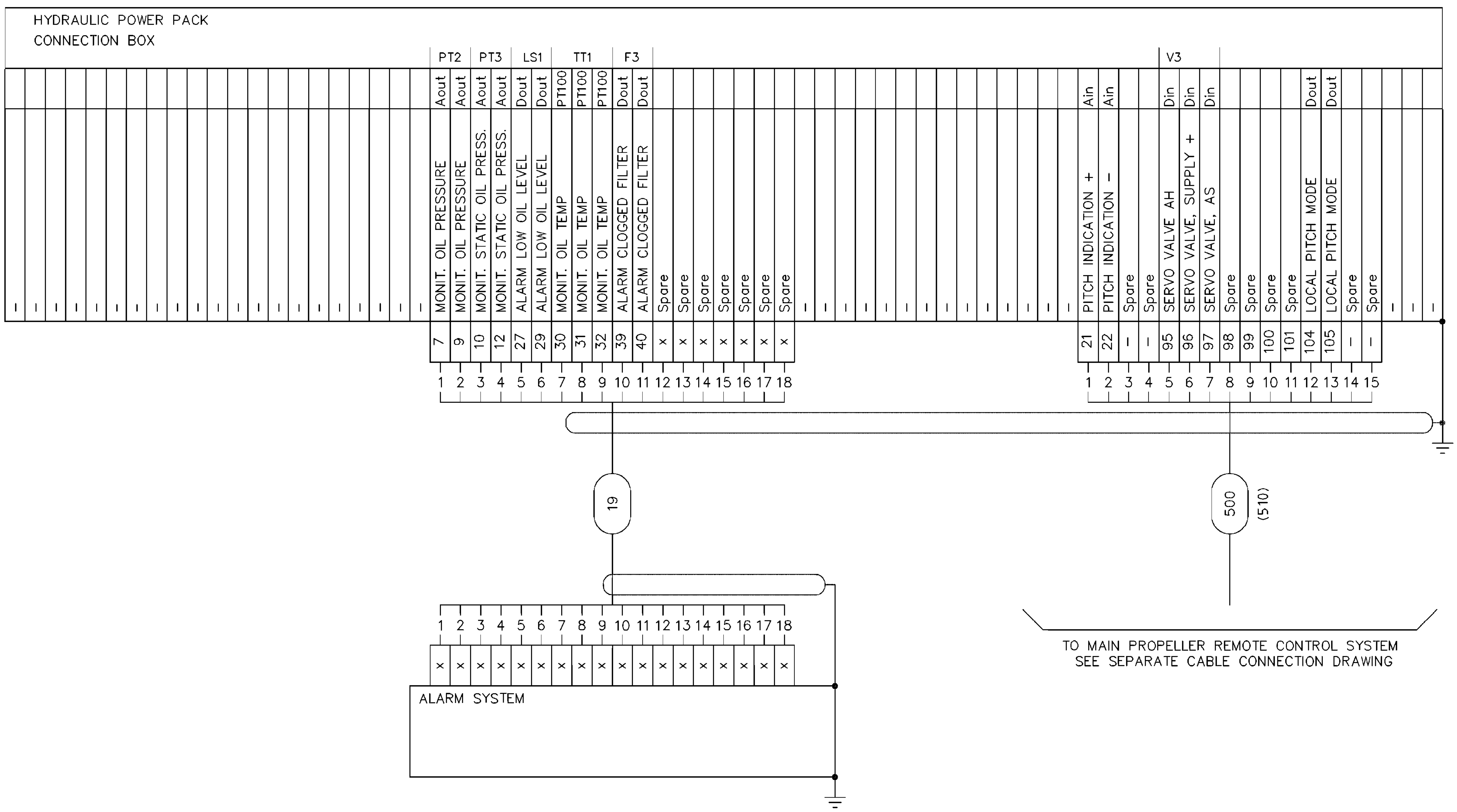
* = NOT ROLLS-ROYCE DELIVERY

THIS CABLE DRAWING SHOWS THE CABLES FOR ONE PROPELLER.
IF TWO PROPELLER THE OTHER PROPELLER TO BE CONNECTED EQUALLY.
IF TWIN PROPELLER CABLE NUMBERS 500, 501, 503, 505 ARE FOR PORT SIDE
AND 510, 511, 513, 515 ARE FOR STARBOARD SIDE.

Acess List

Cable drawing Main propeller			Checked: Har	Previous Drg:	
			Approved: Mnmn	Weight kg:	
Rolls-Royce Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date. Jnla 2010-04-28		Scale:	Format: A2	Sheet: 1 of 1
	Drawing no: DMN200000983				Revision: B

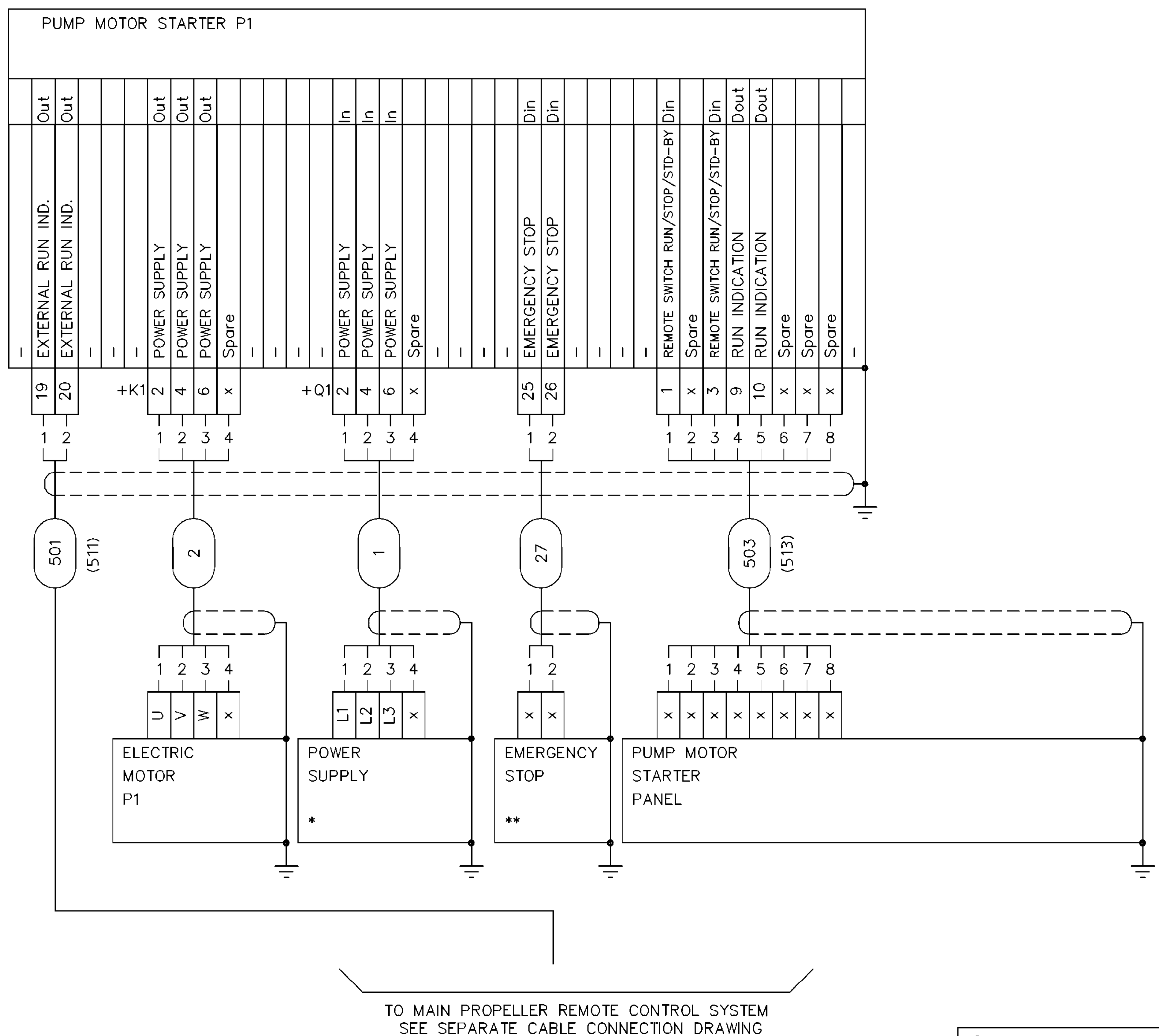
RR AB'S Info. Class: LIMITED



THIS CABLE CONNECTION DRAWINGS SHOWS CONNECTION FOR A ONE PROPELLER SYSTEM.
IF TWIN PROPELLER INSTALLED, THE PORT AND STBD PROPELLER SYSTEMS ARE CONNECTED EQUALLY.
IF TWIN PROPELLER CABLE NUMBERS 500, ARE FOR PORT SIDE
AND 510 ARE FOR STARBOARD SIDE.

Cable connection drawing Main propeller		Checked: Har	Previous Drg:		
		Approved: Mnmn	Weight kg:		
Rolls-Royce Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date: Jnla 2010-04-27	Scale:	Format: A3	Sheet: 1 of 4	
	Drawing no: DMN200000984			Revision: B	

Acess List



* NOT ROLLS ROYCE DELIVERY

** DEPENDING ON CLASSIFICATION SOCIETY THE EMERGENCY SWITCH IS NOT NEEDED.
IF SO CONNECT 25 TO 26

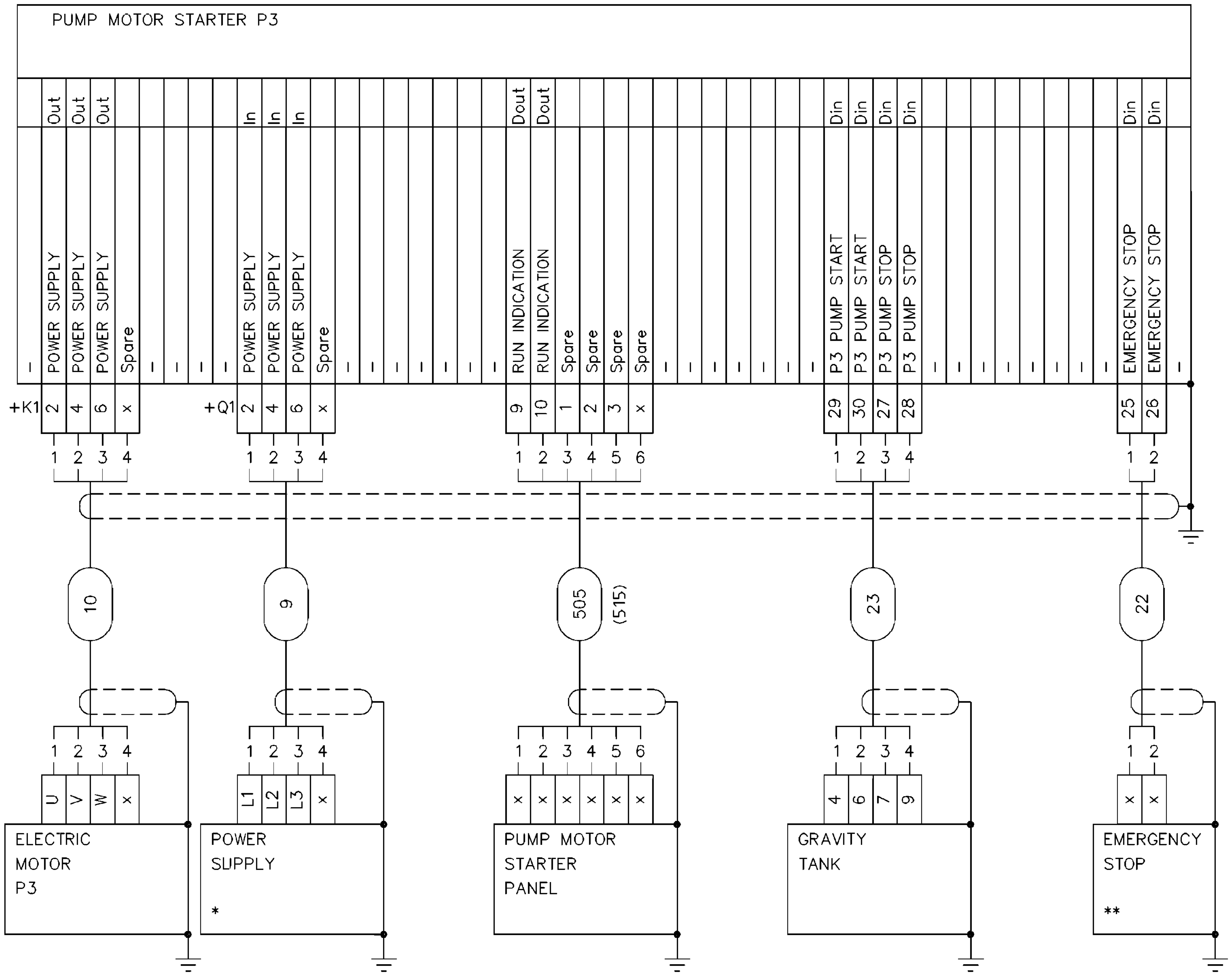
THIS CABLE CONNECTION DRAWINGS SHOWS CONNECTION FOR A ONE PROPELLER SYSTEM.
IF TWIN PROPELLER INSTALLED, THE PORT AND STBD PROPELLER SYSTEMS ARE CONNECTED EQUALLY.
IF TWIN PROPELLER CABLE NUMBERS 501, 503 ARE FOR PORT SIDE
AND 511, 513 ARE FOR STARBOARD SIDE.

Cable connection drawing
Main propeller

Checked: Har	Previous Drg:			
Approved: Mnmn	Weight kg:			
Origin. / Date: Jnla 2010-04-27	Scale:	Format: A3	Sheet: 2 of 4	
Drawing no: DMN200000984			Revision: B	

Rolls-Royce
Rolls-Royce AB
Propulsion Kristinehamn

Acess List
RR AB'S Info. Class: LIMITED

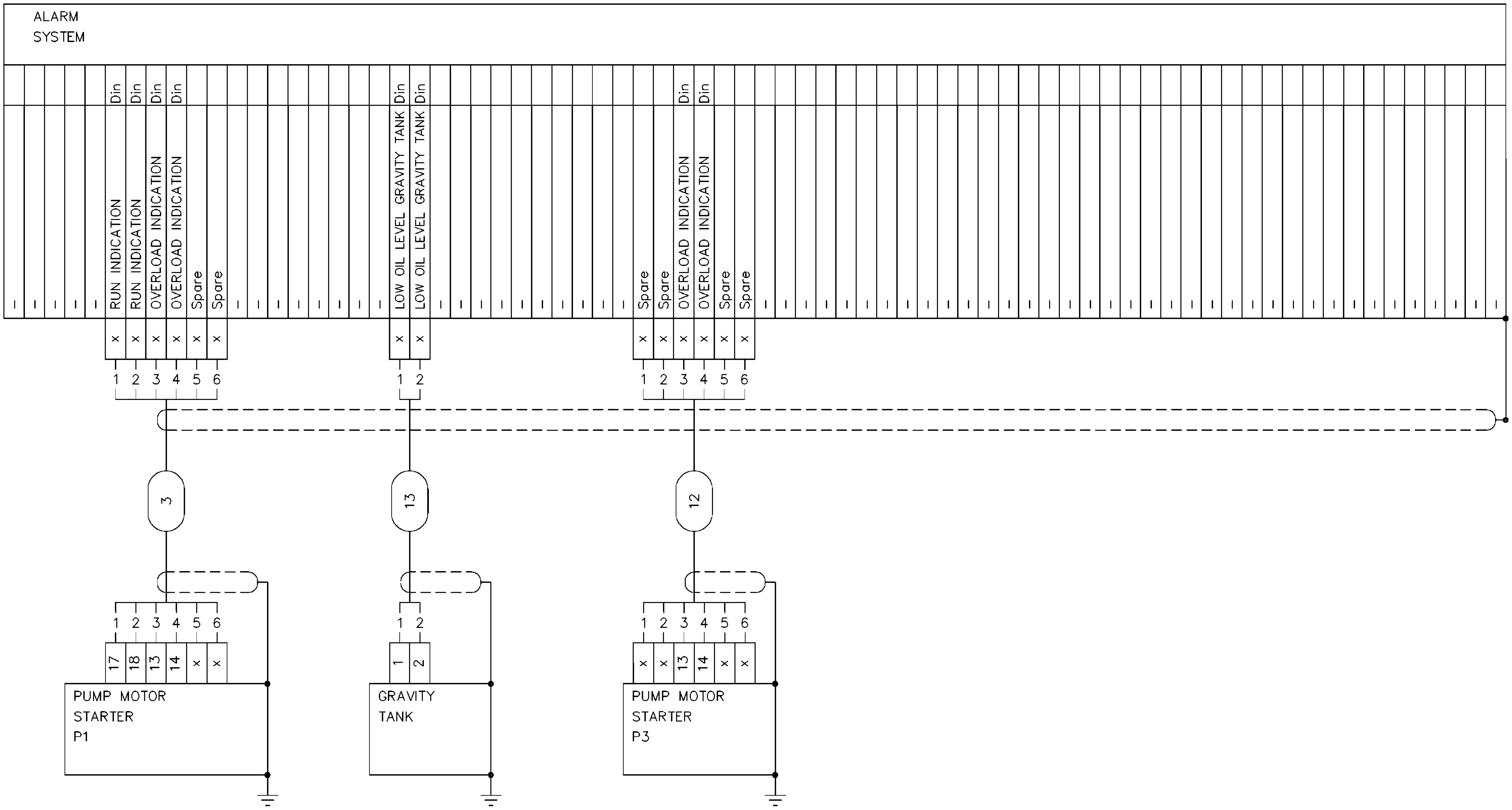


* NOT ROLLS ROYCE DELIVERY

** DEPENDING ON CLASSIFICATION SOCIETY THE EMRGENCY SWITCH IS NOT NEEDED.
IF SO CONNECT 25 TO 26.

THIS CABLE CONNECTION DRAWINGS SHOWS CONNECTION FOR A ONE PROPELLER SYSTEM.
IF TWIN PROPELLER INSTALLED, THE PORT AND STBD PROPELLER SYSTEMS ARE CONNECTED EQUALLY.
IF TWIN PROPELLER CABLE NUMBERS 505 ARE FOR PORT SIDE
AND 515 ARE FOR STARBOARD SIDE.

Cable connection drawing Main propeller	Checked: Har	Previous Drg:		
	Approved: Mnmn	Weight kg:		
Rolls-Royce Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date: Jnla 2010-04-27	Scale:	Format: A3	Sheet: 3 of 4
	Drawing no: DMN200000984			Revision: B



THIS CABLE CONNECTION DRAWINGS SHOWS CONNECTION FOR A ONE PROPELLER SYSTEM.
IF TWO PROPELLER INSTALLED, THE PORT AND STBD PROPELLER SYSTEMS ARE CONNECTED EQUALLY.

Cable connection drawing Main propeller		Checked: Har	Previous Drg:	
		Approved: Mnmn	Weight kg:	
Rolls-Royce Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date: Jnla 2010-04-27	Scale:	Format: A3	Sheet: 4 of 4
	Drawing no: DMN200000984			Revision: B

Acess List

RR AB'S Info. Class: LIMITED

No.	SUPERVISION OF	LOCATION	TO LOW	TO HIGH	TYPE	FUNCTION	MAKER	SETTING POINT	DELAY SEC.	NOTE
1										
2										
3										
4										
5										
6										
7										
8										
9										
10	Overload P1	PMS			R	Overload on pump motor starter for P1	R-R AB			NC
11										
12	Overload P3	PMS			R	Overload on pump motor starter for P3	R-R AB			NC
13										
14										
15										
16										
17	Pressure transmitter PT2	PP			A	Alarm/monitoring oil pressure in mainpump system	Hydac	low 0,8 MPa	10	4-20 mA (0-25MPa)
18	Pressure transmitter PT3	PP			A	Alarm/monitoring static oil pressure in hub	Hydac	low 0,08 MPa	10	4-20 mA (0-1,6MPa)
19										
20	Temperature sensor TT1	PP			S	Alarm/monitoring oil temperature	Thermotech	high 65°C	10	Pt100
21	Level switch LS1	PP	X		L	Alarm low oil level	Barksdale		10	NC
22	Level switch LS3	GT			L	Alarm low oil level, start, stop static pressure pump	Barksdale		10	NC, NO & NC
23										
24	Pressure switch F3	PP		X	P	Alarm clogged filter F3	Hydac	Fixed	10	NC
25										
26										

TYPE:
P=PRESSURE SWITCH
R=RELAY, VOLTAGE FREE CONTACT
L=LEVEL SWITCH
A=ANALOGIC TRANSMITTER
T=TEMPERATURE SWITCH
E=ELECTRIC SWITCH
D=DIFFERENTIAL PRESSURE SWITCH
S=TEMPERATURE SENSOR
M=ELECTRIC MOTOR
V=HYDRAULIC VALVE

LOCATION:
CU=CENTRAL UNIT CLOSED LOOP
PMS=PUMP MOTOR STARTER
PP=HYDRAULIC POWER PACK
DOT=DRAIN OIL TANK
GT=GRAVITY TANK
JCU=JOYSTICK CENTRAL UNIT
OD=OD-BOX

NOTE:
NO=NORMALY OPEN
NC=NORMALY CLOSED

Remote supervision
Main propeller
Alarmlista

Checked: Har
Previous Drg:
Approved: Mnmn
Weight kg:

Rolls-Royce
Rolls-Royce AB
Propulsion Kristinehamn

Origin. / Date: Jnla 2010-04-27
Scale:
Format: A3
Sheet: 1 of 1
Drawing no: DMN200000982
Revision: B

Acess List
RR AB'S Info. Class: LIMITED

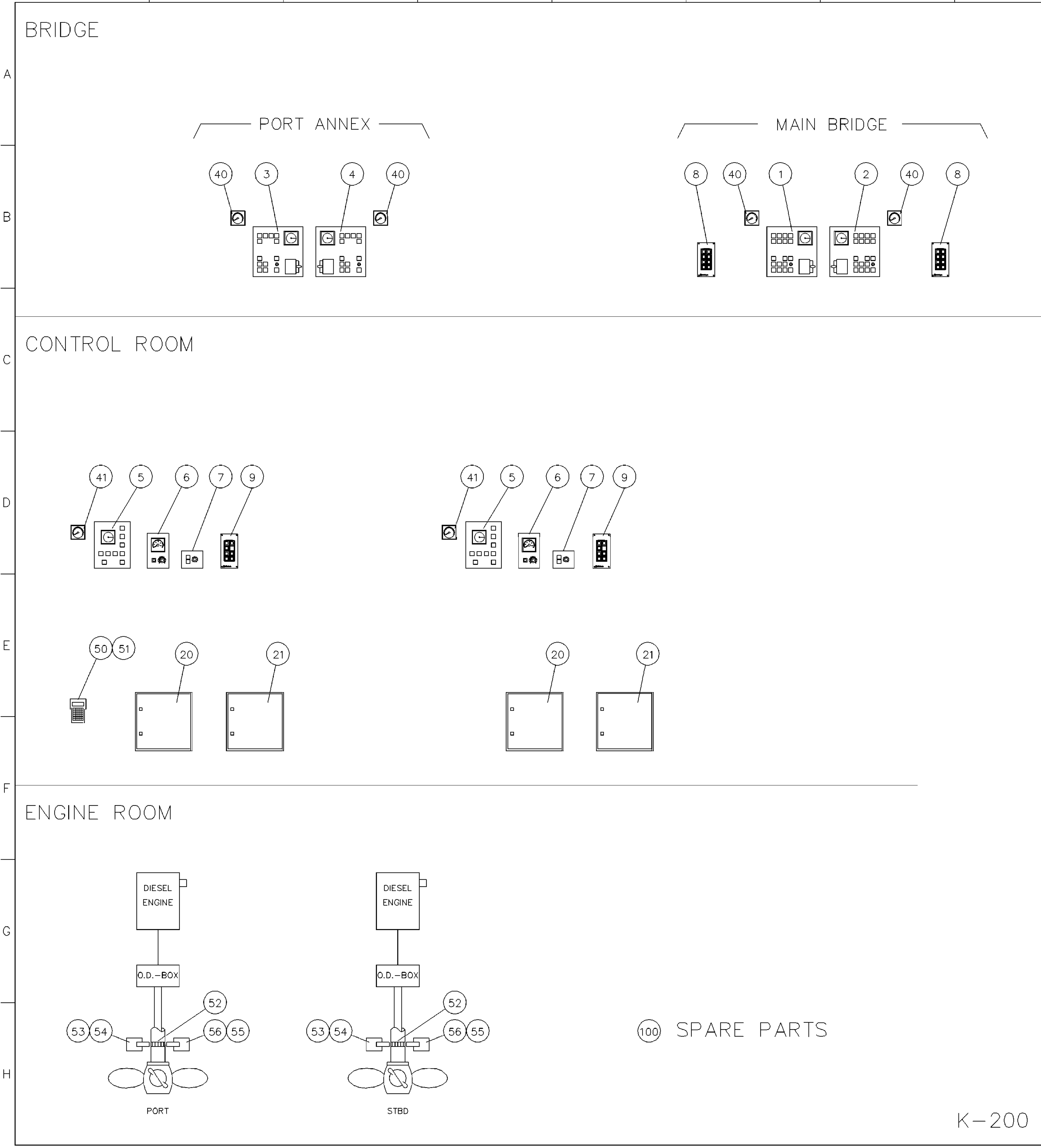
Design Drawings

Yard: Halifax Shipyard

Yard number: 2603

Remote Control System

Drawing Title	Drawing Number	Revision
Main drawing	RRM200005995	C
Bom Report	RRM200005995 A	
Cable drawing DMN200	001162	D
Cable connection drawing DMN200	001162	A
Load curve	- -	
Combinator diagram	- -	
Control panel Main bridge PORT	RRM200005922 A	
Control panel Main bridge STBD	RRM200005925 A	
Control panel Wing stations (PORT propeller)	RRM200005949 A	
Control panel Wing stations (STBD propeller)	RRM200005950 A	
Control panel ECR	RRM200005951 A	
Load control panel	RRM200001864 A	
Sep. RPM control panel	RRM200002414 A	
Clutch Control panel Main bridge	RRM200005928	E
Clutch Control panel ECR	RRM200005952	D
RPM indicator	128 952	-
RPM indicator ECR	128 967	-
Impulse band	107 127	b
RPM transmitter for indication	510 800	c
RPM transmitter for control system	107 009	c
Central unit	129 066	-
Clutch Control unit	129 066	-



NOTES

Item 1: Option 1,2,3,4,5
Item 2: Option 1,2,3,4,5
Item 3: Option 1,2,3, IP66
Item 4: Option 1,2,3, IP66

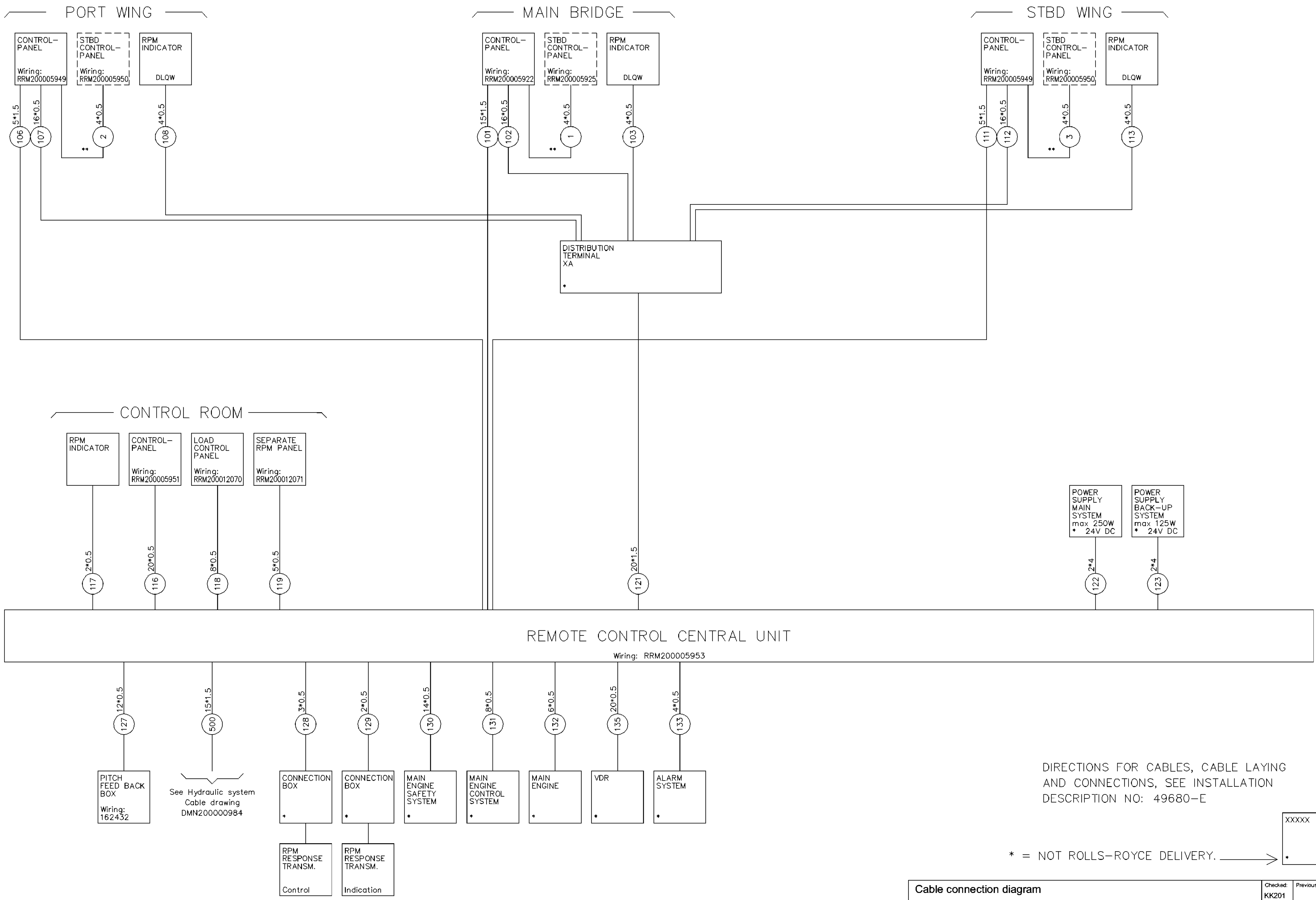
Acess List

Cable connection diagram Kamewa Basic		Checked: KK201 Approved: KK35	Previous Drg: Weight kg:	
Rolls-Royce Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date: WKM 23.03.2010	Scale:	Format: A2	Sheet: 1 of 1
	Drawing no: RRM200005995			Revision: C

External Bom Report

Item ID/Rev	Name	Item State	Size
RRM200005995/C	Sub-System Controller	Unit	CPP,Basic,STD

Sub-Assembly/Part					
Seq No	Qty	Item ID/Rev	Name	Item State	EL Reference
1	1	RRM200005922/A	Control Panel	Assembly	156720
2	1	RRM200005925/B	Control Panel	Assembly	156697
3	2	RRM200005949/A	Control Panel	Assembly	156724
4	2	RRM200005950/A	Control Panel	Assembly	156701
5	2	RRM200005951/A	Control Panel	Assembly	156732
6	2	RRM200012070/A	Control Panel	Assembly	
7	2	RRM200012071/B	Control Panel	Assembly	
8	2	RRM200005928/E	Control Panel	Assembly	176208
9	2	RRM200005952/D	Control Panel	Assembly	176208
20	2	RRM200005953/D	Central Unit	Assembly	129066
21	2	RRM200006020/B	Central Unit	Assembly	129066
40	6	K85250/A	RPM Indicator	Detail	128952
41	2	R128967A/_	RPM Indicator	Detail	128967
50	1	F070492/_	Hand Held Terminal	Detail	968530
51	1	K134069/_	Cable	Detail	*
52	2	RRM200006439/A	Peg Band	Detail	107127
53	2	F004419/_	Transmitter	Assembly	510800
54	2	F073837/_	Holder	Detail	510800
55	2	F070553/_	Transmitter	Detail	107009
56	2	F004546/_	Holder	Detail	107009
100	1	R117018A/B	Spare Parts	Assembly	117018



DIRECTIONS FOR CABLES, CABLE LAYING AND CONNECTIONS, SEE INSTALLATION DESCRIPTION NO: 49680-E

XXXXX *

* = NOT ROLLS-ROYCE DELIVERY.

THIS CABLE DRAWING SHOWS CABLES FOR A SINGLE PROPELLER SYSTEM.
FOR A DOUBLE PROPELLERS SYSTEM, THE PORT AND STBD PROPELLER SYSTEM ARE CONNECTED EQUALLY.

**
FOR CROSS CONNECTION OF COMMAND-REQUEST, BETWEEN PORT/STBD SYSTEM

Cable connection diagram Kamewa Basic		Checked: KK201	Previous Drg:	
		Approved: KK35	Weight kg:	
Rolls-Royce Rolls-Royce AB Propulsion Kristinehamn	Origin. / Date: WKM 10.06.2010	Scale:	Format: A2	Sheet: 1 of 16
	Drawing no: DMN200001162			Revision: D

Acess List
RR AB'S Info. Class: LIMITED