



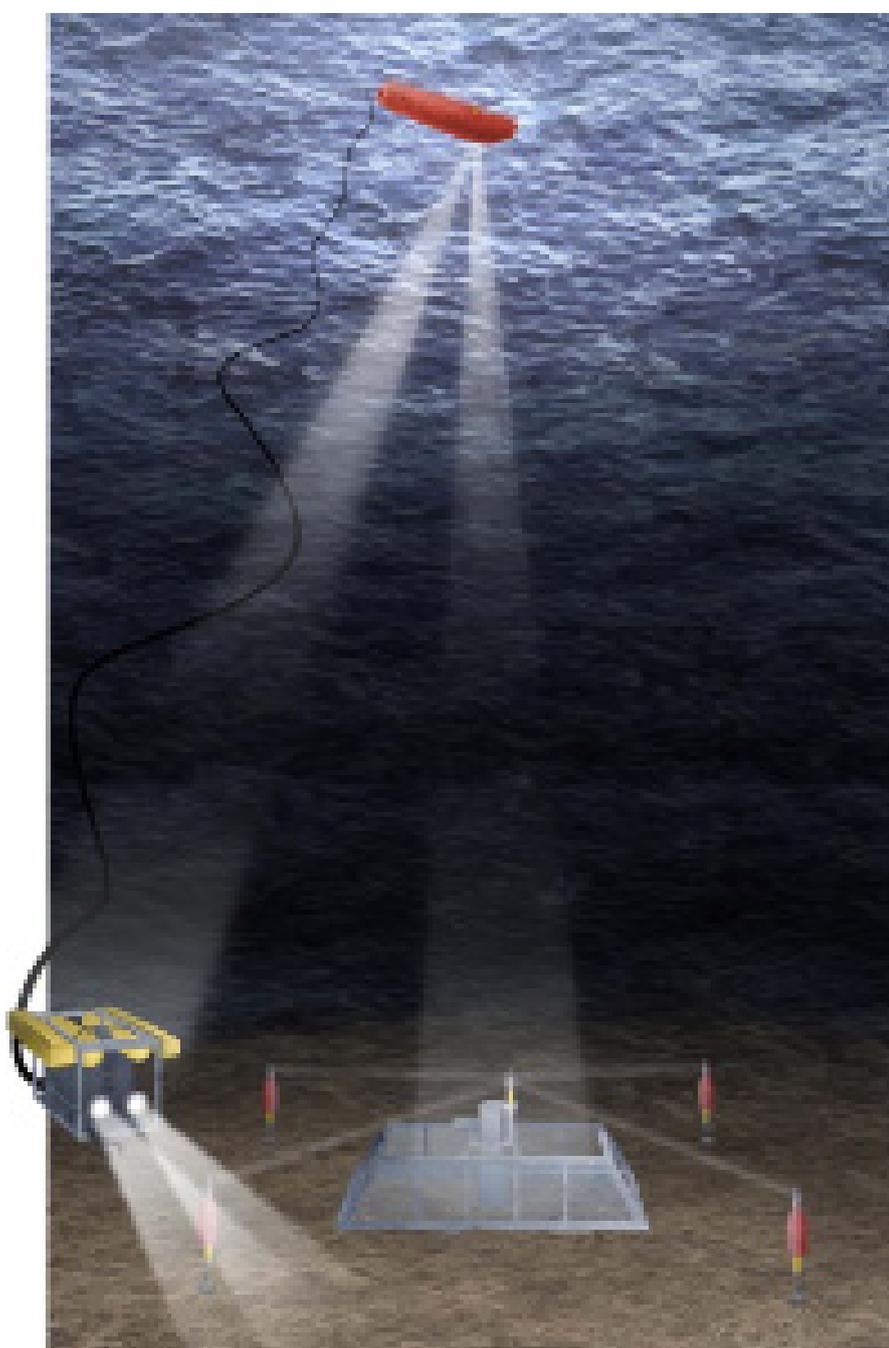
KONGSBERG

# Instruction Manual

## HiPAP® hull units

High Precision Acoustic Positioning

Model 501/451/351/101





***HiPAP® hull units***  
***High Precision Acoustic Positioning***  
***Model 501/451/351/101***  
***Instruction Manual***

## Document history

Rev	Date	Written by	Checked by	Approved by
H	9. October 2013	AJ	HAA	JEF
Added procedure for preserving HiPAP units during commissioning and maintenance work. Updated drawings.				

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## Warning

*The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment. Kongsberg Maritime disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.*

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## **Additional manual**

### **Hydraulic system for activation of the gate valve (option)**

*Separate manual supplied with the hydraulic system. This is not a Kongsberg Maritime document.*

## **Remarks**

### **References**

Further information about the HiPAP® Model 501/451/351/101 may be found in the following manuals:

- APOS for HiPAP® 501/451/351/101 Instruction Manual
- HiPAP® Model 501/451/351/101 Instruction Manual
- HiPAP® Cable plan and interconnections document

### **The reader**

The installation information in this manual is intended for the design and installation engineers at the yard performing the installation. The information is supplied as the basis for the yard's own installation drawings applicable to the vessel. On completion of the installation, this chapter may be used for reference purposes during system maintenance.

The maintenance information in this manual is intended to be used by a trained maintenance technician or engineer, with experience of electronic and digital circuitry, computers and electromechanical design. The level of information is based on Kongsberg Maritime's maintenance philosophy: The onboard technical personnel shall, with the help of the documentation and the system's built-in test functions, be able to identify malfunctions, locate the fault, and replace major parts, modules and components on the "Line Replaceable Unit" (LRU) level. Do not attempt to repair the LRUs.

## High voltage safety warning

The voltages used to power this equipment are potentially lethal. Even 110 volts can kill.

Whenever possible, the following precautionary measures should be taken before any work is carried out inside the equipment:

- Switch off all high-voltage power supplies.
- Check the operation of any door interlocks and any other safety devices.
- Completely discharge all high-voltage capacitors.

It should be noted that interlocks and safety devices are normally located only at regular access points, and high voltages may be exposed during dismantling.

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*Caution*

*Never work alone on high-voltage equipment! Refer to general safety procedures.*

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# 1 ABOUT THIS MANUAL

This is the Instruction manual for the Kongsberg Maritime HiPAP® hull units Model 501/451/351/101 (named HiPAP® hull unit in rest of the manual).

## Manual contents

The manual contains descriptions, specifications, procedures and illustrations required to install and maintain the hull units.

The manual also defines the equipment responsibility, and provides general information about preservation, packing and storage of the units, and provides the Factory Acceptance tests and the alignment procedures.

→ *The operator station and transceiver units are described in the HiPAP® Model 501/451/351/101 Instruction Manual.*

→ *The HiPAP® Cable plan and interconnections are described in a separate document.*

The system is described down to the circuit board level, named as Line Replaceable Units (LRUs), and block diagrams are used to simplify the descriptions.

## Abbreviations

Abbreviations used in this manual:

DN	Diameter Nominal
FP	Fore Perpendicular
HCU	Hoist Control Unit
HiPAP®	High Precision Acoustic Positioning
HPR	Hydroacoustic Position Reference
LBP	Length Between Perpendiculars
LBL	Long Base Line
LRU	Line Replaceable Unit
MTBF	Mean Time Between Failure
RCU	Remote Control Unit
TD	Transducer

## **Important information**

---

<b>Note</b>	<i>When the system is not in use and the hull unit is fully raised, you are advised to keep the gate valve closed.</i>
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<b>Caution</b>	<i>Check the water depth before lowering the transducer to avoid damaging the transducer.</i>
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## 2 SYSTEM DESCRIPTION

This chapter provides a brief description of the HiPAP® hull unit systems and a short description of each unit.

The purpose of the hull unit is to enable the transducer to be lowered out through the vessel's hull to a depth below aerated water and other sources of acoustic noise.

### Topics

- *HiPAP® systems on page 14*
- *HiPAP® hull unit systems description on page 16*

### Related topics

- *Vessel speed on page 23*
- *HiPAP® models - see HiPAP® Model 501/451/351/101 Instruction Manual*

## System overview

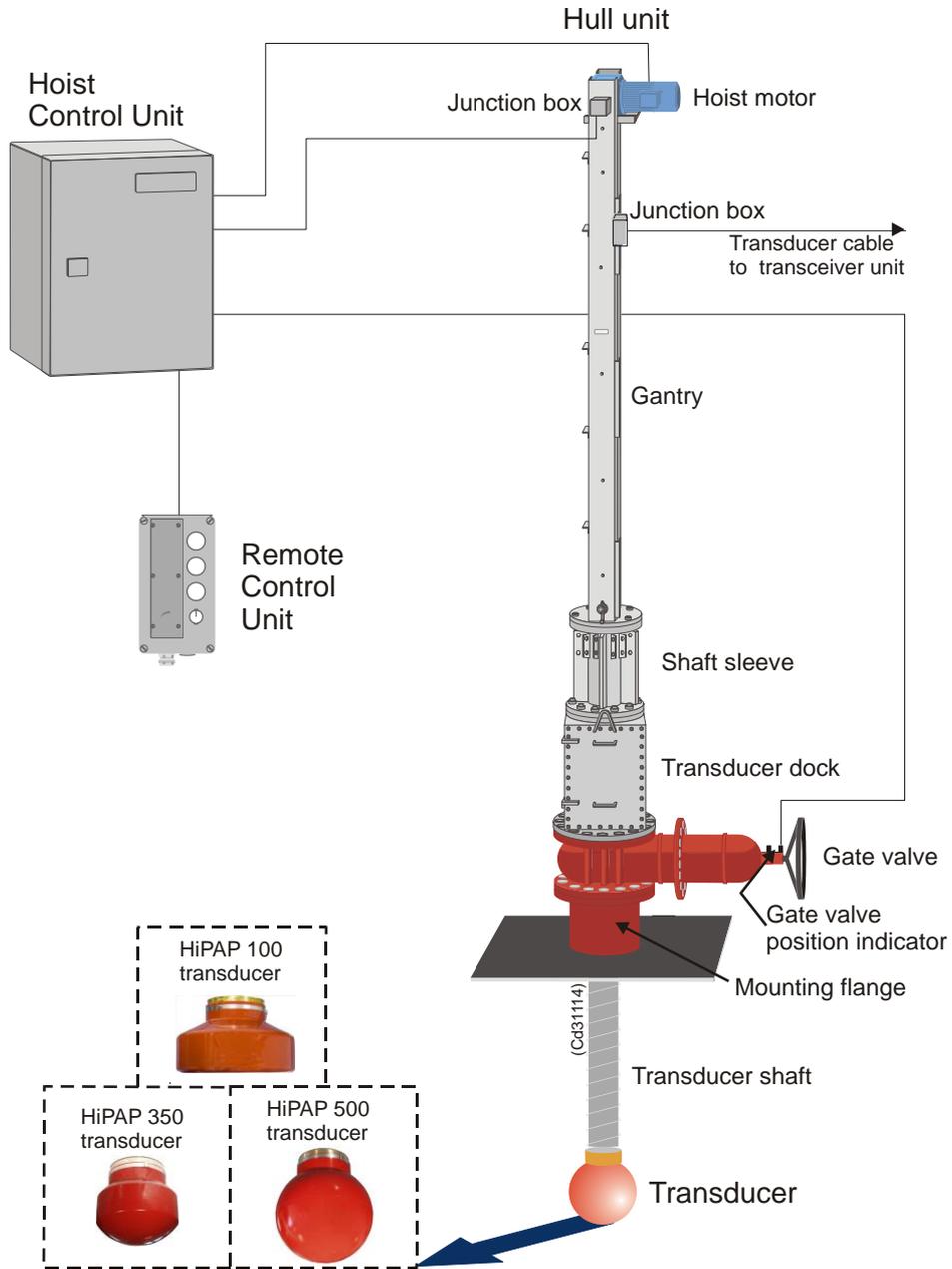


Figure 1 HiPAP® hull unit system

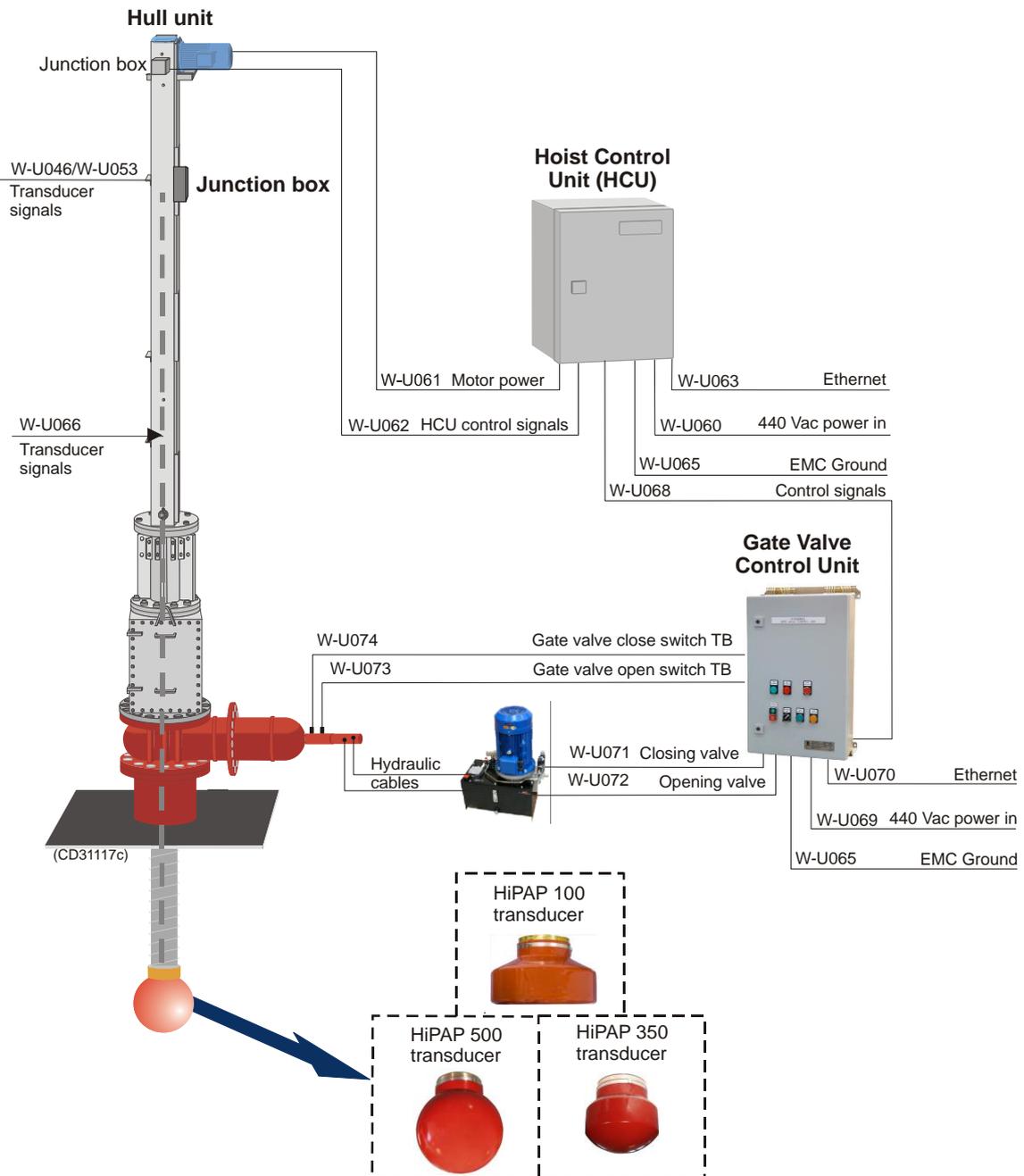


Figure 2 HiPAP® hull unit system with Ethernet interface

## HiPAP® systems

A complete specified HiPAP® system depends on:

- **Type of transceiver unit**
- **Type of hull unit**
- **Type of transducer**

The following are available:

<b>Transceiver unit (available types)</b>	<b>Hull unit (available types)</b>	<b>Transducer (available types)</b>
Model x21	HL 2180	HiPAP® 500 transducer
Model x81	HL 2770	HiPAP® 350 transducer
More information in the HiPAP® Model 501/451/351/101 Instruction Manual	HL 2990	HiPAP® 100 transducer
	HL 3770	More information on page 29
	HL 4570	
	HL 6120	
		(The numbers indicate the hoist length in mm)

A complete HiPAP® hull unit assembly also includes; cables (patch cable and transducer cable), transducer dock, mounting flange and gate valve.

→ *An overview of available HiPAP® assemblies, see table on page 127.*

## Hull units

A HiPAP® hull unit is a retractable hull unit system comprising the following main parts:

→ *Hull unit systems overview - see illustration on page 14*

- Hoist motor and gearbox
- Gantry
- Shaft sleeve
- Transducer dock with service hatch
- Transducer shaft
- Gate valve including:
  - Positioning indicator (switch)
  - Hydraulic system for activation of gate valve (option)

- Separate units:
  - Hoist Control Unit
  - Remote Control Unit
  - Hoist Control Unit with Ethernet interface

## Topics

- *Hoist motor short description on page 17*
- *Gearbox short description on page 17*
- *Gantry short description on page 18*
- *Shaft sleeve short description on page 18*
- *Transducer dock short description on page 18*
- *Mounting flange short description on page 18*
- *Transducer shaft short description on page 19*
- *Transducer short description on page 19*
- *Gate valve short description on page 19*
- *Hoist Control Unit detailed description on page 20*
- *Remote Control Unit detailed description on page 20*
- *Hoist Control Unit with Ethernet interface on page 21*

## Related topics

### Option:

- *Hydraulic system for activation of gate valve (option) → see separate manual delivered with the gate valve.*

## Hoist motor and gearbox

The hoist motor and gearbox are mounted on the hoist platform. This platform is at the top of the hull unit, mounted between the tops of the gantry girders.

The transducer is raised and lowered by this electric motor, which has a lifting capacity of 1000 Kip.

A crank handle is provided, which can be attached to one end of the motor shaft, to enable you to raise or lower the transducer manually in the event of a power failure or for maintenance purposes.

## **Gantry**

The hull unit gantry consists of two vertical, parallel steel girders, welded to a plate at their lower ends and with the hoist motor platform bolted to their upper ends. The girders support the transducer shaft when it is raised, and hold guide rails to ensure the shaft is correctly aligned. The upper and lower limit switches are mounted onto one of the girders.

## **Shaft sleeve**

The shaft sleeve is located in the bottom of the hull unit gantry. The sleeve is bolted to the transducer dock, which in turn is to be bolted to the gate valve. The shaft sleeve absorbs the forces created by the water flow acting on the transducer and the transducer shaft.

To prevent water leakage and to ensure smooth raising and lowering of the transducer, the shaft sleeve is fitted with Lion twin-set packing seals at its upper lower end. The space between the seals is filled with grease to lubricate the seals and provide extra watertight security.

When the sleeve is sufficiently filled, a thin film of grease will be observable on the transducer shaft. Grease refilling and level checking screws are located on the shaft sleeve.

---

### **Note**

*It is important that the shaft sleeve is kept watertight, and that the transducer shaft raising and lowering actions are as smooth as possible. If the system is in frequent use, the shaft sleeve may be exposed to sea growth, dirt and pollution as the transducer shaft is raised. Frequent inspections, and greasing when necessary, are strongly recommended.*

---

## **Transducer dock**

The transducer dock consists of a steel box which holds the transducer when the shaft is in the fully raised position. One side of the transducer dock has a service hatch. If the transducer is raised and the gate valve shut, the hatch may be opened to expose the transducer for maintenance or exchange. Zinc anodes are mounted inside the transducer dock.

## **Mounting flange**

The mounting flange is welded to the vessels hull, and serves as a base for the transducer raise/lower arrangement.

Note

*The height of the mounting flange varies according to the specific installation requirements of the vessel.*

---

The mounting flange carries the gate valve which permits onboard maintenance or replacement of the transducer.

### **Transducer shaft**

The transducer shaft is a stainless steel tube which supports the transducer at its lower end. It is supported at the top by guide rails and the raise/lower drive chains within the hull unit gantry, and it moves through the shaft sleeve. The signal cable between the transducer and the transceiver unit runs up the inside of the shaft, exiting at the top through sealing glands.

The transducer shaft is raised and lowered by drive chains, driven via a gearbox by the motor mounted on the hoist platform. The tension in the drive chain is adjusted using a threaded bolt mechanism.

### **Transducer**

The transducer is bolted to the lower end of the transducer shaft. When the shaft is fully raised:

- The transducer is stored in the transducer dock.
- The gate valve can be closed to protect the transducer completely from the open sea environment.

### **Gate valve**

The gate valve shuts off the opening in the vessel's hull when the transducer is raised. The gate valve is supplied with a position indicator.

A hydraulic system for automatic activation of the gate valve is available as an option. This hydraulic system is described in a separate document.

### **Gate valve position indicator**

The purpose of the gate valve position indicator is to give a feedback-indication of the gate valve position. The feedback is done by use of switches.

The gate valve position indicator is mounted directly onto the gate valve.

It consists of a slider sliding on a threaded spindle and two switches operated by the slider.

**Switch A** - is operated when the gate valve is fully open.

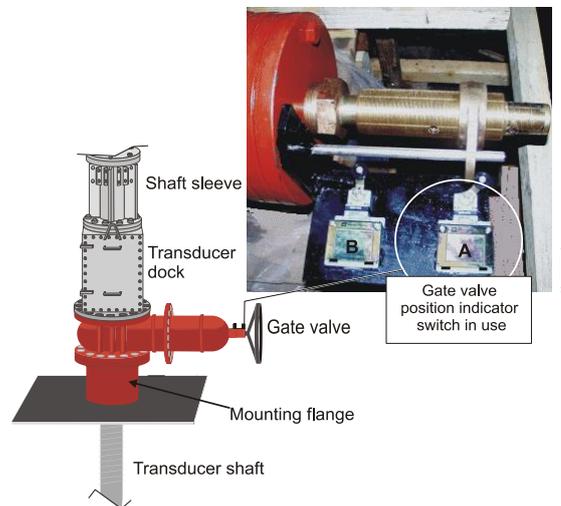
**Switch B** - is operated when the gate valve is fully closed. In the middle position no switch is operated.

---

**Note** *The Hoist Control Unit uses the fully open indication (switch A) only!*

---

The Hoist Control Unit will not allow the hoist motor to move the transducer shaft unless the gate valve is fully open.



*Figure 3 Gate valve with position indicator*

## **Hoist Control Unit**

The Hoist Control Unit (HCU) is a standard unit used with all types of hull units. This unit is a steel cabinet with hinged front door.

The unit is designed to be mounted on a bulkhead close to the hull unit gantry. For safety reasons there must be a clear line of sight from the HCU to the hull unit.

## **Remote Control Unit**

The Remote Control Unit (RCU) is a standard unit used with all types of hull units. This unit is an aluminium cabinet with removable front panel.

It holds the control buttons and indicator lamps required to enable the safe operation of the hull unit from a remote location.

→ *Refer to the figure on page 73*

This unit is designed to be mounted on a bulkhead, and will usually be located in the vicinity of the system operator station. This enables the system operator to control the hull unit rising and lowering operations without being at the physical location of the hull unit.

### **Hoist Control Unit with Ethernet interface**

APOS and HiPAP mk II support remote control of the Hull Unit Hoist and the Gate Valve. A new control unit for the hoist control and/or the gate valve is required. In addition this must be enabled in the HiPAP program.

### 3 TECHNICAL SPECIFICATIONS

This chapter gives the technical specifications of the HiPAP® hull units.

#### Topics

- *Vessel speed on page 23*
- *Packed dimensions and weights on page 23*
- *Hull units outline dimensions on page 23*
- *Gantry on page 24*
- *Mounting flange on page 25*
- *Gate valve on page 25*
- *Raise and lower motor on page 26*
- *Grease on page 26*
- *Gear oil on page 27*
- *Hoist Control Unit on page 27*
- *Remote Control Unit on page 29*
- *Hoist Control Unit with Ethernet interface on page 29*
- *Transducer units on page 29*

## Vessel speed

### Caution

Once the transducer is lowered, the depth of water under the vessel must be monitored closely.  
The **max vessel speed** - when the transducer is in the lowered position:

Hull unit type	Max vessel speed when the transducer is in lowered position
HL 2180	10 knots
HL 2770	10 knots
HL 2990	10 knots
HL 3770 (standard)	10 knots
HL 4570	8 knots
HL 6120	6 knots

## Packed dimensions and weights

### Note

All packed dimensions and weights are approximate and will depend on the packing materials available at the time of shipment.

Hull unit packing material: Wooden crate weight: 400 kg

Typical delivery of HiPAP 500 with 3770 HL:

Unit	Length	Width	Height	Weight	Net weight	Volume
Hull unit	620 cm	82 cm	96 cm	1500 kg	1100 kg	4.88 m <sup>3</sup>
Transceiver	92 cm	87 cm	77 cm	136 kg	85 kg	0.62 m <sup>3</sup>
Transceiver fibre kit	47 cm	32 cm	23 cm	3.5 kg	2.80 kg	0.03 m <sup>3</sup>

## Hull units

### Topics

- *HiPAP® HL 2180 - dimensions on page 178*
- *HiPAP® HL 3770 - dimensions on page 179*

→ HiPAP® HL 4570 - dimensions on page 180

→ HiPAP® HL 6120 - dimensions on page 181

**The following specifications are common for all HiPAP® hull units:**

**Protection**

Degree of protection:	IP 54
-----------------------	-------

**Power supply**

Voltage:	230/440 Vac 3-phase
Frequency:	50-60 Hz
Power consumption max:	1100 W
Operating temperature:	0° C to +55° C

**Environment conditions**

Storage:	- 20° C to +65° C
Storage/operating humidity:	90% / 80% relative

## Gantry

An opening through the deck is required for installation or removal of a hull unit.

- With transducer dock: diameter 800 mm
- Without transducer dock: diameter 700 mm

Specifications	HL 2180 Gantry	HL 3770 Gantry	HL 4570 Gantry	HL 6120 Gantry
Gantry type:	HL 2180	HL 3770	HL 4570	HL 6120
Height (above dock):	3.4 m	5 m	5.8 m	7.35 m
Max diameter (bottom flange):	670 mm	670 mm	670 mm	670 mm
Weight including transducer and transducer dock:	1150 Kg	1330 Kg	1430 Kg	1600 Kg
Distance of raise/lower travel (approx):	2.2 m	3.8 m	4.6 m	6.1 m

## Mounting flange

Specifications	DN 500 mm mounting flange	DN 350 mm mounting flange
Type:	DN 500	DN 350
Standard height:	600 mm	200 mm
Optional height:	Specified by customer	Specified by customer
Diameter Internal/Flange:	506 mm / 670 mm	350 mm / 505 mm
Wall thickness:	20 mm	20 mm
Weight (standard):	Approx. 90 Kg	Approx. 70 Kg
Securing bolt holes:	Quantity: 20 Diameter: M24	Quantity: 16 Diameter: M20
See also drawing:	on page 185	on page 186

## Gate valve

**Certificates** - DNV certifications are standard, others on request.

Specifications	DN 500 gate valve	DN 350 gate valve
Part no:	HDV-088347	HDV-051336
Type:	DN 500	DN 350
Height:	350 mm	290 mm
Weight:	500 kg	225 kg
Material case (body):	670 mm Nodular cast iron	670 mm Nodular cast iron
Material gate (wedge):	Nodular cast iron	Nodular cast iron
Material seat rings:	Bronze	Bronze
Length (from centre):	1335 mm	940 mm
Diameter Internal/Flange:	500 mm / 670 mm	350 mm / 505 mm
Securing bolt holes:	Quantity: 20 Diameter: 26 mm	Quantity: 16 Diameter: 22 mm
See also drawing:	<i>on page 185</i>	<i>on page 186</i>

## Raise and lower motor

Motor type:	SEW EURODRIVE S67 DT80N4BM/HF
Degree of protection:	IP 54
Input voltage:	230/440 Vac
Phase:	3 Phase
Rated power:	750 W
Speed:	1500 RPM
Timken OK Load, ASTM D 2509	lb: 40
Operating temperature:	0°C to +70°C

### Environment conditions

Storage:	- 20°C to +65°C
Storage/operating humidity:	90% / 80% relative

## Grease for shaft and chain

Exxon Mobil Mobile EP2 (or equivalent)

Mobile EP 2 is a high performance, general-purpose industrial-type grease. This lithium hydroxystearate based grease is formulated to provide extra protection against wear, rusting and water washout. It is NLGI Grade 2 with a base oil viscosity of ISO VG 150.

### Typical properties

NLGI Grade:	2
Thickener Type:	Lithium
Colour, Visual:	Brown
Penetration, Worked, 25 °C, ASTM D 217:	280
Viscosity of Oil, ASTM D 445 c St @ 40 °C:	160
Timken OK Load, ASTM D 2509:	1b: 40
4-Ball Wear, ASTM D 2266, Scar:	0.4 mm
4-Ball Weld Load, ASTM D 2509:	250 Kg
Dropping Point, D 2265:	190° C
Rust Protection, ASTM D 6138, distilled water:	0-0

### Equivalents

Possible equivalents – use grease with approximate the same properties as specified above.

## Gear oil

Mobilgear 636 (ISO VG 680) (Shell Tellius oils 32S)  
(or equivalent)

Typical properties	
Viscosity cSt/100 °C:	37.47
Viscosity cSt/40 °C:	680
Viscosity index:	90
Specific gravity at/15 °C:	0.920
Flashpoint COC, °C, min:	250
AGMA No 250.03:	8-EP
Point of solidification, max:	-15°C
Rust ASTMD 665A/B:	pass
Four ball Weld Point, N:	3150

### Equivalents

Possible equivalents – use oil with approximate the same properties as specified above.

## Hoist Control Unit

### Caution

*The Hoist Control Unit is normally delivered without vibration damping devices. However, if the vibration velocity amplitude at the unit's mounting points is expected to exceed 10 mm/s in the range 5 – 50 Hz, constantly during operational life, special precautions are to be taken.*

### Note

*The unit must be kept in an operational environment with the room temperature and humidity within the specified limits, and in a corrosive, salt and dust-free atmosphere.*

### Dimensions

→ *Outline dimensions - see drawing in the Drawing file chapter from page 171.*

**Protection**

Degree of protection:	IP 54
-----------------------	-------

**Power**

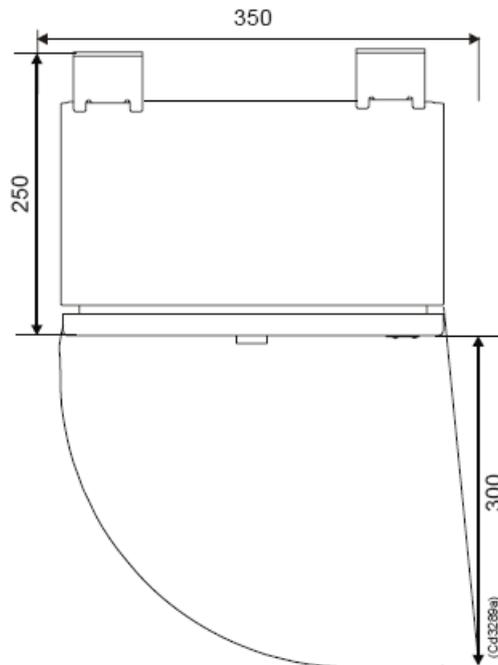
Voltage:	230 Vac / 440 Vac, 3 phase
Frequency:	50 - 60 Hz
Power consumption:	750 - 1100 W depending on application
Operating temperature:	0°C to +55°C

**Note**

*The power supply to the Hoist Control Unit must be kept within  $\pm 10\%$  of the unit's nominal voltage. The maximum transient voltage variations on the main switchboard's bus-bars which could occur (except under fault conditions), are not to exceed -15% to +20% of the nominal voltage.*

**Environment conditions**

Storage:	- 20° C to +65° C
Storage/operating humidity:	90% / 80% relative



*Figure 4 Hoist Control Unit – maintenance access*

## Remote Control Unit

**Note** *The unit must be kept in an operational environment with the room temperature and humidity within the specified limits and in a dust-free atmosphere.*

### Dimensions

→ *Outline dimensions - see drawing in the Drawing file chapter from page 171.*

### Protection

Degree of protection:	IP 54
-----------------------	-------

### Power

Voltage:	24 Vdc (from HCU)
Power consumption:	6 W
Operational temperature:	-0 to +70° C

### Environment conditions

Storage:	- 20° C to +65° C
Storage / operating humidity:	90% / 80% relative

### Cabling

The Remote Control Unit is supplied without cables. All required cabling must be made available and installed by the installation yard.

## Hoist Control Unit with Ethernet interface

The Hoist Control Unit is normally delivered with vibration damping devices.

**Note** *The unit must be kept in an operational environment with the room temperature and humidity within the specified limits, and in a corrosive, salt and dust-free atmosphere.*

### Dimensions

→ *Outline dimensions - see drawing in the Drawing file chapter from page 171.*

**Protection**

Degree of protection:	IP 54
-----------------------	-------

**Power**

Voltage:	230 Vac / 440 Vac, 3 phase
Frequency:	50 - 60 Hz
Power consumption:	750 - 1100 W depending on application
Operating temperature:	0° C to +55° C

**Note**

*The power supply to the Hoist Control Unit must be kept within  $\pm 10\%$  of the unit's nominal voltage. The maximum transient voltage variations on the main switchboard's bus-bars which could occur (except under fault conditions), are not to exceed -15% to +20% of the nominal voltage.*

**Environment conditions**

Storage:	- 20° C to +65° C
Storage / operating humidity:	90% / 80% relative

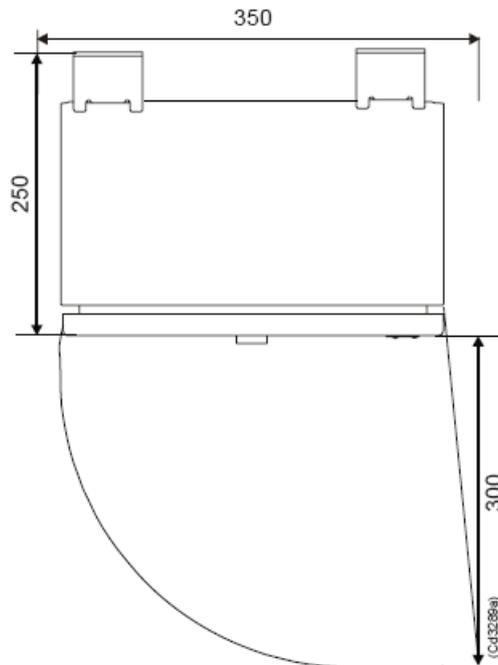


Figure 5 Hoist Control Unit – maintenance access

## **Transducer units**

→ *Weight, see the Drawing file chapter from page 171.*

## 4 INSTALLATION

This chapter provides the descriptions and drawing references required to install the HiPAP® hull units.

The guidelines for installation presented in this manual must be regarded as a base for detailed plans prepared by the installation yard.

---

**Note** *Detailed mechanical drawings for the installation of the hull unit must be created and provided by the yard for the specific vessel. All drawings must be approved by local maritime authorities prior to the start of the installation.*

---

**Warning** ***The installation instructions given in this manual must be followed. Failure to do so may render the guarantee void.***

---

**Warning** ***Kongsberg Maritime AS accepts no responsibility for any damage or injury to the system, ship or personnel caused by drawings, instructions and procedures not prepared by Kongsberg Maritime.***

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### Topics

- *Supply conditions on page 33*
- *Before you start on page 34*
- *Sonar room requirements on page 34*
- *Torque on page 36*
- *Tools on page 36*
- *Basic installation information on page 37*
- *Installation procedures on page 40*

### Related topics

- *Cables on page 58*
- *Drawings in the Drawing file chapter from page 171*

## Supply conditions

### Equipment responsibility

Upon receipt of the equipment the system owner or installation yard automatically becomes fully responsible for the equipment, unless otherwise stated in the contract. This responsibility covers the storage period before installation, the actual installation, commissioning, and the period between the completion of the commissioning and the acceptance of the equipment by the end user (normally the owner of the vessel or platform into which the equipment is to be installed).

- Reception, unpacking and storage. A separate chapter, *Equipment handling* is provided for this information - on page 140.

### Installation guidelines

Unless otherwise stated, the installation yard is responsible for the installation of the entire HiPAP® system. In addition, the yard is responsible for providing and connecting all cables. The actual installation and cable laying must comply with the vessel's classification rules and the recommendations given in this manual.

### Assistance from Kongsberg Maritime

Kongsberg Maritime AS may assist during the installation if specified in the contract or requested by the installation yard or customer. Kongsberg Maritime AS may also assist with installation drawings. All such assistance is charged to the customer at the current rates.

If required during a contractual test period, the yard must provide assistance necessary for the rapid and efficient completion of the work even when the work is to be performed outside normal working hours. This requirement includes assistance from subcontractors when applicable. Excessive waiting time resulting from delays caused by the yard will be charged to the yard.

## Before you start

### Precautions and requirements

Before you start the installation, you must take the following actions:

- Collect the required documentation and read the applicable procedures *before* commencing work.
- Collect the required tools. Normally only a standard tool set will be required. If special tools are necessary to perform a task, the procedure will list those required.
- Ensure that all power is switched off to the system, and remove the fuses. If power is required to perform a task, the procedure will state so.
- Label the on / off switches, circuit breakers and fuses with notes clearly stating that work is being carried out on the system.

## Sonar room requirements

The sonar room should be large enough to house all the system units, with enough space to allow maintenance to be performed efficiently. The maintenance engineer should be able to have all the cabinet doors open without undue restriction to his/her movements.

The room should be easily accessible, via a hatch or door. It would be advantageous if the entry was large enough to allow installation and removal of the equipment contained in the compartment without the requirement for disassembly.

Lights must be permanently installed in the sonar room. A voice intercom terminal, with connections to the operator station and the bridge, is highly recommended.

### Ventilation

The room must be connected to the vessel's ventilation system to ensure a supply of cooling air to the units. It is recommended that the temperature should be between +5 and +40 °C, and relative humidity should not exceed 80%. The MTBF (Mean Time Between Failure) will decrease if these limits are exceeded.

If a ventilation system is not available, install two 3” pipes from the equipment room to a suitable fresh air location on deck. The fresh air should enter the room as close to the floor as possible, and should be extracted from as high as possible. Funnels should be located below the pipes to collect any condensation which may form. To ensure the best possible ventilation, the air outlet on deck should be located four metres higher than the air inlet, and goose-necks or hats should be mounted on the tubes to prevent the ingress of rain or sea water.

### **Bilge pump system**

The room must be serviced by a bilge pump system. If it is impractical to connect the room to the vessel’s bilge pump, a separate pump must be installed to drain the room in the event of water ingress.

## Torques

All the nuts and bolts used in the system must be tightened to their recommended torques to prevent leaks or damage to the threads. The recommended tightening torques for the various sizes of threads is as follows:

Nut/bolt torques	
Thread size (mm)	Torque (Nm)
M6	7 Nm
M8	17 Nm
M10	33 Nm
M12	57 Nm
M16	140 Nm
M20	273 Nm
M24	472 Nm

## Standard tools

A standard mechanical tool set will be required for:

- Perform the installation, removal and replacement of modules and parts described in this manual.
- Perform the majority of the maintenance described in this manual.

A standard electrical tool set may be required to perform repairs to cables etc.

In addition, the normal heavy tools designed for installation work is required.

**The following expendables are recommended:**

- Isolating plastic tape
- Solders
- Wire straps in different sizes

## Special tools

If special tools are required for a particular procedure, they will be listed at the beginning of that procedure.

## Basic installation information

The installation of the hull unit and associated units includes the following:

- Selection of the hull unit location.
- Installation of the hull unit. This includes:
  - Installation of the mounting flange at the site chosen for the hull unit.
  - Installation of the gate valve.
  - Mounting of the hull unit assembly (transducer dock, shaft sleeve, gantry and transducer).
  - Mounting of the hoist motor.
- Mounting of the hoist control and remote control units.
- Control signal and power supply cabling.
- Hydraulic system for activation of gate valve (option) - see separate documentation delivered with the system.
- Test and alignment procedures.

### Topics

- *Important information on page 38*
- *Logistics on page 38*
- *Choice of location on page 38*
- *Installation procedures on page 40*

### Related topics

- *Cable layout and interconnections on page 54*
- *Test and alignments procedures from page 152*
- *Drawing in the Drawing file chapter from page 171*

### **Important information**

- Water inlets and protruding elements that might cause turbulence around the transducer, must not be located forward of the flange.
- Reinforcing plates and braces must be added to the vessel where the hull unit installation might weaken the hull construction.
- The Hoist Control Unit must be mounted on the bulkhead in the vicinity of the hull unit. The Hoist Control Unit controls the hull unit hoisting and lowering operations locally, therefore for safety reasons it should be mounted with a free line of sight to the hull unit.

### **Logistics**

**Safety** - Refer to the local general safety procedures. The parts of the hull unit are heavy. Use only suitable and properly certified lifting apparatus to move the units.

**Personnel** - Trained mechanical fitters/welders and electricians.

**Vessel location** - The vessel must be in a dry dock during the installation of the mounting flange and gate valve. The hull unit gantry can be installed while the vessel is afloat if necessary.

**Special tools** - Certified lifting apparatus suitable for the various parts. Cutting/welding equipment.

### **Choice of location**

---

*Caution*

*Selecting the optimum location for the hull unit is of vital importance for the overall system performance.*

---

All external noise sources (sea noise, machinery noise, air bubbles etc), and the individual performance of the ship, must be taken into consideration.

The hull unit location must be selected by a skilled engineer with experience in positioning system theory and hull unit installation. The supplier will assist if required.

The compartment, within which the hull unit is to be mounted, must be accessible under all conditions. Take into consideration the following:

- The access door / hatch should be large enough to allow installation and removal of the hull unit without the requirement to disassemble it.
- ***The hull unit will pass through a hole of 800 mm diameter,*** provided there are no obstructions either side of the hole.
- The compartment should also be connected to the ship's ventilation system. In tropical regions an air dehumidifier is recommended to reduce the likelihood of problems and corrosion due to condensation.
- The compartment should also be supported by a central or separate bilge pump.

The hull unit should be located within 1/6 to 1/3 of the ship's length between perpendiculars (LBP), measured from the fore perpendicular (FP). Deviations from this specification should not be made without consulting the supplier. In all cases, it is imperative that the transducer array has a free view under the keel when it is in its operational position.

The location must be as close to the keel as possible. The vertical distance from the lower edge of the keel to the top of the mounting flange must be discussed with the supplier.

- The assistance of a dockyard crane will be required to lower the hull unit into the vessel.
- Heater elements of approximately 1000 watts should be installed close to the bottom of the hull unit to prevent the unit icing up in cold weather.
- If there is any chance of damage caused by welding or other work during the installation or a maintenance period, the hull unit must be protected with heat resistant material.
- The installation must be approved by an appropriate classification society.
- When the vessel has been launched, the air must be released from the transducer dock through the air vent cock.

→ *Air vent cock, see figure on page 131*

## Installation procedures

The installation must be carried out according to the arrangement drawings designed specifically for the vessel.

→ *See also drawings in the Drawing file chapter from page 171*

### Topics

→ *Mounting flange installation on page 41*

→ *Gate valve installation on page 43*

→ *Gantry installation on page 45*

→ *Hoist motor mounting on page 47*

→ *Hull unit surface protection on page 47*

→ *Hoist Control Unit installation on page 48*

→ *Remote Control Unit installation on page 51*

→ *Hoist Control Unit with Ethernet interface on page 54*

## Mounting flange installation

The mounting flange is welded into a hole cut in the vessel's bottom and provides a secure base for the hull unit assembly.

- The HiPAP® 500/450/100 transducer (the complete hull unit) must be mounted on the DN 500 mounting flange.
- The HiPAP® 350 transducer (the complete hull unit) can be mounted on the DN 500 or a DN 350 mounting flange.

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**Note** *The total height of the mounting flange will depend on the requirements for the specific installation. The standard height is DN 500 = 600 mm/DN 350 = 200 mm, though other sizes can be provided on request.*

**Note** *Cut the mounting flange to the shortest possible length for installation.*

---

### DN 500 mounting flange

The DN 500 mounting flange comprises a steel cylinder, topped by a flange ring.

The flange ring contains 20 equally spaced holes, each bored and tapped to receive M24 studs. The holes are on a pitch circle diameter of 620 mm, with a pitch of 18°.

→ See drawing in the Drawing file chapter from page 171

The flange welded around the top of the cylinder enables a gate valve to be bolted onto the top.

### DN 350 mounting flange

The DN 350 mounting flange comprises a steel cylinder, topped by a flange ring.

The flange ring contains 16 equally spaced holes, each bored and tapped to receive M20 studs. The holes are on a pitch circle diameter of 460 mm, with a pitch of 22.5°.

→ See drawing in the Drawing file chapter from page 171

The flange welded around the top of the cylinder enables a gate valve to be bolted onto the top.

## Installation accuracy and tolerances

**It is very important for the system accuracy that the angular orientation of the hull unit is as accurate as possible;**

This implies that the welding of the mounting flange into the hull must be completed with the tolerances according to the following three (3) offset angles:

- 1 Roll angle** - The upper surface of the mounting flange must be horizontal in the athwart ships direction when the ship is floating at its normal trim, tolerance  $\pm 1^\circ$ .
- 2 Pitch angle** - The upper surface of the mounting flange must be horizontal in the fore-and-aft direction when the ship is floating at its normal trim, tolerance  $\pm 1^\circ$ .
- 3 Azimuth angle** - No angular requirements.

## Logistics

**Safety** - Refer to the general safety procedures. Note that the mounting flange is heavy. Use only properly certified lifting apparatus to move the unit.

**Personnel** - Minimum 3 trained mechanical fitters / welders.

**Vessel location** - The vessel must be in a dry dock during the installation of the mounting flange.

**Special tools** - Certified lifting apparatus. Cutting and welding equipment.

## References

### Drawings

- DN 350 mounting flange with gate valve on page 186
- DN 500 mounting flange with gate valve on page **Error!**

**Bookmark not defined.**

## Important information

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### Note

*The mating surface of the flange unit must be protected with a wooden cover at all times till the gate valve is about to be installed.*

---

### Warning

***The security of the welding is critical to the safety of the vessel. Welding must only be carried out by***

---

***a certified welder, and the installation must be approved by the local classification authorities.***

---

### **Installation procedure**

- 1 Decide the location of the hull unit.
- 2 Cut out a hole in the vessel's hull with a diameter large enough to accommodate the mounting flange.  
The exact size of the hole must be determined by the yard.
- 3 Orientate the mounting flange correctly, and then weld it into position.
- 4 Check the flange surface to ensure that it is level, undamaged and clean, and cover it for protection.
- 5 Brace the flange to the hull plating and the surrounding hull frames by welding on several strengthening plates.
  - The exact dimensions of the plates must be determined by the yard.

### **Gate valve installation**

- The HiPAP® 500/450/100 hull unit fits on a DN 500 gate valve.
- The HiPAP® 350 hull unit fits either the DN 350 or the DN 500 gate valve. As a standard, Kongsberg Maritime recommend to use a DN 500 gate valve. Details of both are given here.

### **Location of the unit**

The gate valve is installed between the mounting flange and the hull unit transducer dock.

### **Logistics**

**Safety** - Refer to the general safety procedures. Note that the gate valve is heavy. Use only properly certified lifting apparatus to move the unit.

**Personnel** - Minimum 3 trained mechanical fitters.

**Vessel location** - The vessel must be in a dry dock during the installation of the gate valve.

**Special tools** - Certified lifting apparatus.

## References

### Drawings:

- DN 350 mounting flange with gate valve on page 186
- DN 500 mounting flange with gate valve on page 185

## O-ring

A standard delivery includes one O-ring.

- The O-ring is used to seal the connection between the gate valve and the mounting flange.

## Procedure

See also the drawing on page 185

- 1 Ensure that:
  - the mounting flange has been installed correctly
  - the installation has been inspected
  - any offsets are within tolerance.
  - the mating surface is clean and undamaged.
- 2 Manoeuvre the gate valve down into the hull unit compartment, leaving about 15 mm.
  - Take great care not to damage the mating surfaces of the valve.
  - Make sure that the end switches are facing upwards.
  - Protect the end switches from damage.
- 3 Remove the protective cover from the mating surface on the mounting flange.
- 4 Check to ensure the mating surface of the flange is clean and undamaged.
- 5 Orientate the gate valve so that the wheel points in the desired direction.
- 6 Make sure there are no holes alongships or athwartships.  
See the drawing on page 185.
- 7 Wipe a thin film of silicone grease on the O-ring and place it on the mounting flange.
- 8 Attach the nuts and split washers while the gate valve is still suspended.
- 9 Check to ensure the mating surface on the valve is clean and undamaged.

Lubricate the threads with anti-seize lubricant as CRC, Loctite or Molykote.

- 10 Lower the valve carefully onto the mounting flange while tightening the nuts.
- 11 Check to ensure the valve is orientated and aligned correctly.
- 12 Disconnect and remove the lifting apparatus.
- 13 Tighten the nuts to torque 472 Nm.
- 14 Some of the positions have very limited space as indicated on the drawing on page 185.  
Alternative:
- 15 If there is no room for split washer use Loctite 270 or similar.
- 16 M24 holes may be drilled to Ø26. Replace the studs with cylinder head bolt M24x100 DIN933, A4-70 ISO 3506-1 (min).
- 17 Fasten to a torque of 472 Nm.

## Gantry installation

The flange at the bottom is to be mated to the gate valve flange. The mating surface of the hull unit must be protected with wooden covers at all times until the moment of installation.

The hull unit is normally transported in a wooden crate.

### Logistics

**Safety** - Refer to the general safety procedures. Note that the parts of the hull unit are heavy. Use only suitable and properly certified lifting apparatus to move the units.

**Personnel** - Four trained mechanical/electrical fitters.

**Vessel location** - The vessel must be in a dry dock during the installation of the mounting flange and gate valve. The hull unit gantry can be installed while the vessel is afloat if necessary.

**Special tools** - Two certified lifting apparatus, each with the capacity to support the entire hull unit (approximately 1.5 tonnes depending on hull unit model).

### References

**Drawings** - hull units, outline dimensions drawing, in the Drawing file chapter from page 171.

## Procedure

- 1** Manoeuvre the unit into the hull unit compartment, taking care not to damage the unit.
  - The mating surface of the transducer dock flange must be protected at all times during the operation.
- 2** Raise the unit using two cranes/tackles, one of them must be attached to the top of the unit.
- 3** Rotate the unit to the upright position without any part touching the deck.
- 4** Once the entire weight of the unit is supported by the crane attached to the top of the unit, release the crane attached to the lower end.
  - The unit is now hanging from one crane.
- 5** Manoeuvre the unit over the gate valve.
- 6** Stop lowering when the bottom flange of the transducer dock approaches the gate valve.
- 7** Remove the protective cover from transducer dock and gate valve flanges, and check that the mating surfaces are clean and undamaged.
- 8** Wipe a film of grease - (*see page 26*) in its groove, and position the O-ring seal.
- 9** Carefully lower the gantry down onto the gate valve.
  - Make sure that the studs mate correctly and easily with their corresponding holes in the transducer dock flange.
  - Make sure that the O-ring stays in place.
- 10** Place the nuts and washers onto all the stud bolts (ensuring that the required washers are used).
- 11** Tighten all the nuts to finger tight, and then working alternately on opposite sides of the dock.
- 12** Tighten the nuts to a final torque - see table on page 36.

**Note**

*The gantry will be subjected to large forces as the vessel moves through the water, and as it pitches and rolls. The gantry must therefore be supported against the vessel's hull in two directions 90° apart, using steel braces of suitable dimensions. These braces must be BOLTED into position to allow later maintenance or possible removal of the hull unit. Refer to the drawing.*

---

- 13** Ensure that no units or protrusions will obstruct the vertical movement of the hull unit or the transducer cables.

## **Hoist motor mounting**

The hull unit is delivered with the motor dismounted. It must therefore be fitted during the installation. It is recommended to fit the motor after the hull unit has been installed in the vessel.

### **Procedure**

- 1** Remove the plate covering the motor shaft key-way on the gearbox.
- 2** Mount the motor onto the gearbox using all the bolts provided.
- 3** Remove the oil filler and level plugs from the gearbox, and fill the gearbox with oil type SAE 30 if necessary.
- 4** Cut away the plastic vent plug on the oil filler plug to allow the gearbox to “breathe”.

## **Hull unit surface protection**

The hull unit must be protected against corrosion, especially those parts which are open to the sea. The HiPAP® hull unit has two zinc anodes mounted on the shaft sleeve to protect against galvanic corrosion. However, all exposed surfaces must be painted with a primer and topcoat/antifouling paint.

---

*Caution*                      *NEVER paint transducer face, shaft or zinc anodes. Do not paint the sealing surfaces in the gate valve, this will cause leakage.*

---

**Logistics**

**Safety** - Refer to the general safety procedures. Switch off all power to the hull unit before commencing the work.

**Personnel** - Painter.

**Vessel location** - The vessel must be in a dry dock if parts open to the sea are to be painted. Dry parts within the vessel's hull can be painted at any time.

**Special tools** - Painting tools and primer, undercoat, topcoat, anti-fouling paint as for remainder of vessel's hull.

**Hoist Control Unit installation**

This section describes the installation of the Hoist Control Unit (HCU).

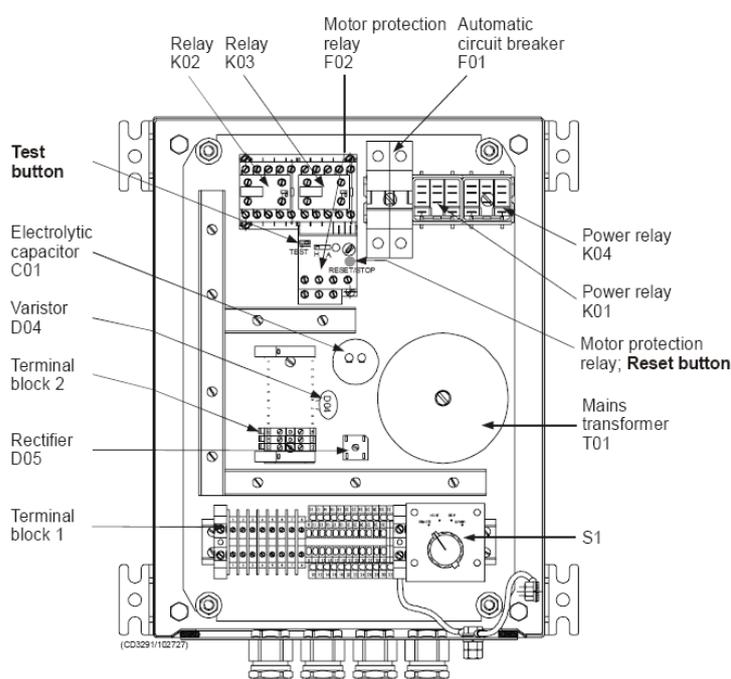
**Internal layout**

The Hoist Control Unit (HCU) contains the electronic circuitry and relays required to raise and lower the hull unit.

A rotary control switch (S1) within the cabinet enables the operator/maintenance engineer to raise or lower the hull unit locally.

An additional position on the switch changes control of the hull unit to a remote control unit, usually located in the vicinity of the system's display monitor. The switch will normally be set to this "Remote position to enable the hull unit to be controlled from the operator's console.

The units and components are laid out as shown below.

**NB!**

Link HTC B1 20 - 21 is not mounted. This to avoid damaging the transducer when lowering the hull unit.

Link HTC B1 20 - 21 should only be mounted if a Gate Valve with no limit switch is mounted - see also drawing on page 192.

Always check the Gate Valve is fully open before lowering the hull unit.

Figure 6 Hoist Control Unit - internal layout

## Connections

All cables to the HCU enter the unit through cable gland located in the base of the unit.

The connections are as follows:

- Controlled mains supply to hull unit raise/lower motor.
- 7 x 2-core signal cable from Remote Control Unit (remote control).
- 6-core signal cable from the hull unit (limit switches etc.).
- 2 cables (4-core) to Gate Valve Open / Closed switch (if mounted).

The connections for the power and interface cables to the Hoist Control Unit are described here.

## Installation of cables

→ Cable layout and interconnection chapter from page 54

The HCU is fitted with four mounting lugs. Holes can be drilled in the bulkhead and bolts, nuts and washers used to secure the unit, or studs can be welded to the bulkhead and the unit secured to these.

## Unit location

The HCU will normally be mounted in the close vicinity of the hull unit.

- The lengths of the system cables do not place any practical restrictions on the distance between the HCU and the hull unit into which it is connected.
- The HCU is designed to be mounted on a bulkhead, but can be mounted directly onto the hull unit gantry if necessary.

## Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Minimum 2 trained mechanical / electrical workers

**Vessel location** - No special requirements.

**Special tools** - None

## References

### Drawings:

→ *Drawings in the Drawing file chapter from page 171*

## Procedure

---

### Caution

*For safety reasons, the Hoist Control Unit must be mounted such that the operator has a direct and unimpeded line of sight from the cabinet to the hull unit.*

---

### Note

*The Hoist Control Unit is not fitted with vibration / shock dampers as standard. Refer to the Technical Specifications chapter for vibration/shock requirements.*

---

- 1 Select an appropriate location for the unit.
- 2 Check on the other side of the bulkhead to ensure there will be no “surprises” when the holes are bored or welding is performed.
- 3 Bore the holes to fit M8 bolts, or weld four M8 x 12 mm long studs to the appropriate positions on the bulkhead.
- 4 Lift the cabinet against the bulkhead and align the mounting holes/studs.

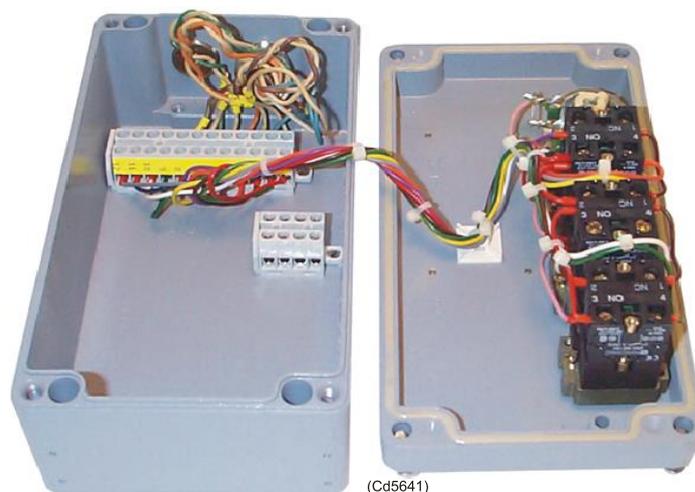
- 5 Locate the bolts/studs through the holes, place washers onto the threads, then screw nuts onto them.
- 6 Ensure the cabinet is positioned correctly, then tighten the nuts to final torque – see table on page 36.
- 7 Referring to the relevant cabling documentation and interconnection diagrams, connect in the cables.
- 8 Once all the cables have been installed and the installation has been checked, remove all “foreign” matter from the cabinet and shut the door.

## Remote Control Unit installation

This section describes the installation of the Remote Control Unit (RCU).

### Internal layout

The Remote Control Unit (RCU) parts and cabling are laid out as shown in the figure below.



*Figure 7 Remote Control Unit - internal layout*

## Connections

The RCU is connected to the Hoist Control Unit via a cable. There are no practical restrictions on the distance between the two units.

The connection is as follows:

- 7 x 2-core signal cable to the Hoist Control Unit

## Installation of cables

→ *Cable layout and Interconnection chapter from page 54*

## Location of the unit

The RCU will normally be mounted in the vicinity of the system's operator unit(s).

- The RCU cables can be as long as necessary, so there is no practical restriction on the distance between the Remote Control Unit and the Hoist Control Unit into which it is connected.
- The RCU is designed to be mounted on a bulkhead.

## Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Minimum 1 mechanical / electrical workers.

**Vessel location** - No special requirements.

**Special tools** - None.

## References

**Drawings:**

→ *Drawings in the Drawing file chapter from page 171*

## Installation procedure

- 1 Select an appropriate location for the unit.
- 2 Mark the positions of the required four holes on the selected bulkhead.
- 3 Check to see what is on the other side of the bulkhead to ensure there will be no “surprises” when you drill the holes.
- 4 Drill the four holes in the bulkhead, each with diameter 6 mm.

- 5 Open the Remote Control Unit by removing the four screws securing the front cover in position.
- 6 Hold the unit in place and bolt it to the bulkhead using four M5 screws, nuts and washers.
- 7 Referring to the cable gland assembly procedure and wiring diagrams.
- 8 Once the interface cable to the Hoist Control Unit has been installed and the installation checked, remove all “foreign” matter from the unit and replace the front panel.

### Pin allocations

The Remote Control Unit contains one terminal block, shown below. The other end of the cable is connected into the Hoist Control Unit.

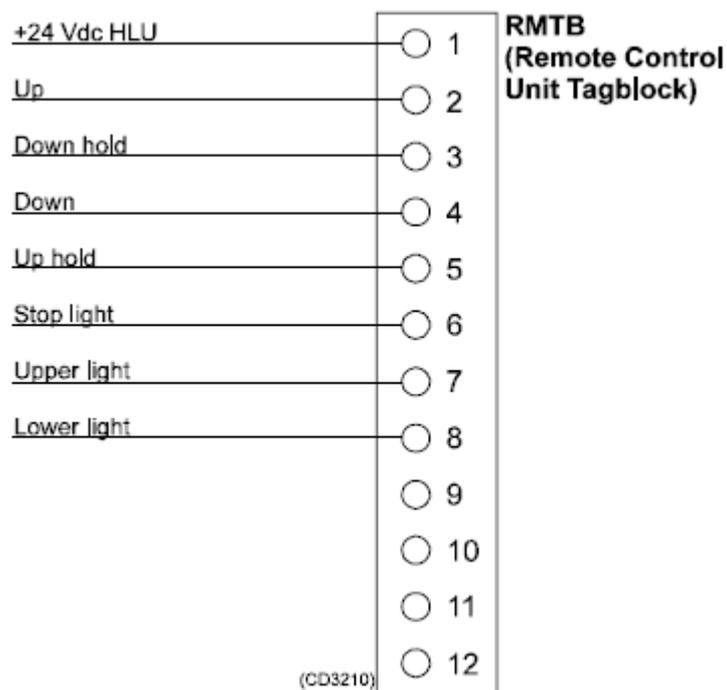


Figure 8 Cable connections

## Hoist Control Unit with Ethernet interface

This section describes the installation of the Hoist Control Unit (HCU).

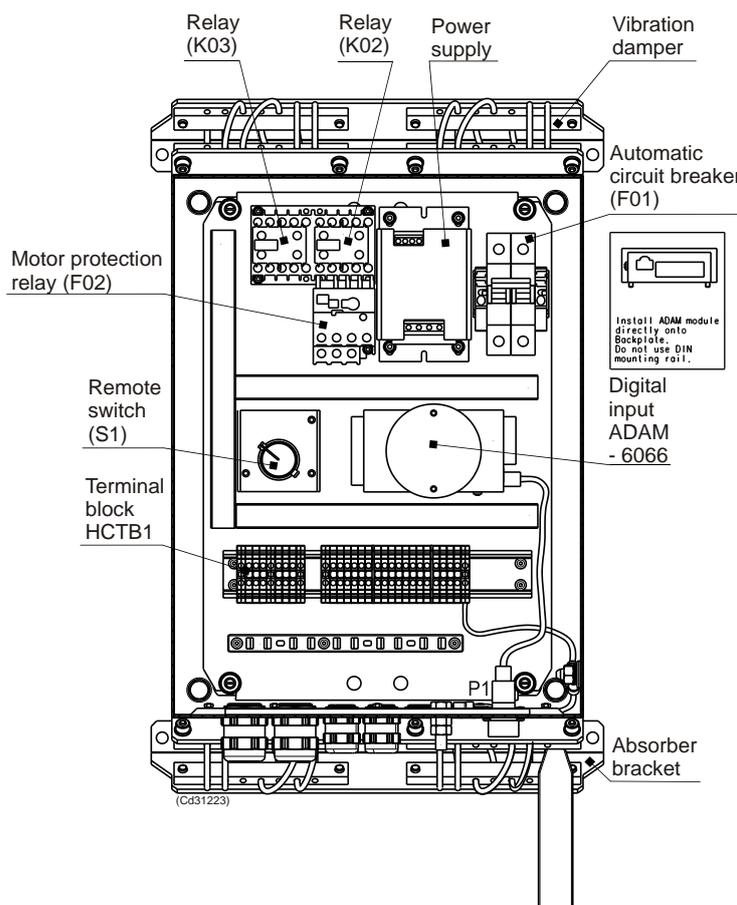
### Internal layout

The Hoist Control Unit (HCU) contains the electronic circuitry and relays required to raise and lower the hull unit.

A rotary control switch (S1) within the cabinet enables the operator/maintenance engineer to raise or lower the hull unit locally.

An additional position on the switch changes control of the hull unit to a remote control via Ethernet from the computer.

The units and components are laid out as shown in the following figure.



### NB!

Always check the Gate Valve is fully open before lowering the hull unit.

→ See also outline drawing on page 184

Figure 9 Hoist Control Unit with Ethernet interface - internal layout

## Connections

All cables to the HCU enter the unit through cable gland located in the base of the unit.

The connections are as follows:

- Controlled mains supply to hull unit raise/lower motor.
- Ethernet cable from Remote Control Unit to Transceiver unit or computer (remote control).
- 6-core signal cable from the hull unit (limit switches etc.).
- 2 cables (4-core) to Gate Valve Open / Closed switch (if mounted).

The connections for the power and interface cables to the Hoist Control Unit are described here.

## Installation of cables

→ *Cable layout and interconnection chapter from page 54*

The HCU is fitted with four mounting lugs. Holes can be drilled in the bulkhead and bolts, nuts and washers used to secure the unit, or studs can be welded to the bulkhead and the unit secured to these.

## Unit location

The HCU will normally be mounted in the close vicinity of the hull unit.

- The lengths of the system cables do not place any practical restrictions on the distance between the HCU and the hull unit into which it is connected.
- The HCU is designed to be mounted on a bulkhead, but can be mounted directly onto the hull unit gantry if necessary.

## Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Minimum 2 trained mechanical / electrical workers

**Vessel location** - No special requirements.

**Special tools** - None

## References

**Drawings:**

→ *Drawings in the Drawing file chapter from page 171*

## Procedure

---

*Caution*

*For safety reasons, the Hoist Control Unit must be mounted such that the operator has a direct and unimpeded line of sight from the cabinet to the hull unit.*

---

- 1 Select an appropriate location for the unit.
- 2 Check on the other side of the bulkhead to ensure there will be no “surprises” when the holes are bored or welding is performed.
- 3 Bore the holes to fit M8 bolts, or weld four M8 x 12 mm long studs to the appropriate positions on the bulkhead.
- 4 Lift the cabinet against the bulkhead and align the mounting holes/studs.
- 5 Locate the bolts/studs through the holes, place washers onto the threads, then screw nuts onto them.
- 6 Ensure the cabinet is positioned correctly, then tighten the nuts to final torque – see table on page 36.
- 7 Referring to the relevant cabling documentation and interconnection diagrams, connect in the cables.
- 8 Once all the cables have been installed and the installation has been checked, remove all “foreign” matter from the cabinet and shut the door.

## Preservation of HiPAP units

This procedure helps preservation of HiPAP units during commissioning and maintenance work on board.

### Mounting flange

After welding completion all exposed surfaces must be painted with primer and topcoat, and antifouling where appropriate. Damaged paint must be repaired.

The mating surface of the flange unit must be protected with a wooden cover at all times till the gate valve is about to be installed.

### **Gate valve**

Keep the gate valve in its transport protection until the start of installation.

The mating surface of the gate valve must be protected with a wooden cover at all times till the gantry is about to be installed.

Make sure the limit switches are protected from mechanical damage as well as from dirt or liquids.

### **Gantry**

The mating surface against the gate valve must be protected with a wooden cover at all times till the gantry is about to be installed.

Transducer cable should be strapped along the gantry until it is to be connected to the transceiver, and wrapped with the gantry in dust and heat resistant material during the building period at yard.

### **Hoist control and transceiver cabinets**

Cabinets to be kept closed at all times when not operated.

Cabinets to be wrapped in heat and dust resistant material during any welding, grinding, painting or cleaning work nearby.

### **Cables**

All installed cables to be securely routed in trays, protected from being stepped on or damaged by falling objects or particles.

## 5 CABLES

This chapter provides general installation requirements for cables and explains how to perform the interconnections between those units.

---

### Note

*All cable connections must be made in accordance with the guidelines laid down by the vessel's classification society.*

---

If no such guidelines exist, Kongsberg Maritime recommends that the *Det Norske Veritas (DNV) Report No. 80-P008, "Guidelines for Installation and Proposal for Test of Equipment"* be used as a guide.

→ *See Cable plan and interconnections document 325840 (separate document) for more information.*

### Topics

- *Cable gland assembly procedure on page 59*
- *Basic cable requirements on page 61*
- *Cable plan on page 64*
- *Transducer to transceiver unit cables installation on page 66*

### Related topics

- *Cable plan and interconnections on page 200*
- *Drawings in the Drawing file chapter from page 171*

---

## Cable gland assembly procedure

Cable glands are used whenever a cable passes through a water-tight bulkhead or into a cabinet, to seal the opening through which the cable passes and to protect the cable from abrasion on the edges of the hole. Follow the guidelines in this chapter when installing cables through cable glands.

---

### Note

*There are many different types of cable gland on the market. This procedure describes the types used (now and previously) as standard in the units manufactured by Kongsberg Maritime. The cable glands are not supplied with the system.*

---

Even though the cabinets from Kongsberg Maritime may be prepared for specific types, the installation yard will be responsible for selecting cable gland types and installing them.

### General procedure

- 1 Ensure all the cables to be connected are completely isolated from any power sources.
  - This is done by:  
Switch off and remove the supply fuses from any units or systems into which the cables are already connected.
- 2 Select the cable to be connected into the cabinet, and select the cable gland through which the cable is to pass.

---

### Note

*A **minimum** of 5 cm (recommended 5 - 10 cm) of slack cable must be allowed, both inside and outside the cabinet, when installing cables. This is to allow for vibration damping, maintenance and measurement errors. Always double-check your measurements before taking any irreversible actions.*

---

- 3 Depending on whether the cable has already been installed in conduits, either
  - a (installed) measure the maximum length of cable required to reach from the final cable clip outside the cabinet to the terminal blocks inside the cabinet, add 20 cm, then remove the excess cable, **or**:
  - b (loose cable) measure the maximum length of wire required to reach from the cable gland to the terminal

blocks inside the cabinet, add 20 cm. and mark the cable.

---

**Note**

*The cable's outer insulation will extend into the cable gland to a point approximately 5 mm **outside** the outer surface of the cabinet wall into which the cable gland is secured.*

---

- 4** Take care not to damage the screening. Carefully remove the outer insulation from the required cable length.
- 5** Leave an appropriate length of the screen exposed from the insulation, and cut off the remainder.

### **Securing and terminating the cables**

- 1** Refer to the wiring diagram and ensure that there is 5 to 10 cm slack cable inside the cabinet, - then prepare and connect the cable cores to the appropriate terminals within the cabinet.
- 2** Secure the cable within the cabinet using cable clips.
- 3** Check the terminal connections against the wiring diagram to ensure they are correct.

---

Follow the same procedure for all the cables and cable glands.  
Once all the cables have been fitted:

- 4 Check the cabinet to ensure all tools and rubbish are removed, before you close the cabinet door.

**Once all the cables have been fitted and checked:**

---

*Caution* Take the appropriate safety measures, then replace the fuses and apply power to the system.

*Caution* Perform a system test to ensure the installation has been conducted successfully.

---

## Basic cabling requirements

### Cable trays

All permanently installed cables associated with the system must be supported and protected along their entire lengths using conduits and/or cable trays. The only exception to this rule is over the final short distance (max. 0.5 m) as the cables run into the cabinets/units to which they are connected. These short service loops are to allow the cabinets to move on their shock mounts, and to allow maintenance and repair.

- Wherever possible, cable trays must be straight, accessible and placed so as to avoid possible contamination by condensation and dripping liquids (oil, etc.). They must be installed away from sources of heat, and must be protected against physical damage. Suitable shields must be provided where cables are installed in the vicinity of heat sources.
- Unless it is absolutely unavoidable, cables should not be installed across the vessel's expansion joints. If the situation is unavoidable, a loop of cable having a length proportional to the possible expansion of the joint must be provided. The minimum internal radius of the loop must be at least twelve times the external diameter of the cable.
- Where a service requires duplicate supply lines, the cables must follow separate paths through the vessel whenever possible.
- Signal cables must not be installed in the same cable tray or conduit as high-power cables.
- Cables containing insulation materials with different maximum-rated conductor temperatures should not be bunched together (that is, in a common clip, gland, conduit

or duct). When this is impractical, the cables must be carefully arranged such that the maximum temperature expected in any cable in the group is within the specifications of the lowest-rated cable.

- Cables with protective coverings which may damage other cables should not be grouped with other cables.
- Cables having a copper sheath or braiding must be installed in such a way that galvanic corrosion by contact with other metals is prevented.
- To allow for future expansion of the system, all cables should be allocated spare conductor pairs. Also, space within the vessel should be set aside for the installation of extra cables.

### **Radio Frequency interference**

All cables that are to be permanently installed within 9 m (30 ft) of any source of Radio Frequency (RF) interference such as a transmitter aerial system or radio transmitters, must, unless shielded by a metal deck or bulkhead, be adequately screened by sheathing, braiding or other suitable material. In such a situation flexible cables should be screened wherever possible.

It is important that cables, other than those supplying services to the equipment installed in a radio room, are not installed through a radio room, high power switch gear or other potential sources of interference. Cables which must pass through a radio room must be screened by a continuous metal conduit or trunking which must be bonded to the screening of the radio room at its points of entry and exit.

### **Physical protection**

Cables exposed to the risk of physical damage must be enclosed in a steel conduit or protected by a metal casing unless the cable's covering (e.g. armour or sheath) is sufficient to protect it from the damage risk.

Cables exposed to an exceptional risk of mechanical damage (for example in holds, storage-spaces and cargo-spaces) must be protected by a suitable casing or conduit, even when armoured, if the cable covering does not guarantee sufficient protection for the cables.

Metallic materials used for the physical protection of cables must be suitably protected against corrosion.

## **Grounding**

Grounding connections should be made using a conductor which has a cross-sectional area appropriate for the current rating of the cable, or with a metal clamp which grips the metallic covering of the cable and is bonded to the hull of the vessel. These cable coverings may also be grounded by means of glands specially intended for this purpose and designed to ensure a good ground connection. The glands used must be firmly attached to, and in good electrical contact with, a metal structure grounded in accordance with these recommendations.

Electrical continuity must be ensured along the entire length of all cable coverings, particularly at joints and splices. In no case should the shielding of cables be used as the only means of grounding cables or units.

Metallic casings, pipes and conduits must be grounded, and when fitted with joints these must be mechanically and electrically grounded locally.

## **Cable connections**

All cable connections are shown on the applicable cable plan and interconnection diagrams.

Where the cable plan shows cable connections outside an equipment box outline, the connections are to be made to a plug or socket which matches the plug or socket on that particular item of equipment.

Where two cables are connected in series via a junction box or terminal block, the screens of both cables must be connected together but not grounded.

## **Cable terminations**

Care must be taken to ensure that the correct terminations are used for all cable conductors, especially those that are to be connected to terminal blocks. In this case, crimped sleeve-terminations must be fitted to prevent the conductor core from fraying and making a bad connection with the terminal block. It is also of the utmost importance that where crimped terminations are used, the correct size of crimp and crimping tool are used. In addition, each cable conductor must have a minimum of 15 cm slack (service loop) left before its termination is fitted.

### **Cable identification**

Cable identification codes corresponding to the cable number shown in the cable plan must be attached to each of the external cables. These identification codes should be positioned on the cable in such a way that they are readily visible after all panels have been fitted. In addition, each cable conductor should be marked with the terminal board number or socket to which it is connected.

### **Cable planning**

All cables must be available at the units, properly installed in cable ducting.

---

*Caution*                      *All power must be switched off to the system prior to the cable installation.*

---

*Caution*                      *Do not to exceed the physical limitations of the cables.*

---

*Note*                              *Special system requirements, adaptations or components may introduce special drawings and cables.*

---

*Note*                              *In order to meet the EMC requirements, dedicated grounding cables have been used to connect the various system units to the vessel's ground. These cables are identified as "X" on the cable plan drawings. The braided grounding cable required is supplied with the system. These cables must not be longer than 1 metre.*

---

The cabling for all HiPAP® systems are in principle the same, and most of the cables are identical. The only system specific cable is:

- Transducer cable from the transceiver unit to the transducer.

All cables used are specified in the following sections.

### **Cable specifications**

Each individual cable is identified on the cable plans. The cables fall into two categories:

- Cables provided by the installation yard.
- System cables supplied with the delivery.

### **Yard cables**

The cables to be provided by the yard are identified as such in the cable listing.

---

**Note** *The cable specifications given are the minimum specifications.*

---

For each cable the following is provided:

- Connection to be made on each end of the cable (including system units, terminal block identification and plug/socket to be used).
- Number of cores.
- Recommended cable type.
- Minimum cable specifications.

---

**Caution** *Any special requirements must be considered in addition to those listed. Kongsberg Maritime accepts no responsibility for damage to the system or reduced operational performance if this is caused by improper cabling.*

---

### **System cables**

Several cables will be supplied with the system. Such cables normally consist of power cables for peripheral equipment, and interconnection cables for computers and/or operator stations. These cables are normally delivered (packed) with the units.

### **Cable connections**

All cables must be terminated correctly. The required information is provided in the applicable interconnection drawings.

### **Special cables**

Special system applications or requirements may result in additional or modified cable runs.

## Transducer to transceiver unit cables installation

### Topics

- *Cable information on page 66*
- *HiPAP® 501/451 (x81) on page 67*
- *HiPAP® 351/101 (x81) on page 67*
- *HiPAP® 351/101 (x21) on page 67*
- *Model x81 - transducer cable connection on page 68*
- *Model x21 - transducer cable connection on page 68*
- *Cables between the hull unit and the Hoist Control Unit on page 68*

### Cable information

Cabling from transducer to transceiver is separated in 2 parts.

- One part is protected inside the hull unit and goes **from the transducer to the junction box**.
- The other part goes **from the junction box to the transceiver unit**, and is the moving part of the transducer cable. Then it is possible to replace this part if damaged, or when connecting to another transceiver type.
  - Various length, depending on type of hull unit - more information see table on page 127.

The cabling from the **transducer to the junction box** is standard for all transceiver types. (It is made be 8 round flat cables placed and protected inside the transducer shaft. (Installed at delivery - various length, depending on type of hull unit - more information see table on page 127).

- Basic cable, see drawing on page 191 and 191.

**Page 1** (on page 191) shows the 8 cables and the location in the hull unit.

- The cable used is a 64 conductor round flat cable with a common shield and insulated protection. The cable diameter is 13 mm.
- Each cable is split in 2 at the transducer end. Each half goes to a 37 pin D-sub connector (not all pins are used). The other end of the cable goes into the junction box and is terminated in a 64 pin flat cable connector.

**Page 2** (on page 191) shows one of the cables inside the hull unit.

**Example:**

P501 and P502 are connected at the transducer end and to J1 in the junction box.

P503 and P504 go to J2 .....

### **HiPAP® 501/451**

→ *Cable details see drawing on pages 188 and **Error! Bookmark not defined.***

All 8 cables going into the junction box are connected to the transceiver with the same type of cable as inside the hull unit.

**Page 1** (on page 188) gives an overview of all 8 cables.

**Page 2** (on page **Error! Bookmark not defined.**) shows the internal connection for every individual cable.

### **HiPAP® 351/101 (x81)**

→ *Cable details, see drawing on pages 189 and **Error! Bookmark not defined.***

Just 2 cables are used from the junction box to the transceiver unit with the same type of cable as inside the hull unit.

**Page 1** (on page 189) gives an overview of the 2 cables.

**Page 2** (on page **Error! Bookmark not defined.**) shows the internal connection for every individual cable.

Note that one of the cables is split into 2 connectors in the junction box.

### **HiPAP® 351/101 (x21)**

→ *Cable details, see drawing on pages 190 and 190.*

Just 2 cables are used from the junction box to the transceiver with the same type of cable as inside the hull unit.

**Page 1** (on page 190) gives an overview of the 2 cables.

**Page 2** (on page 190) shows the internal connection for every individual cable. Note that one of the cables is split into 2 connectors in the junction box.

### **Model x81 - transducer cable connection**

This unit can connect to the transducer with 2 different types of cable.

- Transducer patch cable
- Old transducer cable with plug.

Detailed description,  
see the *HiPAP® Model 501/45/351/101 Instruction Manual*.

### **Model x21 - transducer cable connection**

This unit can connect to the transducer with 2 different types of cable.

- Transducer patch cable
- Old transducer cable with plug.

→ *For detailed description, see the HiPAP® Model 501/45/351/101 Instruction Manual.*

## **Cables between the hull unit and the Hoist Control Unit**

This procedure describes how to install the cables between the hull unit and the Hoist Control Unit.

### **Logistics**

**Safety** - Refer to the general safety procedures.

**Personnel** - Trained electrical fitter.

**Ship location** - No special requirements.

**Special tools** - None.

### **References**

**Drawings** - drawing in the Drawing file chapter from page 171.

### **Installation procedure**

- 1 Remove the junction box lid.  
→ *Refer to the Cable gland assembly procedure on page 59.*
- 2 Dismantle the appropriate cable gland.
- 3 Thread the various parts onto the cable in the correct order.
- 4 Pass the cable into the junction box.

- 5** Connect the cable terminations into the junction box terminal block.
  - Ensure all connections are made firmly.
  - Refer to the diagrams and drawings listed above.
- 6** Reassemble the cable gland and tighten it to ensure a water proof seal, ensuring enough slack is left in the cable so none of the wires is under tension.
- 7** When all cables have been connected, check the entire assembly to ensure all the connections are correct and tight.
- 8** Replace the junction box lid, using a thin film of silicon grease on the seal to ensure the box will be water proof.

## 6 OPERATION

This chapter describes the operation of the HiPAP® hull units. The operation is the same for all types of HiPAP® hull units.

---

### Caution

*Once the transducer is lowered, the depth of water under the vessel must be monitored closely.*

- Max vessel speed - when the transducer is in **the lowered position**, refer to information on page 23.

---

### Warning

***Important information about remote control operation – see page 70.***

---

#### Topics

- *Hoist control operation on page 70*
- *Remote control operation on page 72*
- *Hoist control operation from Operator Station/APOS on page 74*
- *Manual operation of the hoist motor on page 74*
- *Gate valve operation on page 80*

#### Related topics

- *Electrical system principles on page 137*

## Hoist control operation

The hull unit will normally be controlled from the operator's position using the Remote Control Unit (RCU).

### Important remote control information

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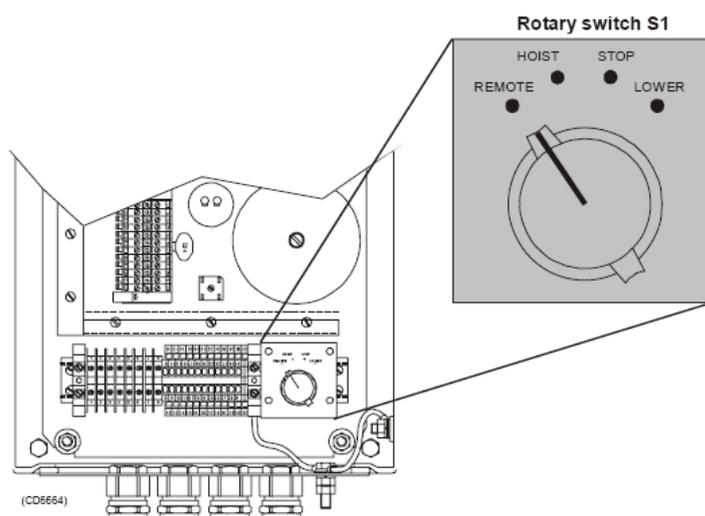
### Warning

***When the system is under remote control the hull unit will move without warning, so ensure;***  
***- Personnel and equipment are kept well clear***  
***- The gate valve is open.***  
***- Check that the link HTCB1 20 – 21 is not mounted in the Hoist Control Unit. This to avoid damaging the transducer when lowering the hull unit.***

**Link HTCB1 20 – 21 should only be mounted if the gate valve with no limit switch is mounted - see also drawing on page 192.**  
**Always set the rotary switch S1 to STOP before approaching the hull unit.**

If the hull unit must be raised or lowered for maintenance purposes, **the HCU must be used**. The HCU is in the vicinity of the hull unit and the maintenance engineer must have a clear view of the hull unit while it is being raised or lowered. The engineer will then be in a much better position to start and stop the unit as required.

The HCU incorporates a rotary switch, **S1**, which is used to raise or lower the hull unit locally.



*Figure 10 Hoist Control Unit - switch S1*

**Before you start lowering/raising the hull unit, check to ensure that:**

- 1 No maintenance work is being performed on the hull unit.
- 2 There are no obstructions around the hull unit which could prevent it from moving (or jam it while it is moving).

### **Lowering the hull unit**

- 1 Ensure that the gate valve is open.
- 2 Open the HCU door.

- 3 Set rotary switch S1 to **LOWER**.
- 4 Once the hull unit has reached the required position, set the switch S1 to **STOP**.  
The hull unit will stop automatically when it reaches its fully lowered position. Once it has stopped, set the switch to **STOP** to prevent the unit from moving in the event of a fault.
- 5 Close the HCU door.

### **Raising the hull unit**

- 1 Open the HCU door.
- 2 Set rotary switch S1 to **HOIST**.
- 3 Once the hull unit has reached the required position, set the switch S1 to **STOP**.  
The hull unit will stop automatically when it reaches its fully raised position. Once it has stopped, set the switch to **STOP** to prevent the unit from moving in the event of a fault.
- 4 Close the HCU door.
- 5 If the hull unit is to be left in fully raised position for some time, you are advised to close the gate valve.

### **Stopping the hull unit**

If the hull unit must be stopped at any position other than fully raised or fully lowered, set the rotary switch to **STOP** at the appropriate time.

Always set the switch to **STOP** before commencing maintenance work on the hull unit.

### **Remote operation of the hull unit**

Once you have completed all operations requiring local control of the hull unit, ensure all personnel, tools etc. are clear of the hull unit and set the rotary switch S1 to **REMOTE**. The hull unit is then controlled by the RCU located in the vicinity of the operator station.

## **Remote control operation**

The operator uses the control buttons on the RCU to raise and lower the hull unit from the vicinity of the operator station.

The RCU holds the following three control buttons (with indicator lamps):

- RAISE / UP
- STOP
- LOWER / DOWN

The unit also holds a dimmer potentiometer for adjusting the light intensity.



Figure 11 Remote Control Unit

## Control buttons

The control buttons have the following functions:

<b>RAISE/UP</b>	This control button initiates the transducer raising function.
<b>STOP</b>	This control will stop all movement of the hull unit. It can be activated at any time. To continue the operation, you must press the <b>RAISE / UP</b> button or the <b>LOWER / DOWN</b> button.
<b>LOWER / DOWN</b>	This control initiates the transducer lowering function.

## Indicator lamps

The indicator lamps operate as follows:

<b>RAISE / UP</b>	This lamp will be lit when the hull unit is in the fully raised position.
<b>STOP</b>	This lamp will be lit whenever the hull unit is stationary.
<b>LOWER /DOWN</b>	This lamp will be lit when the hull unit in the fully lowered position.

---

**Note** *The **STOP** button can be pressed at any time to stop the unit.*

---

**Note** *If movement of the shaft is obstructed between the raised and lowered positions, (for example you could have pressed the **LOWER/DOWN** button without first opening the gate valve), a motor protection relay will trip and cut off power to the hoist motor. The **STOP** lamp will be lit. To restart the motor, it must be reset.*

---

## Motor reset

To reset the motor, press the Reset button on the motor protection relay in the HCU.

→ Refer to the figure on page 49

## Hoist control operation from Operator Station/APOS

---

**Caution** *Check the water depth before lowering the transducer to avoid damaging the transducer.*

---

APOS will automatically display an icon in the toolbar for each hull unit that is available for remote control.



This icon is displayed when the hull unit is in the upper position.



Any other position changes the icon to red colour.

## Operating the Hoist Control from APOS

1 Press the icon to enter the control dialog:

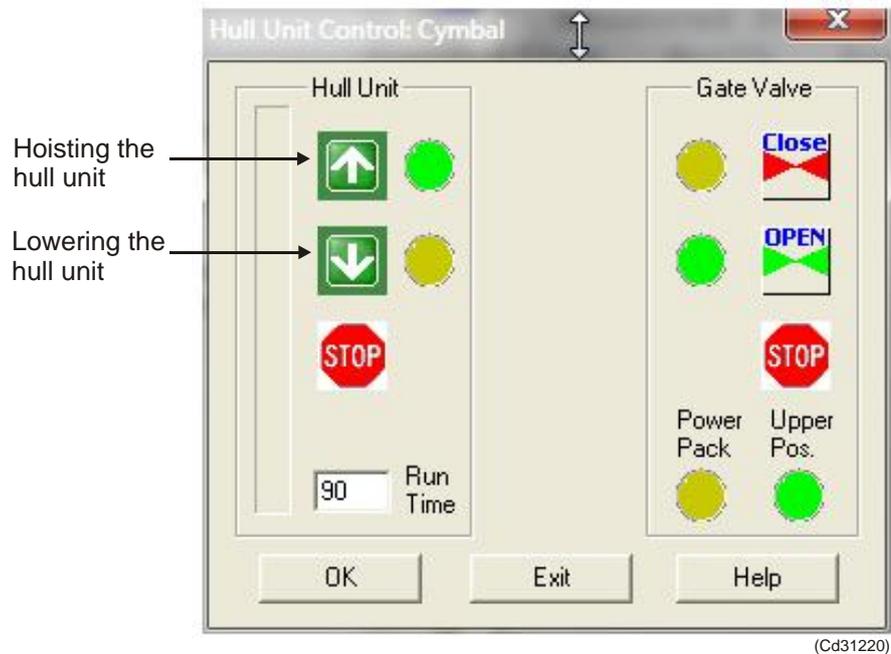
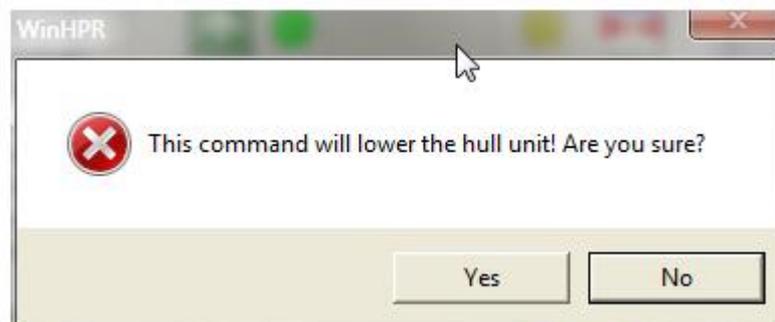


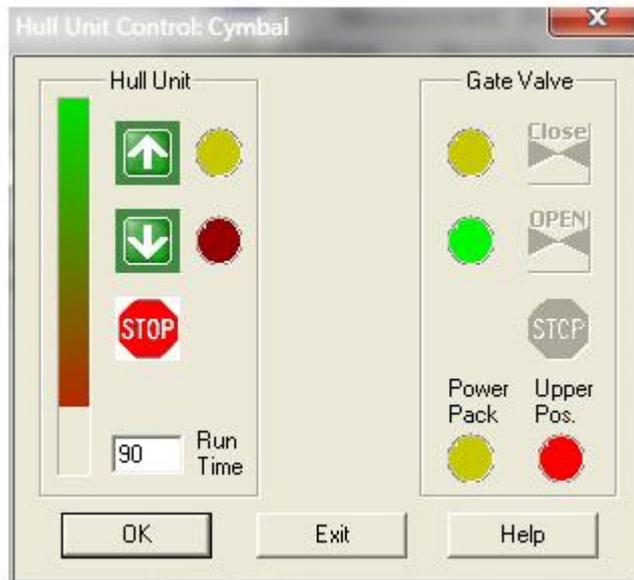
Figure 12 Hoist Unit Control dialog

- The Figure 12 shows the hull unit in the upper position and the gate valve open.
- In this case all buttons are enabled. One can either lower the hull unit or close the gate valve.

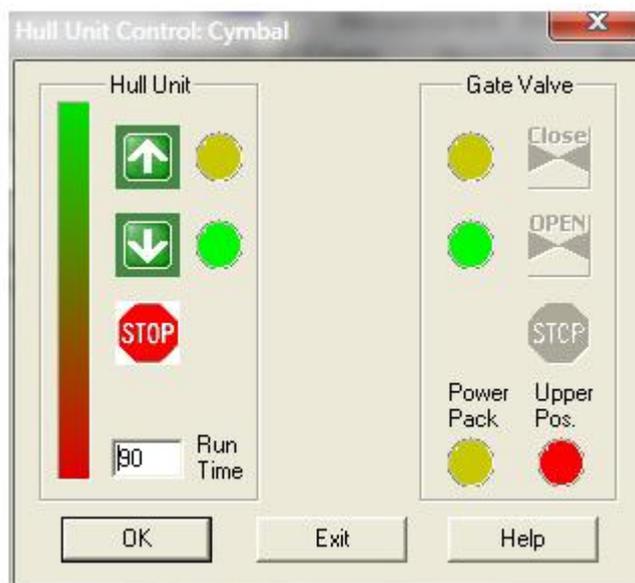
2 Selecting the  arrow for the hull unit will first show a warning dialog:



3 Selecting **Yes** will start lowering the hull unit.



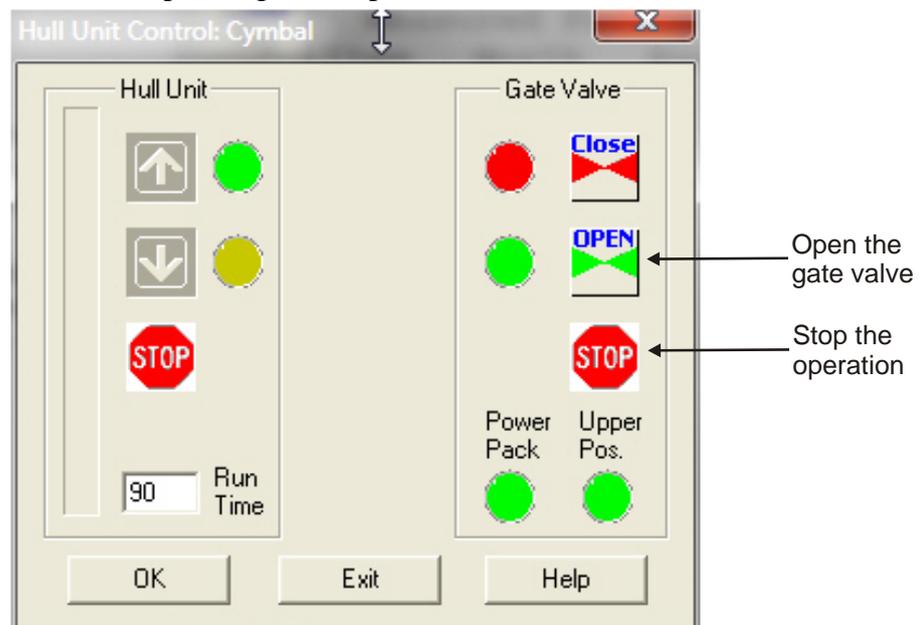
- The indicator beside the down arrow will start flashing while the hull unit moves.
  - The operation will take approximately 90 seconds for a standard hull unit. The progress bar to the left will mimic the operation.
  - It is possible at any time to stop lowering/hoisting by pressing the Stop button.
  - When the hull unit is lowered, the gate valve buttons are disabled.
- 4 When the hull unit is fully extracted, the dialog will look as shown below:



## Gate Valve

### Opening the gate valve

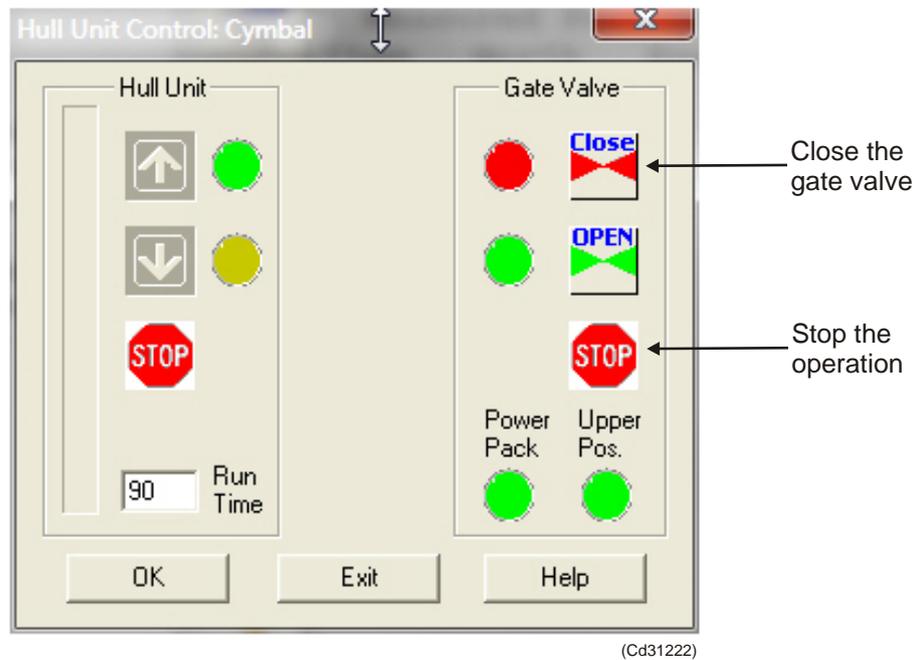
- 1 Select the Open button to start the operation and the accompanying indicator will start to flash green.
  - The gate valve must be fully open before the hull unit up/down buttons are enabled.
  - It is possible at any time to stop closing/opening by pressing the Stop button.



(Cd31221)

## Closing the gate valve

Note *It is only possible to close the gate valve when the hull unit is in the upper position.*



- 1 Select the Close button to start the operation and the accompanying indicator will start to flash red.
  - The hull unit signal "Upper position" must be green before the close operation can start.
  - The hoist control buttons are disabled if the gate valve is not fully open.
  - It is possible at any time to stop closing/opening by pressing the Stop button.
  - The gate valve must be fully open before the hull unit up/down buttons are enabled.

---

## Manual operation of the hoist motor

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**Caution**                      *Check the water depth before lowering the transducer to avoid damaging the transducer.*

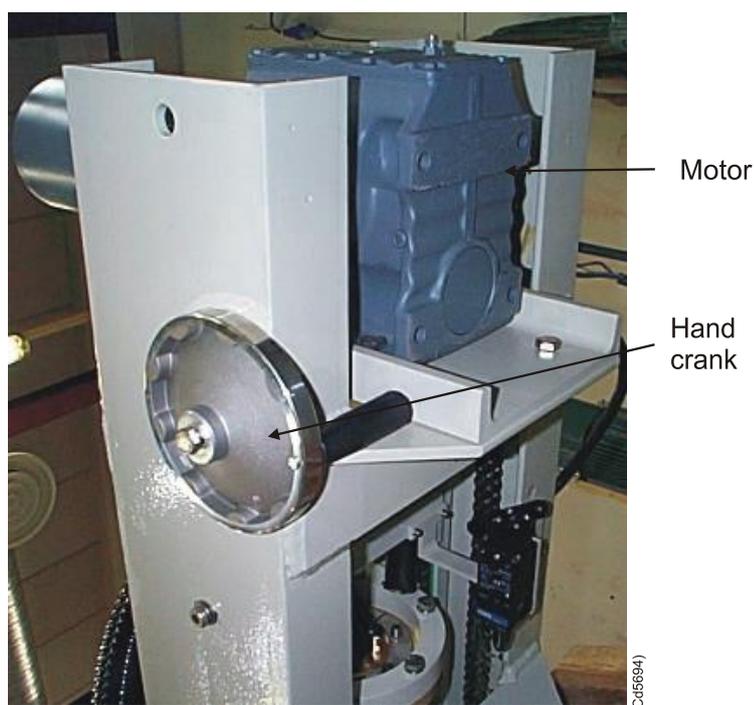
---

A hand crank is provided. It is stowed on the hoist platform. Attach the hand crank to one end of the motor shaft. With this you can raise or lower the transducer manually in the event of a power failure or for maintenance purposes.

- The motor has an internal brake mechanism which must be released manually, if you are to use the hand crank.

**Note**                              *Ensure that power to the hull unit is switched off before using the handle.*

---



*Figure 13 Hand crank stowed*

### Procedure

- 1 Loosen the hand crank from the hoist platform.
- 2 Then put on the hand crank on the top of the motor.
- 3 Tighten the screw (on the top of the motor/gearbox - see figure below) until you are able to turn the motor shaft with the hand crank.

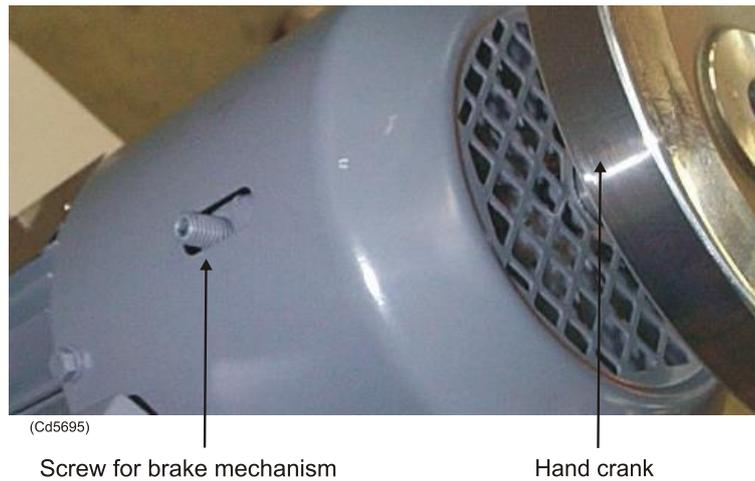


Figure 14 Brake mechanism screw

---

#### Caution

After the manual operation is complete remember to:

- Loosen the screw.
- Remove the hand crank and put it back into storage.

---

#### Warning

**For safety reasons, always keep the gate valve closed when the hull unit is in fully raised position and the break is released.**

---

### Gate valve operation

If a hydraulic system for operation of the gate valve is fitted (option), the gate valve will normally be open / closed using the remote / local unit of the hydraulic system.

However, in the event that the gate valve must be closed or opened for maintenance purposes, use the manual hand wheel.

## 7 MAINTENANCE

This chapter contains information on how to perform all normal preventive and corrective maintenance on the HiPAP® hull units system.

- The procedures are identical for all HiPAP® system.
- The technical descriptions included in this manual are intended to be used by maintenance technician and / or fitters.

---

**Note**

*If your organization (or vessel) does not have the appropriate personnel available, you are strongly advised to contact either Kongsberg Maritime or your dealer for assistance.*

---

**Warning**

***Kongsberg Maritime accepts no responsibility for any damage or injury to the system, ship or personnel caused by drawings, instructions and procedures not prepared by Kongsberg Maritime.***

***Neither Kongsberg Maritime nor our dealers will accept responsibility for damage or injury to the vessel, system or personnel resulting from incorrect maintenance performed on the system.***

---

### Topics

- *Safety on page 82*
- *Before you start on page 83*
- *Maintenance philosophy on page 83*
- *Maintenance schedule on page 84*
- *Shaft sleeve and shaft, special attention on page 84*
- *Watertightness test on page 85*
- *Preventive maintenance on page 86*
- *Corrective maintenance on page 92*

### Related topics

- *Torque on page 36*
- *Tools on page 36*
- *Grease for shaft and chain on page 26*
- *Gear oil on page 27*
- *Spare parts on page 124*
- *Drawings in the Drawing file chapter from page 171*

## Safety

Refer to standard company/vessel safety procedures before commencing maintenance work.

- *See also High voltage safety warning on page II in this manual.*

---

### Note

*After any maintenance work, the system must be checked to ensure it works correctly. Refer to the procedure in the Test and alignment procedures chapter.*

---

## Before you start

**Before you start performing any maintenance**, inform the control room that you are about to carry out maintenance on the hull unit, and that the hull unit will be switched off while the maintenance is being carried out.

## Maintenance philosophy

The maintenance philosophy recommended by Kongsberg Maritime is:

- On-board maintenance should be carried out by a maintenance engineer, with the assistance of the operator. The maintenance should include the following:
  - Calibrations
  - Simulations
  - Functional tests
  - Traditional troubleshooting based on a good knowledge of the system.
- Replacement of faulty parts should be limited to the line replaceable units (LRUs) recommended in the spare parts list.

---

### Note

*To reduce the number of spare boards required, standard circuit boards without software may be provided. In the event of a replacement becoming necessary, the software on the faulty circuit board must then be transferred to the new board. Any links and switches on the new circuit board must also be set as on the old board.*

---

Whenever a faulty unit has been replaced, the unserviceable unit should be sent to Kongsberg Maritime, or an appointed dealer, for repair.

---

### Note

*If maintenance work must be performed on the “wet” sections of the hull unit, always perform a watertightness test before breaking the watertight integrity of the hull unit.*

→ Refer to page 85

---

## Maintenance schedule

Maintenance routines must be performed regularly and effectively to ensure that the equipment is kept in top condition. Effective maintenance is even more important with the equipment described in this manual, as a faulty unit could have disastrous consequences in the presence of an inflammable atmosphere.

The chart below states the **maximum** recommended intervals at which the various routines should be performed - the intervals should be decreased if the system is used excessively, or if the maintenance engineer considers it necessary.

### Maintenance chart

Routine	Frequency
Hull unit general inspection	Annual
Filling motor gearbox	Annual
Filling shaft sleeve	Annual
Cleaning transducer	Annual
Lubricating drive chains/sprockets	2 months
Lubricating elevator screw and nut	2 months
Cleaning transducer shaft	2 months
Cleaning transducer	Regularly
Inspection of junction box	6 months
Hoist Control Unit general inspection	Annual
Remote Control Unit general inspection	Annual
Gate valve OPEN/CLOSE	2 weeks
Actuator	Annual

### Shaft sleeve and shaft, special attention

Special attention must be given to the shaft sleeve and transducer shaft. The sleeve contains several seals, and these will wear as the transducer is lowered and raised. It is therefore important that you:

- Keep the transducer shaft clean, and remove growth and dirt.
- Keep the transducer shaft oiled at all times.
- Keep the shaft sleeve filled with grease at all times.

If the shaft becomes dirty or the shaft sleeve runs dry, the seals will wear faster. This will in turn lead to leaks, and the seals will then need to be replaced.

## Watertightness test

The hull unit compartment is located in the keel of the vessel below the water-line. Maintenance on the hull unit must therefore be carried out with care to ensure that no water leaks occur.

It is important to check that the gate valve below the hull unit is closed and watertight before any maintenance procedure is performed that involves breaking the watertight integrity of the hull unit.

### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Anyone trained in the procedure.

**Vessel location** - Afloat.

**Special tools** - None.

### Procedure

The procedure is as follows:

- 1 Fully raise the hull unit.
- 2 Switch off all power to the system.
- 3 Close the gate valve.
- 4 Check the gate valve is sealed by opening the air-vent cock on the top of the transducer dock.
  - A small amount of water should flow out as the pressure within the transducer dock equalises with the ambient air pressure.
- 5 When the water stops flowing, crack open the gate valve and close it again.
  - Water should start flowing out of the air-vent when the valve is cracked open, and should cease soon after it is closed again. This action will prove that the lack

of water flow is because the gate valve is sealed, and not merely because the air-vent cock is blocked.

Once the test has been performed satisfactorily, you can assume that it is safe to continue with the required maintenance routines.

---

**Caution**

*If for any reason there is a delay between performing the watertightness test and starting the maintenance, play safe - perform the test again.*

---

## Preventive maintenance

### Topics

- *Lubrication on page 86*
- *Hull unit inspection on page 87*
- *Hoist Control Unit inspection on page 89*
- *Remote Control Unit inspection on page 90*

### Lubrication

- *Refer to Drive chains lubrication on page 96*
- *Refer to Hoist motor, gear box lubrication 92*

Several parts of the hull unit must be inspected to ensure the correct amounts of lubricants are present. The following points must be checked:

- 1** The gearbox - Oil level shall be to the top screw on the side of the unit.
  - Oil type: SAE 30 motor oil.
  - 1 litre of oil is needed if the gear box is empty.
- 2** The shaft sleeve - The transducer shaft must be covered with a **thin** film of grease.
  - Grease type: *Exxon Mobil Mobile EP2* (or equivalent)
  - Approx. 1.5 kg of grease on shaft sleeve and chains.
- 3** The drive chains and sprockets - The drive chains must be lightly greased to ensure smooth operation and prevent corrosion.
  - Grease type: *BIRAL VG/HT* (or equivalent).
  - Approx. 1.5 kg of grease on shaft sleeve and chains.

- 4 The transducer shaft guide rails - The guide rails ensure the transducer shaft remains correctly orientated relative to the vessel at all times. These guides must be checked at regular intervals and adjusted as necessary.
  - Grease type: *BIRAL VG/HT* (or equivalent).
- 5 **Limit switches** - The limit switches are activated by rotating arms. These arms are mounted on bearings, and are fitted with wheels to reduce friction. A few drops of oil on the moving parts at regular intervals will help to keep the switches trouble-free.

### **Hull unit inspection**

The hull unit must be inspected at regular intervals and if it has not been used for an extended period of time.

#### **Logistics**

**Safety** - Refer to the general safety procedures.

**Personnel** - Trained maintenance/inspection engineer.

**Vessel location** - Afloat.

**Special tools** - None.

**Spare parts** - Depending on the results of the inspection.

#### **Procedure**

- 1 Switch off power to the system in the Hoist Control Unit.
- 2 Check all power and signal cables for signs of damage or overheating.
- 3 Open all the junction boxes and check all cable terminations to ensure they are tight. Close the boxes firmly on completion.
- 4 Check all cable glands to ensure they seal correctly.
  - Refer to the Cable gland assembly procedure in the Cable layout and interconnections section if a gland is found to be loose.
- 5 Check around the hull unit, especially around the mounting flange for signs of water leakage.
  - If water is detected, find the leak. Tighten the bolts to close the leak, or refer to the appropriate procedure and replace the appropriate seals.
  - Leakage rate:

- 6 Check for signs of damage to the transducer shaft, for example scratches on the shaft surface, or sea growth. Clean if necessary.
  - If serious damage is detected, the shaft may need to be replaced. If in doubt, consult Kongsberg Maritime or your dealer.
- 7 Check the motor gear box for signs of oil leaks.
- 8 Check the oil level in the gear box and fill as necessary.
- 9 Check the transducer shaft to ensure that it is correctly lubricated.
  - The shaft should be covered with a thin film of grease when it is raised. Refill the shaft sleeve when necessary.
- 10 Check the entire hull unit assembly for signs of corrosion.
  - If required, clean the corroded areas and apply the appropriate preservation mediums.
- 11 Check the tension of the drive chains and adjust if necessary.
  - *Refer to procedure on page 97*
- 12 Check that the upper and lower limit switches are securely and correctly located, and operate correctly.
- 13 When the inspection is completed (other units may also need to be inspected), re-apply power to the system.
- 14 Hoist the transducer to its upper position.
- 15 Inspect the transducer.
  - *Cleaning the transducer - see page 104*
  - *Replacing a zinc anode - see page 113*

If necessary, check that the system operates correctly by performing the system test procedure described in the *Test and alignments procedures* chapter.

**List of spare parts:**

→ *Refer to the Spare parts chapter from page 124*

## Hoist Control Unit/Hoist Control Unit with Ethernet interface inspection

The HCU must be inspected at regular intervals, and before use, if it has not been used for an extended period.

### Logistics

**Special tools** - None.

**Spare part** - Depending on results of inspection.

### References

#### Drawings:

→ *Drawings in the Drawing file chapter from page 171*

### Procedure

- 1 Switch off all power to the system and remove the system fuses.
  - Power to the unit can be switched off using breaker F01. However this will not disconnect the mains voltage from the unit, so we recommend that you also remove the fuses in the ship's ac supply to the unit.
  - Label the fuse panel to inform others that maintenance work is being carried out.
- 2 Check that all cable glands are correctly and tightly mounted into the unit, and seal on the cables passing through them.
- 3 Check also that there is no tension on the cables.
- 4 Open the HCU.
- 5 Check for signs of condensation or corrosion.
  - Dampness or corrosion indicates either that the equipment room is not properly ventilated and dry, or that the unit's door is not closed correctly. Investigate, and correct the fault.
- 6 Check that all cable terminations are tight, and that there is no indication of overheating.
  - If a cable termination is not tight, the bad connection will probably result in overheating, leading to more serious damage.
- 7 Check that all component units (relays, breakers, circuit boards etc.) are tight on their mounting rails.

- 8 Check that all manually operable switches and breakers operate smoothly.
  - Refer to Corrective Maintenance for part replacement procedures.
- 9 Refer to Spare Parts for a complete list of the spare parts available.
- 10 On completion of the inspection (other units in the system may also need to be inspected) replace the system fuses and apply power to the system.
- 11 If necessary, check that the system operates correctly by performing the appropriate test procedures

### **Remote Control Unit inspection**

The RCU must be inspected at regular intervals, and before use, if it has not been used for an extended period.

#### **Logistics**

**Special tools** - None.

**Spare part** - Depending on results of inspection.

#### **References**

##### **Drawings:**

→ *Drawings in the Drawing file chapter from page 171*

#### **Procedure**

- 1 Switch off all power to the system and remove the system fuses.
  - Power to the RCU can be switched off using breaker F01 in the HCU.

---

#### **Note**

*This will not disconnect the mains voltage from the Hoist Control Unit, so if you intend to perform maintenance on that unit we recommend that you also remove the fuses in the ship's ac supply to the unit.*

---

- Label the fuse panel to inform others that maintenance work is being carried out.
- 2 Check that the cable gland is correctly and tightly mounted into the unit, and seals on the cable passing through it. Check also that there is no tension on the cable.

- 3** Open the RCU and check for signs of condensation or corrosion.
  - Dampness or corrosion indicates either that the compartment is not properly ventilated and dry, or that the unit's cover is not closed correctly. Investigate, and correct the fault.
- 4** Check that all cable terminations are tight, and that there is no indication of overheating.
  - If a cable termination is not tight, the bad connection will probably result in overheating, leading to more serious damage.
- 5** Check that all component units (pushbuttons, lamps etc.) are tightly secured into the unit.
- 6** Check that the pushbuttons operate smoothly.
- 7** Replace the front panel onto the unit.
- 8** On completion of the inspection (other units in the system may also need to be inspected) replace the system fuses and apply power to the system. If necessary, check that the system operates correctly by performing the appropriate test procedures.
- 9** Once power is restored, check that the hull unit is clear to be lowered, and then operate the RCU to ensure it operates correctly and that the lamps function.
- 10** Check that the light dimmer operates correctly.

## Corrective maintenance

Corrective maintenance on the hull unit system will be required when the system malfunctions. The design does not include a built-in test system, so troubleshooting must be based on the manuals, drawings and diagrams.

### Topics

- *Hoist motor - starting on page 92*
- *Drive chains - starting on page 96*
- *Opening the transducer dock on page 99*
- *Lifting the hull unit on page 101*
- *Transducer - starting on page 102*
- *Transducer cables on page 105*
- *Shaft sleeve - starting on page 109*
- *Zinc anode on page 113*
- *Transducer shaft on page 114*
- *Limit switches on page 115*
- *Gate valve on page 116*
- *Hoist Control Unit on page 120*
- *Remote Control Unit on page 121*
- *Test procedure on page 123*

### Hoist motor, gear box lubrication

The oil level in the motor gearbox must be checked at regular intervals, and new oil must be added when required.

### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Maintenance engineer.

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** - Oil type, see page 26.

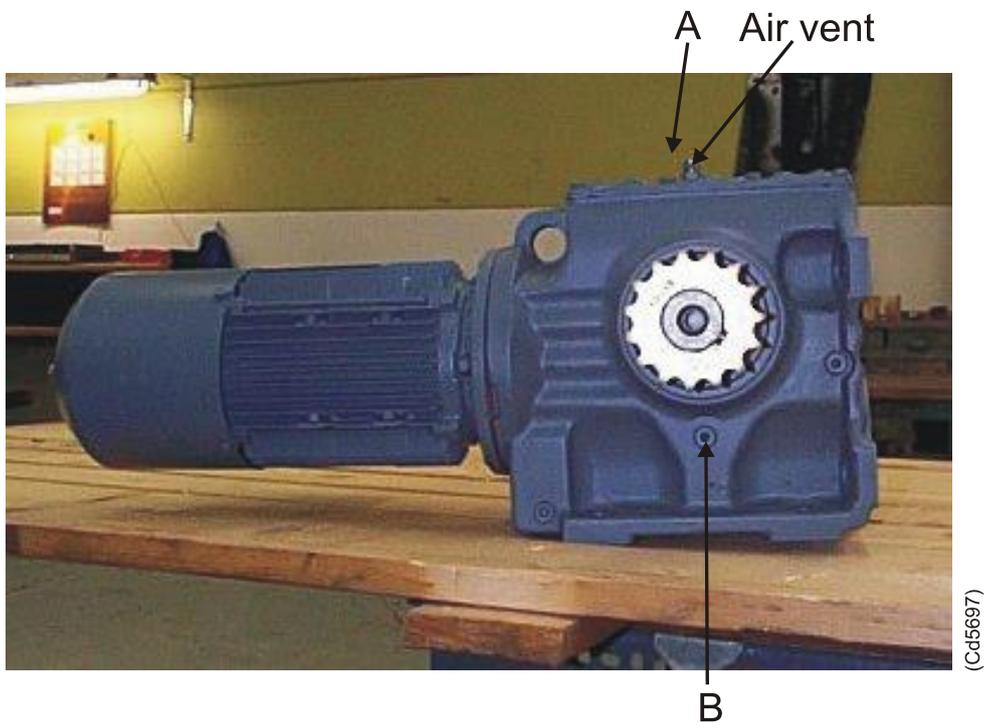


Figure 15 Hoist motor and gearbox

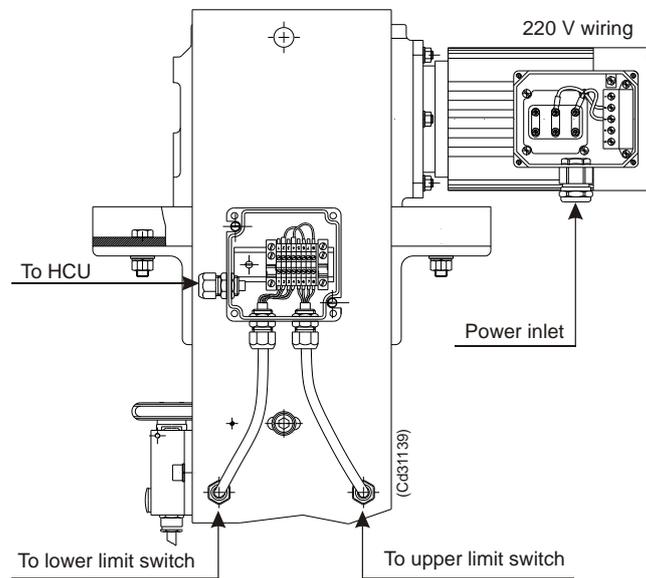


Figure 16 Hoist motor connections

### Procedure

- 1 Switch off power to the system in the HCU.
- 2 Thoroughly clean the gearbox and the surrounding area, removing all dirt and loose debris (paint flakes etc).
- 3 Remove the filler cap (A) and the level screw (B).
- 4 Fill the gearbox with oil to the level hole.
- 5 Replace the level screw and the filler cap.
- 6 Wipe off any excess oil or drips.

### Hoist motor replacement

#### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Two trained maintenance engineers.

**Vessel location** - N/A.

**Special tools** - Lifting apparatus may be required.

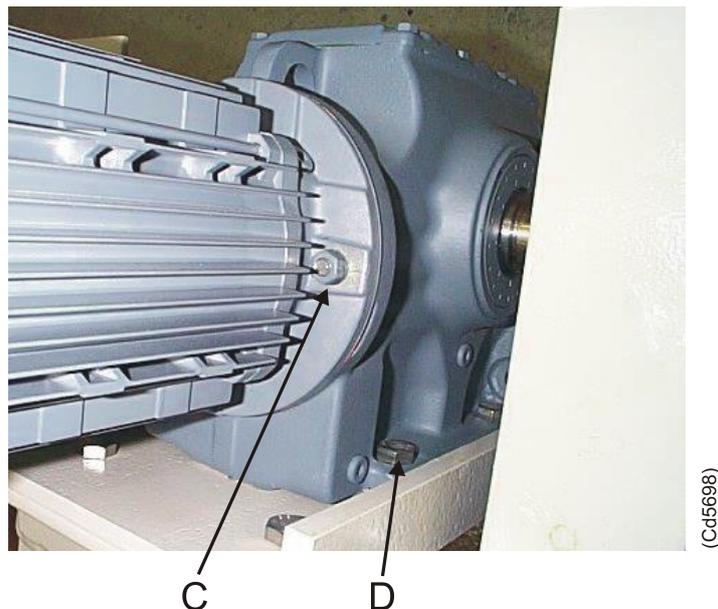
#### Spare parts -

Motor and gearbox: 331-045952

Motor (stand-alone): 331-084150

Four (4) mounting nuts/washers for motor.

*Centa* - motor manufacturer, <http://www.centa.no>.



*Figure 17 Replacing the Hoist motor and/or gearbox*

**Procedure**

- 1 Switch off power to the system in the HCU.
- 2 Clamp the transducer shaft to prevent it from sinking when the motor is disconnected.
- 3 Open the junction box on the motor, label and disconnect all the cables.
- 4 Unscrew the four mounting nuts (C).
- 5 Pull the motor straight off the gearbox.

If the motor is to be sent away for repair, close the gap in the motor brake by mounting the cover plate.  
(This cover plate was supplied initially with the hull unit, and was used for this purpose prior to the motor installation.)

**Reassembly:**

- 1 Insert the new motor, and secure it in position with the four nuts.
- 2 Reconnect the cables.
- 3 Remove the transducer shaft clamp.
- 4 Perform the system test as described in the *Test and alignment procedures* chapter.

**Hoist motor, gear box replacement**

The motor assembly on the top of the gantry comprises two main parts; the motor and the gearbox. This procedure explains how to replace the gear box.

**Logistics**

**Safety** - Refer to the general safety procedures. Note that the various parts are heavy.

**Personnel** - Two trained maintenance engineers.

**Vessel location** - N/A.

**Special tools** - A lifting apparatus may be required.

**Spare parts -**

Motor and gearbox: 331-045952

Gear box (stand-alone): S62A B3 A+B 1:158.08 Ritzel Ø12.

Four (4) mounting bolts M12x50, M12 nuts, washers and spring washers.

### **Procedure**

- *Refer to the figure on page 94.*
- 1 Switch off power to the system in the HCU.
  - 2 Clamp the transducer shaft to prevent it from sinking when the motor is removed.
  - 3 Slacken the drive chains and lift them off the drive sprockets.
  - 4 Support the motor / gearbox unit then remove the four (4) mounting nuts/bolts / washers (**D**) which secure the gearbox to the motor platform on the hull unit gantry.
  - 5 Lift the motor/gearbox off the top of the hull unit and place it on a clean, stable work bench.
  - 6 Remove the sprocket wheels from the drive shaft using a wheel puller.
  - 7 Fit the sprocket wheels onto the new gearbox.
  - 8 Move the motor to the new gearbox if necessary.
  - 9 Lift the motor/gearbox assembly onto the hull unit motor platform and secure it in position using the four mounting nuts / bolts / washers (**D**).
  - 10 Lift the drive chains onto the sprocket wheels, and then check/adjust the tensions in the chains.  
→ *Refer to procedure on page 97.*
  - 11 Reconnect the electrical cables.
  - 12 Remove the transducer shaft clamp

### **Drive chains lubrication**

The drive chains must be kept lubricated to ensure smooth operation and to prevent corrosion. Inspect the chains at regular intervals, and before use, if the hull unit has not been used for an extended period.

### **Logistics**

**Safety** - Refer to the general safety procedures.

**Personnel** - Maintenance engineer.

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** - Grease type, see page 26

**Procedure**

- 1 Switch off power to the system in the HCU.
- 2 Inspect the drive chains looking for corrosion or dry areas.
  - If old grease has congealed or is badly contaminated with dirt etc, clean the effected areas using a scraper, solvents and cloths.
- 3 Inspect the sprockets for signs of wear and corrosion.
- 4 Clean off any corrosion with a chemical rust remover.
- 5 Check the tension in the drive chains, adjust the tension if necessary.  
→ *See below.*
- 6 Lubricate the chain and sprockets using grease type *BIRAL VG/HT* or similar. Apply using a suitable brush.
- 7 Wipe off excess grease and clean up any drips.

**Drive chains tension**

To operate correctly without damaging the various shafts and bearings, the drive chains must be at the correct tension. The chains' tensioning devices are located on either side of the base of the hull unit gantry. There is one device for each drive chain. The devices raise or lower the lower sprocket bearings independently, so adjustment of one chain has no effect on the other.

**Logistics**

**Safety** - Refer to the general safety procedures.

**Personnel** - Trained maintenance engineers.

**Vessel location** - N/A.

**Special tools** - None.

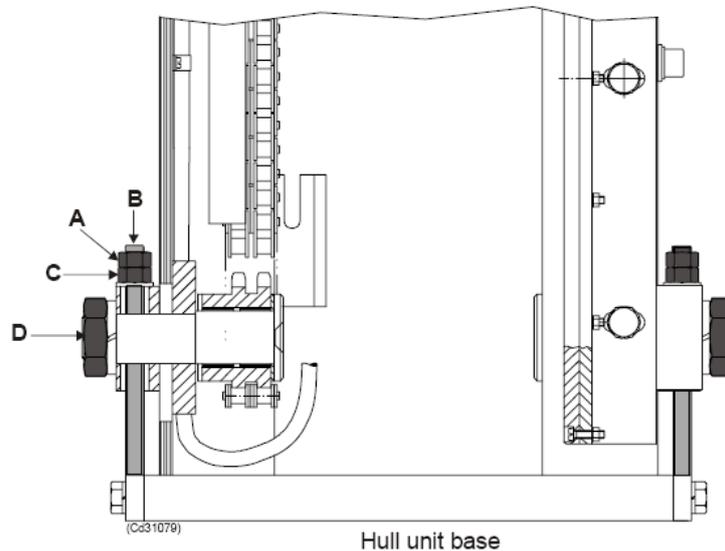
**Special tools** - 12 mm block. Spring-balance (0 - 15 kg).

**Spare parts** - None.

**Test procedure**

- 1 Ensure there is sufficient water below the vessel.
- 2 Open the gate valve.
- 3 Lower the transducer shaft to the fully lowered position.
- 4 Switch off power to the system in the HCU.

- 5 Place a 12 mm block against the inside of the gantry frame, midway between the chain sprockets.
- 6 Using a spring-balance, pull the chain against the block.
  - The tensions must be adjusted such that a force of 9-10 kg is required to pull the chain against the block.
- 7 Grip the chain at the mid-point between the upper and lower chain sprockets. Using reasonable force, attempt to push and pull the chain horizontally in the directions in which the chain would normally bend.
  - It should be possible to move the chain a total of between 1 and 2 cm.



*Figure 18 Tensioning the drive chains*

### **Adjusting the tension**

- 1 Slacken lock-nut (**A**) on tension adjustment bolt (**B**).
- 2 Slacken sprocket bearing nut (**D**) by 1/2 turn.
- 3 Adjust tension adjustment nut (**C**) to achieve the correct tension in the chain.
- 4 Tighten the sprocket bearing nut and the lock-nut.
- 5 On completion, check the chain tension. It may have altered as the nuts were tightened.

## Drive chains replacement

The drive chains transmit the force from the hoist motor to the transducer shaft, to raise or lower the shaft.

### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Trained maintenance engineers/fitters.

**Vessel location** - N/A.

### Spare parts -

Duplex chain (top)	529-047577
Duplex chain (bottom)	529-047575
Guide rail	599-051130
Guide rail	599-051126
Joint	529-047580

### Procedure

Both drive chains should be replaced at the same time.

- 1 Slacken the chains.
- 2 Find and remove the joints, and disconnect the chains from the transducer shaft.
- 3 Replace the chain.
- 4 Adjust the tension.

→ *Refer to page 97*

## Opening the transducer dock

If the hull unit has a transducer dock, gaining access the transducer and the other “wet” parts of the hull unit is a simple operation.

### Logistics

**Safety** - Refer to the general safety procedures. Perform a watertightness test before breaking the watertight integrity of the hull unit.

**Personnel** - Two trained maintenance engineers/fitters.

**Vessel location** - N/A.

**Special tools** - Length of hose pipe. Jubilee clip.

**Spare parts** - Hatch seal 540-084245

### **Procedure**

- 1 Raise the transducer to the fully housed position.
- 2 Switch power off at the HCU.
- 3 Close the gate valve and perform the watertightness test.  
→ *Refer to page 85*
- 4 Secure one end of a suitable length of hose to the drain tap on the inspection hatch, and place the other end in the bilge or in a suitable container.
- 5 Open the air vent on the top of the inspection dock, and the drain tap, and drain the inspection dock.
- 6 Slacken and remove the retaining bolts/nuts around the inspection hatch perimeter, then using suitable lifting apparatus carefully remove the inspection hatch.

---

### **Warning**

***Warning The hatch is heavy. If the operation is being conducted while the vessel is at sea, ensure the hatch is lashed to prevent it swinging should the vessel roll.***

---

- 7 Use a sponge or cloths to soak up any remaining water and wipe clean the interior of the dock and gate valve.
- 8 Perform the required maintenance routines.
- 9 On completion of the maintenance work, ensure that no rubbish, tools etc. have been left in the dock, and then replace the inspection hatch.
- 10 Tighten all the hatch bolts to the correct torque.
- 11 Perform the system test as described in the *Test and alignments procedures from page 152.*

## Lifting the hull unit

If the hull unit does not have a transducer dock, the entire hull unit must be lifted off the gate valve to gain access to the transducer.

### Logistics

**Safety** - Refer to the general safety procedures. Perform a watertightness test before breaking the watertight integrity of the hull unit.

**Personnel** - Three to four trained maintenance engineers/fitters

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** - None.

### Procedure

- 1 Raise the transducer to the fully housed position.
- 2 Switch off power to the system at the HCU.
- 3 Close the gate valve, and perform the watertightness test.  
→ *Refer to page 85*
- 4 Write down the colour coding and connections, then remove all electrical cables to and from the hull unit.
- 5 Secure a tackle capable of lifting the entire hull unit (1500 kg) to the deck head above the hull unit, and attach the tackle to the unit using the lifting eyes provided.
- 6 Tighten the lifting tackle, taking the weight of the hull unit.
- 7 Mark the positions of the bracing beams and the transducer dock relative to the gate valve to minimize changes in the hull unit alignment.
- 8 Remove the bracing beams supporting the hull unit.
- 9 Remove the bolts attaching the transducer dock to the gate valve flange.
  - The water contents of the dock will leak out, but not under pressure. The dock must remain attached to the unit to protect the transducer.
- 10 Carefully hoist the hull unit off the gate valve.
  - If there is not enough headroom above the unit to enable it to be raised high enough for the engineer to

gain access to the transducer, the transducer dock may be pulled to one side and the unit laid on the deck alongside the gate valve.

- The hull unit must be supported to ensure it does not swing if the vessel moves. Protect the gate valve with a wooden cover to ensure the mating surface is not damaged during the operation.
- 11** Lower the transducer using the hand crank until the transducer is fully exposed.
    - If the motor is not accessible for manual operation, the transducer dock may have to be removed to gain access.
  - 12** Perform the required maintenance routines.
  - 13** On completion of the maintenance work, ensure that no rubbish, tools etc. have been left in the dock, and then replace the hull unit by following the above procedure in reverse.
  - 14** Tighten all the bolts to the correct torques.
  - 15** Reconnect all the electrical cables.
  - 16** Perform the system test as described in the *Test and alignment procedures from page 152*.

## **Transducer replacement**

The following procedure describes the removal of the transducer for repair or service under normal conditions.

- A new transducer can be installed by following the same procedure in reverse.

---

### **Caution**

*The transducer locating pin and zero mark must be in the correct positions.*

---

### **Logistics**

**Safety** - Refer to the general safety procedures. Note that the various parts are heavy.

**Personnel** - Three to four trained maintenance engineers/fitters.

**Vessel location** - N/A.

**Special tools** - Depending on procedure.

**Spare parts** - Depending on procedure.

---

**Procedure**

- 1 Gain access to the transducer.  
→ Refer to pages 99 / 101
- 2 Remove loose marine growth, seaweed or mud using a stiff, plastic-bristled brush and copious amounts of water.
- 3 Place suitable planks and pads onto the gate valve, then using the crank handle lower the transducer onto the pads so it will not fall as the bolts are removed.  
Ensure the transducer face is not damaged.
- 4 Flatten down the lugs on the retention plates (if fitted) and remove the bolts attaching the transducer to the shaft flange.

---

**Caution**

*The transducer weighs approximately 60/30 kg, and must be securely supported during the removal procedure.*

---

- 5 Using the crank handle, raise the shaft away from the transducer.
  - The transducer may be retained on the shaft by a vacuum within the flange, and some force may be required to remove it.
- 6 Remove the transducer to an appropriate work area. Extreme care must be used to ensure the transducer face is not damaged during the operation.
- 7 Replace the transducer.
  - The replacement procedure is the reverse of the removal procedure.
  - Ensure that the transducer alignment pin is fitted to orientate the transducer correctly.
  - Ensure that the O-rings and lock washers are used.

## **Transducer, marine growth removal**

Any marine growths on the transducer face, such as weed or crustaceans, can dramatically reduce the efficiency and accuracy of the system. The transducer must therefore be inspected and cleaned at regular intervals.

- If the hull unit is fitted with a transducer dock, open the hatch to gain access to the transducer.
- If the hull unit is not fitted with a transducer dock and the vessel is not in a dry dock, the transducer must be checked for damage and marine growths either by lifting up the hull unit, or by sending a diver down.

### **Logistics**

**Safety** - Refer to the general safety procedures. Perform a watertightness test before breaking the watertight integrity of the hull unit.

**Personnel** - Trained maintenance engineers/fitters.

**Vessel location** - N/A.

**Special tools** - Wooden or plastic scraper. Stiff, plastic-bristled brush.

**Spare parts** - None.

### **Procedure**

- 1 Gain access to the transducer.  
→ *Refer to pages 99 / 101*
- 2 Remove loose marine growth, seaweed or mud using a stiff, plastic-bristled brush and copious amounts of water.
- 3 Carefully remove any crustaceans, for example barnacles, using a round-edged wooden or plastic scraper.
  - Take great care to ensure that the face of the transducer is not damaged.

---

### **Caution**

*A wire brush or a high-pressure hose must not be used!*

---

- 4 When all accessible parts of the transducer, the shaft and the internal surfaces of the dock have been cleaned, dried and inspected, paint the internal surfaces of the dock with suitable preservation and anti-fouling paints.

---

**Caution**                    *The transducer face, shaft and anodes must not be painted.*

---

5     Close the hull unit. Refer to point 1 in this procedure.

### **Transducer cables replacement**

HiPAP® 350 cable comprises of two separate cables.

→    *Refer to page 66*

#### **Logistics**

**Safety** - Refer to the general safety procedures.

**Personnel** -

Two to three trained maintenance/electrical engineers.

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** -

Cable Y<sub>1</sub> (TD end)

Cable Y<sub>2</sub> (TC end)

→    *Refer to the Spare parts chapter from page 124*

#### **Cable Y<sub>1</sub>**

Cable from the top of the transducer, (bottom of the transducer shaft) to the top of the transducer shaft, into the junction box.

#### **Procedure**

- 1     Switch off power to the system in the Hoist Control Unit.
- 2     Switch off power to the Transceiver Unit.
- 3     Open the transducer dock.  
      →    *Procedure on page 99*
- 4     Remove the transducer.  
      →    *Procedure on page 102*
- 5     Remove the four “extended-head” bolts securing the support plate.
  - Access is through the four holes in the plug plate.

- 6** Remove the eight bolts located around the circumference of the connector plate.
  - The connector plate should now be free.
- 7** Open the junction box at the top of the transducer shaft. Disconnect the flat-cables. Remove bolts from nipple plate at the rear side of the junction box.
- 8** Remove the six socket-head screws that secure the two half-ring plates in position on the top of the transducer shaft, and remove the two half-ring plates.
- 9** Pull up the upper gland block, and remove the o-ring.
  - This will reduce the likelihood of the O-ring being damaged and will reduce the force required to pull the block down the shaft.

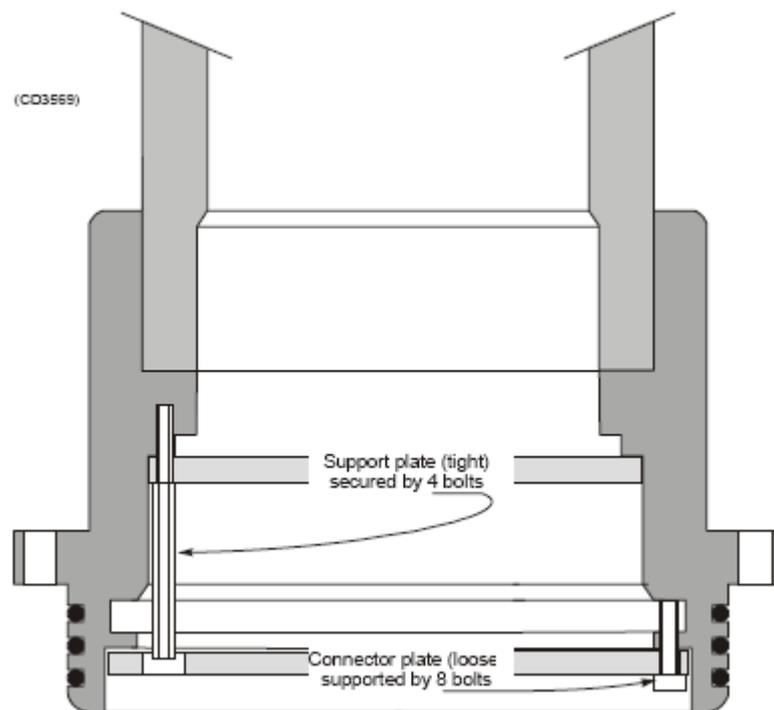
It should now be possible to pull and feed the transducer cable down the transducer shaft and out at the transducer dock.

- 10** Tie a suitable length of rope to the upper connector plate.
- 11** Withdraw the cable through the transducer dock.
- 12** Check the O-rings on the upper gland block on the new cable, replace as necessary.
  - Leave the O-rings on the cable above the gland block to reduce the pull required and reduce the likelihood of damage as they are pulled up the shaft.
- 13** Tie the rope to the transceiver connector on the new cable and carefully pull the cable up through the shaft.
- 14** Once the connector is accessible at the top of the shaft, remove the rope and continue to pull the cable up by hand.
- 15** At the appropriate time, feed the upper gland block into the bottom of the shaft.
- 16** Orient the seal plate correctly, locate it in the bottom of the shaft, and then secure it using the four “extended head” screws.
- 17** Remove the four spacer screws (located beside the access holes for the “extended head” screws).
- 18** Orient the connector plate correctly, locate it in the bottom of the shaft, and secure it using the eight screws.  
Note that the connector plate must be “floating”.

**Note**

*Do not use any washers or packing pieces here. If the screws must be replaced, ensure the new screws are the same length. The connector plate must be loose to allow some movement as the connectors on the cables and the transducer mate.*

- 19** Remove any twists from the cable in the shaft.
- 20** Lift the upper gland block up out of the shaft and fit the O-rings.
- 21** Orient the upper gland block correctly -
  - a** fit it into the top of the shaft, and then
  - b** replace the two half-rings to hold the block in position.



*Figure 19 Securing the support and connector plate*

- 22** Replace the six socket-head screws to secure the half-rings in position.
- 23** Connect the cable in the junction box.
- 24** Close the junction box.

- 25 Replace the transducer.  
→ *Refer to page 102*
- 26 Close the transducer dock.
- 27 Connect the transducer cable to the transceiver unit, and replace any cable clips.
- 28 Perform the system test as described in the *Test and alignment procedures from page 152*.

### **Cable Y<sub>2</sub>**

This cable runs from the junction box to the transceiver unit via the bracket on the hull unit to the junction box.

### **Procedure**

- 1 Switch off power to the system in the Hoist Control Unit.
- 2 Switch off power to the transceiver unit.
- 3 Unplug the transducer cable from the transceiver end.
- 4 Remove all cable clips etc. that secure the transducer cable.
- 5 Open the junction box at the top of the transducer shaft. Disconnect the d-sub.
- 6 Remove bolts from nipple plate at the side of the junction box.
- 7 Unbolt the cable bracket from the gallows.
- 8 Replace the cable.
- 9 Close the junction box.
- 10 Perform the test described in the *Cabling installation checks* on page 162.

## Shaft sleeve lubrication

The transducer shaft must be inspected at regular intervals and the shaft sleeve filled with grease as necessary.

### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Trained maintenance engineer.

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** - Grease type, see page 26.

### Procedure

- 1 Switch off power to the system at the HCU.
- 2 Clean the shaft sleeve, the filler and level/air vent screws and the surrounding area, removing all dirt and loose debris (paint flakes etc).

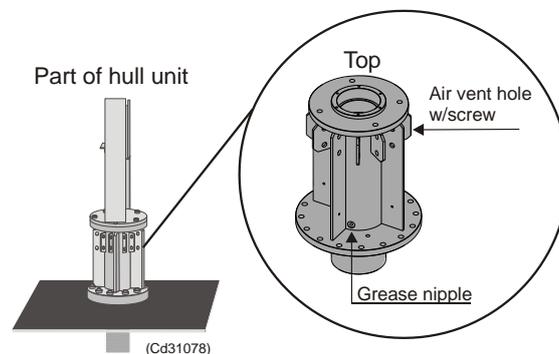


Figure 20 Shaft sleeve lubrication

- 3 Remove the air vent screw.

---

### Caution

*If the vent screw is not removed, the shaft seals can be damaged.*

---

- 4 Fill the sleeve with grease, until the grease appears at the air vent hole.
- 5 Replace the air vent screw.
- 6 Wipe off any excess grease.

## Shaft sleeve disassembly

---

### Caution

*If the shaft sleeve must be disassembled for any reason, you are strongly recommended to ask for assistance from Kongsberg Maritime. If the transducer adapter is not replaced correctly, you risk losing the transducer.*

---

To prevent water leakage and to ensure smooth raising and lowering of the transducer, the shaft sleeve is fitted with:

**At the upper end** - Lion twin-set packing seals.

**At the lower end** – U-cup (NI300-170-15) packing seals and a scraper.

The space between the seals is filled with grease to lubricate the shaft and provide extra watertight security.

When the sleeve is sufficiently filled, a thin film of grease will be observable on the transducer shaft.

---

### Note

*It is important that the shaft sleeve is kept watertight, and that the transducer shaft raising and lowering actions are as smooth as possible. If the system is in frequent use, the shaft sleeve may be exposed to sea growth, dirt and pollution as the transducer shaft is raised. Frequent inspections, and greasing when necessary, are strongly recommended.*

---

### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Two trained maintenance engineers/fitters.

**Vessel location** - N/A.

**Special tools** - Entering tool.

**Spare parts** -

Grease type - see page 26

Set of seals and bearings - see illustration on page 133.

**Procedure**

- 1** Switch off power to the system on the Hoist Control Unit.
- 2** Dismount the hull unit.
- 3** Lower the transducer manually, and clean it using a stiff, plastic-bristled brush and copious amounts of water. On completion, dry the unit carefully.
- 4** Remove the transducer from the end of the shaft.
- 5** Remove the transducer cable.  
→ *Procedures on pages 105*
- 6** Remove the transducer adapter from the end of the shaft.
- 7** Remove the transducer dock from the hull unit.
- 8** Loosen the nuts/bolts holding the upper and lower clamping rings to decompress the seals, and remove the shaft sleeve from the hull unit.
- 9** Replace the upper shaft bearing and seals as follows:
  - a** Remove the six nuts holding the upper gland clamping ring onto the sleeve.
  - b** Lift off the upper gland clamping ring.
  - c** In preparation for replacement, unscrew the six spacing bolts till the ends of the threads are flush with the surface of the clamping ring.
  - d** Extract the two parts of the upper sleeve seal and the upper sleeve bearing from the sleeve.
  - e** Clean the grease from the upper (internal) part of the shaft sleeve.
  - f** Use the entering tool, and fit a new upper shaft bearing and seals into the top of the sleeve.
  - g** Place the upper clamping ring in position and secure it loosely using the nuts.
- 10** Replace the lower shaft bearing and seals as follows:
  - a** Remove the six socket-head screws securing the lower clamping ring onto the bottom of the shaft sleeve, and then remove the ring.
  - b** Use the entering tool and extract the lower sealing ring and the lower shaft bearing.

- c** Clean the grease from the lower (internal) part of the shaft sleeve.
  - d** Fit a new lower shaft bearing using the entering tool, and new lower shaft seal, ensuring they are correctly orientated.
  - e** Fit a new scraper ring into the lower clamping ring.
  - f** Locate the lower clamping ring on the bottom of the shaft sleeve, and hold it loosely in position with the six socket-head screws.
- 11** Mount the shaft sleeve onto the hull unit gantry.

---

Note

*Ensure the shaft passes smoothly through the bearings and seals. If the seals are pinched or otherwise damaged, they must be replaced.*

---

- 12** Mount the transducer dock onto the shaft sleeve.
- 13** Replace the transducer adapter onto the bottom of the shaft.
  - Ensure the holes and bolts are scrupulously clean and all traces of grease and old loctite are removed.
  - Use new O-rings. Use Loctite 577 on the bolts, and tighten the bolts to final torque - see table on page 36.
- 14** Using new O-rings and lock washer, remount the transducer.
- 15** Remount the hull unit onto the gate valve.
- 16** Ensure the gantry is correctly orientated, then bolt it firmly into position and refit the gantry braces.
  - Ensure that the gantry is replaced as exactly as possible in its original position.
- 17** Tighten all the mounting bolts for the dock, shaft sleeve and gantry to the appropriate torques.
- 18** Tighten the six socket-head screws holding the lower clamping ring onto the shaft sleeve to final torque - see table on page 36.
- 19** Tighten the upper shaft seals against the shaft by tightening the six nuts around the upper clamping ring.
- 20** Once the upper seals are tight, tighten the six spacing bolts to fix the pressure on the seals.

- 21 Refill grease.  
→ *Refer to procedure on page 109*
- 22 If required, adjust the tension.  
→ *Refer to page 98*
- 23 Perform a system test to ensure the hull unit operates correctly.

## **Zinc anode, inspection and replacement**

### **Logistics**

**Safety** - Refer to the general safety procedures.

**Personnel** - Two trained maintenance engineers/fitters.

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** - Zinc anode, 629-076530

### **Procedure**

- 1 Switch off power to the system at the HCU.
- 2 Open the transducer dock.  
→ *Refer to page 99*
- 3 Clean the transducer and transducer dock using a stiff, plastic-bristled brush and copious amounts of water.
- 4 Inspect the anodes.
  - The anodes are bolted to the underside of the shaft sleeve.  
→ *Refer to the figure on page 131*
  - If the anodes are severely corroded, replace them. If not, assess the extent of the corrosion and the time since the previous inspection, and estimate when the anodes will require replacing.
  - Program another inspection for a date some time before the anodes will need to be replaced.
- 5 On completion, close the transducer dock.

## **Transducer shaft, guide rails adjustment**

### **Logistics**

**Safety** - Refer to the general safety procedures.

**Personnel** - Trained maintenance engineer.

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** - None.

### **Procedure**

The guide rails ensure the transducer is aligned correctly. When the shaft is fully lowered there should be no space between the guide rails and the adjustable sliders.

The guide rails ensure the transducer is aligned correctly. When the shaft is fully lowered there must be no space between the guide rails and the adjustable sliders, see (2 and 3) on figure below.

- 1** Fully lower the transducer shaft.
- 2** Slacken the lock nuts and adjust the sliders until they are tight against the guide rails.
- 3** Tighten the lock nuts and re-check the clearance.
- 4** Raise the transducer shaft and check the clearances at several places as it is raised.
  - If the clearances between the sliders and the rails changes (2/3) as the shaft is raised, the rails will need to be adjusted.

---

**Note** *These adjustments could affect the system alignment. If in doubt, contact Kongsberg Maritime AS for assistance.*

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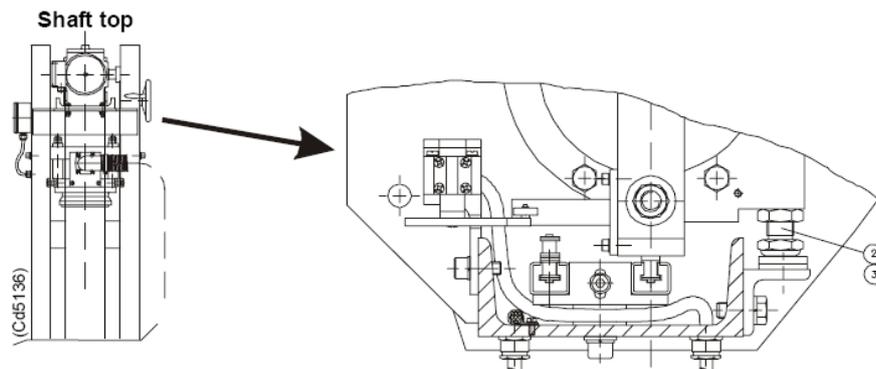


Figure 21 Shaft top - indicating the adjustable sliders

### Limit switches replacement

Two limit switches are mounted on the gantry; one to stop the drive motor when the shaft is fully down, and one to stop the motor when the shaft is fully raised. The two limit switches are identical.

#### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Trained maintenance engineer.

**Vessel location** - N/A.

**Special tools** - None.

**Spare parts** - Limit switch 350-087309

#### Procedure

- 1 Switch off power from the system on the Hoist Control Unit.
- 2 Note the connections, and then disconnect the cables from the limit switch.
- 3 Remove the mounting bolts and replace the switch.

- 4** Set up the switches as follows:
  - a** Adjust the lower limit switch so that the springs are compressed 2-3 mm when the transducer shaft is fully lowered.
  - b** Retract the transducer shaft fully and adjust the upper limit switch such that it operates when there is approximately 15-20 mm clearance between the top of the transducer adapter and the bottom of the shaft sleeve.

### **Gate valve replacement**

This procedure explains how to replace the gate valve.

---

**Note**

*The vessel must be in a dry dock while this procedure is performed.*

---

#### **Logistics**

**Safety** - Refer to the general safety procedures. Note that the various parts are heavy.

**Personnel** - Three to four trained maintenance engineers/fitters.

**Vessel location** - Dry dock.

**Special tools** – Two (2) winches or cranes.

One for the hull unit - 1500 kg, and one for the gate valve - 500 kg.

#### **Spare parts** -

Gate valve DN 500

Gate valve DN 350

→ *Torque - see table on page 36.*

→ *See the Spare parts chapter from page 124*

---

**Procedure**

The hull unit must be lifted to enable the old gate valve to be taken out and a new valve to be fitted. Check that all electrical cables to the hull unit have enough slack such that they will not be placed under tension as the hull unit is lifted.

---

**Note** *If an electrical actuator (option) is fitted, it must be removed before you take out the gate valve.*

---

- 1** Fully raised the transducer.
- 2** The vessel must be in dry dock.
- 3** Mount a suitable lifting apparatus to the deck head above the hull unit, and attach it to the top of the hull unit.
- 4** Remove all the gantry braces, and disconnect cables as necessary.
- 5** Take the weight of the hull unit on the lifting apparatus.
- 6** Remove the upper and lower mounting nuts/bolts to unbolt the gate valve from the transducer dock and the mounting flange.
- 7** Lift the hull unit clear of the gate valve.
- 8** Pull the old gate valve out.
  - Note that the gate valve is heavy. Lifting apparatus will be required.
  - Great care must be exercised to ensure the mating surfaces of the mounting flange and the transducer dock are not damaged.
- 9** Clean the mating surfaces and replace all O-rings.
- 10** Manoeuvre the new gate valve into position and lower it carefully onto the mounting flange.
- 11** Check that it is aligned correctly, and then secure it into position.
- 12** Lower the hull unit onto the gate valve.
  - Check that it is aligned correctly, and then secure it into position.
- 13** Replace all the gantry braces.
- 14** Check all electrical cables and connections.

- 15 Perform the system test described in the:  
*Test and alignments procedures from page 152.*

### Gate valve position indicator replacement

This procedure explains how to replace the complete gate valve position indicator.

#### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - Two trained maintenance engineers/fitters.

**Spare parts** - As required.

#### References

##### Drawings:

→ See drawing in the Drawing file chapter from page 171

#### Procedure

The positioning indicator is standard. It is mounted directly on the gate valve with two bolts.

- 1 Fully raise the transducer.
- 2 Remove the switch unit.  
→ Procedure on page 119
- 3 Remove the gate valve wheel.
- 4 Unscrew the two bolts holding the positioning indicator (see figure below).

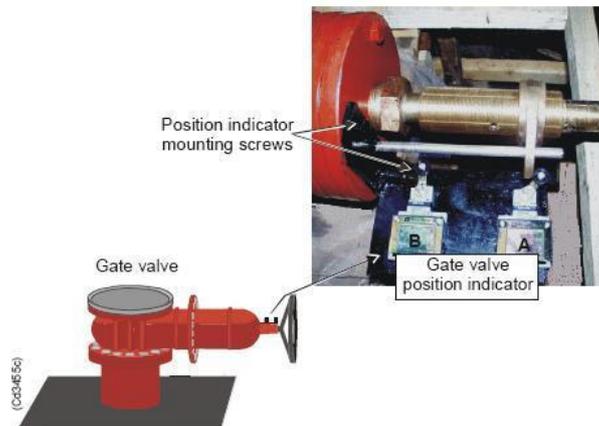


Figure 22 Position indicator

- 5 To mount the new position indicator unit, proceed in reverse order.

### Position indicator switch unit replacement

This procedure explains how to replace a position indicator switch unit.

#### Logistics

**Safety** - Refer to the general safety procedures.

**Personnel** - One trained maintenance engineers/fitters.

**Spare parts** - As required. Switch, see mounted switch.

#### References

##### Drawings:

→ See drawing in the Drawing file chapter from page 171

#### Procedure

- 1 Disconnect the switch cable. This is done as follows:
  - a Unscrew the two screws holding the lid on the top of the switch unit, see figure below (1).
  - b Open the switch unit lid, see figure below (2).
  - c Connection 13 and 14 is used. Refer to Interconnection diagram, hoisting system.
- 2 Unscrew the two switch unit fastening screws, see figure below (2).

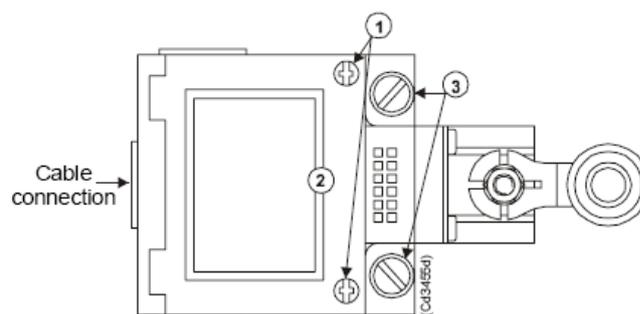


Figure 23 Position indicator switch unit

- 3 Remove the defect switch unit.
- 4 Mounting the new switch unit, proceed in reverse order.

## Hoist Control Unit

Troubleshooting is based on this manual, drawings and diagrams, and the engineer's knowledge of the system.

### Logistics

**Special tools** - None.

**Spare part** - Refer to the *Spare parts chapter from page 124*

### References

#### Drawings:

→ *See drawing in the Drawing file chapter from page 171*

## Hoist Control Unit/ Hoist Control Unit with Ethernet interface parts replacements

The relays and switches within the unit can be replaced individually. The replacement procedures for these items are similar.

### Procedure

- 1 Inform the system supervisor that the system will be out of use while maintenance is performed.
- 2 Switch off all power to the system and remove the system fuses on the ship's supply.
- 3 Open the door to the cabinet.
- 4 Identify the defective unit.
  - *The Hoist Control Unit - internal layout see figure on page 49.*
  - *The Hoist Control Unit with Ethernet interface - internal layout see figure on page 54.*
- 5 Attach identification labels to all cables connected to that unit, and the terminals to which those cables are connected.
- 6 Disconnect the cables.
- 7 Detach the unit by slackening/removing the appropriate screws and/or unclipping the unit from the mounting rail.
- 8 Mount the replacement unit and reconnect the wires.
- 9 Check the connections against the circuit diagram to ensure they are correct.

- 10 Check the cabinet to ensure that all connections are tight.
- 11 Remove all tools and rubbish.
- 12 Close the cabinet door correctly.
- 13 Take the appropriate safety measures, and then replace the fuses.
- 14 Apply power to the system.
- 15 Perform a system test as necessary to ensure the maintenance has been conducted successfully.

## Remote Control Unit

Troubleshooting is based on the maintenance manual, drawings and diagrams, and the engineer's knowledge of the system.

### Logistics

**Special tools** - None

**Spare parts** - Refer to the Spare Parts chapter.

### References

#### Drawings:

→ See drawing in the Drawing file chapter from page 171

## Remote Control Unit parts replacement

The switches and lamps within the unit can be replaced individually.

### Button replacement

- 1 Inform the system supervisor that the system will be out of use while maintenance is performed.
- 2 Switch off all power to the system and remove the system fuses on the ship's supply.
- 3 Remove the front of the Remote Control Unit.
- 4 Attach identification labels to all cables connected to the defective switch, and the terminals to which those cables are connected.
- 5 Disconnect the cables.
- 6 Unscrew the mounting bolt and remove the defective switch.
- 7 Mount the replacement switch and reconnect the wires.

- 8 Check the connections against the circuit diagram to ensure they are correct.
- 9 Check the unit to ensure that all connections are tight.
- 10 Remove all tools and rubbish. Replace the front of the unit correctly.
- 11 Take the appropriate safety measures, then replace the fuses and apply power to the system.
- 12 Perform a system test as necessary to ensure the maintenance has been conducted successfully.

### **Lamp replacement**

- 1 Unscrew the lens on the button containing the defective lamp, and remove the coloured filter.
- 2 Remove the defective lamp from the button by pushing it in and turning it 45° anti-clockwise.
  - A short length of 6 mm diameter plastic tube will be a useful tool in this operation. A pair of “snipe-nose” pliers (insulated) may be required to extract the lamp as it is located quite deep within the holder.
- 3 Insert a new lamp into the holder, push it in and turn it 45° clockwise to secure it.
- 4 Replace the coloured filter and lens onto the button.
- 5 Perform a system test as necessary to ensure the maintenance has been conducted successfully.

**Note**

*The Remote Control Unit is a “Repair by replacement” item. If further repairs are necessary, the entire unit should be replaced. The faulty unit should then be returned to Kongsberg Maritime for repair.*

---

**Test procedure****General checks**

On completion of any maintenance on the hull unit, the system must be checked to ensure the maintenance was successful and to ensure the hull unit may be operated safely.

→ *Refer to the hull unit raise / lower checks on page 164.*

**System alignment**

One of the most important variables that will affect system accuracy is the alignment of the transducer with respect to the vessel’s fore-and-aft axis. After any maintenance procedure which could affect the alignment of the transducer (removal of the transducer, adjustment of guide rails etc.), or if the maintenance engineer suspects that the transducer has moved out of alignment, an alignment test should be conducted. This may require that the vessel goes into dry dock, so all other options should be thoroughly investigated first.

The system software can then be set up to take into account any misalignments in the system. Contact Kongsberg Maritime for assistance with the alignment checks.

→ *Refer to the hull unit installation test and alignment procedure on page 152.*

## 8 SPARE PARTS

This chapter lists the parts and modules defined by Kongsberg Maritime as *Line Replaceable Units (LRUs)*. The required mounting components (such as nuts, bolts, washers etc.) are identified on the diagrams, but have not been allocated order numbers as we regard these items as standard commercial parts available from retail outlets around the world.

### Codes used

The following codes are used in the parts lists:

<b>Part no.</b>	- Kongsberg Maritime's part number.
<b>Item name</b>	- The name of the item.
<b>Technical data</b>	- Technical specifications and any other relevant information.
<b>Drw. ref.</b>	- Reference number of the production / illustration drawing where the item is included. If a number is given here, the drawing will be included in the manual.
<b>Drw. pos.</b>	- The item's position number on the drawing referenced above.
<b>No. in sys.</b>	The quantity of the item used in the system. <i>Note that this information is not provided for standard components such as nuts, bolts and washers.</i>
<b>Rec. spares</b>	The quantity of the item recommended to be carried as spares onboard the vessel. <i>Note that this information is not provided for standard components such as nuts, bolts and washers.</i>

## Topics

- *Service kits for transducer cables on page 126*
- *Repair kits on page 126*
- *Junction box kit for HiPAP® hull unit on page 126*
- *Main units spare parts list on page 126*
- *HiPAP® units/transducer cables on page 127*
- *Hull unit assembly spare parts list on page 128*
- *Chains on page 129*
- *Transducer dock on page 131*
- *Transducer shaft sleeve on page 133*
- *Transducer shaft sleeve-top on page 135*
- *Transducer on page 136*
- *Remote Control Unit on page 137*
- *Hoist Control Unit on page 137*

## Service kits for transducer cables

- Service Kit TD Cable HL2180, P/N: 319108
- Service Kit TD Cable HL3770, P/N: 319114
- Service Kit TD Cable HL4570, P/N: 319115
- Service Kit TD Cable HL6120, P/N: 319116

## Repair kit

- Set of seals and bearings (for shaft sleeve), part. no: KIT-103324

## Junction box kit for HiPAP® hull unit

- Junction box kit for HiPAP® Hull Unit, part.no: 333287

## Main units spare parts list

Part no.	Item name	No. in system	Recommended spares
-	Technical data		
HCU-102818	Hoist Control Unit, complete assembly	1	0
RCU-102819	Remote Control Unit, complete assembly	1	0
599-042237	350 mm transducer dock without service hatch	1	0
HDV-051336*	DN 350 gate valve	1	0
HDV-088347*	DN 500 gate valve	1	0

*\*Several options available, check your system.*

*Part numbers for Hull units, transducer cables, transducers and transducer docks are given in the table on page 127.*

## HiPAP® units/transducer cables

Hull unit	Part no.	Transceiver cable / Transceiver unit	Part no.	Transducer	Part no.	Transducer (TD) dock	Part no.
<b>HL 2180</b>							
Hull Unit HL 2180 (TD cable is included part no. 306057)  <b>Drawing:</b> 316242	306080	Patch cable HL 2180 HiPAP® 501/451 for x81 TU	306068	HiPAP® 500	100-103315	TD dock 500	499-089777
		Patch cable HL 2180 HiPAP® 351/101 for x81 TU	306071	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007
		Patch cable HL 2180 HiPAP® 351/101 for x21 TU	306076	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007
		<b>HL 3770</b>					
Hull Unit HL 3770 (TD cable is included part no. 304105)  <b>Drawing:</b> 316243	305427	Patch cable HL 3770 HiPAP® 501/451 For x81 TU	304106	HiPAP® 500	100-103315	TD dock 500	499-089777
		Patch cable HL 3770 HiPAP® 351/101 for x81 TU	306072	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007
		Patch Cable HL 3770 HiPAP® 351/101 for x21 TU	306077	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007
		<b>HL 4570</b>					
Hull Unit HL 4570 (TD cable is included part no. 306058)  <b>Drawing:</b> 316244	306081	Patch cable HL 4570 HiPAP® 501/451 for x81 TU	306069	HiPAP® 500	100-103315	TD dock 500	499-089777
		Patch cable HL 4570 HiPAP® 351/101 for x81 TU	306073	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007
		Patch Cable HL 4570 HiPAP® 351/101 for x21 TU	306078	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007
		<b>HL 6120</b>					
Hull Unit HL 6120 (TD cable is included part no. 306059)  <b>Drawing:</b> 316245	306082	Patch cable HL 6180 HiPAP® 501/451 for x81 TU	306070	HiPAP® 500	100-103315	TD dock 500	499-089777
		Patch cable HL 6120 HiPAP® 351/101 for x81 TU	306075	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007
		Patch Cable HL 6120 HiPAP® 351/101 for x21 TU	306079	HiPAP® 350	100-103317	TD dock 500	499-089777
				HiPAP® 100	100-103318	TD dock 350	499-210007

Note:

Patch cable = Transducer cable Y<sup>2</sup>

TD = Transducer

TU = Transceiver Unit

TD dock 500 requires 500 mounting flange w/DN 500 Gate valve

TD dock 350 requires 350 mounting flange w/DN 350 Gate valve

## Hull unit assembly spare parts

Part no.	Item name	No. in system	Recommended spares
-	Technical data		
331-045952	Motor with gearbox	1	0
-	S62 DT80N4BM/HF 2WE		
331-084150	Motor alone	-	-
-	DFT80N4BM/HF 2WE		
529-084151	Gearbox alone	-	-
-	-		
350-087309	Limit switch	2	0
-	-		
TDH-089996	HiPAP® 500 / 450 Transducer	1	0
-	Complete spare parts kit		
TDH-212000	HiPAP® 350 Transducer	1	0
-	Complete spare parts kit		
316798	HiPAP® 100 Transducer	1	0
-	Complete spare parts kit		

# Chains

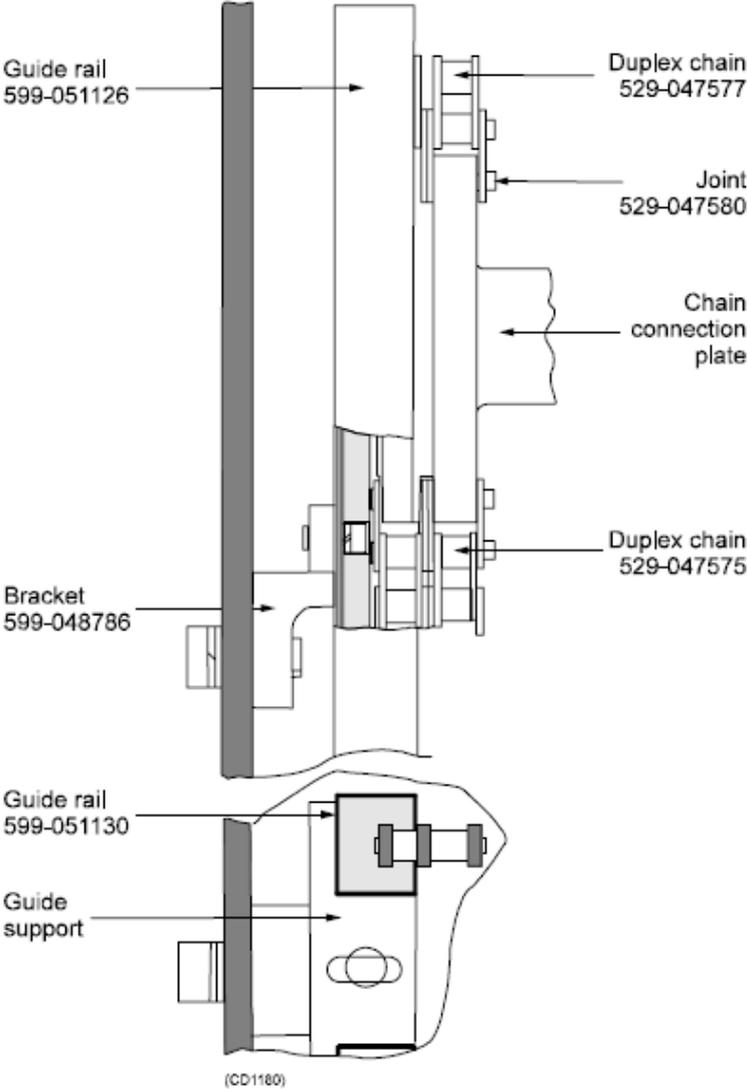


Figure 24 Chains and guide rails

### Chains spare parts

Part no.	Item name	No. in system	Recommended spares
-	<b>Technical data</b>		
529-047575	Duplex chain	2	0
-	Length = 8305.24 mm (523 links)		
529-047577	Duplex chain	2	0
-	Length = 206.44 mm (13 links)		
529-047580	Joint no. 26	6	0
-	P = 0.625		
599-051126	Guide rail	2	0
-	-		
599-048786	Bracket	12	0
-	-		
599-051130	Guide rail	2	0
-	-		
599-048785	Guide support	2	0
-	-		

# Transducer dock

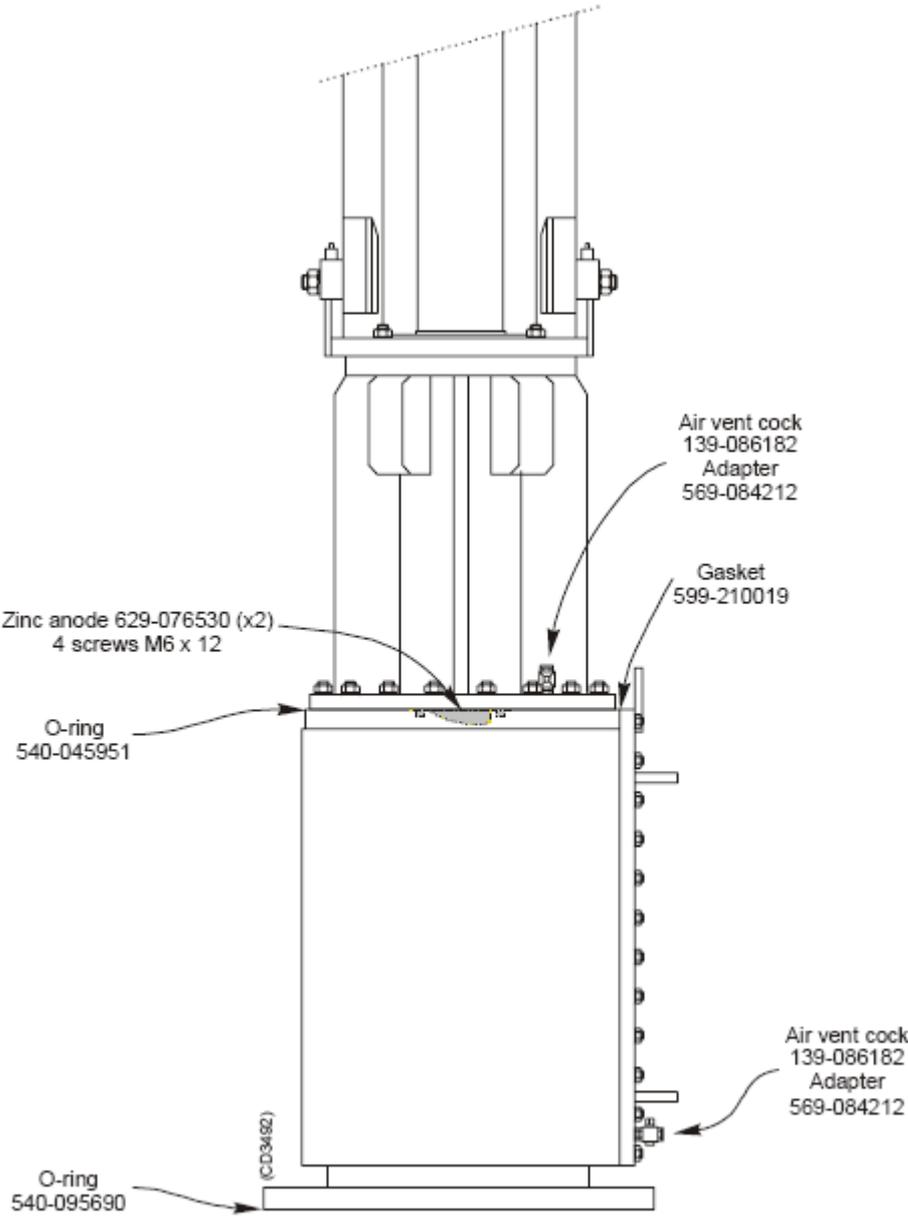


Figure 25 Transducer dock O-rings, cocks and zinc anode

**Transducer dock spare parts**

<b>Part no.</b>	<b>Item name</b>	<b>No. in system</b>	<b>Recommended spares</b>
-	<b>Technical data</b>		
540-045951	O-ring (shaft sleeve - dock)	1	0
-	381.2 x 8.2 MIL413B / SMS1817		
540-095690	O-ring (dock - gate valve)	1	0
-	522.0 x 8.4 N SKEGA 4666142 Nitril 6370001		
540-045951	O-ring	2	0
-	381.2 x 8.2 MIL413B		
599-210019	Gasket	1	1
-	2,5 m		
139-086182	Air vent / Drain cock	2	1
-	Stainless steel SS316 3/8" with handle. Also used on shaft sleeve.		
569-084212	Adapter 3/8"	2	1
-	Also used on shaft sleeve.		
629-076530	Zinc anode	2	2
-	Coral type Z-5		

### Transducer shaft sleeve

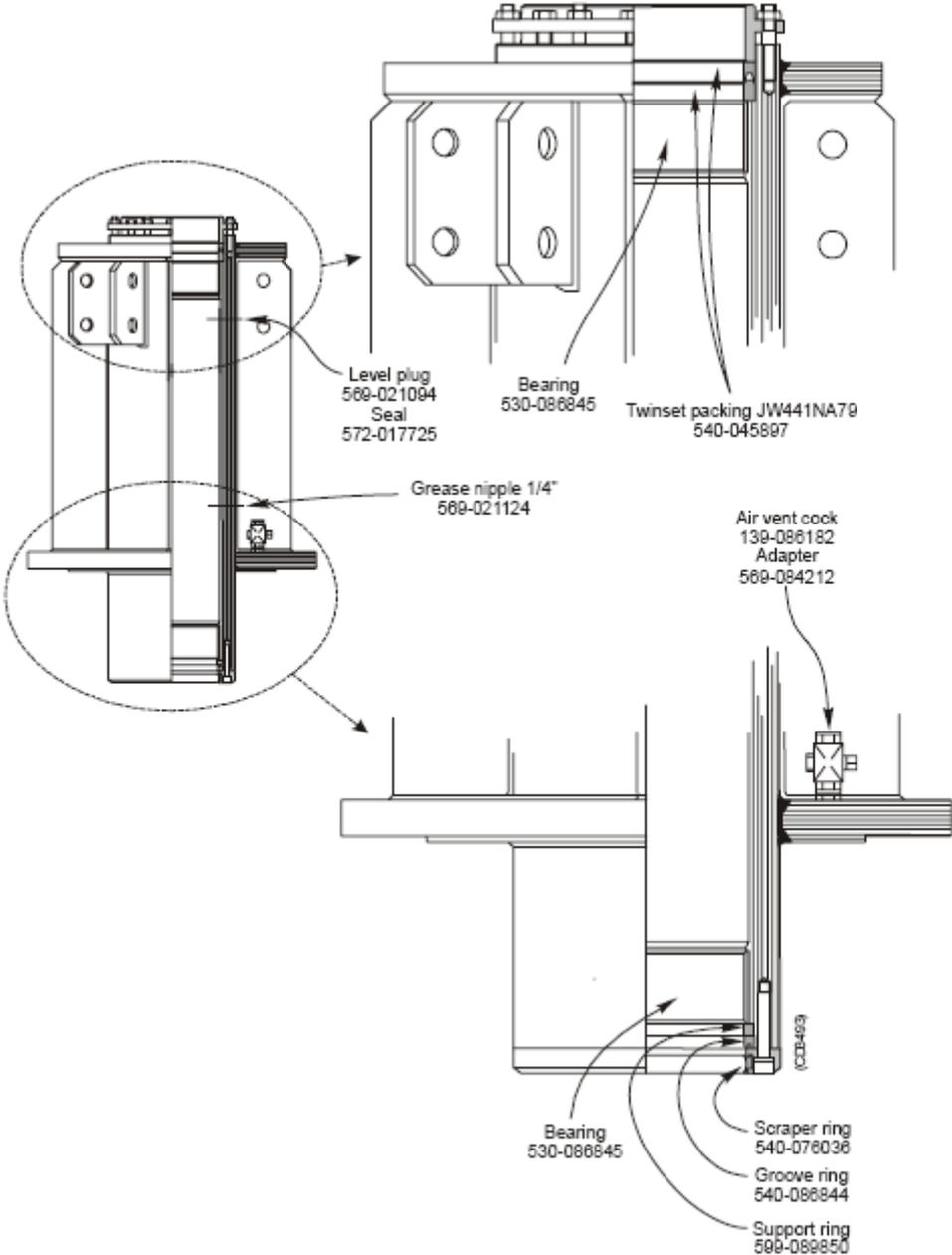


Figure 26 Transducer shaft sleeve with level plug, vent screw and grease nipple

### Transducer shaft sleeve spare parts

Part no.	Item name	No. in system	Recommended spares
Technical data			
530-042321	Bearing	2	0
-	One at top, one at bottom of shaft sleeve		
530-086845	Bearing	2	0
-	One at top, one at bottom of shaft sleeve		
540-045897	Twin-set packing	1	0
-	JW441NA79		
569-021124	Grease nipple	2	1
-	R 1/4"		
569-021124	Grease nipple	1	1
-	R 1/4"		
139-086182	Air vent / drain cock	2	1
-	Stainless steel SS316 3/8" with handle. Also used on transducer dock.		
569-084212	Adapter 3/8"	2	1
-	Also used on transducer dock.		
540-047661	Groove ring	2	0
-	AUN 150-101		
540-086844	Groove ring	1	0
-	NI300-150-170-15		
576-024904	Lock pin	1	0
-	-		
599-069243	Mounting ring	2	0
-	Between and below groove rings		
KIT-103324	Transducer shaft casing, spare parts kit	1	0
-	See note below		
599-089850	Support ring	1	0
-	-		
540-076036	Scraper ring	1	0
-	DA17-1500-N90		
569-021094	Plug	1	1

Part no.	Item name	No. in system	Recommended spares
Technical data			
-	R 1/4"	1	1
572-017725	Seating gasket		
-	R 1/4"		

Note *A spare parts kit is available under order no. KIT-083818. This kit contains all the above items with the exception of the ball valve.*

## Transducer shaft sleeve-top

Note *The mounting components (nuts, bolts, washers etc.) on the drawing below are considered "standard" hardware items. Kongsberg Maritime order numbers are therefore not given.*

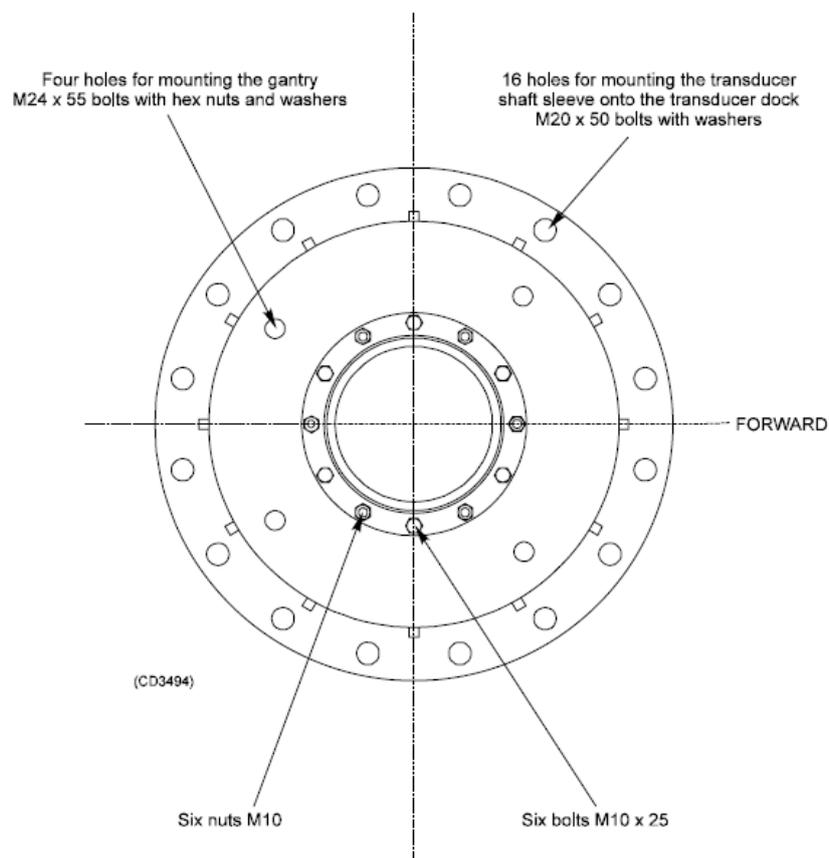


Figure 27 Transducer shaft sleeve - top view with mounting components

## Transducer

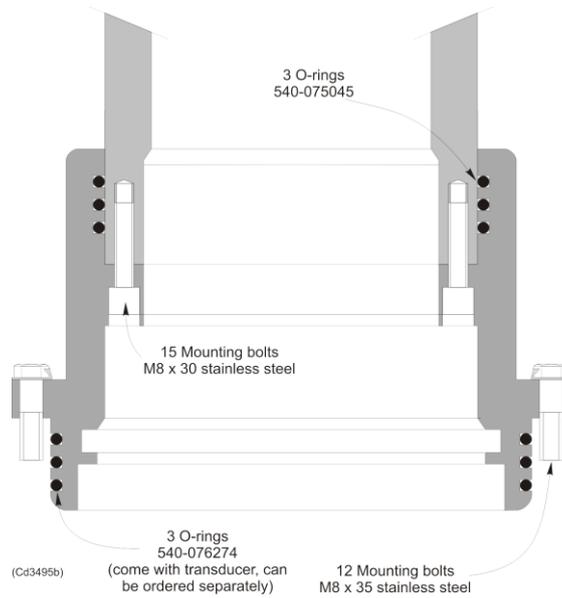


Figure 28 Mounting the transducer

### Standard transducer spare parts

Part no.	Item name	No. in sys.	Recommended spares
-	<b>Technical data</b>		
540-075045	O-ring	3	-
-	149.3 x 5.7 MIL413C		
540-076274	O-ring	3	-
-	180.0 x 4.0 N SKEGA 465833		
540-045548	O-ring	2	0
-	189.5 x 3.0 MIL413B		
540-076355	O-ring	1	0
-	148.82 x 3.53 N		
581-050407	Vibration absorber	1	1

## Hoist Control Unit

The Hoist Control Unit - internal layout, see figure on page 49.

### Hoist Control Unit spare parts

Part no.	Item name	Drw. ref.	No. in system	Recommended spares
-	Technical data	Drw. pos.		
351-093666	Remote switch	-	1	-
-	-	S1		
251-057328	Automatic breaker	-	1	-
-	S272-K 2A	-		
352-103085	Thermal relay	-	1	-
-	Current limit 1.8 - 2.6 A	F02		
352-075772	Power relay	-	2	-
-	RM738024 24 VDC	K01/04		
221-076438	Mains transformer	-	1	-
-	Ulveco N12272-TD	T01		
242-084064	Rectifier	-	1	-
-	KBPC806 600 V 8 A	D05		
213-084668	Capacitor	-	1	-
-	Electrolitic 4700 mF -10+50% 63 V	C01		
204-075163	Varistor	-	1	-
-	SIOV-S20K300 300 V RMS	D04		

## Hoist Control Unit with Ethernet interface

The Hoist Control Unit with Ethernet interface - internal layout, see figure on page 54.

### Hoist Control Unit spare parts

Part no.	Item name	Drw. ref.	No. in system	Recommended spares
-	Technical data	Drw. pos.		
351-093666	Remote switch	Page 54	1	-
-	-	S1		
251-057328	Automatic breaker	-	1	-
-	S272-K 2A	-		
352-103085	Thermal relay	Page 54	1	-
-	Current limit 1.8 - 2.6 A	F02		
352-075772	Power relay	-	2	-
-	RM738024 24 VDC	-		

## Remote Control Unit

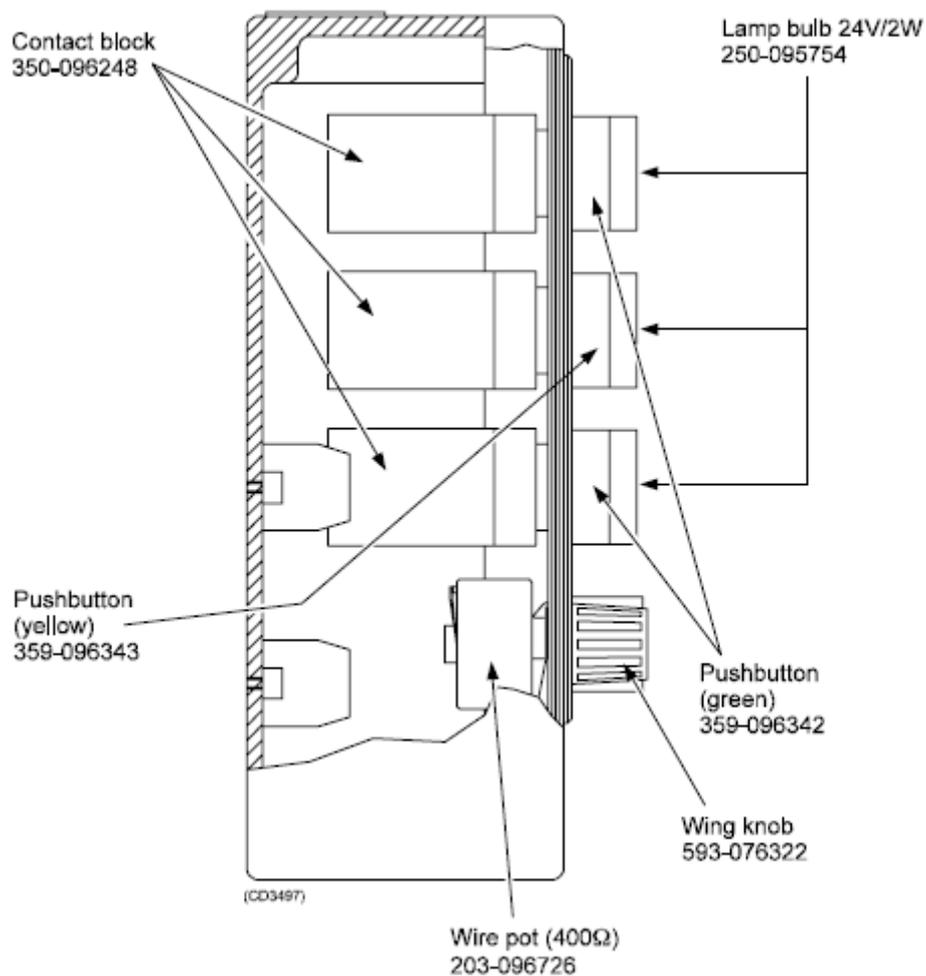


Figure 29 Remote Control Unit - parts identification

**Remote Control Unit spare parts**

Part no.	Item name	No. in system	Recommended spares
-	<b>Technical data</b>		
250-095754	Lamp bulb 24 V / 2 W	3	-
-	DLP-CE024. 85 mA		
350-096248	Contact block	3	-
-	ZB2-BW265		
359-096342	Push button / illuminated, green	2	-
-	ZB2-BW33		
359-096342	Push button / illuminated, yellow	1	-
-	ZB2-BW35		
203-096726	Wire potentiometer	1	-
-	400 W, 10%, 30 W.		
593-076322	Wing knob	1	-
-	-		

## **9 LASER OPTION**

→ *The laser option is described in the HiPAP® Model 501/451/351/101 instruction Manual.*

## 10 EQUIPMENT HANDLING

This chapter describes how to transport, pack and unpack, clean, preserve and store electronic, electro-mechanical and mechanical units supplied by Kongsberg Maritime AS.

The units may be supplied as spare parts, or as parts of a delivery.

### Topics

- *Transportation on page 141*
- *Re-packing on page 150*
- *ESD precautions on page 150*
- *Temperature protection on page 151*

### Transportation

Unless otherwise stated in the accompanying documentation, electronic, electro-mechanical and mechanical units supplied by Kongsberg Maritime can be transported using all methods approved for delicate equipment; (by road, rail, air or sea). The units are to be transported in accordance with general or specific instructions for the appropriate unit(s), using pallets, transport cases, or carton boxes as appropriate.

---

#### Note

*Special local restrictions concerning air transportation may be applied to units containing certain types of batteries. The units should be checked and the regulations investigated by the packer/shipper before the unit is dispatched.*

---

#### Local transportation

All local transportation must be carried out according to the same specifications as for the initial delivery. In general, all units must be handled with care. The carton or case containing the equipment must be kept dry at all times, and must be sheltered from the weather. It must not be subjected to shocks, excessive vibration or other rough handling.

The carton or case will normally be marked with text or a symbol indicating which way up it is to be placed. Follow any instructions given and ensure the case is always placed with its “top” uppermost.

The carton or case must not be used for any purpose for which it was not intended (step, table, etc.), and in the absence of other information, no other cartons or cases must be stacked on top of it.

### **Lifting**

A heavy crate will normally be marked with its weight, and the weights of other cartons or crates will normally be entered on the packing list.

- You must always check the weight of a crate before attempting to lift it.
- You must always use lifting apparatus that is certified for the load.

Heavy units may be equipped with lifting lugs for transportation by crane within the workshop or installation area. Before a crane is used, check:

- You must check the applicable weight certificate for the crane.
- You must check the security of the lifting lugs.

Ensure that all available lifting lugs are used. Ensure the unit remains under control during the operation to avoid damage to the unit, equipment or personnel.

Heavy units may be transported using a fork-lift truck. Special attention must then be paid to the position of the unit's centre of gravity. The units must be properly secured to the truck.

### **Storage prior to installation or use**

When a system, a unit or a spare part has been delivered to the customer, it may be subject to long-time storage prior to installation and use. During this storage period, certain specifications must be met.

The equipment must be preserved and stored in such a way that it does not constitute any danger to health, environment or personal injury.

- 1 The equipment must be stored in its original transportation crate.
- 2 Ensure that the units are clearly separated in the shelves and that each unit is easily identifiable.
- 3 The crate must not be used for any purpose for which it was not intended (e.g. work platform etc.).

- 4 The crates must not be placed on top of each other, unless specific markings permit this.
- 5 The crates must not be placed directly on a dirt-floor.
- 6 Do not open the crate for inspection unless special circumstances permit so.
  - “Special circumstances” may be suspected damage to the crate and its content, or inspections by civil authorities.
  - If any units are damaged, prepare an inspection report stating the condition of the unit and actions taken. Describe the damage and collect photographic evidence if possible. Re-preserve the equipment.
  - If the units are not damaged, check the humidity absorbing material. If required, dry or replace the bags, then repack the unit(s) according to the packing instructions.
- 7 If the crate has been opened, make sure that it is closed and sealed after the inspection.  
Use the original packing material as far as possible.

### **Storage temperature and humidity**

- 1 The storage room/area must be dry, with a non-condensing atmosphere. It must be free from corrosive agents.
- 2 The storage area’s mean temperature must not be lower than -30° C, and not warmer than +70° C.
  - If other limitations apply, the crates will be marked accordingly.

---

**Note**

*Transducers must not be stored in temperatures below -30° C, or higher than +55° C.*

---

- 3 The crate must not be exposed to moisture from leakages.
- 4 The crate must not be exposed to direct sunlight or excessive warmth from heaters.

### **Shock and vibration**

- 1 The crate must not be subjected to excessive shock and vibration.

### **ESD precautions**

→ Refer to the information on page 150.

### **Inspection**

An inspection must be carried out immediately after the units have arrived at their destination.

- Check all wooden or cardboard boxes, plastic bags and pallets for physical damage. Look for signs of dropping, immersion in water or other mishandling.
- If damage is detected externally, you will have to open the packaging to check the contents.
  - Request a representative of the carrier to be present while the carton is opened, so any transportation damage can be identified.
- If any units are damaged, prepare an inspection report stating the condition of the unit and actions taken. Describe the damage and collect photographic evidence if possible. Send the inspection report to Kongsberg Maritime as soon as possible.
- If the units are not damaged, check the humidity absorbing material. If required, dry or replace the bags, then repack the unit(s) according to the packing instructions.

### **Unpacking**

Normal precautions for the handling, transportation and storage of fragile electronic equipment must be undertaken.

---

#### **Note**

*If the unit is not to be prepared for immediate use, you may consider storing it unopened in its original packing material. However, it may be useful to open the case to check its contents for damage and retrieve any accompanying documentation.*

---

- Check the carton before opening it to ensure it shows no signs of dropping, immersion in water or other mishandling.
  - If the carton shows signs of such damage, refer to the paragraph covering Inspection on receipt.
- Place the carton on a stable work bench or on the floor with the top of the carton uppermost.
- In the absence of other instructions, always open the top of the carton first. The contents will normally have been

lowered into the carton from above, so this will usually be the easiest route to follow.

- Care must be used when opening the carton to ensure the contents are not damaged.

---

**Caution**      *Do not use a knife to open cardboard cartons - the contents may lie close to the surface, and may be damaged by the blade.*

---

- If the carton has been closed using staples, remove the staples from the carton as you open it. This will reduce the possibilities of scratch injury to yourself and damage to the contents.
- If a wooden crate has been closed using screws, always remove them using a screw-driver. Do not attempt to prise the lid off with a crow-bar or similar.
- Once the carton is open, carefully remove all loose packing and insulation material. Check for manuals and other documents that may have been added to the carton during packing, and put these to one side. Check also for special tools, door keys etc.

### **Electronic and electro-mechanical units**

---

**Caution**      *Beware of the dangers of Electro-Static Discharge (ESD) both to yourself and to the equipment, when handling electronic units and components.*

---

Electronic and electro-mechanical units will normally be wrapped in a clear plastic bag. Lift the unit, in its bag, out of the carton and place it in a stable position on the floor/work bench.

- 1**      Inspect the unit for damage before opening the plastic bag.

---

**Note**      *Cables must **never** be used as carrying handles or lifting points.*

---

**Note**      *Do not break the seal to open a circuit board package before the board is to be used. If the board package is returned to the manufacturers with the seal broken, the contents will be assumed to have been used and the customer will be billed accordingly.*

---

- 2**      Assuming all is well, open the bag and remove the unit.

- 3 Open the unit and check inside. Remove any packing and desiccant material that may be inside.

### **Mechanical units**

Mechanical units may be heavy.

- 1 Using a suitably certified lifting apparatus, lift the unit out of the crate and place it in a stable position on the floor/work bench.
- 2 Inspect the unit for damage and remove any packing material that may be inside the unit.

### **Transducers**

Transducers may be supplied mounted to a hull unit (if any), or packed separately. Crates are normally identified by the order number and the serial number.

The transducer face must be protected by a rigid, padded cover (e.g. a wooden box lined with foam rubber) all the time it is exposed to the risk of physical damage.

---

#### **Note**

*Once the units are unpacked, great care must be taken to ensure that transducers and cabling are not exposed to any mechanical stress. Never lift the transducers by the transducer cable.*

---

### **Re-packing**

If the unit is not to be installed immediately, re-pack it in its original packing material to prevent damage in the intervening period.

→ Refer to the information on page 150.

## **Storage after unpacking**

The equipment should be stored in its original transportation crate until ready for installation. The crate must not be used for any purpose for which it was not intended (e.g. work platform etc.).

Once unpacked, the equipment must be kept in a dry, non condensing atmosphere, free from corrosive agents and isolated from sources of vibration.

---

**Note** *Do not break the seal to open a circuit board package before the board is to be used. If the board package is returned to the manufacturers with the seal broken, the contents will be assumed to have been used and the customer will be billed accordingly.*

---

The unit must be installed in its intended operating position as soon as possible after unpacking.

If the unit contains normal batteries, these may have been disconnected/isolated before the unit was packed. These must then be reconnected during the installation procedure. Units containing batteries are marked.

---

**Caution** *Units containing lithium or alkaline batteries must be handled separately and with care. Such units are marked accordingly. Do not attempt to recharge such batteries, open them or dispose of them by incineration. Refer to the applicable product data sheets.*

---

### **After use storage**

If a unit is removed from its operating location and placed into storage, it must be properly cleaned and prepared before packing.

### **Cleaning cabinets**

If a cabinet has been exposed to salt atmosphere while it was in use, it must be thoroughly cleaned both internally and externally to prevent corrosion.

- Wipe the cabinet externally using a damp cloth and a little detergent. Do not use excessive amounts of water as the unit may not be water tight. On completion, dry the unit thoroughly.
- All surfaces must be inspected for signs of corrosion, e.g. Flaking / bubbling paint, stains etc. Damaged or suspect areas must be cleaned, prepared and preserved using the correct preservation mediums for the unit. The mediums to be used will usually be defined in the units' maintenance manual.
- All surfaces must be inspected for signs of corrosion, e.g. flaking/bubbling paint, stain etc. Damaged or suspect areas must be cleaned, prepared and preserved using the correct preservation mediums for the unit.
- Open the unit, and using a vacuum cleaner, remove all dust etc. from the unit. Great care must be taken to ensure the circuit boards and modules are not damaged in the process.

### **Mechanical units**

If a mechanical unit may have been exposed to a salt atmosphere while it was in use, it must be thoroughly cleaned both internally and externally to prevent corrosion.

- If the construction materials and type of unit permits, wash the unit using a high-pressure hose and copious amounts of fresh water.

Examples:

- The lower parts of hull units (outside the hull)
- Subsea units

- Ensure that all traces of mud and marine growth are removed. Use a wooden or plastic scraper to remove persistent growth, barnacles etc. On completion, dry the unit thoroughly.

---

**Caution**

*Do not use a high pressure hose in the vicinity of cables or transducers. Do not use sharp or metal tools on a transducer face.*

---

- If the materials or type of unit prevents the use of a high-pressure hose, wipe the unit using a cloth dampened with water containing a little detergent.

**Examples:**

- The upper parts of hull units (inside the hull)
- Hydraulic systems
- Do not use excessive amounts of water as some components on the unit may not be water tight. Wipe off the detergent with a damp cloth, and then dry the unit thoroughly.
- All surfaces must be inspected for signs of corrosion, e.g. flaking/bubbling paint, stain etc. Damaged or suspect areas must be cleaned, prepared and preserved using the correct preservation mediums. The mediums to be used will normally be defined in the unit's maintenance manual.

**Cables**

Wipe clean all exposed cables, and check for damage. If a cable shows signs of wear or ageing, contact Kongsberg Maritime for advice.

**Dehumidifier**

Place a suitably sized bag of desiccant material (silica gel or similar) into the unit to keep the electronic components as dry as possible.

**Coatings**

Spray the unit externally with a corrosion inhibitor (e.g. light oil) before packing.

## Re-packing

The unit should be stored and transported in its original packing material and/or crate. In the event that this material is not available, proceed as follows:

- Small units must be protected from damp by being placed within a plastic bag at least 0.15 mm thick. An appropriate quantity of desiccant material should be placed inside this bag, and the bag sealed. The sealed unit must then be placed in an appropriate carton or crate, and supported in the container by appropriate shock-absorbing insulation (polystyrene foam chips etc.).
- Large units must be placed in a suitable cardboard box or wooden crate. The unit must be protected against physical damage by means of shock-absorbing insulation mats. The box must be clearly marked with its contents, and must be stored in a dry and dust-free area.

## ESD precautions

### What is ESD?

Electro-Static Discharge (ESD) is the transfer of an electrostatic charge between two bodies at different electrostatic potentials, caused either by direct contact or induction by an electrostatic field.

The passing of a charge through an electronic device can cause localised overheating, and it can also “puncture” insulating layers within the structure of the device. This may deposit a conductive residue of the vaporised metal on the device, and thus create a short circuit. This may result in a catastrophic failure, or degraded performance of the device.

### ESD Protection during transport and storage

Sensitive electronic equipment must be transported and stored in protective packing bags, boxes and cabinets. The equipment must NOT be transported or stored close to strong electrostatic, electro-magnetic or radioactive fields.

### Unpacking and servicing ESD sensitive equipment

If it is necessary to open and touch the electronics inside the boxes/cabinets, then *the following precautions MUST be taken*:

- The working area must be covered by an approved conductive service mat that has a resistance of between

50 k $\Omega$  and 2 M $\Omega$  and is connected directly to a reliable grounding point via its grounding cord.

- The service personnel involved must wear a wrist-band in direct contact with the skin, connected to the service mat.
- Printed circuit boards and other components should be placed on the conductive service mat during installation, maintenance etc.

---

**Caution**

*If, for any reason, it is necessary to move the circuit board or components from the conductive service mat, they must be placed in an approved anti-static transportation container (e.g. static shielding bag) before transportation.*

- 
- During installation and servicing, all electrical equipment (soldering irons, test equipment etc.) must be grounded.

## Temperature protection

If the unit must be protected against extremes of temperature, the carton/crate must be lined on all walls, base and lid with 5 cm thick polyurethane or polystyrene foam.

These units will be identified as delicate in the applicable documentation.

The package must then be clearly marked:

---

**Note**

*Must not be transported or stored in temperatures below -5 degrees Celsius.*

---

Other units can normally be stored in temperatures between -30° C and +70° C, refer to the system's technical specifications for details.

Transducers must not be stored in temperatures below - 20° C and above + 60° C.

## 11 TEST AND ALIGNMENT PROCEDURES

This chapter presents checks, tests and alignment procedures that must be conducted on the hull unit before it is put into operational service.

### Purpose

After the physical installation has been carried out, all the system units must be checked to ensure that the units have been installed correctly.

This chapter contains the instructions and procedures required to ensure the system is installed correctly, is correctly set up and is safe to switch on and use.

### Topics

- *Test certificate on page 152*
- *Visual inspection on page 152*
- *Test procedures introduction on page 153*

### Test certificates

Once the testing engineer has performed or witnessed the performance of a test or part of a test, he should sign on the dotted line under each check/test to certify that the unit or system has passed that particular part of the procedure.

The use of these fields is optional, but we recommend that they are properly filled in for future references.

---

#### Note

*If the testing engineer is not satisfied with the standard of any part of the installation, he must contact the personnel who performed the installation to have the work rectified and brought up to the required standards.*

---

### Visual inspections

After the installation has been carried out, all the system units must be checked visually to ensure the system has been installed correctly.

The testing engineer must ensure that the units have been mounted in the correct locations, correctly orientated (that is, the right way up) and are correctly secured to the bulkhead/deck/mounting brackets. The inspection engineer must understand that correct installation of some parts of the Hull unit is critical to the safety of the vessel.

## Test procedures introduction

In all cases the step-by-step instructions must be followed if the tests are to be trustworthy.

In order to verify that the HiPAP® system work properly, the following tests must be carried out:

### Topics

- *Inspection of the hull unit on page 154*
- *Inspection of the Hoist Control Unit on page 158*
- *Inspection of the Remote Control Unit on page 160*
- *Cabling installation checks on page 162*
- *Hull unit raise/lower manual checks on page 164*
- *Electrical check on page 166*
- *Remarks and signatures on page 170*

Follow the procedures and fill in the tables. Once the system has been tested, sign the signature page (use the last page of this section).

The test results will be:

- |             |                                     |
|-------------|-------------------------------------|
| <b>OK</b>   | when the test is done satisfactory. |
| <b>FAIL</b> | if the test fails.                  |
| <b>NA</b>   | if the test is non-applicable.      |

## Inspection of the hull unit

After the installation has been completed, all parts of the Hull unit must be checked to ensure a secure and safe installation. These checks must be performed before the system is switched on for the first time.

---

### **Warning**

***The correct installation of the hull unit is critical to the safety of the vessel.***

---

### **Logistics**

**Safety** - N/A.

**Personnel** - Experienced engineer from the yard's quality assurance department. Installation supervisor.

**Vessel location** - N/A.

**References** - This manual.

**Special tools** - None.

### **Procedure**

Start at the bottom of the unit. Refer to the installation drawings and cable diagrams in the *Drawing file* chapter of this manual, and any relevant drawings and procedures which may have been prepared for the vessel by the yard.

- 1** Perform a close visual inspection of the vessel's hull, both internally and externally, in the area around the mounting flange.
- 2** Check that the hull plates have not buckled during the cutting and welding processes. Check that hull strengthening plates have been fitted as per the drawings, and that all welds are strong and watertight.
- 3** Ensure that all exposed metal surfaces have been properly painted with the appropriate preservation mediums to prevent corrosion.
- 4** Perform a close visual check of the mounting flange installation.
  - Ensure that the unit is mounted properly, that all joints are satisfactory and that the unit has been correctly braced to the vessel's hull.

---

*Caution*

*If the installation of this part of the hull unit is not correctly performed, the safety of the vessel will be compromised.*

---

- 5 Ensure the unit is mounted properly using the o-rings provided and the correct type and number of bolts, nuts and washers.
  - 6 Ensure all the bolts are correctly tightened.
- 

*Caution*

*If the installation of this part of the hull unit is not correctly performed, the safety of the vessel will be compromised.*

---

- 7 Ensure the painted parts are properly painted with the appropriate preservation mediums to prevent corrosion.
- 8 Check that the hull unit assembly is correctly orientated and installed, and that the upper part of the gantry is suitably supported to the hull with reinforcing braces.
- 9 Check that the braces are **BOLTED** into position, **NOT WELDED**.
- 10 Ensure all nuts and bolts used are suitable for the application, and that the appropriate flat and shake-proof washers are used.
- 11 Ensure all nuts and bolts are correctly tightened.
- 12 Ensure all applicable metal surfaces are properly painted with the appropriate preservation mediums to prevent corrosion.
- 13 Ensure the guide rails, sprockets and drive chains within the gantry have sufficient grease to ensure smooth raising and lowering of the shaft.
  - Type shall be ESSO MP grease Beacon EP 2.
- 14 Wipe off any excess grease.
- 15 Check that there is sufficient grease in the shaft sleeve.
  - Type shall be 1 litre oil type ESSO MP grease Beacon EP 2.
  - When sufficiently filled, a thin film of oil should be noticeable on the transducer shaft as it is raised. Oil filling and level plugs are located on the side of the

shaft sleeve. Check that the filler and level screws are tight and not leaking. Clean up any oil spillage.

- 16** Check that the limit switches are properly secured into the gantry.
  - Limit switch operation will be checked during the "Setting to work" phase.
- 17** Check that the self-locking electric motor is correctly mounted, and that all securing bolts are tight.
- 18** Find the hand crank stowed on top of the hull unit, and check that the hand crank fits in position on the hoist motor shaft.
- 19** Replace the hand crank into position.
- 20** Check that the motor gearbox is filled with oil, and that there are no oil leaks.

Type shall be SAE 30 motor oil.

**Test certificate**

<b>Inspection of the hull unit</b>	
<b>Item to be checked</b>	<b>Checked (sign)</b>
Hull unit installation and preservation correct	
Mounting flange installation and preservation correct	
Gate valve installation and preservation correct	
Gantry installation and preservation correct	
Guide rail, sprockets and drive chains lubricated	
Sleeve filled, no oil leaks	
Limit switches correct	
Motor and hand crank correct, gearbox full and sealed	
The installation of the hull unit has been checked according to the procedures defined in this manual. Comments concerning inaccuracies, faults and/or poor workmanship have been filed as a separate report.	
<i>Yard's quality assurance department</i>	
Signature	Date
<i>Installation team supervisor</i>	
Signature	Date

## **Inspection of the Hoist Control Unit/Hoist Control Unit with Ethernet interface**

The Hoist Control Unit must be located as close as practically possible to the hull unit, preferably within the same compartment. For safety reasons there should be a clear line of sight between the two units. The Hoist Control Unit is designed to be bolted to a bulkhead.

### **Logistics**

**Safety** - N/A.

**Personnel** - Experienced engineer from the yard's quality assurance department. Installation supervisor.

**Vessel location** - N/A.

**References** - Drawings included in this manual.

**Special tools** - None.

### **Procedure**

- 1** Perform a close visual inspection of the cabinet.
- 2** Check that the unit is installed in the correct location, and is suitably orientated to enable easy maintenance.
- 3** Check that the unit is not damaged, and that the paintwork is clean.
- 4** If the unit is secured to mounting brackets, check that the brackets are manufactured correctly and are bolted or welded securely to the bulkhead.
- 5** If bolts have been used, ensure they are of an appropriate size and number to ensure the brackets are secure.
- 6** If the brackets are welded, ensure the welds are satisfactory and strong enough to hold the brackets and unit.
- 7** Check that the cabinet is securely fastened to the bulkhead/mounting brackets using four M8 bolts.
- 8** Check that the correct flat and shake-proof washers have been used, and that all the bolts are tight.
- 9** Check that the braided ground conductor is correctly installed.

- 10** Check that all welds/brackets have been painted with the correct preservation medium to prevent corrosion.

**Test certificate**

<b>Inspection of the Hoist Control Unit/ Hoist Control Unit with Ethernet interface</b>	
<b>Item to be checked</b>	<b>Checked (sign)</b>
Bolted/Welded	
Bolts / ground conductor correct	
Paintwork correct	
The installation of the hull unit has been checked according to the procedures defined in this manual. Comments concerning inaccuracies, faults and/or poor workmanship have been filed as a separate report.	
<i>Yard's quality assurance department</i>	
Signature	Date
<i>Installation team supervisor</i>	
Signature	Date

## Inspection of the Remote Control Unit

The Remote Control Unit will normally be located close to the operator station to allow the operator immediate control of the hull unit. The Remote Control Unit is designed to be bolted to a bulkhead.

### Logistics

**Safety** - N/A.

**Personnel** - Experienced engineer from the yard's quality assurance department. Installation supervisor.

**Vessel location** - N/A.

**References** - Drawings included in this manual.

**Special tools** - None.

### Procedure

- 1 Perform a close visual inspection of the unit.
- 2 Check that the unit is installed in the correct location, and is suitably orientated to enable easy operation and maintenance.
- 3 Check that the unit is not damaged, and that the paintwork is clean.
- 4 Check that the unit is securely fastened to the bulkhead/mounting brackets using four M5 screws, nuts and washers.

**Test certificate**

<b>Inspection of the Remote Control Unit</b>	
<b>Item to be checked</b>	<b>Checked (sign)</b>
Remote Control Unit correct	
The installation of the hull unit has been checked according to the procedures defined in this manual. Comments concerning inaccuracies, faults and/or poor workmanship have been filed as a separate report.	
<i>Yard's quality assurance department</i>	
Signature	Date
<i>Installation team supervisor</i>	
Signature	Date

## Cabling installation checks

This is the test procedures for the system's power and signal interface cables.

---

### **Warning**

***These checks must be completed before any power is switched onto the system.***

---

### **Logistics**

**Safety** - N/A.

**Personnel** - Experienced engineer from the yard's quality assurance department. Installation supervisor.

**Vessel location** - N/A.

**References** - Drawings included in this manual.

**Special tools** - None.

### **Visual inspection of the cabling**

Refer to the cable plans and interconnection diagrams, and check all power and inter-connection cables. Any locally fitted plugs and connectors must also be checked to ensure the correct types have been used for the specific locations.

(Sealed/spark-proof connectors in areas where flammable gasses may accumulate, etc.)

Ensure all cable connections have been made according to the cable plan, and that all connections are tight and secure. Ensure all cables are correctly laid in conduits, or are otherwise protected according to the regulations and recommendations laid down by the vessel's registering authority. Ensure all protective covers are fastened correctly.

### **Cable connections and continuity**

After the cable connections have been completed and the visual inspection has been carried out, all the cable cores must be checked for correct connection and continuity. Refer to the cable plans and interconnection diagrams, and check all interconnection cables. Any locally fitted plugs and connectors must also be checked for shorts or open circuits. Ensure all cable connections have been made according to the cable plan, and that all connections are tight and secure.

**Warning**                    ***These checks must be completed before any power is switched onto the system.***

**Procedure**

The check procedure will require pairs of engineers, equipped with the appropriate cable plans and wiring diagrams, two-way communication devices and tool kits. The “tester” will require continuity test equipment and the assistant will require a suitable shorting strap.

**Note**                            *The exact resistance values will depend on the type and lengths of the cables and the units to which the cables are connected. If in doubt, check with the manufacturers.*

**Follow the check procedure below for each cable core:**

- 1**     The test engineers must position themselves one at each extremity of the cable to be checked.
- 2**     Good communications must be established.
- 3**     Ensure the cable to be tested is not connected to any power source.

**Note**                            *If a cable terminates in a plug at the unit, the test will be more easily conducted if the plug is disconnected.*

- 4**     Select one pair of cable cores, and check that the cores are connected to the correct terminals in the unit.
- 5**     The tester then connects his continuity tester to the two terminals in question and checks the continuity.

**Note**                            *If a low resistance exists between the two cores, this may indicate the cores are connected to circuits or units with low internal resistance. If this is the case, disconnect the cores from the terminal block and test again. The resistance should be approaching RW. If so:*

- 6**     The assistant then shorts the two cores together, and the tester repeats the test. The Resistance should be  $\approx 0\Omega$ .

- 7 The assistant then removes the shorting strap, and the resistance should go up to  $\approx \infty \Omega$  again.
- 8 The tester then checks each core's resistance to ground, (this should be  $\approx \infty \Omega$ ), and each core's resistance to all the other cores in the cable, (this should be  $\approx \infty \Omega$ ).
- 9 Assuming the test results are correct, the cores must then be reconnected to the terminal block (if they had been removed), and the terminals checked to ensure they are correct and tight.
- 10 On completion, move on to the next pair of cores and repeat the tests till the entire cable has been checked.

**Test certificate**

<b>Cable connections and continuity</b>	
<b>Item to be checked</b>	<b>Checked (sign)</b>
Connector type	
Cable continuity	
The installation of the hull unit has been checked according to the procedures defined in this manual. Comments concerning inaccuracies, faults and/or poor workmanship have been filed as a separate report.	
<i>Yard's quality assurance department</i>	
Signature	Date
<i>Installation team supervisor</i>	
Signature	Date

**Hull unit raise/lower manual checks**

This procedure is a mechanical test during which the hull unit is operated manually. These test checks that the hull unit is free to move without striking any obstructions and that the transducer cables are not going to become caught on anything during the lowering and raising operations. This check is to be used before the hull unit is powered up for the first time, and after any major maintenance or replacement has been carried out on the unit.

---

**Warning**

***Before lowering the hull unit, ensure there is a sufficient depth of water beneath the vessel's hull. If the vessel is in dry dock, check in the hull unit compartment and under the vessel to ensure no-one is working on the equipment and there are no obstructions. Rope off the area under the hull to ensure no one goes into the area while the hull unit is being operated.***

---

**Logistics**

**Safety** - N/A.

**Personnel** - Experienced engineer from the yard's quality assurance department. Installation supervisor.

**Vessel location** - N/A.

**References** - Drawings included in this manual.

**Special tools** - None.

**Procedure**

- 1** Check around the hull unit and ensure there are no obstructions liable to hinder the lowering or raising of the unit.
- 2** If the vessel is in a dry dock, check under the vessel to ensure the transducer will not strike an obstruction when it is lowered.
- 3** Remove the hand crank lever from the hoist platform and place it in position on the hoist motor shaft.
- 4** Release the motor brake by tightening the screw on the side of the motor, and lower the transducer approximately 30 cm.
- 5** Reset the brake by slackening the screw.
- 6** Check that the cable is free to follow the transducer shaft as it is lowered, and is not liable to be caught on any obstructions.
  - Remember that the cable may swing some distance from the hull unit in rough seas, so check to the full radius of the cable.
- 7** Repeat steps 1 to 6 until the hull unit is fully lowered.

- 8 Follow the same procedure to raise the hull unit again, paying particular attention to the cable.
- 9 If the vessel is floating, release any air which may be trapped in the mounting flange by cracking open the air vent cock.

**Test certificate**

<b>Hull unit raise/lower manual checks</b>	
<b>Item to be checked</b>	<b>Checked (sign)</b>
Manually (by hand crank) lower/rise transducer shaft	
Transducer cable free to move	
The installation of the hull unit has been checked according to the procedures defined in this manual. Comments concerning inaccuracies, faults and/or poor workmanship have been filed as a separate report.	
<i>Yard's quality assurance department</i>	
Signature	Date
<i>Installation team supervisor</i>	
Signature	Date

**Electrical check**

This procedure checks the electrical operation of the hull unit and sets up the limit switches.

It must be performed after all inspections, cable connection checks and the manual operation check have been performed, but before the hull unit is operated under power for the first time.

**Logistics**

**Safety** - N/A.

**Personnel** - Min 2 experienced engineer from the yard's quality assurance department. Installation supervisor.

**Note** *When performing the Remote Control Unit test, one engineer must operate the Remote Control Unit, while the other inspects the hull unit and operates the Hoist Control Unit. Communication between the two engineers is essential.*

**Vessel location** - N/A.

**References** –

→ *Hoist system, Interconnection diagram.*

**Special tools** - None.

**Procedure**

→ *Buttons location, see figure on page 49.*

- 1 Open the Gate Valve.
- 2 Lower the transducer manually by using the hand crank. Approximately 50 cm down.

**Note** *Remember to release the brake.*

- 3 Remove the hand crank.
- 4 Switch power on, using breaker F01 on the Hoist Control Unit (HCU).
- 5 Switch S1 in the HCU to **HOIST** and then **STOP** in rapid succession.
  - The transducer shaft should move upwards. If the transducer moves downwards interchange two leads of the motor supply.
- 6 Switch to **LOWER**.
- 7 After a few seconds, operate the **lower limit switch** manually.
  - Verify correct function of the switch. Lowering transducer should stop when operating the limit switch.
- 8 Switch to **HOIST**.
- 9 After a few seconds, operate the **upper limit switch** manually.

- Verify correct function of the switch. Raising the transducer should stop when operating the limit switch.
- 10** Switch to **HOIST**. Let the transducer move all the way up to the fully raised position.

---

*Caution*

*Check the water depth/clearance under the ship/transducer before proceeding!*

---

- 11** Switch to **LOWER**. Let the transducer go all the way down to the fully out position.
- 12** Switch to **HOIST**. Let the transducer go all the way up to the fully raised position.
- 13** Release any air which may have accumulated in the transducer dock and gate valve using the air vent cock.
- 14** Set switch S1 to **REMOTE**.
- This to check remote operation, using the Remote Control Unit (RCU).
  - The **RAISE/UP** and **STOP** lamps on the RCU should light.
- 15** Press **LOWER/DOWN** and monitor the lowering of the transducer.
- 16** After a few seconds, press **STOP**.
- The **STOP** lamp shall be lit.
- 17** Press **LOWER/DOWN**.
- 18** After a few seconds, press the **Test** button on the protection relay (F02), in the HCU.
- The **STOP** lamp shall be lit.
- 19** Press the **Reset** button (blue) on the protection relay (F02), in the HCU.
- 20** Press **LOWER/DOWN**.
- Verify that the **LOWER/DOWN** and **STOP** lamps are lit when the lower limit is in fully out position.
- 21** Press **RAISE/UP**, and monitor the raising of the transducer.
- Verify that the **RAISE/UP** and **STOP** lamps are lit when the transducer is in the fully raised position.
- 22** Check that the lamp dimmer operates correctly.

**Test certificates**

<b>Electrical check</b>	
<b>Item to be checked</b>	<b>Checked (sign)</b>
DOWN/UP function-local	
Lower limit switch	
Upper limit switch	
DOWN function-remote	
STOP function-remote	
UP function-remote	
The installation of the hull unit has been checked according to the procedures defined in this manual. Comments concerning inaccuracies, faults and/or poor workmanship have been filed as a separate report.	
<i>Yard's quality assurance department</i>	
Signature	Date
<i>Installation team supervisor</i>	
Signature	Date

## Remarks and signatures

Remarks (if any) must be noted here or in a separate report.

Item	Subject
<p><i>Customer representative</i></p> <p>Signature _____ Date _____</p>	
<p><i>Kongsberg Maritime representative</i></p> <p>Signature _____ Date _____</p>	

## 12 DRAWING FILE

This chapter holds illustrations referred to in various sections in this manual. The illustrations are based on the original system drawings and wiring diagrams.

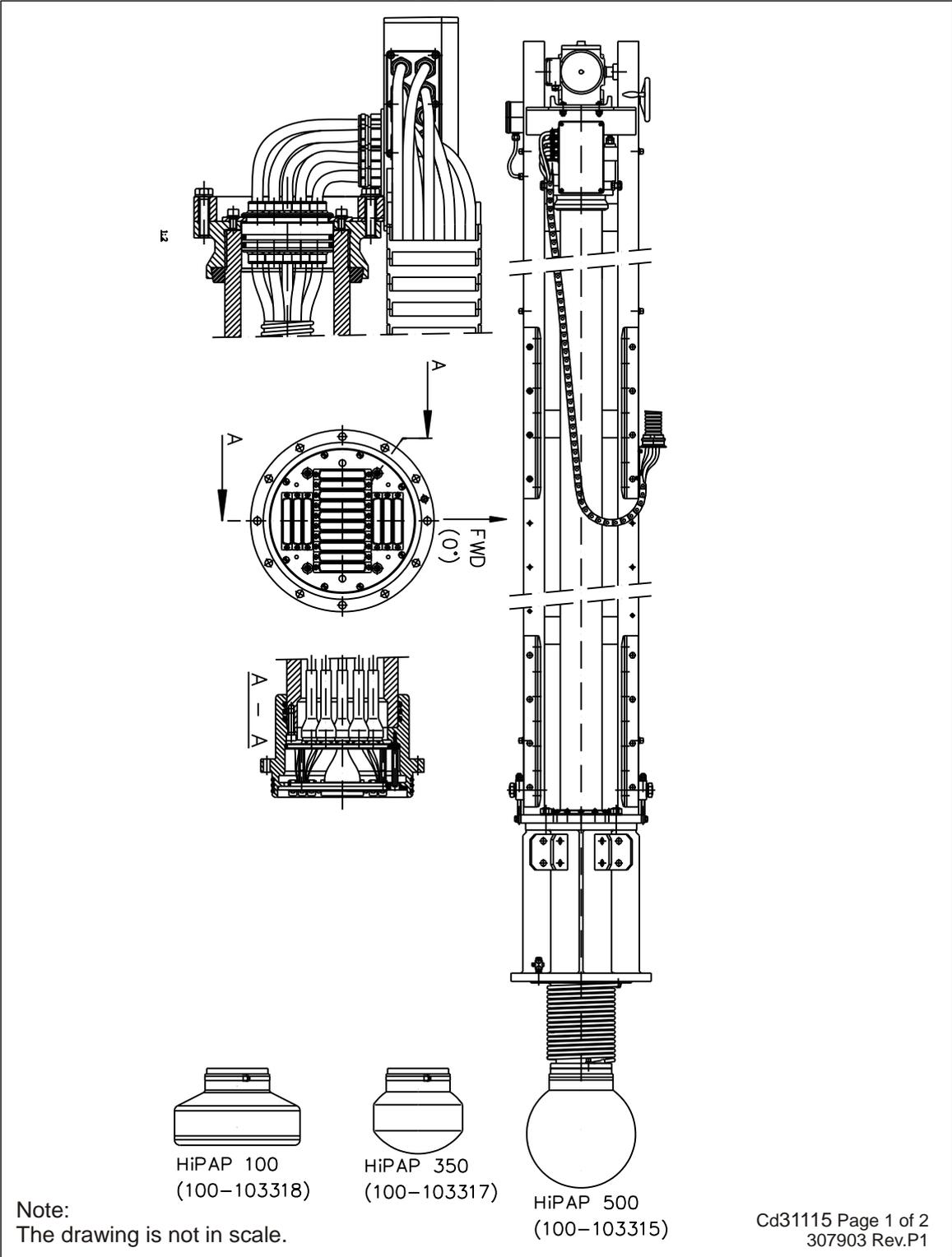
- Unless otherwise noted, all measurements are in millimetres.
- The illustrations are not in scale.
- The original drawings are available in electronic format upon request.

### Drawings

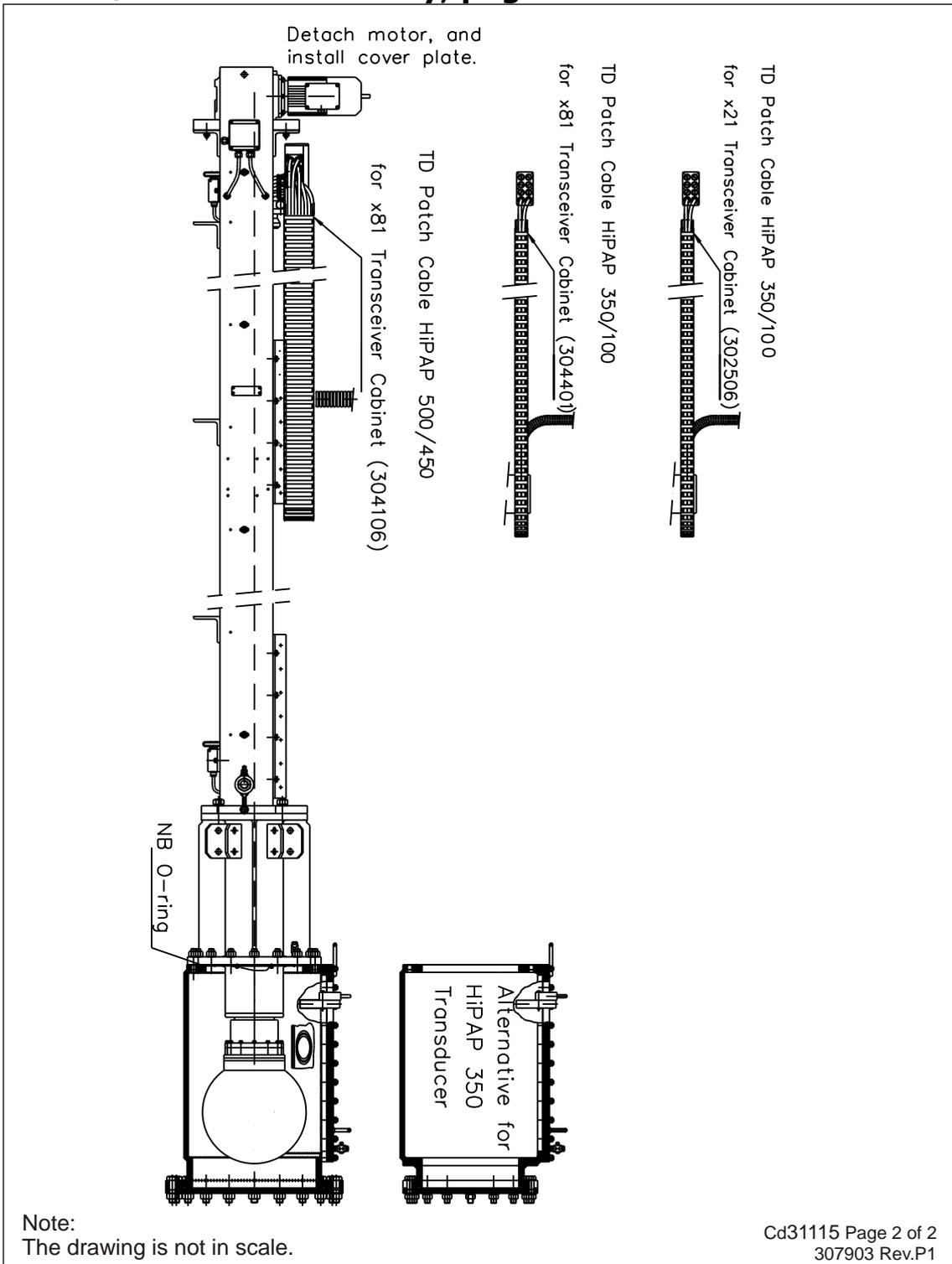
Part No.	Rev.	Description	Ref.
<b>HiPAP® hull unit assembly</b>			
307903	P1	For all HiPAP® systems	on page 173 and 174
<b>Typical arrangement</b>			
302021	A	HiPAP® hull unit	on page 175 and 176
N/A	N/A	HiPAP® hull unit mounting information	on page 177
<b>Outline dimensions</b>			
316242	A	HiPAP® HL 2180	on page 178
316243	A	HiPAP® HL 3770	on page 179
316244	A	HiPAP® HL 4570	on page 180
316245	A	HiPAP® HL 6120	on page 181
345320	A	Hoist Control Unit - outline dimensions	on page 182
830-103012	B	Remote Control Unit - outline dimensions	on page 183
355186	A	Hoist Control Unit with Ethernet interface - outline dimensions	on page 184
<b>Installation/dimensions</b>			
830-214043	E	DN 350 mounting flange with gate valve	on page 186
830-083045	H	DN 500 mounting flange with gate valve	on page 185
<b>Cables</b>			
306009	B	Transducer cable for HiPAP® 501/451 Transceiver unit Model x81 end	on page 188
306577	D	Transducer cable for HiPAP® 351/101 Transceiver unit Model x81 end	on page 189
306580	D	Transducer cable for Transceiver unit Model x21 end	on page 190

<b>Part No.</b>	<b>Rev.</b>	<b>Description</b>	<b>Ref.</b>
305992	D	Transducer hull unit cable, <i>for all</i> HiPAP® systems	on page 191
W311	C	EMC ground cable	on page 187
<b>Interconnection and circuit diagrams</b>			
824-102993	H	Hoist system, <i>without hydraulic system</i> for activating the gate valve - interconnection diagram	on page 192
323912	C	Hoist system, <i>with hydraulic system</i> for activating the gate valve - interconnection diagram	on page 193
824-102987	D	Hoist Control Unit - wiring diagram	on page 194
824-219190	B	Hoist Control Unit - circuit diagram	on page 195 and 196
824-094181	D	Remote Control Unit - wiring diagram	on page 197
343293	A	Hoist system, <i>with hydraulic system</i> for activating the gate valve via computer - interconnection diagram	on page 198
334116	B	Hoist Control Unit with Ethernet interface – wiring diagram	on page 199

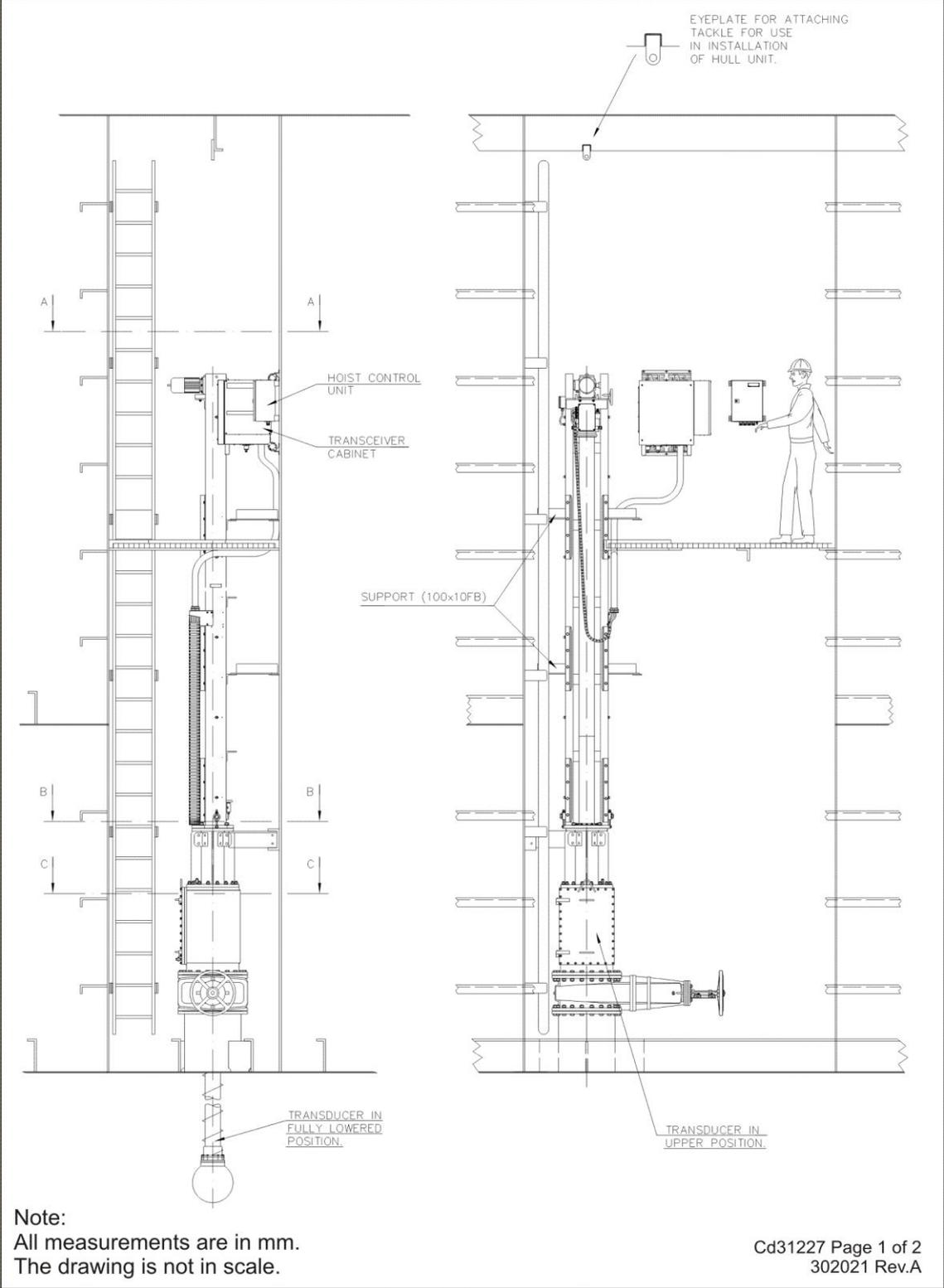
**HiPAP® hull unit assembly, page 1**



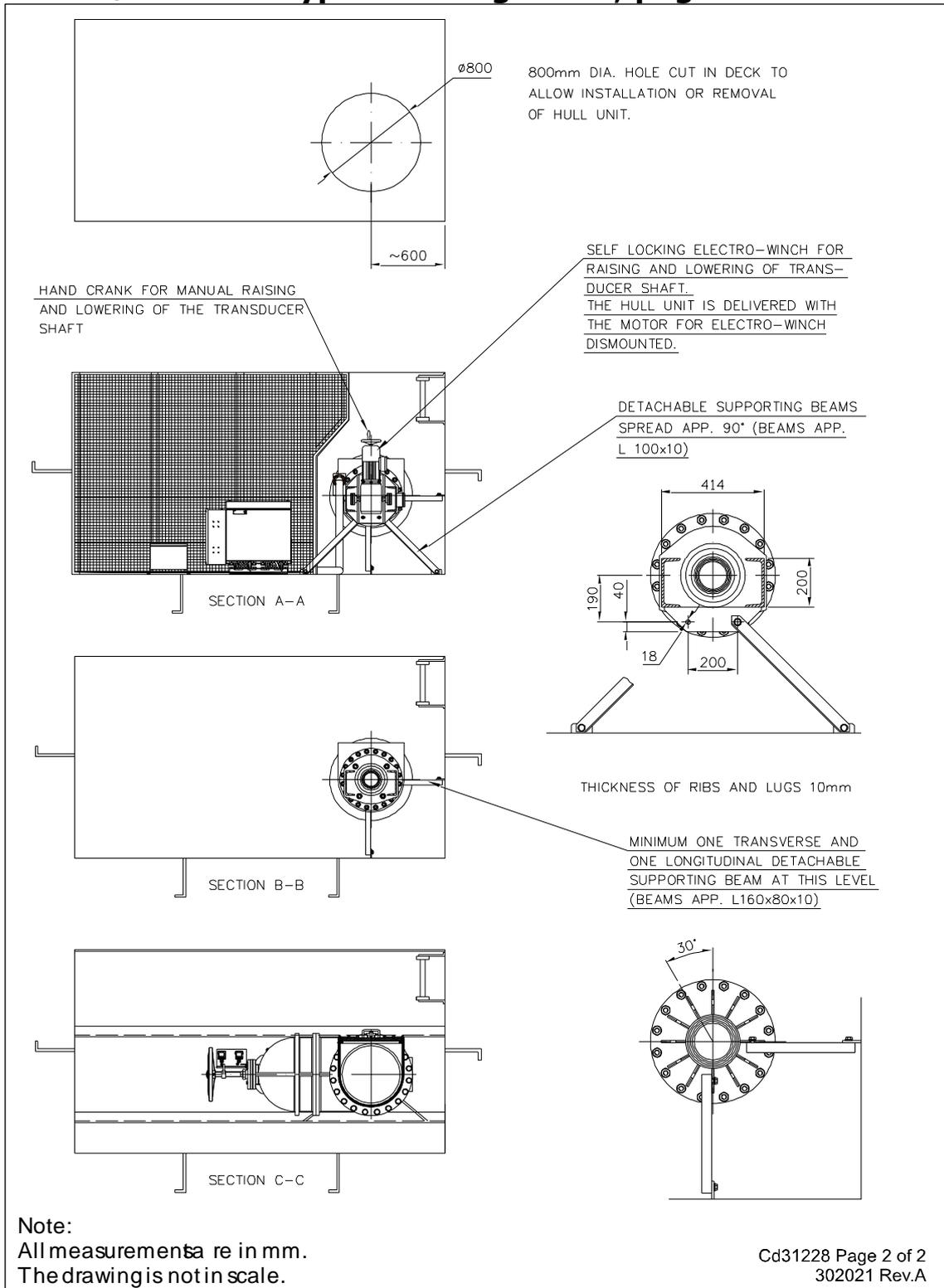
## HiPAP® hull unit assembly, page 2



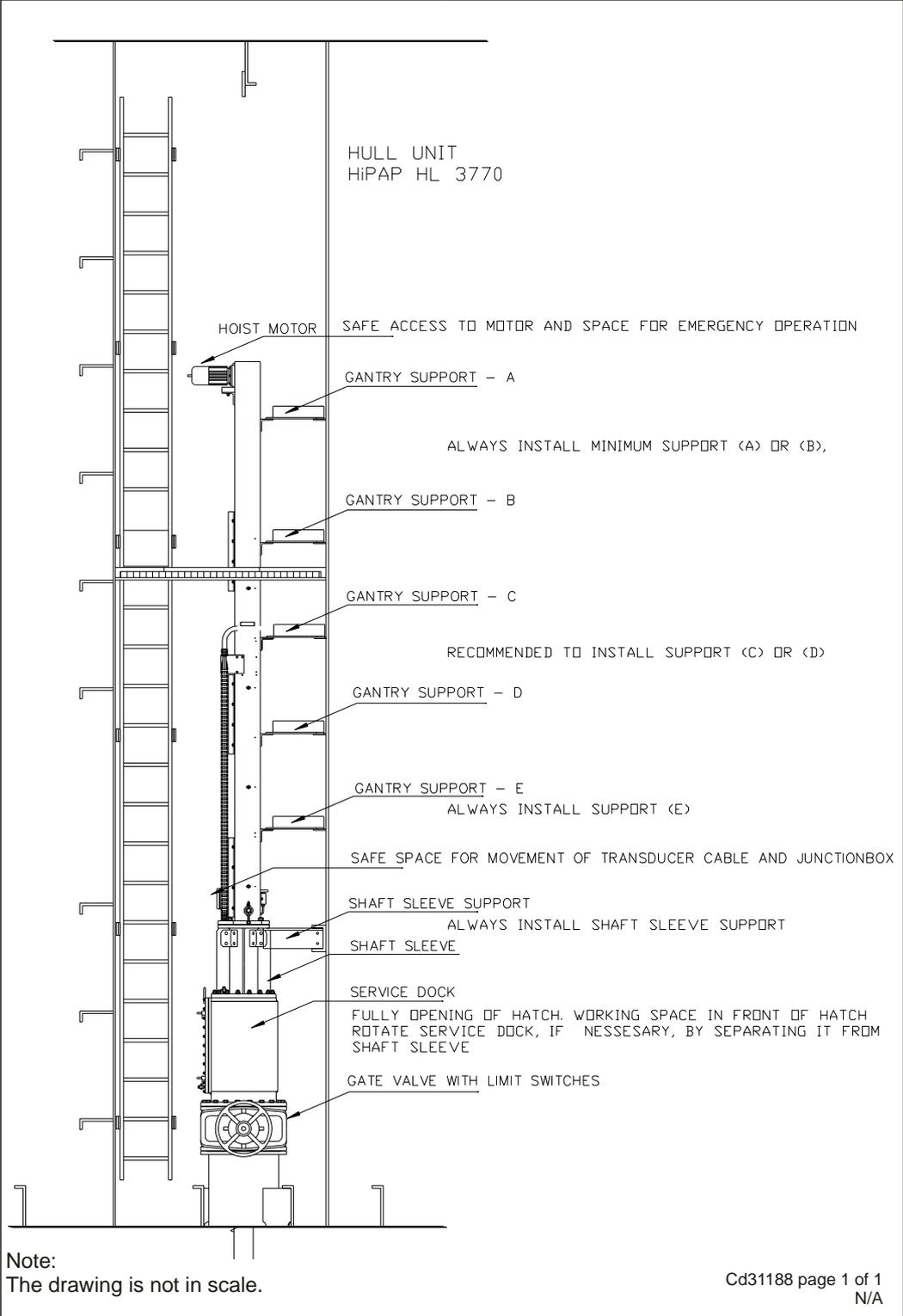
# HiPAP® hull unit typical arrangement, page 1



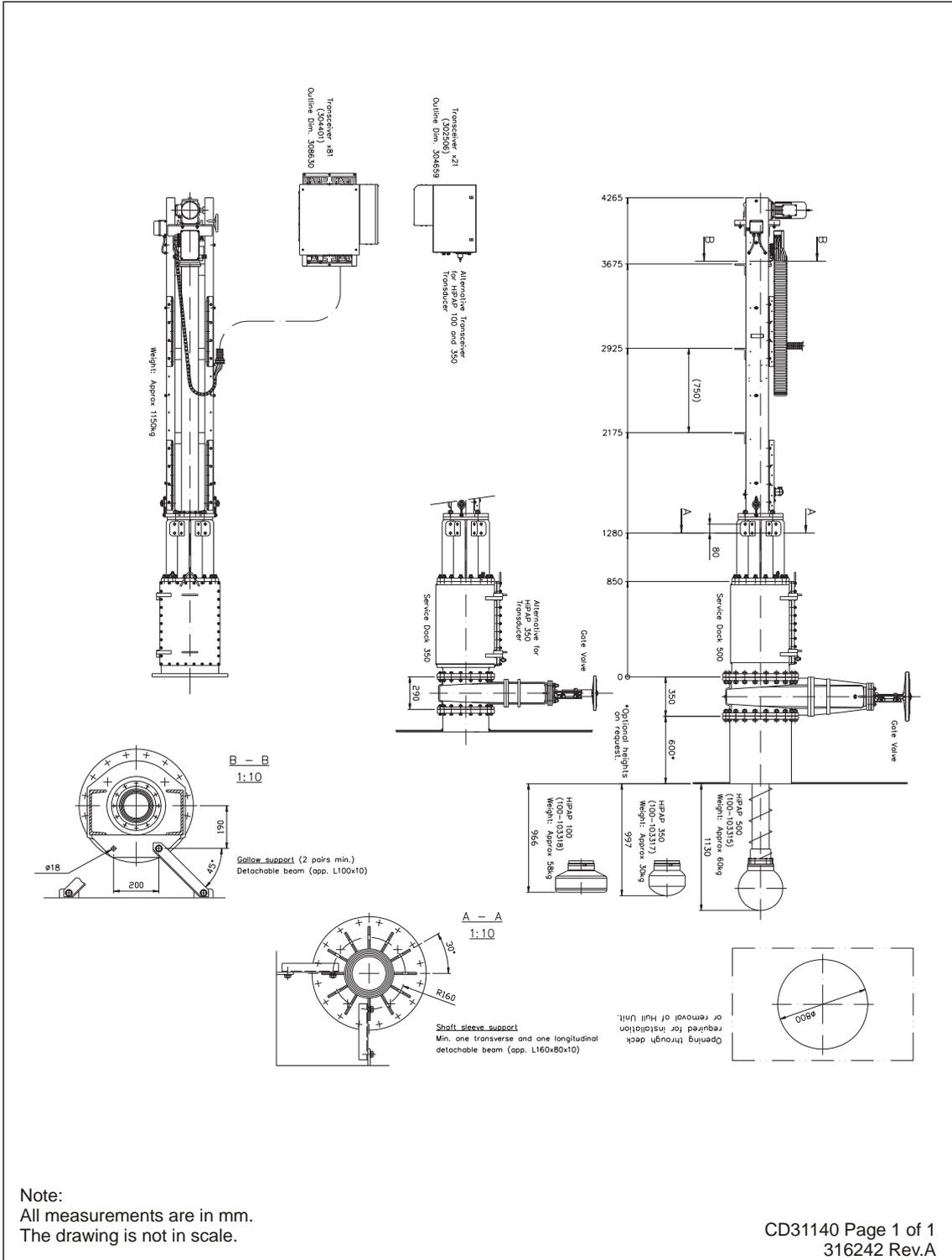
## HiPAP® hull unit typical arrangement, page 2



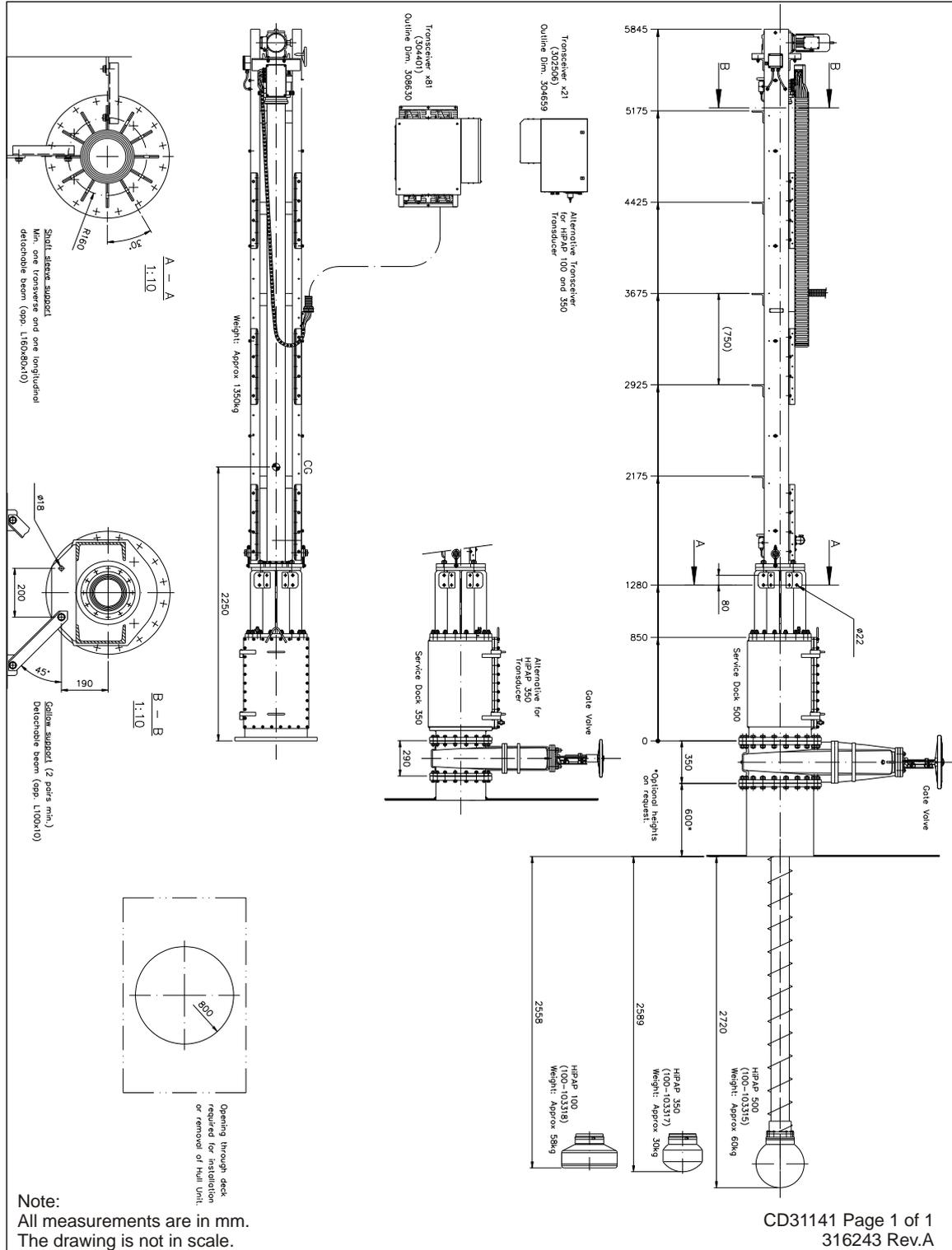
### HiPAP® hull unit mounting information



# HiPAP® HL 2180



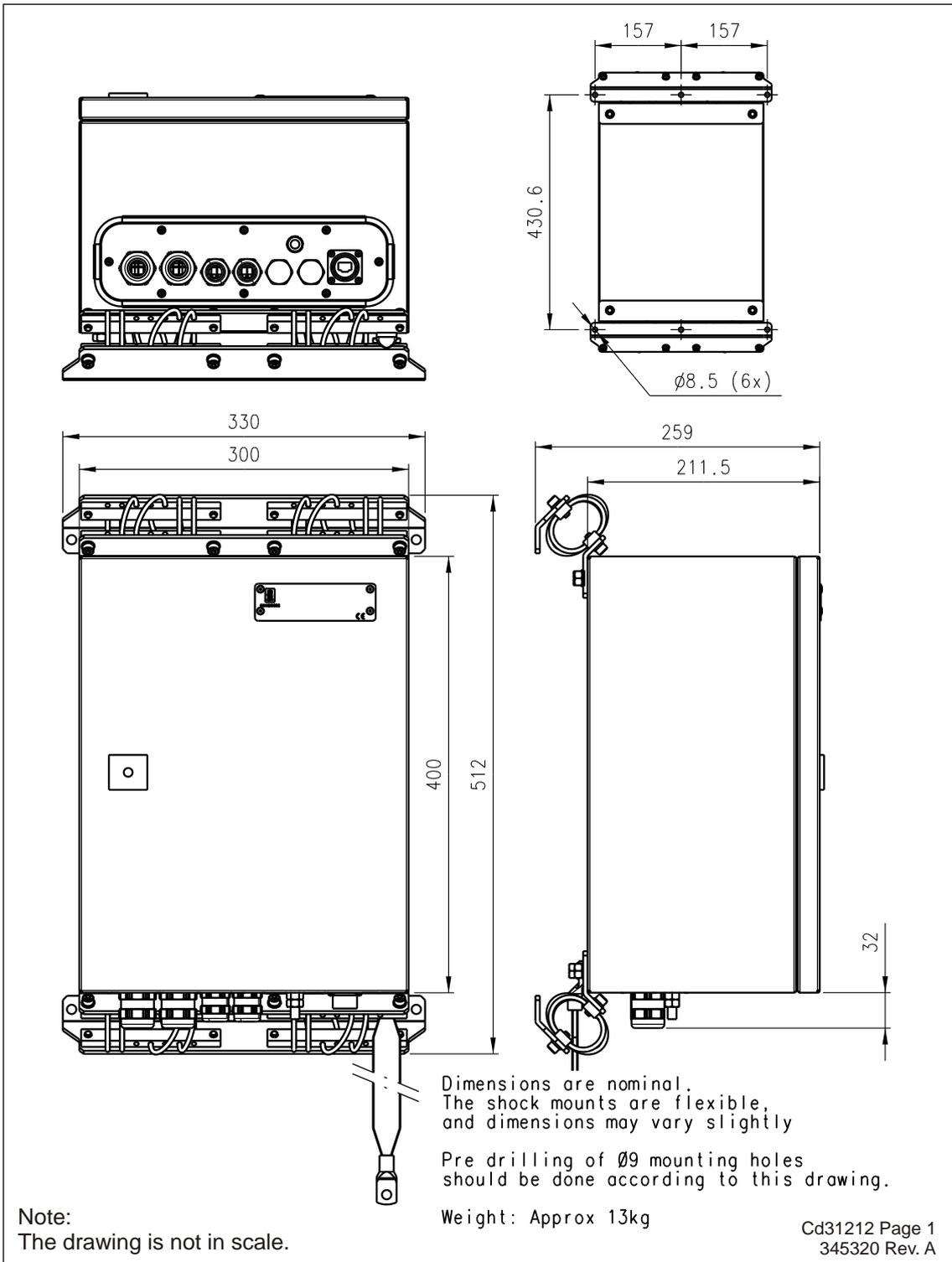
# HiPAP® HL 3770



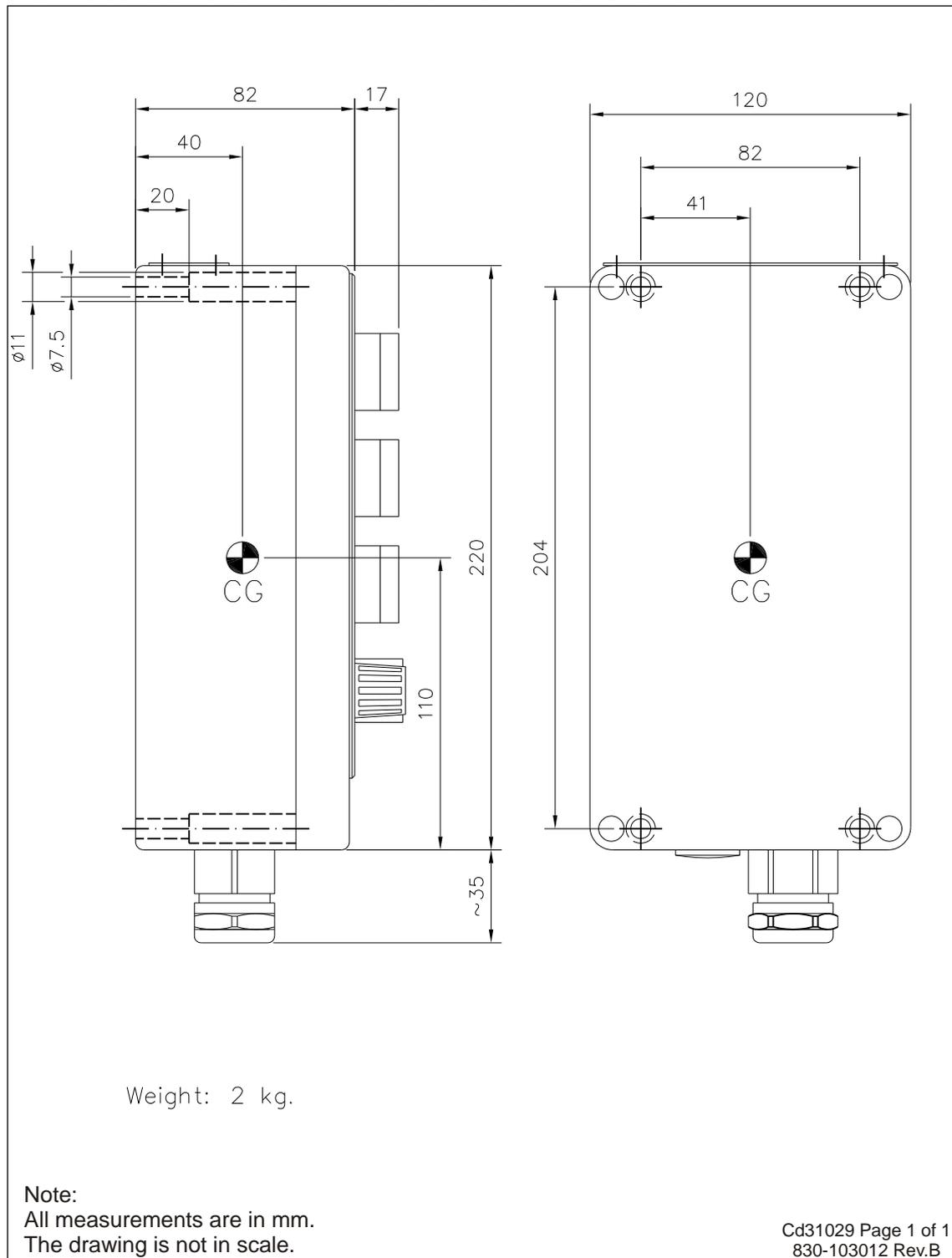




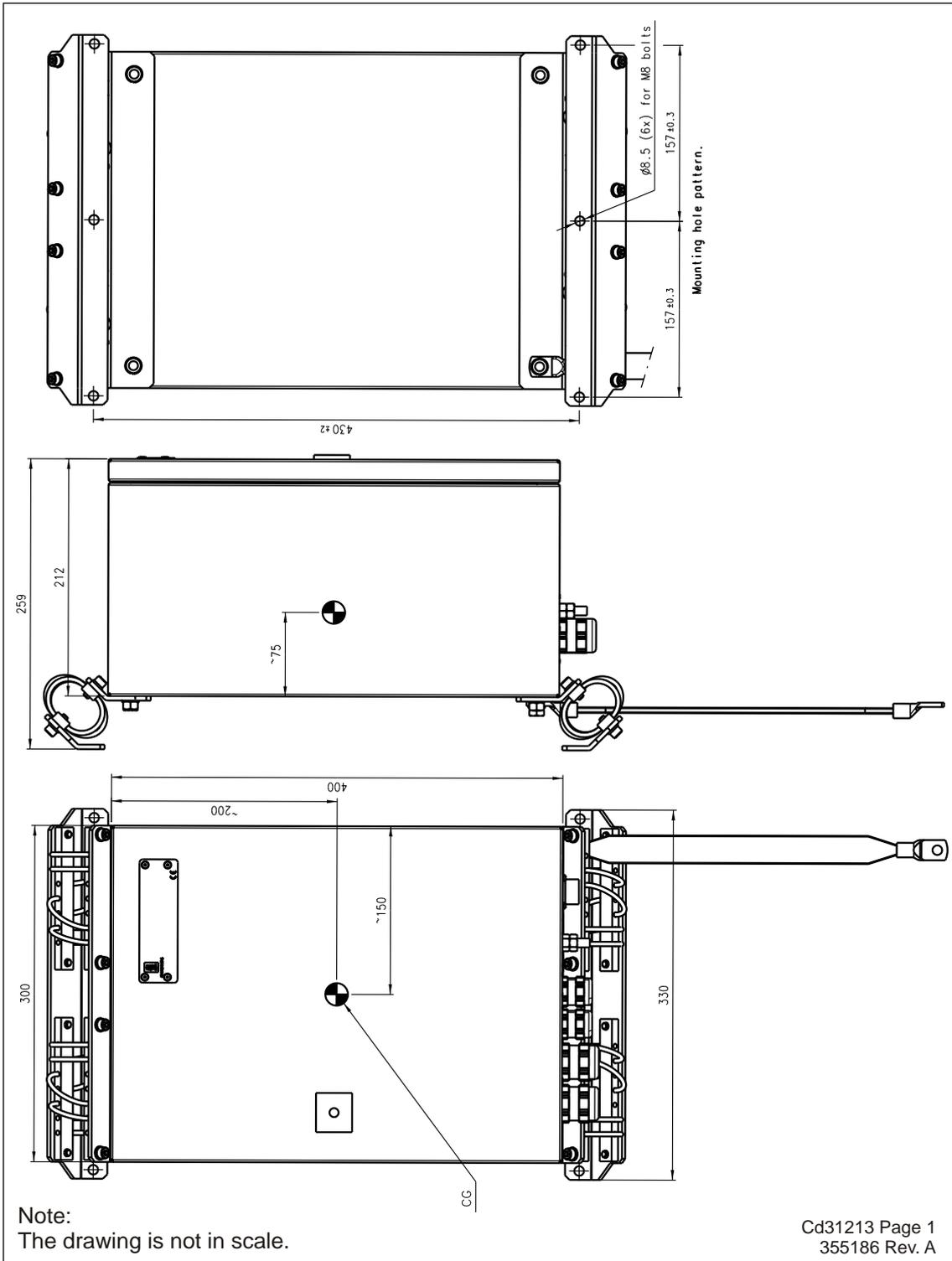
### Hoist Control Unit – outline dimensions



### Remote Control Unit – outline dimensions

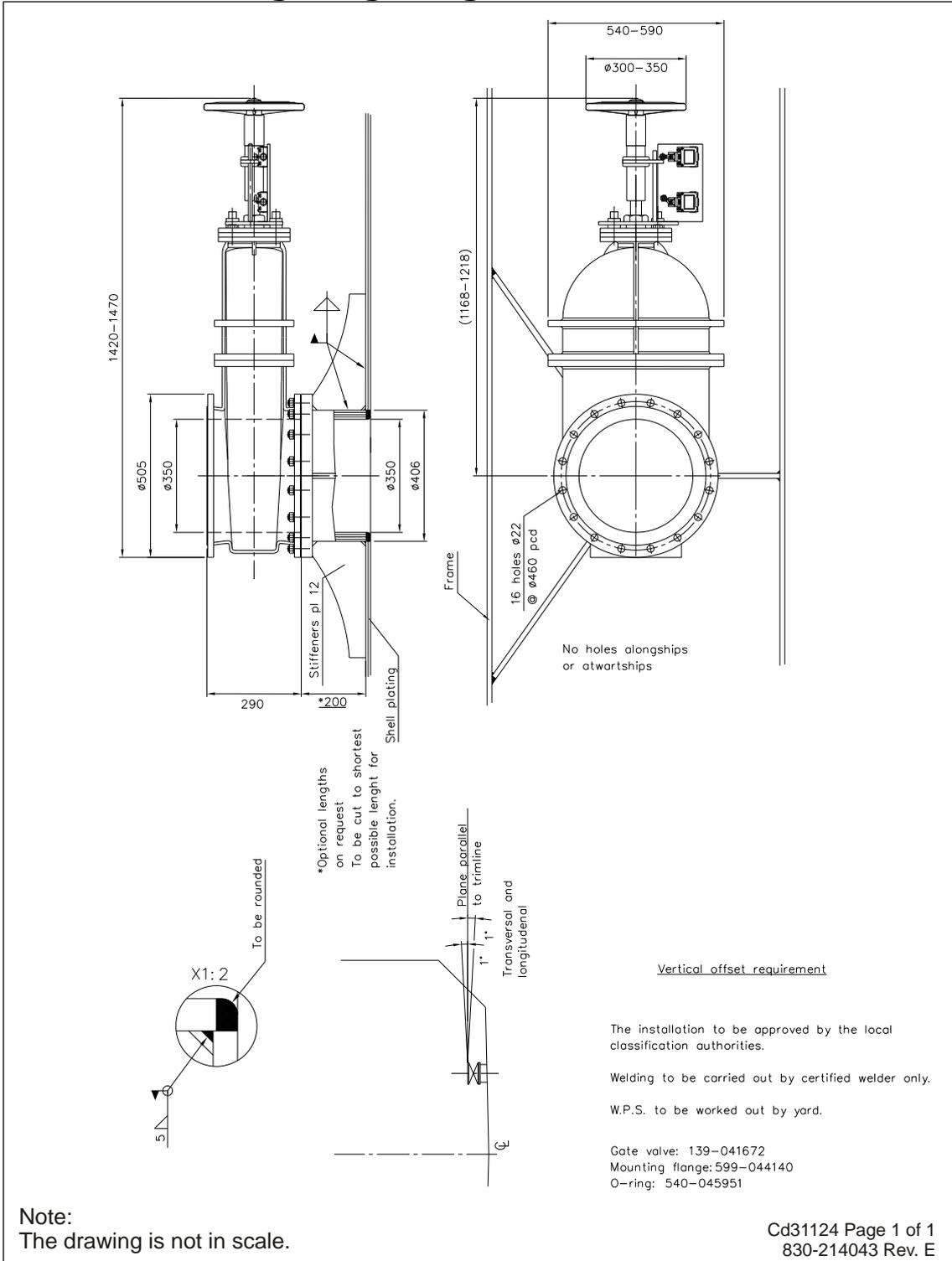


### Hoist Control Unit with Ethernet interface – outline dimensions





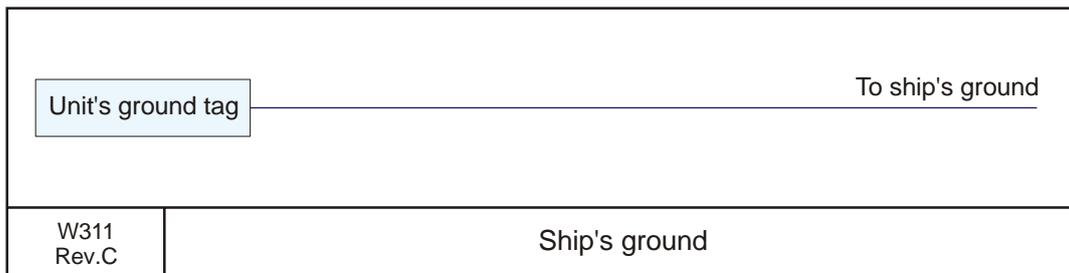
### DN 350 mounting flange w/gate valve



## EMC ground

This cable is used to connect the system unit to the ship's ground.

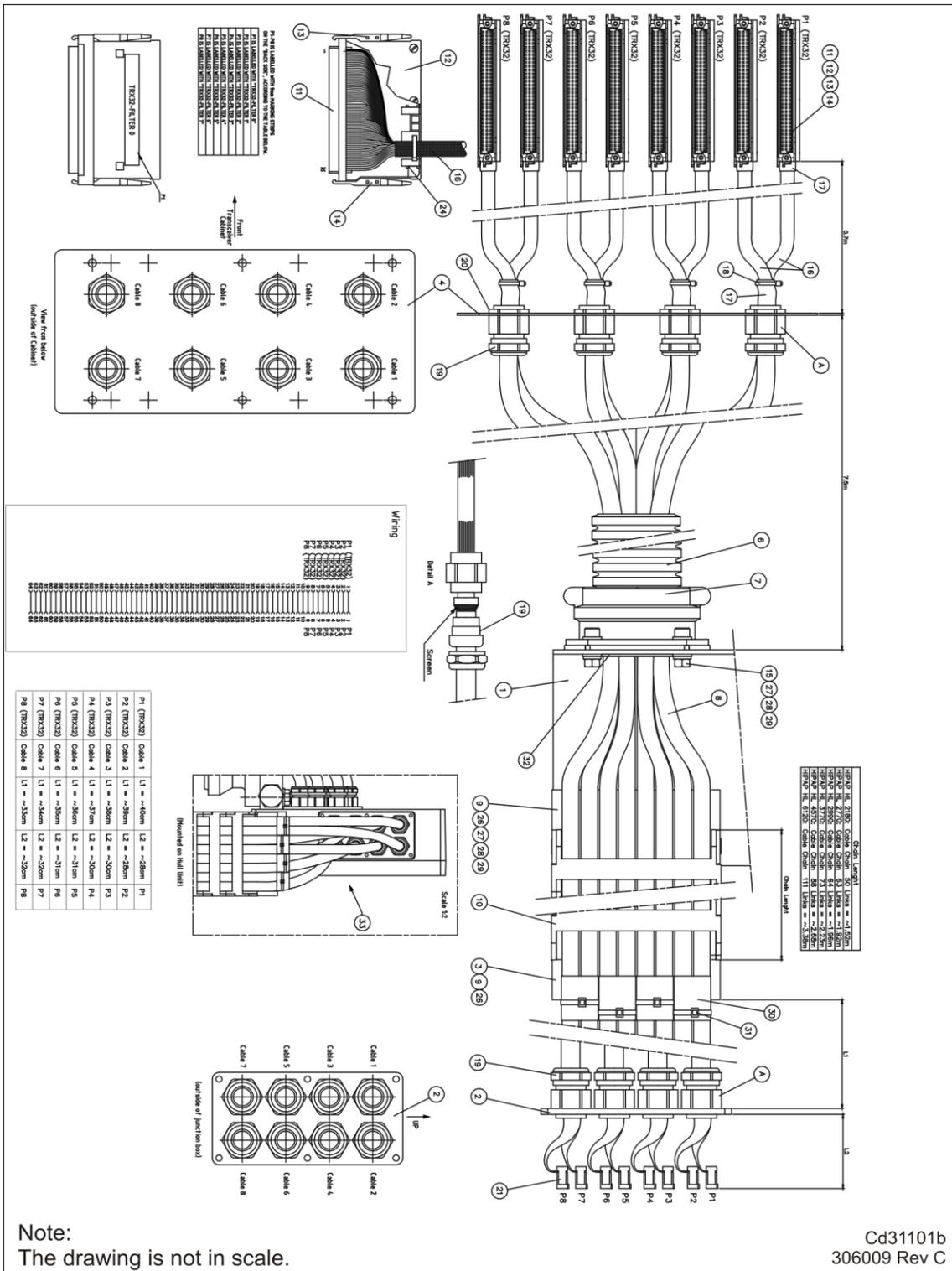
Note that this cable must be as short as possible.



## Minimum specifications

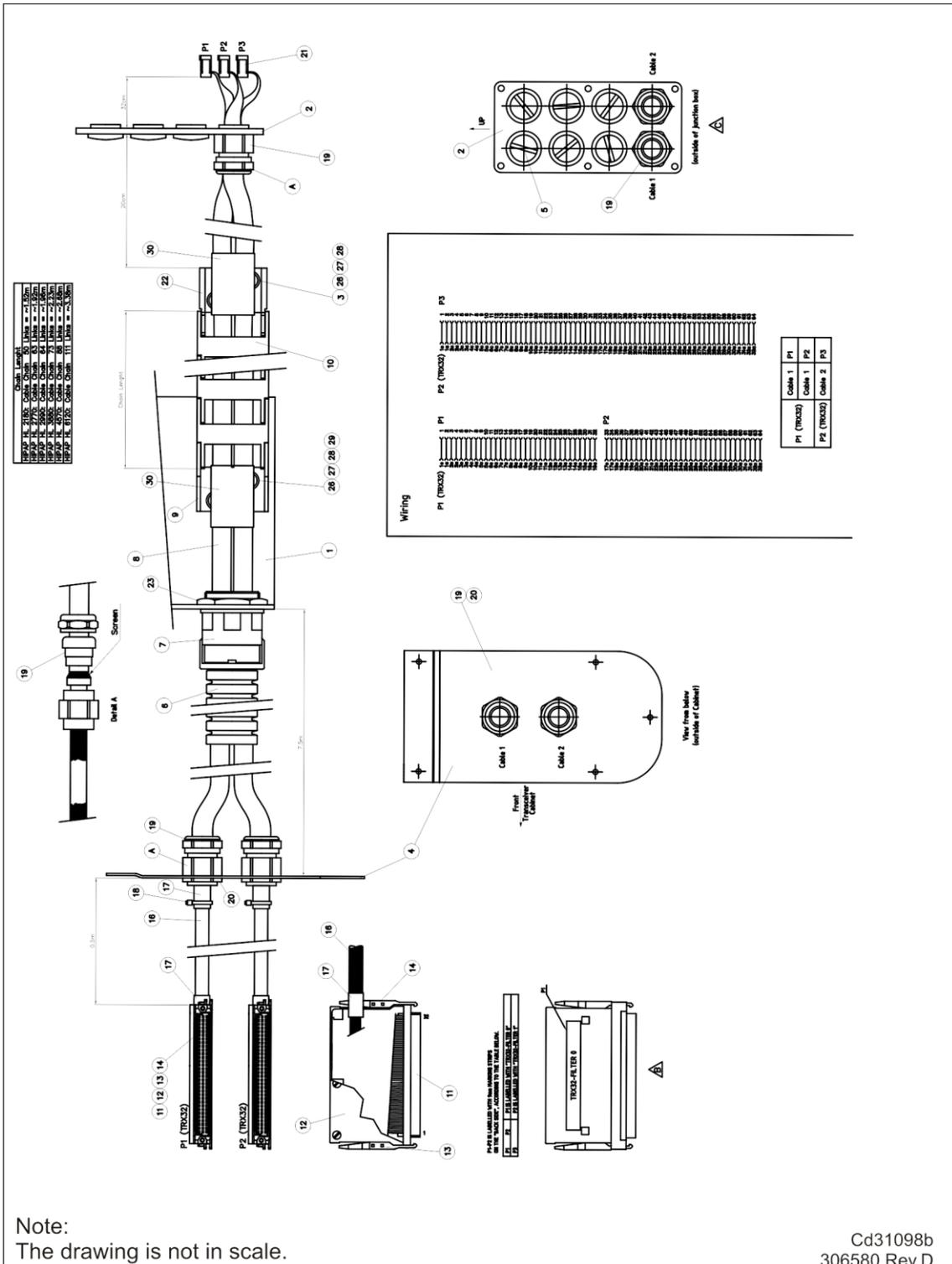
- Conductors. 1 x 6 mm<sup>2</sup>
- Screen: None
- Voltage: 60V
- Max. diameter: N/A

### Transducer cable for HiPAP® 501 / 451



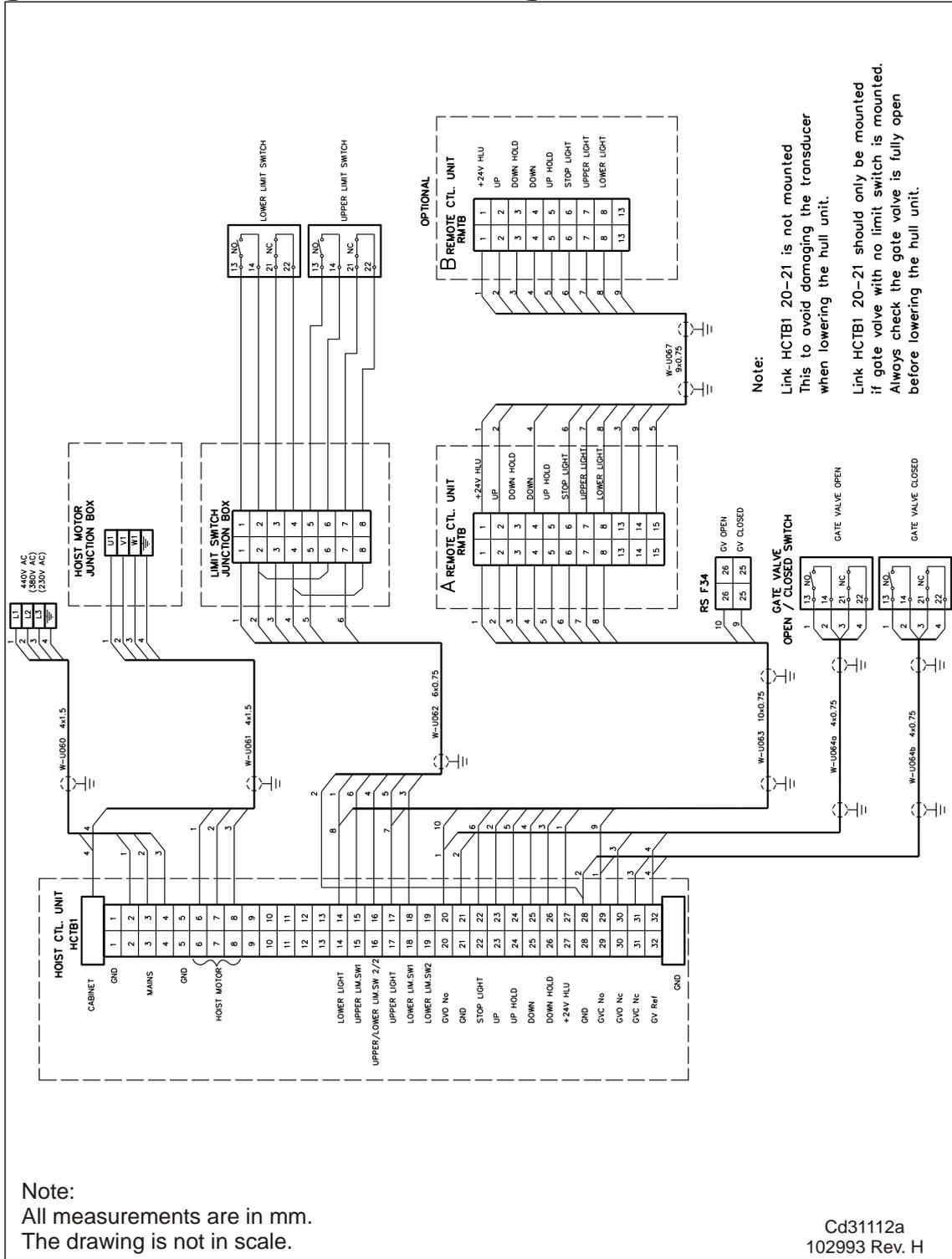


### Transducer cable for Transceiver unit Model x21

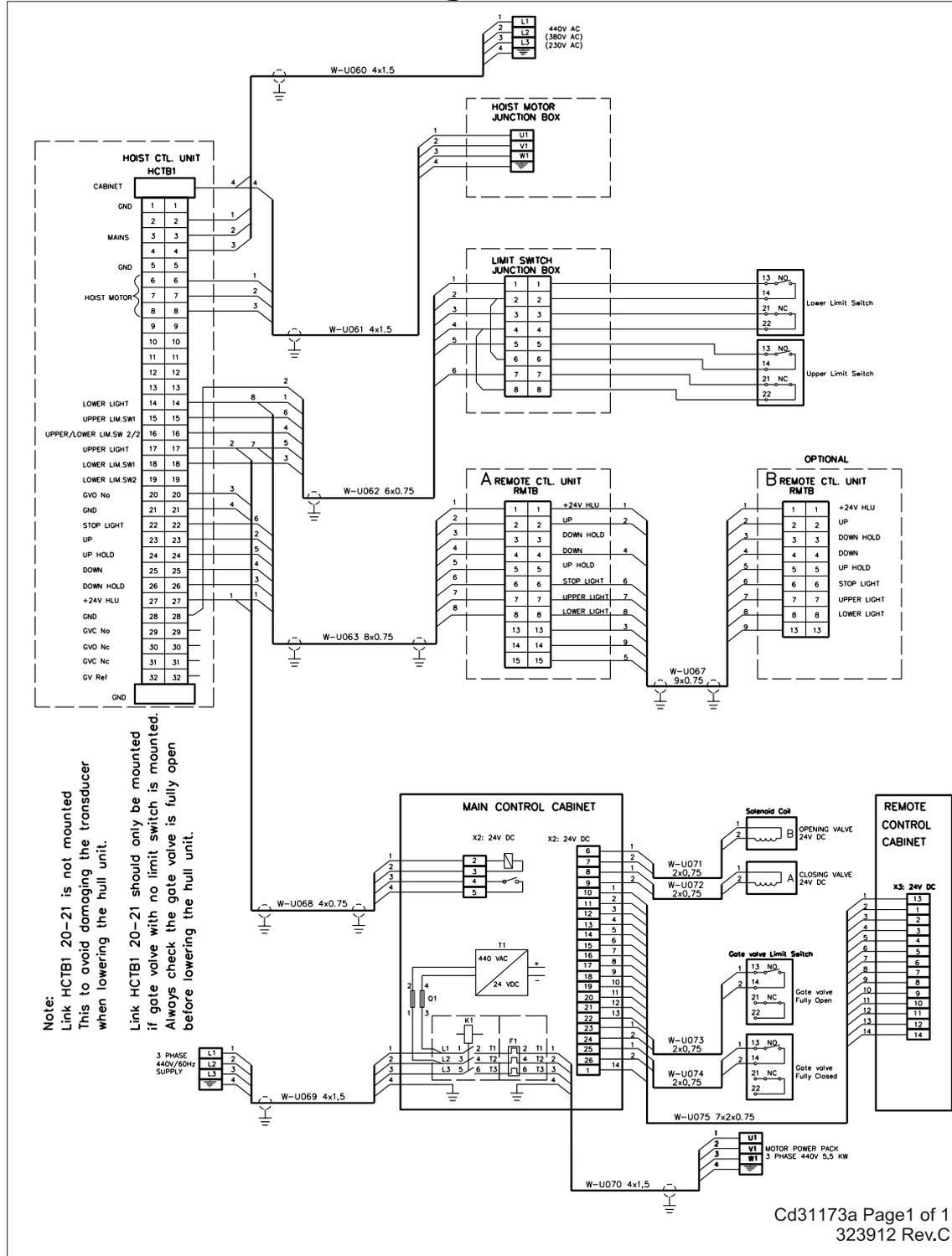




## Hoist system, *without hydraulic system* for activating the gate valve - interconnection diagram

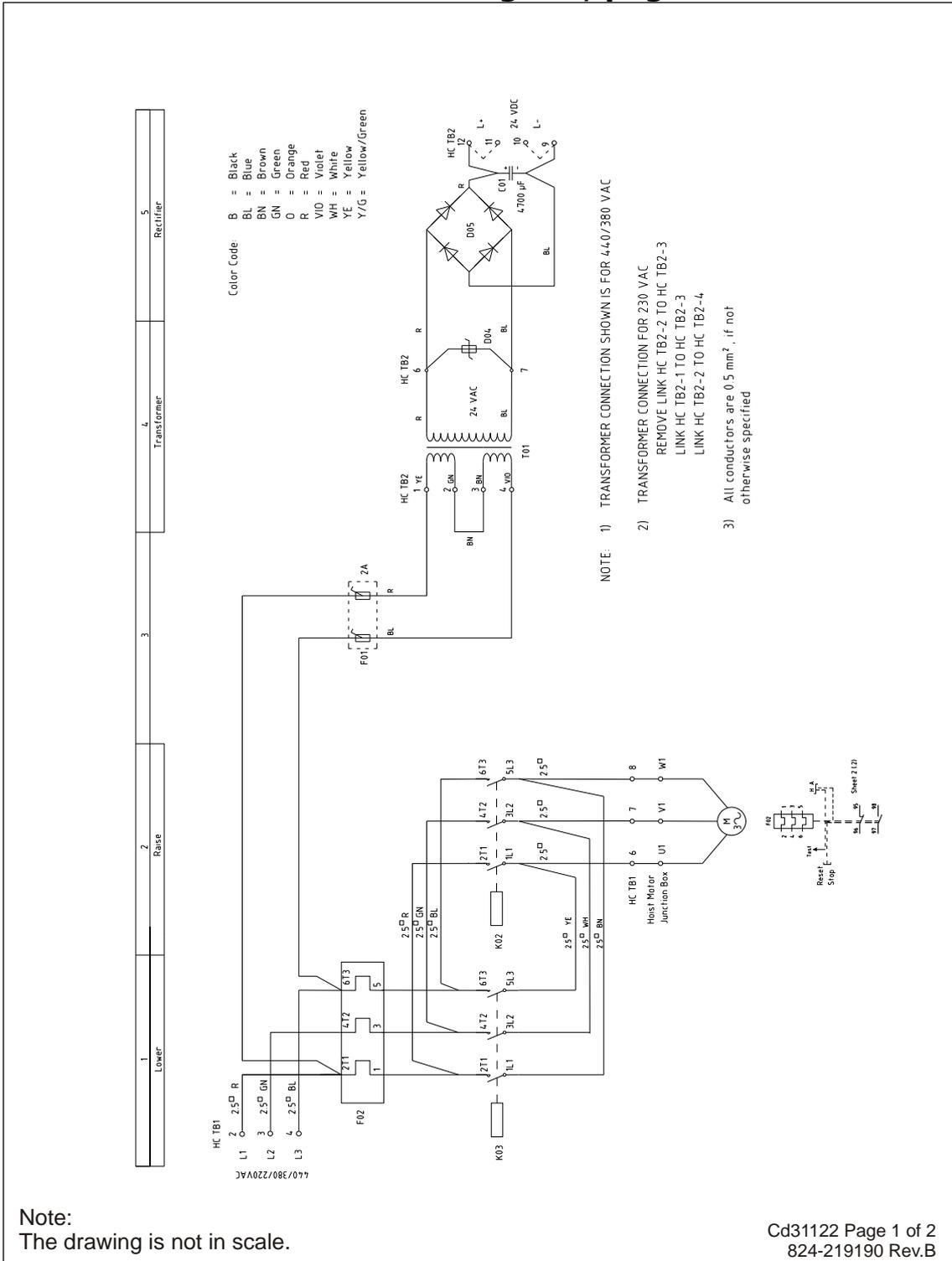


# Hoist system, with hydraulic system for activating the gate valve - interconnection diagram

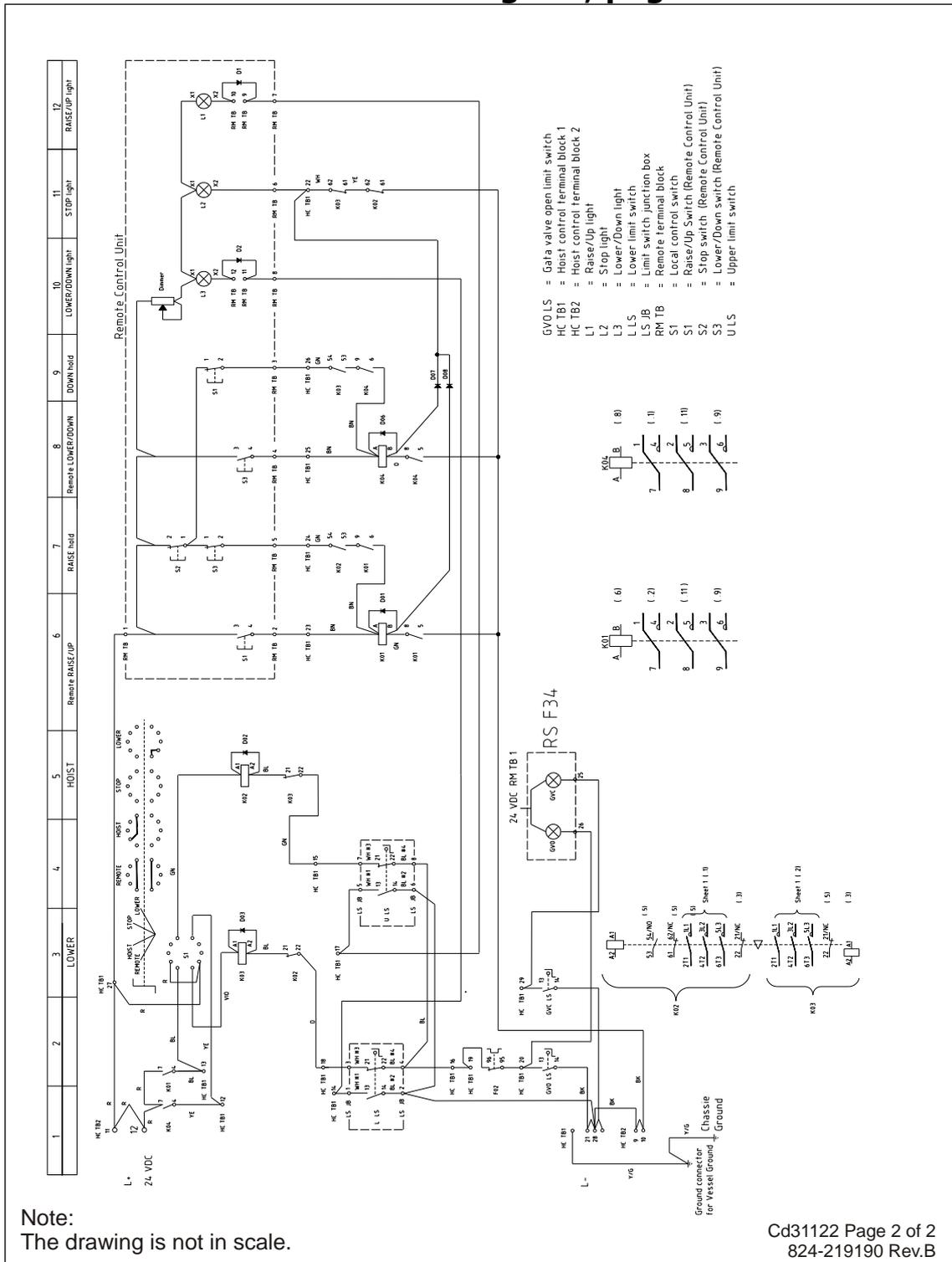




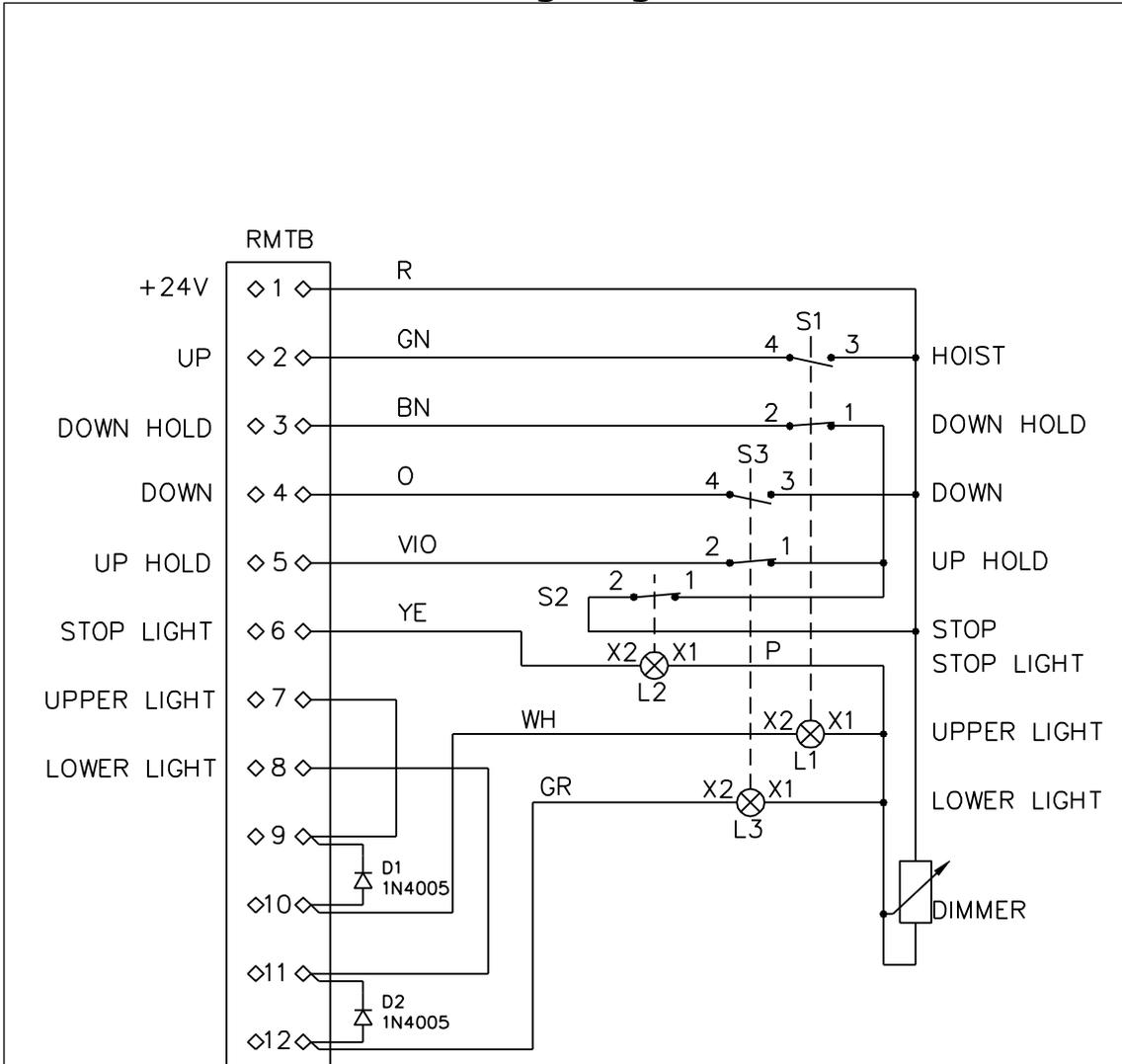
# Hoist Control Unit – circuit diagram, page 1



## Hoist Control Unit – circuit diagram, page 2



### Remote Control Unit - wiring diagram

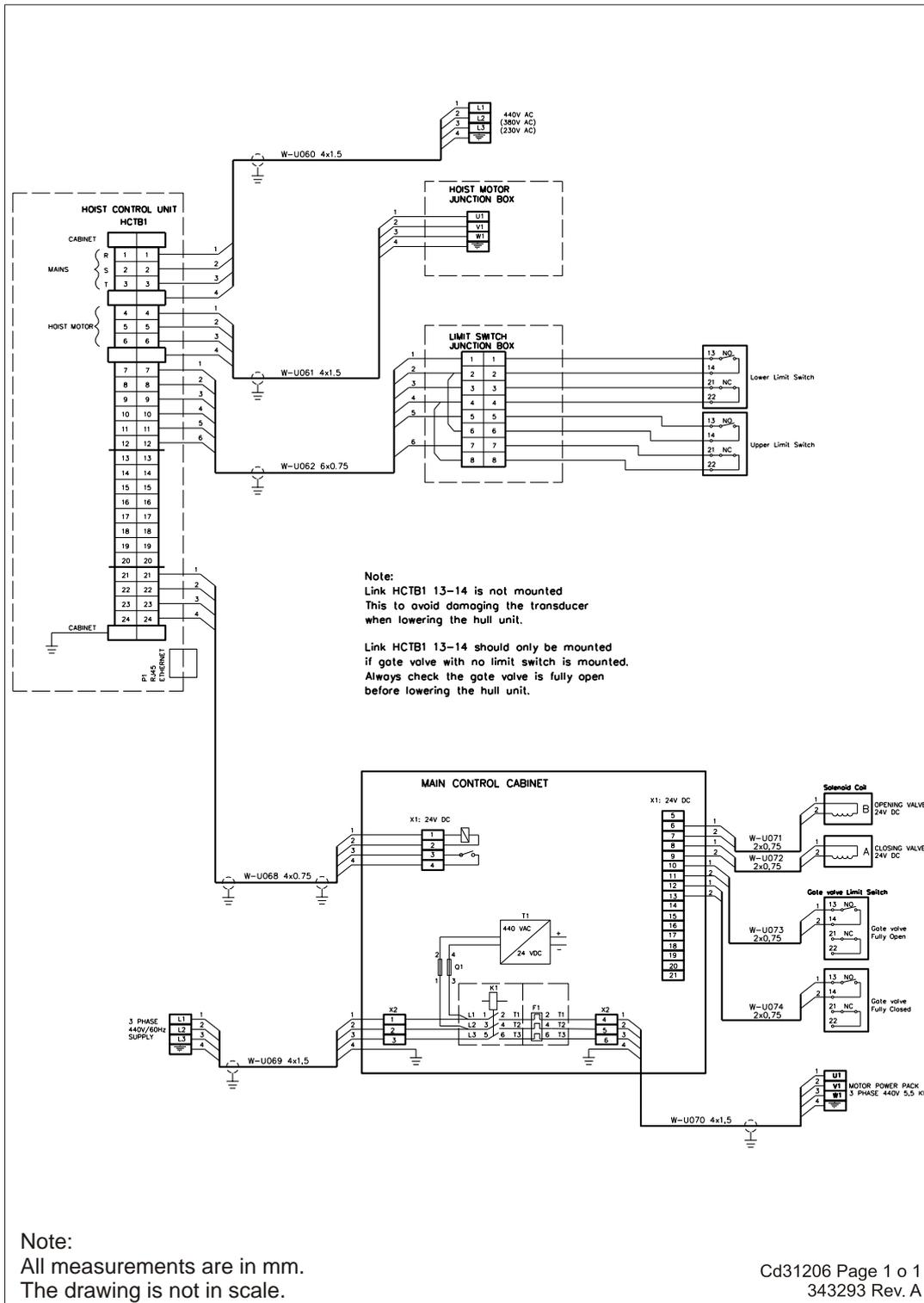


Note: All conductors, 0.5<sup>2</sup>

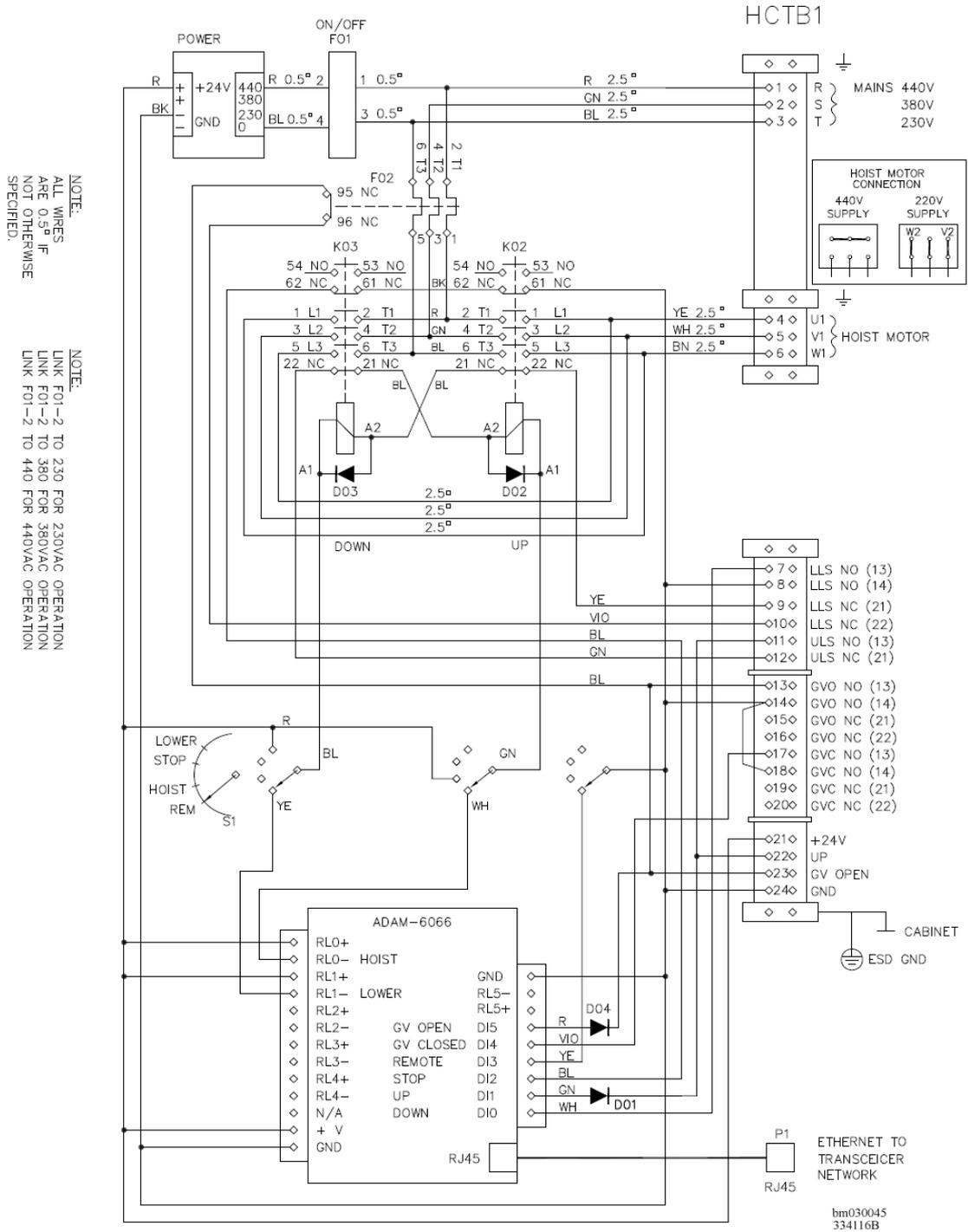
Note:  
The drawing is not in scale.

Cd31121 Page 1 of 1  
824-094181 Rev.D

## Hoist system, with hydraulic system for activating the gate valve via computer - interconnection diagram



# Hoist Control Unit with Ethernet interface – wiring diagram



bm030045  
334116B

## **13 CABLE PLAN AND INTERCONNECTIONS**

Separate document; *Cable plan and interconnections*  
doc. No 325840.

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# 14 INDEX

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