

USER MANUAL

400 MT OMC



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REVISION LIST

Revision	Description	Name	Date
A	1st Release	WDO	01-11-2013
B	2nd Release	AWH	12-9-2014
C	3rd Release: Add new heave compensator hydraulic diagram, sheave block drawing and wire rope manual	AWH	5-10-2015
D	4th Release: Add 3 stage PIU description in Ch3.5 and updated hydraulic diagrams. 6.3.5.4 updated SCADA screen + description	MED	19-07-2017

Table 1: Revision list

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PREFACE

This manual describes the 400 mt OMC as supplied to Subsea7¹.

The OMC was designed and manufactured in <production year> by Huisman Equipment B.V.² under order number A11-41800.

This manual consists of the following:

- General description
- Mechanical description
- <Heave compensator>
- Hydraulic description
- Electrical description
- Operation
- Maintenance
- Appendices
- Supplier documentation

WARNING



The OMC may only be operated by persons who have read and fully understand the contents of this manual. This implies that the operators, maintenance engineers and all other personnel working with the system must have a sufficient level of education and/or training.

WARNING



It is strictly prohibited to carry out any heat treatment on the OMC, such as welding, cutting or grinding. The OMC is made of high tensile steel and therefore requires special heat treatment procedures.

1. In this manual 'Subsea7' will be used to designate Subsea7
2. In this manual 'Huisman' will be used to designate Huisman Equipment B.V.

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Please refer in all correspondence to the original order number A11-41800.

WARNINGS AND NOTES

In this manual, the following symbols and indications are used to highlight important parts of information:

NOTE	<i>Indicates important information off the system or the documentation which requires special attention.</i>
-------------	--

CAUTION



Indicates a potentially hazardous situation which, if not avoided, could result in minor injury or mechanical damage.

WARNING



Indicates a hazardous or potentially hazardous situation which, if not avoided, could result in serious injury or death and considerable mechanical damage.

NITROGEN SAFETY

This provides the safety measures that need to be implemented during nitrogen filling of the pressure vessels. Although all systems have been designed and constructed with high technical standards, in theory a leakage of the gas holding system could occur.

If nitrogen gas or a part of the gas volume is by accident, or technical failure, released into a room it may cause a hazardous situation for the health of all users involved in that area.

Breathing an oxygen deficient atmosphere can have serious and immediate effects. The exposed person has no warning and cannot sense that the oxygen level is too low. Because this fact people involved are required to wear a personal gas monitor (Gas Badge) when working in immediate vicinity of the installation.

The badge will initiate a low oxygen alarm at a level of 19% (Vibrating, Acoustic and Optical alarm).

This badge must be attached to the outside of the overalls or clothing of the user at breast height if you are entering the area. The personal monitor will continuously monitor the oxygen percentage in your surrounding.

If this alarm is raised the user shall immediately leave the area. If possible also inform other personnel on the dangerous condition.

The following safety measures must be taken:

- Safety text signs (Restricted area, use of personal oxygen monitor)
- Safety markers (Red-white ribbon)
- Toolbox meeting
- Escape breathing device

Always keep the area closed. Only come in the immediate vicinity when necessary.

During a filling one person must remain with the nitrogen package. In the event of a spill during the filling, the supply of nitrogen can be stopped immediately. If necessary, radio-communication between the persons that are checking for leakage and the person with the package is prohibited.

For further information on nitrogen related safety, see [Appendix F: "Nitrogen related safety guidelines"](#).

LIST OF ABBREVIATIONS

Abbreviation	Meaning
AFT	Stern side of vessel ("after")
AHC	Active Heave Compensation
AHH	Auto Hook Height
AOL	Aeronautical Obstruction Light
BT	Block
CT (hoist)	Constant Tensioning
CT (s)	Constant torque
CW	Clock Wise
CCW	Counter Clock Wise
DISPS	Digital Independent Speed Protection System
ELCA	Electrical Cabinet
EPU	Electrical Power Unit
HP	High Pressure
HPU	Hydraulic Power Unit
I/O	Input / Output
kW	Kilo Watts
LP	Low Pressure
LT	Load Tugger
MH	Main Hoist
MRU	Motion Reference Unit
mt	(metric) tons
PIU	Pressure Intensifier Unit
PLC	Programmable Logic Controller
POCA	Power Cabinet
PS	Port Side
PVU	Pressure Vessel Unit
SCADA	Supervisory Control and Data Acquisition
SB	StarBoard side
SH	Sling Hoist
SWL	Safe Working Load
UPS	Uninterruptible Power Supply
VMS	Vessel Management System
WAB	Walk Around Box
WH	Whip Hoist
WIP	Watchdog Interface Print

Table 2: List of abbreviations

LIST OF TERMS

Term	Explanation
Boom hoist	or Booming up/down is the upward or downward movement of the main boom. This movement is done with the or Boom hoist
Slewing	Slewing is the pivot movement (left or right rotation) of the whole crane above the slewbearing.
Personnel lifting	Personnel lifting or manriding is transporting personnel by means of the crane on the whip hoist with the manriding winch.
Jib	The Jib or Boom is the arm of the crane.
Boom stop	The boom stop is integrated on the jib to prevent the jib from exceeding the maximum hoist angle.
Boom drag chain	The boom drag chain is a protection for the cables which transfer power and control signals onto the jib.

Table 3: List of terms

CONVERSION TABLE SI - IMPERIAL

SI	Times conversion factor	Imperial
1 mm		0.0394 inch
mm	25.4	1 inch
1 kN = 1000 N		0.225 kipf
kN	4.448	1 kipf
1 bar		14.504 psi
bar	0.0689	1 psi
1 N/m ² = 1 Pa		0.000145 psi
Pa	6 894.76	1 psi
1 m/s ²		39,37 in./s ²
m/s ²	0,0254	1 in./s ²
1 mt (metric ton)		2204.6 lbs
mt (metric ton)	0.000454	1 lbs
1 mt (metric ton)		1.1 sht (short ton)
mt (metric ton)	0.91	1 sht (short ton)

Table 4: Conversion table SI-Imperial

1 GENERAL DESCRIPTION

1.1 INTRODUCTION

This manual was produced for the 400 mt Offshore Mast Crane (OMC) as supplied to Subsea7. The crane is designed to be installed on Subsea7's vessel the Seven Waves.

This chapter of the manual includes a brief description of the system and its main characteristics as well as the overall technical specifications. Detailed technical data on subsystems or components are given in the following chapters.

- The 400 mt OMC is designed according to Lloyd's Register of Shipping, Code for Lifting Appliances in a Marine Environment (CLAME), 2009.
- Personnel Lifting is designed according to the NEN-EN 13852-1, June 2004.

The electrical system is designed and built in accordance with:

- Lloyd's Register - Rule and Regulations For The Classification Of Ships - Part 6, 2007

Design of the electrical system is based on the following standards:

- IEC 60092-101 Electrical installations in ships – Definitions and general requirements
- IEC 60092-352 Electrical installation in ships – Choice and installation of electrical cables
- IEC 60204-1 Safety of machinery – Electrical equipment of machines – General requirements
- IEC 60529 Degrees of protection provided by enclosures (IP code)
- IEC 60439-1 Low-voltage switchgear and control gear assemblies – Type-tested and partially type-tested assemblies
- IEC 60529 Degrees of protection provided by enclosures (IP codes)
- ISO13850 Emergency stop – Principles for design
- IEC 60947 Low-voltage switchgear and control gear
- IEC 60034 Rotating electrical machines
- IEC 60269 Low-voltage fuses

The hydraulic piping is designed and built in accordance with:

- Lloyd's Register of Shipping, (CLAME), January 2003.
(Hydraulic part:) Ch. 7 section 1.1.2 refers to the Lloyd's rules for ships Pt. 5, Ch. 12-14 for piping systems.

1.2 PURPOSE OF THE SYSTEM

The 400 mt OMC is permanently installed on the ship and is especially designed for lift operations at sea or open water.

The 400 mt OMC has the following main systems for hoisting:

- Main hoist
- Whip hoist
- Boom hoist
- Tuggers
- Slewing

The main hoist system has the highest lifting capacity. It is mainly operated for construction and deconstruction operations. The whip hoist is mainly operated to transfer equipment and supplies to or from supply boats. Tuggers serve to stabilize the load and to reduce the offlead. The slewing is able to rotate around the mast for transferring loads. For an overview of the hoisting systems, see [Figure 1-1](#).

1.2.1 MAIN CHARACTERISTICS

- The crane consists of a fixed mast, a rotating slew platform and a jib with fly jib.
- The slew platform rotates on a slew bearing on the outside of the mast.
- The operator cabin is suspended onto the slew platform and follows the slewing movements.
- The crane is able to rotate 450 degrees (225° in both directions)
- The maximum load of the crane is 400 mt.
- The main hoist and whip hoist have a safe working load (SWL) of 400 mt and 40 mt respectively.
- The crane contains 2 tuggers.
- The crane is fully electrically driven.

In [Chapter 2: "Mechanical description"](#) characteristics will be explained in detail. For detailed specifications, see [Section 1.4: "Technical Specifications"](#).

WARNING



The 400 mt OMC may only be used for the purpose it was designed for, and only within the limits of the design criteria.

NOTE

The tons in this manual are metric tonnes (mt). One metric tonne is equivalent to 1.1 short tonne (st) or 2204 lbs. See Conversion table SI - Imperial for the conversion factors.

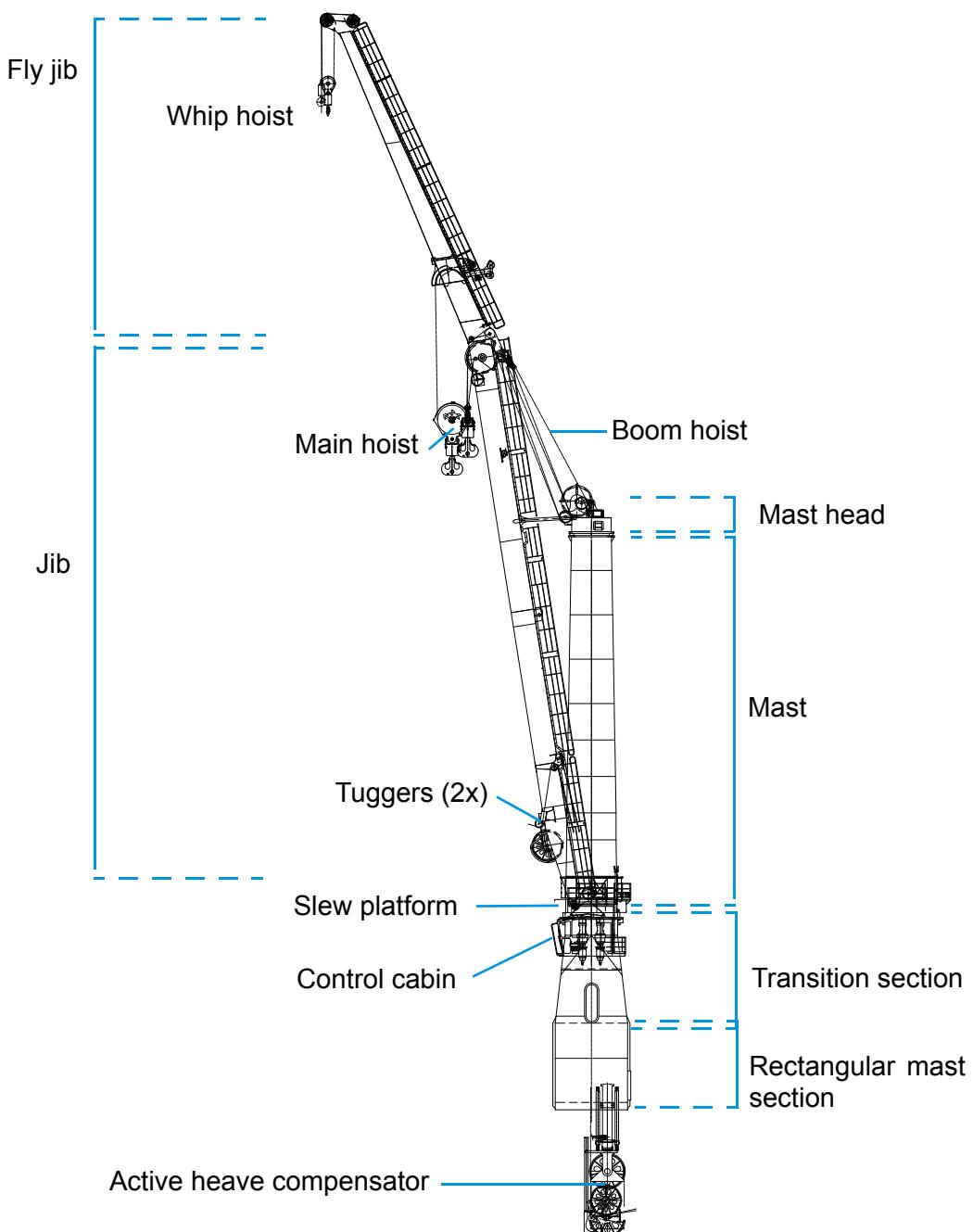


Figure 1-1: Overview 400 mt OMC

1.3 SYSTEM OVERVIEW

An overview of the system and the positions of its main components is shown in [Table 1-1](#).

Component	Function
Whip hoist	To hoist loads up to 40 mt
Fly jib	The extension of the jib which supports the whip hoist
Tuggers (2x)	To stabilize the load and reduce offlead
Main hoist	To hoist loads up to 400 mt
Jib	The steel arm which is actually holding the load
Mast head	The bearded upper part of the mast which enables the rotation movements
Mast	The connection between the vessel and the jib. It acts also as a housing for all inner components
Slew platform	To revolve the jib and load
Boom hoist	The hoisting mechanism to change the angle of the jib
Winch frame	The assembly of the winches at the inner side of the mast
Control cabin	The controlling room for the operator
Heave compensator	To compensate relative motion between the vessel and fixed objects

Table 1-1: Crane components

NOTE *Padeyes could be present on the construction. These padeyes are used for installing or removing of that part of the construction. Using these padeyes is prohibited during the operation.*

1.4 TECHNICAL SPECIFICATIONS

This chapter gives an overview of major specifications of the crane systems. More detailed specifications are shown in the appendices.

1.4.1 DEFINITIONS

Prior to the specifications, a theoretical overview of definitions is given in this section.

1.4.1.1 Operations

The technical specifications define under which conditions the 400 mt OMC should be operated within the safety margins. If any operation takes place outside these conditions, the 400 mt OMC might be seriously damaged or there could be great danger to the operator or bystanders. Disregarding the technical specifications could also result in the loss of load.

1.4.1.2 Lift types

The 400 mt OMC was designed for the following lift types:

Lift type	Description
Harbour lift	Lifting in sheltered waters without vessel motion due to waves
Internal lift	Lifting to or from the own deck of the crane vessel
Supplier lift	Lifting to or from another floating object
Personnel Lifting	Lifting to transport personnel with the crane

Table 1-2: Lift types

The type of lifting is related to the load charts, which are presented in [Appendix E: "Load curves".](#)

Seabed lifts and lifts through the splash zone are to be treated as engineered lifts, with the applied load to be determined taking into account the dynamic factors involved. The applied load is influenced by:

1. Stiffness of the crane
2. Stiffness of the wire
3. Mass of the suspended wire
4. Mass of load
5. Buoyancy of the suspended wire
6. Wave height or water motion
7. Crane tip motion
8. Buoyancy of load
9. Added mass of the load
10. Sub-sea currents
11. Drag of the load
12. Suction forces to seabed
13. DP accuracy
14. Dynamic excitation of the load
15. Etc.

The hoist factor of the crane can be used to accommodate these effects, as long as:

Maximum applied dynamic force in these considerations < stated SWL for that condition x applicable hoist factor.

1.4.1.3 Load factors

In [Table 1-3](#), [Figure 1-2](#) and [Figure 1-3](#) the load factors are described in detail.

Definition	Description
Safe working load	The Safe working load (SWL) is the allowed static weight of the lifted load
Duty factor	The duty factor is the factor by which the sum of all the static and dynamic loads acting on the system (excluding wind loading) is multiplied by in calculations.
Hoisting factor	The hoist factor is the factor which the SWL and all components undergoing the same motion as the load is multiplied by to take dynamic effects into account.
Side lead	Side lead is the angle between the vertical and hoist tackle perpendicular to the plane of the boom.
Off lead	Off lead is the angle between the vertical and hoist tackle in plane of the boom.
Radius	The radius is measured relative to deck and defined as the distance between the slewing axis of the crane and the load without trim and/or off lead.
Jib angle	The jib angle is the angle between perpendicular line of the slew platform axis and the longitudinal centerline of the jib, see Section 1.4.1.6: "Ship movements static"
Alpha(α)	Alpha is the output of the inclinometer is the angle of the jib relative to the horizon.
Beta (β)	Output of the inclinometer is the angle between the slewing axis of the crane and the line in the direction of the gravity vector in the side lead direction of the crane.
Gamma(γ)	Output of the inclinometer is the angle between the slewing axis of the crane and the line in the direction of the gravity vector in the off lead direction of the crane = static off lead.

Table 1-3: Load factor definitions

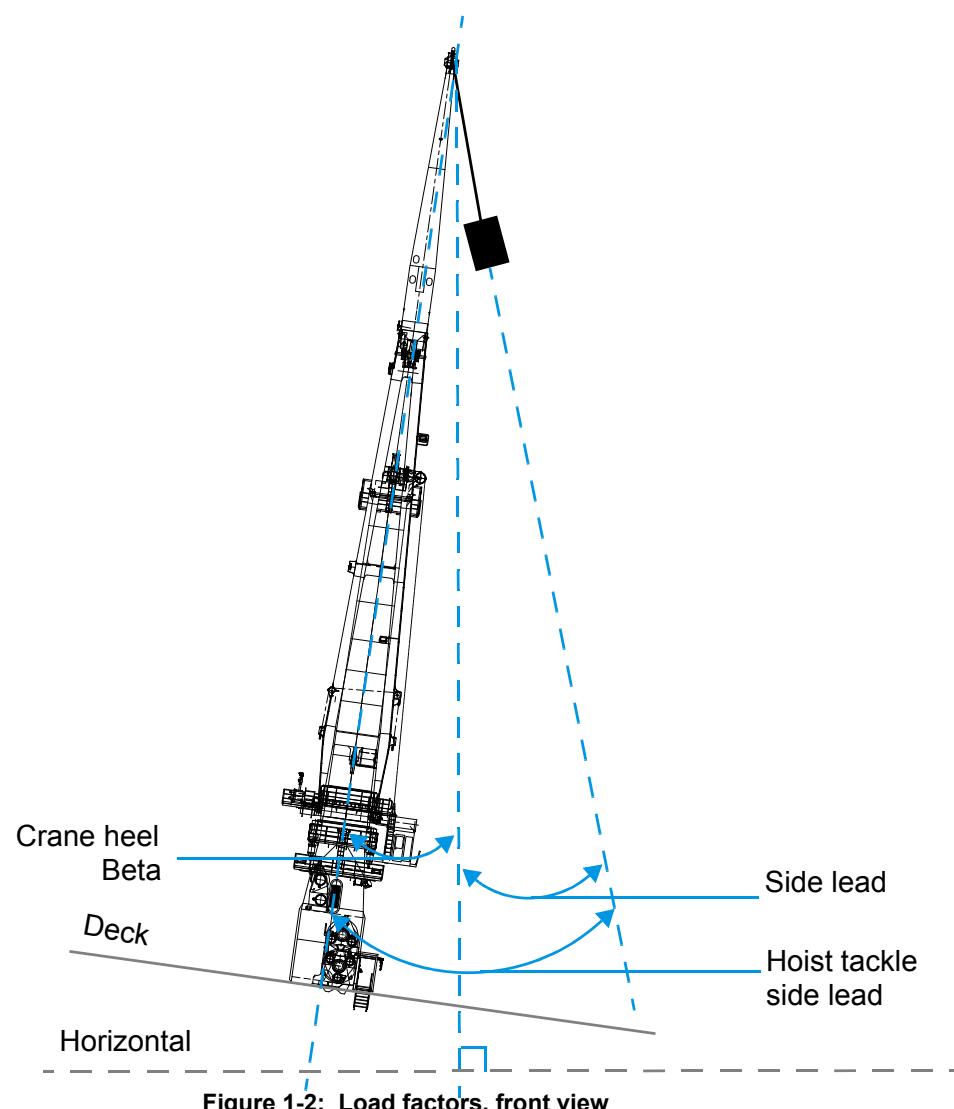


Figure 1-2: Load factors, front view

It is advised to prevent the load from dynamic and static offload. This can be realized by use of the provided Tuggers on the crane.

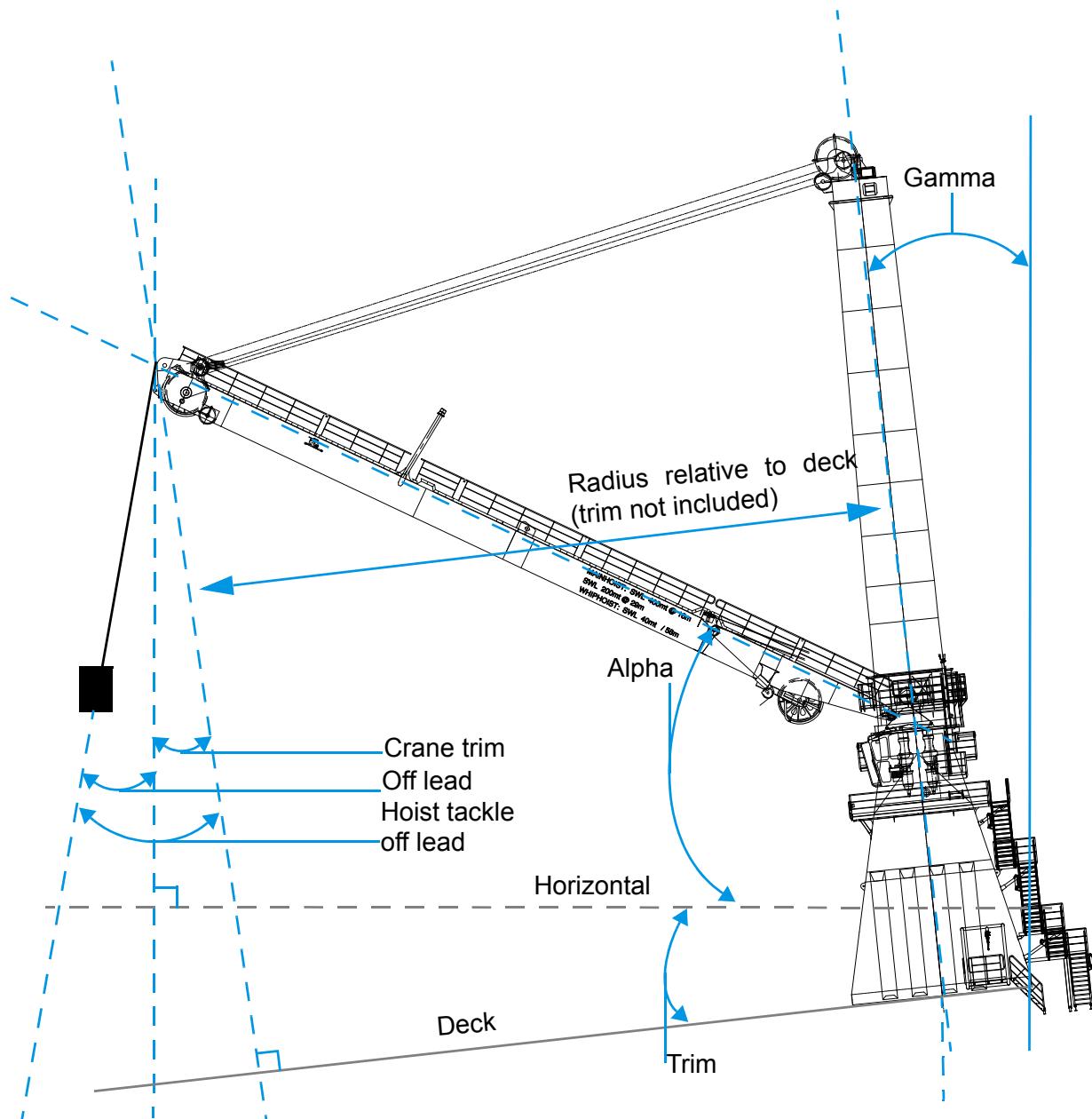


Figure 1-3: Load factors, side view

1.4.1.4 Dynamic load

For calculation of the dynamic load Huisman recommends the following code:

DNV-RP-H103: Recommended Practice on Modeling and Analysis of Marine Operations.

1.4.1.5 Sea state

This is the name for a number of environmental conditions (such as wind speed, wave height, wave period) which together result in motion of the crane vessel and the boat or structure from which a load has to be lifted. The sea states are classed in categories (see, [Table 1-4](#)). If sea-state 7 is exceeded, the jib of the crane has to be in the jibrest.

Beau fort No.	Sea stat e No.	Description of sea condition	Wind speed range m/s	Sig- ni- fic- ant wave height $H^1/3$ m	Min- imum hoist spee d V_h m/s	Wav e fac- tor F_w	Offlead angle in degrees			
							Case 1		Case 2	
							α	β	α	β
2	1	Small wavelets, short but more pronounced, crests have glossy appearance but do not break	2,0-3,1	0,6	0,2	8,1	5	2	2	5
4	2-3	Small waves, becoming larger: fairly frequent white horses	5,7-8,2	1,6	0,33	13,7	6	3	3	6
6	5-6	Large waves begin to form: the white foam crests are more extensive everywhere: probably some spray	11,3-13,9	3,9	0,46	21,7	8	4	4	8
8	7	Moderately high waves of greater length: edges of crest break into spindrift. The foam is blown in well marked streaks along the direction of the wind.	17,5-20,6	7,0	0,64	33,3	12	6	6	12
NOTES										
1. α = offlead in plane of jib.										
2. β = offlead normal to plane of jib.										

Table 1-4: Sea state according to Lloyd's of Shipping

1.4.1.6 Ship movements static

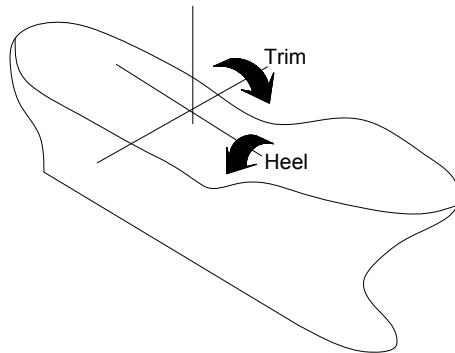


Figure 1-4: Movements static

1.4.1.7 Ship movements dynamic

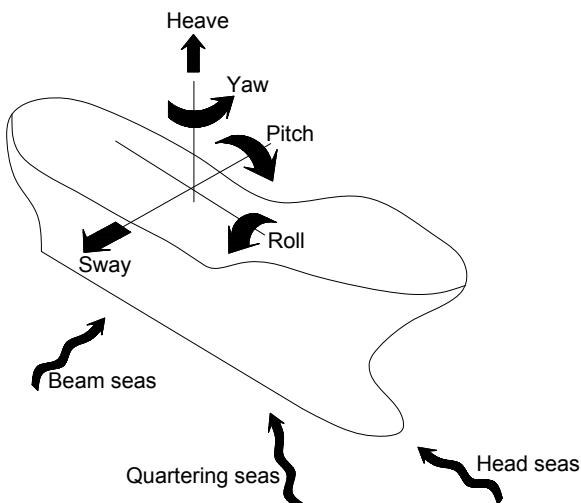


Figure 1-5: Movements dynamic

1.4.1.8 Dynamic factor

The dynamic factor is a function of:

- Crane type and use
- Hoisting speed
- Smoothness of the engine
- Stiffness of the construction
- Speed of the freight, before hoisting
- Speed of the crane tip, before hoisting
- Accelerations of the hanging load due to load and boom hoisting /
- Crane base movements at sea

1.4.1.9 Jib angle

The jib angle is the angle between the horizontal line and the longitudinal centerline of the jib. The minimum jib angle of the crane is the angle between the horizontal line and the longitudinal centerline in lowest position. The maximum jib angle is the angle between the horizontal line and the longitudinal centerline in hoisted position.

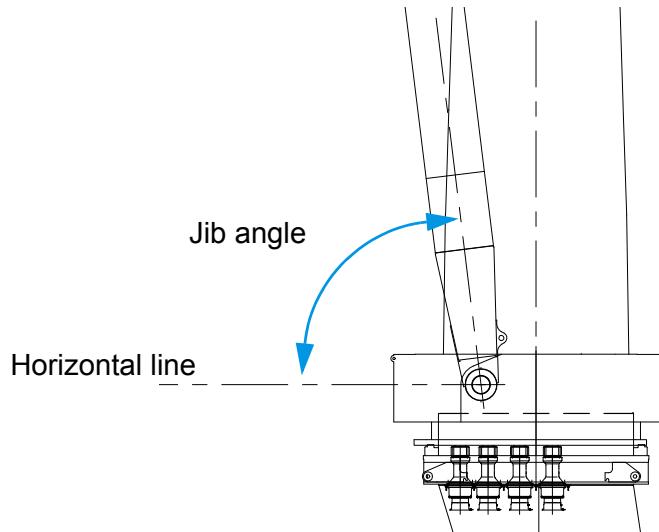


Figure 1-6: Jib angle

1.4.1.10 Slewing range

The slewing range concerns sum of the maximum rotation angle to the left and the maximum rotation angle to the right.

The maximum slewing range of the 400 mt OMC is 450°.

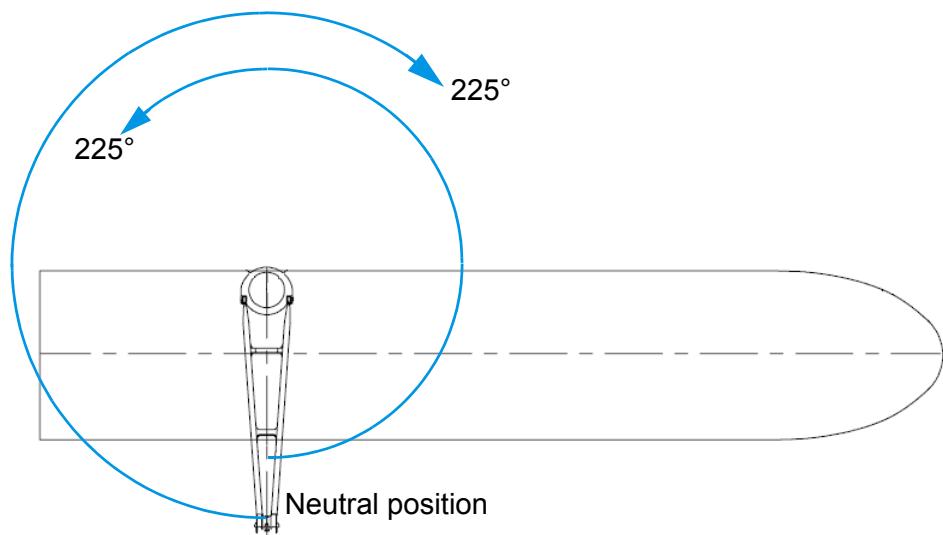


Figure 1-7: Slewing range

1.4.2 MAIN HOIST

Capacity harbour		Fall configuration	
SWL at approx. 16 m radius	2 falls	400	[mt]
SWL at approx. 29 m radius	1 fall	200	[mt]
Capacities given for the following conditions			
Dynamic factor	2 falls	1.1	
Dynamic factor	1 fall	1.15	
Off lead		1	[°]
Side lead		4	[°]

Table 1-5: Capacity harbour

Capacity offshore		Fall configuration	
SWL at approx. 12.5 m radius	2 falls	340	[mt]
SWL at approx. 22 m radius	1 fall	200	[mt]
Capacities given for the following conditions			
Dynamic factor		1.4	
Off lead		2	[°]
Side lead		5	[°]

Table 1-6: Capacity offshore

Hoisting speed	Fall configuration		
Full load	2 falls	Approx. 10.5	[m/min]
	1 fall	Approx. 21	[m/min]
Reduced load	2 falls	Approx. 21	[m/min]
	1 fall	Approx. 42	[m/min]

Table 1-7: Hoisting speed at outer layer of the drum

Operational working range		Fall configuration	
Min. radius	2 falls	Approx. 8.8	[m]
Max. radius	2 falls	Approx. 39.5	[m]
Min. radius	1 fall	Approx. 7.8	[m]
Max. radius	1 fall	Approx. 37.0	[m]
Storage capacity storage winch		Approx. 3000	[m]
Hook travel	2 falls	Approx. 1500	[m]
Hook travel	1 falls	Approx. 3000	[m]

Table 1-8: Operational working range

Main hoist wire rope			
Wire rope diameter		92	[mm]
Wire rope type	Non spinning		
Submerged wire weight	2 falls	Approx. 7.2	[mt/100m]
Submerged wire weight	1 fall	Approx. 3.6	[mt/100m]

Table 1-9: Wire rope specifications



1.4.3 MAIN HOIST HEAVE COMPENSATOR SYSTEM

Capacity	
Cylinder mechanical stroke	Approx. 3 [m]
Theoretical stroke on wire (single line)	Approx. 6 [m]
Operational stroke on wire (single line)	Approx. 5 [m]
Maximum compensating line speed	Approx. 75 [m/min]
On top of compensating motion, the normal crane hoisting speed can be achieved.	

Table 1-10: Heave compensator specifications

1.4.4 WHIP HOIST

Capacity		Fall configuration	
SWL at approx. 44 m radius	2 falls	40	[mt]
SWL at all radii	2 falls	36	[mt]
SWL at all radii	1 fall	20	[mt]
Whip hoist is suitable for personnel lifting operations			2 [mt]
Capacities given for the following conditions			
Dynamic factor		1.4	
Off lead		5	[°]
Side lead		5	[°]

Table 1-11: Capacity

Hoisting speed	Fall configuration		
Full load	2 falls	Approx. 35	[m/min]
	1 fall	Approx. 70	[m/min]
Reduced load	2 falls	Approx. 70	[m/min]
	1 fall	Approx. 140	[m/min]

Table 1-12: Hoisting speed

Operational working range		Fall configuration	
Min. radius	2 falls	Approx. 16.5	[m]
Max. radius	2 falls	Approx. 57.5	[m]
Min. radius	1 fall	Approx. 17	[m]
Max. radius	1 fall	Approx. 58	[m]
Hook travel	2 falls	Approx. 250	[m]
	1 fall	Approx. 500	[m]

Table 1-13: Operational working range

Specification		
Wire rope diameter	36	[mm]

Table 1-14: Additional specification

1.4.5 BOOM HOIST

Working range		
Minimum jib angle operating	0	[°]
Maximum jib angle operating	81	[°]
Maximum jib angle jibrest position	-5	[°]

Table 1-15: Working range

Hoist time		
Full load from 15° to 75° jib angle	Approx. 7	[min]
Reduced load from 15° to 75° jib angle	Approx. 2.5	[min]

Table 1-16: Hoist time

Specification		
Wire rope diameter	36	[mm]

Table 1-17: Additional specification

1.4.6 TUGGERS (2x)

Capacity		Fall configuration		
Safe working load		Single line	10	[mt]
Max. Constant Tension (CT)		Single line	8	[mt]
Dynamic factor		Single line	1.5	

Table 1-18: Capacity

Hoisting speed		
Full load	Approx. 54	[m/min]
Reduced load	Approx. 108	[m/min]

Table 1-19: Hoisting speed

Working range	Fall configuration		
Stroke	Single line	Approx. 90	[m]

Table 1-20: Working range

Specification		
Wire rope diameter	24	[mm]

Table 1-21: Additional specification

1.4.7 LOWER SLEW SYSTEM

Slewing speed		
Full load	Approx. 0.4	[RPM]
Reduced load	Approx. 0.6	[RPM]

Table 1-22: slewing speed

Capacity		
Maximum side lead at full moment	4	[°]
Slewing range	450	[°]
Zero degrees slewing angle as indicated on the general arrangement and Figure 1-7 .		

Table 1-23: Capacity

1.4.8 DIMENSIONS

Dimension		
Total height from deck level (jib horizontal)	40	[m]
Total height from deck level (jib 81°)	70	[m]
Pivot height above main deck	14	[m]
Tailswing	6.4	[m]
Length jib (pivot to main hoist sheaves)	37	[m]
Length jib (with fly jib)	58	[m]

Table 1-24: Crane dimensions

1.4.9 WEIGHT

Components		
Total mass	Approx. 660	[mt]
Offshore Mast Crane, including jib etc.	Approx. 315	[mt]
Storage winch	Approx. 50	[mt]
Main hoist wire Ø92 mm, length= 3275 m	Approx. 135	[mt]
Traction winch	Approx. 80	[mt]
Hydraulic Power unit	Approx. 20	[mt]
Heave compensator assembly	Approx. 25	[mt]
Pressure Vessel Unit	Approx. 35	[mt]

Table 1-25: Weight of crane systems

1.4.10 POWER CONSUMPTION

Installed power		
Main hoist traction winch	6 x 145	[kW]

Table 1-26: Installed power

Installed power		
Main hoist storage winch	2 x 45	[kW]
Whip hoist winch	2 x 132	[kW]
Boom hoist	2 x 132	[kW]
Slew system	4 x 60	[kW]
Tuggers	2 x 100	[kW]
Hydraulic power unit	2 x 400	[kW]
Auxiliaries	100	[kW]

Table 1-26: Installed power

Inverter controlled consumers		
Total installed power	2800	[kW]
Maximum simultaneous power consumption	2000	[kW]

Table 1-27: Inverted controlled consumers

Power supply		
Main power supply	930	[VDC]
Auxiliary power supply from vessel switch board	440 60	[VAC] [Hz]
Auxiliary power supply from emergency board	230 60	[VAC] [Hz]
Auxiliary power supply from vessel switch board	110	[VAC]

Table 1-28: Power supply

1.4.11 ENVIRONMENTAL CONDITIONS

Environmental condition	Measure
Min. operating temperature	-10 [°C]
Max. operating temperature	45 [°C]
Max. operating wind speed	20 [m/s]
Survival wind speed	63 [m/s]

Table 1-29: environmental condition

1.5 INTERFACE REQUIREMENTS

Reference drawings:

- [A11-41800-00-010](#): Interface drawing
- [A11-41800-00-011](#): Jib rest interface
- [A11-41800-00-012](#): Interface free space
- [A11-41810-88-1008](#): Hydraulic power unit
- [A11-41810-00-010](#): Interface heave compensator
- [A11-41810-88-0108](#): Pressure vessel unit
- [A11-41830-00-0118](#): Interface storage winch

The client is responsible for the vessel structure to be strong enough to withstand the forces and moments caused by interaction with the 400mt OMC (see the interface drawing, mentioned above). During sea travel or harsh weather conditions, the 400 mt OMC jib must be placed in the jibrest.

1.6 SAFETY

This section provides general safety instructions. Detailed safety information is given wherever appropriate in the next chapters.

1.6.1 GENERAL SAFETY INSTRUCTIONS

- Prior to operating, maintaining or repairing the system, all instructions and safety regulations in this manual, as well as in the suppliers documentation, must have been read and fully understood by all personnel who will be working with, or in the vicinity of, the OMC.
- The load specifications as well as the environmental conditions as described in this manual may NOT be exceeded. It is strongly advised to STOP the OMC before it reaches its limits! In case of any doubt on the definition of the operating conditions, do not hesitate to consult Huisman. Huisman does not accept liability due to neglect or disregard of the procedures and specifications stated in this manual.
- No persons are allowed near or on the system during operation, without prior knowledge and consent of the operator.
- The system may only be operated by an authorized operator, who is well trained and experienced in operating similar equipment, and who has full knowledge and understanding of the contents of this manual.
- Regular maintenance, service and inspection are required in order to guarantee safe use of the system for the duration of its lifetime. Maintenance may only be carried out by well-trained and experienced personnel.
- Before starting maintenance or repair activities, make sure that all electrical power is disconnected and that all components are in a safe position. Always secure movable parts that could present a risk of injury or damage.
- Welding operations to the main structure or any other heat treatment can influence the system's integrity or fatigue life. It is therefore not allowed to carry out any welding, grinding or cutting operations without a written confirmation from Huisman in advance.
- The keys of key switches used for operation must be kept in a safe place by an authorized person (supervisor) when not in use. The key switches may only be used when the person concerned has full knowledge and understanding of any possible consequences of doing so.
- The operator must have clear view of the system and its direct vicinity during operation.
- External noise level from activities in the surrounding area can be considerable. In this case it is the Offshore Installation Manager's responsibility to supply hearing protection (ear muffs, ear plugs etc.)
- During sea travel, or when the maximum operating conditions are exceeded, the jib must be placed in the jibrest (see Section 6: "Operation").

1.6.2 SAFETY SIGNS

The following safety signs are to be applied at the appropriate locations in the system.

SYMBOL	MEANING
	Keep away from moving loads. Extreme caution is required.
	General warning sign. Caution is required (e.g. moving machine parts).
	Potentially lethal voltages are present in the cabinets.
	Wear safety gloves to protect skin from aggressive cleaning or during maintenance.
	Wear safety glasses.
	Wear safety boots.
	Wear ear protection.
	Wear a safety helmet.
	Beware of automatically starting machines.
	Beware of rotating parts.
	Fire extinguisher.

Table 2: Symbols safety signs

It is responsibility of the client to apply the appropriate safety signs / labels at the appropriate locations in the system (e.g. warnings for moving loads, dangerous voltage etc.)

2 MECHANICAL DESCRIPTION

2.1 INTRODUCTION

Reference drawing:

- [A11-41800-00-0038](#): General arrangement

This chapter describes the mechanical and constructional aspects of the crane. For an overview of the main components, see [Chapter 1: "General description"](#). The following subsystems will be described:

- [Section 2.2: "Mast"](#)
- [Section 2.3: "Mast head"](#)
- [Section 2.4: "Upper slew system"](#)
- [Section 2.5: "Rope leading system"](#)
- [Section 2.6: "Slew platform"](#)
- [Section 2.7: "Lower slew system"](#)
- [Section 2.8: "Winch frame"](#)
- [Section 2.9: "E-room"](#)
- [Section 2.10: "Control cabin"](#)
- [Section 2.11: "Jib"](#)
- [Section 2.12: "Fly jib"](#)
- [Section 2.13: "Boom hoist"](#)
- [Section 2.14: "Main hoist"](#)
- [Section 2.15: "Whip hoist"](#)
- [Section 2.16: "Tuggers"](#)
- [Section 2.17: "Outfitting"](#)
- [Section 2.18: "Mechanically actuated sensors"](#)

Each section gives an overview of accessory reference drawings and can be found in [Appendix J: "Reference drawings - Mechanical"](#). Further information about components supplied by third parties can be found in the supplier documentation.

2.2 MAST

The mast is a welded structure which consists of multiple sections, see [Figure 2-1](#). The lower part is welded onto the deck of the vessel. In this chapter these sections are described in detail.

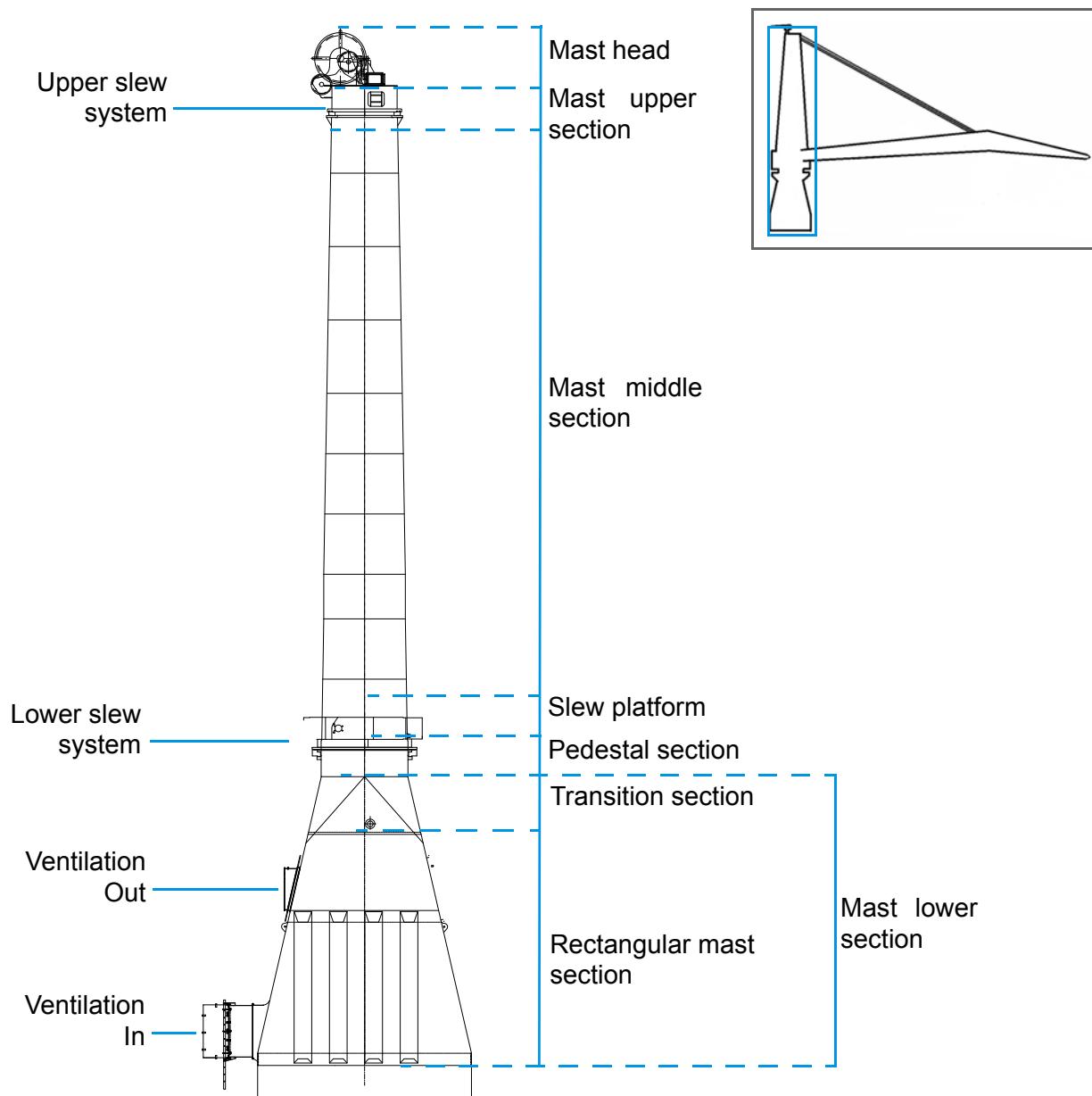


Figure 2-1: Overview mast sections

Two main bearings are provided in the crane:

- A three row roller bearing, to connect the mast head and sheaves with the mast. This is called the upper slew system, see [Section 2.4: "Upper slew system"](#).
- A one row ball bearing, to connect slew platform and jib with the mast. This is called the lower slew system, see [Section 2.7: "Lower slew system"](#).

2.2.1 MAST UPPER SECTION

The mast upper section is welded on top of the mast middle section. It contains the upper slew system which enables the rotation of the mast head around the mast axis, see [Section 2.3: "Mast head"](#).

2.2.2 MAST MIDDLE SECTION

The mast middle section is a cylindrical, slightly conical shell, which connects the slew platform with the mast upper section. Platforms are accessible by ladders fitted on the inner side of the section, see also [Section 2.17.1: "Stairs & platforms"](#). The mast middle section is a non-rotating component.

2.2.3 PEDESTAL SECTION

The pedestal section is the support for the slew system. The inner ring of the lower slew bearing is bolted to the flange of the pedestal section, the outer ring supports the slew platform. The slew drives, which actuate the slewing movement, are mounted on the outer side of the pedestal section. The pedestal section is welded on top of the transition section.

2.2.4 TRANSITION SECTION

The transition section is the connection between the rectangular top of the mast base and the circular mast. The lower side is welded onto the top of the mast base, the upper side is welded onto the pedestal section.

2.2.5 RECTANGULAR MAST SECTION

Reference drawing:

- [A11-41800-12-0108](#): Rectangular mast section

The rectangular mast section connects the crane with the deck of the vessel. The winch frame including the whip hoist, boom hoist and traction winches as well as the E-rooms are located inside the rectangular mast section.

2.2.5.1 Ventilation fans

The rectangular mast section is provided with ventilation fans to control temperature inside the mast, see [Figure 2-1](#). Sensors are integrated for measuring the temperature. The obtained data is translated to ventilation intensity by the control system.

	Supplier	Type	Quantity
In	N.R. Koeling bv	Rax 900 IEC 132	1
Out	N.R. Koeling bv	ES400 ICE 90	2

Table 2-1: Ventilation fan

2.3 MAST HEAD

Reference drawing:

- [A11-41800-13-0108](#): Mast head
- [A11-41800-13-0208](#): Mast head shafts
- [A11-41800-13-0418](#): Rope guides on mast head
- [A11-41800-32-0308](#): Boom hoist sheave mast head

The mast head rotates on top of the mast and is the base for the sheaves of the boom hoist, main hoist and whip hoist, see [Figure 2-2](#). The mast head is connected to the mast through a non-driven slew bearing. If the driven lower slew system is activated, the mast head is taken along by the reeved hoist wires.

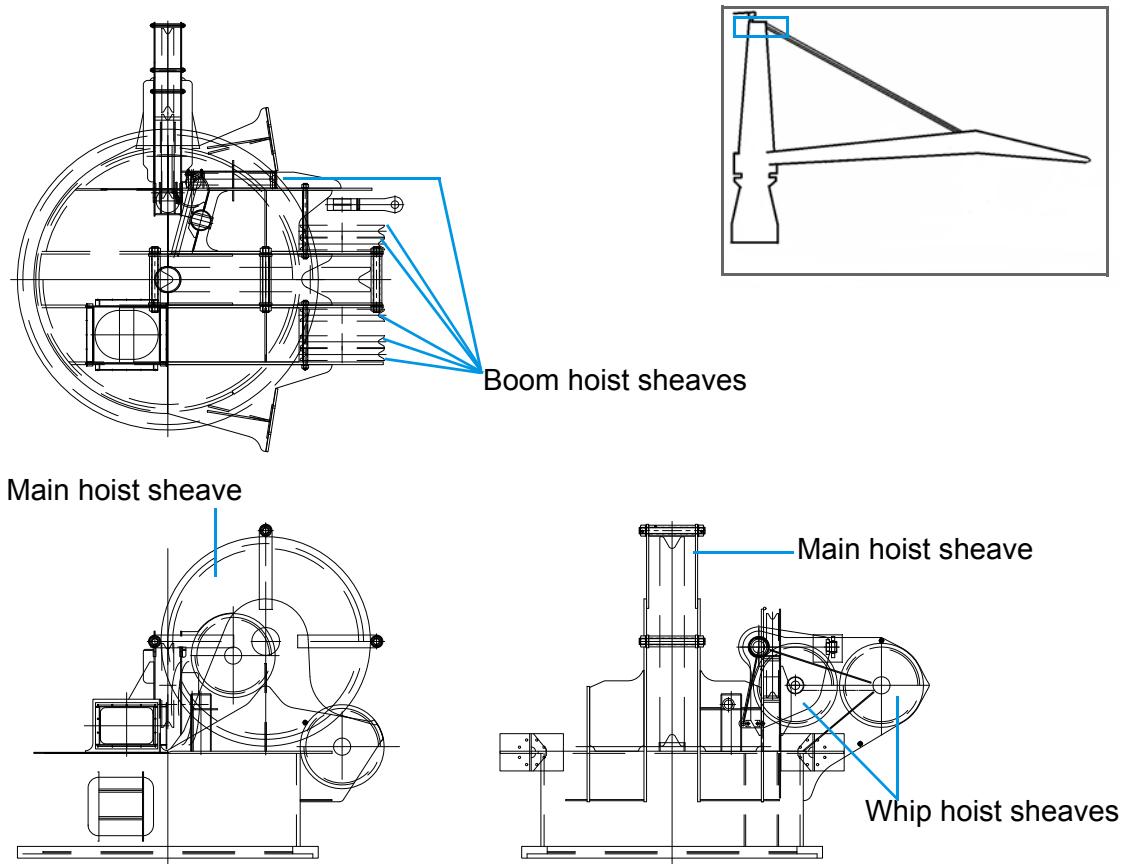


Figure 2-2: Mast head

2.3.1 PREVENTER ON BOOM STOP COUNTER PARTS

Counter plates for the boom stop are placed on the front side of the mast head, see [Figure 2-3](#). When the jib is in the highest position of 81°, the boom stop lands against the plates to prevent the jib exceeding the allowed highest position.

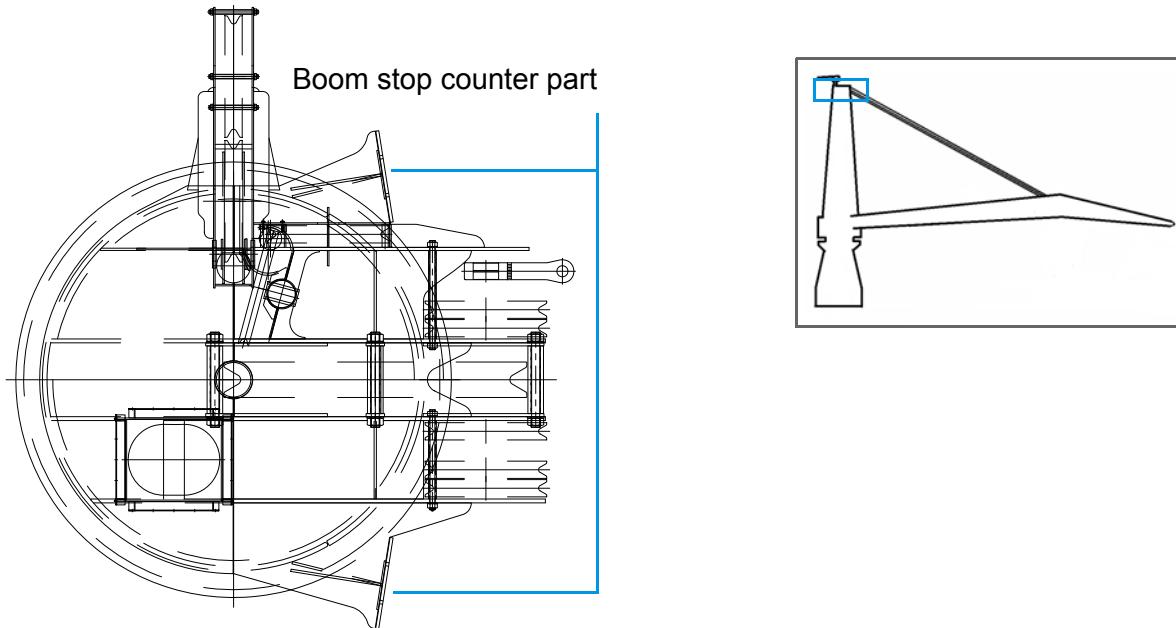


Figure 2-3: Boom stop counter parts

2.4 UPPER SLEW SYSTEM

The upper slew system supports and enables to rotate the mast head. For the upper slew system no drives are required; the mast head is taken along by the reeved wires which run from the rotating jib over the sheaves of the mast head to the winches. The rotation is enabled by the drives in the lower slew system, see [Section 2.7: "Lower slew system"](#).

2.4.1 UPPER SLEW BEARING

Reference drawing:

■ [A11-41800-22-0208](#): Upper slew system bolts

The lower ring of the upper slew bearing is bolted to the mast upper section, see [Figure 2-4](#). The upper ring is connected to the mast head. If the mast head is rotating, the upper ring is moving along the lower ring of the bearing. For more information, please refer to [Table 2-2](#) or supplier documentation Rothe Erde.

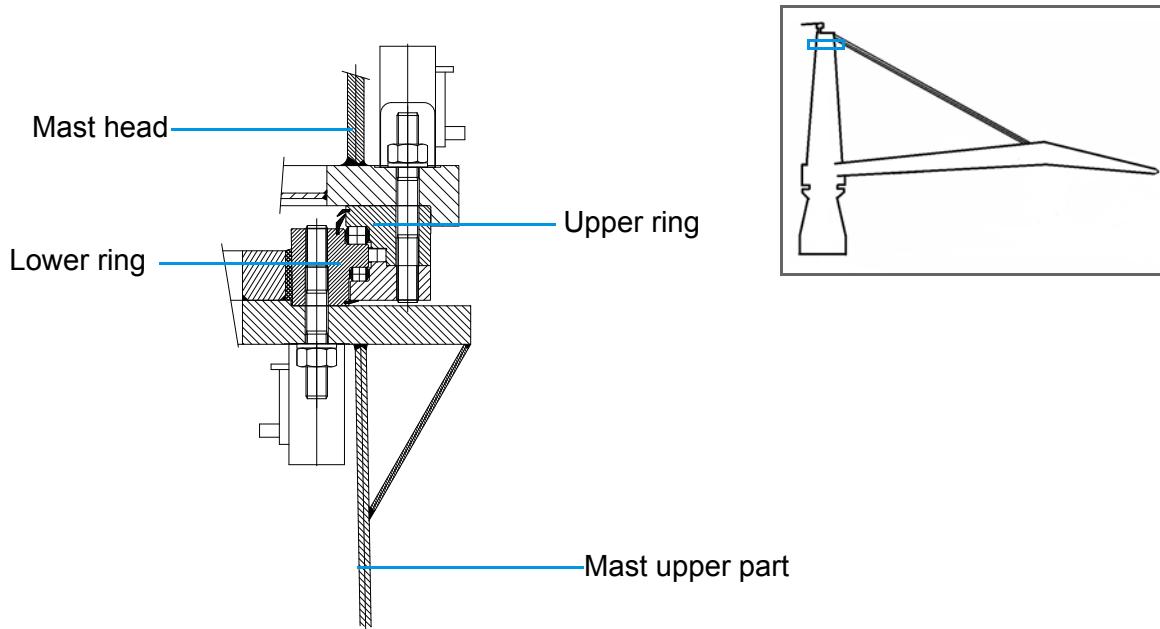


Figure 2-4: Upper slew system

Component	Supplier	Type	Quantity
Bearing	Rothe Erde	PCD 2340 75xM39	1

Table 2-2: Supplier information upper slew bearing

2.5 ROPE LEADING SYSTEM

Reference drawing:

- [A11-41800-35-0108](#): Rope leading mainh. + whiph.
- [A11-41800-35-0208](#): Rope leading guide sheaves
- [A11-41800-35-0308](#): Rope leading topping sheavebox
- [A11-41800-35-0408](#): Rope leading topping sheave

To guide the wires of the boom hoist, main hoist and whip hoist properly, and to ensure these wires will not intersect routes of other wires while rotating the slew platform, a rope leading system has been integrated. The system contains guiding sheaves on the inner side of the mast. The rope leading system enables the crane to rotate 225° to each side. [Figure 2-5](#) and [Figure 2-6](#) show the rope leading parts which are located in the mast section.

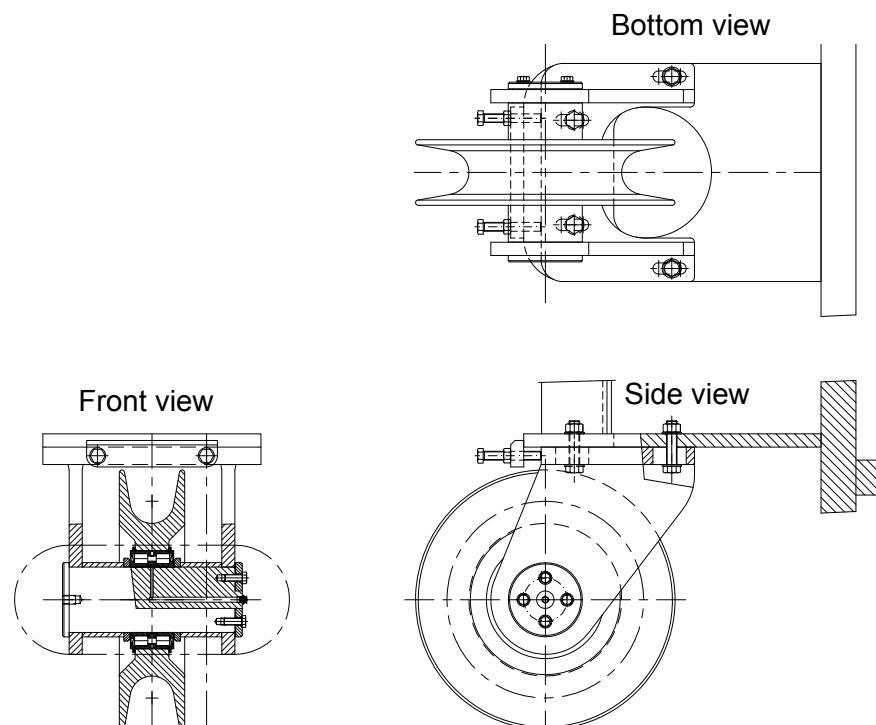


Figure 2-5: Rope leading system - sheave

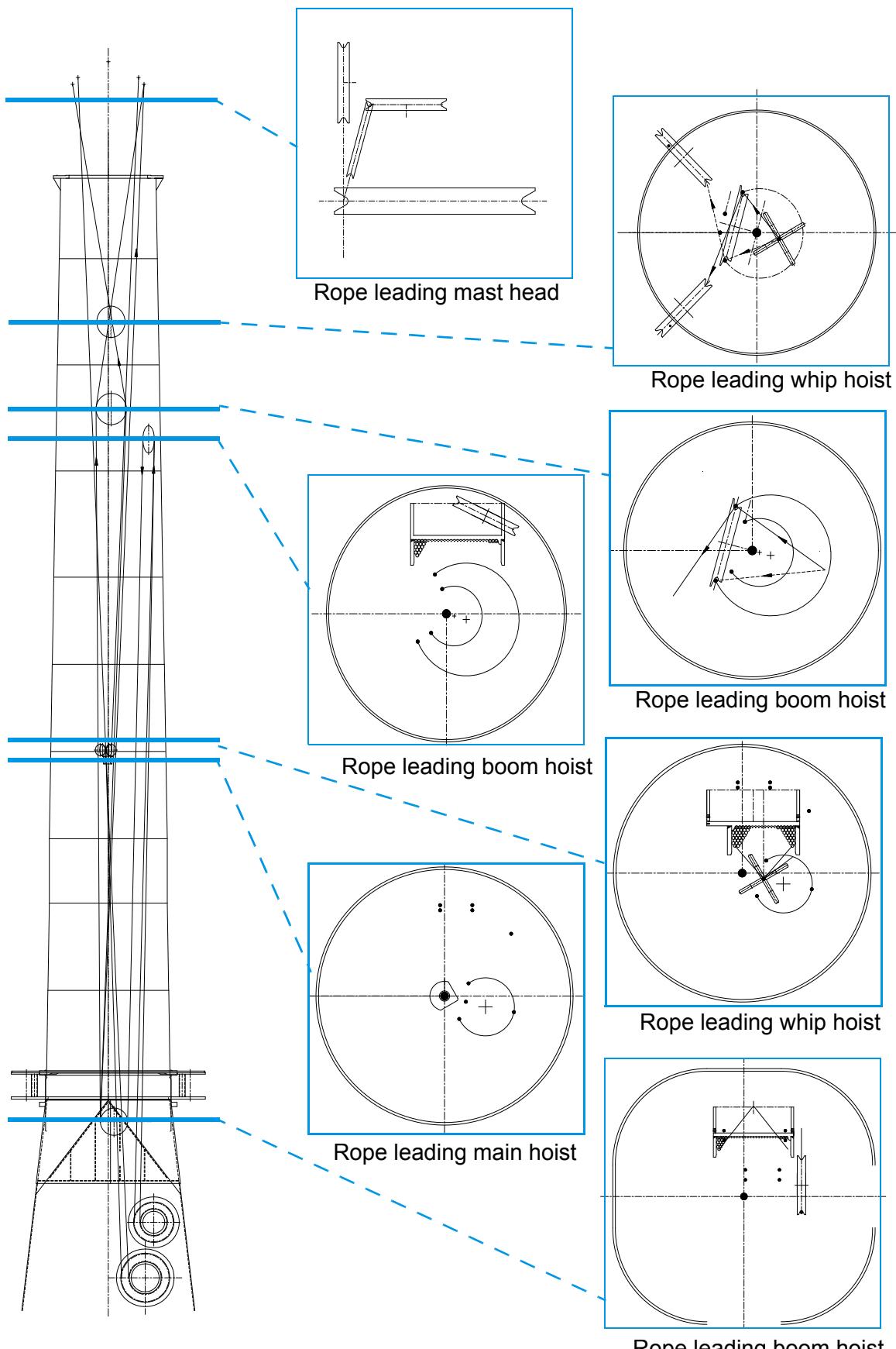


Figure 2-6: Rope leading system - in mast

2.6 SLEW PLATFORM

The slew platform is the rotating part between the pedestal section and the mast middle section, see [Figure 2-7](#). The platform rotation is activated by four slew drives, see [Section 2.7.2: "Lower slew drive system"](#). The slew platform provides access to the tugger winches and jib. Accessible areas are surrounded by protective railings.

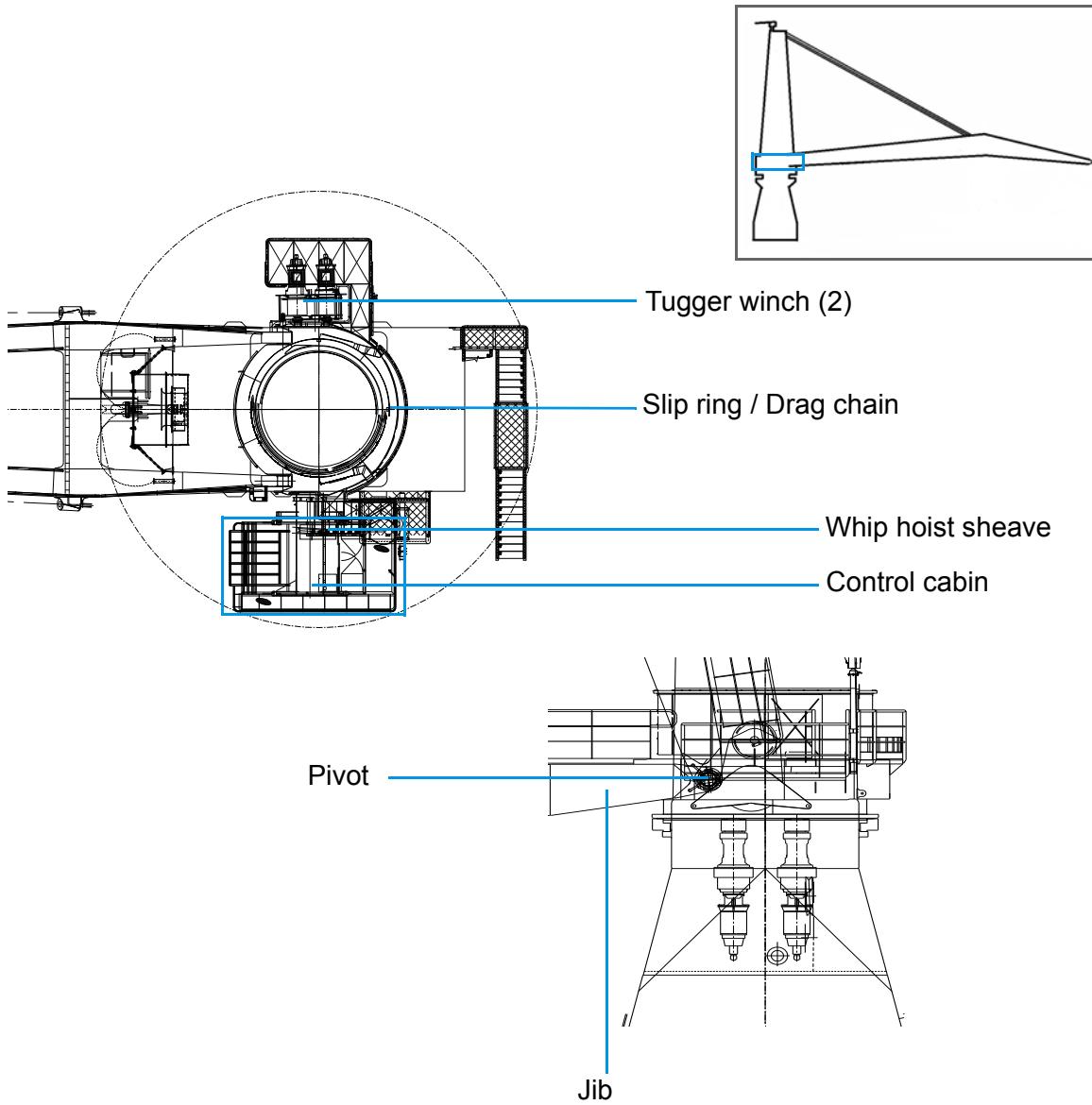


Figure 2-7: Slew platform

The slew platform contains the following elements:

- Pivots, see [Section 2.11: "Jib"](#)
- Control cabin, see [Section 2.10: "Control cabin"](#)
- Two load tuggers, see [Section 2.16: "Tuggers"](#)
- Slip ring, see [Section 2.6.1: "Slew platform slip ring"](#)
- Drag chain, see [Section 2.6.2: "Slew platform drag chain"](#)
- Stairs and platforms, see [Section 2.17.1: "Stairs & platforms"](#)

2.6.1 SLEW PLATFORM SLIP RING

A slip ring is provided to transfer the power from the fixed mast structure to the rotating platform. It is located on the slew platform, see [Figure 2-7](#). This low resistance connection enables the crane to be 450° revolving. For more information, see [Chapter 5: "Electrical description"](#) and supplier documentation.

2.6.2 SLEW PLATFORM DRAG CHAIN

In order to transfer the signals from the fixed mast structure to the rotating slew platform without risk of signal loss, the crane is equipped with a drag chain.

2.7 LOWER SLEW SYSTEM

The lower slew system enables the slew platform to turn around the vertical axis of the mast, see [Figure 2-8](#). The slew system contains a slew bearing and 4 slew drives.

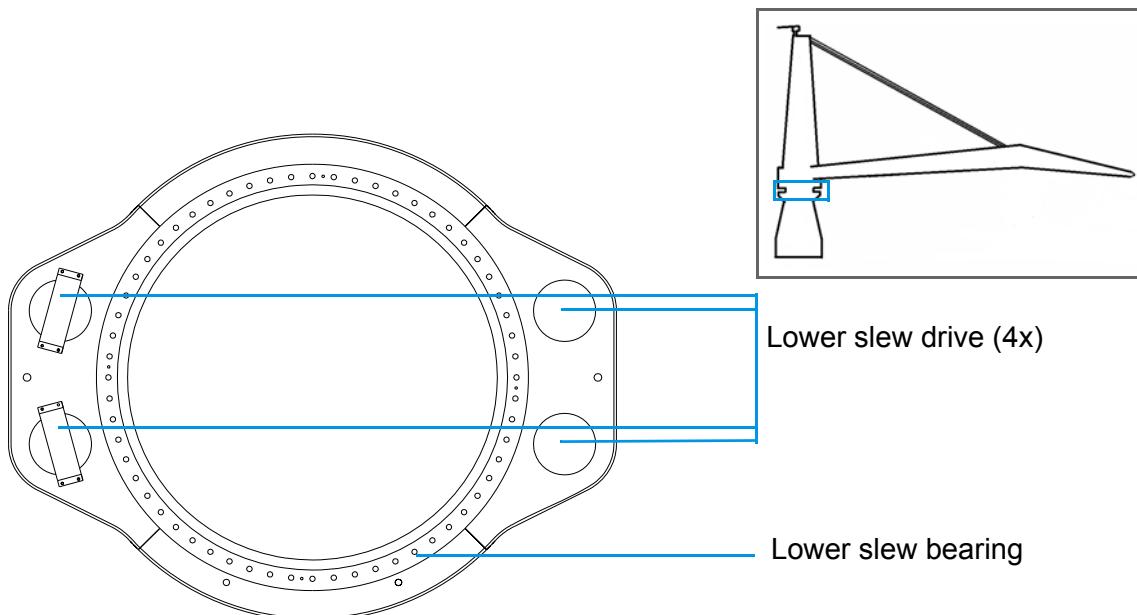


Figure 2-8: Lower slew system

2.7.1 LOWER SLEW BEARING

Reference drawing:

[A11-41800-22-0108](#): Lower slew system bolts

The lower slew bearing is located at the pedestal section of the mast, see [Figure 2-8](#). The inner ring of the lower slew bearing is bolted to the pedestal section, the outer ring is connected to the slew platform, which rotates around the mast, see [Figure 2-9](#). The slew drives, which actuate the slew movement, are mounted at the outside of the pedestal section. For more information about the drive system, see [Table 2-3](#) and supplier documentation.

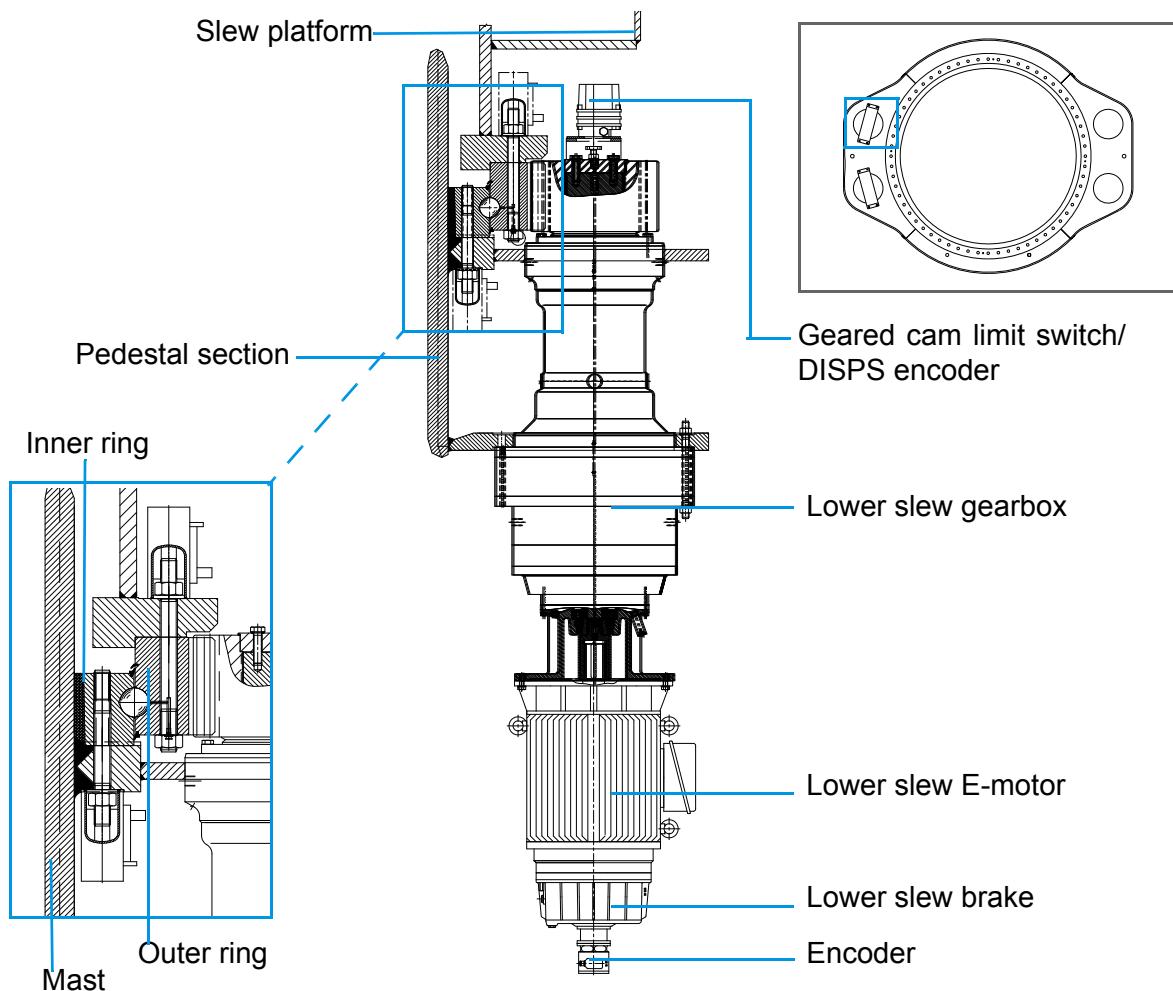


Figure 2-9: Lower slew bearing

2.7.2 LOWER SLEW DRIVE SYSTEM

The slew drives, which consists of E-motors, gearboxes, and brakes, serve to activate the slew platform rotation. The drives are located on the outer side of the pedestal section, see [Figure 2-9](#). The lower slew drive system contains 4 E-motors. A geared cam limit switch is mounted on two of the four drives

The drives are equipped with 'fail-safe' brake systems which act on the motor shaft. Fail-safe brakes ensure mechanically brake activation in case of a power fail. For more information about the drive system, see [Table 2-3](#) and supplier documentation (Pintsch Bamag).

Drive system component	Specifications		
E-motor	Supplier	Woelfer	[-]
	Type	MDRKO 250M-4	[-]
	Quantity	4	[-]
	Power	60	[kW]

Table 2-3: Lower slew drive system specifications

Drive system component	Specifications		
Gearbox	Supplier	Siebenhaar	[-]
	Type	09 DD 12/0	[-]
	Quantity / motor	1	[-]
Brake	Supplier	Pintsch Bamag	[-]
	Type	SFB 63/52	[-]
	Quantity / motor	1	[-]

Table 2-3: Lower slew drive system specifications (Continued)

2.7.3 GEARED CAM LIMIT SWITCH

Reference drawing:

- [A11-41800-45-0108](#): Slewdrive sensor foundation
- [A11-41800-00-4018](#): Sensor arrangement - crane

A geared cam limit switch is used to determine the slewing end positions. The switch is mounted on one of the pinions of the slew drives. A certain number of rotations of the pinion corresponds with a certain rotational displacement of the crane. For more information about geared cam limit switches, see [Section 2.18.3: "Geared cam limit switch"](#).

2.7.4 ENCODERS

Reference drawing:

- [A11-41800-00-4018](#): Sensors arrangement - crane

The lower slewing system is provided with 2 E-motor encoders and 1 DISPS encoder. The E-motor encoders are provided on 2 of the 4 drive motors, see [Figure 2-9](#). These are integrated to measure the motor speed. A DISPS encoder is provided on 1 of the 4 motors for detecting slewing over speed.

2.8 WINCH FRAME

Reference drawing:

■ [A11-41800-21-0108](#): Winchframe

The winch frame is a welded steel construction that contains the boom hoist and whip hoist winches. It is positioned in the rectangular mast section, see [Figure 2-10](#).

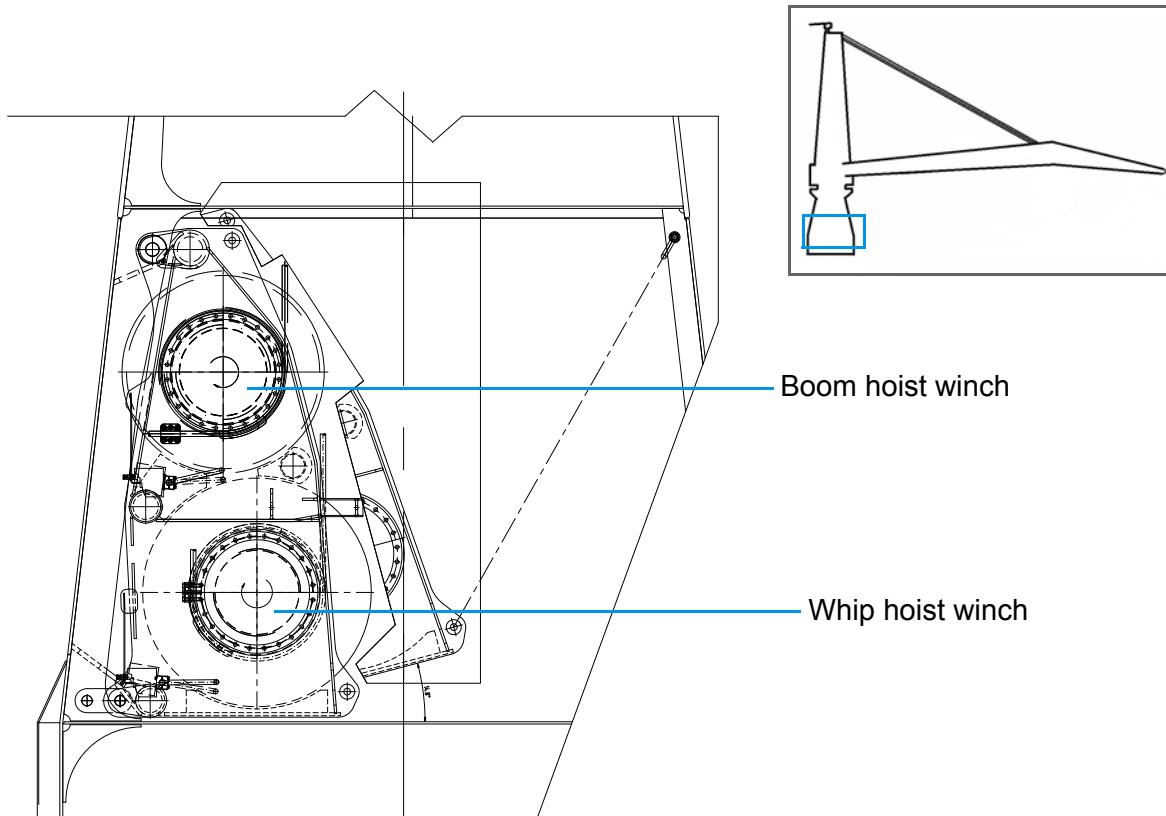


Figure 2-10: Winch frame

2.9 E-ROOM

The E-room in the rectangular mast section hold the electrical cabinets for the crane, see [Figure 2-11](#). For more information about the cabinets, refer to [Chapter 5: "Electrical description"](#).

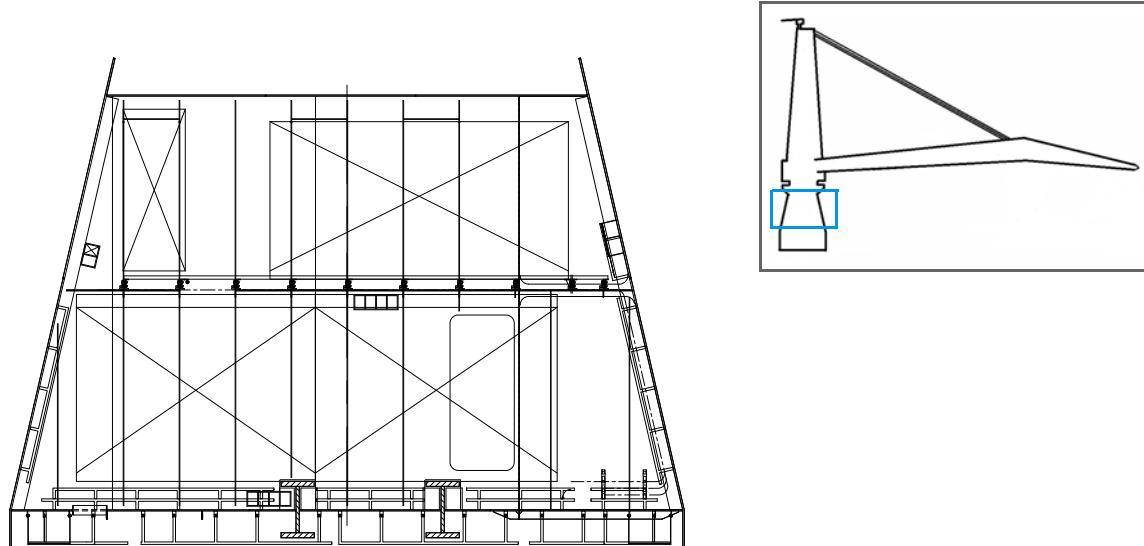


Figure 2-11: Side view E-rooms

2.10 CONTROL CABIN

The control cabin is the location where the crane operations are controlled. The control cabin is suspended on a support construction which is welded to the slew platform, see [Figure 2-12](#). The cabin is divided into two compartments, the front and the back compartment. The front compartment is equipped with all controls to operate the crane.

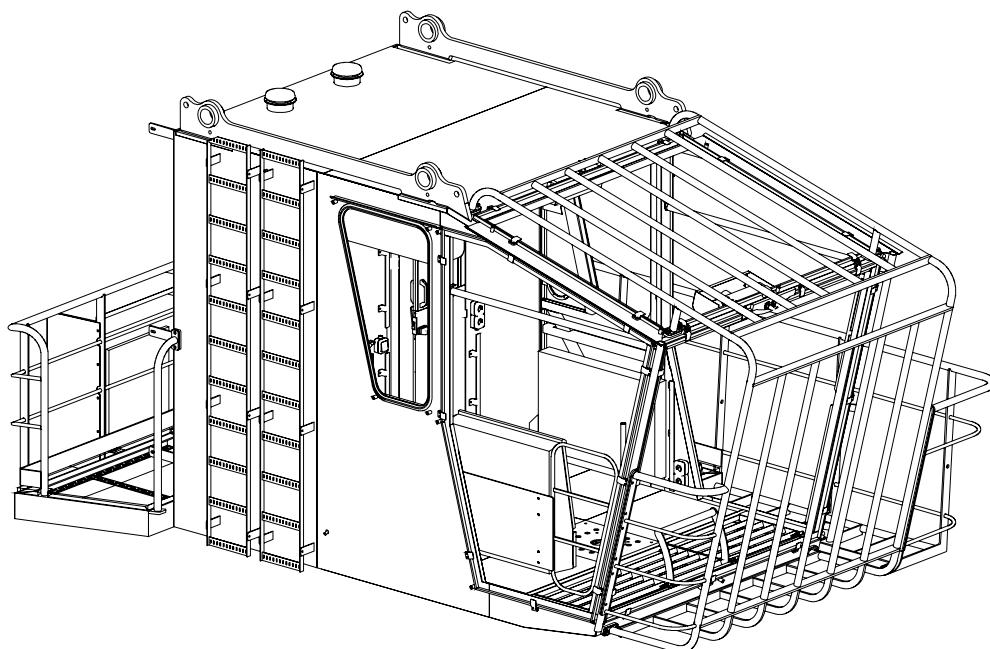


Figure 2-12: Control cabin

For more information see supplier documentation.

Controls are located on two consoles beside the operator chair. See [Chapter 6: "Operation"](#) for controlling details.

2.11 JIB

Reference drawing:

■ [A11-41800-15-0108](#): Crane jib

The jib is a 35 meter box girder construction which serves as a support for the hoist systems. The jib consists of two converging jib legs which are interconnected with crossbeams, see [Figure 2-13](#). Rope leading sheaves are integrated in the jib construction for a proper guidance of the hoist ropes. The jib can be divided in the following sections:

- Jib pivot section
- Jib box girder section
- Jib head

The jib is suspended in two ways:

- By the boom hoist system, from the mast head to the boom hoist sheaves.
- By the pivot; two rotating shafts are located on the slew platform.

From the control cabin platform, stairs and platforms provide access to the components which are located on the jib.

Accessible areas on the jib are provided with protective railings. Two fair leaders for the tugger wires are mounted at the lower side of the box girder section. For more information, please refer to [Section 2.16.3.2: "Fairlead"](#).

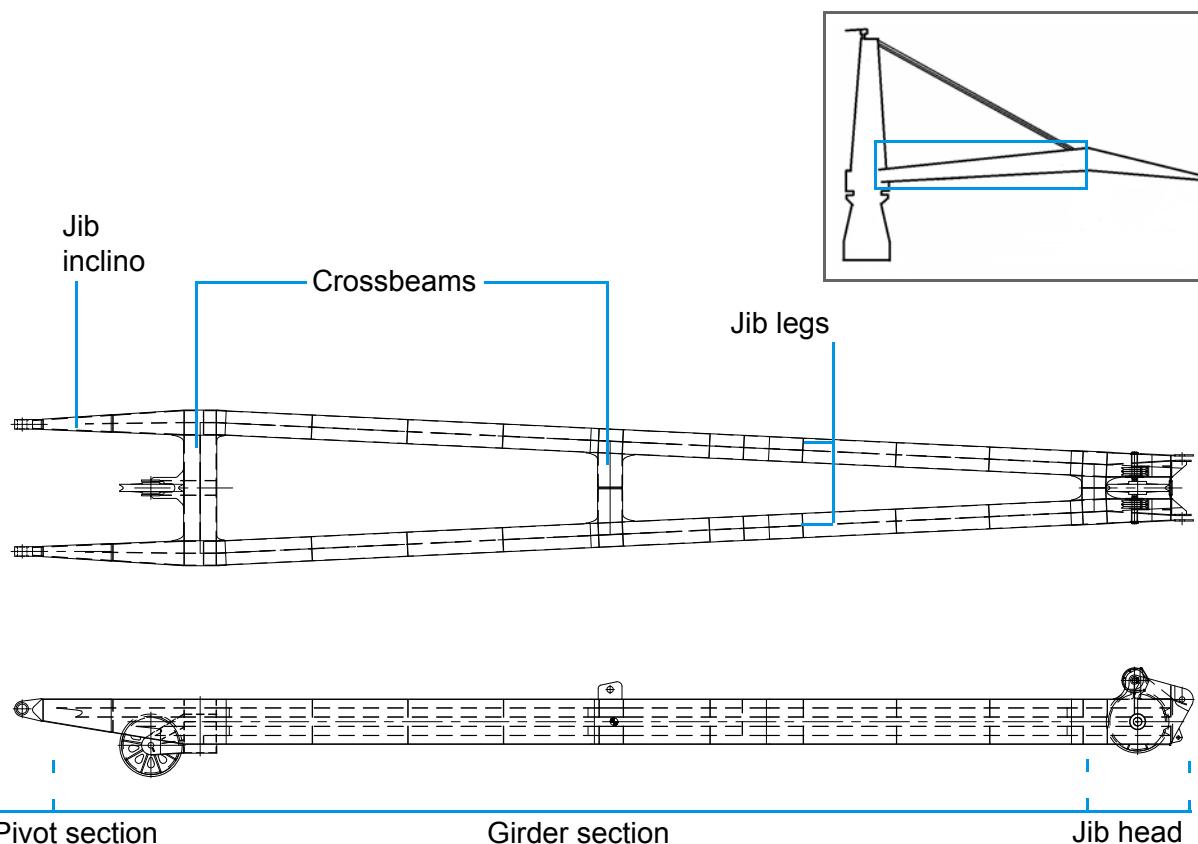


Figure 2-13: Jib

2.11.1 JIB HEAD

Reference drawing:

- [A11-41800-16-0108](#): Jibhead
- [A11-41800-15-0308](#): Pivot shaft
- [A11-41800-15-0508](#): Sheaveboxes on jib head
- [A11-41800-32-0508](#): Whip hoist sheave on jib
- [A11-41800-53-0308](#): Cable protection jibhead

The jib head is a constructive part which forms the end of the jib section, see [Figure 2-13](#). It contains the hoisting sheave boxes for the boom hoist, main hoist and whip hoist.

2.11.2 PREVENTER ON JIB

Reference drawing:

- [A11-41800-15-0418](#): Preventer on cranejib

A boom stop is integrated on the jib to prevent exceeding the maximum hoist angle, see [Figure 2-14](#). When the jib is in the highest position, the boom stop lands against the counter plate on the mast head, see [Section 2.3.1: "Preventer on boom stop counter parts"](#). The boom stop is provided with a jib highest position switch. For more information, please refer to [Section 2.13.9: "Jib highest position switch"](#).

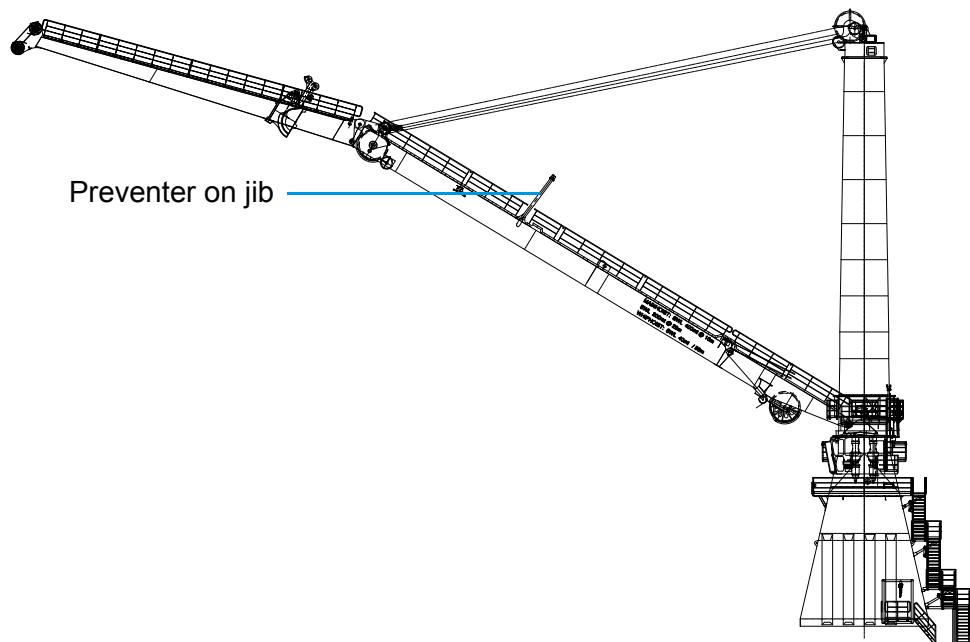


Figure 2-14: Preventer on jib

2.11.3 BOOM DRAG CHAIN

In order to transfer the electrical power and signals from the slew platform to the jib without damaging the electrical cables, the crane is equipped with a boom drag chain, see [Figure 2-15](#). If the jib rotates, the drag chain moves along the angle bar for a proper guidance of the chain.

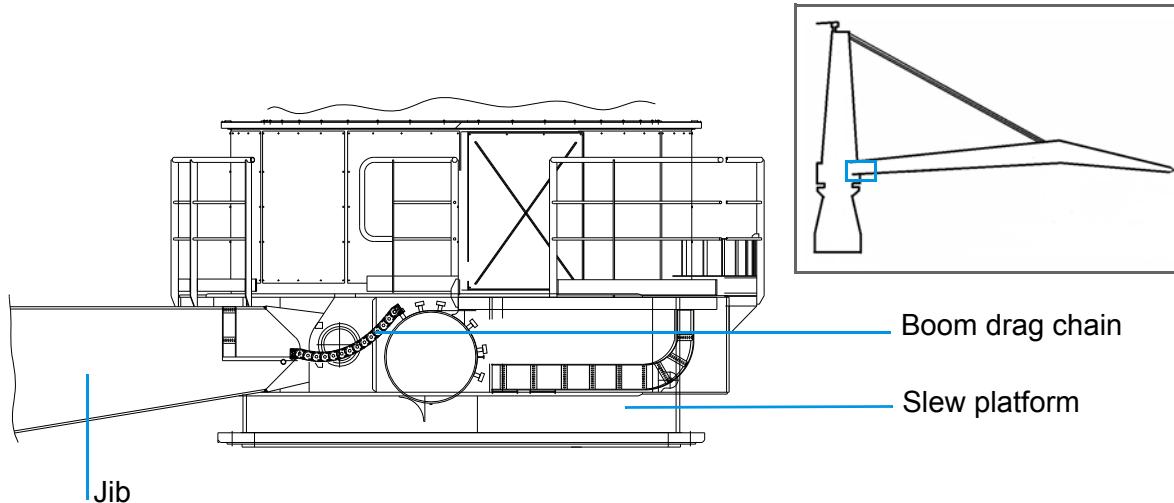


Figure 2-15: Boom drag chain (lowered position)

2.11.4 JIB SENSORS AND SWITCHES

Reference drawing:

[A11-41800-00-4018](#): Sensor arrangement

Sensors and switches are integrated to measure and control the jib movements. These are shown in [Section 2.13: "Boom hoist"](#).

2.12 FLY JIB

Reference drawing:

- [A11-41800-17-0108](#): Fly-jib
- [A11-41800-32-0408](#): Whip hoist sheave on jib

The fly jib is an extension of the jib and serves as a support for the whip hoist tackles. The fly jib is detachable from the jib. Without the detachable part, the main and whip hoist can be reeved in 1 fall. The fly jib is connected with pins to the jib head.

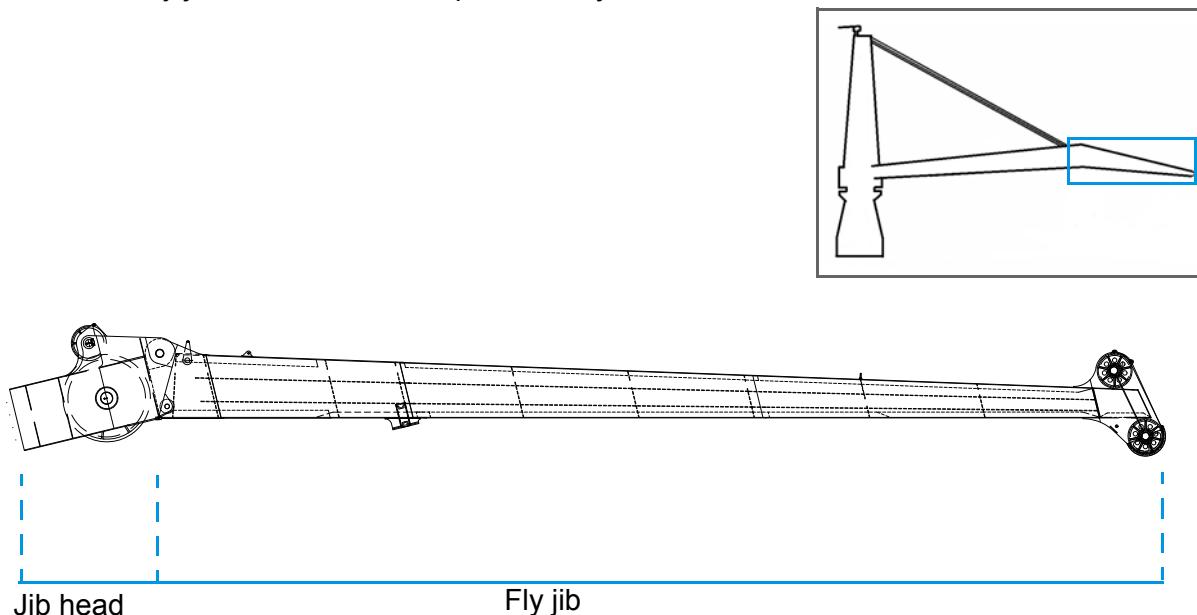


Figure 2-16: Sideview fly jib

2.13 BOOM HOIST

The boom hoist system serves to vary the angle of the jib. The maximum operational angle is 81° and the minimum operational angle is 0° . The boom hoist system contains the following elements:

- Boom hoist winch
- Wire
- Reeving
- Sensors and switches

2.13.1 BOOM HOIST WINCH

Reference drawing:

 [A11-41800-21-0208](#): Boom hoist winch

The boom hoist winch is mounted on the winch frame which is located in the rectangular mast section. The drive system contains two E-motors, one on each side of the drum, see [Figure 2-17](#). More information about the drive system is shown in [Table 2-4](#). The drives are provided with 'fail-safe' brakes, which are positioned on the motor shaft. In case of an electrical power fail, the brake is mechanically actuated.

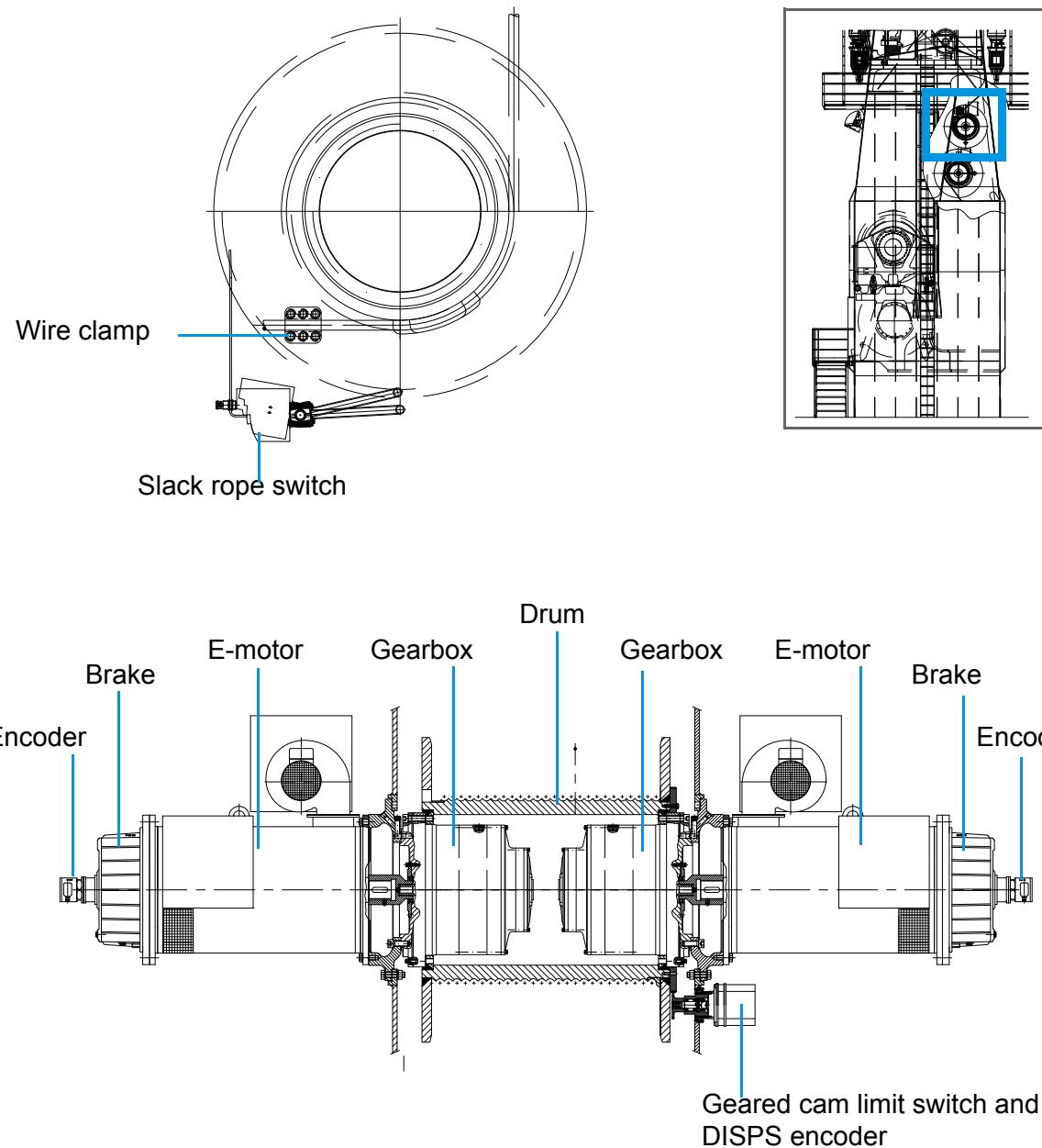


Figure 2-17: Boom hoist winch

Drive system component	Specifications		
E-motor	Supplier	Woelfer	[-]
	Type	MODRF280M-6s	[-]
	Quantity / winch	2	[-]
	Power	132	[kW]
Gearbox	Supplier	Siebenhaar	[-]
	Type	4088 WH 144/0 4088 WH 145/0	[-]
	Quantity / winch	2	[-]

Table 2-4: Boom hoist drive system specifications

Drive system component	Specifications		
Brake	Supplier	Pintsch Bamag	[-]
	Type	SFB 250/330	[-]
	Quantity / winch	2	[-]
Drum	Groove type	Lebus	[-]
	Diameter in groove	785	[mm]
	Wire storage (gross)	480	[m]
	No. of layers	6	[-]
	No. of safety windings	5	[-]
	Pitch	37.44	[mm]

Table 2-4: Boom hoist drive system specifications (Continued)

2.13.2 BOOM HOIST WIRE

The wire is clamped to the flange of the drum, see [Figure 2-17](#). The bolts of the clamp must be tightened with a torque of 617 Nm. More information about the wire is shown in [Table 2-5](#).

Boom hoist wire	Specifications		
Wire	Supplier	Redaelli	[-]
	Type	right handed ordinary lay	[-]
	Diameter	36	[mm]

Table 2-5: Boom hoist wire specifications

2.13.3 BOOM HOIST REEVING

Reference drawing:

- [A11-41800-31-0108](#): Reeving diagram
- [A11-41800-33-0608](#): BH sheaveblock jibhead
- [A11-41800-32-0908](#): Sheaves for rope leading - arrangement

The boom hoist is reeved in 12 falls. [Figure 2-18](#) shows a schematic overview of the boom hoist reeving. The dead end of the boom hoist rope is connected to the mast head with an open spelter socket.

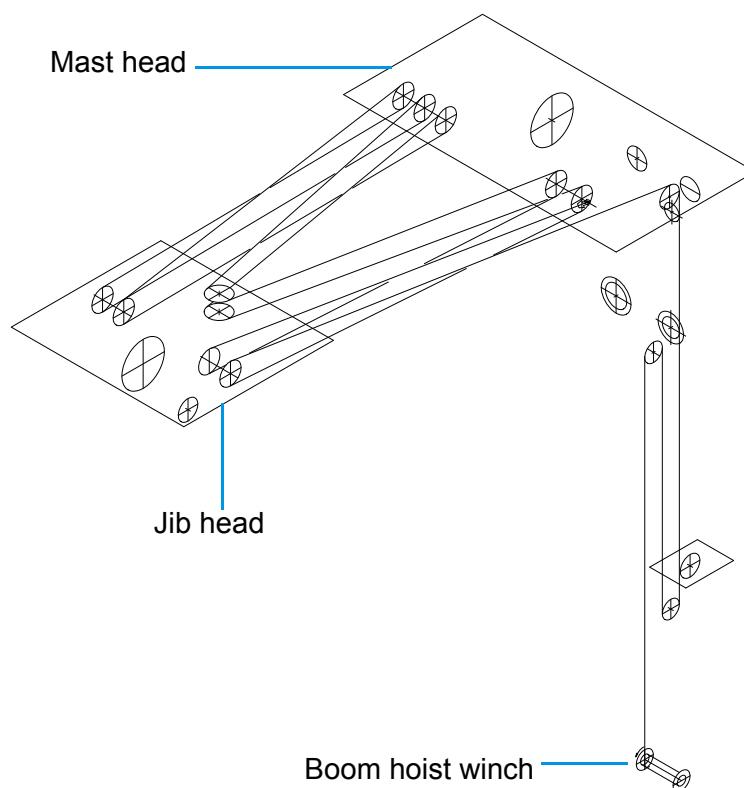


Figure 2-18: Boom hoist reeving diagram

2.13.3.1 Sheaves

Reference drawing:

- [A11-41800-32-0208](#): Sheave for wire Ø36 - P.C.D. 720

The boom hoist system contains sheaves to lead the wire rope from the winch to the jib head. The sheaves for the boom hoist have a minimum diameter of 20 times the wire diameter to ensure proper lifetime of the wires. They are fitted with roller bearings.

2.13.4 JIB INCLINOMETER

Reference drawing:

- [A11-41800-45-0308](#): Angle measuring jib

The boom hoist system is provided with a jib inclinometer. It is located on the jib, see [Figure 2-19](#). With the detected information, the control system calculates the radius and so guarding the maximum allowable load.

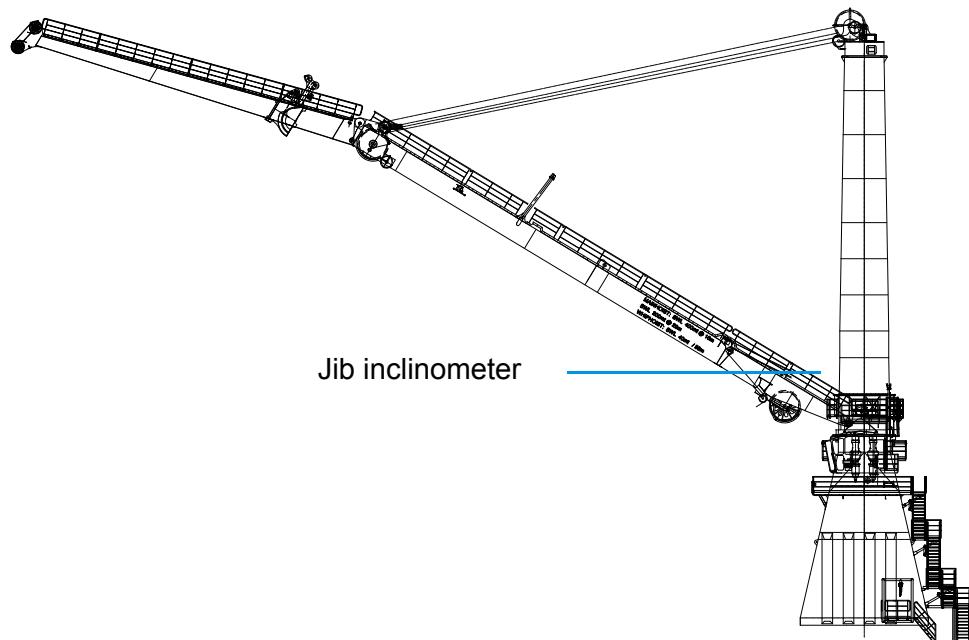


Figure 2-19: Position inclinometer

2.13.5 JIB ANGLE SENSOR

Reference drawing:

■ [A11-41800-45-0308](#): Angle measuring jib

The boom hoist system is provided with a jib angle sensor at the jib pivot. The jib angle sensor is used as a reference for the jib angle..

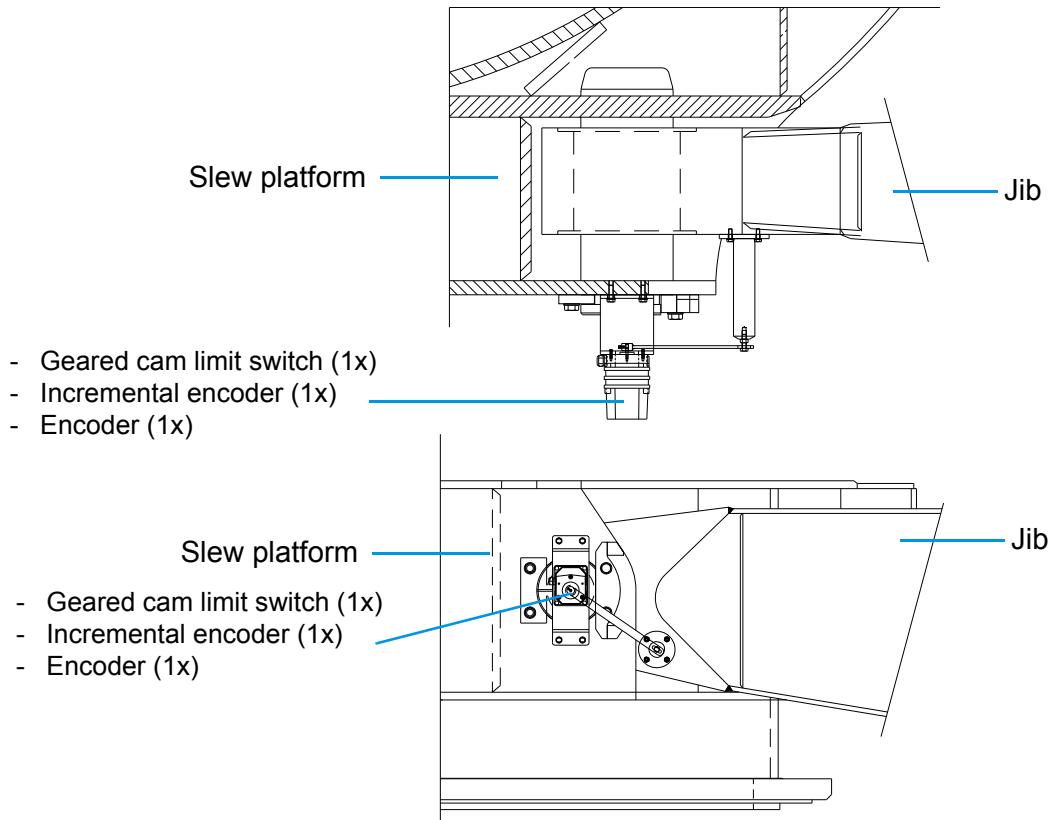


Figure 2-20: Jib angle sensor

2.13.6 GEARED CAM LIMIT SWITCH

The boom hoist system is provided with a geared cam limit switch. This is used to count the number of revolutions of the winch drum and to determine the spooled length of the hoist wire. It is located on the boom hoist winch, see also [Figure 2-17](#). For more information, see also [Section 2.18.3: "Geared cam limit switch"](#).

2.13.7 SLACK ROPE SWITCH

Reference drawing:

■ [A11-41800-44-0108](#): Slack rope switches

The boom hoist winch is provided with a slack rope switch mechanism. This is used to stop the drum in case of a wire slack. It is located underneath the drum, see also [Figure 2-17](#). For more information, see [Section 2.18.5: "Slack rope switch"](#).

2.13.8 ENCODERS

The boom hoist system is provided with 2 E-motor encoders and 1 DISPS encoders. The E-motor encoders are provided on the two drive motors, see [Figure 2-17](#). These are integrated to measure the motor speed. A DISPS encoder is integrated for detecting hoisting overspeed.

2.13.9 JIB HIGHEST POSITION SWITCH

Reference drawing:

■ [A11-41800-42-0208](#): Jib highest position switch

To prevent the jib from being hoisted through its maximum operational angle of 81° which may cause damage to the construction, two highest position switch is mounted, see [Figure 2-21](#). The device, consists of a spring-set pin which is pushed inwards when these contact the counter plates at the mast. The pins are each provided with a proximity switch that reacts to the presence of steel. With the pins extended, the proximity switches detect the thicker bottom portion of the pin. When the pins hit the mast, these are pushed in. The proximity switches no longer detect steel so that the contact is broken and hoisting is disabled by the control system.

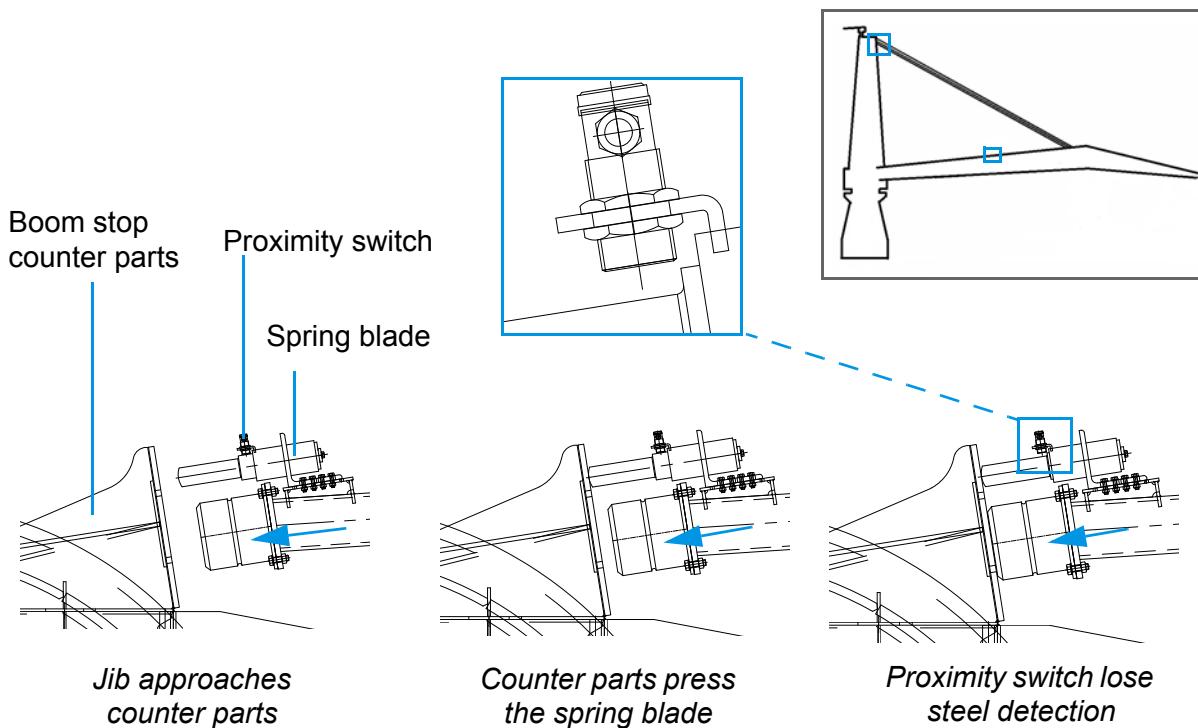


Figure 2-21: Jib highest position switch

2.14 MAIN HOIST

The main hoist system serves to hoist and lower the load which is suspended in the main hoist hook. The main hoist system contains the following elements:

- Storage winch
- Spooling device
- Traction winch
- Wire
- Reeving
- Hydraulic heave compensator
- Lower block
- Sensors and switches

2.14.1 STORAGE WINCH

Reference drawing:

 [A11-41830-21-0008](#): General arrangement

The storage winch is located below deck. The storage winch is driven through 2 E-motors. The drum is left handed with Lebus grooves. The storage winch has a constant tension of 10 mt. However, the winch is capable of handling a large overload. This may be caused during power failure or crash-stop when the brakes are applied, and the traction winch is still pulling. The storage capacity is 3080 m, with 5 safety windings.

More information about the drive system is shown in [Table 2-6](#). The drives are provided with a fail-safe brake positioned on the motor shaft. In case of an electrical power fail, the brake is mechanically actuated. See [Figure 2-22](#) for an overview of the storage winch..

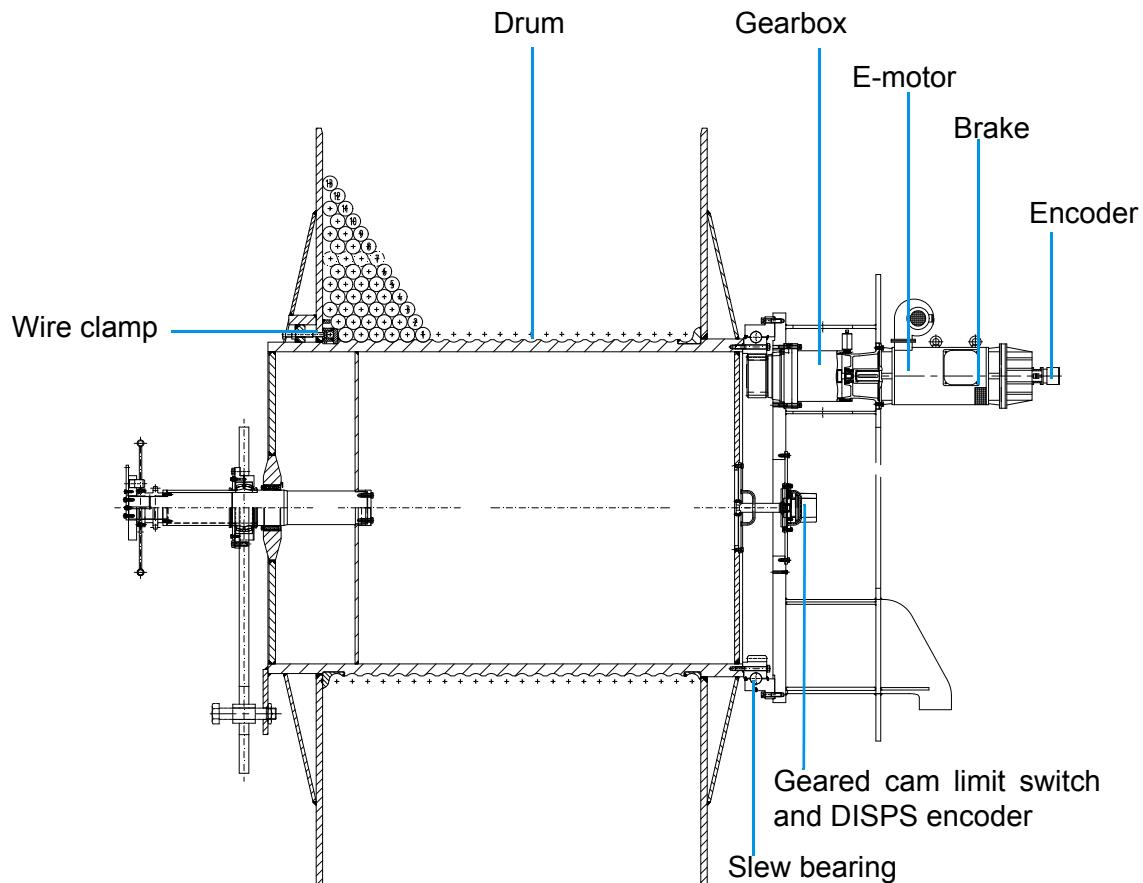


Figure 2-22: Main hoist storage winch

Drive system component	Specifications		
E-motor	Supplier	Woelfer	[-]
	Type	MODRKF180L-4b	[-]
	Quantity / winch	2	[-]
	Power	45	[kW]
Gearbox	Supplier	Liebherr	[-]
	Type	DAT 350/ 1406	[-]
	Quantity / winch	2	[-]
Brake	Supplier	Pintsch Bamag	[-]
	Type	SFB 40T	[-]
	Quantity / winch	2	[-]

Table 2-6: Main hoist drive system specifications

Drive system component	Specifications		
Drum	Groove type	Lebus	[-]
	Diameter in groove	2060	[mm]
	Wire storage (gross)	3080	[m]
	No. of layers	13	[-]
	No. of safety windings	5	[-]
	Pitch	96	[mm]

Table 2-6: Main hoist drive system specifications (Continued)

2.14.2 SPOOLING DEVICE

Reference drawing:

- [A11-41830-21-0408](#): Spooling device diamond screw block
- [A11-41830-21-0508](#): Spooling device frame and shaft

To guarantee proper spooling behavior of the wire rope and to lead it to the traction winch in a controlled manner (max. fleet angle 1.5°), a spooling device (see [Figure 2-23](#)) is mounted in front of the winch. The spooling device consists of a diamond screw shaft connected to the winch drum by means of a chain transmission. The diamond screw shaft drives a block with two wire rope guiding rollers that moves from left to right and follows the spooling direction of the wire rope. A pin on the block fits into the groove of the diamond screw shaft and will turn automatically at the end of the stroke.

The chain is kept at the right tension by means of an adjustable chain tensioner. A proximity switch detecting the chain ensures that the winch is stopped in case of a broken transmission chain or jammed chain / wheel.

The trolley is provided with a nut assembly, which meshes with a spindle. This spindle is driven by means of a chain, connected to the storage winch electric motor. The spindle is provided with a brake and a speed encoder.

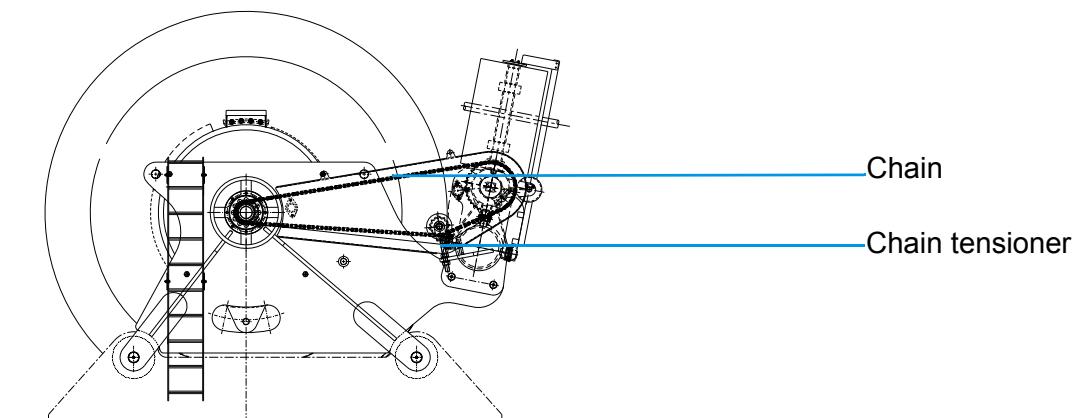
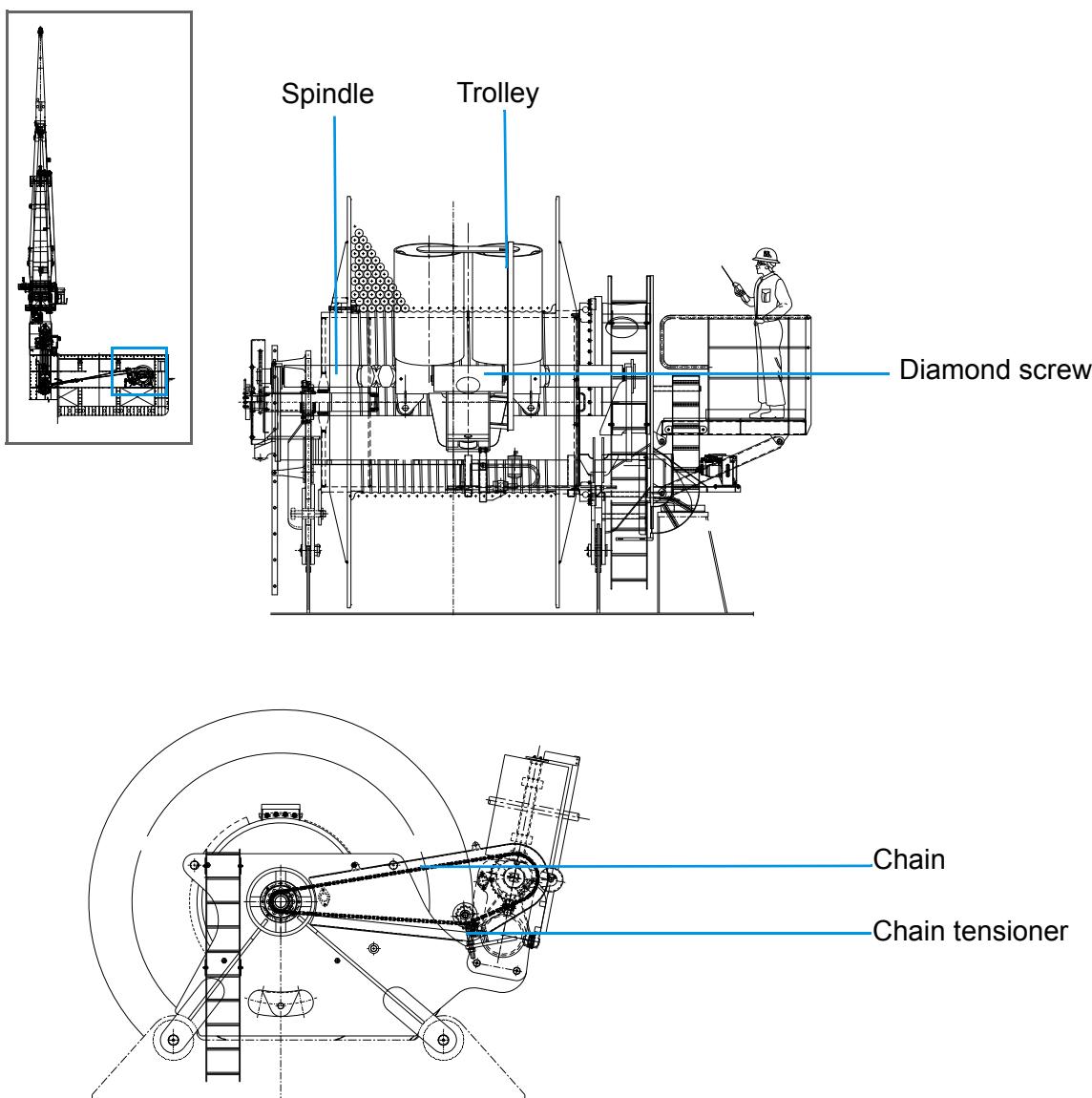


Figure 2-23: Main hoist spooling device

2.14.3 TRACTION WINCH

Reference drawing:

 [A11-41820-10-0018](#): 210 M.TS. Traction Winch general arrangement

The traction winch is located in the rectangular mast section. Each of the traction winch drums is provided with three E-motors, gearboxes and brakes.

The traction winch consists of two drums mounted together in one winch frame, see figure [Figure 2-24](#). The wire is wound over these two drums in several windings. The traction winch principle is based on friction build-up between the drums and the wire rope.

The drum axes are mounted in an angle relative to each other, which allows the wire to run in a straight line from one drum to the other. This reduces wire rope fatigue since there is no build up of torsion in the rope. The drums are provided with hardened and grooved sleeves to prevent wear of the drum surface. The groove diameter increases with every wrap in order to cope with the elastic elongation of the wire rope when tensioned. This type of grooves eliminates slipstick effects of the wire rope on the drum.

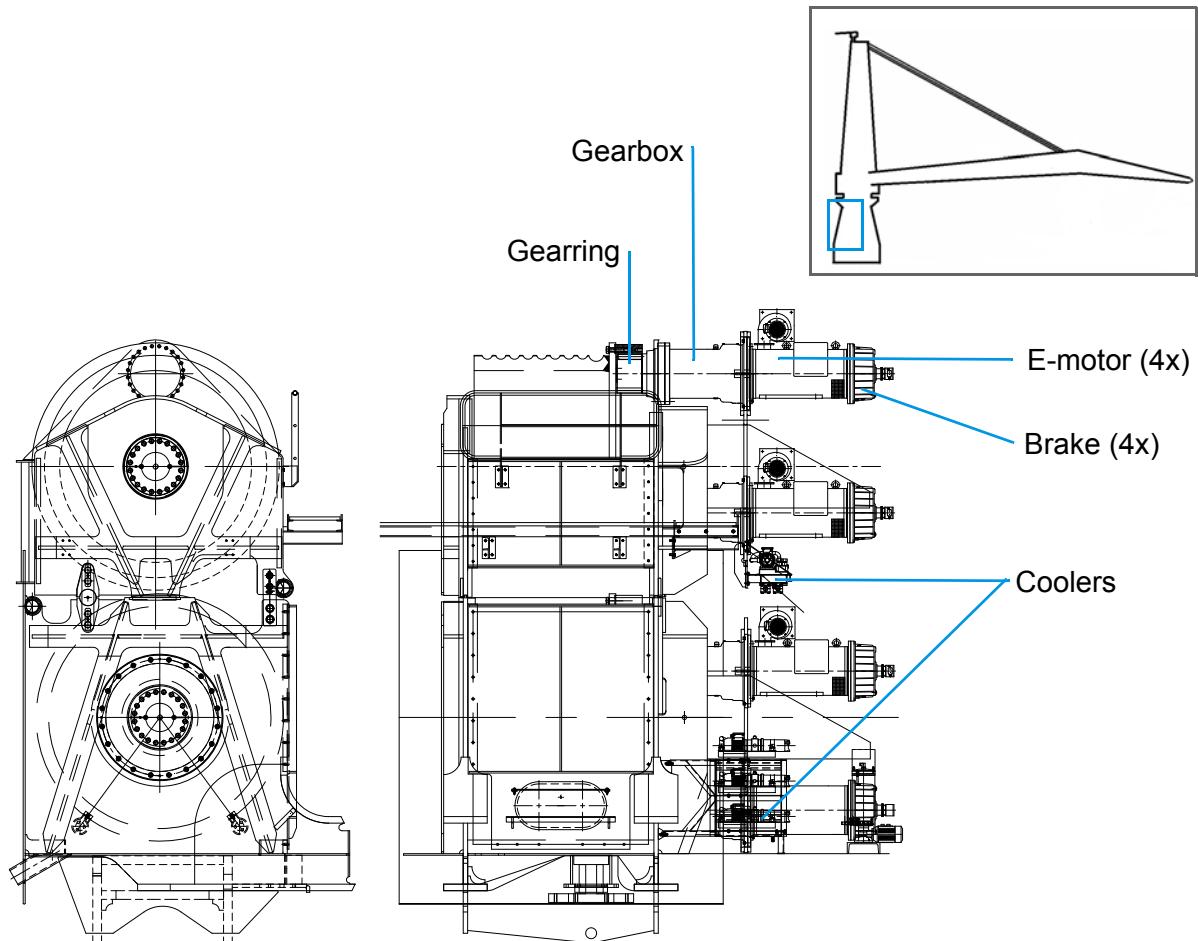


Figure 2-24: Main hoist traction winch

Drive system component	Specifications		
E-motor	Supplier	Woelfer	[-]
	Type	MODRF225L-4bbb	[-]
	Quantity / winch	6	[-]
	Power	145	[kW]
Gearbox	Supplier	Liebherr	[-]
	Type	DAT500/1403	[-]
	Quantity / winch	6	[-]
Brake	Supplier	Pintsch Bamag	[-]
	Type	SFB160 T	[-]
	Quantity / winch	6	[-]

Table 2-7: Main hoist traction winch drive specifications

Drive system component	Specifications		
Drum	Groove type	Helical	[\cdot]
	Diameter	2060	[mm]
	No. of layers	1	[\cdot]
Gearbox coolers	Supplier	Hydac	
	Type	UKF-1	

Table 2-7: Main hoist traction winch drive specifications (Continued)

2.14.3.1 Automatic greasing system

Reference drawing:

■ [A11-41820-13-0208](#): Traction winch grease system

The traction winch is provided with an automatic greasing system. The automatic greasing system consists of a pump and hoses. The pump has an interval of 30 seconds on / 1 hour off.

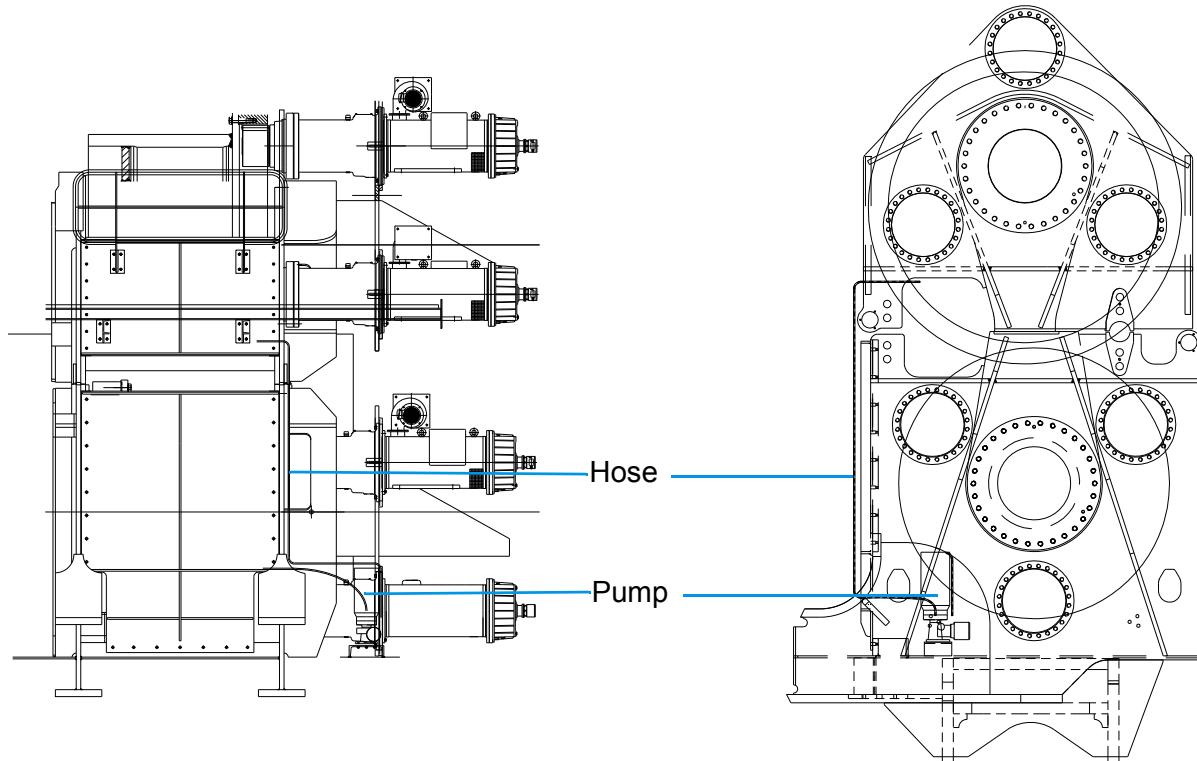


Figure 2-25: Traction winch automatic greasing system

2.14.4 MAIN HOIST WIRE

The main hoist wire is clamped to the main hoist drum with a safety clamp, see [Figure 2-22](#). The bolts of the clamp must be tightened with a torque of 1759 Nm (70%). More information about the wire is shown in [Table 2-8](#) and supplier documentation (Redaelli)

Main hoist wire	Specifications		
Wire	Supplier	Redaelli	[-]
	Type	Flexpack compacted R.H.O.L. Non spinning	[-]
	Diameter	92	[mm]

Table 2-8: Main hoist wire specifications

2.14.5 MAIN HOIST REEVING

Reference drawing:

- [A11-41800-31-010](#): Reeving diagram
- [A11-41800-17-0208](#): Main hoist dead end
- [A11-41800-33-0208](#): Main hoist sheave block
- [A11-41800-32-0908](#): Sheaves for rope leading - arrangement
- [A11-41830-53-0208](#): Guide roller main hoist

The main hoist is reeved in 1 or 2 falls. [Figure 2-26](#) shows a schematic overview of the main hoist reeving. When reeved in 2 falls, the dead end of the main hoist wire is connected to fly jib with a closed spelter socket. See [Section 6.8: "Main hoist reeving procedure"](#) for the procedure to reeve the main hoist from 1 to 2 falls or vice versa.

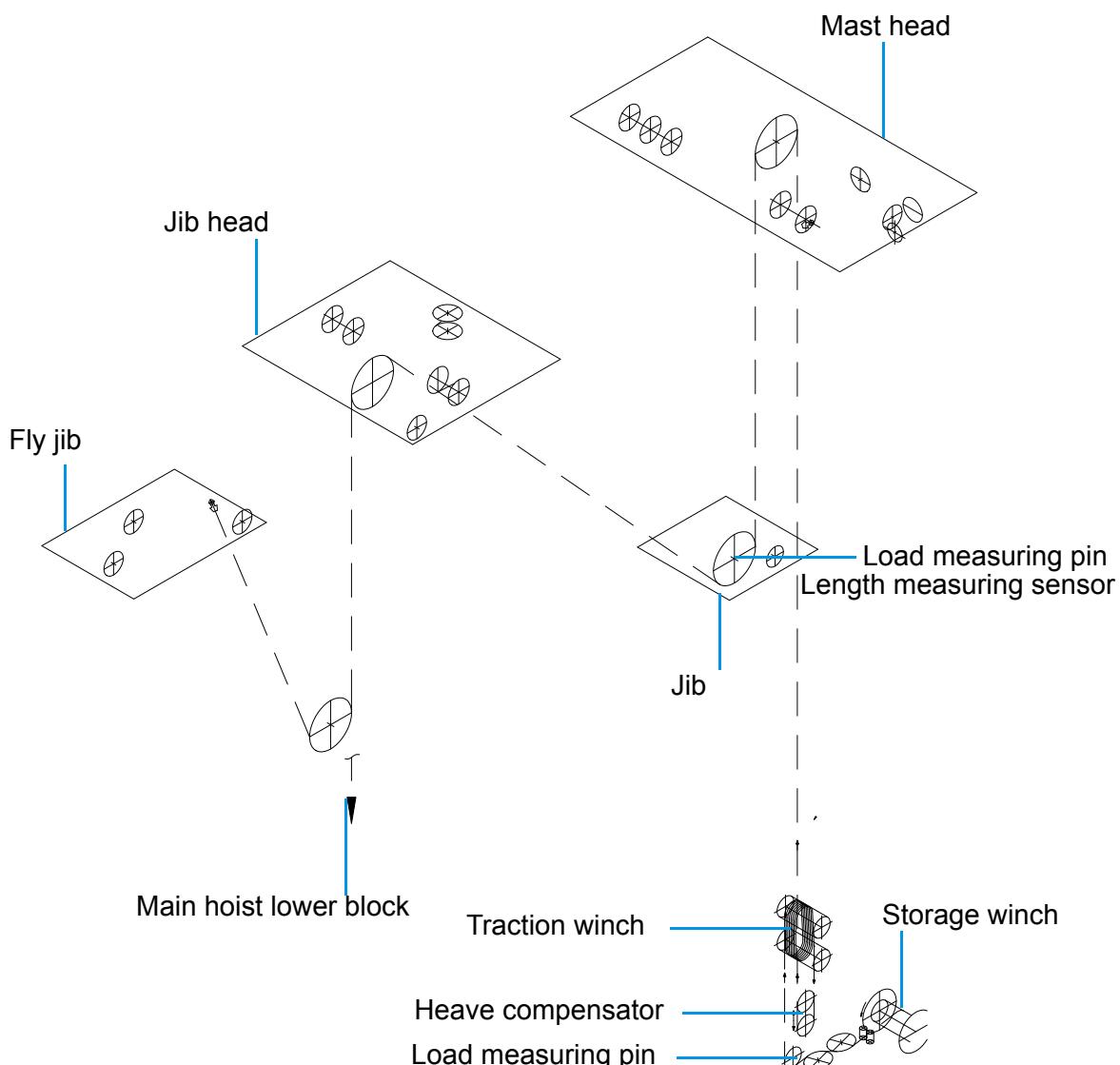


Figure 2-26: Main hoist reeving diagram

2.14.5.1 Sheaves

Reference drawings:

- [A11-41800-32-0108](#): Sheave for wire

The main hoist system contains sheaves to lead the wire rope from the winch to the main hoist lower block. The sheaves have a minimum diameter of 20 times the wire diameter to ensure proper lifetime of the wires. The sheaves are fitted with roller bearings. The sheave at the jib pivot is provided with a load measuring pin. The location is shown in [Figure 2-26](#).

2.14.5.2 Wire brake

CAUTION

The crane and especially the main hoist must not be operated when the wire brake is applied

CAUTION

There are no sensors installed on the wire brake system. The pressure in the cylinder can only be monitored with the pressure gauge.

In case the pressure drops below 310bar on the bottom side of the cylinder during operation, it should be pumped up to 320bar again. At the start, the pressure must be checked regularly, because the pressure may drop due to temperature increase while pumping. After the brake is applied it must be checked each hour.

The main hoist jibhead sheave is equipped with a wire brake for reeving procedures. See [Section 6.8: "Main hoist reeving procedure"](#) for the reeving procedure of the main hoist.

The brake consists of a frame, a cylinder and a brake block. A tank and a hand pump are installed on the fly jib. The maximum allowed linepull for this brake is 5 mt. For information about the brake hydraulic see [Section 4.2: "Wire brake system"](#). See [Section 6.8: "Main hoist reeving procedure"](#) for the reeving procedure of the main hoist.

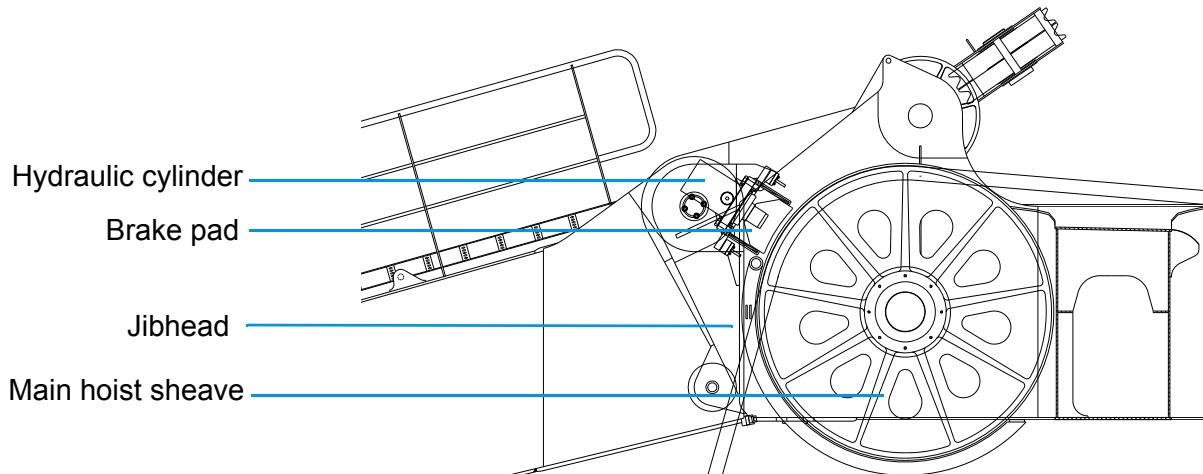


Figure 2-27: Wire brake location

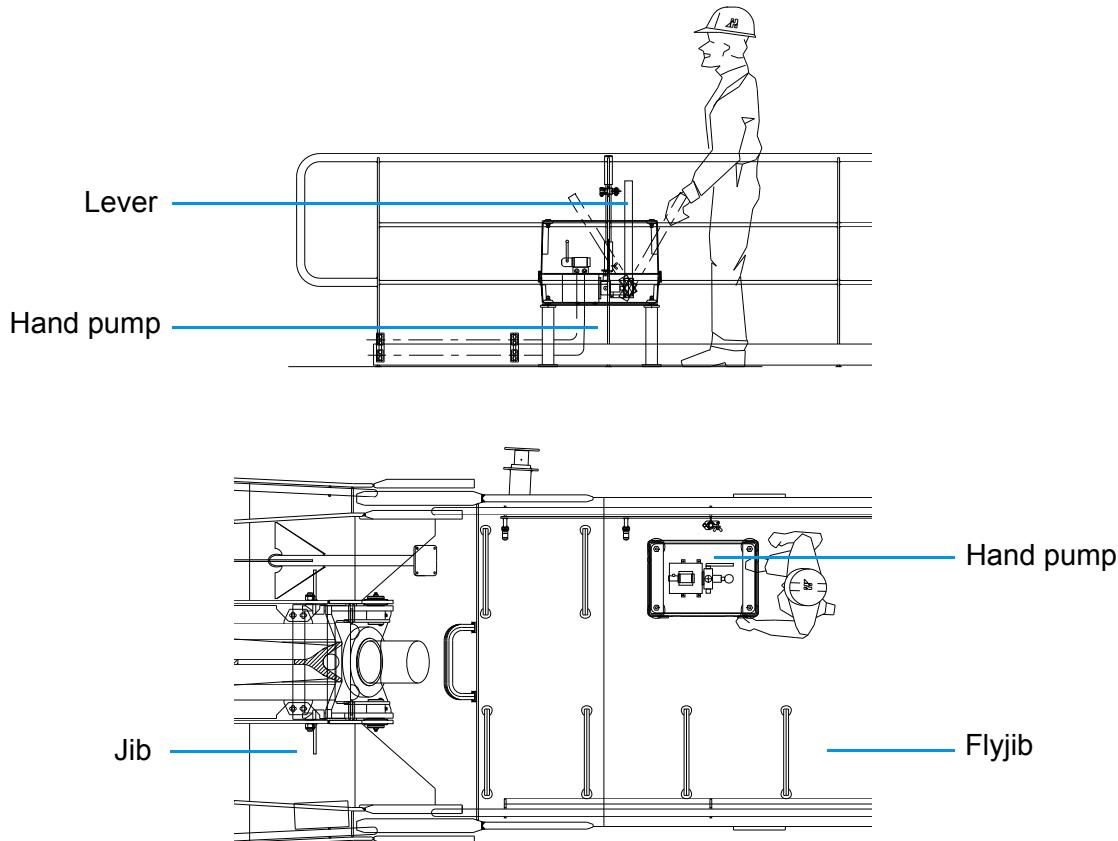


Figure 2-28: Wire brake hand pump location

2.14.5.3 Airtugger and deck winch

The flyjib is equipped with support for an airtugger (2.4mt) for reeving procedures (the airtugger is Subsea 7 delivery). See [Section 6.8: "Main hoist reeving procedure"](#) for the reeving procedure of the main hoist.

2.14.6 HEAVE COMPENSATOR

Reference drawing:

 [A11-41810-10-0018](#): General arrangement

The main hoist winch is provided with a hydraulic heave compensation system. It serves to reduce the vertical movements of a submerged load, caused by heave and roll motions of the vessel in rough sea circumstances. For an extended description of the mechanical and hydraulic properties of the heave compensator, see [Chapter 3: "Heave compensator"](#).

2.14.7 MAIN HOIST LOWER BLOCK

Reference drawing:

■ [A11-41800-33-0108](#): Main hoist lower block 400 mt

The main hoist lower block is equipped with a double hook. Safety latches are provided to prevent slings from slipping out of the hook. Eyes are provided for stabilizing the load. For an overview, see figure [Figure 2-29](#).

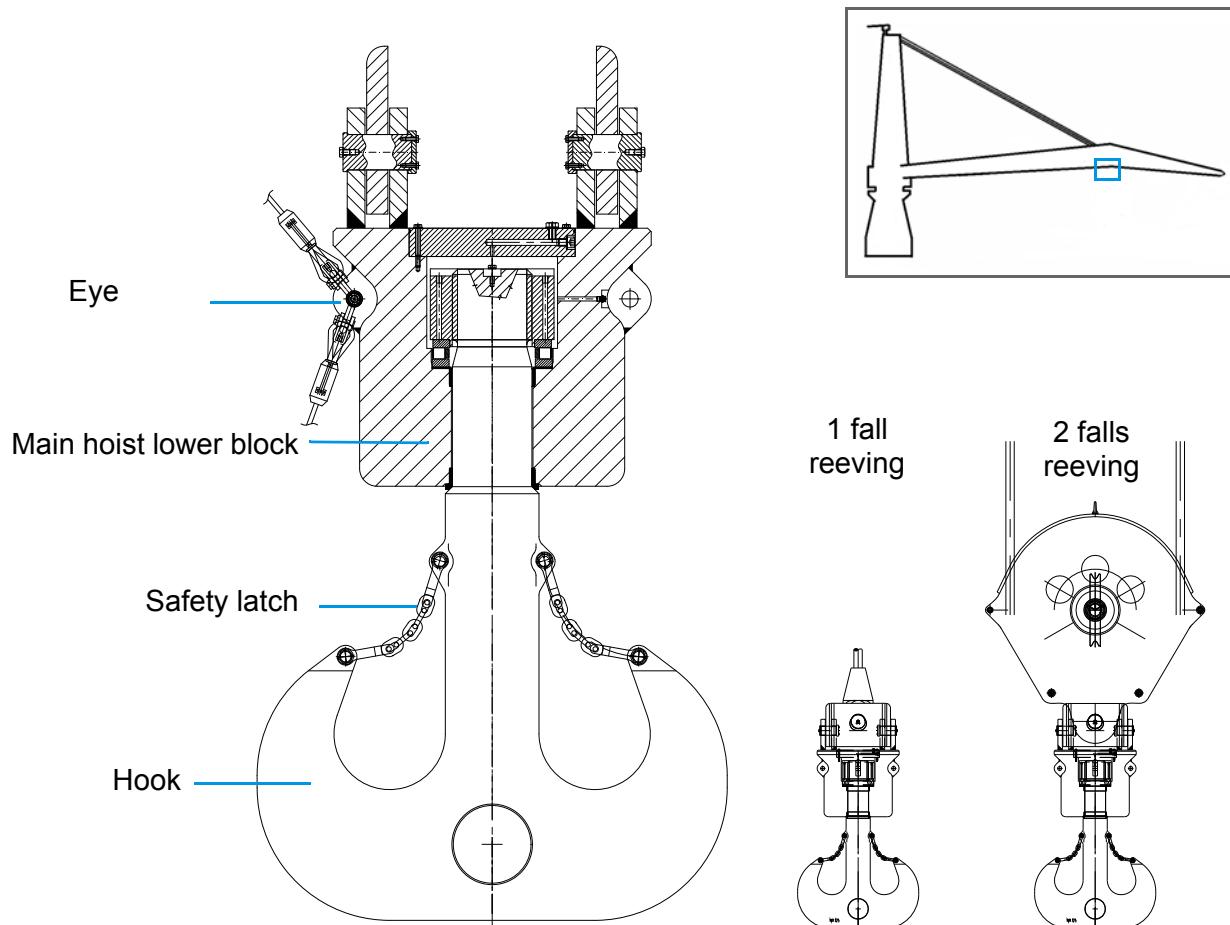


Figure 2-29: Main hoist lower block

2.14.8 MAIN HOIST HIGHEST POSITION SWITCH

Reference drawing:

■ [A11-41800-42-0108](#): MH highest position switch

The main hoist system is provided with a highest position switch, see [Figure 2-30](#). This is used to prevent the block from hitting the jib when hoisting. It is located on the jib head. The mechanism contains a blade spring, a proximity switch and a steel frame. The spring is held on a narrow distance from the proximity switch by use of the weight of a hanging steel frame, which is

suspended with cables. When hoisting the main hoist block, the weight is pushed upwards, which cause a loss of tension in the cables. This results in an increased distance between the spring blade and the proximity switch. The proximity switch detects no blade anymore so that the contact is broken and the winch is switched off by the control system.

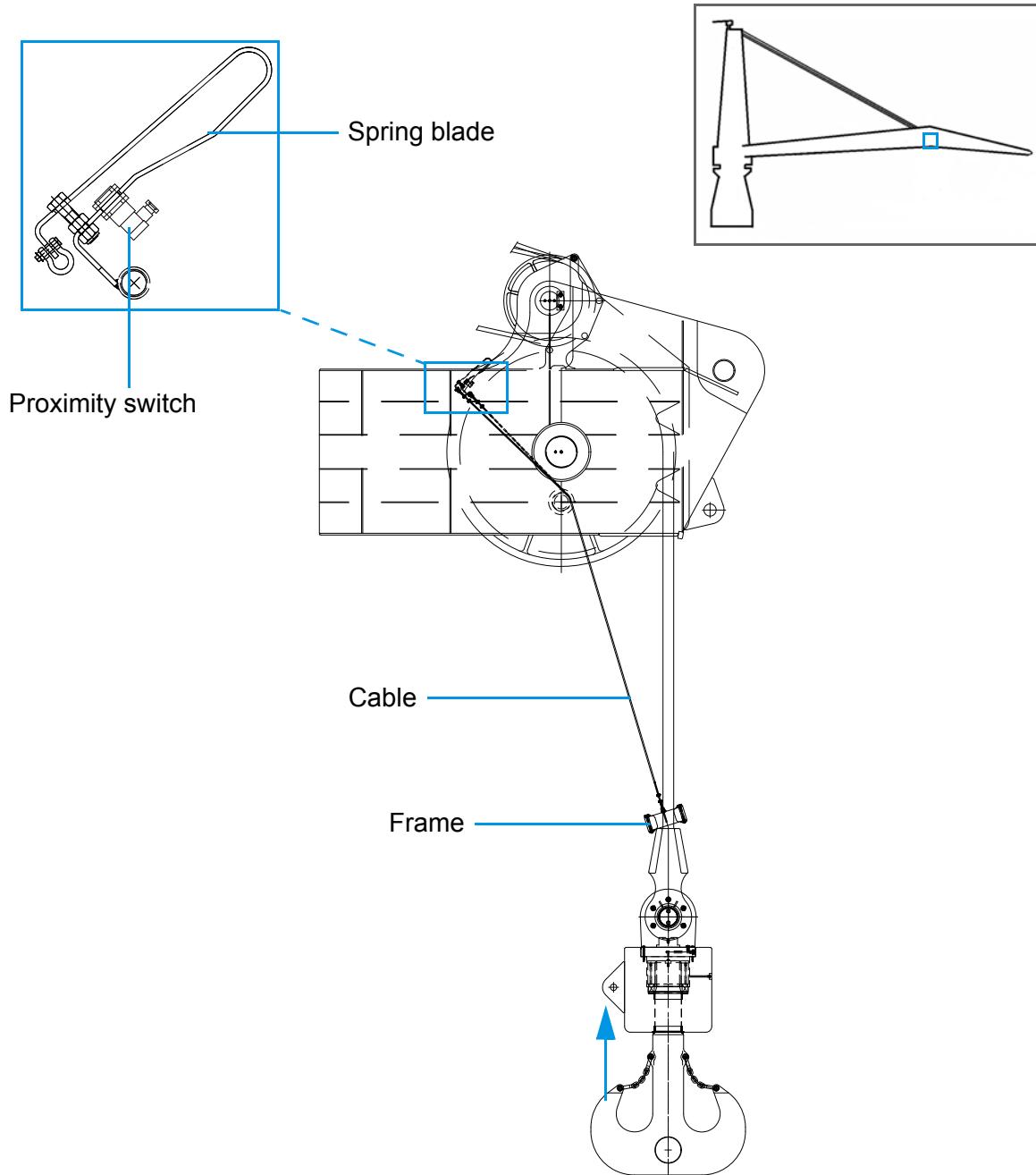


Figure 2-30: Main hoist highest position switch

2.14.9 LENGTH MEASURING SENSOR, MAIN HOIST

Reference drawing:

- [A11-41800-53-0108](#): Cable protection m.h. sheave

The main hoist system is provided with a length measuring sensor. This is used to measure the length of the hoisted wire. It is located on jib pivot, see also [Figure 2-26](#). For more information, see also [Section 2.18.2: "Length measuring sensor"](#).

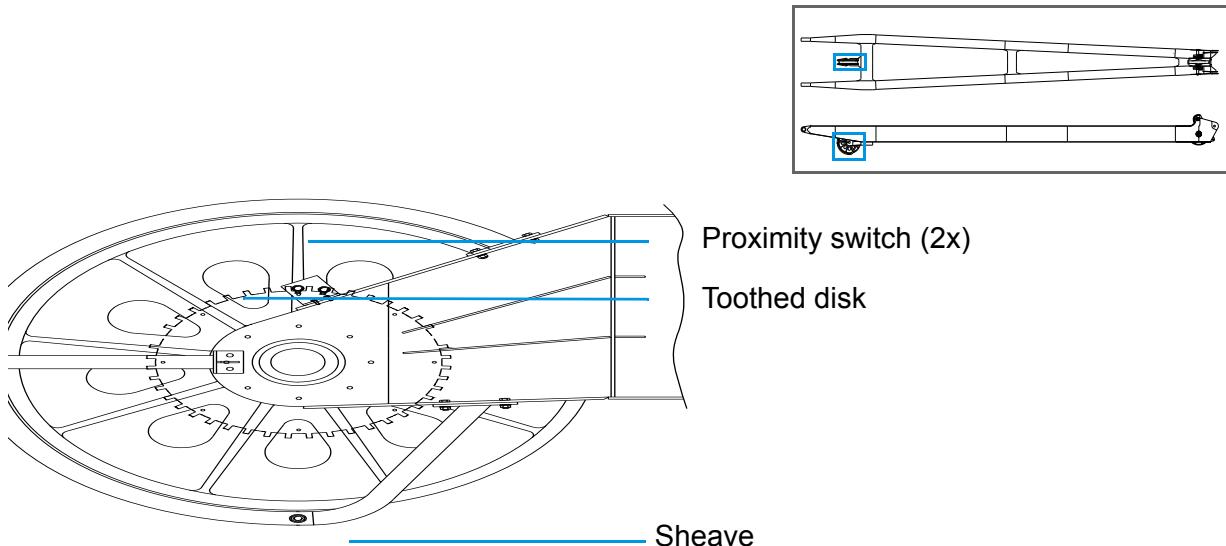


Figure 2-31: Length measurement proximity switch, main hoist

2.14.10 GEARED CAM LIMIT SWITCH

The main hoist system is provided with a geared cam limit switch. This is used to count the number of revolutions of the storage winch drum and to determine the spooled length of the hoist wire. It is located on the storage winch, see also [Figure 2-22](#). For more information, see also [Section 2.18.3: "Geared cam limit switch"](#).

2.14.11 SLACK ROPE SWITCH

Reference drawing:

- [A11-41830-41-0108](#): Slack rope switch

The main hoist storage winch is provided with a slack rope switch mechanism. This is used to stop the drum in case of a wire slack. It is located underneath tone of the guide sheaves below deck. For more information, see [Section 2.18.5: "Slack rope switch"](#).

2.14.12 LOAD MEASURING PIN

Reference drawing:

- [A11-41800-46-0108](#): Load Measuring Pin

The main hoist system is provided with 2 load measuring pins (LMP's). One of the LMP's is located at the sheave at the jib pivot, to measure the load acting on the hoist. The other one is located at the guide sheave unit, measuring the linepull on the storage winch. See also [Figure 2-26](#). For more information, see [Section 2.18.6: "Load measuring pin"](#).

2.14.13 ENCODERS

The main hoist system is provided with seven E-motor encoders. The E-motor encoders are provided on one of the drive motors of the storage winch, see [Figure 2-22](#) and on all motors of the traction winch. These are integrated to measure the motor speed.

2.15 WHIP HOIST

The whip hoist system serves to hoist and lower the load which is suspended in the whip hoist hook. The whip hoist system contains the following elements:

- Hoist winch
- Wire
- Reeling
- Lower block
- Sensors and switches
- Personnel lifting

2.15.1 WHIP HOIST WINCH

Reference drawing:

 [A11-41800-21-0308](#): Whip hoist winch

The whip hoist winch is mounted on the winch frame and located in the rectangular mast section. The drive system of the whip winch consists of two E-motors, located on the side of the drum, see [Figure 2-32](#). More information about the drive system is shown in [Table 2-9](#). The drives are provided with a fail-safe brake positioned on the motor shaft. In case of an electrical power fail, the brake is mechanically actuated.

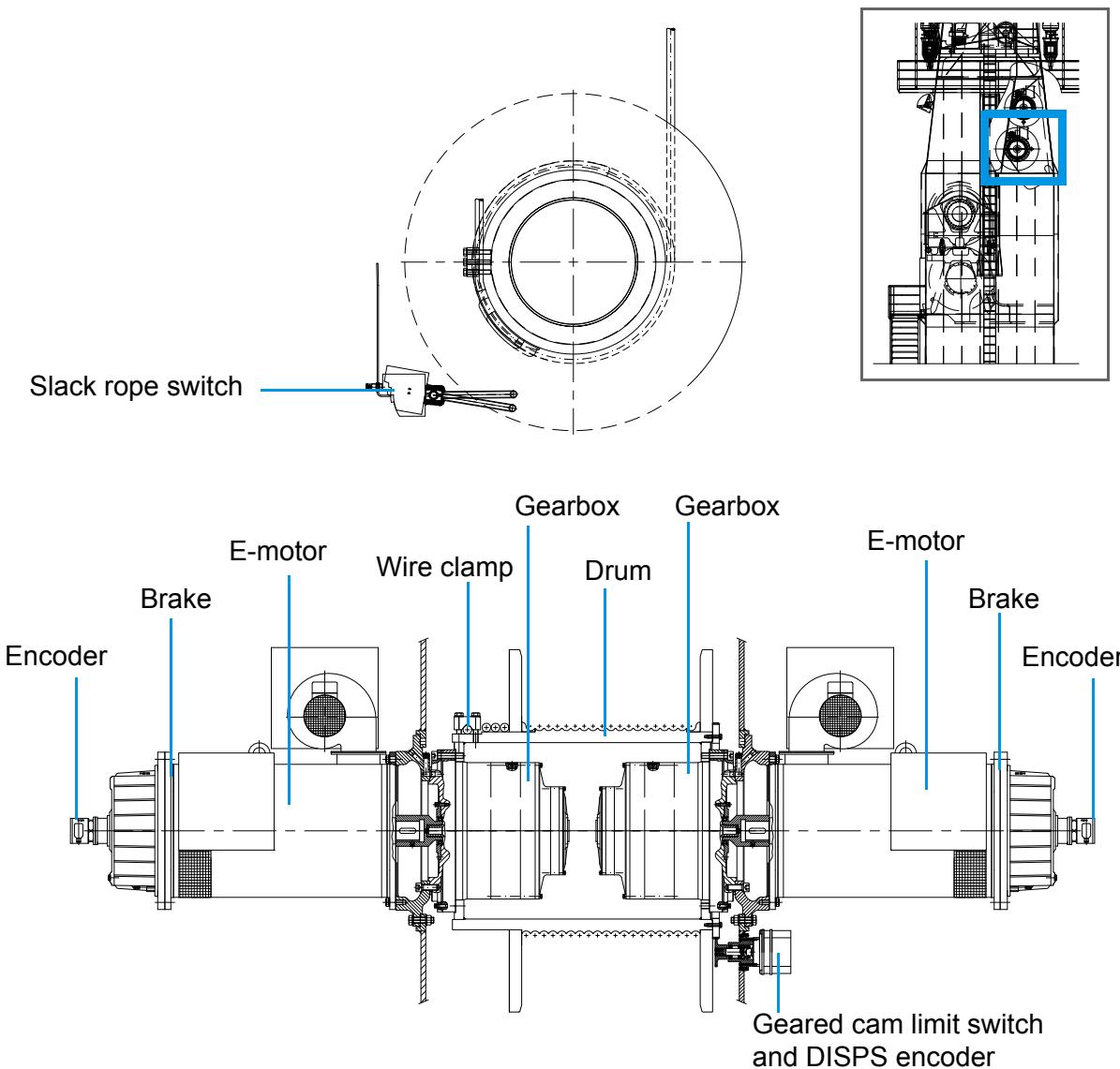


Figure 2-32: Whip hoist winch

Drive system component	Specifications		
E-motor	Supplier	Woelfer	[-]
	Type	MODRF280M-6s	[-]
	Quantity / winch	2	[-]
	Power	132	[kW]
Gearbox	Supplier	Siebenhaar	[-]
	Type	4088 WH 146/0 4088 WH 147/0	[-]
	Quantity / winch	2	[-]
Brake	Supplier	Pintsch Bamag	[-]
	Type	SFB250T	[-]
	Quantity / winch	2	[-]

Table 2-9: Whip hoist drive system specifications

Drive system component	Specifications		
Drum	Groove type	Lebus	[-]
	Diameter in groove	840	[mm]
	Wire storage (gross)	526	[m]
	No. of layers	8	[-]
	No. of safety windings	3	[-]
	Pitch	37.44	[mm]

Table 2-9: Whip hoist drive system specifications (Continued)

2.15.2 WHIP HOIST WIRE

The wire is clamped to the whip hoist drum with a wire clamp, see [Figure 2-32](#). The bolts of the clamp must be tightened with a torque of 617 Nm (90%). More information about the wire is shown in [Table 2-10](#) and supplier documentation (Redaelli)

Whip hoist wire	Specifications		
Wire	Supplier	Redaelli	[-]
	Type	right handed langs lay non spinning	[-]
	Diameter	36	[mm]

Table 2-10: Whip hoist wire specifications

2.15.3 WHIP HOIST REEVING

Reference drawing:

- [A11-41800-31-0108](#): Reeving diagram
- [A11-41800-17-0308](#): Whip hoist dead end
- [A11-41800-33-0408](#): Sheave box whip hoist
- [A11-41800-32-0908](#): Sheaves for rope leading - arrangement

The whip hoist is reeved in one or two falls. [Figure 2-33](#) shows a schematic overview of the whip hoist reeving. The dead end of the whip hoist rope is connected to the fly jib with a open wedge socket.

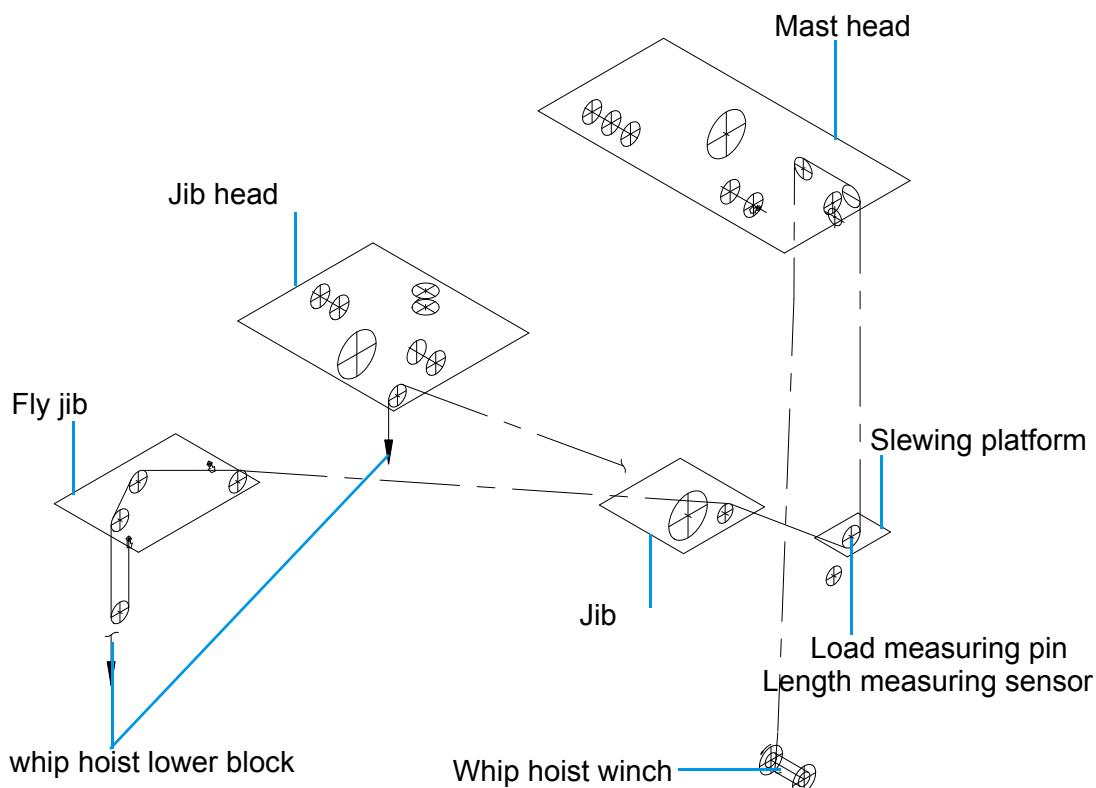


Figure 2-33: Whip hoist reeving diagram

2.15.3.1 Sheaves

Reference drawing:

- [A11-41800-32-0208](#): Sheave for wire Ø36 - P.C.D. 720

The whip hoist system contains sheaves leading the wire rope from the winch to the whip hoist lower block. The sheaves have a minimum diameter of 20 times the wire diameter to ensure proper lifetime of the wires. The sheaves are fitted with roller bearings. One of the sheaves contains a load measuring pin. The location is shown in [Figure 2-33](#).

2.15.4 WHIP HOIST LOWER BLOCK

Reference drawing:

■ [A11-41800-32-0608](#): Whip hoist lower block

The whip hoist lower block is equipped with a single hook. A safety latch is provided to prevent slings from slipping out of the hook.

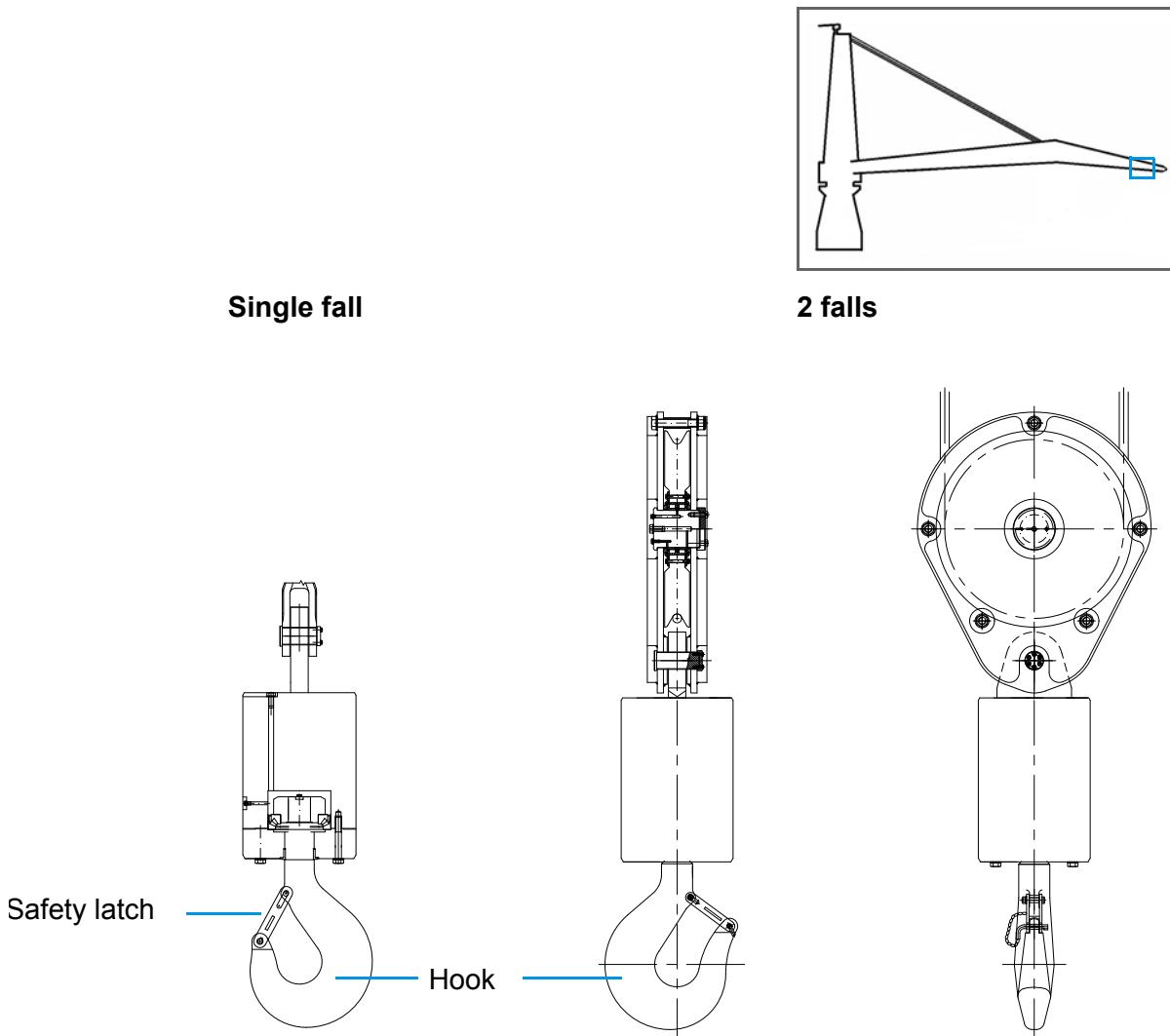


Figure 2-34: Whip hoist lower block

2.15.5 PERSONNEL LIFTING

Personnel lifting is used to transport personnel. At a reduced load of 2 mt, the whip hoist is suitable for personnel lifting operation. For more information see [Section 6.12.4: "Personnel lifting"](#).

2.15.6 WHIP HOIST HIGHEST POSITION SWITCH

Reference drawings:

- [A11-41800-42-0308](#): WH highest position switch
- [A11-41800-00-4018](#): Sensors arrangement

The whip hoist system is provided with a highest position switch, see [Figure 2-35](#). This is used to prevent the block from hitting the fly jib when hoisting. The mechanism contains a blade spring, a proximity switch and a steel frame. The spring is held on a narrow distance from the proximity switch by use of the weight of a hanging steel frame, which is suspended with cables. When hoisting the whip hoist block, the weight is pushed upwards, which cause a loss of tension in the cables. This results in an increased distance between the spring blade and the proximity switch. The proximity switch detects no blade anymore so that the contact is broken and the winch is switched off by the control system.

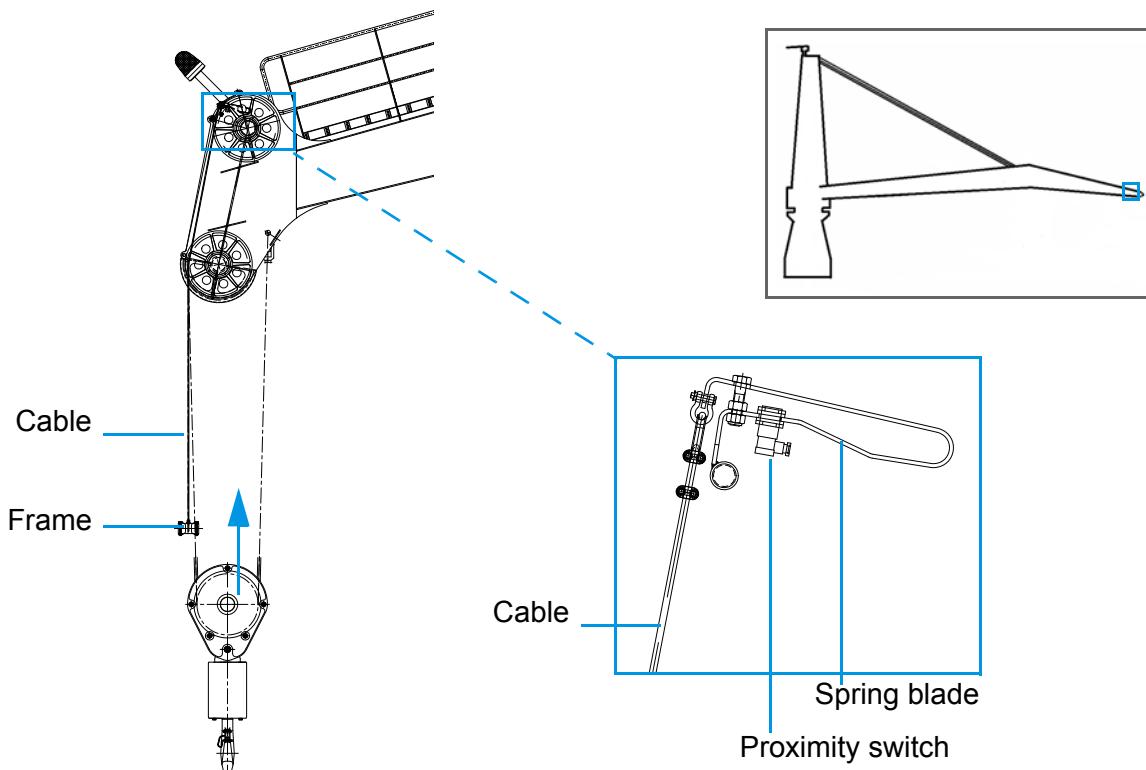


Figure 2-35: Whip hoist highest position switch

2.15.7 LENGTH MEASURING SENSOR, WHIP HOIST

Reference drawing:

- [A11-41800-14-0208](#): Found cabin / Whip h. sheave

The whip hoist system is provided with a length measuring sensor. This is used to measure the length of the hoisted wire. It is located on top of the control cabin, see also [Figure 2-33](#). For more information, see also [Section 2.18.2: "Length measuring sensor"](#).

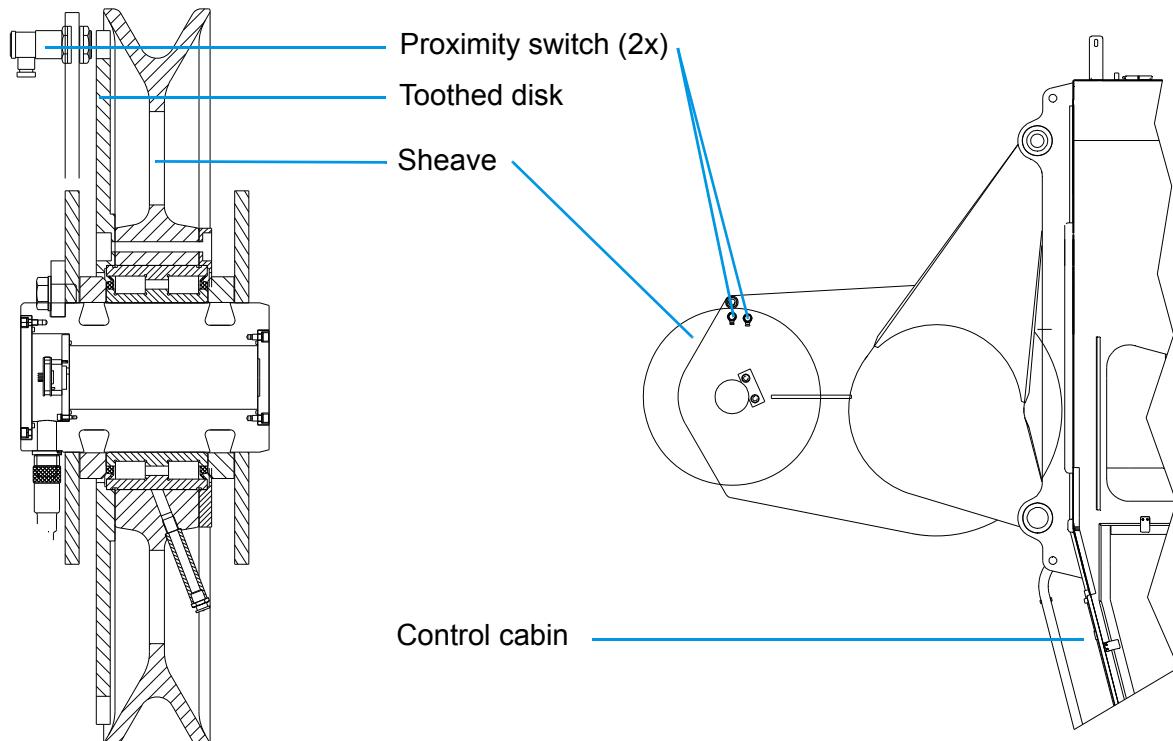


Figure 2-36: Length measurement proximity switch, whip hoist

2.15.8 GEARED CAM LIMIT SWITCH

Reference drawing:

- [A11-41800-00-4018](#): Sensors arrangement

The whip hoist system is provided with a geared cam limit switch. This is used to count the number of revolutions of the winch drum and to determine the spooled length of the hoist wire. It is located on the whip hoist winch, see also [Figure 2-32](#). For more information, see also [Section 2.18.3: "Geared cam limit switch"](#).

2.15.9 SLACK ROPE SWITCH

Reference drawings:

- [A11-41800-44-0108](#): Slack rope switches
- [A11-41800-00-4018](#): Sensors arrangement

The whip hoist winch is provided with a slack rope switch mechanism. This is used to stop the drum in case of a wire slack. It is located underneath the drum, see also [Figure 2-32](#). For more information, see [Section 2.18.5: "Slack rope switch"](#).

2.15.10 LOAD MEASURING PIN

Reference drawing:

- [A11-41800-46-0208](#): Load Measuring Pin

The whip hoist system is provided with a load measuring pin. This is used to measure the load acting on the hoist. It is located in one of the sheaves in the reeving, see also [Figure 2-33](#). For more information, see [Section 2.18.6: "Load measuring pin"](#).

2.15.11 ENCODERS

Reference drawing:

- [A11-41800-00-4018](#): Sensors arrangement

The whip hoist system is provided with two E-motor encoders and one DISPS encoder. The E-motor encoders are provided on the two drive motors, see [Figure 2-32](#). These are integrated to measure the motor speed.

2.16 TUGGERS

Load tuggers serve to stabilize the load and reduce offlead. These can be attached to the hook or to strong points on the load. The 400 mt OMC is equipped with two load tuggers. [Figure 2-37](#) shows where the tuggers are located. The load tuggers contain the following elements:

- Hoist winch
- Wire
- Reeving
- Sensors and switches

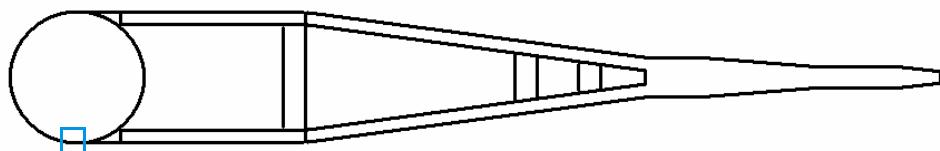


Figure 2-37: Location load tuggers

2.16.1 WINCH

Reference drawing:

- [A11-41800-21-0408](#): Winch Drum
- [A11-41800-14-0308](#): Tugger Frame
- [A11-41800-21-0508](#): Winch Covers

The drive system of each load tugger contains one E-motor on the side of the drum, see [Figure 2-38](#). More information about the drive systems is shown in [Table 2-11](#). The drives of the winches are provided with a fail-safe brake positioned on the motor shaft. In case of an electrical power fail, the brake is mechanically actuated. The load tugger winches can operate in either speed mode or in constant tension (CT) mode. CT mode enables the crane operator to control a load automatically, with a constant line pull. The load tugger winches are each with a SWL of 10 mt and a maximum constant tension load of 2-8 mt.

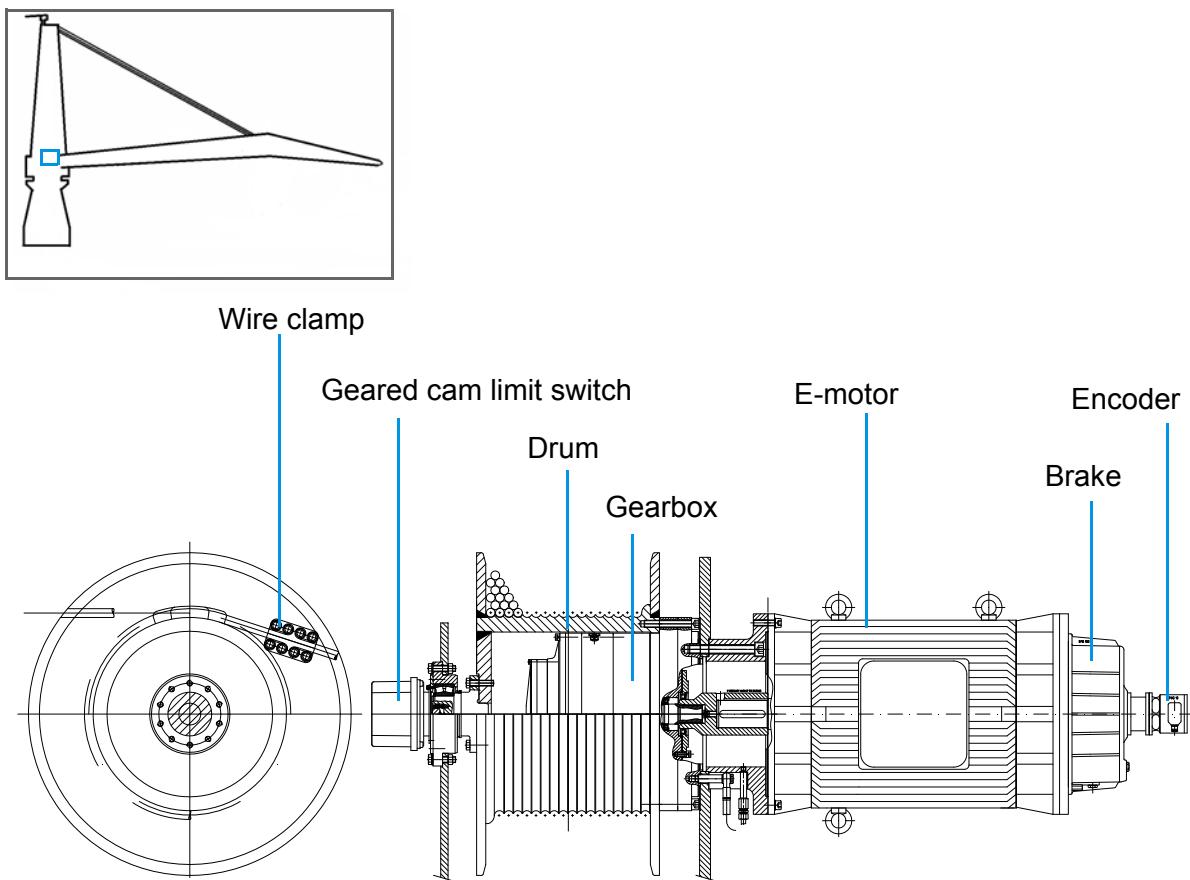


Figure 2-38: winch

Drive system component	Specifications		
E-motor	Supplier	Woelfer	[-]
	Type	MDRKO 280M-4bb	[-]
	Quantity / winch	1	[-]
	Power	100	[kW]
Gearbox	Supplier	Siebenhaar	[-]
	Type	4066 WH	[-]
	Quantity / winch	1	[-]
Brake	Supplier	Pintsch Bamag	[-]
	Type	SFB 100/130	[-]
	Quantity / winch	1	[-]
Drum	Groove type	Lebus	[-]
	Wire storage (gross)	130	[m]
	No. of layers	4	[-]
	No. of safety windings	3	[-]
	Pitch	24.96	[mm]

Table 2-11: Load drive system specifications

2.16.2 WIRE

The wire is clamped to the load tucker drum with a safety clamp, see [Figure 2-38](#). The other end of the wire is fitted on a open wedge spelter socket. The bolts of the clamp must be tightened with a torque of 216 Nm (90%). More information about the wire is shown in [Table 2-12](#).

Load hoist wire	Specifications		
Wire	Supplier	Redaelli	[-]
	Type	Right handed Langs Lay non spinning	[-]
	Diameter	24	[mm]

Table 2-12: Load tucker wire specifications

2.16.3 TUGGERS REEVING

Reference drawing:

- [A11-41800-31-0108](#): Reeving diagram
- [A11-41800-34-0408](#): Tucker weights
- [A11-41800-32-0908](#): Sheaves for rope leading - arrangement
- [A11-41800-15-0608](#): Tucker guide sheaves for reeving

The load tuggers are reeved in single fall. [Figure 2-39](#) shows a schematic overview of the reeving. One of the tucker wires can be reeved to the dead-end connection of the main hoist on the fly jib to assist in reeving operations.

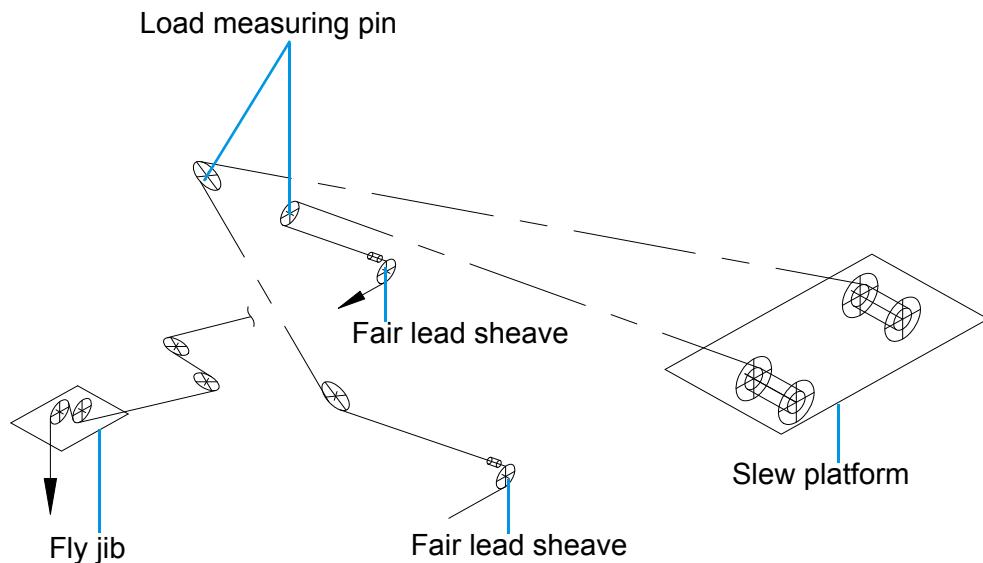


Figure 2-39: Load tuggers reeving

2.16.3.1 Sheaves

Reference drawing:

- [A11-41800-32-0808](#): Sheave for wire Ø24 - P.C.D. 424

The load tugger system contains sheaves leading the wire rope from the slewing platform to the jib. The sheaves are fitted with roller bearings. One of the sheaves contains a load measuring pin. The location is shown in [Figure 2-39](#).

2.16.3.2 Fairlead

Reference drawing:

- [A11-41800-33-0808](#): Fairlead
- [A11-41800-15-0208](#): Foundation fairlead and sheaves
- [A11-41800-32-0708](#): Tugger sheave fairlead

To guide the wire rope from the jib to the load, fairleads are provided for both tuggers. These are mounted at the lower side of the jib.

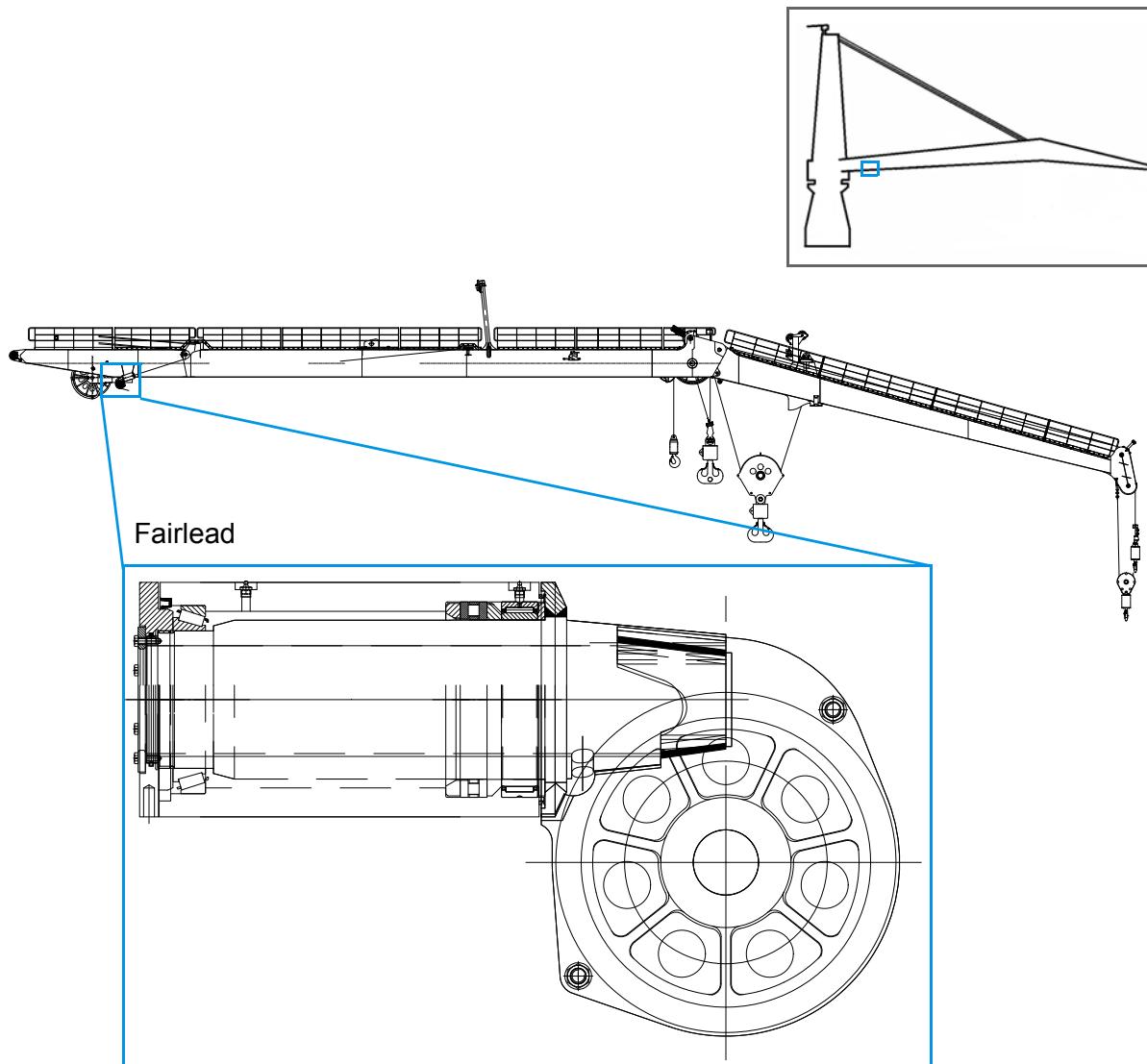


Figure 2-40: Fairlead

2.16.4 GEARED CAM LIMIT SWITCH

Reference drawing:

- [A11-41800-00-4018](#): Sensors arrangement

All load tuggers are provided with a geared cam limit switch. This is used to count the number of revolutions of the winch drum and to determine the spooled length of the wire. It is located on the winch, see also [Figure 2-38](#). For more information, see also [Section 2.18.3: "Geared cam limit switch"](#).

2.16.5 LOAD MEASURING PIN

Reference drawing:

- [A11-41800-46-0308](#): Load Measuring Pin

All load tuggers are provided with a load measuring pin. This is used to measure the load acting on the hoist. It is located in one of the sheaves in the reeving, see also [Figure 2-39](#). For more information, see [Section 2.18.6: "Load measuring pin"](#).

2.16.6 ENCODERS

Reference drawing:

- [A11-41800-00-4018](#): Sensors arrangement

The load tugger systems are provided with two E-motor encoders. The E-motor encoders are provided on each of the drive motors, see [Figure 2-38](#). These are integrated to measure the motor speed.

2.17 OUTFITTING

This section describes the outfitting characteristics of the 400 mt OMC.

2.17.1 STAIRS & PLATFORMS

The accessible areas can be divided into the following sections:

- Accessible areas boom
- Accessible areas outside mast
- Accessible areas inside mast

For easy and safe access, the crane is provided with stairs and platforms. A single door in the box section at port side provides access to the inside of the crane. The traction winch is located here. From here, another door provides access to the E-room. From the E-room stairs lead to the winch room and the mast upper part. In the mast upper part a hatch leads to the mast head and the circular platform around the masthead.

The slew platform is safely accessible by stairs and platforms on the outside of the crane. A circular platform is installed on the slew platform on the outer side of the mast. From here the cabin can be accessed. From the cabin the slew platform, and from the slew platform the jib can be accessed.

2.17.1.1 Accessible areas jib

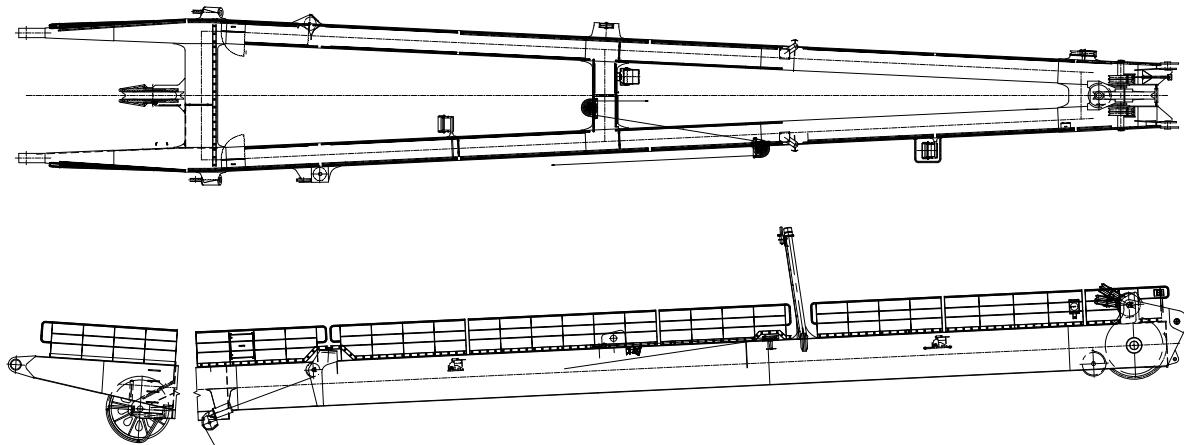


Figure 2-41: Accessible areas jib

2.17.1.2 Accessible areas outside mast head

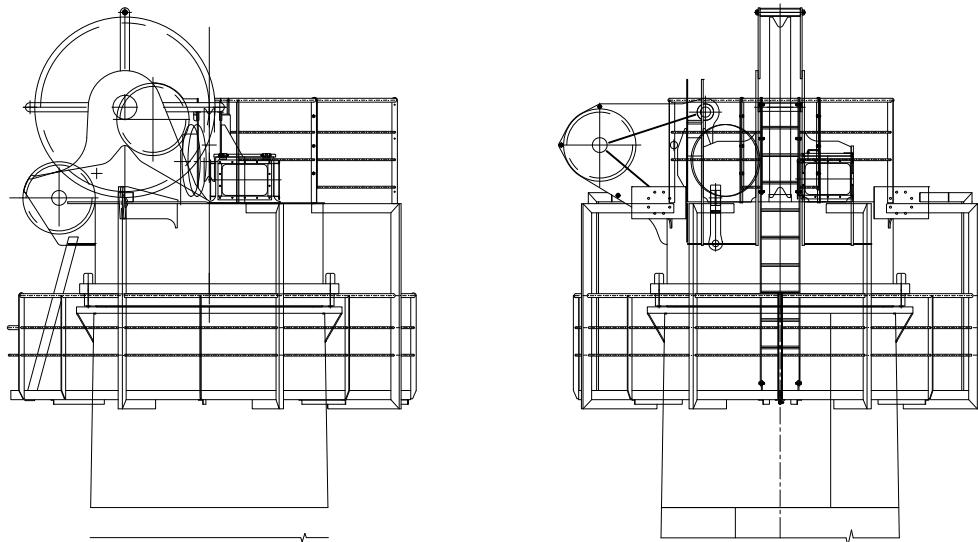


Figure 2-42: Accessible areas outside mast head

2.17.1.3 Accessible areas outside slew platform

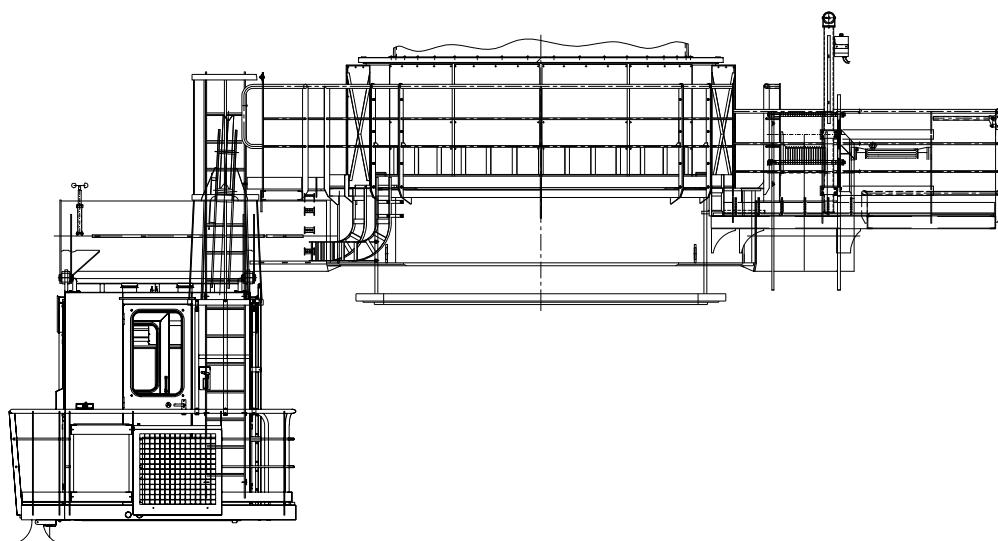


Figure 2-43: Accessible areas outside slew platform

2.17.1.4 Accessible areas inside mast

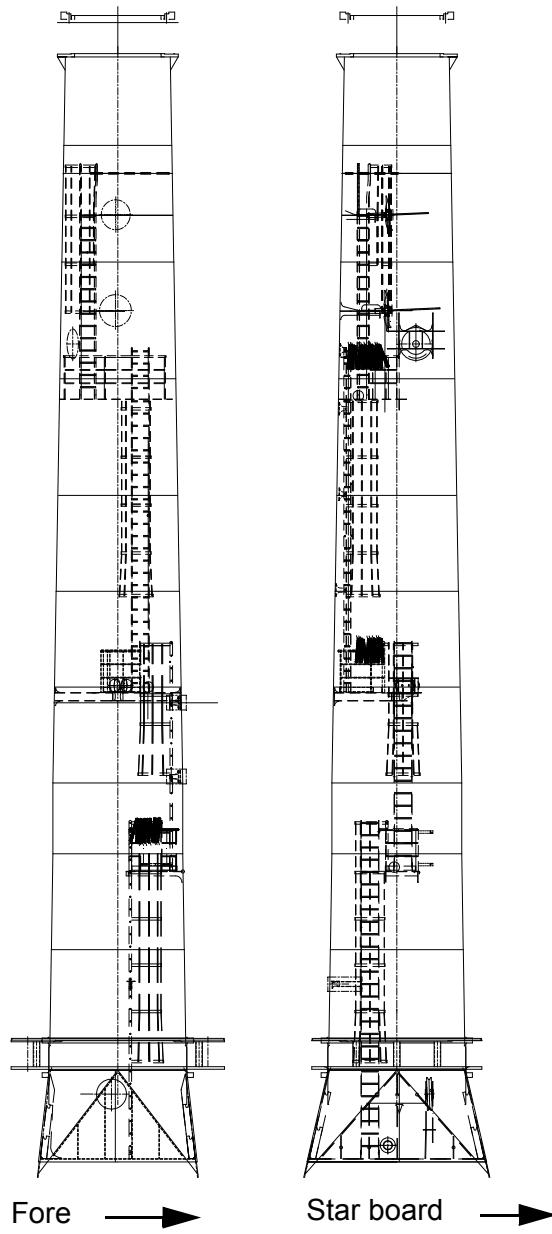


Figure 2-44: Accessible areas inside mast

2.17.2 LIGHTING

Reference drawing:

- [A11-41800-54-0408](#): Mast head warning lamps
- [A11-41800-54-0508](#): Lamp foundation on jib
- [A11-41800-54-0608](#): Lamp foundation for fly jib

The crane is provided with multiple lighting at different locations. [Table 2-13](#) gives an overview

of all lights on the 400 mt OMC.

Light type	Power [W]	Amount	Location
Floodlight	400	4	Mastbase
Floodlight	400	3	Jib
Floodlight	400	1	Fly jib
Aircraft warning light	11	4	Masthead
Aircraft warning light	11	1	Jib head
Fluorescent lighting	18	-	Along all access routes
Cabinet lighting	-	-	Cabinet

Table 2-13: Lighting on the 400 mt OMC

2.17.2.1 Emergency lighting

The machinery room, the operator's cabin and all access ways have battery powered emergency lighting units.

2.18 MECHANICALLY ACTUATED SENSORS

Reference drawing:

- [A11-41800-00-4018](#): Sensors arrangement - Crane
- [A11-41800-00-4028](#): Sensors arrangement - Under deck equipment

This section describes the mechanically actuated sensors which are implemented in the 400 mt OMC. Additional information considering sensors can be found in [Chapter 5: "Electrical description"](#).

NOTE *The shown figures serve to clarify the working principle. The figures are not captured from this particular crane.*

2.18.1 PROXIMITY SWITCH

Proximity switches are found in multiple systems of the crane. These are able to detect the presence of objects without physical contact of the detected component. The sensor is positioned (i.e. by use of a supportive component) close to a moving steel object. The transition from 'detecting steel' to 'lose steel detection' will influence the control system and results in mechanical consequences. These sensors are often used in mechanical constructions and can be used for multiple purposes.

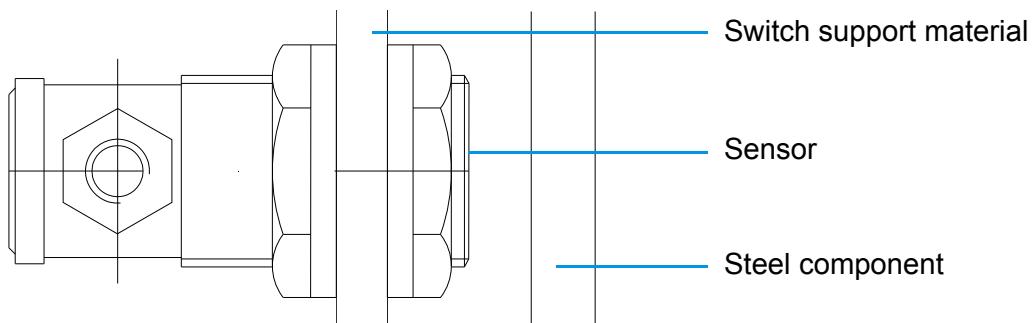


Figure 2-45: Proximity switch

2.18.2 LENGTH MEASURING SENSOR

The main hoist system and the whip hoist system are provided with a length measuring sensor. This is used to measure the length of the hoisted wire. The paid out length of the hoist wire is measured by means of a toothed disc in combination with 2 proximity switches. The proximity switch detects each rotation of the sheave by use of counting the passed tooth of the disk. The input can be used to record the payed length of the hoist.

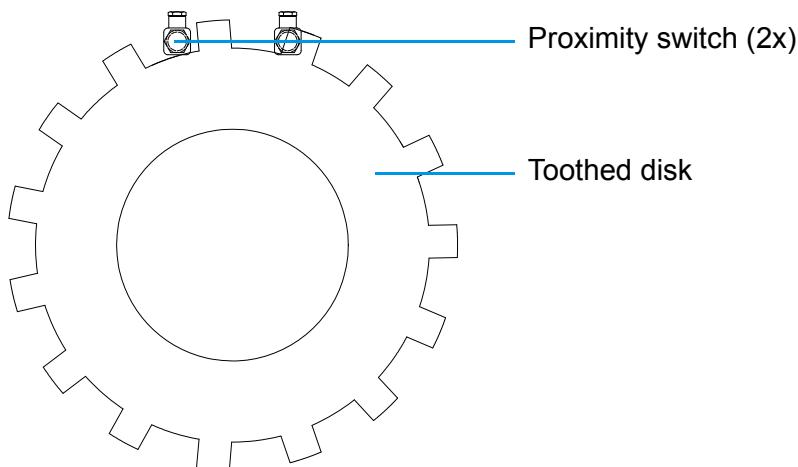


Figure 2-46: Length measurement proximity switch

2.18.3 GEARED CAM LIMIT SWITCH

The following systems are provided with a geared cam limit switch:

- Main hoist storage winch
- Whip hoist winch
- Boom hoist winch
- Tugger winches (2x)
- Lower slew system

Geared limit switches are used to count the number of rotations of a winch drum to determine the spooled length of the hoist wire. The internal mechanism inside the switch tracks the number of rotations of the drum. The switch is adjusted such that the winch is stopped at a number of predefined positions (i.e. 'empty drum' position, only the safety windings are left on the drum). Geared cam limit switches can be placed on the outgoing shaft (axis) of the drum. These are provided with a cam disc that is actuated by the rotation of the shaft, see [Figure 2-48](#). A geared cam limit switch can also be positioned parallel to the shaft, which connects the

winch with a gearing system, see [Figure 2-47](#). In this case, a gear ring, which is bolted to the winch, connects the geared cam limit switch with a pinion. The rotations of the pinion is converted to the amount of rotations of the winch. See supplier documentation for detailed information of the switch.

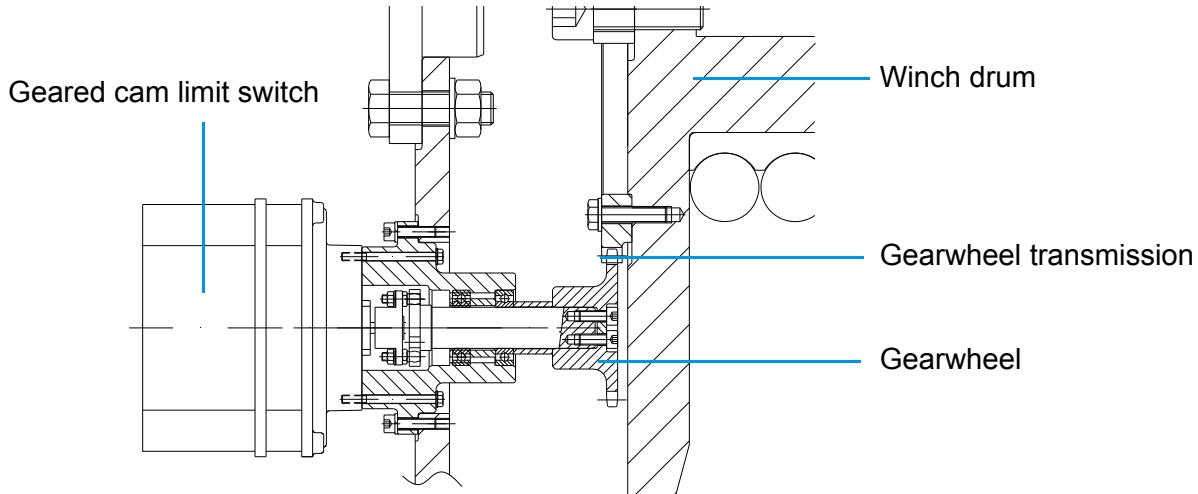


Figure 2-47: Geared cam limit switch with gear wheel

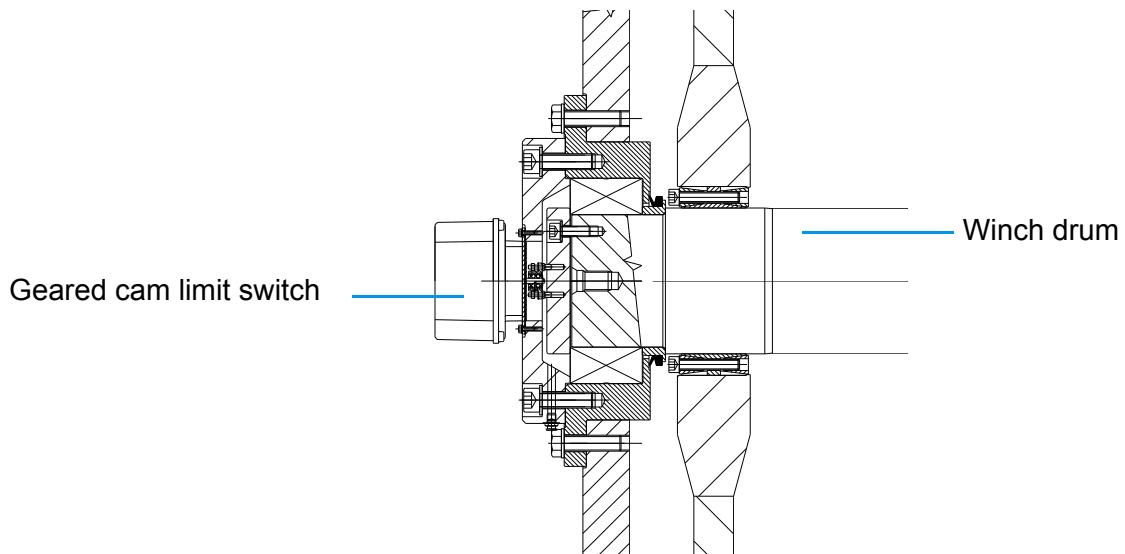


Figure 2-48: Geared cam limit switch on shaft

A geared limit switch is also used to determine the slewing end positions. For this purpose a geared limit switch is mounted on one of the pinions that engage in the geared ring of the slew bearing, see [Figure 2-49](#). A certain number of rotations of the pinion corresponds with a certain rotational displacement of the crane.

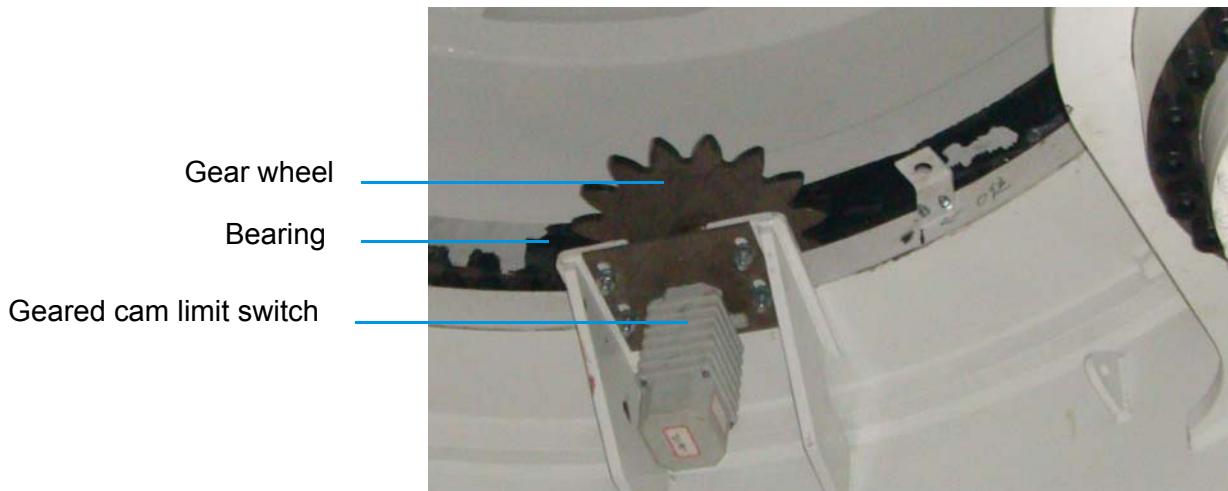


Figure 2-49: Geared cam limit switch on slewing systems

2.18.4 ENCODER

The following systems are provided with an encoder:

- Main hoist storage winch
- Whip hoist winch
- Boom hoist winch
- Tugger winches (2x)

Encoders are positioned at the backside of the motors. These are used to determine positions of slewing and hoisting systems.

2.18.5 SLACK ROPE SWITCH

The following systems are provided with a slack rope switch:

- Main hoist system
- Whip hoist winch
- Boom hoist winch

The slack rope switch consists of a bar which is mounted underneath the drum of a winch. In case of a slack rope, the rope falls down (gravity forces) and makes contact with the bar. The rope weight moves the bar downwards which moves the frame away from a proximity switch, see [Figure 2-50](#). Since the frame is not detected anymore, the control system deactivates the winch automatically.

2.18.5.1 Reset the slack rope switch

The slack rope bar must be reset manually in order to enable a working position again. This can be done by pulling the proximity switch bar away from the detection counter weight. The counter weight will fall back into its original position.

NOTE *When a slack rope situation occurs, first check the rope leading, sheaves and other items that could have caused the slack, and do not reset until the cause of the slack has been removed*

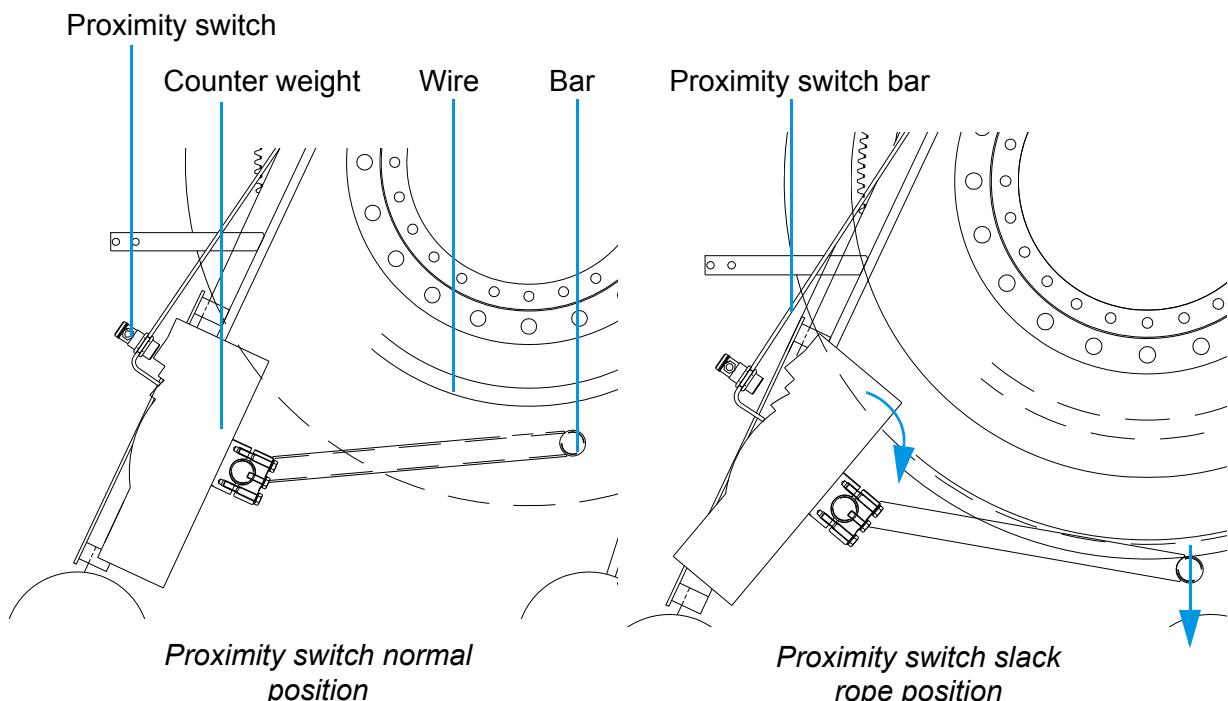


Figure 2-50: Slack rope system (typical)

NOTE *When a slack rope situation occurs, first check the rope leading, sheaves and other items that could have caused the slack, and do not reset until the cause of the slack has been removed*

2.18.6 LOAD MEASURING PIN

The following systems are provided with a load measuring pin:

- Main hoist system
- Whip hoist system
- Tuggers system

Load measuring pins (LMP's) are integrated in sheave shafts and serve to measure the load acting on the hoist. The positions of the LMP's are indicated in the reeving diagrams. LMP's sense the force perpendicular on the pin axis, see [Figure 2-51](#). Inside the pins, strain gauges are able to measure the shear. This value is amplified and calculated to a weight value (tons) by

the control system. If the SWL for the given conditions is exceeded, the overload protection system will be activated and the movement will be stopped. For a detailed description of the load measuring pins, see LMP manual in [Appendix C: "Load cell documentation"](#). Further details are also given in <refer to electrical description and in the electrical diagrams>.

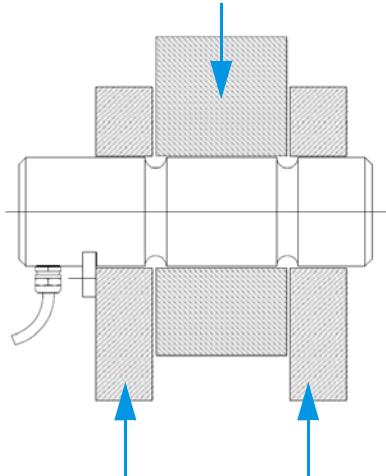


Figure 2-51: Load measuring pin (typical)

3 HEAVE COMPENSATOR

3.1 INTRODUCTION

This chapter describes the mechanical and hydraulic properties of the main hoist heave compensator. The chapter describes the following aspects:

- Heave compensation system
- Hydraulic power unit (HPU)
- Passive heave compensation (PHC)
- Active heave compensation (AHC)
- Pressure vessel unit (PVU)
- Pressure intensifier unit (PIU)

The chapter describes the different subsystems in the following sections:

- System description: this section describes the function of the system
- Hydraulic description: this section describes the hydraulic aspects of the concerned subsystem this section

The operational description can be found in [Chapter 6: "Operation"](#).

Each section gives an overview of accessory reference drawings and can be found in Appendix C: "Heave compensator documentation". Further information about components supplied by third parties can be found in the supplier documentation.

3.2 HEAVE COMPENSATION SYSTEM

3.2.1 HEAVE COMPENSATION SYSTEM DESCRIPTION

Reference drawings:

- [A11-41800-80-0008](#): OMC Single Line Hydraulic Diagram
- [A11-41810-10-0018](#): Heave compensator - general arrangement
- [A11-41810-80-0208](#): Heave compensator - hydraulic diagram
- [A11-41810-80-0308](#): Pressure vessel unit - hydraulic diagram

The OMC is used to lower loads to the seabed. The position of the ship in relation to the seabed will change, because of the heave and roll motions of the vessel. As a result the load will move in vertical direction in relation to the seabed. The heave compensator serves to reduce the vertical movements of the load.

The heave compensation system consists of three main subsystems:

- A passive part: the passive heave compensator (PHC), see [Section 3.2.2.1: "Passive manifold"](#).
- An active part: the active heave compensator (AHC), see [Section 3.2.2.2: "Active manifold"](#).
- The pressure vessel unit (PVU), see [Section 3.4: "Pressure vessel units"](#).

The passive system consists of a gas loaded spring system connected to the hoist wire. The spring system extends or retracts depending on the tension in the hoist wire. The passive system in this case comprises a main cylinder connected through a medium separator to a battery of pressure vessels charged with nitrogen pressure. By varying the pressure of the gas, the system can be adjusted to different static loads. Due to the stiffness of the gas system the tension in the hoist wire changes if the passive cylinder extends or retracts.

The passive system will start to move up and down under influence of the initiated drag and acceleration forces from the load, caused by the vertical movement of the load due to vessel heave and roll movements. As these forces always have a phase lag in relation to the position of the load itself and as these forces are dependent on the weight and size of the load, the passive system cannot compensate for all ship's motions.

The active system adds two so called active cylinders to the system. These cylinders are mechanically connected to the main cylinder and are controlled by the active manifold that receives its control signal from the automatic control system. The active cylinders assist the main cylinder to extend or retract. The major part of the load on the system (the static component) is supported by the passive main cylinder. The active cylinders only have to overcome the load that is caused by the varying pressure of the nitrogen pressure, the friction forces and the eventual unbalance in forces from the average nitrogen pressure compared with the average load.

The average nitrogen pressure in the pressure vessels has to be in balance with the average load of the system. The better this is achieved the lesser the active cylinders have to compensate.

For a schematic overview of the heave compensation system, see [Figure 3-1](#). For an overview of the heave compensator components, see [Figure 3-2](#).

The indicated subsystems and components will be mentioned through the different sections and these figures will be used as references.

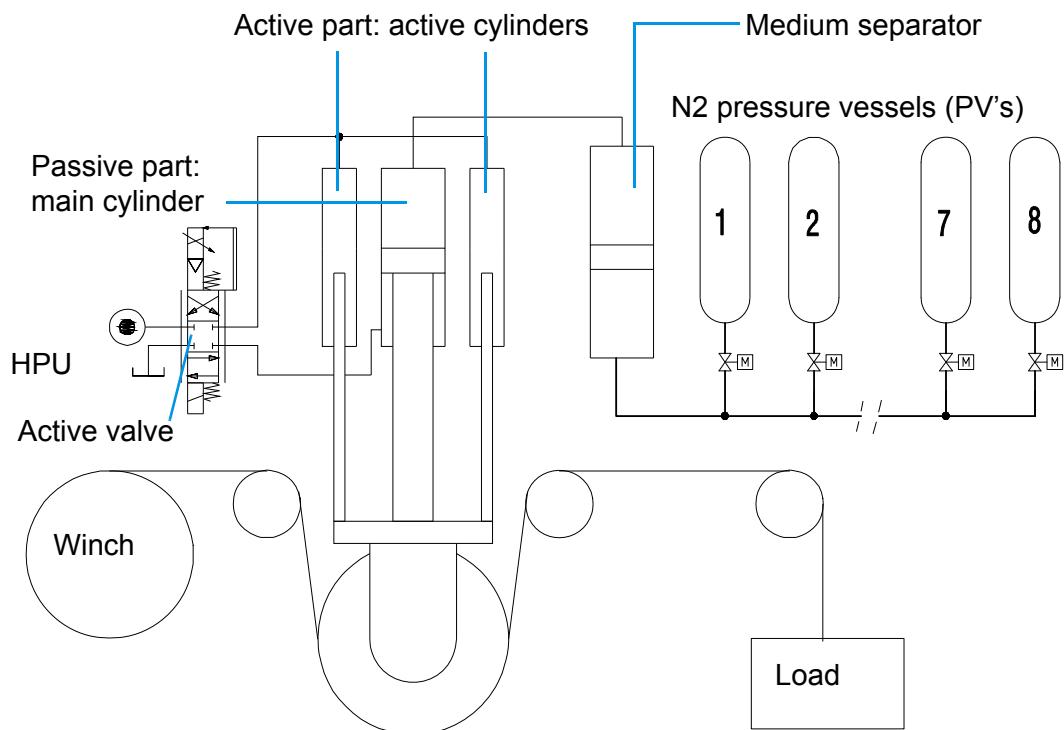


Figure 3-1: Heave compensation system, schematic overview

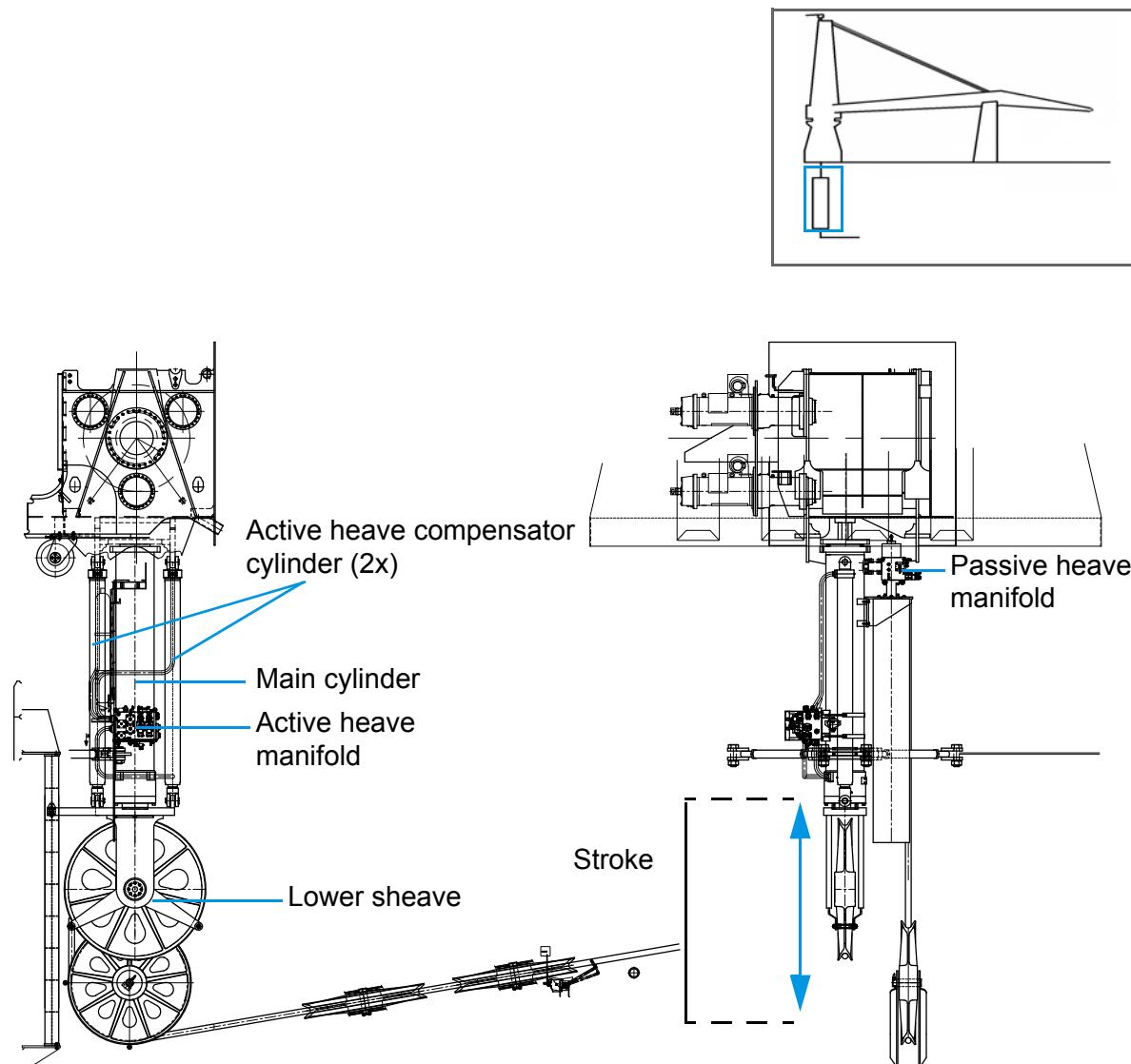


Figure 3-2: Overview of the heave compensator

3.2.2 HEAVE COMPENSATOR HYDRAULIC DESCRIPTION

The heave compensator consists of one passive main cylinder (A150) and two active auxiliary cylinders (A160) at both sides of the main cylinder. The bottom compartment of the main cylinder can be connected to the PVU with the passive manifold (M100). Normally the pushing force of the passive cylinder takes the static load on the system.

The force required for the compensation movement is added to the system by the pushing force of the active cylinders and the pulling force of the main cylinder. The active cylinders are single acting cylinders; therefore they only add a pushing force to the system. Both active cylinders and the rod compartment of the passive cylinders are connected to the active manifold (M070).

The position of the lower sheave is measured with two length sensors, (951B71, 951B72) the speed of the lower sheave is determined by the PLC from the position sensor signal.

The hydraulic system and the nitrogen system of the heave compensator are connected in the medium separator (Z170). The medium separator is a large piston accumulator, the oil side is connected to the passive manifold (M100) and the gas side is connected to the PVU. The position of the piston is measured with a position sensor (952B71) which is mounted in the gas compartment of the medium separator.

Normally the heave compensator cylinders are retracted in order to protect the rod surfaces.

3.2.2.1 Passive manifold

The passive manifold (M100) is mounted between the passive main cylinder (A150) and the medium separator (Z170). The functions of the passive manifold are:

- pressure relief of bottom compartment passive main cylinder
- pressure measurement passive main cylinder and medium separator
- manual equalize and cylinder manual release
- connect/disconnect the medium separator to the passive cylinder (main valve)
- set up of the position of the main passive cylinder (fill/ empty valve main cylinder)
- set up of the piston position of the medium separator (fill/empty valve separator)

It is possible to manually empty the passive main cylinder with a needle valve (V101A) and to manually equalize the pressure between the bottom compartment of the main cylinder and the medium separator also with a needle valve (V101B). Normally these valves are closed.

The pressure in the bottom compartment of the main cylinder is limited with a cartridge pressure relief valve (V115 - V117) and a smaller fast-reacting pressure relief valve (V118) to reduce pressure peaks. The pressure in the passive main cylinder and the medium separator is measured with two pressure sensors (S084E, F). The pressure difference across the main valve can be determined from these two sensors.

Main valve

The bottom side of the main cylinder is connected to the medium separator with the main valve which is one large cartridge valve (V120). The position of the valve is monitored with a position switch. The switch detects the open and not open position of the valve. The main valve is operated with a pilot valve assembly (M122). This manifold with four 2/2 poppet valves (V181, V182, V183, V184) operated with one poppet 3/2 directional valve (V121). The four 2/2 poppet valves operate together as a valve with 4/2 function. When valve V121 is not actuated the main valve is kept closed. Valve 182 is kept switched by oilpressure from P. When valve V121 is activated, the main valve is closed. As the main valve is operated, the valve will remain its position during an emergency stop or a power failure. This is ensured in the electrical system. The pilot oil is taken from the P-line, the medium separator or the bottom part of the passive main cylinder. Interconnecting of the pilot lines is prevented with check valves (V125).

Safety conditions main valve

The main valves (V120) are opened and closed by the operator when the passive heave system is switched on or off. It is only allowed to switch on the passive heave system when the safety conditions are fulfilled. The main valve is only closed on:

- Passive heave emergency stop
- Cylinder speed higher than allowed
- Operator switches off passive heave

The passive heave can be switch off directly at any moment by the operator.

CAUTION



It is not recommended to switch off the passive heave system on full speed!

Cylinder and Separator Fill / Empty Valves

It is important that the positions of the main cylinder and the piston of the medium separator are adjusted before the passive heave system is switched on. To ensure the cylinder, as well as the separator, can make a large stroke, the relative position of the medium separator and the cylinder should be correct before activating the PHC. This can be done by means of both fill/empty valves when the main valve is closed.

When, during PHC or AHC operation, the relative position between the separator and the cylinder changes, oil needs to be added or drained from the system. This has to be done manually.

The cylinder and separator fill/empty valves are two pilot operated valves (V130, V140). The switching time of the valves is adjustable with throttle/check valves (V135, V145) between the pilot and main stage. With the cylinder fill/empty valve (V130) the bottom side of the main cylinder can be filled and drained, in this way changing the position of the cylinder (when the main valve is closed) is possible. With the separator fill/empty valve (V140) the oil side of the separator can be filled or drained, changing the position of the piston in the separator (when the main valve is closed).

The fill/empty flow can be adjusted with pressure compensated throttle/check valves (V132, V133, V142 and V143). Leak free closure of the cylinder and separator is provided by two pilot operated check valves (V131, V141).

It is not allowed to use the medium separator to compress gas in the pressure vessels of the PVU. Using the medium separator as a pressure intensifier can cause too high temperature inside the medium separator.

Active retract

It is possible that without load on the cylinder, the cylinder will not retract on a cylinder empty command. In that case the 'active retract' function is used.

3.2.2.2 Active manifold

The active heave system is controlled by the valves on the active manifold (M070).

The active part of the heave compensation system consists of:

- Two active heave compensator cylinders
- Several pressure measurements
- Several free wheel valves
- A, B line valve
- Length measurements
- Two servo valves with a large flow capacity

The functions provided by the active manifold are:

- supply boost pressure to the heave compensator cylinders when the system is in idle or in passive heave mode
- interconnect A and B connections with freewheel valves
- control of cylinder position with servo valves
- disconnect servo valves from the A en B connections with A and B line valves
- pressure relief on A and B connections
- pressure measurements

The bottom side of the two active cylinders are connected to the A-connections of the active manifold and the rod side of the main cylinder is connected to the B-connections of the manifold. Because the rod area of both auxiliary cylinders equals approximately the annular area of the main cylinder, the system is symmetric

Free wheel valves

The free wheel valve (V075, V076, V077 and V085) is a large cartridge valve which provides a free flow between A and B during passive or idle mode. The slow free wheel valve (V079) is a much smaller valve that also connects the A-port and the B-port and is used to provide a smooth transfer between the passive and active mode. The free-wheel valves are normally opened.

The flow through the slow free-wheel valve can be adjusted with an adjustable throttle valve (V078). The free wheel valve (V075) is controlled with a pilot valve (V077). Pilot oil is taken from the A-line, the B-line or directly from the P-port via a check valve (V086).

Boost valves

The boost pressure is provided from the P-port of the active manifold. The boost pressure is reduced by a pilot operated 2-way reducing valve (V094). The pressure is reduced to half the system pressure, because it is the theoretical pressure in the cylinders when the servo valves are at zero set point. Leakage from the cylinders to the P-port when the HPU is not running is prevented by a check valve (V095). The boost pressure is connected to the A and B port of the manifold with two normally opened 2/2 way seated directional valves (V096A, B). A 50ltr bladder accumulator (Z052) is connected to the boost system to compensate the small area difference between the cylinders and to keep the boost system pressurized when the HPU is not running. The boost pressure is monitored with a pressure sensor (954B42). It is possible to release the boost pressure for maintenance with a ball valve (V081), this valve is normally closed.

A-line and B-line valves

The A-line and B-line valves (V071) are used to disconnect the servo valves from the cylinders. The valves are cartridge valves with a separate pilot valve. The closed position of the valves is indicated with a switch (954B72, 954B71). The A-line and B-line valves are both operated with one seated 3/2 directional control valve (954Y64). The A-line and B-line valves are opened by activating the directional control valve. The pilot oil is taken from either the boost pressure via a check valve (V097A) or directly from the P-port of the manifold via a check valve (V097B). The opening and closing speed of the A-line and B-line valves is adjusted with throttle/check valves (V072 and V074).

Servo valves

The servo valves (V093) control the flow to the cylinders. On the manifold there are two parallel acting servo valves. The servo valves are pilot operated servo-proportional valves with a high accuracy. The pilot oil is supplied from the P-port of the manifolds. The pilot oil is filtered by a small pressure filter (F092) to protect the servo valves pilot circuit. The filter has a bypass valve with an electrical contamination indicator. In order to achieve a constant pilot pressure a diaphragm accumulator (Z050) is connected to the pilot circuit. The pilot pressure is measured with a pressure sensor (954B41) (feed line pressure).

Pressure relief valves

The pressure in the heave cylinders is limited with two pressure relief valves (V080). The A-line pressure relief valve is connected to the B-line with cartridge check valve (V090B) and the B-line relief valve is connected to the A-line also via a cartridge check valve (V090A). The relief valves are cross connected via the T-connection of the manifold. A cartridge check valve (V098) in the T connections with a higher opening pressure than the check valves in the A and B (V090) line prevent a too low pressure in the opposite connection when a pressure relief valve is opened.

3.2.2.3 Retract manifold

The retract manifold (M200) is mounted directly on the active manifold and is used to keep the heave compensator cylinders retracted when the heave compensator is not used. A cartridge valve (V201) is used to prevent that oil flows out of the rod side of the main cylinder. The valve opens when the pressure difference between the B and A connections of the manifold exceeds 20 bar, which is sufficient to compensate the weight of the cylinder. This pressure difference is adjusted by a direct operated relief valve (V204). The cartridge valve (V201) allows flow into the rod side of the cylinder which is required for the active retract function.

When the passive heave mode is used, the cartridge valve (V201) is fully opened to ensure a low pressure drop between the A and B connections of the retract manifold. A high pressure drop would decrease the performance of the passive heave system. The cartridge valve is opened by switching a hydraulic operated 3/2 poppet valve (V203), switching of this valve (V203) connects the C port of the cartridge valve (V201) to the drain connection Y. In this way the cartridge valve is always fully open when the pressure on the A and B connections exceeds the spring pressure of the cartridge valve which is the case when passive or active heave is used. The 3/2 poppet is hydraulically actuated together with the main valve on the passive manifold.

3.3 HYDRAULIC POWER UNIT

Reference drawing:

■ [A11-41810-80-0108](#): Hydraulic Power Unit - Hydraulic diagram

This section describes the hydraulic power unit system in terms of systematic, and hydraulic aspects. Operational aspects are described in [Chapter 6: "Operation"](#).

3.3.1 SYSTEM DESCRIPTION

The HPU is located in the ships hold and is dedicated for the heave compensator system. The heave compensator itself consists of the following parts:

- Heave Compensator
- Pressure Vessel Unit & Pressure Intensifier Unit

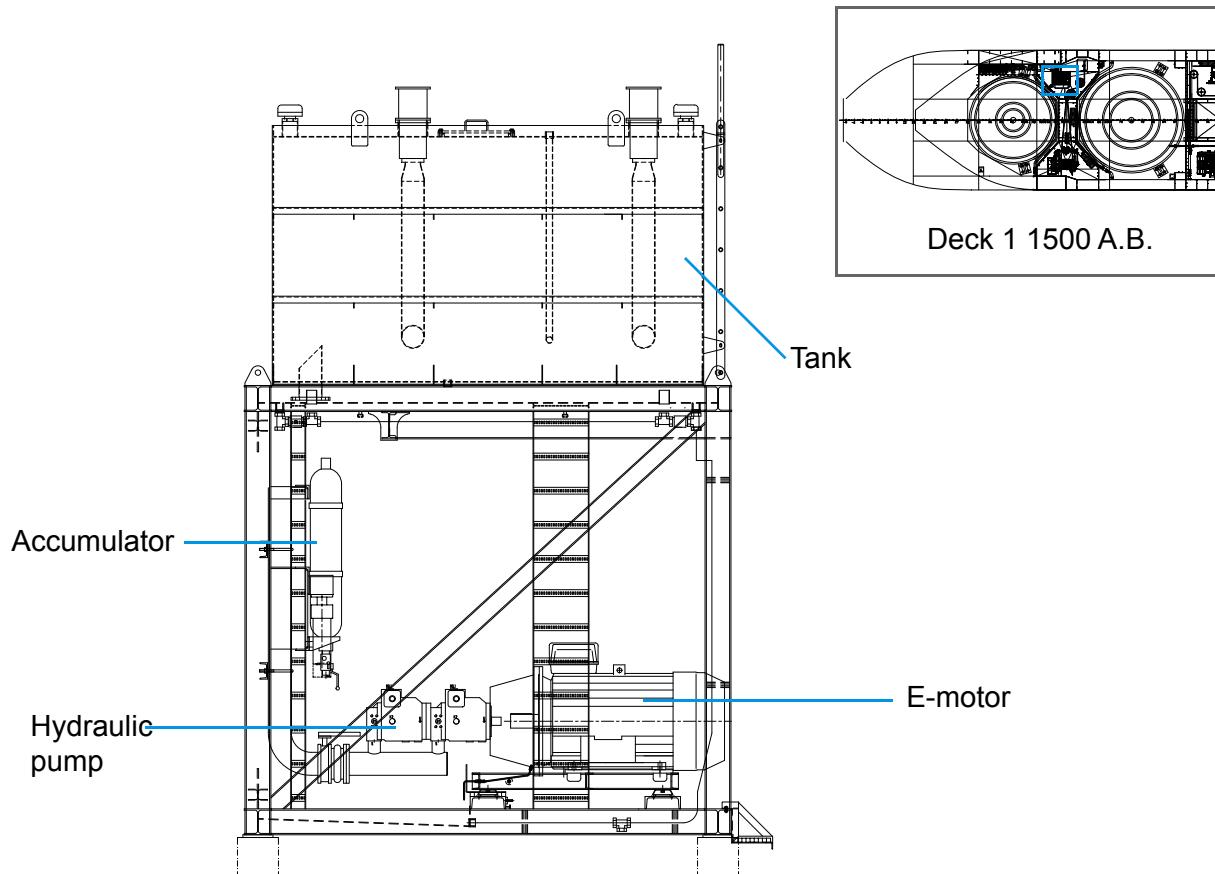


Figure 3-3: Hydraulic power unit

3.3.2 HYDRAULIC DESCRIPTION

The main parts of the HPU are:

- Hydraulic reservoirs with appendages
- Cooling and filtration system

- High pressure system

3.3.2.1 Hydraulic reservoir

There is one hydraulic reservoirs (Z301) which contains 6500 liters of hydraulic oil. The reservoir is practically divided in a so-called 'dirty' and 'clean' compartment.

The drain lines and the return lines enter in the "dirty", compartment. The suction lines of the circulation pumps (P201) are connected to the "dirty" compartment while the pressure side is connected to the "clean" compartment. In this way clean and cooled oil is supplied to the 'clean' compartment from where the main pumps (P104A, P104B) are supplied.

The suction lines of the off-line filtration pumps (F401) are connected to the "dirty" compartment while the pressure side is connected to the "clean" compartment.

Filling of the reservoirs can be done via ball valve (V013A) mounted in the cooling and filtration circuit between the cooler (Z209) and the tank top filter (F213). In this way the oil is filtered before it enters the reservoirs. During filling ball valve (V014C) to the flushing of the main pump has to be closed. Sampling of the oil can be done from the measuring connection between the circulation pump and the flushing filter (F206).

Parts on the reservoirs

The oil level in the tank is measuring by sensor S005. The sensor has an output of 04-20mA. This signal is used for an analog gauge located in the E-cabinet and a signal for the PLC.

To prevent overpressure in the reservoir, check valve (V007) is mounted on the tank with a cracking pressure of 0.1 bar. The reservoir is protected from dirt out of the environmental air that enters the reservoir by tank breathers (Z006). The breather(s) have a 3µm element. The reservoir can be drained with ball valves (V013B, C).

The drain lines are provided with check valves to prevent oil from running back into the system (V012A).

Temperature sensor (S003) monitors the temperature of the hydraulic tank. The analog signal is used by the PLC.

The temperature of the oil can be seen on the temperature gauge (S023)

Return line

Two return 10µm filters (F212) filters the oil coming out of the return line from the system going to the "dirt" part of the reservoir. This filter is not used to filter the oil to the specified cleanliness, but is used for safety reasons. Each return filter (F212) has an electrical clogging indicator which indicates a pressure drop higher than 5 bar. The bypass valve opens when the pressure drop across the filter is more than 6 bar.

3.3.2.2 High pressure system

Pumps

There are two main pump sets in total for the HP system. This pump sets consist of one E-motor connected to two axial piston pumps with variable displacement and pressure control (P104). The swash plate of the pumps is controlled by the pressure compensator which sets the pressure of the pump to approximately 33bar. This pressure is the minimum pressure for accurate swash plate control.

With the pressure enable valves (V111) it is possible to increase the pressure control setting of each pump set to the setting of the pressure relief valve (V112). It is allowed to activate the pressure enable valves when the electric motors switch are switched from star to delta.

The pressure of the main system is monitored with pressure sensors. The pressure of each individual pump can be monitored with a pressure gauge. In case of a malfunction of the pump control system, the pump is protected against high pressure by pressure relief valves (V122). Check valves on each pump (V123) prevent back-flow in the direction of the pumps.

The case drain and main bearing of the pumps are flushed with oil from the cooling and filtration system. Case drain pressure can be read by connecting a pressure gauge on the minimess connection on the drain oil connection.

The suction line of the main pumps can be disconnected from the reservoir with a valve (V011). The position of the valve is checked with a switch because the main pumps may not run with the suction valves closed to avoid cavitation.

Filtration

On the pressure side of each pump pressure filters (F121) are placed to protect the system from 'large' particles. This filter is not used to filter the oil to the specified cleanliness but is mounted for safety reasons. The maximum pressure drop across the filter element of this filter is 210bar, therefore a by-pass valve is not required for these filters. The optical dirt indicators switch at a pressure drop of 5 bar.

Dirt indicators (S105) with a magnet are mounted in the T-port of the pumps to monitor the drain oil. The indicator will detect if the drain oil contains steel parts. Steel parts on the magnet could be an indication of serious damage on the pump.

Accumulators

Hydraulic accumulators (Z130) are connected to the HP system to reduce pressure oscillations and to assist the pumps in case of short high flow demands. Each accumulator can be isolated and drained with the accumulator safety block (V131). The pressure relief valve in the safety block protects the accumulator against too high pressure when the accumulator is isolated from the main system. Ball valves (V016) placed on the connection to the accumulator can be used to drain the HP system.

3.3.2.3 Cooling and filtration system

The cooling and filtration system is used to provide clean oil in the required temperature range.

Circulation pumps

There are two circulation pumps (P201) used in the cooling and filtration circuit. The circulation pumps are screw pumps provided with an internal pressure relief valve with a fixed setting of 5bar. Check valves (V010) on the pressure side of each pump prevent backflow through the pumps. The butterfly valves (V015) in the suction lines have switches that detect the open position.

There are two circulation pumps on the HPU. When the main pumps are running one circulation pump is required, the second circulation pump is added for redundancy.

Cooling

For cooling an oil-water plate cooler (Z209) is mounted. The cooling water is provided by the ships cooling system. The water inlet temperature is between 35 and 38 degrees. In this way a minimum oil temperature around 40 degrees is provided.

Filtration

Tank top filter (F213), with a 5µm element, filters the oil coming out of the “dirty” parts of the reservoirs, going to the “clean” parts. Filter F213 has an electrical clogging indicator indicating a higher than 2 bar pressure drop over the filter. The built-in bypass valve opens when the pressure drop over the filter exceeds 3 bar.

Flushing

The bearing of the main pumps is flushed from the cooling and filtration system. In this way it is guaranteed that the pump housing is full of oil and at operation temperature when the pumps are started. The flushing oil flows through the flushing filter F206. The flushing filter has visual indication at 5 bar and has no bypass valve.

Contamination sensor

A contamination sensor is mounted with a T coupling between valve V014 and the flushing filter (F206). The contamination sensor detects dirt particles in the oil. The contamination sensor can be disconnected from the system by two ball valves (V014 and V404) for service.

Off line filter unit

The suction line of the off-line filter unit (F401) is connected to the first, so called “dirty”, compartment. Clean oil out of the filter unit goes to the second, so-called “clean”, compartment. The off-line filter unit can be disconnected from the reservoir by two ball valves (V014). Always make sure that both ball valves are open when the off line unit is started.

The off-line filter unit contains a large 2µm filter element and is used to increase the cleanliness level of the system additional to the other filters. The filter is equipped with an optical dirt indicator. It is advised to keep it in operation at all times even when the system is not in use.

3.4 PRESSURE VESSEL UNITS

Reference drawing:

■ [A11-41810-80-0308](#): Pressure vessel unit - hydraulic diagram

This section describes the pressure vessel system in terms of systematic and hydraulic aspects.

3.4.1 SYSTEM DESCRIPTION

The N₂ gas pressure system consists of 16 individual vessels, each with a capacity of 500dm³. The pressure vessels can be re-charged or drained to different gas pressures with the Pressure Intensifier Unit. Each pressure vessel section contains two pressure vessels and can be connected to the Pressure Intensifier Unit and the medium separator by remote operated ball valves.

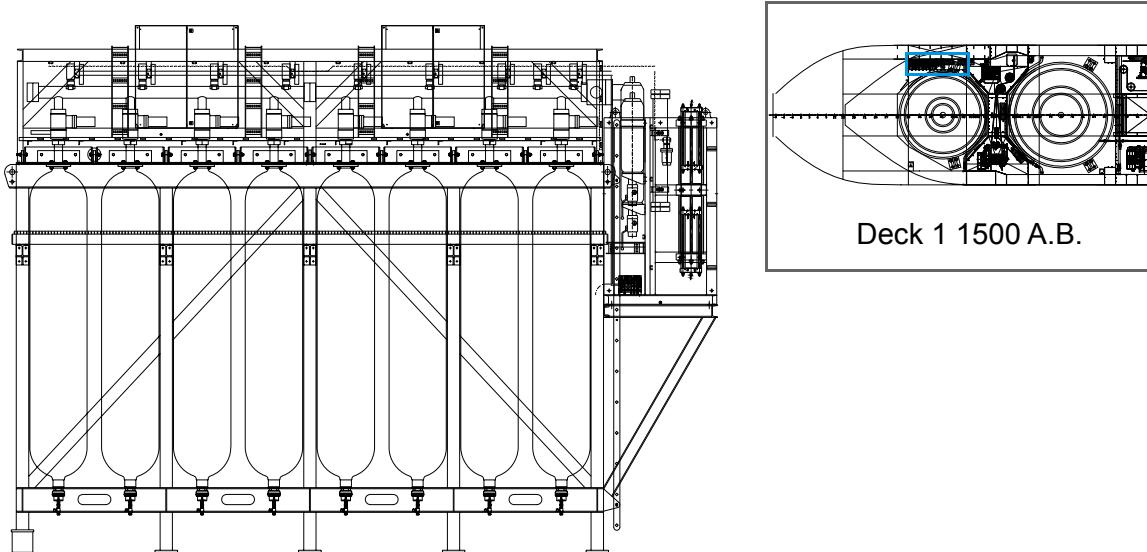


Figure 3-4: Pressure vessel unit

3.4.1.1 Pressure vessels

On each pressure vessel (Z060) is mounted a gas pressure relief valve (V002) and a pressure sensor (S061). The separator valves (V010) are directly mounted on the pressure vessel and connect the pressure vessels to the medium separator. On each pressure vessel a drain valve is mounted.

Each vessel section can be connected to the high pressure port of the PIU with the high pressure line (HP) and to the low pressure port with the low pressure line (LP). The vessel sections can be isolated from the LP and HP line with a manual operated ball valve (V003). During operation the hydraulic operated HP and LP ball valves (V020) are used to connect or disconnect a vessel section to the PIU.

It is also possible to connect the medium separator and the pipes between the medium separator and the pressure vessels (referred to as separator line) to the HP and LP connections of the PIU. There is also a manual operated ball valve (9V003) to isolate the HP and LP valves from the separator line, pressure sensors (9S061) and a pressure relief valve (9V002) connected to the separator line. Practically the separator line is also considered as a pressure vessel.

3.4.1.2 Hydraulic operated ball valves

The separator valves (V010) and HP and LP line (V020) valves are hydraulic actuated with directional control valves. A separate pilot circuit with reduced pressure is used for the pilot valves. The pilot pressure is reduced to 200 bar in the PIU manifold (M201) from the main system pressure with a reducing valve (V211) and limited with a pressure relief valve (V212). A check valve (V213) prevents leakage from the pilot circuit in case of a power failure. The bladder accumulator (Z252) makes it possible to switch several times ball valves after a power failure. The bladder accumulator can be disconnected from the system with an accumulator safety block (V253). The hydraulic pressure of the main system and the pilot circuit can be read from pressure gauges (Z224 and Z225).

The separator valves are controlled by 4/3 directional control valves (V011). The separator valves are controlled by two solenoids, one for each position. As the separator valves are equipped with a mechanical lock, the solenoids only must remain energized until the newly requested position is detected. Both the open and closed position of the ball valves is detected with a switch.

The HP and LP ball valves are controlled with 4/2 directional control valves (V021). The HP and LP ball valves are opened as long as the pilot valves are actuated. Both the open and closed position of the ball valves is detected with a switch.

3.5 PRESSURE INTENSIFIER UNIT

This section describes the pressure intensifier system in terms of systematic and hydraulic aspects.

3.5.1 SYSTEM DESCRIPTION

The heave compensator system is equipped with a PIU which is used to charge gas from one pressure vessel to another. The PIU is a three stage intensifier, all stages are hydraulically driven. The PIU consists of one double acting first stage, two single acting second stages and two single acting third stages. The PIU can operate as a single stage, two stage or three stage intensifier. When the pressure ratio between the HP and LP pressure vessels is small, only the first stage is used. At higher pressure ratios both stages are used.

3.5.2 PRESSURE INTENSIFIER UNIT MANIFOLD

The PIU cylinders are controlled by the PIU manifold. The strokes of each stage are controlled by a 4/3 directional control valve (V203). The directional control valves are pilot operated with a separate pilot circuit. The pressure of the pilot circuit is controlled by a reducing valve (V202). The reduced pilot pressure and the flow control valves (V206) between the pilot and the main stage of the directional control valves ensure a smooth switching behavior of the valves. An accumulator (Z240) is mounted in the T-line of the PIU manifold. The accumulator reduces a peak flow and pressure shock in the T-line. When the directional valves are not activated, all ports (C1 - C4) of the cylinders are connected to the tank. If they are activated, one part of each stage is pressurized and the opposite is connected to tank. In this way one compartment of a stage is making a pressure stroke and at the same time the other compartment is making a suction stroke.

The cycle time of the first stage is controlled by two pressure compensated flow control valves (V204A, V204B), which control the flow to the two connections (C1 and C2) of the first stage cylinder (meter-in control). The pressure on the C1 and C2 ports of the cylinder is limited by two pressure relief valves (V205).

The cycle time of the two second stages is determined by three pressure compensated flow control valves. The pressure stage of both second stages is controlled by a single pressure compensated flow control valve (V204E). The suction stroke of each cylinder is controlled by a separate pressure compensated flow control valve (V204C, V204D).

The two third stages are controlled by a directional valve (V262) on a separate manifold (M260). This manifold is connected to the P and T lines of the PIU Manifold. The cycle time of the third stages are controlled by three pressure compensated flow control valve (V264) in similar way as the second stage.

3.5.2.1 Pressure intensifier cylinders

The PIU is connected to the HP and LP lines of the PVU with ball valves (V220). The cylinders have check valves (V221) connected on the inlet and outlet to reduce the clearance volume of the PIU. Between the first and the second stages of the PIU a N2-water cooler is mounted to reduce the inlet temperature of the second stages of the PIU. A second N2-water cooler is mounted between the second and third stage to reduce the N2 inlet temperature of the third stages. The pressure intensifier cylinders of the first and second stage are cooled with a cooling jacket.

A filter (F230) is mounted before the first stage of the PIU manifold. This filter is not used to filter the gas to the specified cleanliness, but is used for safety reasons.

The pressure on the inlet and outlet of the PIU is measured with a sensor. The hydraulic pressure in the C1-C6 compartments is also measured with sensors. The sensors are used to determine if a cylinder is at end of stroke. The temperature at the outlet of the PIU to the HP line is measured with a temperature sensor (S227), a too high temperature indicates a failure of the cooling circuit or a too high pressure ratio.

3.5.2.2 Equalize valve

The equalize valve is used to equalize the pressure between the pressure vessel which is connected to the HP line and the pressure vessel connected to the LP line. The equalize valve is controlled with a 4/2 directional control valve (V210) which is mounted on the PIU manifold. The equalize valve is opened as long as the pilot valve is actuated. Both the open and closed position of the equalize valve are detected with a switch.

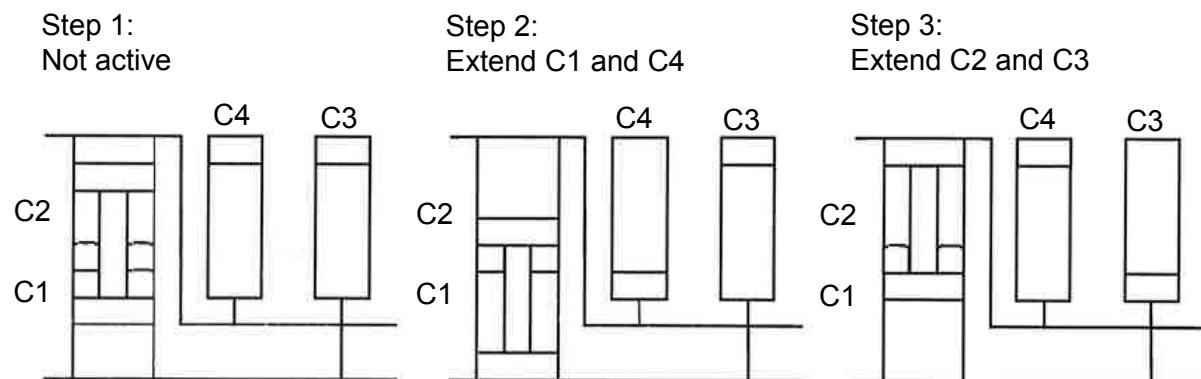


Figure 3-5: Sequence double stage PIU

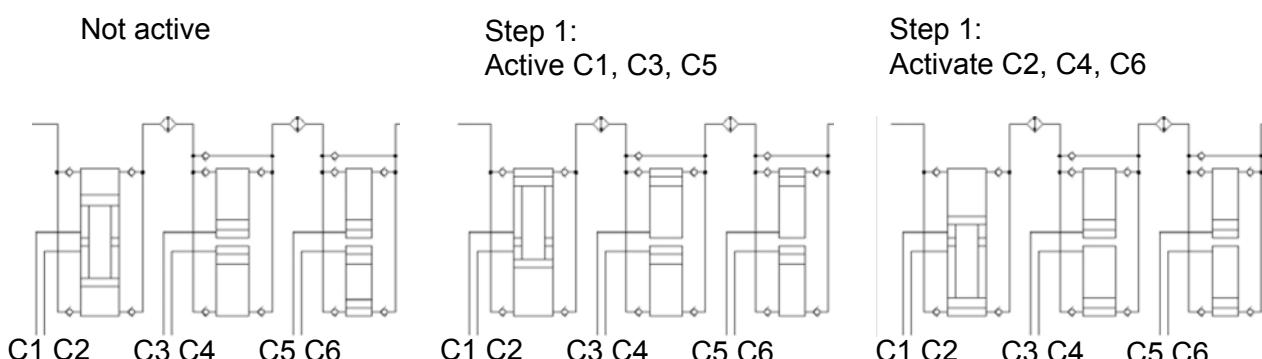


Figure 3-6: Sequence three stage PIU

4 HYDRAULIC DESCRIPTION

4.1 INTRODUCTION

This chapter is part of the hydraulic documentation belonging to the OMC, excluding the hydraulic documentation belonging to the heave compensator. The drawings referred to in this chapter are provided in [Appendix I: "Reference drawings - Hydraulic"](#). The hydraulic documentation belonging to the heave compensator can be found in [Chapter 3: "Heave compensator"](#).

4.1.1 CODING OF HYDRAULIC COMPONENTS

See NEN ISO 1219-1 for an explanation of the coding used on the hydraulic documentation for the hydraulic parts and hoses.

4.2 WIRE BRAKE SYSTEM

CAUTION



The crane and especially the main hoist must not be operated when the wire brake is applied

CAUTION



There are no sensors installed on the wire brake system. The pressure in the cylinder can only be monitored with the pressure gauge.

In case the pressure drops below 310bar on the bottom side of the cylinder during operation, it should be pumped up to 320bar again. At the start, the pressure must be checked regularly, because the pressure may drop due to temperature increase while pumping. After the brake is applied it must be checked each hour.

4.2.1 GENERAL HYDRAULIC DESCRIPTION

Reference drawing:

- [A11-41800-80-0108](#): Wire Brake System hydraulic diagram

[Figure 4-1](#) gives a schematic reproduction of the hydraulic in the wire brake system. The wire brake system is a stand-alone system, and consists of a brake, a tank and a hand pump. For more information, see supplier's documentation.

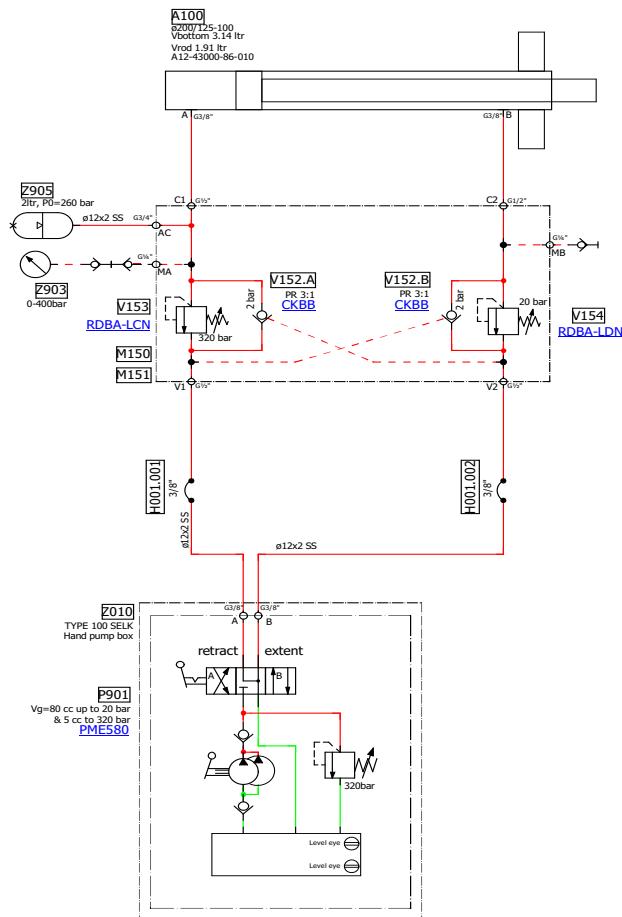


Figure 4-1: Scheme

The wire brake, used for reeving procedures, is located on the jibhead. This brake is actuated by a hydraulic cylinder and operated by a manual pump. The maximum allowed linepull for this brake is 5 mt. See [Section 2.14.5.2: "Wire brake"](#) for the location of the wire brake. See [Section 6.8: "Main hoist reeving procedure"](#) for the reeving procedure of the main hoist.

4.2.1.1 Hand pump

A hand pump with two stroke volumes [P901] is connected to a 5L tank {Z902} and to a directional valve that is part of the hand pump assembly. This directional valve controls the direction of the movement of the cylinder [A100].

The two stroke hand pump has a 80cc stroke volume, when the required pressure is lower than 20bar. Above 20bar and below 320bar a 5cc volume is displaced.

4.2.1.2 Cylinder

The cylinder is held in place by the pilot operated check valves [V152].

Pressure on the bottom side of the cylinder can be measured with the pressure gauge [Z903]. An accumulator [Z905] is connected to the cylinder to compensate for temperature changes during the day.

Two safety valves [V153] are installed in the manifold to release overpressure.

The accumulator and cylinder can be drained over the measuring points on the manifold block [M150].

4.2.1.3 Accumulator

The accumulator [Z905] prefill pressure must be checked when the cylinder is retracted and the gauge reads ~0bar. The prefill pressure must be 260bar. The accumulator prefill pressure must be checked each year.

To refill the accumulator to the correct prefill pressure, retract the cylinder until the gauge [Z903] reads ~0bar, decouple the gauge, empty the bottom side of the cylinder through connection MA and fill the accumulator with nitrogen to 260bar.

4.3 OIL COOLING SYSTEM

The storage winch gearboxes and the traction winch gearboxes are oil cooled. The following chapter describes the oil cooling system of the 400 mt OMC.

4.3.1 STORAGE WINCH

The two storage winch gearboxes are both cooled by an oil cooler. Each oil cooler includes a cooler motor and a temperature sensor. If the temperature measured by the sensor raises above 50°C the oil cooler motor is switched on. If then the temperature lowers below 45°C the cooler is switched off again. A 'high temperature' warning will be generated if the temperature raises above 80°C. See [Figure 4-2](#) for the hydraulic scheme of the storage winch oil cooling system.

< 45deg SWITCH OFF COOLERS
T > 50deg SWITCH ON COOLERS
T > 80deg WARNING HIGH TEMPERATURE

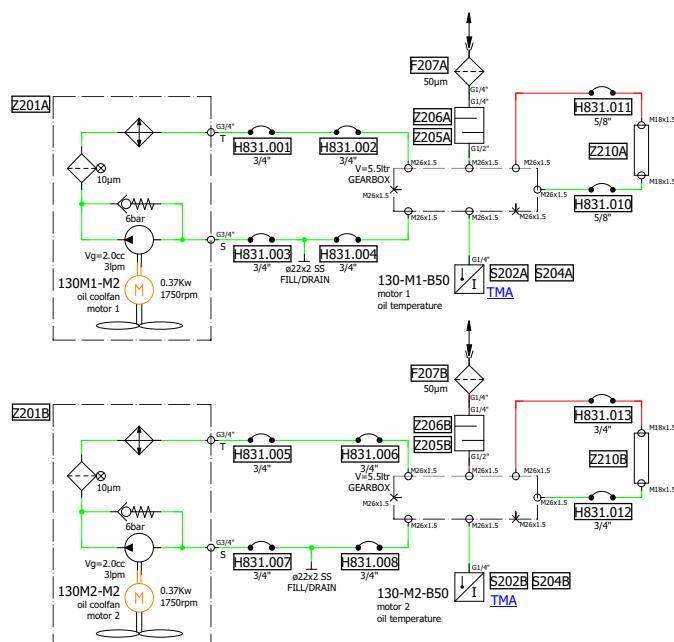


Figure 4-2: Storage winch gearbox cooling hydraulic scheme

4.3.2 TRACTION WINCH

The six traction winch gearboxes are all cooled by an oil cooler. Each oil cooler includes a cooler motor and a temperature sensor. If the temperature measured by the sensor raises above 50°C the oil cooler motor is switched on. If then the temperature lowers below 45°C the cooler is switched off again. A 'high temperature' warning will be generated if the temperature raises above 80°C. See [Figure 4-3](#) for the hydraulic scheme of the traction winch oil cooling system.

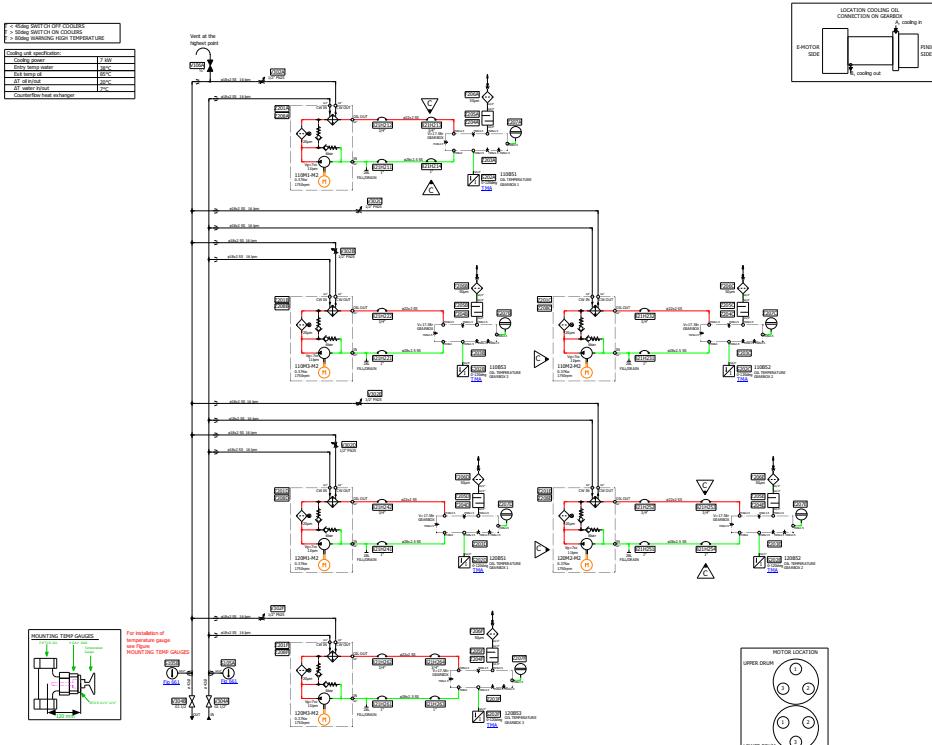


Figure 4-3: Traction winch cooling hydraulic scheme

4.4 WATER COOLING SYSTEM

The gearboxes of the traction winch, the airco units in the E-room and the HPU and PIU of the heave compensator are water cooled. See [Figure 4-4](#) for the single line diagram of the water cooling system. The following chapter describes the water cooling system of the 400 mt OMC.

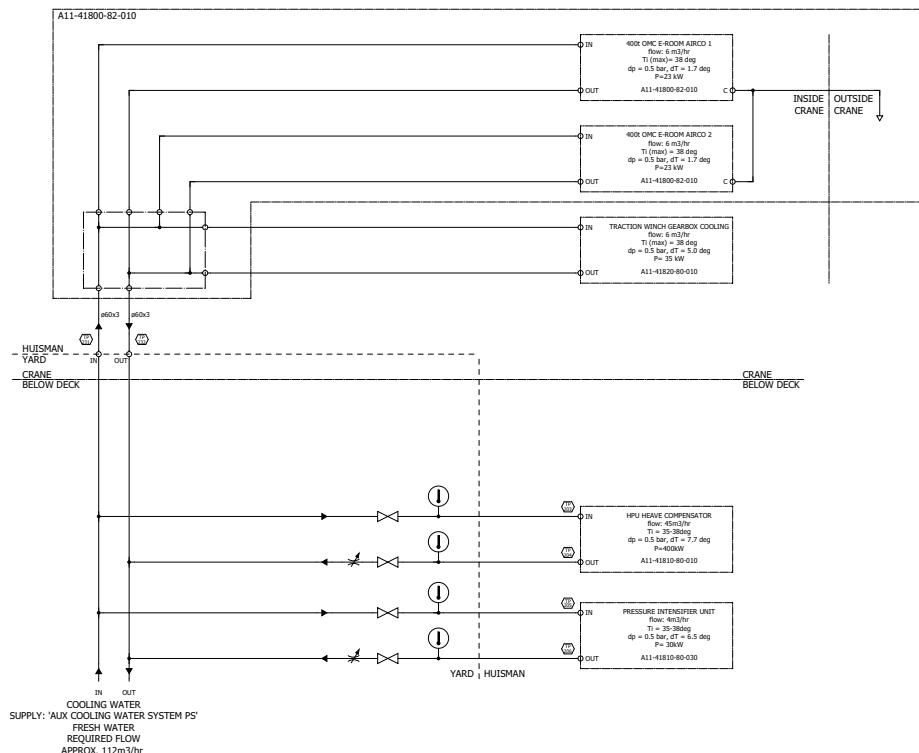


Figure 4-4: Single line diagram water cooling system

4.4.1 E-ROOM COOLING

The cooling water for the E-room cooling system comes from the vessel. Via cooling manifold [M101] it is connected to the E-room and traction winch cooling system. Temperature gauges measure the temperature of the incoming and outgoing water. See [Figure 4-5](#) for the hydraulic scheme of the e-room water cooling system.

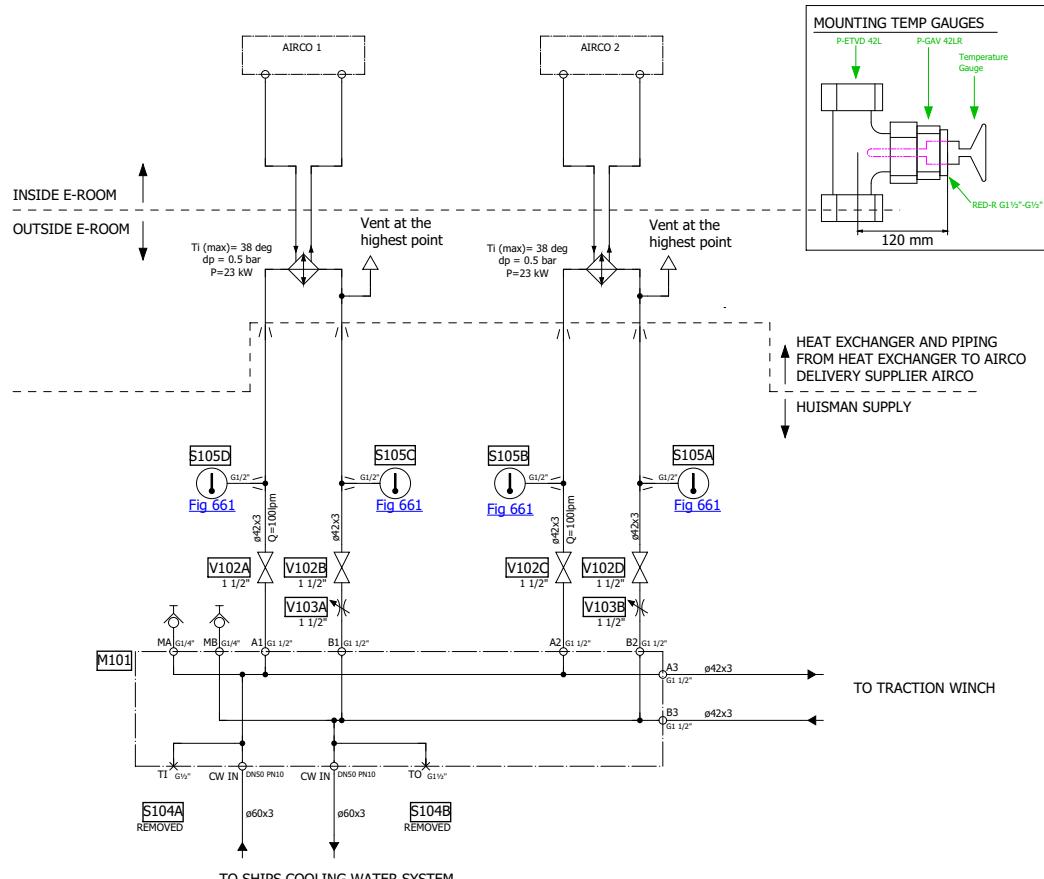


Figure 4-5: E-room cooling hydraulic scheme

4.4.2 TRACTION WINCH

The cooling water for the traction winch cooling system comes from the vessel. Via cooling manifold [M101] it is connected to the E-room and traction winch cooling system. Temperature gauges measure the temperature of the incoming and outgoing water. See [Figure 4-3](#) for the hydraulic scheme of the traction winch water cooling system.

5 ELECTRICAL DESCRIPTION

5.1 INTRODUCTION

5.1.1 SCOPE OF ELECTRICAL DESCRIPTION

This chapter provides a detailed description of the electrical system of the 400t OMC. The description is an outline of the electrical installation, the engineering and considerations. Additional information is provided by the drawings and diagrams.

The electrical system of Huisman Equipment B.V. on board performs the following main functions:

- Power distribution for the 400t OMC.
- Control of all movements.
- Safety.

The complete electrical documentation belonging to the system comprises the electrical diagrams [10013281A](#). The diagrams can be found in [Appendix H: "Reference drawings - Electrical"](#). Third party supplier manuals can be found in the CD folder "Supplier Documentation". Information related to Huisman Equipment B.V. products are added in the Appendixes.

The electrical diagrams will not be completely described. However, the reference is made wherever appropriate. General safety and maintenance information is given in [Section 1.6: "Safety" on page 19](#) and in [Section 7: "Maintenance" on page 183](#).

The explanation of electrical coding and how to navigate through the electrical diagrams is provided in [Appendix H: "Reference drawings - Electrical"](#), and is also briefly explained on the first pages of the electrical drawing [10013281A](#).

The electrical diagrams are delivered in PDF format. The electronic version of the .pdf drawing has some advantages over the printed version. Using the electronic version it is possible to flip through the pages by following the wiring. When the hand changes into a pointing finger, it is possible to click with the left mouse button. After the click the page will be opened that connects to the wire that was pointed at. The same applies to most of the relay contacts and relay coils.

5.1.2 DESIGN CRITERIA

The electrical system is designed as Fail-Safe. A malfunction or error of a specific sensor, device, circuit or system will result in a transition to a safe situation.

The 400t OMC is mainly electrical driven.

5.2 ELECTRICAL POWER UNIT

The switchboard room of the OMC is located at level 1 of the mast base. The switchboard room contains one of the ELCA/POCA cabinets. The crane is supplied from the TLS with 960 Vdc from the main power switchboard P11 part 8. The vessel switchboards supply 440 Vac for the rest of the consumers. A 440/230 V three phase transformer supplies the 230 Vac consumers. A 440/230 V single phase transformer supplies the 230 Vac control.

The OMC has been outfitted with a 24 Vdc UPS system. This UPS system feeds the essential equipment, which is needed to maintain operation, for maximum 30 minutes. The essential equipment are (examples):

24 Vdc

- PLC
- Computers
- I/O Modules
- Sensors

The OMC is supplied with 230 Vac from the vessel. This UPS system feeds the essential equipment, which is needed to maintain operation, for maximum 30 minutes. The essential equipment are (examples):

230 Vac

- AOL
- Exit lighting

The outside floodlights on the pedestal are fed from the vessel.

More details, see electrical diagram [10013281A](#) in [Appendix H: "Reference drawings - Electrical"](#).

The power distributed to the various system components is protected by fuses / automatic circuit breakers.

5.3 DRIVE SYSTEM

5.3.1 ELECTRICAL - HYDRAULIC DRIVE

Two electrical motors are used to drive the hydraulic main pumps, these motors can operate parallel or separate. This is decided by the operator, and depends on the amount of power required. The power required is depending on the circumstances and is the combination of speed and load.

Two small electrical pumps are used for cooling the oil. Only one pump may be running at a time which is guarded by the PLC. During start up of the main pumps it is necessary to have a cooling pump running. This is because the cooling pump will make sure the main pump is filled with oil prior to the start of the main pump.

A third motor is used for filtering the oil. It is advised to keep this pump running at all times.

5.3.2 ELECTRICAL DRIVE

The crane is equipped with several electrical motors for controlling the movements. These motors are controlled by inverters that are situated in the drive system cabinets located in the crane switchboard room.

Drive cabinet

The drive cabinet (M21) consist of 9 panels. See [Figure 5-1 on page 121](#) and [Figure 5-2 on page 122](#).

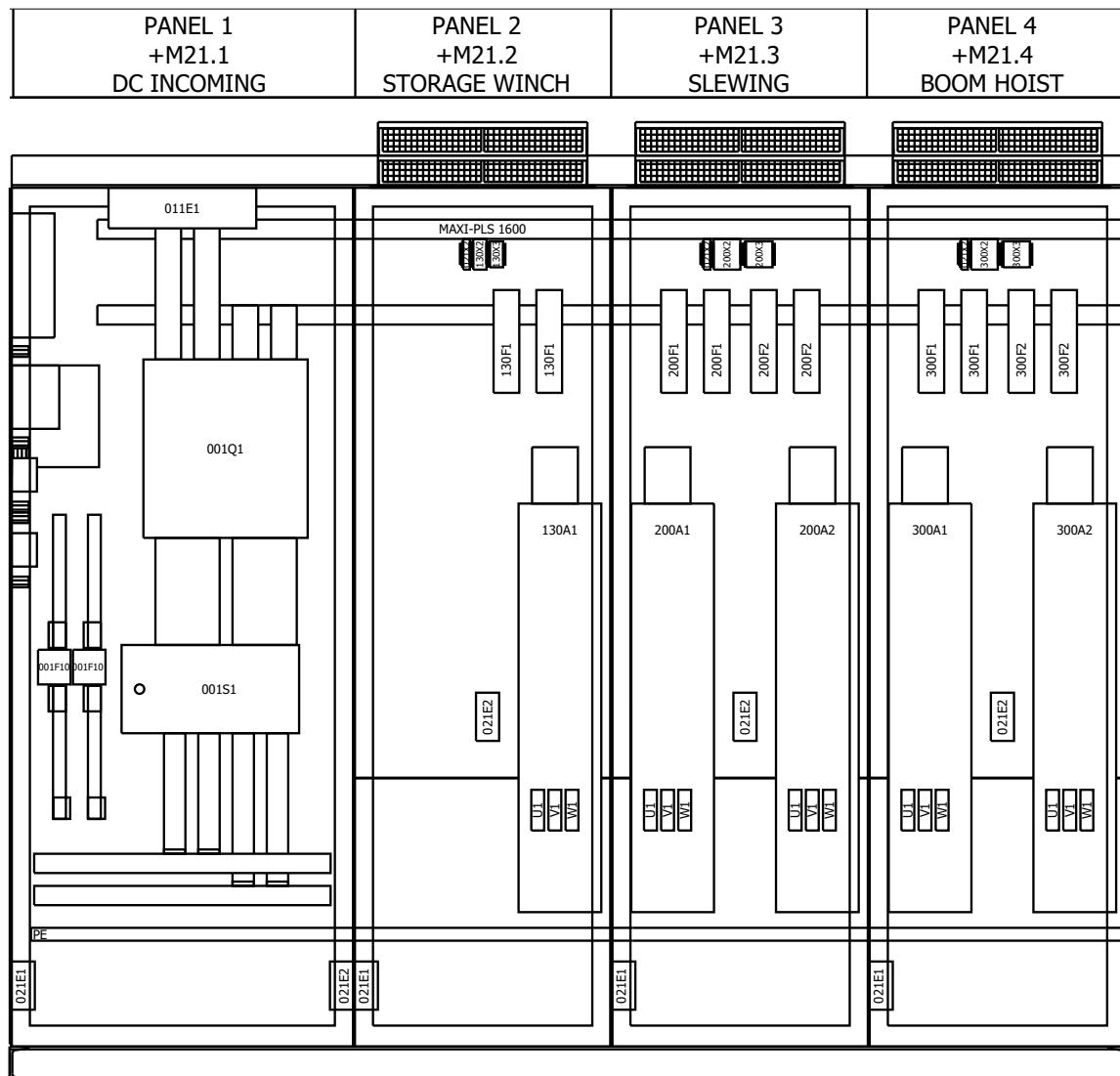


Figure 5-1: Drive cabinet - panel 1 till 4

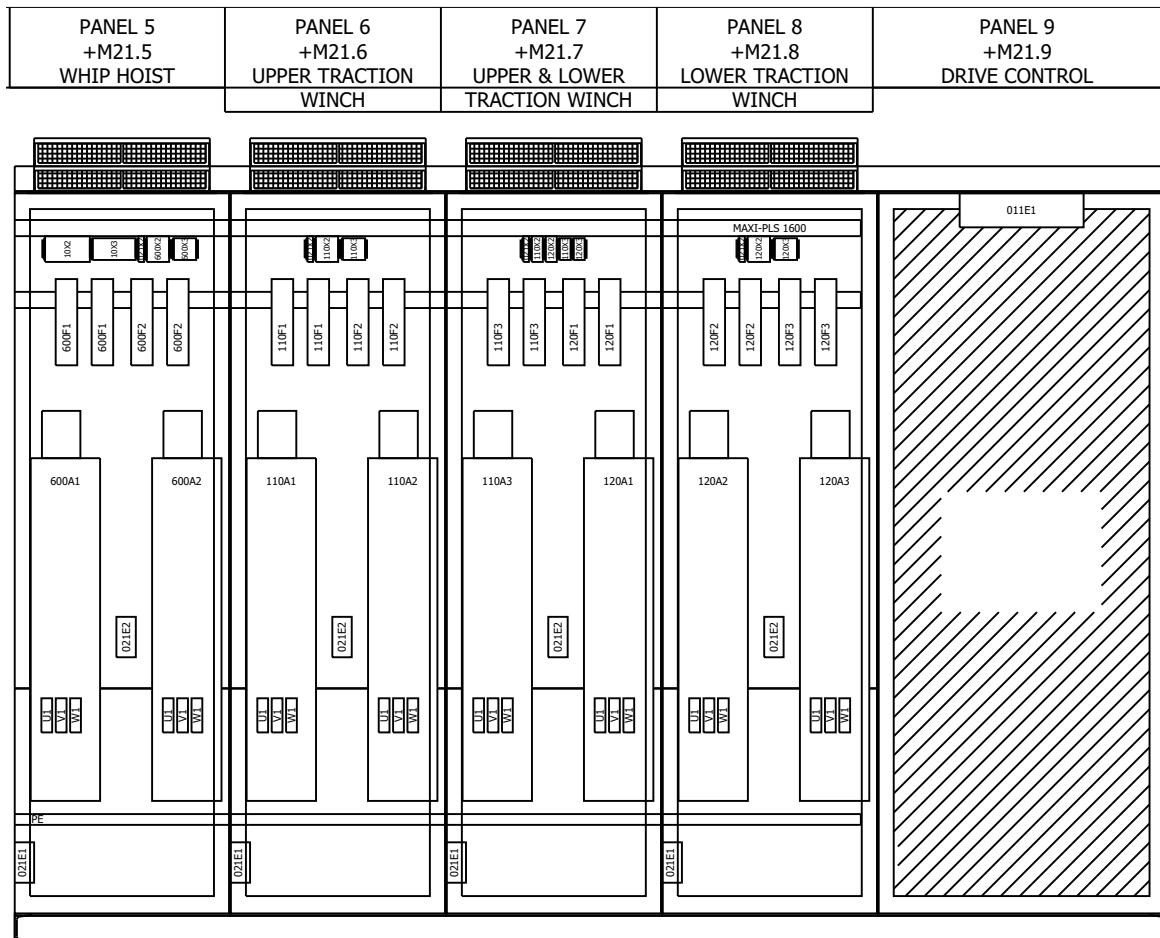


Figure 5-2: Drive cabinet - panel 5 till 9

DC pre charge system

The 930 Vdc supply switch has a pre charge circuit. Resistor based pre charge circuit is used. The purpose of the charge system is limiting the charging current at switching on the DC supply. Because of this, high start currents are avoided when the drive system is started.

Inverters

A method of controlling an induction motor for hoist applications is to use speed control with feedback from a encoder fitted to the motor shaft.

The heat production of the motor is partly proportional to the motor current (or motor torque) and partly proportional to the motor speed. The heat loss produced by the resistance of the motor windings is only dependent on the motor current. The heat loss produced by the iron magnetization changes, is proportional to current multiplied by motor speed.

In crane applications, the torque is determined by the load, which is the same at every speed. Depending on the duty cycle of each movement the motor is engineered in such a way that overheating will not appear under normal circumstances. The motors do have thermistors inside which are connected to the PLC. In this way the motor is protected.

Another specific characteristic of a frequency controlled drive system is the possibility to extend the operational speed above the rated speed of the motor. By increasing the frequency above the rated motor frequency, the motor speed can be increased.

The available motor torque will decrease in this case, so using the motor above rated speed (or field weakening), the motor can only be used with partial load. In order to guarantee a safe crane operation, field weakening is only allowed when the load protection system (PLC) has detected a load which is less than the maximum allowed in field weakening. This detection is "fail safe", meaning that in case of a broken connection of the load measuring sensor, the PLC will not allow the frequency inverter to accelerate the motor above the motor rated speed.

The frequency inverter has several functions:

- control of motor speed
- control of lifting mechanical brake
- control of motor in case of a slipping brake situation

A slipping brake is detected when the drive detects that the actual motor torque is higher than the normal standstill motor torque, while the brakes are applied. If this happens the drive will force the motor to zero speed according to the shaft encoder. At the same time the drive will issue a slipping brake alarm to the PLC in order to alarm the operator. After this, the operator will need to bring the load to a safe position - such as putting the load on deck, lay the boom in its boom rest - BEFORE stopping the crane. The reason of the slipping brake should be investigated.

NOTE *The PLC detects the "slipping brake", in this case the PLC is ignoring the stop command (system OFF button). At the SCADA screen a warning appears for not to push the E-stop buttons.*

Traction winch inverters 110A1, 110A2, 110A3 and 120A1, 120A2, 120A3

The mainhoist traction winch consists of two separate drums, each drum is operated by three motors. Each motor is driven by an inverter of 160 kW. The inverters are connected to the DC-bus by special (high speed) fuses and they are fed by the DC-bus.

All Inverters are connected to the PLC by means of a Profibus serial link. This Profibus is used for all communication between the PLC and the drives, for example the speed set point from the PLC to the drive, or the actual motor current from the drive to the PLC. In order to achieve a good control of the winch, all inverters need to communicate with each other. This is done by means of a dedicated high speed optical link.

Slewing inverters 200A1, 200A2

The slewing inverters are 160 kW each. The slewing gear has four motors of 60 kW each. Each inverter controls two motors. The inverters are connected to the DC-bus by special (high speed) fuses and they are fed by the DC-bus. The inverters are connected to the PLC by means of a Profibus serial link.

This Profibus is used for all communication between the PLC and the drives, for example the speed set point from the PLC to the drive, or the actual motor current from the drive to the PLC. In order to achieve a good control of the winch, both inverters need to communicate with each other. This is done by means of a dedicated high speed optical link.

Boom hoist inverters 300A1, 300A2

The boom hoist inverters are 160kW each. The boom hoist winch has two motors of 132 kW each. Each inverter controls one motor. The inverters are connected to the DC-bus by special (high speed) fuses and they are fed by DC-bus. The inverters are connected to the PLC by means of a Profibus serial link.

The inverters are connected to the PLC by means of a Profibus serial link. This Profibus is used for all communication between the PLC and the drives, for example the speed set point from the PLC to the drive, or the actual motor current from the drive to the PLC. In order to achieve a good control of the winch, both inverters need to communicate with each other. This is done by means of a dedicated high speed optical link.

Whip hoist inverters 600A1, 600A2

Each whip hoist inverters is 160kW. The whip hoist winch has two motors (132 kW each motor). Each inverter controls one motor. The inverters are connected to the DC-bus by special (high speed) fuses and they are fed by DC-bus. The inverters are connected to the PLC by means of a Profibus serial link.

The inverters are connected to the PLC by means of a Profibus serial link. This Profibus is used for all communication between the PLC and the drives, for example the speed set point from the PLC to the drive, or the actual motor current from the drive to the PLC. In order to achieve a good control of the winch, both inverters need to communicate with each other. This is done by means of a dedicated high speed optical link

Tugger winch inverter 801A1, 802A1

The crane is equipped with two independent tugger winch inverters. Left tugger and right tugger that is situated in the main jib.

The tugger inverters are 160 kW each. The inverters are connected through the slip rings to the DC-bus bar by special (high speed) fuses.

The inverters are connected to the PLC by means of a Profibus serial link. This bus is used for all communication between the PLC and the drives, for example the speed set point from the PLC to the drive, or the actual motor current from the drive to the PLC.

5.4 AUXILIARY POWER SUPPLY

All of the auxiliaries such as cooling, air conditioning, lighting, brakes etc. are controlled and supplied from the power cabinet. There are two electrical power cabinets (ELCA/POCA) in the crane:

- (M22) for all functions related to the non rotating part.
- (M52) for all functions related to the rotating part.

The power cabinet (M22) in the pedestal is supplied from the vessel.

The power cabinet (M52) in the operator cabin is supplied from the power cabinet (M22) located inside the pedestal. The electric energy to the crane operator cabin is fed through slip rings.

A selection of components follows for cabinet (M22). Info regarding cabinet (M52) can be found in the electrical diagrams.

Main 440 Vac power switch (002Q1)

This is the manual operated main switch for the power cabinet, inside the crane switchboard room.

Main 440 Vac power monitoring system (002P440, 002S440, 002K440)

002P440 is a volt meter which indicates the voltage level of the AC bus in the power cabinet. With switch 002S440, the desired phases can be selected. 002K440 indicates to the PLC whether the voltage is correct or not.

440 Vac / 230 Vac transformer (002T1)

This transformer converts 440 Vac to 230 Vac for equipment such as lighting, brakes, control circuits etc.

Overvoltage protection (003F230-2.1/4)

This is a voltage limiter device. More information can be found in the Phoenix supplier documentation.

Main 230 Vac power monitoring system (003P230, 003S230, 003U1 003K230)

003P230 is a voltmeter which indicates the voltage level of the 230Vac in the power cabinet. With switch 003S230, the desired phases can be selected. 003U1 is a ground fault detector relay. More information can be found in the Bender supplier documentation. 003K230 indicates to the PLC whether the voltage is correct or not.

230 Vac / 24 Vdc converter UPS (007U3)

The battery charger 007U3 is connected to two batteries that are mounted in the switchboard room. This charger supplies 24 V to all 24 V consumers which are connected to the 24 V UPS supply in the crane house. The 24 V consumers in the cabin and on the boom are powered from the cabin. More information can be found in the Mastervolt supplier documentation.

Contactor standstill heating (003Q1)

This contactor switches the standstill heating. This heating is disabled by the PLC when the drive system is active. When the heating is on, this is indicated by the blue light 003H1. The heating is controlled by a cabinet Hygrostat.

Brake lift circuit (061K13, 061K14, 100K11 ... 600K11, 110K70 ... 600K712, 110K710 ... 600K720)

The brake lift circuit for one brake consists of a breaker that feeds the circuit, a contactor that switches the power to the brake rectifier unit and a brake rectifier unit that converts the 230 Vac to 65Vdc for the brake. The varistor absorbs the voltage peak that occurs when a brake is applied. The brake lift circuits for the other movements work in the same way. More information about the brake lift relays can be found in the supplier documentation (Binder).

Thermistor relays (110F51...600F52)

These relays are connected to the thermistor temperature sensor that is placed in each motor. When the temperature of a motor becomes too high, a contact of the applicable relay will switch over, which indicates to the PLC that there is an overheated motor. The PLC will stop the movement to protect the motor.

Main fan switch (022S1)

This switch selects the operating mode of the fresh air supply fan in the mast base. Normally, this switch should be in the 'Auto' position. The positions 'Manual Low speed' or 'Manual High speed' may only be used for maintenance.

440 Vac supply ok (002H440)

This light is lit when the 440Vac is OK.

When the 440 Vac is not ok device 003K400 must be reset to start-up the system

230 Vac supply ok (002H230)

This light is lit when the 230 Vac is OK.

When the 230Vac is not ok device 003K230 must be reset to start-up the system

Hour counters

These hour counters indicate the number of hours that the brake(s) of the applicable movement have been lifted, which corresponds with the running hours of a winch.

5.5 ELECTRICAL MOTOR

The choice for a particular type of the asynchronous squirrel cage induction motor is based on calculations. In these calculations the following parameters are included:

- Inertia
- Required torque
- Required speed
- Frame size

Once the right motor is selected, important features are the start up current, power and rpm of the motor.

For each drive system the most important part is the start and stop cycle which includes the brake control.

Brand

Table 5-1: Motor brands

Description	Brand	Type	Cooling method	Protection	Remark
Storage winch	Wölfer	MODRKF 180 L -4b/SFB63T	IC 06	IP23	With air Filter
Traction winch	Wölfer	MODRKF 225 L -4bbb/SFB160FUT	IC 06	IP23	With air Filter
Boomhoist	Wölfer	MODRF 280 L -6S/SFB250T	IC 06	IP23	With air Filter
Whip hoist	Wölfer	MODRF 280 M-6S/SFB250T	IC 06	IP23	With air Filter
Slewing	Wölfer	MDRKO 250 M-4b/SFB63/52T	IC 410	IP56	
Tuggers	Wölfer	MDRKO 280 X-4/SFB100/100T	IC 410	IP56	

Speed control

The incremental encoder provides a speed- and direction signal to the frequency converter that controls the motor.

The motor speed is controlled by the inverter by varying the frequency and voltage to the motors using vector control (depending on operator command and actual load).

Cooling

According to Table 5-1 on page 127 the motors marked with 'IC 06' are forced ventilated, which reduces size and weight of the motor.

The cooling fans provide an air flow through the motor. If these fans are not running, the E-motors can only run for a very short time, and will be overheated. It is not allowed to run the motor without filter because this will pollute or can even damage the motor. More information with respect to connections and maintenance of the electric motors is in the supplier documentation.

The used cooling method for the different motors are added in [Table 5-1 on page 127](#). In [Table 5-2 on page 127](#) the cooling method definitions are described.

Table 5-2: Cooling methods

IC 410	Cooling without using a fan, only by natural ventilation and radiation on the totally enclosed motor surface.
--------	---

Table 5-2: Cooling methods

IC 06	Cooling air is blown through the motor by a separately excited fan motor. The inlet side may be equipped with an air filter.
-------	--

Standstill heating

Electrical equipment is sensitive for moisture. When not in use, the equipment can easily be damaged by dew due to changing environmental conditions. To prevent corrosion and damage of e.g. insulation, motors are equipped with standstill heating. The standstill heating is only active when the drive system is not running. The PLC regulates the standstill heating.

Thermistors

The thermistors in the motors are used for monitoring the temperature in the motor and are connected to the special thermistor relays that are placed in cabinet M22 and M52. When a motor temperature is too high, this relay will de-activate the applicable digital input of the PLC and the frequency converter will switch off or stop the movement.

5.6 BRAKES

5.6.1 BRAKES

On the backside of the motors brakes are located. These brakes are electrically controlled. A voltage of 65 Vdc to the coils of the brake will keep the brakes lifted. When the brakes are lifted, for a short moment a higher voltage (>200 Vdc) will be applied, to enable quick brake release. The brake will close immediately when no voltage is applied.

5.6.2 BRAKE CONTROL

All motors for driving the winches are equipped with Pintsch Bamag brakes. All brakes are static brakes. At a start of a movement, first the inverter will build up the required torque to hold the load, then the brakes are lifted (load balance). After the brakes are released the motor may accelerate. When the movement is stopped the inverter will actively ramp the speed to zero after which the brakes will apply.

At the moment the drive is active and in standby mode, the drive will generate a 4% torque against the brakes. This is done to avoid vibrations at a stand still.

5.6.3 BRAKE LIFT SENSOR

The inverter informs the PLC via the profibus when the inverter gives the command to release the brake(s). On each brake a proximity switch detects whether the brake is released or not. The signal from the proximity switch is sent to the PLC. The PLC can check with these two signals the status (high = released and low = applied) of the brakes. When a "Brake Release" command is given, the brake must be released within 1 second.

If the proximity switch is not activated in 1 second, the alarm "Brake Release failure" is given. The PLC immediately disables the move command. If the operator stops a movement it will ramp down to zero and the brakes will be applied. After this brake apply the PLC must detect the brake apply within one second after the brake apply command was given by the drive.

If not, the PLC will give an alarm: "Brake Apply Failure".

The PLC will hold back the speed set point to the drives after it has detected that indeed all brakes for that movement are released.

There are three contacts in series, see Table 5-3 on page 130, which all must be activated to lift the brakes. These contacts are:

- A PLC contact. This contact depends on whether the inverter is active and has no fault or if there is an external reason to hold back the brake(s).
- An DISPS contact. The DISPS can pre-release the brakes depending on its settings.
- An inverter contact. This is directly controlled by the inverter.

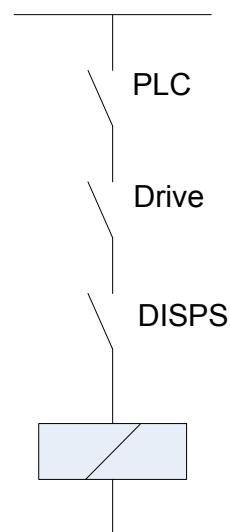


Figure 5-3: Brake lift conditions

NOTE During normal operation, when the system is active and no failures are appearing, the PLC and DISPS contacts are closed. The drive is the master controller regarding brake lifting or brake applying.

5.7 MISCELLANEOUS ELECTRICAL COMPONENTS

5.7.1 PLC (040A1 AND 040A2)

Two PLC's are implemented in the crane:

- crane PLC
- heave PLC

This crane can only be controlled from the operator cabin by means of dedicated controllers, buttons and switches.

The heart of the electrical system is the crane PLC which is placed in the ELCA/POCA (M22).

The crane PLC has the following tasks:

- Control of all the frequency inverters and rectifier units by Profibus serial connection
- Control of the remote cabin PLC
- Control of all operator manoeuvres such as highest position, maximal slew angle, etc.
- Control of the overload protection

The heave PLC is located in the ELCA/POCA (M22). The SCADA stations are interconnected by ethernet. The crane PLC and heave PLC are interconnected by profibus. The PLC's are connected to the remote IO station by profibus cables.

Explanation of operation & control is described in [Section 6: "Operation" on page 81](#).

5.7.2 WATCHDOG INTERFACE PRINT (WIP) (040K1 AND 040K2)

This PCB located in cabinet (M22) is integrated in the emergency stop circuit. The WIP monitors a pulse pattern from the PLC with a certain frequency; when this pulse pattern stops or drops below a certain level the emergency stop is activated. When this pulse pattern is active it indicates that the PLC program is running.

5.7.3 EARTH FAULT DETECTION (003U1)

The each insulated supply has a earth monitoring system:

- 230 Vac with Bender IR-420-D4-1

The 230 VAC is created with transformer 002T1 (440V/230V).

The good operation of the earth fault monitors should be tested regularly. This can be done by creating a high impedance earth fault. An insulated 100 kOhm resistance or a Duspol measurement device can be used for this purpose.

Insulation	Location	Bender type	Monitored by PLC	
			Alarm 1	
230 Vac	M22	IR-420-D4-1	46 kOhm	23 kOhm

Table 5-3: Earth Fault detection

5.7.4 EMERGENCY STOP CIRCUIT

The crane has two emergency stop circuits.

- The HPU, crane and the active heave compensation system, named Main Safety System.
- The passive heave compensation system.

See [Figure 5-4 on page 132](#).

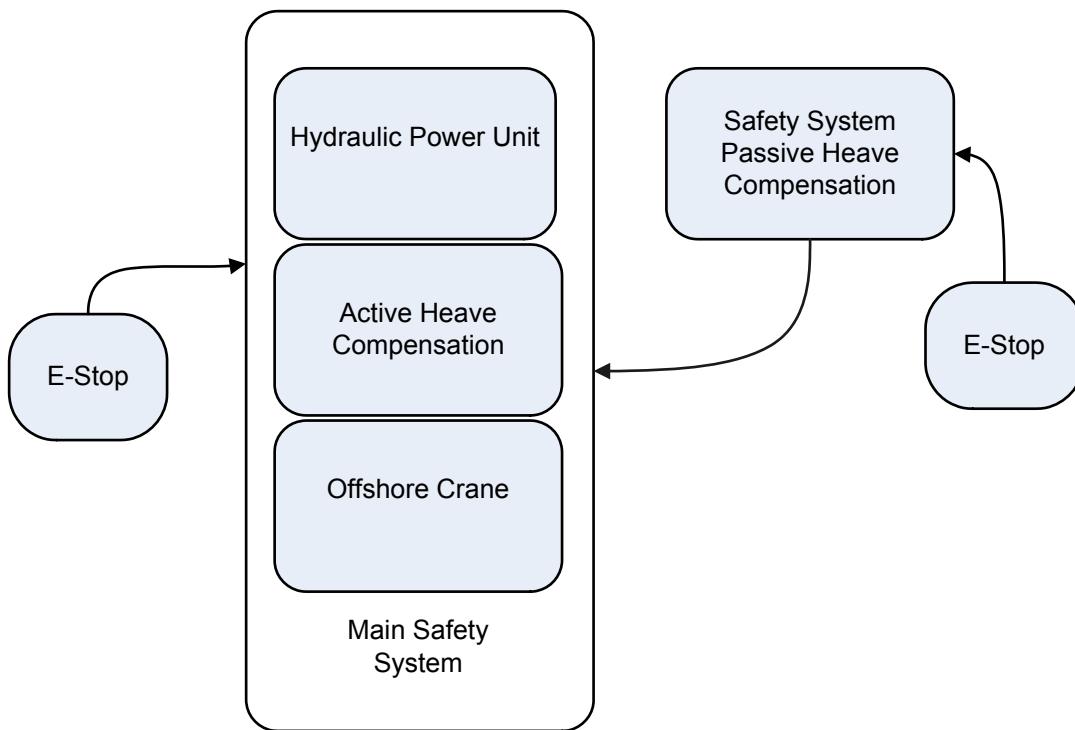


Figure 5-4: Safety system overview

Main Safety System shutdown actions

In general the Main Safety System shuts down all activators of the heave compensation system except the main passive heave valve.

Main Safety System shutdown action:

- Deactivation of all hydraulic valves of the passive heave compensator cylinder manifold except the main passive heave valve.
- Deactivation of all hydraulic valves of the active heave compensator cylinders manifold.
- Deactivation of all hydraulic valves of the Pressure Vessel Unit.
- Deactivation of all hydraulic valves of the Pressure intensifier system.
- Shutdown of hydraulic power.
- Movements of the crane.

Passive Heave Compensation safety system shutdown actions

In general the Passive Heave Compensation safety system shuts down the passive heave main valve and triggers the Main Safety System and will activate the close valves of the Pressure Vessel Unit for at least 10 seconds.

- Deactivation of the passive heave main valve.
- Trigger of Main Safety System.
- Activate the close valves of the Pressure Vessel Unit for at least 10 seconds.

Emergency stop buttons

Emergency stop push buttons are placed on several places in the crane. Four buttons are integrated in the passive heave compensation safety system. Remaining buttons are integrated in the Main Safety System. See [Table 5-4 on page 133](#).

Table 5-4: e-stop push buttons

Symbol code	Safety system E-stop actions	Safety system		
		HPU	Active Heave Compensation Crane	Passive Heave Compensation
061SX	E-Stop (2) buttons near hydraulic power unit and on cabinet	x		
061S3	E-Stop button on Storage winch	x		
061S1X	E-Stop button inside Offshore crane 5x	x		
061S10	E-Stop button on offshore crane operator chair (push button main system)	x		
062SX	E-Stop button on PVU 2X and one on the cabinet	x		x
062S2	E-Stop button near heave compensation cylinder	x		x
062S1	E-Stop button on offshore crane operator chair (push button passive heave system)	x		x
061S7	E-Stop button on slew platform	x		
	Watchdog Main PLC	x		

NOTE *The Passive Heave Compensation buttons are visually indicated with a name plate.*

The crane emergency stop system has a direct and a delayed contact. The direct contact is used to force the winches into a controlled stop, the delayed contact will switch off power to the fans, brakes and the 'Prevention of unexpected start-up' of the inverters.

All contactors and relays that are connected to the emergency stop circuit should be inactive before the emergency stop can be reset.

5.7.5 DIGITAL INDEPENDENT SPEED PROTECTION SYSTEM (DISPS)

Each movement (except the tugger winches) is equipped with an overspeed protection system. An incremental encoder, which is installed inside the spindle switch (geared cam switch) housing is connected to the applicable DISPS board. The signal from the back-up speed encoder is monitored by the DISPS circuit board for each specific movement.

Each DISPS board controls one relay with two contacts. The first one is for switching the brakes directly; the other one informs the PLC in case an DISPS alarm is present. There are three situations in which an emergency stop will be induced.

- Overspeed detected.
- Excessive acceleration detected.
- Deviation between back-up encoder signal and motor encoder signal detected.

The deviation is determined by the N>X signal. When the motor speed is above a certain level, which is determined by the inverter, the DISPS is activated by the N>X signal from the inverter. As long as the DISPS is activated, the DISPS should measure a minimum actual speed from the dedicated DISPS speed encoder.

NOTE *Every DISPS board has a different setting and therefore they are not interchangeable.*

5.7.6 MOTION REFERENCE UNIT (MRU)

Inside the crane switch board room the MRU sensor is fitted. This sensor detects all ships movements (pitch, roll, yaw, and heave). The signals are send directly to the PLC and processed. The PLC information is used for the active heave compensator. More info see Kongsberg Seatex Supplier Documentation.

5.8 CRANE MOVEMENTS

NOTE *For the description of the motor sensors, see "Electrical Motor" on page 127.*

5.8.1 TRACTION WINCH AND STORAGE WINCH

The winches contain the following sensors and components:

Spindle (geared cam limit) switch (only for the storage winch)

The spindle switches have several contacts which are monitored by the PLC. For the main hoist/ storage movement, two (2) contacts are installed on the storage drum:

- 130GS1-S1 Pre Empty drum
This switch is adjusted in such a way that the traction and storage drum will go to reduced speed.
- 130GS1-S4 Highest
- 130GS1-W5 Empty drum
This switch is adjusted in such a way that the traction and storage drum will stop in lowering direction.
- 130GS1-W7 Pre Highest..

WARNING



Replacing the wire or adjusting the wire requires re-adjustment of the gearcam switch. After the first 5 windings on the storage winch the empty drum switch has to be adjusted and tested.

- 130GS1-B61 DISPS encoder for storage winch.
- 111B61 DISPS encoder for upper traction winch.
- 121B61 DISPS encoder for lower traction winch.

See [Section 5.7.5: "Digital Independent Speed Protection System \(DISPS\)" on page 134.](#)

Gearbox oil cooling upper and lower traction (110M1-M2/110M2-M2/110M3-M2, 120M1-M2/120M2-M2/120M3-M2)

The gearboxes are equipped with temperature sensors and oil coolers. When the temperature rises above a certain level, the gearbox oil coolers will be activated to cool down the gearbox oil. The fans will stop automatically when the temperature is below the preset level again.

Grease pump (100M1,130M3)

The gears of the traction winch are automatically greased during operation. A sensor (100B71, 130B21) on the grease pump will indicate a low grease level.

More sensors

Table 5-5: More sensors storage / traction winch

Description	Code
Slackrope storage winch	(130B23)
Spooling device running	(130B22)
Lubrication empty	(100B71, 130B21)
Motor 1 upper traction winch temperature sensor gearbox	(110B51)
Motor 2 upper traction winch temperature sensor gearbox	(110B52)
Motor 3 upper traction winch temperature sensor gearbox	(110B53)
Motor 1 lower traction winch temperature sensor gearbox	(120B51)
Motor 2 lower traction winch temperature sensor gearbox	(120B52)
Motor 3 lower traction winch temperature sensor gearbox	(120B53)
Storage winch loadcell	(130B10)
Main hoist loadcell	(100B10)
Main hoist highest position proximity switch	(100B25)
Motor 1 upper traction winch temp sensor	(110M1-B51)
Motor 2 upper traction winch temp sensor	(110M2-B51)
Motor 3 upper traction winch temp sensor	(110M3-B51)
Motor 1 lower traction winch temp sensor	(120M1-B51)
Motor 2 lower traction winch temp sensor	(120M2-B51)
Motor 3 lower traction winch temp sensor	(120M3-B51)
Motor 1 storage winch temp sensor	(130M1-B51)
Motor 2 storage winch temp sensor	(130M2-B51)

5.8.2 BOOM HOIST WINCH

The motors of the boom hoist winch are the same with respect to the general function of brakes and sensors.

Slack rope switch

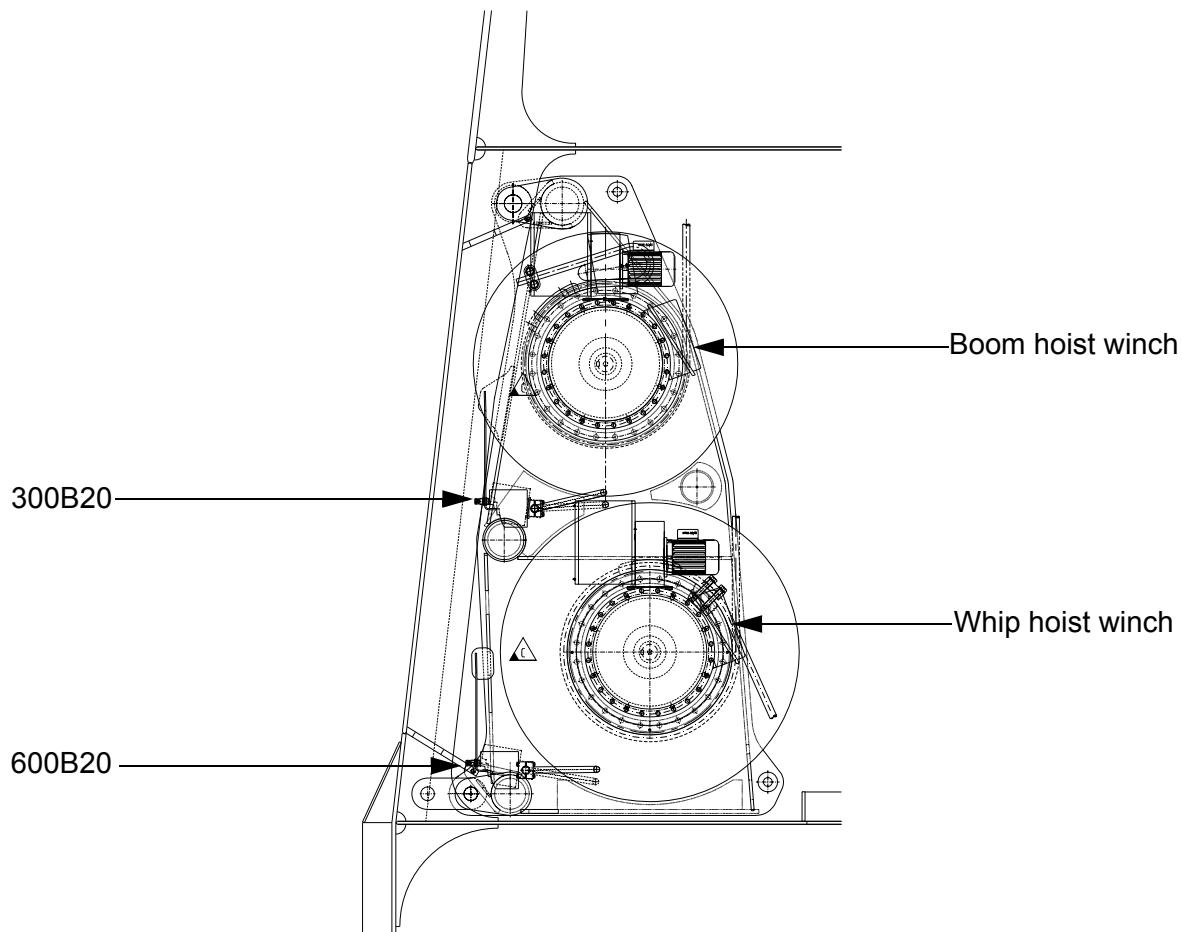


Figure 5-5: Slack Rope switch

See [Figure 5-5](#). See [Section 2.13.7: "Slack rope switch" on page 50](#), [Section 2.14.11: "Slack rope switch" on page 64](#) and [Section 2.15.9: "Slack rope switch" on page 73](#) with the accompanying explanation. Each winch is equipped with a slack rope device. Under each winch a bar is constructed which will be activated and latched when the wire falls slack. The proximity switch will then be deactivated and the applicable winch will stop. Each sensor is connected to the PLC.

Spindle (geared cam limit) switch (300GS1)

The spindle switches have several contacts which are monitored by the PLC. For the boom movement four (4) switches are installed:

- 300GS1-S1 Parking position
This switch is adjusted in such a way that the drum will stop in booming down direction when the boom is on the boom rest.
- 300GS1-S2 0 position
This switch is adjusted in such a way that the drum will stop in booming down direction when the boom angle is 0 degrees.
- 300GS1-S3 pre lowest position boom hoist
This switch is adjusted in such a way that the drum will go to reduced speed when the boom is near the 0 position.

- 300GS1-S4 pre highest position boom hoist
 This switch is adjusted in such a way that the drum will go to reduced speed when the boom has reached approximately 75 degrees boom angle.

DISPS encoder (300B61)

See [Section 5.7.5: "Digital Independent Speed Protection System \(DISPS\)" on page 134](#).

Shaft incremental encoders (300M1-B61, 300M2-B61)

See [Section 5.5: "Electrical Motor" on page 127](#).

More sensors

Table 5-6: More sensors

Description	Code
Boom hoist highest position proximity switch	(300B25/26)
Slackrope boom hoist	(300B20)

5.8.3 WHIP HOIST WINCH

The motors of the whip hoist winch are the same with respect to the general function of brakes and sensors. A slack rope switch is part of the construction, see [Figure 5-5 on page 137](#).

Gearcam

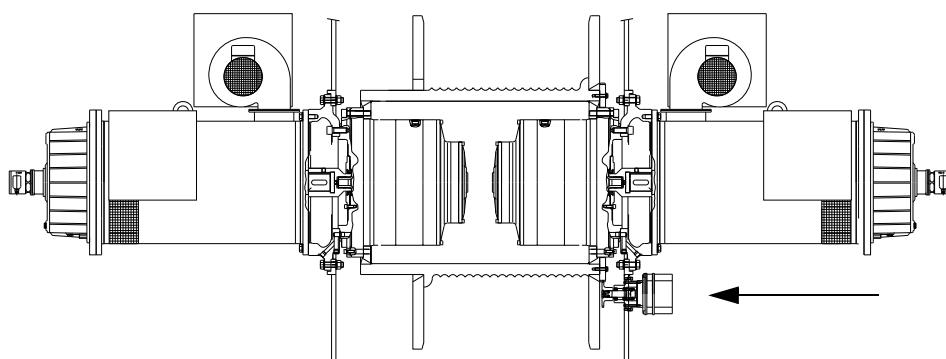


Figure 5-6: Gearcam location

Spindle (geared cam limit) switch (600GS1), see [Figure 5-6 on page 138](#)

For the whip hoist movement eight (8) switches are installed:

- 600GS1-S2 Empty drum whip hoist
 This switch is adjusted in such a way in lowering direction when 4 windings are left at the drum.
- 600GS1-S1 Pre empty drum whip hoist.
 This switch is adjusted in such a way that the drum will go to reduced speed prior to its empty drum position.
- 600GS1-S4 Pre highest position whip hoist in 2-fall reaving.

This switch is adjusted in such a way that the drum will go to reduced speed prior to its highest position.

- 600GS1-S5 Highest position whip hoist in 1-fall reeving.
This switch is adjusted in such a way that the drum will stop due to its highest position.
- 600GS1-S6 Highest position main whip hoist.
This switch is adjusted in such a way that the drum will stop due to its highest position.

DISPS encoder (600B61)

See [Section 5.7.5: "Digital Independent Speed Protection System \(DISPS\)" on page 134.](#)

Shaft incremental encoders (610M1-B61, 620M2-B61)

See [Section 5.5: "Electrical Motor" on page 127.](#)

More sensors

Table 5-7: More sensors

Description	Code
Highest position whip hoist winch	(600B25)
Slackrope whip hoist winch	(600B20)

5.8.4 SLEWING GEAR

The slewing movement is driven by 4 motors. The motors contain the following sensors and components:

Spindle (geared cam limit) switch (200GS1)

Due to the construction of the crane, the slew angles are limited. From zero position the maximal slew range is 225 degrees in each direction (left or right). Prior to each maximal position a pre warning is generated. These positions are adjusted in a spindle switch which is located on top of one of the sprockets. For the slewing movement four switches are installed:

- 200GS1-S1 Maximal Slewing Left
When this maximal slewing left spindle switch is deactivated the slewing left movement will stop. It is adjusted at 225 degrees from zero position.
- 200GS1-S2 Pre Maximal Slewing Left
Prior to the maximal left position the spindle switch pre maximal left position will be deactivated. It is adjusted at 205 degrees from zero position. From this position the speed will be reduced until maximal position is reached.
- 200GS1-S3 Maximal Slewing Right
When this max slewing right spindle switch is deactivated the slewing right movement will stop. It is adjusted at 225 degrees from zero position.
- 200GS1-S4 Pre Maximal Slewing Right
Prior to the maximal right position the spindle switch pre maximal right position will be deactivated. It is adjusted at 205 degrees from zero position. From this position the speed will be reduced until maximal position is reached.

Slew angle absolute encoder (200B70)

The absolute slew angle is measured by a SSI encoder. The slew angle is used by the heave compensation system to calculate the motion of the boom tip.

DISPS encoder (200B61)

See [Section 5.7.5: "Digital Independent Speed Protection System \(DISPS\)" on page 134.](#)

Shaft incremental encoders (210M1-B61, 230M3-B61)

See [Section 5.5: "Electrical Motor" on page 127.](#)

5.9 CRANE HOUSE AND MAST

Cooling fans

The crane house is equipped with three cooling fans to cool the crane house. One large two-speed (Dahlander) fan (022M1) is mounted at deck-level, the other two smaller single speed fans (022M2 and 022M3) are mounted near to the boom hoist and whip hoist winch. The inlet fan is equipped with a filter box, which is mounted outside the crane house.

To achieve optimal ventilation, the crane house and E-room door needs to be closed.

NOTE	<i>The filter box must be opened to operate the crane.</i>
-------------	--

Crane house Thermostat (020S2)

This thermostat controls the crane house cooling fans.

E-room Thermostat (020S1)

This thermostat safeguards the maximum temperature in the E-room. When the temperature is higher than a predefined level, which can be caused by a non-functional air-conditioning system, an alarm is generated on the SCADA screen. The thermostat is located above cabinet (M21).

Evaporators A/C system (020E1 and 020E2)

See supplier documentation Liebert Hiross HPM.

Floodlights crane house (013E4-1/4)

Four 400W floodlights are present at the crane house. More documentation: See Chalmit supplier documentation.

FL lighting (winch room: , and 011E3-1/6, E-room 011E1-1/4, mast: 011E3-1/5)

FL lighting slipring (011E2-1/4)

Slipring

Power (930 VDC for the drive system and 230 Vac for auxiliaries) and small signals are transferred via conductor bars inside the slew platform. All Profibus signals are transferred via Siemens power rail booster and transported by means of the conductor rails (maximal is 187 kB/sec.). The transfer of SCADA data goes via a optical connection.

Aircraft obstruction lights (014E1-1/4)

On the highest fixed part of the mast, four red obstruction lights are mounted. They are powered from the emergency supply (230 Vac). It is possible to switch (014S1) the obstruction lights off.

Emergency FL-light

- (012E1-1/2) located in the E-room?
- (012E3-1/4) located in the Winch room.
- (012E1) located at the mast.?

- (012E4-1/3) outside winch room

Wind speed sensor (086B71)

5.10 CRANE CABIN

Cabin control

The 400t OMC is controlled from the crane cabin. Inside the crane cabin the operator chair and a cabinet are located. At the operator chair three controllers are located. One controller at the left operates the slewing and boom hoist movement, the other two at the right operates the main and whip hoist and either tugger. On the cabin floor foot pedals are located for the tugger winches.

The cabin is equipped with air-conditioning and heating, which is thermostat-controlled. All components in the cabin are fed from the power and electronics cabinets that are placed in the cabin.

All controllers and buttons inside the crane cabin are connected through remote I/O to the crane PLC inside the electronics cabinet (Profibus link) in the crane house.

Two SCADA touchscreen monitors are present for status information.

For a complete overview of the operator cabin and all its consoles, refer to [Section 6: "Operation" on page 153](#).

Power and electronics cabinets (M52)

The cabinet in the cabin is the power cabinet. From this cabinet consumers like lighting, heating, a/c, tugger winch brakes etc. are fed.

Inside the ELCA/POCA cabinet the remote I/O PLC is located as well as the SCADA crane and SCADA heave computers. These computers are responsible for the control of the status information for both the crane and the heave system screens.

Drive cabinet (M51)

Both tugger winches are driven by inverters located in the cabin. The inverters are fed with 930Vdc from the drive cabinet in the switchboard room of the crane. The inverters are controlled by the crane PLC via a profibus link, like all other inverters in the crane. The inverters are equipped with a constant tension control to keep the line pull of the winches equal when they are connected to a load or to the hook.

5.11 SLEW PLATFORM

5.11.1 TUGGER WINCHES

The motors are connected to a frequency inverter in the crane cabin. The motors contain the following sensors and components.

Spindle (geared cam limit) switch (810GS1 and 820GS1)

To safeguard the outer limits each tugger is also equipped with a spindle switch. Each spindle switch has three switches.

- Empty drum tugger
This switch is adjusted in such a way that the drum will stop in lowering direction when 5 windings are left at the drum.
- Pre Highest position tugger
This switch is adjusted in such a way that the drum speed is reduced in hoisting direction when the tugger is near its highest position.
- Highest position tugger
This switch is adjusted in such a way that the drum will stop in hoisting direction when the tugger is in its highest position.

Shaft incremental encoders (811B61) and (821B61)

The shaft encoder is placed on the secondary shaft of the motor, located on top of the brake. These encoders provide a speed and direction signal to the frequency inverter that controls the motors. Each inverter uses one encoder.

5.12 BOOM

Boom angle sensor (300B72)

This sensor generates a 4...20mA current signal corresponding with -15...90 degrees boom angle. With this information the PLC is able to calculate the exact main hoist and whip hoist radius, thus guarding the maximum allowable load curve.

The location of this sensor is just above the left boom hinge point.

Absolute boom angle sensor (300B70)

At the right pivot point of the boom, a empty geared cam housing is mounted which contains an absolute SSI encoder. The signal of this encoder is used to calculate the angle of the boom tip during heave compensator operations.

Load cell main hoist (100B10)

This is the load cell that measures the line pull, by means of strain-gauges. The sensor has a built-in amplifier which generates a current signal. This current signal is led directly to the PLC, thus guarding the main hoist load curve. This sensor is located in the sheave near to the pivot point. (See load cell description in Appendix G: "Load cell documentation").

Load cell whip hoist (600B10)

This is the load cell that measures the line pull, by means of a loadcell. The sensor has a built-in amplifier which generates a current signal. This current signal is led directly to the PLC, thus guarding the load curve. This sensor is located in the sheave above the cabin. (See load cell description in Appendix G: "Load cell documentation").

Load cell tuggers (800M1-B10 and 800M2-B10)

This is the load cell that measures the actual load, by means of strain-gauges, at the hook. The sensor has a built-in amplifier which generates a current signal. This current signal is led directly to the PLC, thus guarding the load curve. The value is used for CT mode. (See load cell description in Appendix G: "Load cell documentation").

Length measurements (mainhoist: 100B21 and 100B22, whip hoist: 600B21 and 600B22)

The mainhoist and whip hoist of the crane are equipped with a length measurement, which is particularly helpful during under water operations. The main hoist length measurement is placed on the same sheave near to the pivot point as the loadcell. The length measurement of the whip hoist is placed at the sheave above the cabin.

Proximity switch highest position main hoist (100B25)

This proximity switch will be deactivated when the main hook is at its highest position, thus resulting in a ramping down/stop of the main hoist winch in hoisting direction, and of the boom hoist winch in booming down direction.

Proximity switch highest position whip hoist (600B25)

This proximity switch will be deactivated when the whip hook is at its highest position, thus resulting in a ramping down/stop of the whip hoist winch in hoisting direction, and of the boom hoist winch in booming down direction.

Proximity switch highest position boom (300B25 and B26)

When this proximity switch is deactivated the boom will stop in booming-up direction. This proximity switch is located halfway up the main boom, at the spring returning device (see Section 2.4.4: "Main hoist highest position switch" on page 36 for details on the mechanism).

Floodlights main jib (013E1-1/4)

Two 400 W floodlights are present at the boom. They are directly switched from the power cabinet inside the cabin. These floodlights can be activated from the crane cabin.

Aircraft obstruction light (014E1)

A red obstruction light is placed on the tip of the fly jib. This light is fed from the UPS DC/AC converter.

5.13 BELOW DECK

This section describes the systems below deck:

- Storage winch
- HPU
- PVU

5.13.1 STORAGE WINCH

See [Section 5.8.1: "Traction winch and storage winch" on page 135](#)

In above mentioned sections the cabinets and components has been described.

5.13.2 HPU (HYDRAULIC POWER UNIT) CABINETS

The HPU cabinets are located in the below deck, at SB. The following cabinets will be described:

- HPU starter cabinets (H11) and (H12)
- HPU control cabinet (H13)

HPU starter cabinets H11, H12

The complete power unit is controlled and started from the 3 cabinets mounted on the HPU skid. The main pump motors are started from the 2 power cabinets H11 and H12.

All I/O generated inside these cabinet is connected to local remote I/O units in H13. This includes supplying the actual start and stop commands for the pumps. Refer to [Section 6: "Operation" on page 81](#) for more information.

During normal operation, cabinet H11 is used to start the main pump of pump set 1. Cabinet H12 is used for plumpest 2. Inside the cabinets the star-delta starter is fitted for both main HPU motors. Starting and stopping can be done local from these cabinets, and also from remote using the SCADA screen in the operator cabin. The status on the SCADA screen will show which pumps are operational.

HPU controller cabinet H13

Most sensors and valves that supervise and control the HPU's are connected to this cabinet. A indication is available on the cabinet doors which indicate that the 230 Vac control power is available. This light gives no information about the 24 Vdc required for the remote I/O station. The 24 Vdc supply that feeds the remote I/O station and other critical parts is obtained from this cabinet.

During an emergency stop, several contactors inside these cabinets must open. This is checked by the emergency stop relays in cabinet H13. If this has not happened, it is not possible to reset the emergency stop situation.

Sensors used in the HPU are described in [Section 4: "Hydraulic description" on page 107](#).

5.13.3 PVU (PRESSURE VESSEL UNIT) CABINETS

The PVU cabinets P01 and P02 are located on top of the PVU.

The control and monitoring of the PVU is from these cabinets via remote I/O units.

They control:

- Valves.

They monitor:

- Valve positions.
- Pressures.

WARNING

Make sure to switch the power in the cabinet off before doing maintenance in the cabinet.

WARNING

Be careful before opening any cabinet! After switching the power off it will take several minutes before the voltage on the copper bars is safe!

WARNING

Apart from waiting several minutes before opening the cabinet after switching, check the voltmeters mounted on the first cabinet to verify if the voltage is zero volts.

5.14 EMERGENCY PROCEDURES

5.14.1 USE OF EMERGENCY CONTROL BOX

Emergency control box

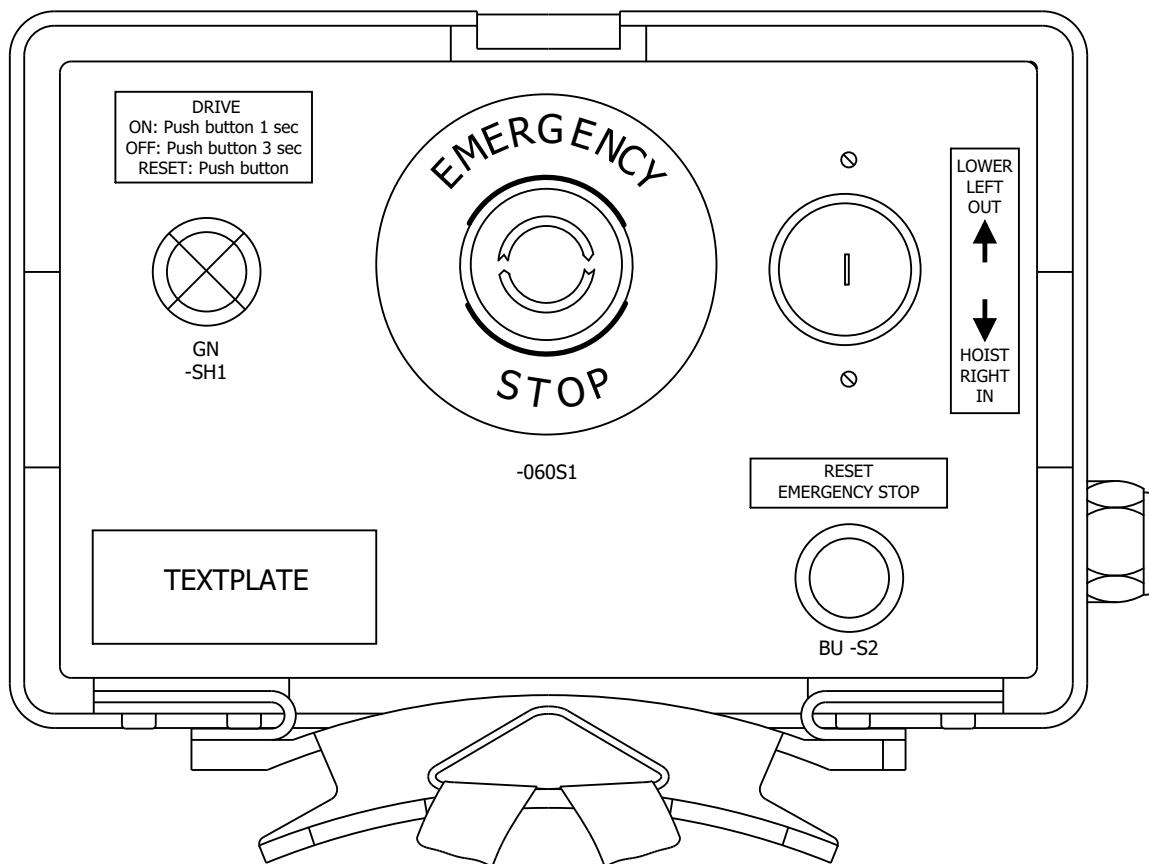


Figure 5-7: Emergency control box

The emergency control box, also known as walk around box (WAB) can be used to control boom hoist and main hoist winch, as well as slewing in case of PLC failure. The box is connected to the connectors on the door of the ELCA / POCA cabinet M22

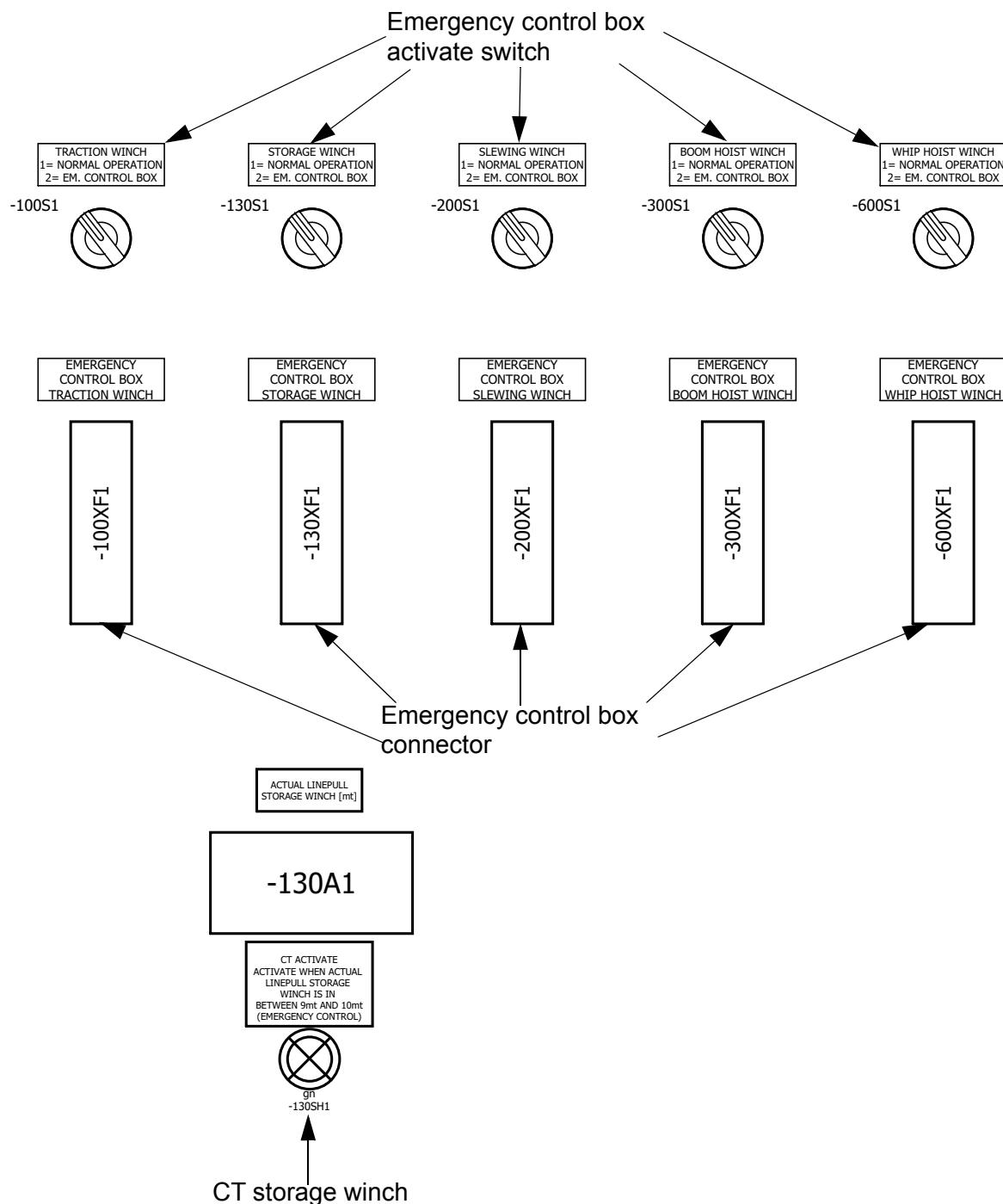


Figure 5-8: Emergency control box connections and controls

Before controlling the drive with the emergency control box, make sure the E-stop on the emergency control box is working correctly. No limit switches will stop the movement in this mode. Make sure no crash can occur.

WARNING



*When using the 'emergency control box' the motor can come into fieldweakening,
 this means that a limited amount of torque is available.*

When the emergency control box is used the CT option of the storage winch can be used with limitations.

Operation:

- Open the cap of the connector of the movement that has to be controlled by the emergency control box.
- Connect the emergency control box connector.
- The “ON” button has three functions
 - Press and release: RESET command
 - Press and hold 1 second: Switch drive ON, a green LED will lit when the drive is ON
 - Press and hold 3 seconds: Switch drive OFF.
- Now, the movement can be operated by means of the controller. Pull it back to hoist, go right, clockwise or retract and push it forward to lower, extend, go left or counterclockwise.
- When the emergency control box is no longer needed remove the connector of the emergency control box.
- Close the cap of the connector.

6 OPERATION

6.1 INTRODUCTION

This chapter describes the operational functionality of the 400 mt OMC. It provides descriptions of the control system, the operational procedures and troubleshooting explanations. The chapter is categorized in the following sections:

[Section 6.2: "Control locations"](#)

[Section 6.3: "SCADA"](#)

[Section 6.4: "Operation modes"](#)

[Section 6.5: "Operation speed"](#)

[Section 6.6: "Operational procedures"](#)

[Section 6.6.6: "Placing jib in jib rest"](#)

[Section 6.8: "Main hoist reeving procedure"](#)

[Section 6.9: "System operations"](#)

[Section 6.10: "General procedures"](#)

[Section 6.11: "Emergency procedures"](#)

[Section 6.12: "Troubleshooting"](#)

6.2 CONTROL LOCATIONS

This OMC is operated from the operator cabin at the left side of the slewing platform. [Figure 6-1](#) and [Table 6-1](#) show the location of the control location. In the following sections, the controls will be described more in detail.

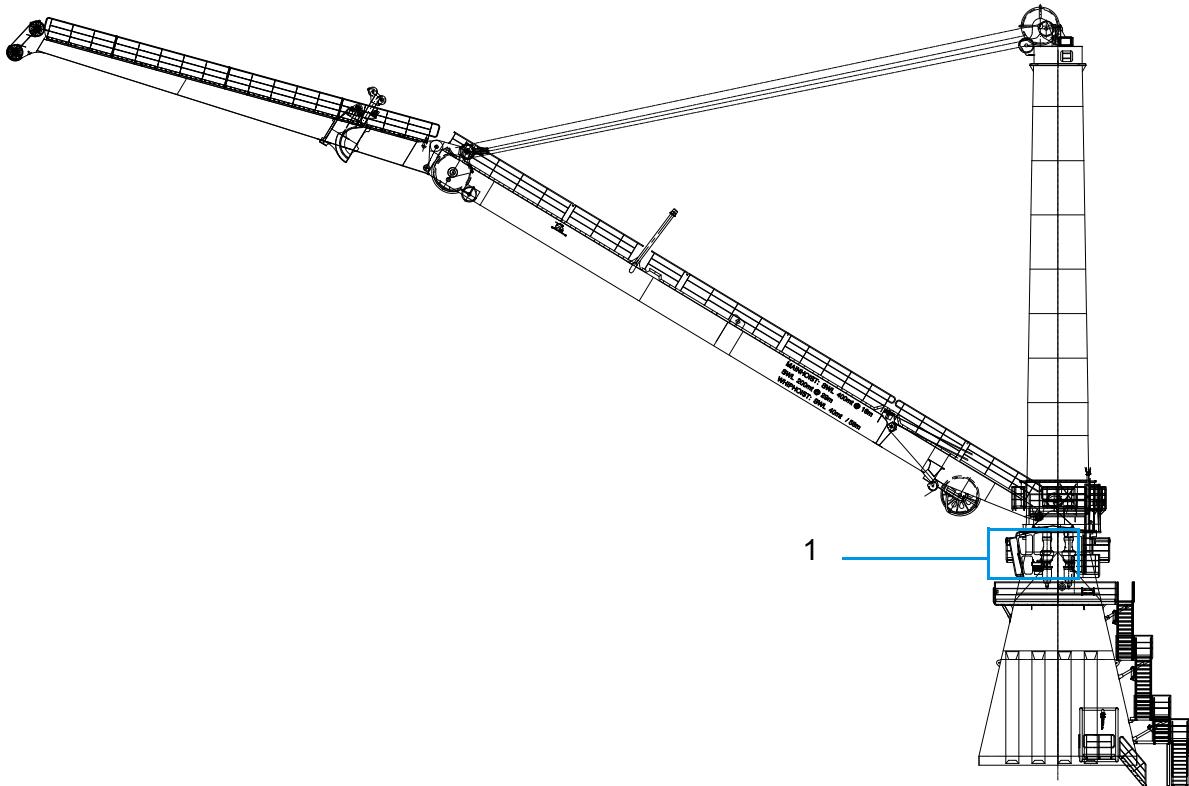


Figure 6-1: Crane control locations

No.	Control system	Location	Description
1	Control cabin	On slewing platform	The control cabin contains the main controls for operating the system. Switches, buttons joy sticks are located near the operator seat. Screens are located in front of the operator seat.

Table 6-1: Controls and locations

6.2.1 CONTROL CABIN CONTROLS

The control cabin is equipped with an operator chair. The main control panels are located in the left and right arm rests of the chair. These panels contain most of the controls. Two foot pedals are designed to control the tugger winches. The operator chair should be in the correct position for good operating overview.

The following sections describe the controls in detail.

6.2.1.1 Left hand console

The left hand console contains multiple controls. These are shown in [Figure 6-2](#). The functions are described in [Table 6-2](#).

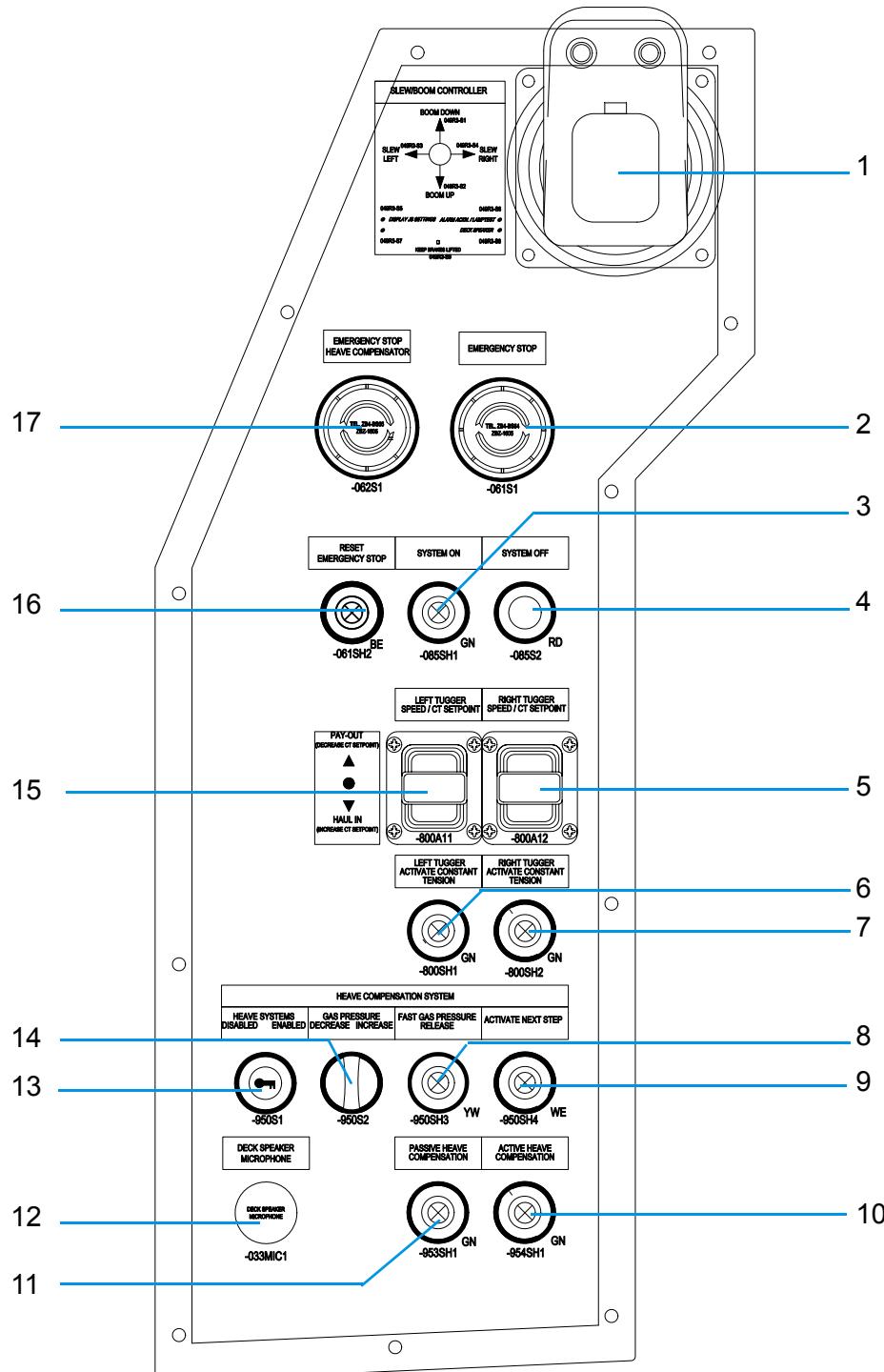


Figure 6-2: Left hand controls

No.	Control	Description
1	Left joystick	X-axis = slew left/right Y-axis = /boom up/down On top of the joystick, buttons are provided. The functions of these buttons are: 1 = Display JS Settings 2 = Alarm acknowledge/ Lamptest 3 = not applicable 4 = Deck speaker 5 = Keep brakes lifted
2	Emergency stop	The emergency stop is used to stop the crane, HPU and AHC in the event of a dangerous situation. When any of the red emergency stop buttons is pressed, the drive system of the crane, the HPU and the Active heave compensation, shut down. Passive heave compensation remains active. The start-up procedure (Section 6.6.3: "Start up procedure") must be carried out to restart the crane. Release the button by turning it clockwise until it springs back into the neutral position.
3	System on	Push button (for 3 seconds) to turn the drive system on. During the start-up sequence the button indicator blinks; when the system is on the indicator is on continuously.
4	System off	Push button to turn the drive system off. During the stop sequence the indicator of the 'System on' button blinks; when the system is off the indicator is off.
5	Right tugger CT set-point	Joystick to operate the tugger and to set the CT setpoint. When in speed mode: joystick to set movement speed. Up = Pay out Down = Haul in The further the controller is deflected, the faster the tugger moves. When in CT setpoint mode: The setpoint has a lower and an upper limit, in between limits the CT-setpoint can be set from 0-100%. Up = Decrease CT setpoint Down = Increase CT setpoint The further the controller is deflected, the faster the CT setpoint changes.
6	Left tugger activate constant tension	Push button to activate constant tension for the left tugger
7	Right tugger activate constant tension	Push button to activate constant tension for the right tugger
8	Fast gas pressure release (Heave compensator)	Push button to use the fast gas release function of the heave compensator
9	Activate next step (Heave compensator)	Push button to go to the next step in the heave compensation sequencers.
10	Active heave compensation	Push button to activate/deactivate active heave compensation
11	Passive heave compensation	Push button to activate/deactivate passive heave compensation.

Table 6-2: Left hand console controls

No.	Control	Description
12	Deck speaker	Microphone for the deck speaker.
13	Heave systems	Key switch to enable or disable the heave systems Left: Disabled Right: Enabled
14	Gas pressure	Switch to increase or decrease the gas pressure in the heave system Left: Decrease Right: Increase
15	Left tugger CT setpoint	Joystick to operate the tugger and to set the CT setpoint. When in speed mode: joystick to set movement speed. Up = Pay out Down = Haul in The further the controller is deflected, the faster the tugger moves. When in CT setpoint mode: The setpoint has a lower and an upper limit, in between limits the CT-setpoint can be set from 0-100%. Up = Decrease CT setpoint Down = Increase CT setpoint The further the controller is deflected, the faster the CT setpoint changes.
16	Reset emergency circuits	First unlock the emergency push stop button by turning, until it changes back into the neutral position. After reset, the system has to be restarted.
17	Emergency stop heave compensator	The emergency stop is used to stop the crane, HPU, AHC & PHC in the event of a dangerous situation. When any of the red emergency stop buttons is pressed, the drive system of the crane, the HPU, AHC & PHC shut down. The start-up procedure (Section 6.6.3: "Start up procedure") must be carried out to restart the crane. Release the button by turning it clockwise until it springs back into the neutral position.

Table 6-2: Left hand console controls (Continued)

NOTE 'System on' can only be activated after the emergency stop circuit has been reset, and all controllers are in the neutral position.

NOTE To start the crane, all joysticks must be in neutral position.

NOTE The joysticks have a quadratic curve. This means that in lower speed regions an increased control accuracy is obtained.

6.2.1.2 Right hand console

The right hand console contains multiple controls. These are shown in [Figure 6-3](#). These functions are described in [Table 6-3](#).

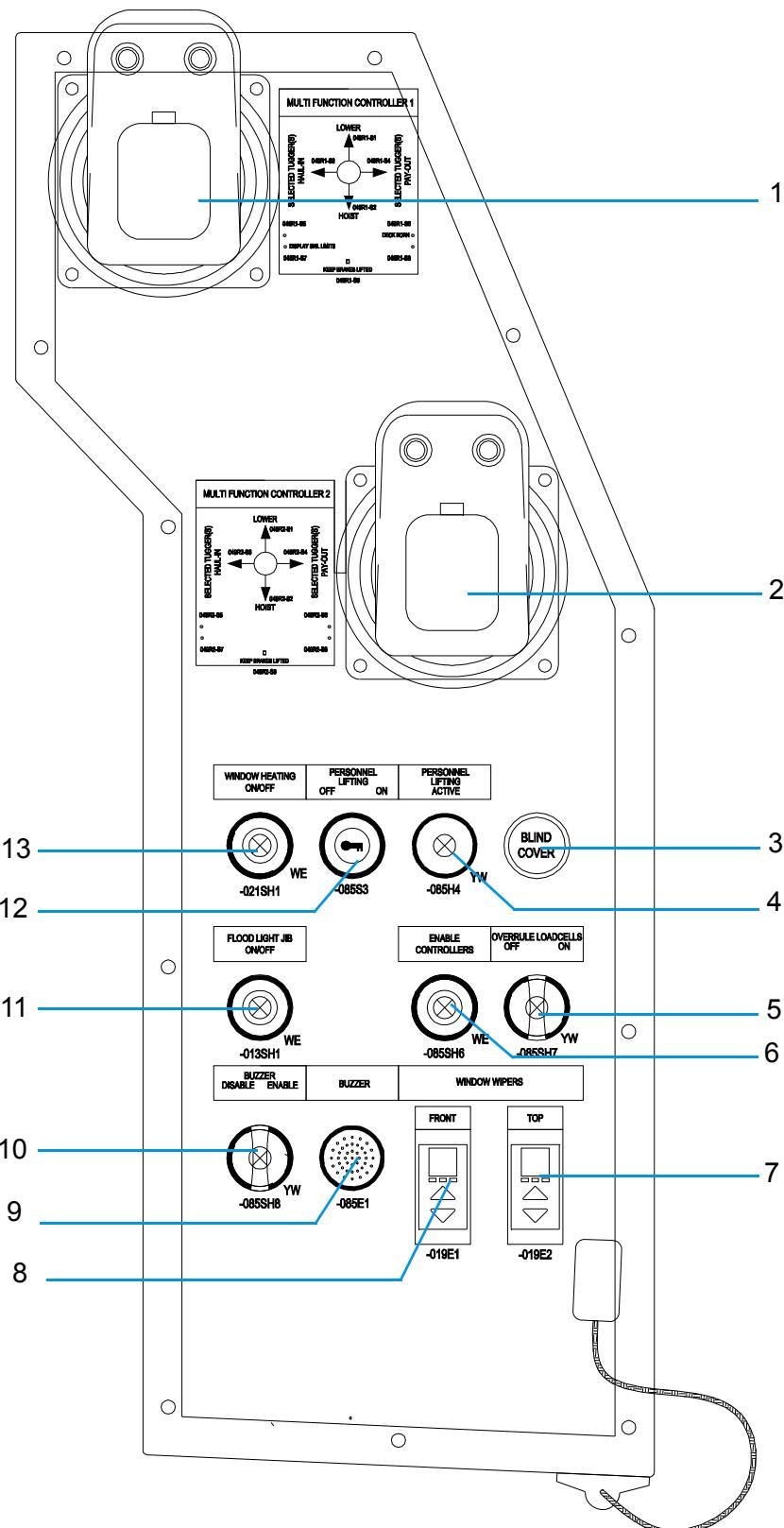


Figure 6-3: Ri

No.	Component	Description
1	Left joystick	Y-axis = hoisting up/down with main or whip hoist X-axis = Haul in / pay out selected tugger On top of the joystick, buttons are provided. The functions of these buttons are: 1 = not applicable 2 = Deck horn 3 = Display SWL limits 4 = not applicable 5 = Keep brakes lifted
2	Right joystick	Y-axis = hoisting up/down with main or whip hoist X-axis = Haul in / pay out selected tugger On top of the joystick, buttons are provided. The functions of these buttons are: 1 = not applicable 2 = not applicable 3 = not applicable 4 = not applicable 5 = Keep brakes lifted
3	Blind cover	-
4	Personnel lifting active	Indication light: Indicates when personnel lifting is active
5	OVERRULE loadcells	Switch to disable the overload protection system. To disable the overload protection system, turn to “enable”. The overload protection system is now disabled for 30 minutes. To disable overrule, turn the switch to “disable”. The loadcells are no longer overruled. An overrule situation is indicated by both a light in the switch and a buzzer, which will sound 3 beeps every 30 sec.
6	Enable controller	Switch to enable or disable the joysticks and pedals.
7	Window wiper	Wiper control, with various speeds
8	Window wiper	Wiper control, with various speeds
9	Buzzer	Buzzer
10	Buzzer disable/enable	Switch to enable or disable the buzzer Left = Disable for 15 minutes Right = Enable
11	Flood light jib on/ off	Push button to turn the floodlights on the jib on or off. The flood light has 5 minutes off protection, it can not be switched on if it was switched off within 5 minutes ago.
12	Personnel lifting	Switch to activate personnel lifting. Follow the procedure described in Section 6.4.4: "Personnel lifting mode"
13	Window heating on/off	Push button to turn the window heating on or off.

Table 6-3: Right hand console controls

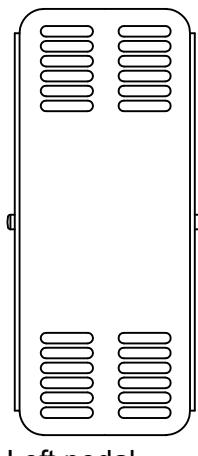
WARNING



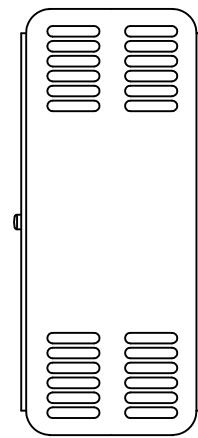
Overruling load cells is dangerous and should not be used unless absolutely necessary!

6.2.1.3 Pedals

Two pedals are available for the crane operator, see [Figure 6-4](#). [Table 6-4](#) gives an overview of the pedal functions. All pedals and joysticks, except the joysticks for slewing and boom hoist, should be assigned to movement(s) before they can be used for movement control..



Left pedal



Right pedal

Figure 6-4: Foot pedals

Pedal	Function
Left	Haul in / pay out left tugger
Right	Haul in / pay out right tugger

Table 6-4: Pedal function

6.2.1.4 CCTV monitor

A CCTV monitor is mounted in the control cabin. The monitor is connected to 3 cameras which are projected to different systems of the crane, see [Table 6-5](#)

Projected system	Location
Traction winch	Storage winch room
Boom and Whip hoist winch	Winch room
Tugger winches	Slewing platform

Table 6-5: Monitored systems of the crane

It is possible to switch between the different camera views.

6.2.1.5 SCADA monitor

Two computer panels with a SCADA (Supervisory Control And Data Acquisition) application are located in the control cabin. SCADA visualizes data, statuses, measurements and alarms. It enables the operator to monitor and coordinate the actions to be taken to control the crane. SCADA is started automatically when the respective PC is started and can only be shut down by users with administrator access level. The two computer panels have the same SCADA system. One of the screens is for crane operation, the other for heave compensation. [Section 6.3: "SCADA"](#) describes the SCADA system more in detail.

6.3 SCADA

6.3.1 INTRODUCTION

SCADA (Supervisory Control And Data Acquisition) is a control system to monitor and coordinate the actions to be taken to control the crane. The SCADA system is used to enter parameters and commands. It provides logging and trending capability to store process values over a period in time. SCADA includes operational and maintenance pages for all subsystems, as well as various alarm pages and general pages. The status of the control system can also be shown.

SCADA starts automatically when the respective PC is started and can only be shut down (utilities menu) by users with administrator access level.

The operational pages are discussed per subsystem. In this chapter, the following screens will be described:

[Section 6.3.3: "Operation screen"](#)

[Section 6.3.4: "Equipment screen"](#)

[Section 6.3.5: "Heave screen"](#)

[Section 6.3.6: "Power screen"](#)

[Section 6.3.7: "Controller screen"](#)

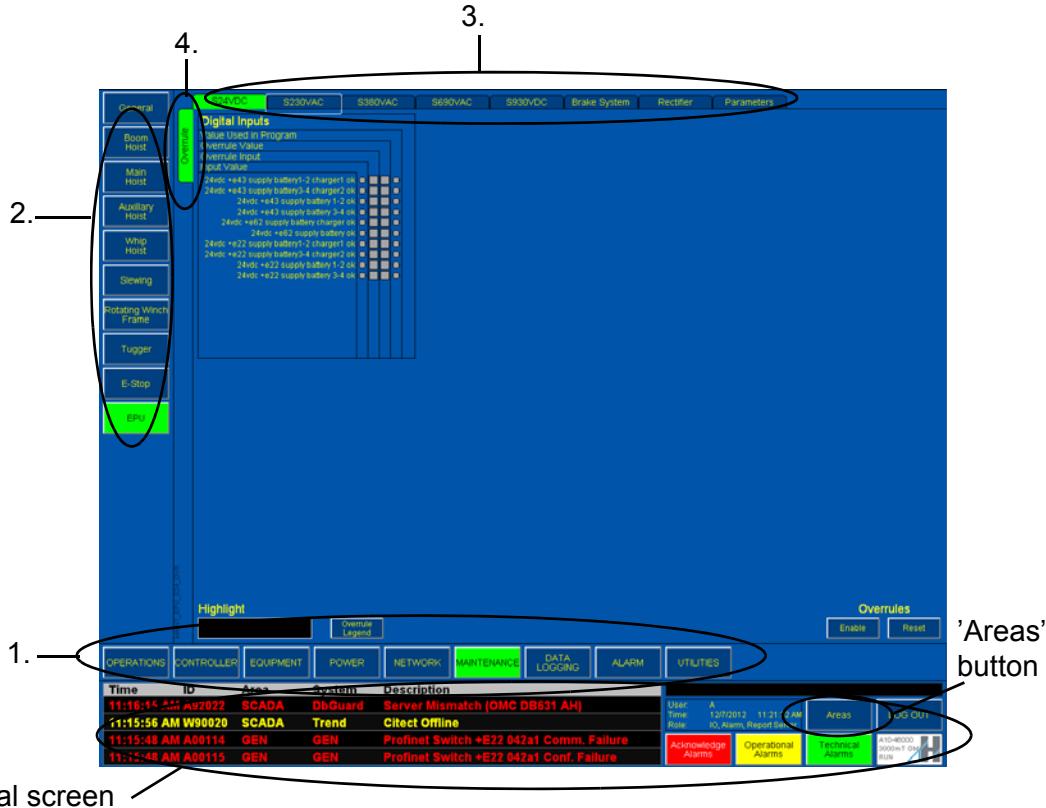
[Section 6.3.8: "Additional screens"](#)

NOTE

The values in the displayed SCADA screens are examples.

6.3.2 SCADA STRUCTURE

The SCADA application structure is listed in [Table 6-6](#). This table refers to the buttons as shown in [Figure 6-5](#).



[Figure 6-5: SCADA application structure](#)

The SCADA control system is structured in multiple area buttons, tabs and sub tabs. In [Table 6-6](#) the structure is shown.

1. Topic button	2. Area buttons	3. Main tabs	4. Sub tabs
Operation screen Section 6.3.3: "Operation screen"		General	
Equipment screen Section 6.3.4: "Equipment screen"	Slewing Boom hoist Main hoist Whip hoist Load tugger	Traction winch Drive Storage winch Load tugger 1 Load tugger 2	General Drive

[Table 6-6: SCADA menu structure](#)

1. Topic button	2. Area buttons	3. Main tabs	4. Sub tabs
Heave screen Section 6.3.5: "Heave screen"	Heave	Heave	
		Details	
	PVU	PVS	
		PIU	
	Sequencers	Lower Load	
		Lift Overpull	
		Subsea Lift	
		Supply Boat	
	APC		
Power screen Section 6.3.6: "Power screen"	EPU	OMC	
		General	VDC930
	HPU	Heave	
Network screen Section 6.3.8: "Additional screens"	E-stop	OMC	
	Profibus	OMC	
	Ethernet	OMC	
Alarm screen Section 6.3.8: "Additional screens"		SCADA	Active
			Disabled
			Alarms
Data Logging Section 6.3.8: "Additional screens"		Trend	
		Commands	
		Events	
Parameters Section 6.3.8: "Additional screens"	OMC	General	
		Slewing	
		Boom Hoist	
		Main Hoist	
		Whip Hoist	
		Load tugger	
	Heave	Heave	Parameter 1
			Parameter 2
	PVU		
	EPU	OMC	
	HPU	Heave	

Table 6-6: SCADA menu structure (Continued)

1. Topic button	2. Area buttons	3. Main tabs	4. Sub tabs
Overrule screen Section 6.3.8: "Additional screens"	OMC	General	General Lighting HVAC Controller
		Slewing	
		Boom Hoist	
		Main Hoist	Traction Winch Storage winch
		Whip Hoist	
		Load Tugger	Load Tugger 1 Load Tugger 2
	Heave	Heave	
		PVU1	
		PVU2	
	EPU	OMC	
	HPU	Heave	
	Emergency Stop	OMC	
		Heave	
	Network	Network	
		DP-DP Coupler	
Utilities screen Section 6.3.8: "Additional screens"		Standard	
		Service	
		I/O Devices	
Controller screen Section 6.3.7: "Controller screen"		General	

Table 6-6: SCADA menu structure (Continued)

6.3.3 OPERATION SCREEN

To access the operations screen, the 'Operations' topic button must be pressed. See [Figure 6-6](#) for a screenshot.

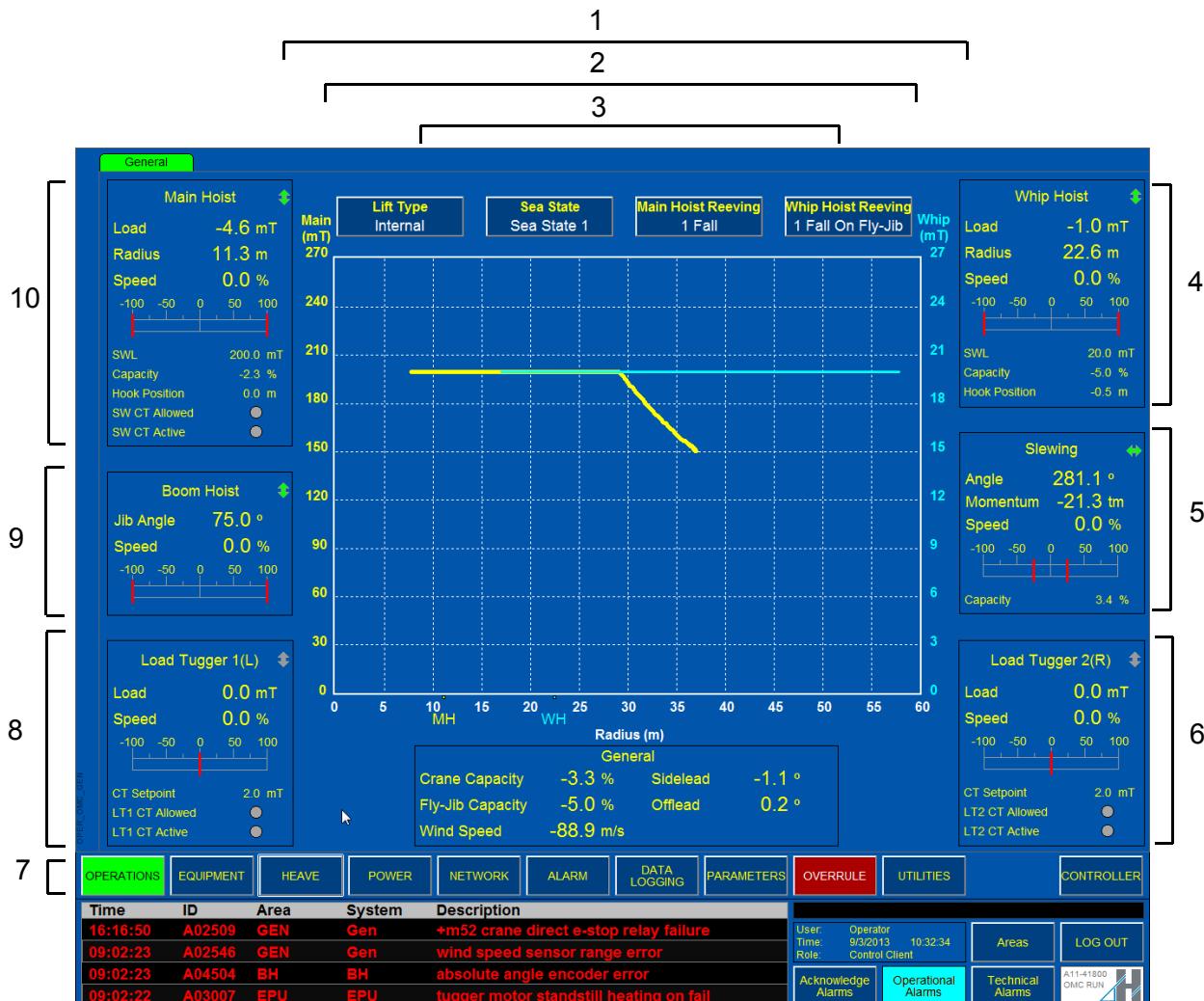


Figure 6-6: Operations - Main

6.3.3.1 Information

[Table 6-7](#) provides the different information fields, including a brief description.

No.	Field	Options
1	Load curves	- Visible load curves of the Main Hoist and Whip Hoist
2	OMC setup	Options for: - Selecting Lift Type - Selecting the sea state by entering the value for Significant wave height (Hsig). - Selecting reeving selection for the main hoist, the number of falls. - Selecting reeving selection for the whip hoist, the number of falls.

Table 6-7: Operations screen

No.	Field	Options
3	General	Information displayed on: <ul style="list-style-type: none"> - Windspeed [m/s] - Sidelead [°] - Offlead [°] - Crane Capacity [%] - Fly-Jib Capacity [%]
4	Whip hoist	Information displayed on: <ul style="list-style-type: none"> - Load [mt] - Radius [m] - Speed [%] - SWL [mt] - Capacity [%] - Hook Position [m]
5	Slewing	Information displayed on: <ul style="list-style-type: none"> - Angle [°] - Momentum [tm] - Speed [%] - Capacity [%]
6	Right Load Tugger	Information displayed on: <ul style="list-style-type: none"> - Load [mt] - Radius [m] - Speed [%] - CT Setpoint [mt] - LT2 CT Allowed [indicator] - LT 2 CT Active [indicator]
7	Screen Buttons	Buttons to access the screens: <ul style="list-style-type: none"> - Operations - Equipment - Heave - Power - Network - Alarm - Data Logging - Parameters - Overrule - Utilities - Controller
8	Left Load Tugger	Information displayed on: <ul style="list-style-type: none"> - Load [mt] - Radius [m] - Speed [%] - CT Setpoint [mt] - LT2 CT Allowed [indicator] - LT 2 CT Active [indicator]
9	Boom Hoist	Information displayed on: <ul style="list-style-type: none"> - Jib Angle [°] - Speed [%]

Table 6-7: Operations screen (Continued)

No.	Field	Options
10	Main Hoist	Information displayed on: - Load [mt] - Radius [m] - Speed [%] - SWL [mt] - Capacity [%] - Hook Position [m] - SW CT Allowed [indicator] - SW CT Active [indicator]

Table 6-7: Operations screen (Continued)

Speeds and capacities

For movements without a load curve, the actual used load capacity is displayed by means of a numeric relative value.

The load capacity = the actual load / maximum load * 100%

The actual motor speed is displayed by means of a bar graph, and indicates a value of the relative speed from -125% to +125%. A negative value means lowering a hoist or slewing to the left. A positive value means hoisting or slewing to the right.

Loadcurves

For some movements, the current SWL depends on the current radius of the hoist. The relation between the radius and the SWL is visualized in a loadcurve. A line graph and a box with all numeric values provide information on the loadcurve of a movement.

6.3.3.2 Pop-up Screens

The pop ups which are provided in this screen are shown in this section.

Crane setup

After a restart, the correct setup of the OMC and the hoist conditions must be re-selected. .

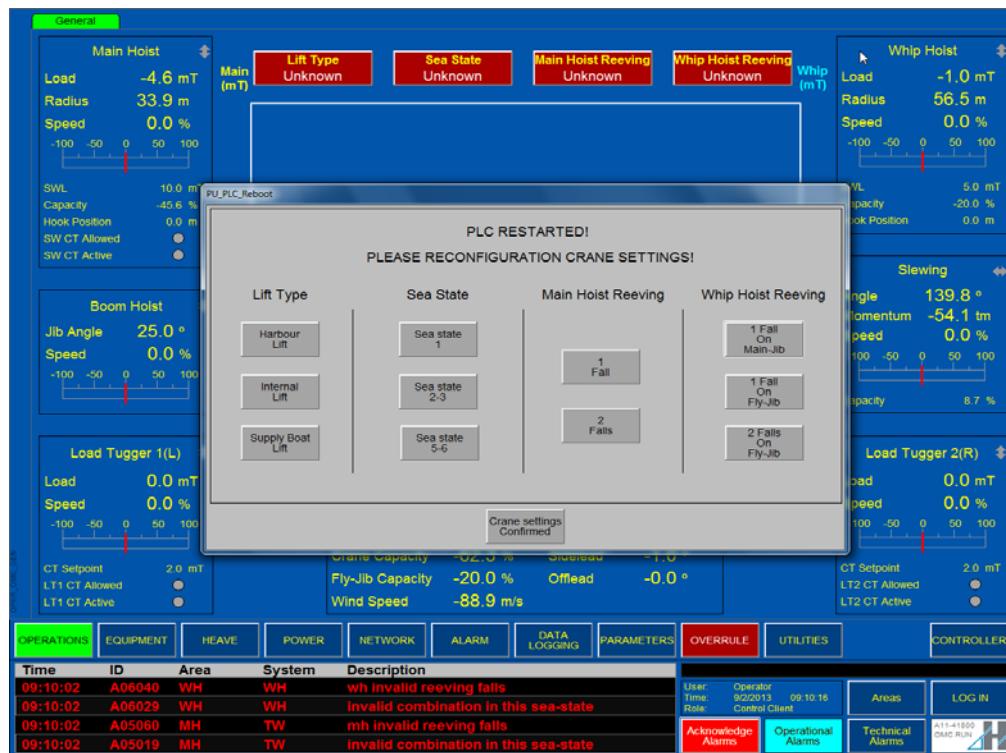


Figure 6-7: Crane setup screen

Lift types

4 lift types are possible to select:

Lift type	Description
Harbour lift	Lifting in sheltered waters without vessel motion due to waves
Internal lift	Lifting to or from the own deck of the crane vessel
Supplier lift	Lifting to or from another floating object
Personnel Lifting	Lifting to transport personnel with the crane

Table 6-8: Lift types 400 mt OMC



Figure 6-8: Lift type selection screen

Sea state

Sea conditions are set and displayed in sea state categories, quantified in significant wave height (Hsig). If a sea state is not allowed to set, the button is not displayed. A button will be green when that mode is selected. When more selections are made, the selected buttons will

be red. Press one button again to deselect that selection.

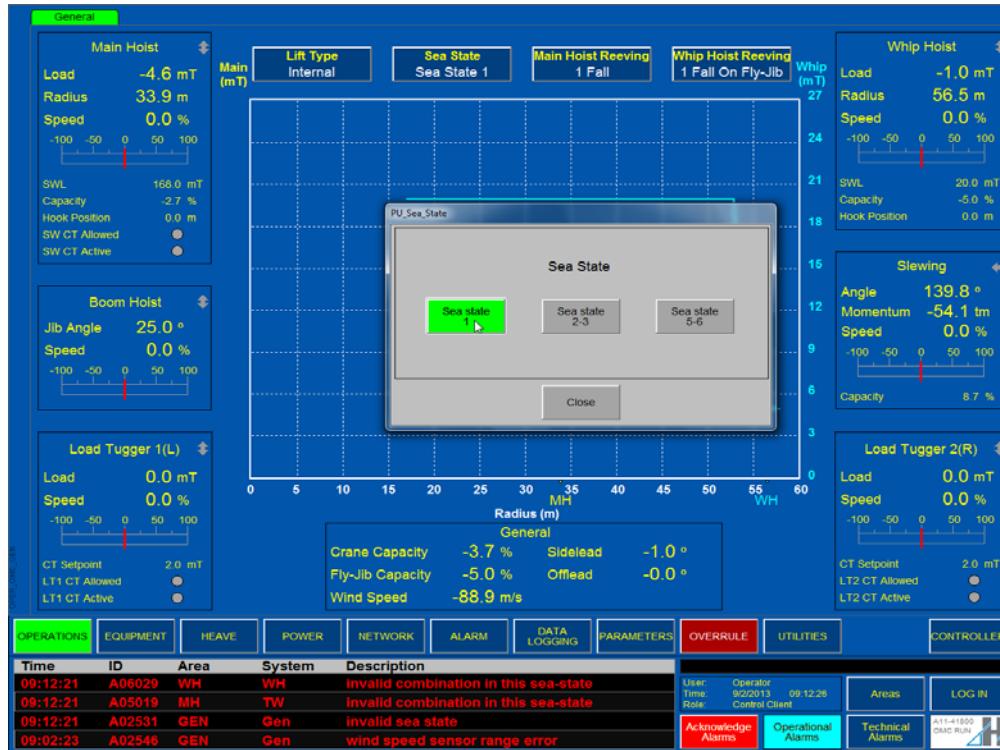


Figure 6-9: Sea state selection screen

Main hoist reeving

The main hoist can be reeved in 1 or 2 falls. When the main hoist is used, a pop up screen appears. In this pop up screen the operator indicates a reeving preference.

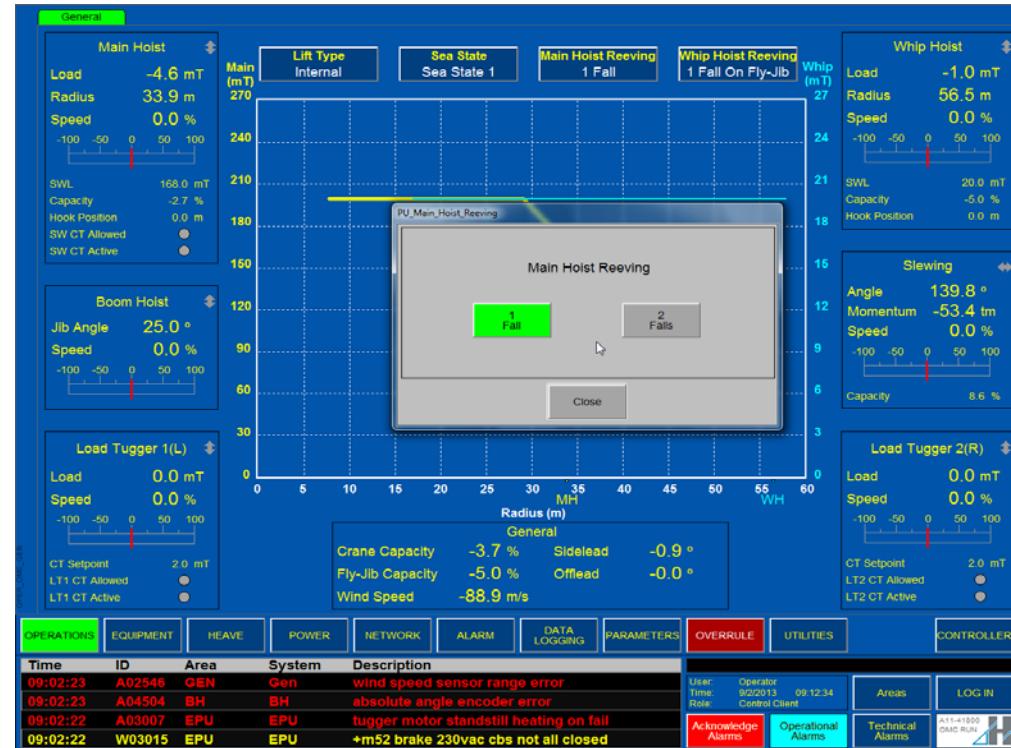


Figure 6-10: Main hoist reeving selection screen

Whip hoist reeving

The whip hoist can be reeved in 1 or 2 falls. When the whip hoist is used, a pop up screen appears. In this pop up screen the operator indicates a reeving preference.

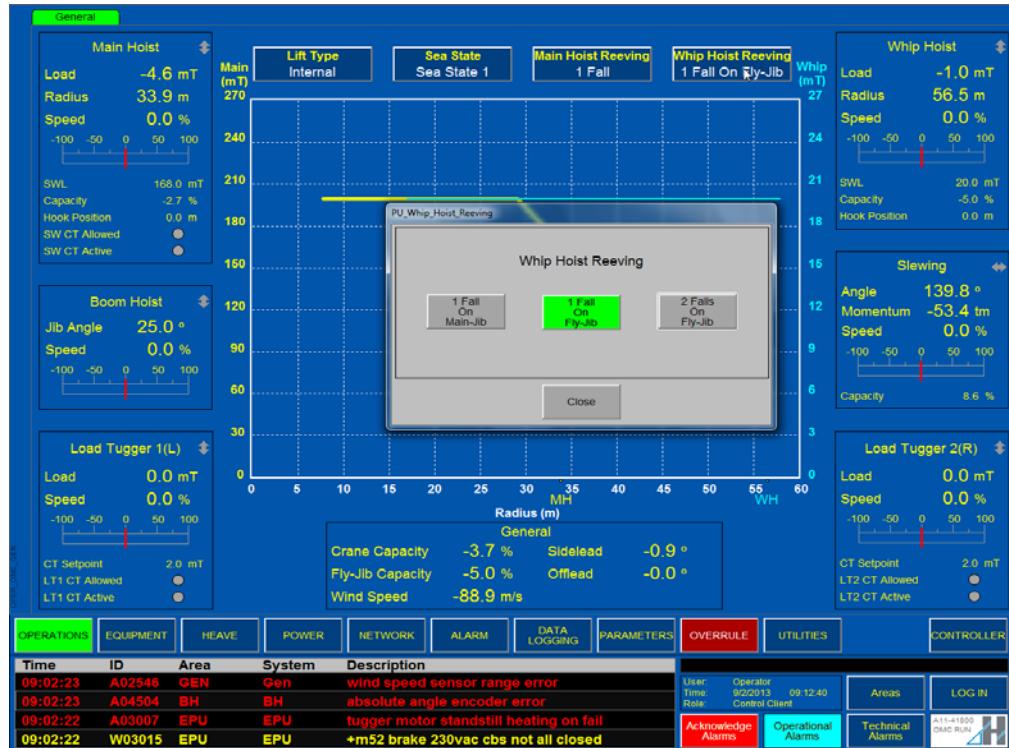


Figure 6-11: Whip hoist reeving selection screen

6.3.4 EQUIPMENT SCREEN

To access the Equipment screen, the Equipment topic button must be pressed. The equipment screen shows the following information on the drive systems:

6.3.4.1 Equipment - Slewing

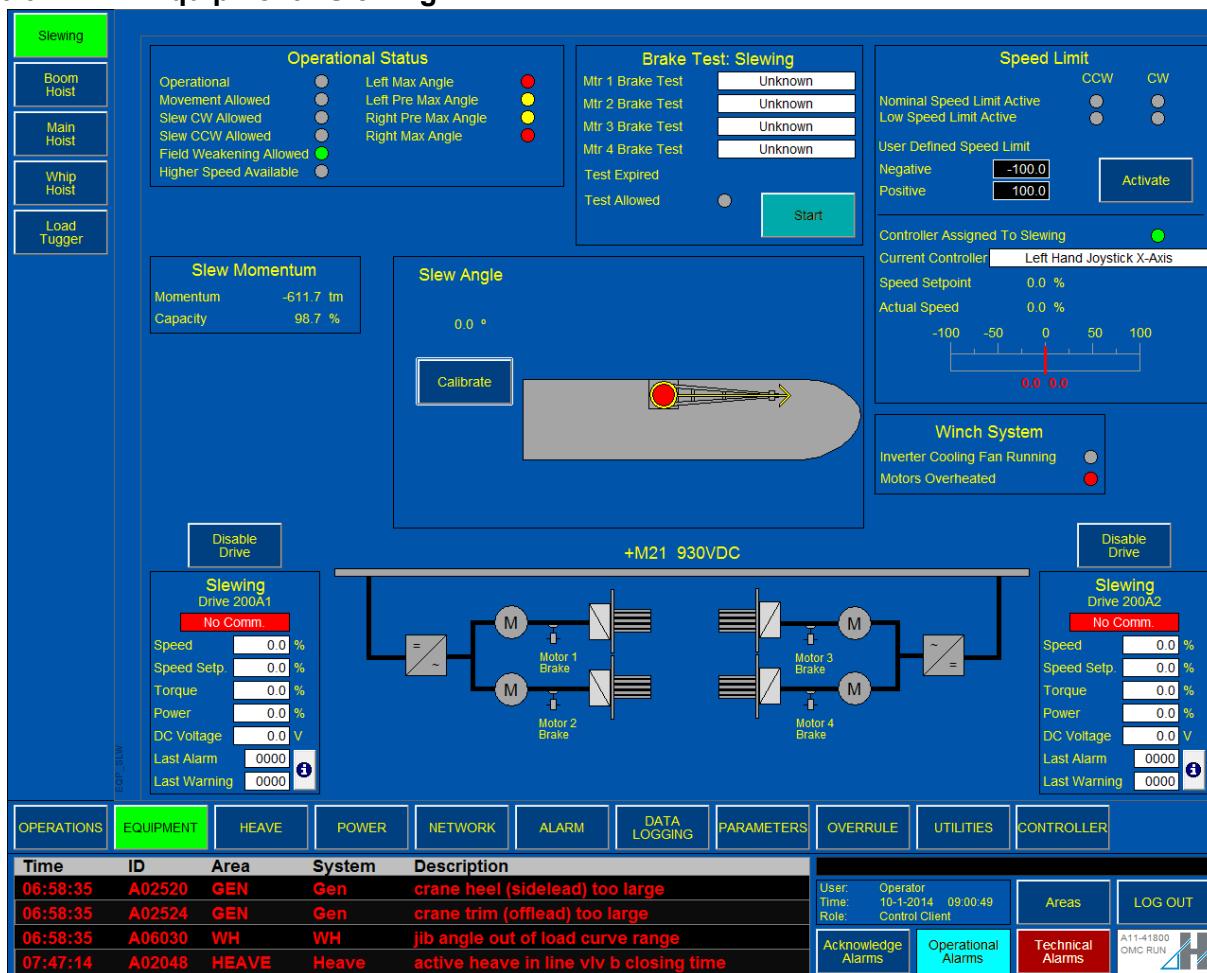


Figure 6-12: Equipment - Slewing screen

Field	Options
Operational status	Information displayed on current state: <ul style="list-style-type: none"> - Operational [indicator] - Movement Allowed [indicator] - Slew CW Allowed [indicator] - Slew CCW Allowed [indicator] - Field Weakening Allowed [indicator] - Higher Speed Available [indicator] - Left Max Angle [indicator] - Left Pre Max Angle [indicator] - Right Pre Max Angle [indicator] - Right Max Angle [indicator]
Brake test: Slewing	Information displayed on current state: <ul style="list-style-type: none"> - Mtr. 1 Brake [indicator] - Mtr. 2 Brake [indicator] - Mtr. 3 Brake [indicator] - Mtr. 4 Brake [indicator] - Test Required in [Days] - Test Allowed [indicator] 'Start' button, press this button to start the brake test

Table 6-9: Equipment - Slewing Screen

Field	Options
Speed Limit	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Nominal Speed Limit Active [indicator CCW / CW] - Low Speed Limit Active [indicator CCW / CW] - Customize Speed Limit <ul style="list-style-type: none"> - Negative [field] - Positive [field] <p>'Activate' button, limit the speed manually to the value entered on the left input field</p> <p>Controller Assigned To Slewing [indicator] Current Controller Speed Setpoint [%] Actual Speed [%]</p>
Slew Momentum	<p>Information displayed on:</p> <ul style="list-style-type: none"> - Slew Momentum [tm] - Capacity [%]
Slew Angle	<ul style="list-style-type: none"> - Slew Angle [°] <p>'Calibrate' button, press this button to calibrate the slewing angle</p>
Winch System	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Inverter Cooling Fan Running [indicator] - Motor Cooling Fans Running [indicator] - Motors Overheated [indicator]
General	<p>Brake state indication for all brakes, see Section 6.3.4.9: "Brake state indication"</p>
Slewing Drive 200A1	<p>'Disable Drive' button, press this button to disable this drive</p> <p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p>
Slewing Drive 200A2	<p>'Disable Drive' button, press this button to disable this drive</p> <p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p>

Table 6-9: Equipment - Slewing Screen

6.3.4.2 Equipment - Boom Hoist

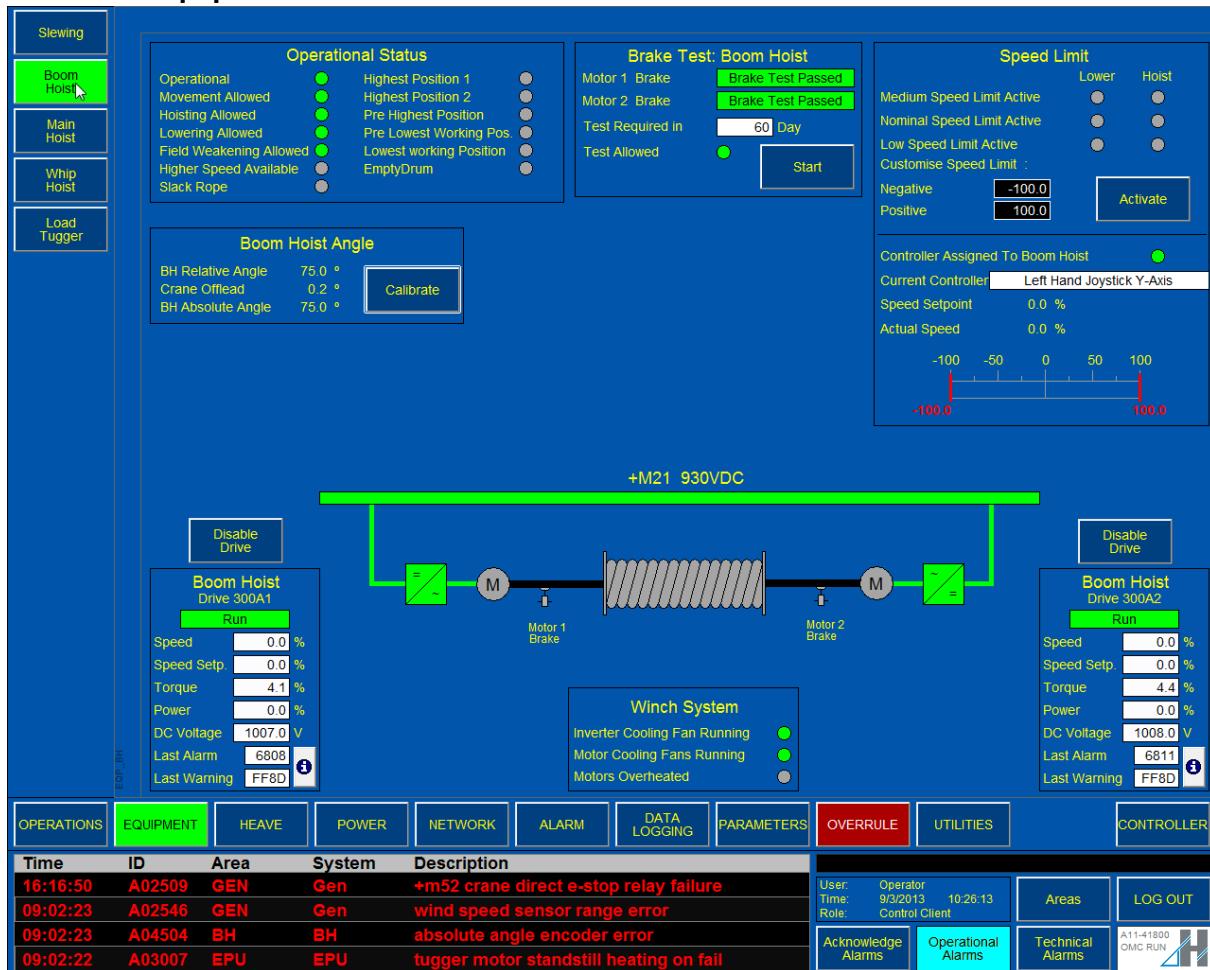


Figure 6-13: Equipment - Boom Hoist screen

Field	Options
Operational status	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Operational [indicator] - Movement Allowed [indicator] - Hoisting Allowed [indicator] - Lowering Allowed [indicator] - Field Weakening Allowed [indicator] - Higher Speed Available [indicator] - Slack Rope [indicator] - Highest Position 1 [indicator] - Highest Position 2 [indicator] - Pre Highest Position [indicator] - Pre Lowest Working Pos [indicator] - Lowest Working Position [indicator] - EmptyDrum [indicator]

Table 6-10: Equipment - Boom Hoist Screen



Field	Options
Brake test: Boom Hoist	Information displayed on current state: <ul style="list-style-type: none"> - Motor 1 Brake [indicator] - Motor 2 Brake [indicator] - Test Required in [Days] - Test Allowed [indicator] 'Start' button, press this button to start the brake test
Speed Limit	Information displayed on current state: <ul style="list-style-type: none"> - Medium Speed Limit Active [indicator Lower / Hoist] - Nominal Speed Limit Active [indicator Lower / Hoist] - Low Speed Limit Active [indicator Lower / Hoist] - Customize Speed Limit <ul style="list-style-type: none"> - Negative [field] - Positive [field] 'Activate' button, press this button to limit the speed manually to the value entered on the left input field. Controller Assigned To Boom Hoist [indicator] Current Controller Speed Setpoint [%] Actual Speed [%]
Boom Hoist Angle	Information displayed on: <ul style="list-style-type: none"> - BH Relative Angle [°] - Crane Offlead [°] - BH Absolute Angle [°] 'Calibrate' button, press this button to calibrate the angle of the boom hoist
General	Brake state indication for all brakes, see Section 6.3.4.9: "Brake state indication"
Winch System	Information displayed on current state: <ul style="list-style-type: none"> - Inverter Cooling Fan Running [indicator] - Motors Overheated [indicator]
Boom Hoist- Drive 300A1	'Disable Drive 300A1' button, press this button to disable this drive Information displayed on: <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] 'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"

Table 6-10: Equipment - Boom Hoist Screen

Field	Options
Boom Hoist Drive 300A2	'Disable Drive 300A2' button, press this button to disable this drive Information displayed on: <ul style="list-style-type: none">- State, see Section 6.3.4.8: "State"- Speed [%]- Speed Setp. [%]- Torque [%]- Power [%]- DC Voltage [V]- Last Alarm [-]- Last Warning [-] 'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"

Table 6-10: Equipment - Boom Hoist Screen

6.3.4.3 Equipment - Main Hoist - Traction Winch - General



Figure 6-14: Equipment - Main Hoist - Traction winch - General screen

Field	Information
Operational status	Information displayed on current state: - Operational [indicator] - Movement Allowed [indicator] - Hoisting Allowed [indicator] - Lowering Allowed [indicator] - Up Field Weak. Allowed [indicator] - Low Field Weak. Allowed [indicator] - Higher Speed Available [indicator] - Highest Position [indicator] - Pre Empty Drum [indicator] - Empty Drum [indicator]

Table 6-11: Equipment - Main Hoist - Traction Winch - General

Field	Information
Load	<p>Information displayed on:</p> <ul style="list-style-type: none"> - Load [mt] - Radius [m] - SWL [mt] - Capacity [%] - Linepull [mt] - MH Loadcell Corrected [indicator] <p>'Loadcell Correction' button, press this button to correct the LMP based on the boom angle</p>
Single Mode	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Single Mode Allowed [indicator] <p>'Single Mode' button, press this button to turn traction winch single mode on/off</p>
Winch System	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Up Inverter Cooling Fan Running [indicator] - Up Motor Cooling Fans Running [indicator] - Up Motor Oil Coolers Running [indicator] - Up Motors Overheated [indicator] - Low Inverter Cooling Fan Running [indicator] - Low Motor Cooling Fans Running [indicator] - Low Motor Oil Coolers Running [indicator] - Low Motors Overheated [indicator] - Lubrication Pump Running [indicator] - Up Mtr1 GB Temp. [°C] - Up Mtr2 GB Temp. [°C] - Up Mtr3 GB Temp. [°C] - Low Mtr1 GB Temp. [°C] - Low Mtr2 GB Temp. [°C] - Low Mtr3 GB Temp. [°C]
Brake test: Traction Winch	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Up Motor 1 Brake [indicator] - Up Motor 2 Brake [indicator] - Up Motor 3 Brake [indicator] - Low Motor 1 Brake [indicator] - Low Motor 2 Brake [indicator] - Low Motor 3 Brake [indicator] - Test Required in [Day] - Test Allowed [indicator] <p>'Start' button, press this button to start the brake test</p>
Speed Limit	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Nominal Speed Limit Active [indicator Lower / Hoist] - Low Speed Limit Active [indicator Lower / Hoist] - Customize Speed Limit <ul style="list-style-type: none"> - Negative [field] - Positive [field] <p>'Activate Customize Speed Limit' button, press this button to limit the speed manually to the value entered on the left input field.</p> <p>Controller Assigned To MH/TW [indicator] Current Controller Speed Setpoint [%] Actual Speed [%] Hook Speed [m/s]</p>

Table 6-11: Equipment - Main Hoist - Traction Winch - General

Field	Information
Hook Position	<p>Information displayed on:</p> <ul style="list-style-type: none">- Absolute [m]- Relative [m]- Reset To [field] <p>'Reset Absolute' button, press this button to reset the absolute hook position (only possible in highest position)</p> <p>'Reset Relative' button, press this button to reset the relative hook position</p>

Table 6-11: Equipment - Main Hoist - Traction Winch - General

6.3.4.4 Equipment - Main Hoist - Traction Winch - Drive

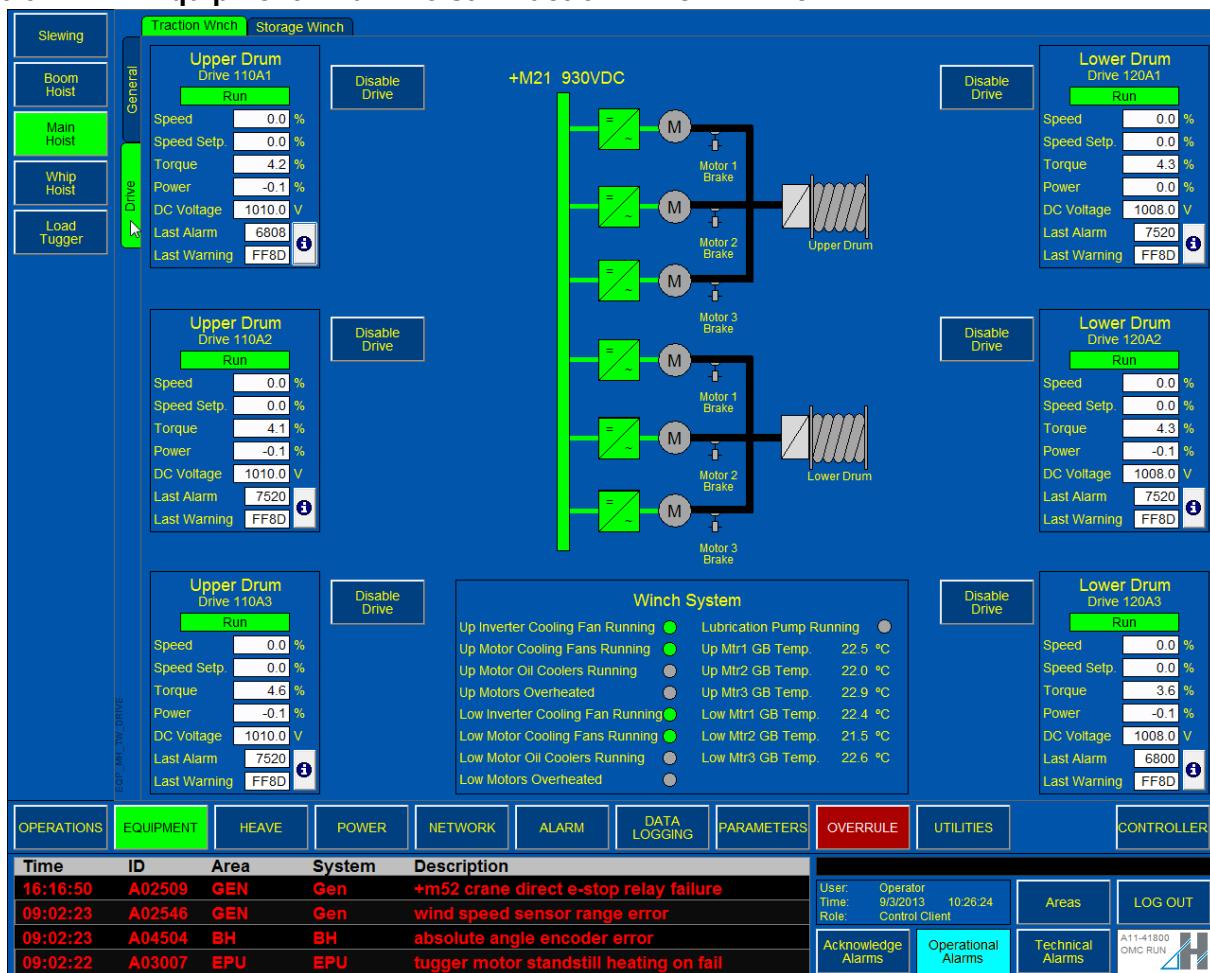


Figure 6-15: Equipment - Main Hoist - Traction winch - Drive screen

Field	Information
TW Upper Drum Drive 110A1	<p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p> <ul style="list-style-type: none"> - 'Disable Drive' button, press this button to disable this drive

Table 6-12: Equipment - Main Hoist - Traction Winch - Drive

Field	Information
TW Upper Drum Drive 110A1	<p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p> <ul style="list-style-type: none"> - 'Disable Drive' button, press this button to disable this drive
TW Upper Drum Drive 110A2	<p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p> <ul style="list-style-type: none"> - 'Disable Drive' button, press this button to disable this drive
TW Upper Drum Drive 110A3	<p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p> <ul style="list-style-type: none"> - 'Disable Drive' button, press this button to disable this drive
General	Brake state indication for all brakes, see Section 6.3.4.9: "Brake state indication"
Winch System	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Up Inv. Cooling Fan Running [indicator] - Up Mttrs Cool Fan Run [indicator] - Up Motors Overheated [indicator] - Up Oil Coolers Run [indicator] - Up Mtr1 GB Temp. [°] - Up Mtr2 GB Temp. [°] - Up Mtr3 GB Temp. [°] - Lub. Pump Running [indicator] - Low Inv. Cooling Fan Running [indicator] - Low Mttrs Cool Fan Run [indicator] - Low Motors Overheated [indicator] - Low Oil Coolers Run [indicator] - Low Mtr1 GB Temp. [°] - Low Mtr2 GB Temp. [°] - Low Mtr3 GB Temp. [°]

Table 6-12: Equipment - Main Hoist - Traction Winch - Drive

Field	Information
TW Lower Drum Drive 120A1	<p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p> <ul style="list-style-type: none"> - 'Disable Drive' button, press this button to disable this drive
TW Lower Drum Drive 120A2	<p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p> <ul style="list-style-type: none"> - 'Disable Drive' button, press this button to disable this drive
TW Lower Drum Drive 110A3	<p>Information displayed on:</p> <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p> <ul style="list-style-type: none"> - 'Disable Drive' button, press this button to disable this drive

Table 6-12: Equipment - Main Hoist - Traction Winch - Drive

6.3.4.5 Equipment - Main Hoist - Storage winch

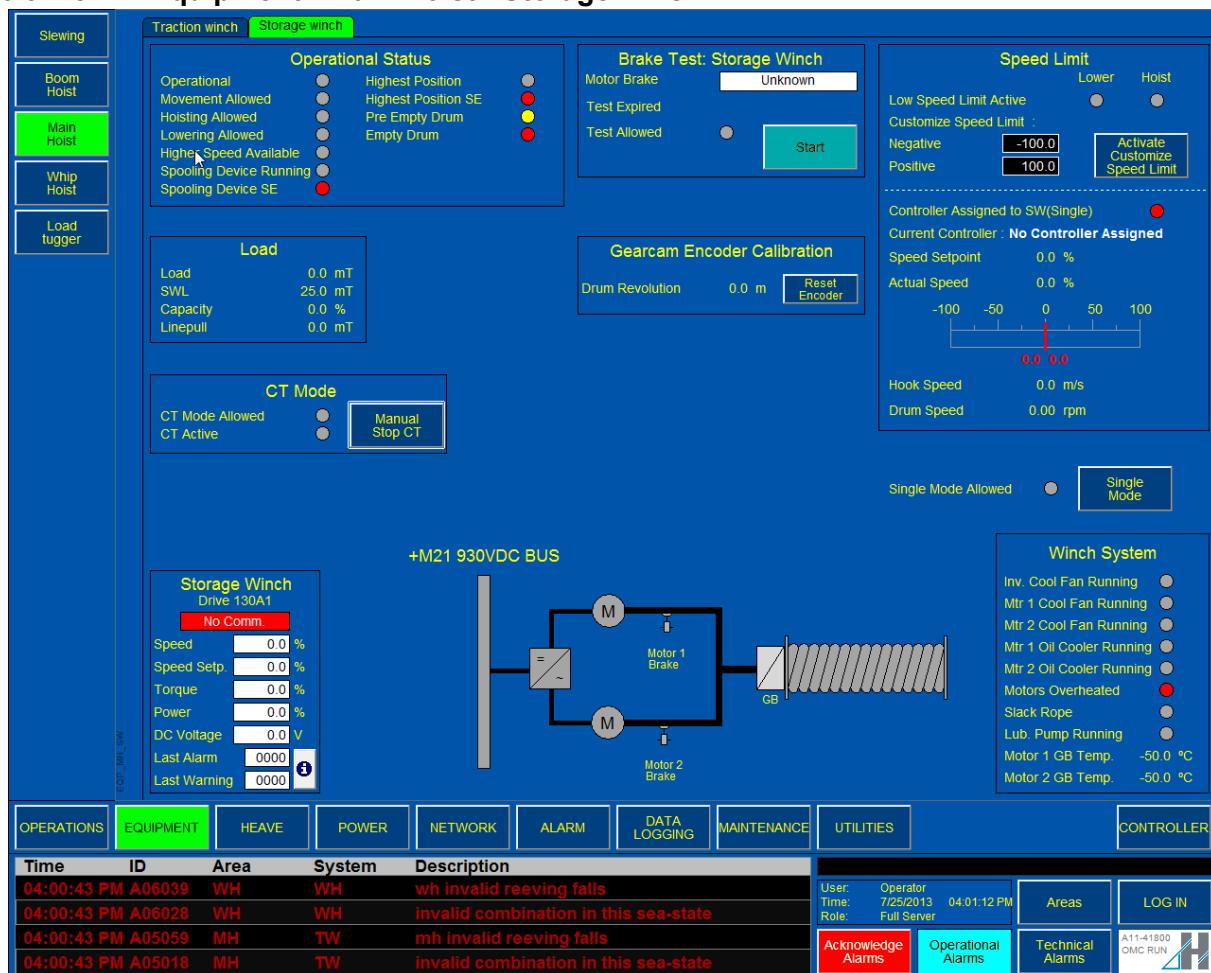


Figure 6-16: Equipment - Main Hoist - Storage Winch screen

Field	Information
Operational status	Information displayed on current state: <ul style="list-style-type: none"> - Operational [indicator] - Movement Allowed [indicator] - Hoisting Allowed [indicator] - Lowering Allowed [indicator] - Higher Speed Available [indicator] - Spooling Device Running [indicator] - Spooling Device SE [indicator] - Highest Position [indicator] - Highest Position SE [indicator] - Pre Empty Drum [indicator] - Empty Drum [indicator]
Load	Information displayed on: <ul style="list-style-type: none"> - Load [mt] - SWL [mt] - Capacity [%] - Linepull [mt] - Tension OK [indicator]

Table 6-13: Equipment - Main Hoist - Storage Winch

Field	Information
CT Mode	Information displayed on current state: <ul style="list-style-type: none"> - CT Mode Allowed [indicator] - CT Active [indicator] 'Manual Stop CT' button, press this button to stop the CT Mode manually
Single Mode	Information displayed on current state: <ul style="list-style-type: none"> - Single Mode Allowed [indicator] 'Single Mode' button, press this button to turn traction winch single mode on/off
Brake test: Storage Winch	Information displayed on current state: <ul style="list-style-type: none"> - Motor Brake [state indicator] - Test Allowed [indicator] 'Start' button, press this button to start the brake test
Speed Limit	Information displayed on current state: <ul style="list-style-type: none"> - Low Speed Limit Active [indicator Lower / Hoist] - Customize Speed Limit <ul style="list-style-type: none"> - Negative [field] - Positive [field] 'Activate Customize Speed Limit' button, press this button to limit the speed manually to the value entered on the left input field. Controller Assigned To SW(Single) [indicator] Current Controller Speed Setpoint [%] Actual Speed [%] Hook Speed [m/s] Drum Speed [rpm]
Gearcam Encoder Cali- bration	Information displayed on: <ul style="list-style-type: none"> - Drum Revolution [m] 'Reset Encoder' button, press this button to reset the gearcam encoder
Storage Winch Drive 130A1	Information displayed on: <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] 'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"
General	Brake state indication for all brakes, see Section 6.3.4.9: "Brake state indication"
Winch System	Information displayed on current state: <ul style="list-style-type: none"> - Inverter Cooling Fan Running [indicator] - Motor 1 Cooling Fan Running [indicator] - Motor 2 Cooling Fan Running [indicator] - Motor 1 Oil Cooler Running [indicator] - Motor 2 Oil Cooler Running [indicator] - Motors Overheated - Slack Rope - Lubrication Pump Running - Motor 1 GB Temp. [°] - Motor 2 GB Temp. [°]

Table 6-13: Equipment - Main Hoist - Storage Winch

6.3.4.6 Equipment - Whip Hoist

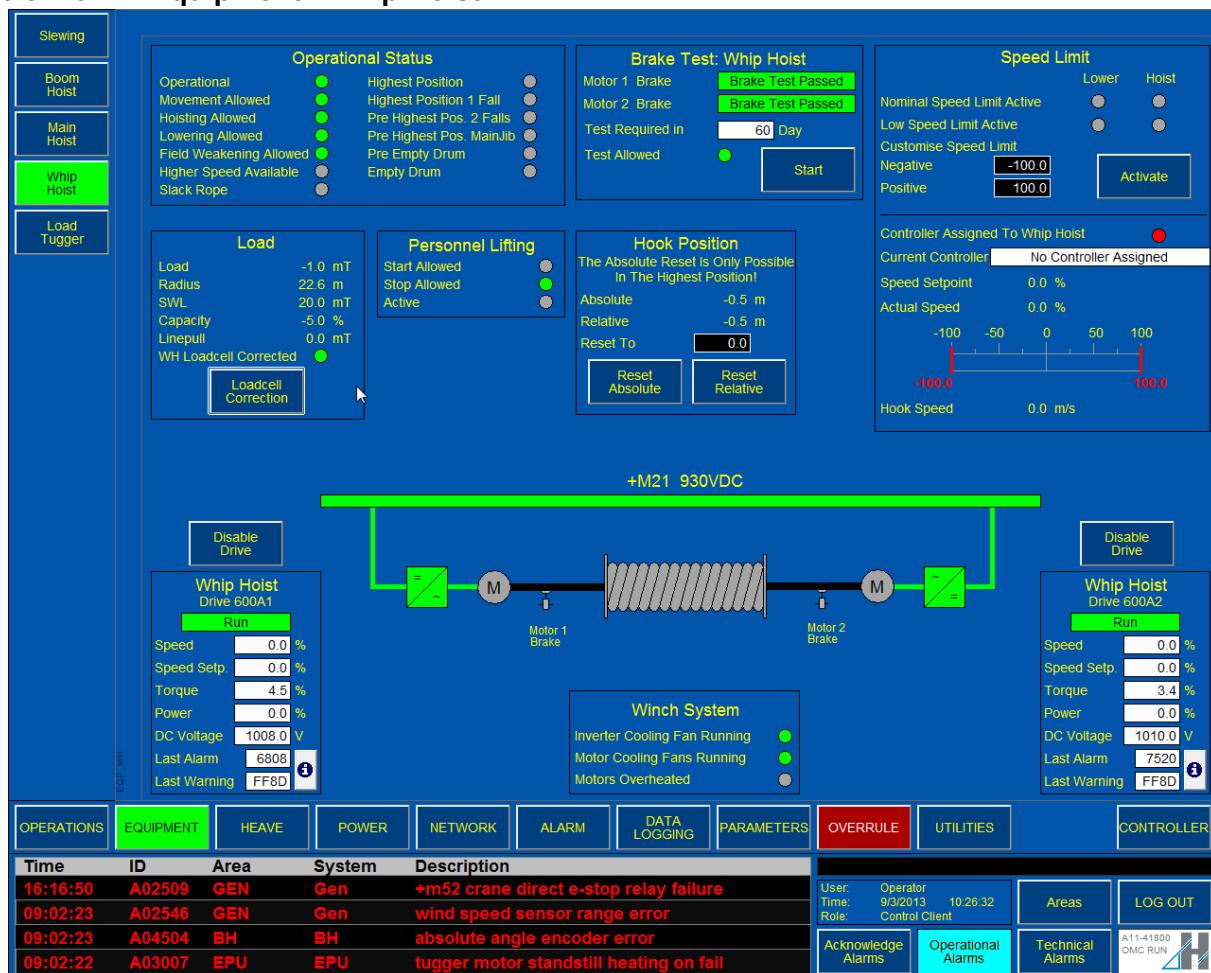


Figure 6-17: Equipment - Whip Hoist screen

Field	Information
Operational status	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Operational [indicator] - Movement Allowed [indicator] - Hoisting Allowed [indicator] - Lowering Allowed [indicator] - Field Weakening Allowed [indicator] - Higher Speed Available [indicator] - Slack Rope [indicator] - Highest Position [indicator] - Highest Position 1 Fall [indicator] - Pre Highest Position 2 Falls [indicator] - Pre Highest Pos. MainJib [indicator] - Pre Empty Drum [indicator] - Empty Drum [indicator]

Table 6-14: Equipment - Whip Hoist Screen

Field	Information
Load	<p>Information displayed on:</p> <ul style="list-style-type: none"> - Load [mt] - Radius [m] - SWL [mt] - Capacity [%] - Linepull [mt] - WH Loadcell Corrected [indicator] <p>'Loadcell Correction' button, press this button to correct the LMP based on the boom angle</p>
Personnel lifting	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Man Riding Start Allowed [indicator] - Man Riding Stop Allowed [indicator] - Man Riding Active [indicator]
Brake test: Whip Hoist	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Motor 1 Brake [state indicator] - Motor 2 Brake [state indicator] - Test Required in [Days] - Test Allowed [indicator] <p>'Start' button, press this button to start the brake test</p>
Hook Position	<p>Information displayed on:</p> <ul style="list-style-type: none"> - Absolute [m] - Relative [m] - Reset To [field] <p>'Reset Absolute' button, press this button to reset the absolute hook position (only possible in highest position)</p> <p>'Reset Relative' button, press this button to reset the relative hook position</p>
Speed Limit	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Nominal Speed Limit Active [indicator Lower / Hoist] - Low Speed Limit Active [indicator Lower / Hoist] - Customize Speed Limit <ul style="list-style-type: none"> - Negative [field] - Positive [field] <p>'Activate' button, press this button to limit the speed manually to the value entered on the left input field</p> <p>Controller Assigned To Whip Hoist [indicator] Current Controller Speed Setpoint [%] Actual Speed [%] Hook Speed [m/s]</p>
General	Brake state indication for all brakes, see Section 6.3.4.9: "Brake state indication"
Winch System	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Inverter Cooling Fan Running [indicator] - Motors Cool Fan Running [indicator] - Motors Overheated [indicator]

Table 6-14: Equipment - Whip Hoist Screen

Field	Information
Whip Hoist Drive 600A1	'Disable Drive' button, press this button to disable this drive Information displayed on: <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] 'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"
Whip Hoist Drive 600A2	'Disable Drive' button, press this button to disable this drive Information displayed on: <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] 'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"

Table 6-14: Equipment - Whip Hoist Screen

6.3.4.7 Equipment - Load tugger



Figure 6-18: Equipment - Load tugger

The Equipment Load Tugger screen has 2 tabs: 'load tugger 1' for the load tugger left and 'load tugger 2' for the load tugger right. The two screens are identical.

Field	Information
Operational status	Information displayed on current state: <ul style="list-style-type: none"> - Operational [indicator] - Movement Allowed [indicator] - Haul In Allowed [indicator] - Pay Out Allowed [indicator] - Field Weakening Allowed [indicator] - Higher Speed Available [indicator] - Highest Position [indicator] - Pre Highest Position [indicator] - Empty Drum [indicator]
Load	Information displayed on: <ul style="list-style-type: none"> - Load [mt] - SWL [mt] - Capacity [%] - Linepull [mt]

Table 6-15: Equipment - Load tugger Screen

Field	Information
CT Mode	Information displayed on current state: <ul style="list-style-type: none"> - CT Mode Allowed [indicator] - CT Active [indicator] - CT Setpoint [mt]
Brake test: Load Tugger Left / Right	Information displayed on current state: <ul style="list-style-type: none"> - Motor Brake [state indicator] - Test Required [days] - Test Allowed [indicator] <p>'Start' button, press this button to start the brake test</p>
Speed Limit	Information displayed on current state: <ul style="list-style-type: none"> - Nominal Speed Limit Active [indicator Lower / Hoist] - Low Speed Limit Active [indicator Lower / Hoist] - Customize Speed Limit <ul style="list-style-type: none"> - Negative [field] - Positive [field] <p>'Activate' button, press this button to limit the speed manually to the value entered on the left input field</p> <p>Controller Assigned To Left / Right Load Tugger [indicator] Current Controller Speed Setpoint [%] Actual Speed [%]</p>
Left / Right Load Tugger Drive 801A1 / 802A1	'Information displayed on: <ul style="list-style-type: none"> - State, see Section 6.3.4.8: "State" - Speed [%] - Speed Setp. [%] - Torque [%] - Power [%] - DC Voltage [V] - Last Alarm [-] - Last Warning [-] <p>'i' button, press this button for more information on the last alarm / last warning, see Section 6.3.4.12: "Pop-Up - Last Alarm / Last Warning"</p>
General	Brake state indication for all brakes, see Section 6.3.4.9: "Brake state indication"
Winch System	Information displayed on current state: <ul style="list-style-type: none"> - Motors Overheated [indicator]

Table 6-15: Equipment - Load tugger Screen

6.3.4.8 State

On the equipment screens, information is displayed on the state of the equipment. The following states can be displayed for all hoists, tuggers and slewing.

- Inhibit (power on inhibit, orange)
- Ready (ready for charging, green)
- Charging (charging, orange)
- Ready run (ready for run /charging completed, orange)
- Run (ready for move / setpoint, green)
- Move (drive active / brakes lifted by drive, green)
- Warning (drive alarm, orange)
- Alarm (drive fault, red)

- Fast stop (fast stop active, red)
- Coast stop (coast stop active, red)
- No PLC Ctrl (no PLC control, red)
- Ext disable (no external run enable, red)
- Watchdog (watchdog error, red)
- No comm. (communication failure, red)

NOTE

When multiple states are active, the last one is displayed

6.3.4.9 Brake state indication

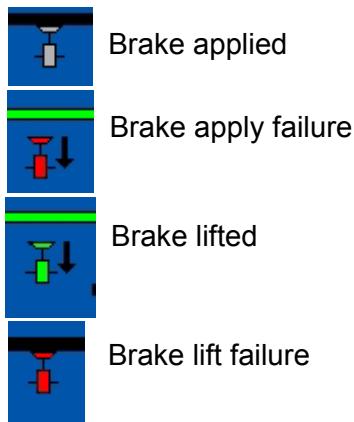


Figure 6-19: Brake state indication

The state of a brake is indicated in SCADA by the brake symbol, see [Figure 6-19](#). Four states can be indicated:

- Brake applied
- Brake apply failure
- Brake lifted
- Brake lift failure

6.3.4.10 Calibration

The slewing encoders, boom hoist angle encoders and main hoist and whip hoist hook position encoders can be calibrated with a button on the equipment screen. Two situations require calibration of the encoders:

- After a PLC restart
- After a PLC system 24VDC power black out
- Encoder malfunction

If a calibrate message appears, calibrate the encoder:

For slewing and boom hoist:

- Rotate the slewing or hoist the boom to the calibration position.
- The 'Slewing Angle Calibrate' or 'Boom Hoist Angle Calibrate' button on the equipment screen is blinking green when slewing is in the calibration position and calibration is allowed.

- A pop-up screen opens on which the angle can be calibrated.

For main hoist and whip hoist:

- Hoist the hook to the calibration position.
- The 'Reset Absolute' button on the equipment screen is blinking green when hoist is in the calibration position and calibration is allowed.
- Press the 'Reset Absolute' button to calibrate the angle to zero.

6.3.4.11 Loadcell Correction

Pressing the 'Loadcell Correction' button on the Equipment - Main Hoist - Traction Winch - General screen or the Equipment - Whip Hoist screen opens a pop-up screen.

On this pop-up screen the LMP can be corrected based on the boom angle automatically by following the steps on the screen and pressing 'start'.

6.3.4.12 Pop-Up - Last Alarm / Last Warning

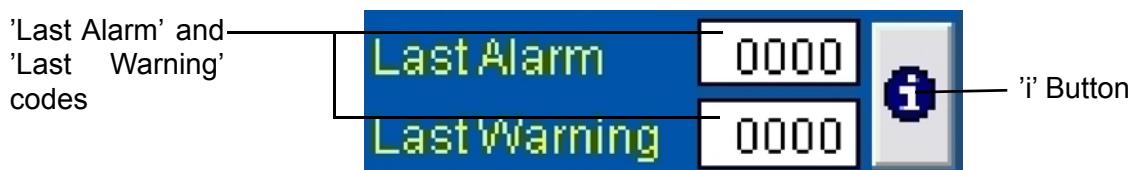


Figure 6-20: 'i' Button

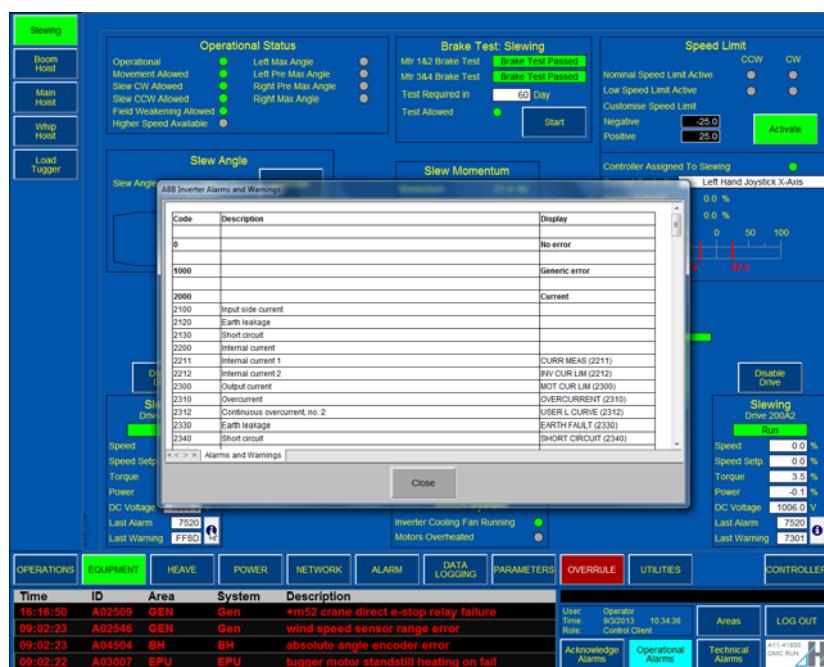


Figure 6-21: Pop-up Last Alarm / Last Warning

On several screens Last Alarm and Last Warning codes are displayed. This is the most recent alarm/warning the system has given about the equipment. Next to the codes there is an 'i' button. See [Figure 6-20](#). Pressing this button opens a pop-up, see [Figure 6-21](#). This pop-up gives an overview of the codes and their meaning.

6.3.5 HEAVE SCREEN

The heave compensator is part of the main hoist system. To access the Heave system screen, press the HEAVE button. The heave screen has two four tabs with sub tabs:

- Heave
 - Heave
 - Details
- PVU
 - PVU
 - PIU
- Sequencers
 - Lower Load
 - Lift Overpull
 - Subsea Lift
 - Supply Boat
- APC

As far as possible the status of all parts of the system is displayed by means of colors:

- Green lines and parts stand for an active system / parts.
- Red lines and parts stand for faulty system / parts.
- Green buttons indicate the mode is activated

6.3.5.1 Heave - Heave - Heave

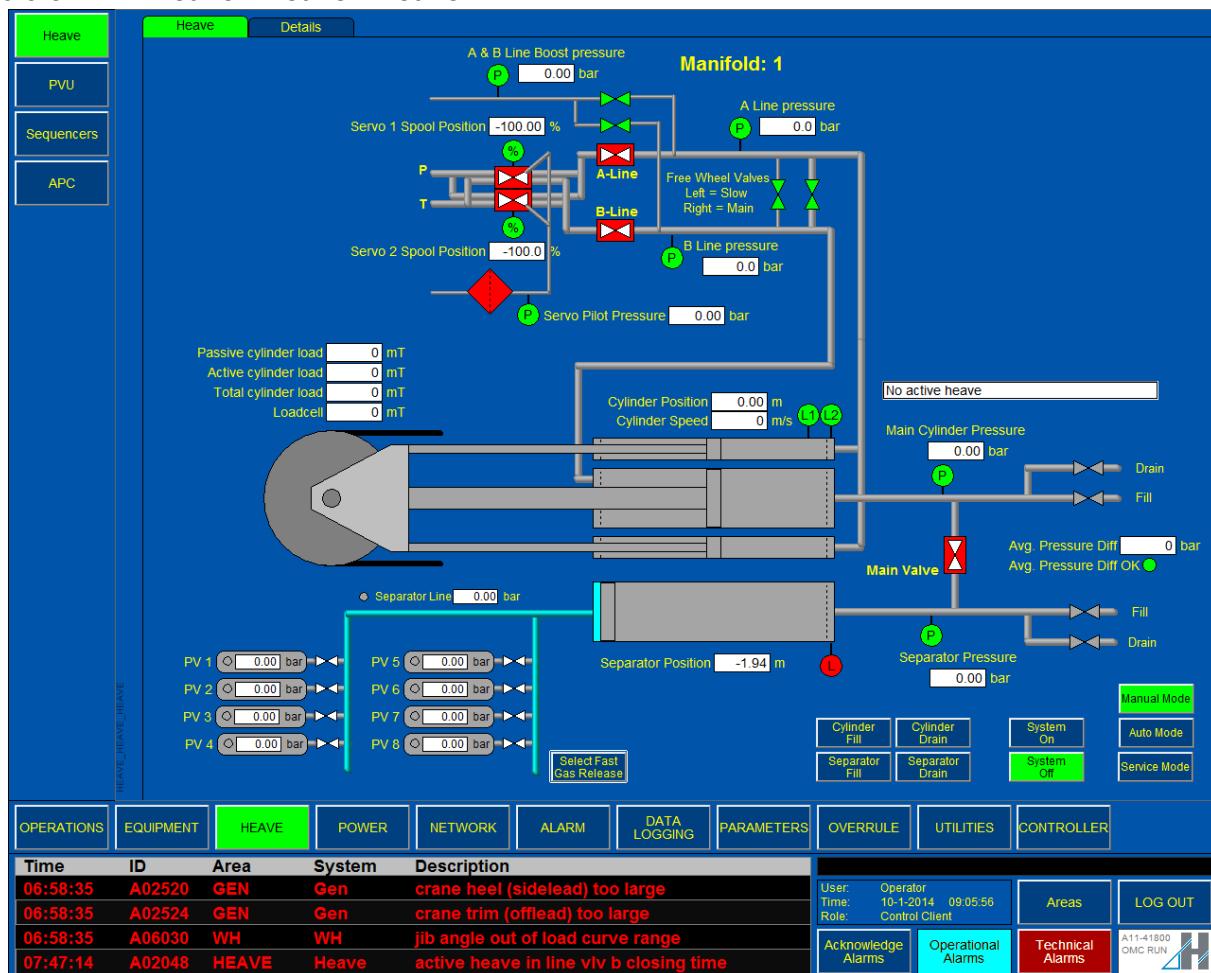


Figure 6-22: Heave- Heave - Heave Screen

Field	Options
Buttons	'System On' button, press this button to switch on the system 'System Off' button, press this button to switch off the system
Buttons	'Manual Mode' button, press this button to set the system to manual mode 'Auto Mode' button, press this button to set the system to auto mode 'Service Mode' button, press this button to set the system to service mode
Manifold	Information displayed on: <ul style="list-style-type: none"> - A & B Line Boost Pressure [bar] - A Line pressure [bar] - B Line pressure [bar] - Servo 1 Spool Position [bar] - Servo 2Spool Position [bar] - Servo Pilot Pressure [bar]
Cylinder load	Information displayed on: <ul style="list-style-type: none"> - Passive cylinder load [mT] - Active cylinder load [mT] - Total cylinder load [mT] - Loadcell [mT]

Table 6-16: Heave - Heave - Heave Screen

Field	Options
Active cylinder	Information displayed on: <ul style="list-style-type: none"> - Cylinder Position [m] - Cylinder Speed [m/s] - Active Heave status [text indicator]
Main cylinder	Information displayed on: <ul style="list-style-type: none"> - Main Cylinder Pressure [bar] ' Cylinder Fill' button, press this button to extend the cylinder (fill the bottom side) ' Cylinder Drain' button, press this button to retract the cylinder (empty the bottom side)
Main valve	Information displayed on: <ul style="list-style-type: none"> - Main valve - Avg. Pressure Diff [bar] - Avg. Pressure Diff OK [indicator]
Separator	Information displayed on: <ul style="list-style-type: none"> - Separator Pressure [bar] - Separator Position [m] - Separator Line [indicator] [bar] ' Separator Fill' button, press this button to retract the separator (fill the oil side) ' Separator Drain' button, press this button to extend the separator (empty the oil side)
PIU	Information displayed on: <ul style="list-style-type: none"> - PV 1 [bar] - PV 2 [bar] - PV 3 [bar] - PV 4 [bar] - PV 5 [bar] - PV 6 [bar] - PV 7 [bar] - PV 8 [bar] ' Select Fast Gas Release' button, press this button to select fast gas release

Table 6-16: Heave - Heave - Heave Screen

6.3.5.2 Heave - Heave - Details



Figure 6-23: Heave - Heave - Details Screen

Field	Options
Passive heave	Information displayed on current state: <ul style="list-style-type: none"> - Allowed [indicator] - System operational [indicator] - Sep /Cyl rel Pos OK [indicator] - Pressure difference OK [indicator] - Lift sequence selected [indicator] - DAHC Allows PH [indicator] - Paid out wire OK [indicator] - Supply boat seq. select [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Stopped [indicator]

Table 6-17: Heave - Heave-Details Screen

Field	Options
Active heave	Information displayed on current state: - Allowed [indicator] - Passive heave ON [indicator] - DAHC Operation Allowed [indicator] - DAHC Allowed by Passive [indicator] - Supply Pressure OK [indicator] - MRU signal OK [indicator] - Servo valves OK [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Stopped [indicator]
Direct active heave	Information displayed on current state: - Conditions met [indicator] - Start Allowed [indicator] - Allowed [indicator] - On [indicator] - All systems auto mode [indicator] 'Enable DAHC' button, press this button to enable the direct active heave compensator 'Fall Back to Passive Heave' button, press this button to disable the direct active heave compensator
MRU	Information displayed on: - MRU Signal OK [indicator] - MRU Roll Angle [°] - MRU Roll Speed [°/s] - MRU Roll Acceleration [°/s ²] - MRU Pitch Angle [°] - MRU Pitch Speed [°/s] - MRU Pitch Acceleration [°/s ²] - MRU Heave Position [m] - MRU Heave Speed [m/s] - MRU Heave Acceleration [m/s ²] 'Initialize MRU' button, press this button to initialize the MRU 'FreeWheel Maint. Close' button, press this button to close the freewheel valves (only allowed in service mode and with the main valve closed) 'Disable Servos Manifold 1' button, press this button to disable the servos manifold 1
Active Retract	Information displayed on current state: - Active Retract Operation Allowed [indicator] - Active Retract Starting [indicator] - Active Retract On [indicator] - Active Retract Stopping [indicator] - Active Retract Operation Stopped [indicator] 'Heave Cylinder Active Retract' button, press this button to switch on the heave cylinder active retract 'Calibrate Encoders' button, press this button to calibrate the encoders

Table 6-17: Heave - Heave-Details Screen

Field	Options
Heave	Information displayed on: <ul style="list-style-type: none"> - Heave position setpoint [m] - Heave speed setpoint [m/s] - Cylinder position setpoint [m] - Cylinder speed setpoint [m/s] - Feed forward speed setpoint [m/s] - Total speed setpoint [m/s]
Crane	Information displayed on: <ul style="list-style-type: none"> - Crane slew angle [°] - Crane jib angle [°] - Paid out wire [°] - Winch speed [rpm]
Load	Information displayed on: <ul style="list-style-type: none"> - Passive cylinder load [mT] - Active cylinder load [mT] - Total cylinder load [mT] - Loadcell [mT]
Pressure Difference	Information displayed on: <ul style="list-style-type: none"> - Pressure Diff [bar] - Pressure Diff OK [indicator] - DAHC Pressure Diff OK [indicator] - Avg. Pressure Diff [bar] - Avg. Pressure Diff OK [indicator] - Sep/Cyl Relative Pos Diff [m] - Sep/Cyl Relative Pos Diff OK [indicator]

Table 6-17: Heave - Heave-Details Screen

6.3.5.3 Heave - PVU - PVU

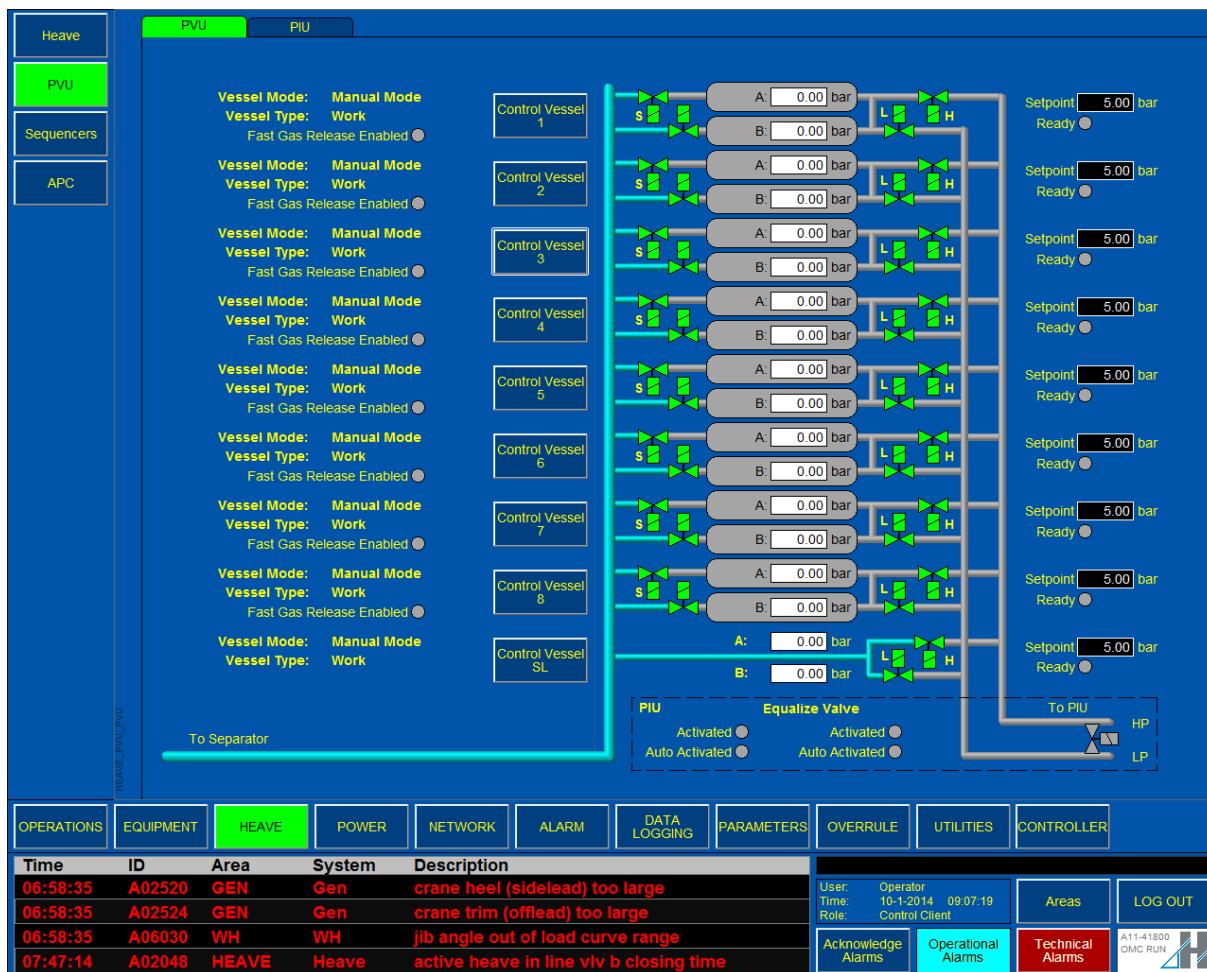


Figure 6-24: Heave- PVU - PVU Screen

Field	Options
PVU Vessel	For each PVU Vessel (1, 2, 3, 4, 5, 6, 7, 8, SL): Information displayed on: <ul style="list-style-type: none"> - Vessel Mode [text indicator] - Vessel Type [text indicator] - Fast Gas Release Enabled [indicator] - 'Control Vessel x' button, press this button to open the corresponding pop-up screen, see Section 6.3.6: "Power screen". - A [bar] - B [bar] - Setpoint [bar] - Ready [indicator]
PIU	Information displayed on current state: <ul style="list-style-type: none"> - Activated [indicator] - Auto Activated [indicator]
Equalize Valve	Information displayed on current state: <ul style="list-style-type: none"> - Activated [indicator] - Auto Activated [indicator]

Table 6-18: Heave - PVU - PVU Screen

6.3.5.4 Heave - PVU - PIU

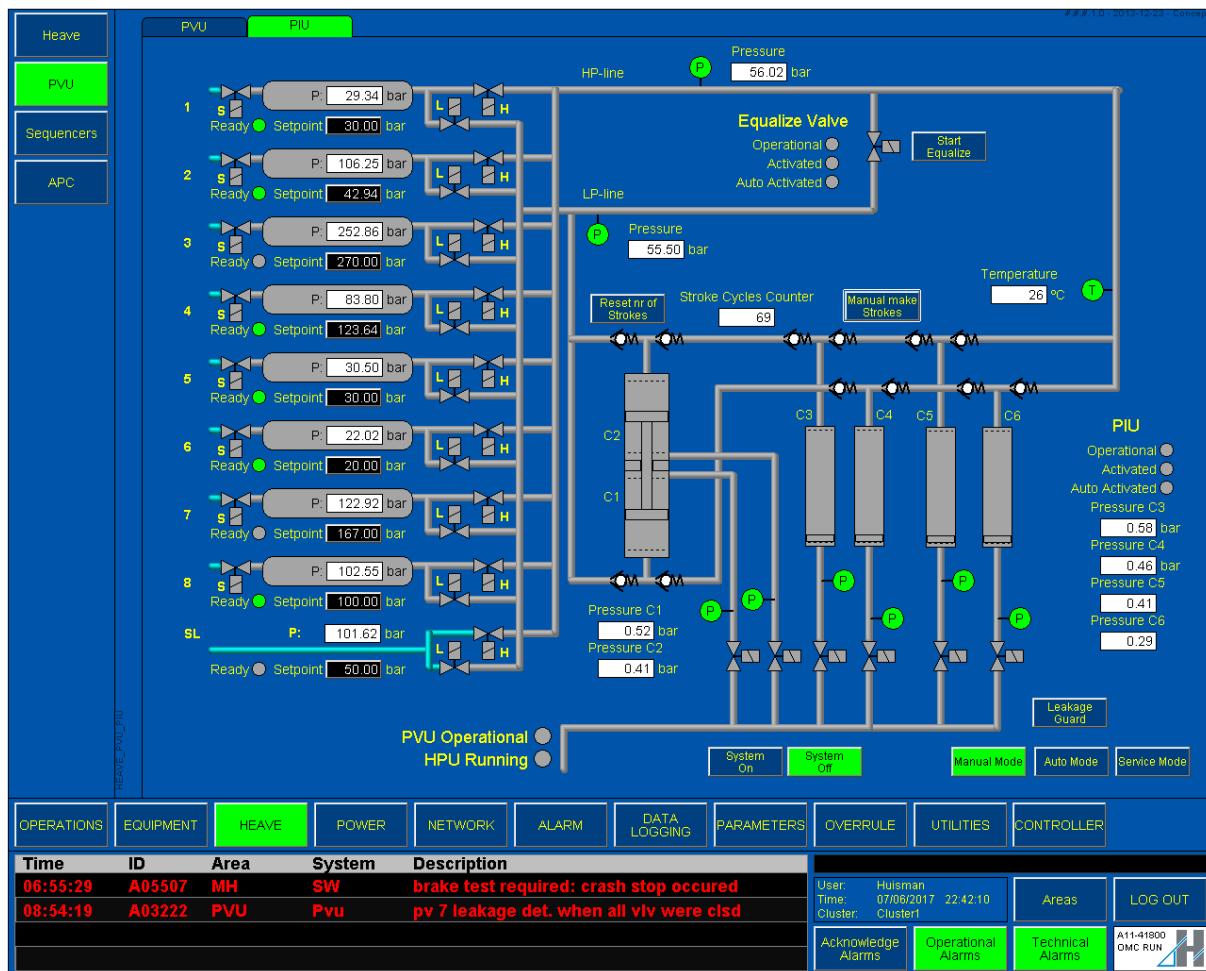


Figure 6-25: Heave- PVU - PIU Screen

Field	Options
Indicators	Information displayed on current state: <ul style="list-style-type: none"> - PVU Operational [indicator] - HPU Running [indicator]
Buttons	'System On' button, press this button to switch on the system 'System Off' button, press this button to switch off the system
Buttons	'Manual Mode' button, press this button to set the system to manual mode 'Auto Mode' button, press this button to set the system to auto mode 'Service Mode' button, press this button to set the system to service mode
Button	'Leakage Guard' button, press this button to open a pop-up screen, see Section 6.3.6: "Power screen" .
Pressure cylinders	Information displayed on: <ul style="list-style-type: none"> - Pressure C1 [bar] - Pressure C2 [bar] - Pressure C3 [bar] - Pressure C4 [bar] - Pressure C5 [bar] - Pressure C6 [bar]

Table 6-19: Heave - PVU - PIU Screen

Field	Options
PIU	Information displayed on current state: - Operational [indicator] - Activated [indicator] Auto Activated [indicator]
Manual make strokes	'Manual make Strokes' button, press this button to manually make strokes
Stroke Cycles Counter	'Reset nr of Strokes' button, press this button to reset the stroke cycles counter Information displayed on: - Stroke cycles Counter [-]
Temperature	Information displayed on: Temperature [°C]
Pressure lines	Information displayed on: - HP-line Pressure [bar] - LP-line Pressure [bar]
Equalize Valve	Information displayed on current state: - Operational [indicator] - Activated [indicator] - Auto Activated [indicator] 'Start Equalize' button, press this button to activate the equalize valve
PVU Vessel	For each PVU Vessel (1, 2, 3, 4, 5, 6, 7, 8, SL): Information displayed on: - Ready [indicator] - P [bar] - Setpoint [bar]

Table 6-19: Heave - PVU - PIU Screen

6.3.5.5 Heave - PVU - Pop-Up Screens

Control Vessel

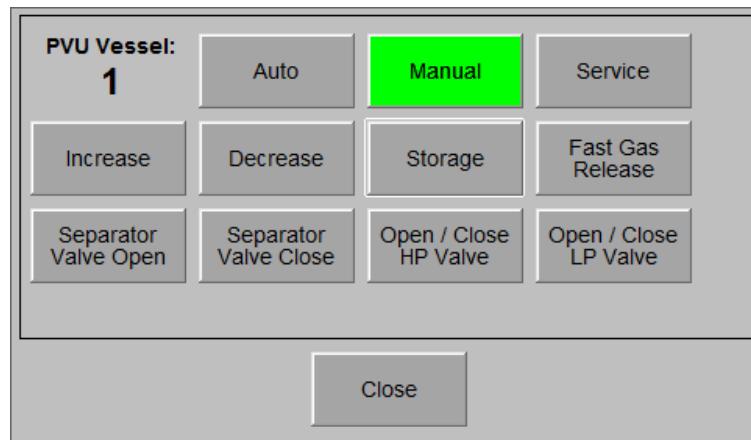


Figure 6-26: Pop-up Control Vessel

The 'Control Vessel 1 to 8' and 'Control Vessel SL' buttons on the Heave - PVU -PVU screen open a pop-up screen as shown in [Figure 6-26](#). This pop-up screen provides buttons to control the corresponding vessel:

- Auto
- Manual
- Service

- Increase
- Decrease
- Storage
- Fast Gas Release
- Separator Valve Open
- Separator Valve Close
- Open / Close HP Valve
- Open / Close LP Valve
- Close

Leakage Guard

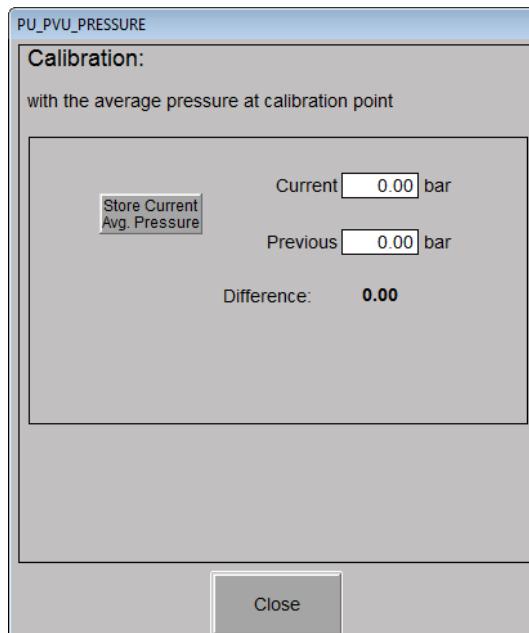


Figure 6-27: Pop-up Leakage Guard

The 'Leakage Guard' button on the Heave - PVU - PIU screen open a pop-up screen as shown in [Figure 6-40](#). On this pop-up screen the 'gas leakage detected' parameter can be calibrated. The current gas level can be stored. An alarm rises when the amount of gas decreases more than the 'gas leakage detected' parameter.

6.3.5.6 Heave - Sequencers - Lower Load

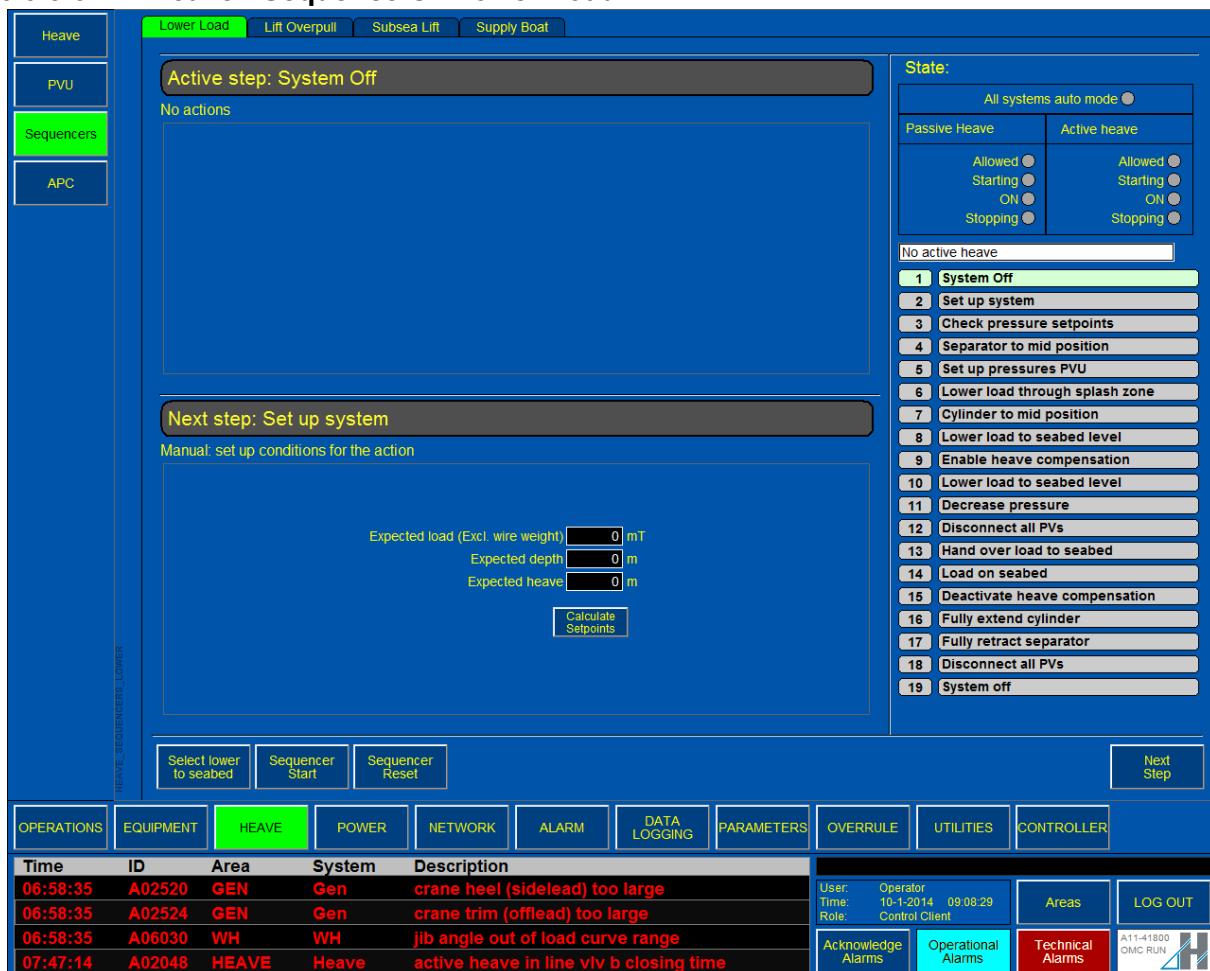


Figure 6-28: Heave - Sequencers - Lower Load Screen

Field	Options
Active step	Information displayed on: <ul style="list-style-type: none"> - Active step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]
Next step	Information displayed on: <ul style="list-style-type: none"> - Next step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]

Table 6-20: Heave - Sequencers - Lower Load Screen

Field	Options
State	<p>Information displayed current state:</p> <ul style="list-style-type: none"> - All systems auto mode [indicator] - Passive Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Active Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Status [text indicator]
Step list	<p>Step list:</p> <ul style="list-style-type: none"> - 1. System off - 2. Set up system - 3. Check pressure setpoints - 4. Separator to mid positions - 5. Set up pressures PVU - 6. Lower load through splash zone - 7. Cylinder to mid position - 8. Lower load to seabed level - 9. Enable heave compensation - 10. Lower load to seabed level - 11. Decrease pressure - 12. Disconnect all PVs - 13. Hand over load to seabed - 14. Load on seabed - 15. Deactivate heave compensation - 16. Fully extend cylinder - 17. Fully retract separator - 18. Disconnect all PVs - 19. System off
Buttons	<p>'Select lower to seabed' button, press this button to select the 'lower to seabed' sequencer</p> <p>'Sequencer start' button, press this button to start the 'lower to seabed' sequencer</p> <p>'Sequencer Reset' button, press this button to reset the 'lower to seabed' sequencer</p> <p>'Next Step' button, press this button to go to the next step of the 'lower to seabed' sequencer</p>

Table 6-20: Heave - Sequencers - Lower Load Screen

6.3.5.7 Heave - Sequencers- Lift Overpull



Figure 6-29: Heave- Sequencers - Lift Overpull Screen

Field	Options
Active step	Information displayed on: <ul style="list-style-type: none"> - Active step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]
Next step	Information displayed on: <ul style="list-style-type: none"> - Next step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]

Table 6-21: Heave - Sequencers - Lift Overpull Screen

Field	Options
State	<p>Information displayed current state:</p> <ul style="list-style-type: none"> - All systems auto mode [indicator] - Passive Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Active Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Status [text indicator]
Step list	<p>Step list:</p> <ul style="list-style-type: none"> - 1. System off - 2. Set up system - 3. Check pressure setpoints - 4. Separator to mid positions - 5. Set up pressures PVU - 6. Lower empty hook to load - 7. Cylinder to mid position - 8. Activate heave compensation - 9. Connect load to hook - 10. Increase pressure & fast gas release - 11. Hoist load clear of seabed - 12. Deactivate passive heave comp. - 13. Hand over load to seabed - 14. Fully extend cylinder - 15. Fully retract separator - 16. Disconnect all PVs - 17. System off
Buttons	<p>'Select lift with overpull' button, press this button to select the 'lift with overpull' sequencer</p> <p>'Sequencer start' button, press this button to start the 'lift with overpull' sequencer</p> <p>'Sequencer Reset' button, press this button to reset the 'lift with overpull' sequencer</p> <p>'Next Step' button, press this button to go to the next step of the 'lift with overpull' sequencer</p>

Table 6-21: Heave - Sequencers - Lift Overpull Screen

6.3.5.8 Heave - Sequencers - Subsea Lift



Figure 6-30: Heave - Sequencers - Subsea Lift Screen

Field	Options
Active step	Information displayed on: <ul style="list-style-type: none"> - Active step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]
Next step	Information displayed on: <ul style="list-style-type: none"> - Next step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]

Table 6-22: Heave - Sequencers - Subsea Lift Screen

Field	Options
State	<p>Information displayed current state:</p> <ul style="list-style-type: none"> - All systems auto mode [indicator] - Passive Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Active Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Status [text indicator]
Step list	<p>Step list:</p> <ul style="list-style-type: none"> - 1. System off - 2. Set up system - 3. Check pressure setpoints - 4. Separator to mid positions - 5. Set up pressures PVU - 6. Lower empty hook to load - 7. Cylinder to mid position - 8. Activate heave compensation - 9. Connect load to hook - 10. Increase pressure and hoist winch - 11. Hoist load clear of seabed - 12. Deactivate passive heave comp. - 13. Hand over load to seabed - 14. Fully extend cylinder - 15. Fully retract separator - 16. Disconnect all PVs - 17. System off
Buttons	<p>'Select subsea lift' button, press this button to select the 'subsea lift' sequencer 'Sequencer start' button, press this button to start the 'subsea lift' sequencer 'Sequencer Reset' button, press this button to reset the 'subsea lift' sequencer 'Next Step' button, press this button to go to the next step of the 'subsea lift' sequencer</p>

Table 6-22: Heave - Sequencers - Subsea Lift Screen

6.3.5.9 Heave - Sequencers - Supply Boat

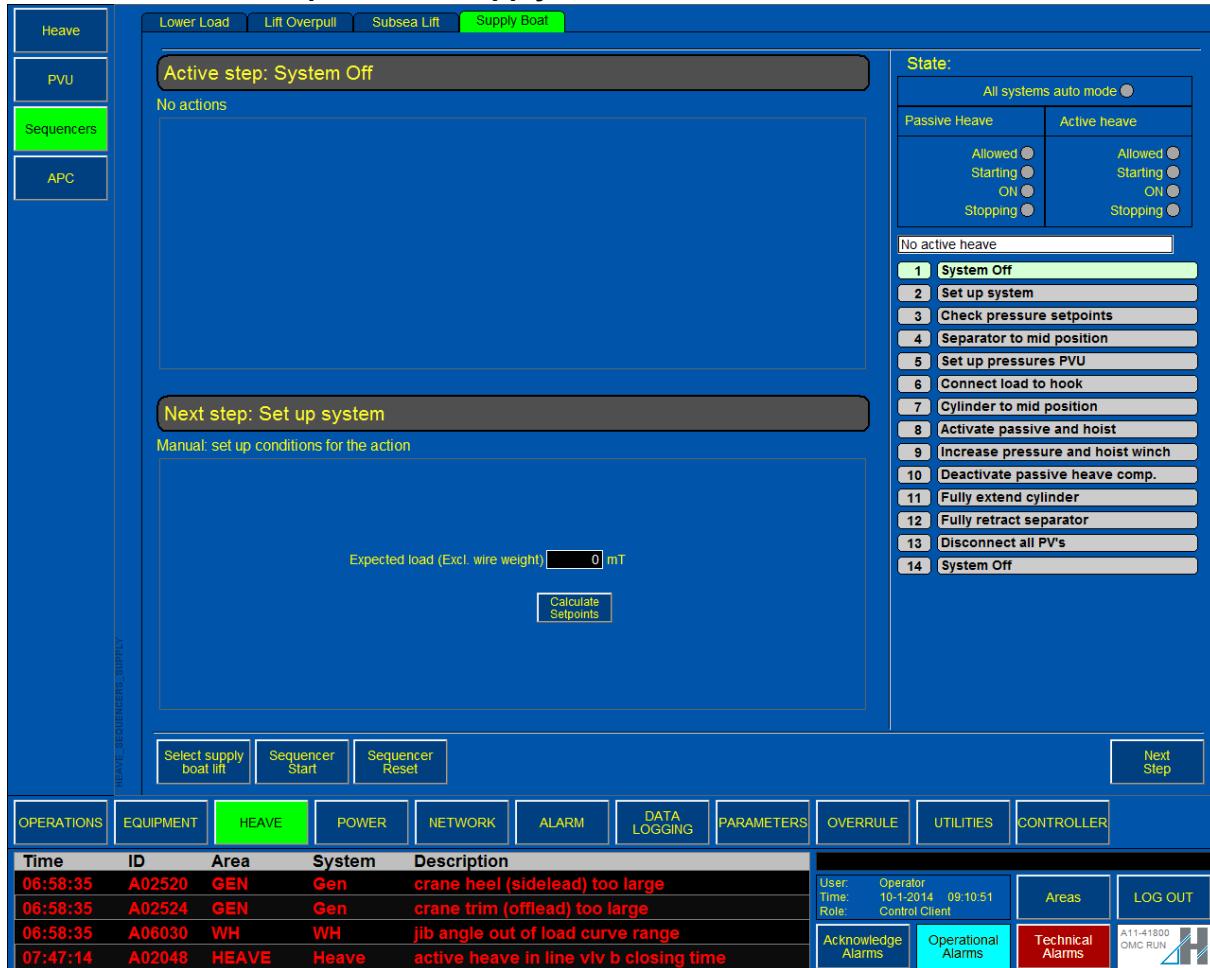


Figure 6-31: Heave- Sequencers - Supply Boat Screen

Field	Options
Active step	Information displayed on: <ul style="list-style-type: none"> - Active step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]
Next step	Information displayed on: <ul style="list-style-type: none"> - Next step [text indicator] - Actions [text indicator] - Information related to actions [indicators and buttons]

Table 6-23: Heave - Sequencers - Supply Boat Screen

Field	Options
State	<p>Information displayed current state:</p> <ul style="list-style-type: none"> - All systems auto mode [indicator] - Passive Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Active Heave <ul style="list-style-type: none"> - Allowed [indicator] - Starting [indicator] - ON [indicator] - Stopping [indicator] - Status [text indicator]
Step list	<p>Step list:</p> <ul style="list-style-type: none"> - 1. System off - 2. Set up system - 3. Check pressure setpoints - 4. Separator to mid positions - 5. Set up pressures PVU - 6. Connect load to hook - 7. Cylinder to mid position - 8. Activate passive and hoist - 9. Increase pressure and hoist winch - 10. Deactivate passive heave comp. - 11. Fully extend cylinder - 12. Fully retract separator - 13. Disconnect all PVs - 14. System off
Buttons	<p>'Select supply boat lift' button, press this button to select the 'supply boat lift' sequencer</p> <p>'Sequencer start' button, press this button to start the 'supply boat lift' sequencer</p> <p>'Sequencer Reset' button, press this button to reset the 'supply boat lift' sequencer</p> <p>'Next Step' button, press this button to go to the next step of the 'supply boat lift' sequencer</p>

Table 6-23: Heave - Sequencers - Supply Boat Screen

6.3.5.10 Heave - APC

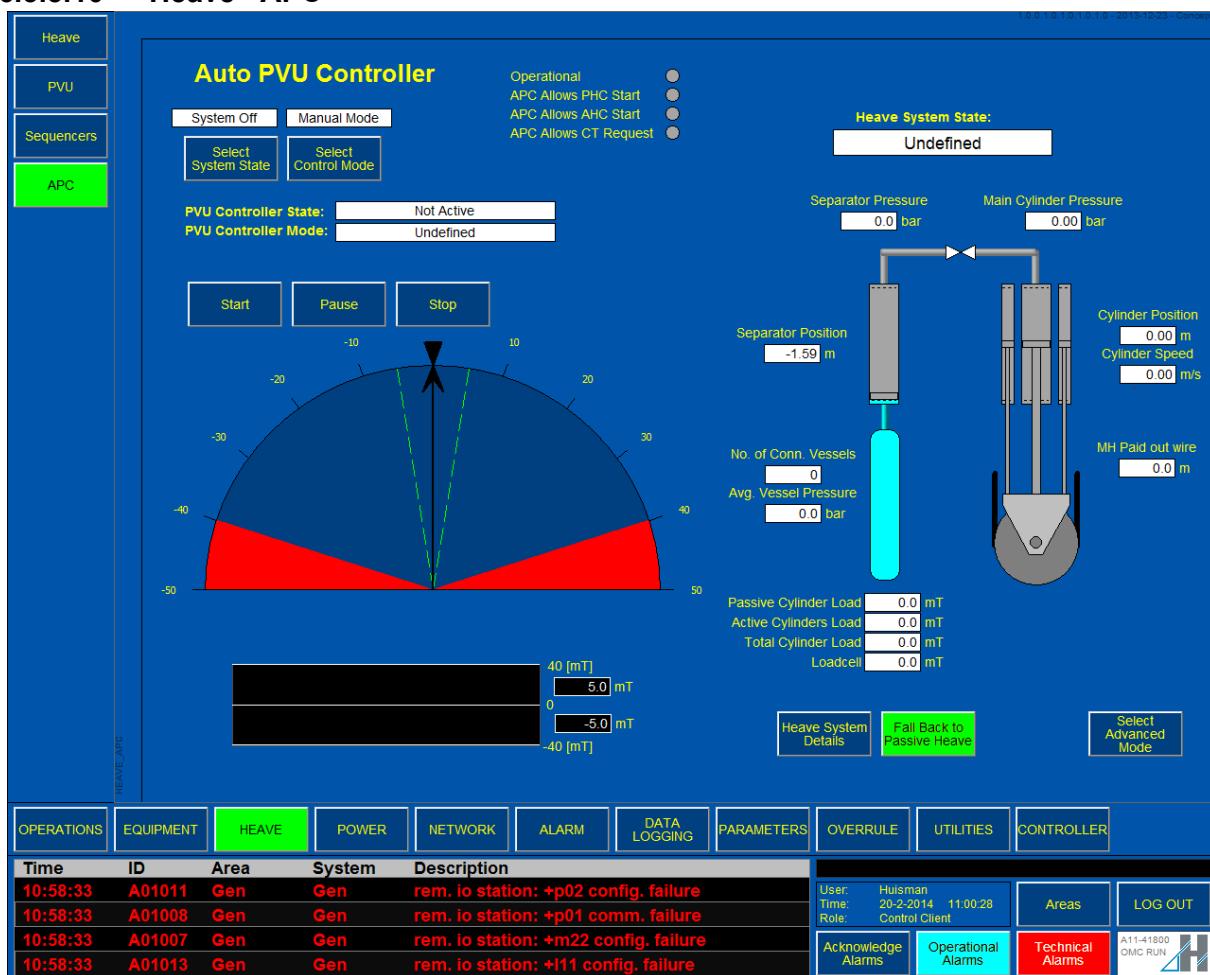


Figure 6-32: Heave- APC Screen

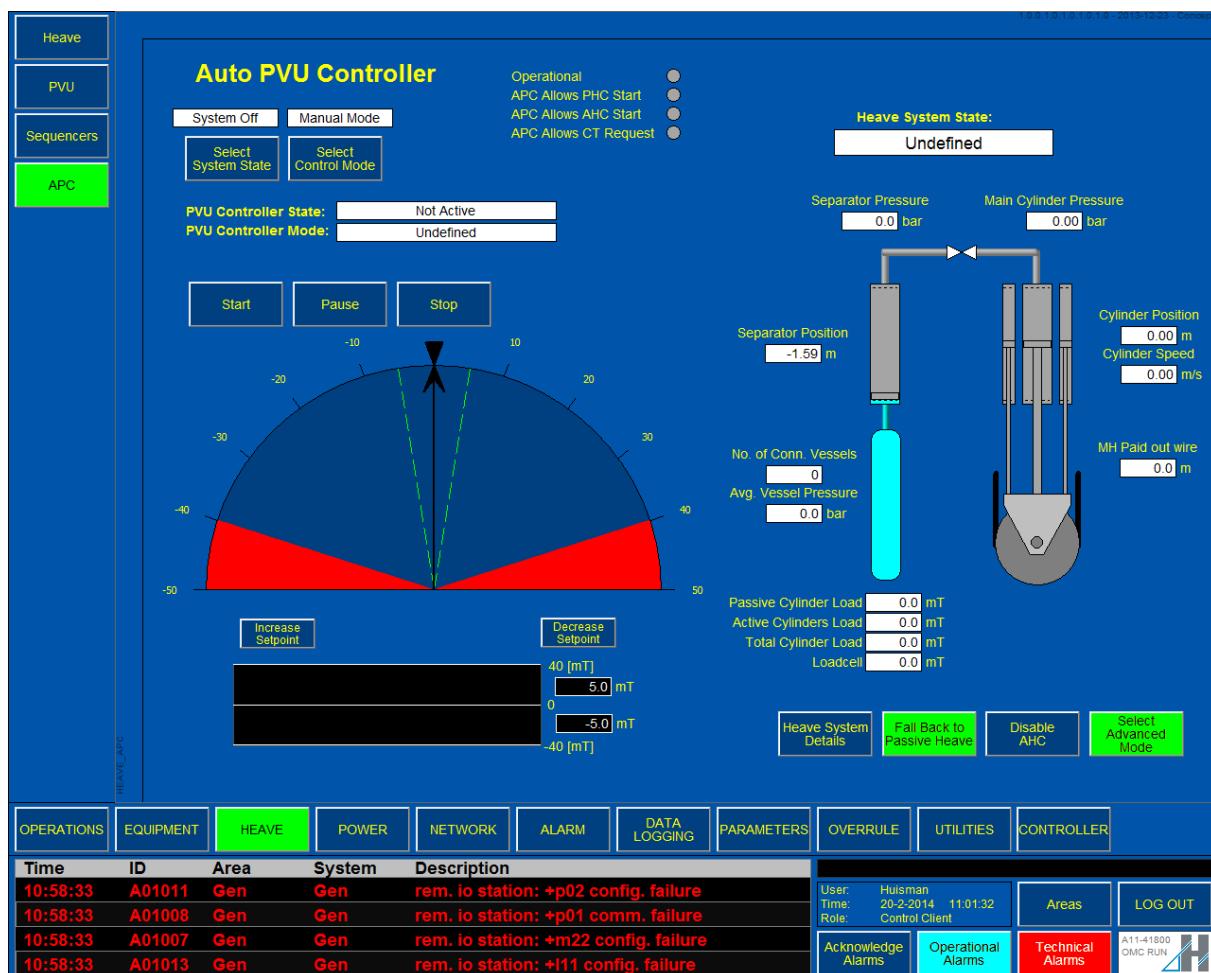


Figure 6-33: Heave- APC - Advanced Mode Screen

Field	Options
State	Information displayed on current state: <ul style="list-style-type: none"> - Operational [indicator] - PHC Start Allowed [indicator] - AHC Start Allowed [indicator] - CT Request Allowed [indicator]
System state / mode	Information displayed on: <ul style="list-style-type: none"> - System state [text indicator] (System on / System off) - 'Select system state' button, press this button to select the state of the system - Control mode [text indicator] (Manual mode / Automatic mode) - 'Select control mode' button, press this button to select the control mode of the system
PVU controller	Information displayed on: <ul style="list-style-type: none"> - PVU Controller State [text indicator] (Wait for user input / Balancing / Preparing / Parking / Not active) - PVU Controller Mode [text indicator] (Undefined / Subsea Deploy & Lift) - 'Start' button, press this button to start the APC system - 'Pause' button, press this button to pause the APC system - 'Stop' button, press this button to stop the APC system

Table 6-24: Heave - APC Screen

Field	Options
Balance indicator	<p>Displays:</p> <ul style="list-style-type: none"> - Current balance [arrow] - Balance setpoint [triangle] - Controller deadband [green dashed lines] - Max. unbalance [red area] - Min. / max. filtered actual balance from last 30 sec. [dark blue area] - Controller deadband increase and decrease [graph] <p>Only when in Advanced Mode:</p> <ul style="list-style-type: none"> - 'Increase Setpoint' button, press this button to increase the balance setpoint - 'Decrease Setpoint' button, press this button to decrease the balance setpoint - Increase Controller Deadband Settings, fill in the desired setting for the controller deadband - Decrease Controller Deadband Settings, fill in the desired setting for the controller deadband
Heave system state	<p>Information displayed on current state:</p> <ul style="list-style-type: none"> - Operational [text indicator] (Off / Starting / PHC on / AHC on / Fallback on PHC)
Schematic overview of heave / pvu systems	<p>Information displayed on:</p> <ul style="list-style-type: none"> - Separator Pressure [bar] - Main Cylinder Pressure [bar] - Separator Position [m] - Cylinder Position [m] - Cylinder Speed [m/s] - No. of Connected Vessels [-] - Average Vessel Pressure [bar] - Passive Cylinder Load [mt] - Active Cylinders load [mt] - Total Cylinder Load [mt] - Loadcell [mt]
Buttons	<p>Information displayed on:</p> <ul style="list-style-type: none"> - 'Heave System Details' button, press this button to see the details of the heave system - 'Fall back to Passive Heave' button, press this button to fall back to passive heave <p>Only in advanced mode:</p> <ul style="list-style-type: none"> - 'Disable AHC' button, press this button to disable the active heave compensator
Select Advanced Mode	<ul style="list-style-type: none"> - 'Select Advanced Mode' button, press this button to go to the Advanced Mode screen

Table 6-24: Heave - APC Screen

6.3.5.11 Heave - APC - Pop-Up Screens

System state

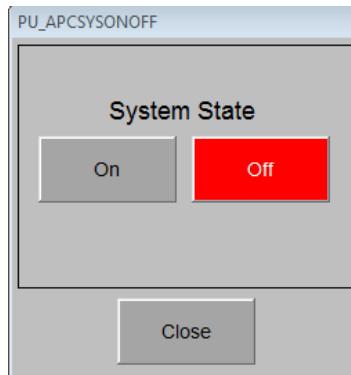


Figure 6-34: Pop-up System state

The 'Select System State' button on the Heave - APC screen opens a pop-up screen as shown in [Figure 6-34](#). This pop-up screen provides buttons to switch the system state on and off.

Control mode

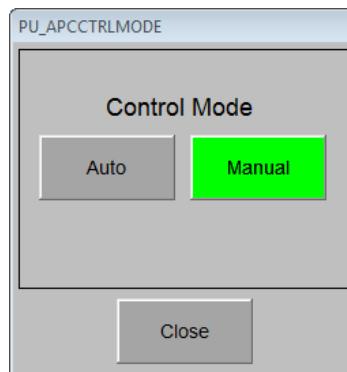


Figure 6-35: Pop-up Control Mode

The 'Select Control Mode' button on the Heave - APC screen opens a pop-up screen as shown in [Figure 6-35](#). This pop-up screen provides buttons to switch between auto and manual control mode.

Heave System Details

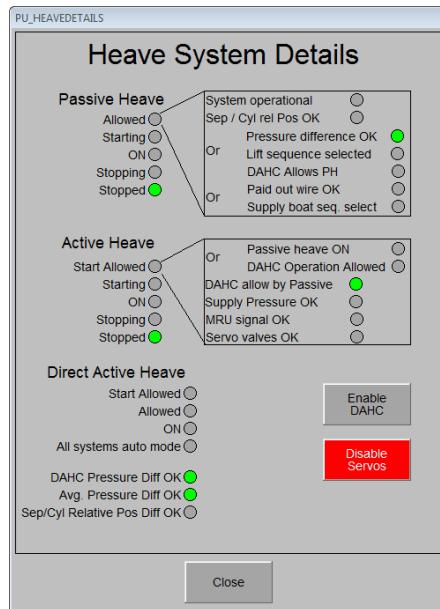


Figure 6-36: Pop-up Heave System Details

The 'Heave System Details' button on the Heave - APC screen opens a pop-up screen as shown in [Figure 6-36](#). This pop-up screen provides indicators to give information about the status of the heave compensator.

PVU Controller Initial Settings

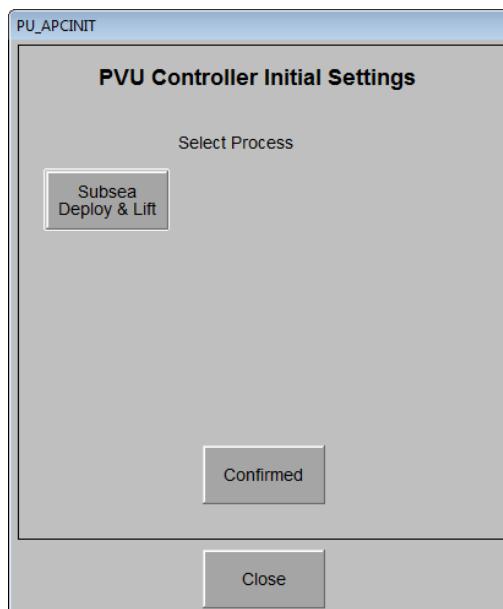


Figure 6-37: Pop-up PVU Controller Initial Settings

When the APC operation starts a pop-up screen opens as shown in [Figure 6-37](#). This pop-up screen provides buttons to select the process. Select a process and press 'confirmed' to continue operation.

PVU Controller Cylinder Positioning

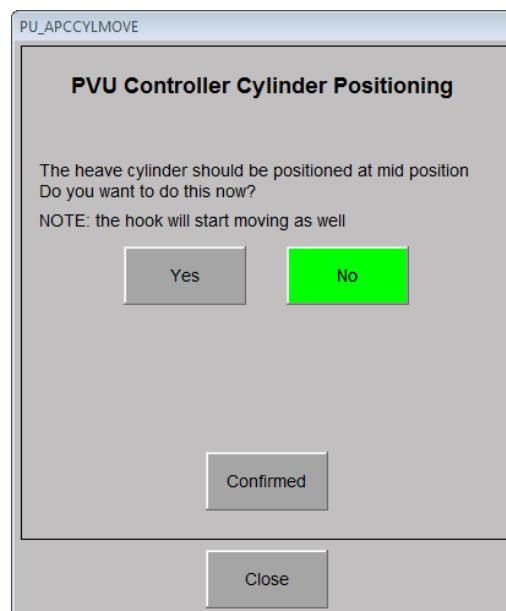


Figure 6-38: Pop-up PVU Controller Cylinder Positioning

When during the APC operation the cylinder needs to move, a pop-up screen opens as shown in [Figure 6-38](#). This pop-up screen provides buttons to confirm movement of the cylinder (and hook). Select 'yes' and then press 'confirmed' to continue operation or select 'no' and then press 'confirmed' to prevent the cylinder from moving.

PVU Controller Parking Settings

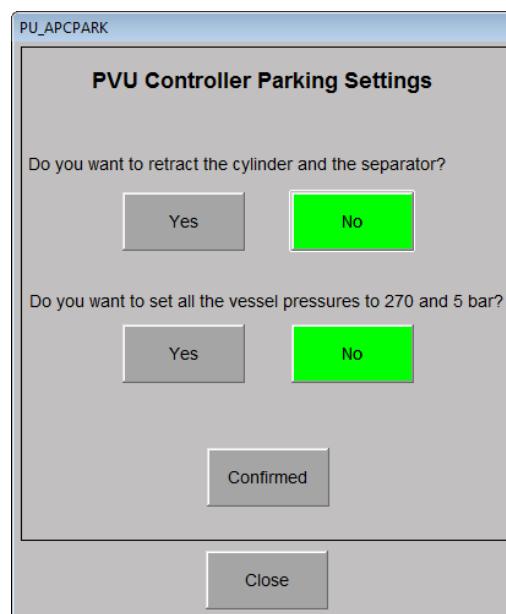


Figure 6-39: Pop-up PVU Controller Parking Settings

When parking after the APC operation, a pop-up screen opens as shown in [Figure 6-39](#). This pop-up screen provides buttons to confirm or reject retracting of the cylinder and separator and setting of the vessel pressures. Select 'yes' or 'no' and then press 'confirmed'.

6.3.6 POWER SCREEN

To access the power screen, press the POWER button. The power screen has two tabs:

- EPU
- HPU

As far as possible the status of all parts of the system is displayed by means of colors:

- Green lines and parts stand for an active system / parts.
- Red lines and parts stand for faulty system / parts.

6.3.6.1 Power - EPU - OMC

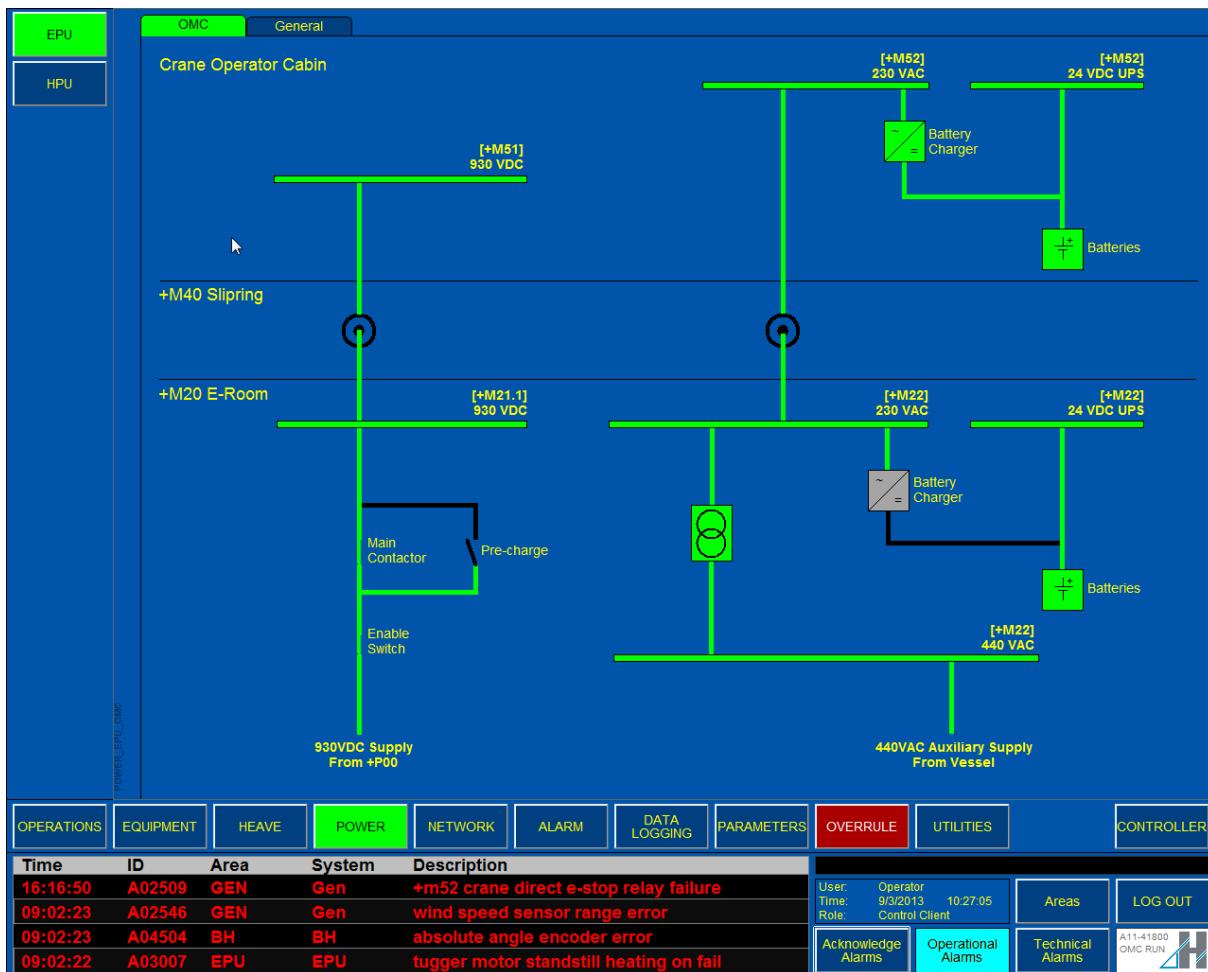


Figure 6-40: Power - EPU- OMC Screen

Field	Information
+M20 E-Room	<ul style="list-style-type: none"> - 930 VDC Supply from +P00 - Main Contactor Switch - Pre-Charge Switch - +M21.1 930 VDC bus - 440 VAC Supply from Vessel - +M22 440 VAC bus - 440 VAC / 230 VAC transformer - +M22 230 VAC bus - 230 VAC / 24 VDC transformer - Battery pack - +M22 24 VDC UPS bus
+M40 Slipring	<ul style="list-style-type: none"> - +M40 Slipring (2x)

Table 6-25: Equipment - Power - EPU - OMC Screen

Field	Information
Crane Operator Cabin	<ul style="list-style-type: none">- +M51 930 VDC bus- +M52 230 VAC bus- 230 VAC / 24 VDC transformer- Battery pack- +M22 24 VDC UPS bus

Table 6-25: Equipment - Power - EPU - OMC Screen

6.3.6.2 Power - EPU - General

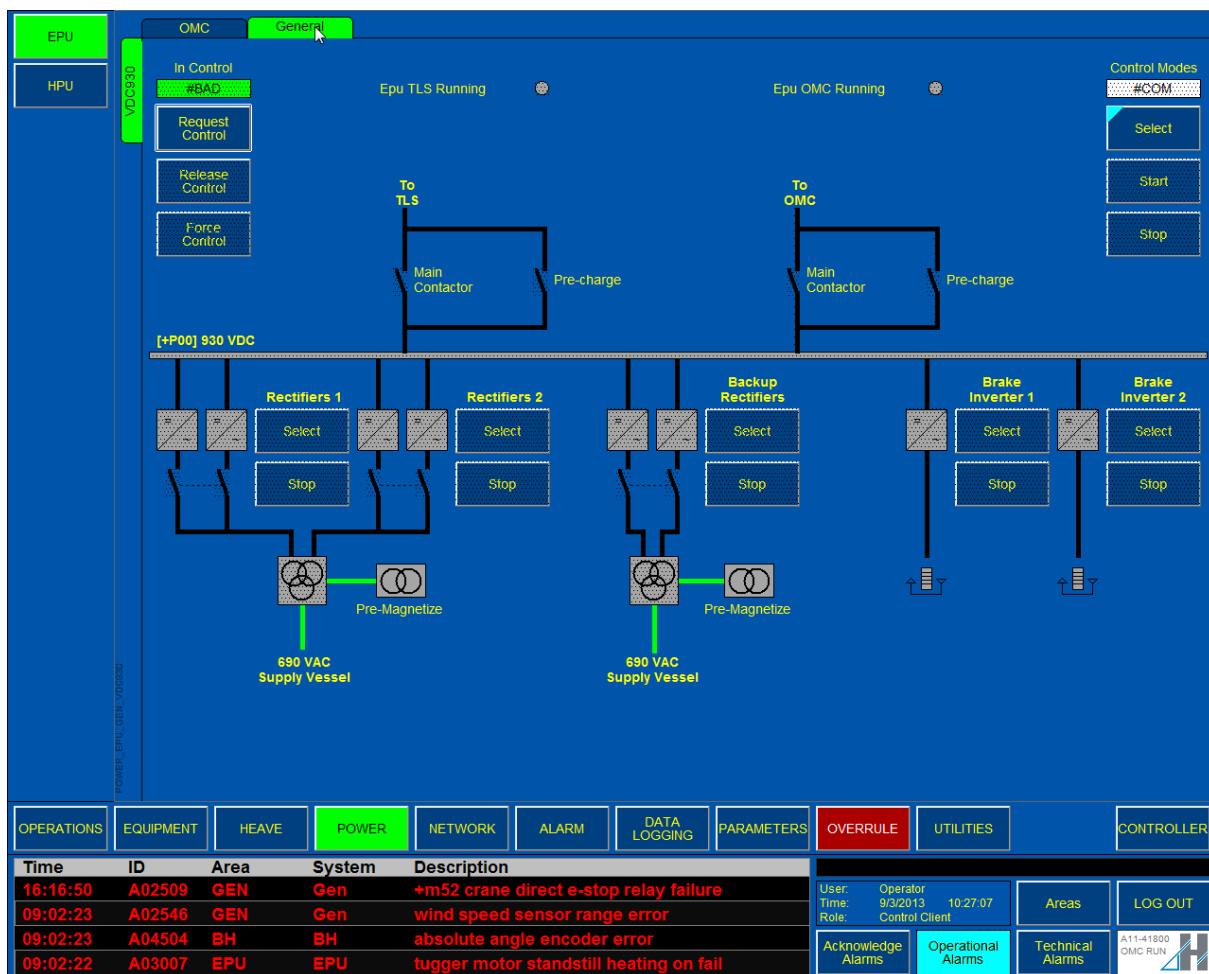


Figure 6-41: Power - EPU- General Screen

Field	Information
General	<ul style="list-style-type: none"> - 690 VAC Supply from Vessel - 690 VAC / 930 VAC transformer - Pre-Magnetize transformer - Rectifiers 1 <ul style="list-style-type: none"> - 'Select' button, press this button to select these rectifiers - 'Stop' button, press this button to stop these rectifiers - Rectifiers 2 <ul style="list-style-type: none"> - 'Select' button, press this button to select these rectifiers - 'Stop' button, press this button to stop these rectifiers - 690 VAC Supply from Vessel - 690 VAC / 930 VAC transformer - Pre-Magnetize transformer - Backup Rectifiers <ul style="list-style-type: none"> - 'Select' button, press this button to select these rectifiers - 'Stop' button, press this button to stop these rectifiers - Brake Inverter 1 <ul style="list-style-type: none"> - 'Select' button, press this button to select this brake inverter - 'Stop' button, press this button to stop this brake inverter - Brake Inverter 2 <ul style="list-style-type: none"> - 'Select' button, press this button to select this brake inverter - 'Stop' button, press this button to stop this brake inverter - +P00 930 VDC bus - To TLS <ul style="list-style-type: none"> - Main Contactor switch - Pre-charge switch - EPU TLS Running [indicator] - To OMC <ul style="list-style-type: none"> - Main Contactor switch - Pre-charge switch - EPU OMC Running [indicator]
In Control	<ul style="list-style-type: none"> - State [state indicator] - 'Request Control' button, press this button to request to take over the control from another SCADA control location - 'Release Control' button, press this button to hand over the control to another SCADA control location - 'Force Control' button, press this button to take over the control from another SCADA control location
Control Modes	<ul style="list-style-type: none"> - State [state indicator] - 'Select' button, press this button to switch between the EPU manual and auto mode - 'Start' button, press this button to start the EPU in auto mode - 'Stop' button, press this button to stop the EPU in auto mode

Table 6-26: Equipment - Power - EPU - General Screen

6.3.6.3 Power - HPU - General

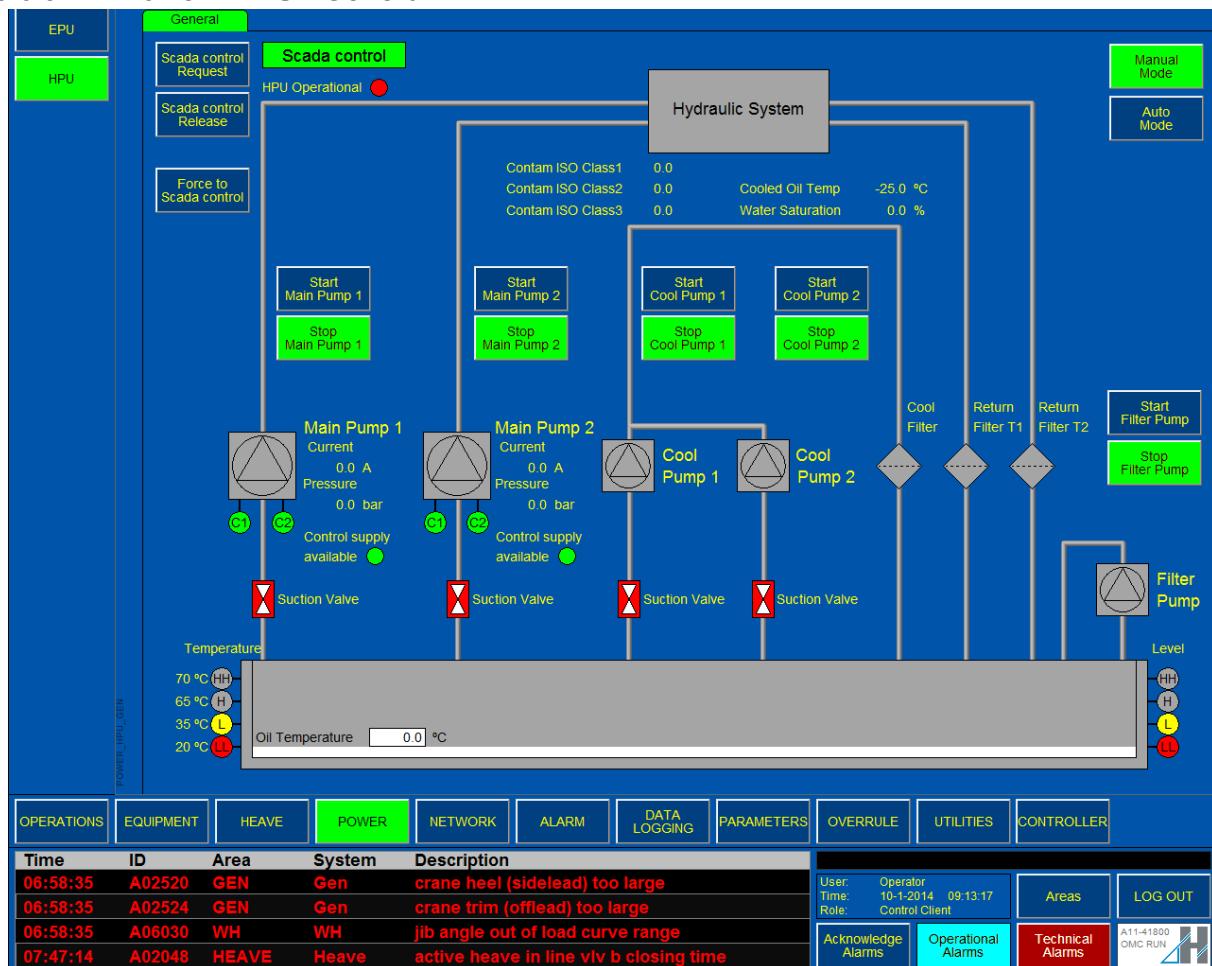


Figure 6-42: Power - HPU- Heave Screen

Field	Information
Oil	<ul style="list-style-type: none"> - Oil Temperature [°] - Temperature <ul style="list-style-type: none"> - LL [indicator] [°] - L [indicator] [°] - H [indicator] [°] - HH [indicator] [°] - Level <ul style="list-style-type: none"> - LL [indicator] - L [indicator] - H [indicator] - HH [indicator]
Suction Valves	<ul style="list-style-type: none"> - Suction Valve (4x)

Table 6-27: Equipment - Power - HPU - General Screen

Field	Information
Main Pumps	<ul style="list-style-type: none"> - Main Pump 1 <ul style="list-style-type: none"> - Current [A] - Pressure [bar] - Control supply available [indicator] - C1 [indicator] - C2 Indicator - 'Start Main Pump 1' button, press this button to start main pump 1 - 'Stop Main Pump 1' button, press this button to stop main pump 1 - Main Pump 2 <ul style="list-style-type: none"> - Current [A] - Pressure [bar] - Control supply available [indicator] - C1 [indicator] - C2 Indicator - 'Start Main Pump 2' button, press this button to start main pump 2 - 'Stop Main Pump 2' button, press this button to stop main pump 2
Cooling Pumps	<ul style="list-style-type: none"> - Cool Pump 1 <ul style="list-style-type: none"> - 'Start Cool Pump 1' button, press this button to start cooling pump 1 - 'Stop Cool Pump 1' button, press this button to stop cooling pump 1 - Cool Pump 2 <ul style="list-style-type: none"> - 'Start Cool Pump 2' button, press this button to start cooling pump 2 - 'Stop Cool Pump 2' button, press this button to stop cooling pump 2 - Cooled Oil Temp [°] - Water Saturation [%]
Hydraulic system	<ul style="list-style-type: none"> - Hydraulic system - Indicators of contamination: <ul style="list-style-type: none"> - Contam ISO Class1 [-] - Contam ISO Class2 [-] - Contam ISO Class3 [-]
Filters	<ul style="list-style-type: none"> - Filter Pump <ul style="list-style-type: none"> - 'Start Filter Pump' button, press this button to start filter pump - 'Stop Filter Pump' button, press this button to stop filter pump - Cool Filter - Return Filter T1 - Return Filter T2
SCADA control	<ul style="list-style-type: none"> - 'SCADA Control Request' button, press this button to request to take over the control from another SCADA control location - 'SCADA Control Release' button, press this button to hand over the control to another SCADA control location - 'Force to SCADA Control' button, press this button to take over the control from another SCADA control location - State indicator - HPU Operational [indicator]
Modes	<ul style="list-style-type: none"> - 'Manual Mode' button, press this button to set the HPU in manual mode - 'Auto Mode' button, press this button to set the HPU in auto mode

Table 6-27: Equipment - Power - HPU - General Screen

6.3.7 CONTROLLER SCREEN

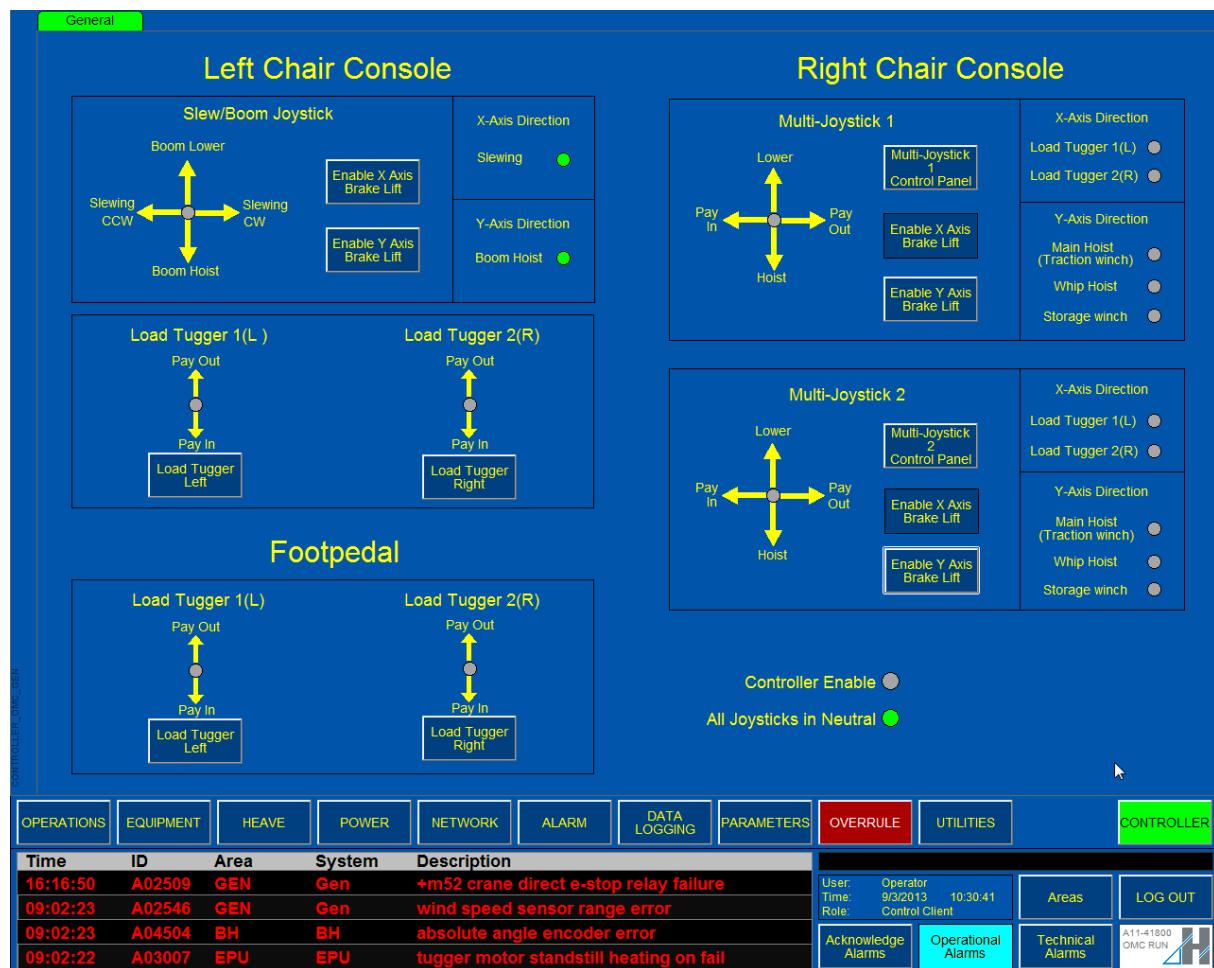


Figure 6-43: Controller Screen

Field	Information
Left Chair Console	
Slew/Boom Joystick	<p>Slew/Boom Joystick</p> <ul style="list-style-type: none"> - Boom Lower - Boom Hoist - Slewing CCW - Slewing CW <p>'Enable X Axis Brake Lift' button, press this button to lift the slewing brakes 'Enable Y Axis Brake Lift' button, press this button to lift the boom hoist brakes</p> <p>X-Axis Direction</p> <ul style="list-style-type: none"> - Slewing [indicator] <p>Y-Axis Direction</p> <ul style="list-style-type: none"> - Boom Hoist [indicator]

Table 6-28: Controller Screen

Field	Information
Load Tuggers	<p>Load Tugger 1 (L) Joystick</p> <ul style="list-style-type: none"> - Pay Out - Pay In <p>'Load Tugger Left' button, press this button to enable the left load tugger control</p> <p>Load Tugger 2 (R) Joystick</p> <ul style="list-style-type: none"> - Pay Out - Pay In <p>'Load Tugger Right' button, press this button to enable the right load tugger control</p>
Right Chair Console	
Multi-Joystick 1	<p>Multi-Joystick 1</p> <ul style="list-style-type: none"> - Lower - Hoist - Pay in - Pay out <p>'Multi-Joystick 1 Control Panel' button, press this button to open a pop-up screen to switch between hoists controlled by the joystick, see Section 6.3.7.1: "Pop-Up Screens".</p> <p>'Enable X Axis Brake Lift' button, press this button to lift the X-axis brakes</p> <p>'Enable Y Axis Brake Lift' button, press this button to lift the Y-axis brakes</p> <p>X-Axis Direction</p> <ul style="list-style-type: none"> - Load Tugger 1 (L) [indicator] - Load Tugger 2 (R) [indicator] <p>Y-Axis Direction</p> <ul style="list-style-type: none"> - Main Hoist (Traction winch) [indicator] - Whip Hoist [indicator] - Storage Winch [indicator]
Multi-Joystick 2	<p>Multi-Joystick 2</p> <ul style="list-style-type: none"> - Lower - Hoist - Pay in - Pay out <p>'Multi-Joystick 2 Control Panel' button, press this button to open a pop-up screen to switch between hoists controlled by the joystick, see Section 6.3.7.1: "Pop-Up Screens".</p> <p>'Enable X Axis Brake Lift' button, press this button to lift the X-axis brakes</p> <p>'Enable Y Axis Brake Lift' button, press this button to lift the Y-axis brakes</p> <p>X-Axis Direction</p> <ul style="list-style-type: none"> - Load Tugger 1 (L) [indicator] - Load Tugger 2 (R) [indicator] <p>Y-Axis Direction</p> <ul style="list-style-type: none"> - Main Hoist (Traction winch) [indicator] - Whip Hoist [indicator] - Storage Winch [indicator]
Footpedal	

Table 6-28: Controller Screen

Field	Information
Load Tuggers	Load Tugger 1 (L) Joystick - Pay Out - Pay In 'Load Tugger Left' button, press this button to enable the left load tugger control Load Tugger 2 (R) Joystick - Pay Out - Pay In - 'Load Tugger Right' button, press this button to enable the right load tugger control
General	
General	Information displayed about: - Controller Enable [indicator] - All Joysticks in Neutral [indicator]

Table 6-28: Controller Screen

6.3.7.1 Pop-Up Screens

Multi-Joysticks

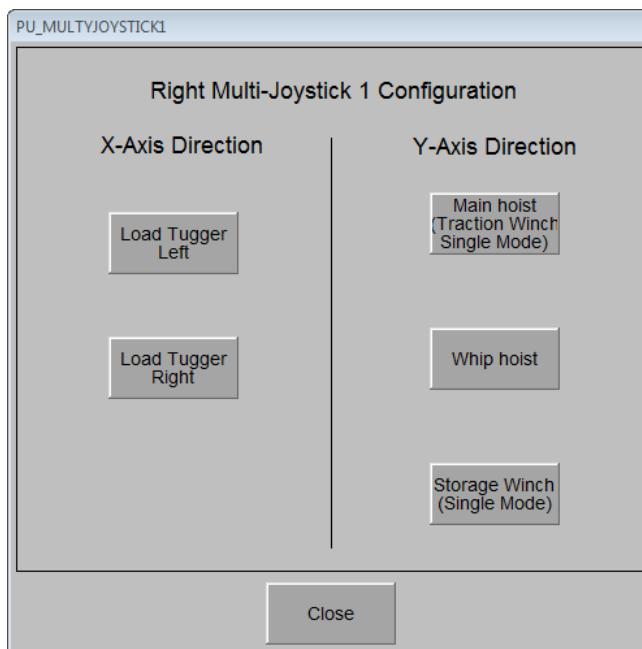


Figure 6-44: Pop-up Multi-Joystick

The two multi-joysticks on the right chair console can control multiple hoists. The "Multi-Joystick 1 Control Panel" and "Multi-Joystick 2 Control Panel" buttons open a pop-up screen to switch between hoists, see [Figure 6-44](#). Shown is the pop-up screen for Multi-Joystick 1, the pop-up screen for Multi-Joystick 2 looks similar.

The X-Axis direction of Multi-Joystick 1 and Multi-Joystick 2 can control:

- Load Tugger Left
- Load Tugger Right

The Y-Axis direction of Multi-Joystick 1 and Multi-Joystick 2 can control:

- Main Hoist (Traction winch if the system is in Single Mode)
- Whip hoist
- Storage winch (Single Mode)

6.3.8 ADDITIONAL SCREENS

For the following screens see: [Huisman SCADA standard user manual](#)

- Network screen
- Alarm screen
- Data logging screen
- Parameters screen
- Overrule screen
- Utilities screen

6.4 OPERATION MODES

Four operation modes can be identified:

- Automatic mode
- Manual mode
- Single mode
- Personnel lifting mode

The following sections describe these more in detail. Specific procedures will be mentioned in [Section 6.6: "Operational procedures"](#).

6.4.1 AUTOMATIC MODE

In automatic mode, the system performs sequences of operations. The operator initiates each sequence by pressing a button on the desk. Automatic mode is not available for any hoist function, only for the storage winch and for the heave system.

6.4.2 MANUAL MODE

In manual mode, each piece of equipment is controlled individually (all safety interlocks are active). An action or movement continues for as long as the button is pressed.

6.4.3 SINGLE MODE

In single mode, the storage winch and traction winch can be controlled individually, similar to manual mode, but independently of each other.

6.4.4 PERSONNEL LIFTING MODE

Personnel lifting mode is used to transport personnel and is therefore extra secured. Personnel lifting is only allowed when the crane is working in this mode.

For personnel lifting operational procedures refer to [Section 6.9.3: "Personnel lifting on whip hoist"](#). ..

WARNING



Personnel lifting is safe only when all regulations, both local and as stated in this manual, are being observed.

WARNING



Personnel lifting operation is safe only when Hsig ≤ 1,5 m, and load ≤ 2 mt.

WARNING



Personnel lifting should only be used during daylight or equivalent

6.5 OPERATION SPEED

The crane movement speeds are automatically limited depending on hook load, operating mode, position limits and other variables.

The maximum speed for a movement is determined by the PLC depending on the current SWL and hook load. The operator can vary the actual speed with the joystick. For the maximum speeds for each movement refer to [Section 1.4: "Technical Specifications"](#).

6.5.1 LOW SPEED

Reduced speed is automatically selected by the control system. Reduced speed varies per movement and is less than nominal. A safe speed before the end position is guaranteed by the automatic low speed selection. Reduced speed is applicable in pre-conditions like pre-highest position, pre-lowest and more.

6.5.2 NOMINAL SPEED

At nominal speed the applicable movement can perform at maximum torque. Nominal speed varies per movement and is between low and high speed. Nominal speed mainly depends on the motor characteristics. The control system will select nominal speed based on measured hook-load or position related interlocks.

6.5.3 HIGH SPEED

High speed is above nominal speed. At this speed the applicable movement can not perform at maximum torque. The available torque is decreased with an increase of the speed. The control system will measure the actual load and based on that will release the corresponding maximum allowable speed according to a pre-defined curve.

If one or more of the conditions required for activation of high speed mode no longer apply (e.g. if the maximum allowed load is exceeded), the control system will switch back to nominal speed mode automatically. High speed mode is disabled in emergency mode, personnel lifting mode and when the overload protection system is disabled.

6.6 OPERATIONAL PROCEDURES

6.6.1 CRANE OPERATIONS DURING THUNDERSTORMS

6.6.1.1 Danger regarding electronic equipment

Lightning often causes defects to electronics, for cranes most often the load measurement is affected. Difficulties are the unpredictable behavior of lightning, it may not always hit the highest location or the best grounded part. Even without direct lightning strike, there is the effect of Lightning Electromagnetic Pulse, with possible damage to electronics.

6.6.1.2 Danger to personnel

Continue crane work may be considered as an unsafe action, with high potential for personal injuries due to lightning strike in the crane and discharge through objects in the crane and to the deck near personnel.

6.6.1.3 Advised pre-cautions

- Lower the jib into the jib rest
- Personnel which is in or near the crane:
 - stay inside the crane house or cabin.
 - leave open deck area.

6.6.2 PRE-START CHECKS

Before start-up, make sure that:

- The oil level in gearboxes is OK.
- No one is present in the immediate vicinity of the winches and the crane.
- The drums can rotate freely (without obstruction).
- The slewing gears are free of foreign objects and well greased.
- The crane can slew without obstruction.
- The hooks can be lifted freely (check before every lifting operation).

The crane system can be started when:

- Emergency Stop circuit OK.
- 930 VDC power OK.
- There is no system on timeout failure.
- All applicable (remote) I/O stations communication and configuration OK.
- The 'crane configurations settings' pop-up on SCADA is confirmed.
- All brakes are applied.
- All controllers are in neutral position.
- The insulation of the DC bus is OK.

6.6.3 START UP PROCEDURE

1. Check the SCADA screen for alarms and status of the system.

2. Pull out emergency stop button(s).
3. If the SCADA screen displays 'Emergency stop active', push the 'Reset emergency stop' button during 2 seconds.
4. If the button flashes, overspeed protection system (DISPS) of one of the movements is not OK. If the button flashes, reset the DISPS before proceeding with start up procedure.
5. Push 'System on' button on the left hand control panel [Figure 6-2/3](#) during 3 seconds.
6. Wait a few seconds, to enable the system to start-up (green indicator is blinking).
7. Push 'Alarm acknowledge' button if the display shows non-acknowledged faults.

At this point the crane is ready for operation. The green 'System on' indicator is lit continuously to indicate that the system is ready and the start-up sequence has been completed. (A rectifier, a brake system and a drive are running.) If the 'System on' indicator keeps flashing, the start-up sequence is not completed, the flashing will timeout in 10s with alarm. If the indicator of the 'Reset drive system' starts flashing, one of the following problems is probable:

- Frequency inverters main hoist not ready.
- Frequency inverters auxiliary hoist not ready.
- Frequency inverters slewing not ready.
- Frequency inverters boom hoist not ready.

Reset the drives.

8. Turn the CONTROLLER switch to 1 = enable.

6.6.4 SHUT DOWN PROCEDURE

The installation can be switched off with the 'System off' button on the left hand control panel [Figure 6-2/4](#) if the following conditions are met:

- All brakes are applied.
- There are no slipping brakes.
- There is no brake apply failure.
- There is no brake test in progress.

6.6.5 EMERGENCY STOP PROCEDURE

The crane has two levels of emergency stop:

- Level 1: Crane , which will stop crane system (drives), HPU and AHC.
- Level 2: Heave compensator E-stop, which will stop crane system (drives), HPU, AHC and PHC

Applying one of the emergency stop buttons will cause immediate braking and shutdown of the applicable equipment (stated above). In case of a dangerous situation anywhere in or around the equipment, or if the operator is no longer able to control the equipment, the equipment has to be stopped as soon as possible by pressing the emergency stop button. This will cause an immediate braking and shutdown of the equipment.

The crane can be restarted by doing the following;

1. Deactivate of the emergency stop buttons.
2. Press the 'Reset emergency stop' button for 2 seconds.
3. Press the SYSTEM ON button for 3 seconds.

6.6.6 PLACING JIB IN JIB REST

During sea travel and extreme weather conditions, the jib of the crane the jib is to be lowered to -5° and to be fastened in a jib rest. The jib rest is not supplied by Huisman.

The procedure for placing the jib in the jib rest consists of the following steps:

1. Lower the jib above the jib rest (0°)
2. Attach the whip hoist to the jib rest with a sling
3. Lower the jib in the jib rest, and the hoist blocks in their baskets
4. Tension the sling

6.7 HEAVE COMPENSATOR PROCEDURES

6.7.1 SEMI-AUTOMATIC LOWERING / LIFTING PROCEDURES

The heave system contains several sequencers to assist the operator in handling some common lift and lowering situations. These sequencers are semi-automatic and require the operator to perform one or more actions in each step.

A sequencer can be activated in SCADA. Four sequencers are defined:

- Lowering load a load to the seabed
- Lifting a load from the seabed with overpull
- Lifting a load from the seabed
- Lifting a load from a supply boat

For the corresponding SCADA screens see:

- [Section 6.3.5.6: "Heave - Sequencers - Lower Load"](#)
- [Section 6.3.5.7: "Heave - Sequencers- Lift Overpull"](#)
- [Section 6.3.5.8: "Heave - Sequencers - Subsea Lift"](#)
- [Section 6.3.5.9: "Heave - Sequencers - Supply Boat"](#)

If a sequencer is selected the PLC will walk through pre-defined steps. The sequencer is controlled by inserting the requested data and pressing the 'next step' button in the control desk. The following paragraphs describe the manual and automatic actions in each step of each sequencer.

6.7.1.1 Lowering load a load to the seabed

Step No.	Step (SCADA)	Manual / SCADA	Auto
1	No active sequence	No actions	No actions
2	Give conditions	Give the following conditions: Expected load Expected depth Expected heave	Pressing the next step button will calculate the pressure setpoints for the PVU
3	Check pressure setpoints	The pressure setpoints are shown. Check these setpoints for inconsistency.	No actions
4	Connect PV1 to separator	No actions	Pressure Vessel 1 is connected to the separator
5	Separator to mid position	No actions	The separator is sent to its mid position
6	Set pressures for PVU	No actions	The PVU sets the pressures in the vessels to their required setpoints
7	Lower load through splash zone	Operate the crane to lower the load through the splash zone	No actions
8	Cylinder to mid position	No actions	The cylinder is sent to its mid position (start position)
9	Lower load to seabed level	Operate the crane to lower the load tot he level where the heave compensation is to be activated.	The pressure and the number of connected pressure vessels are automatically kept in balance with the load. Note: when a pressure vessel has to be connected or disconnected this action is performed with a 'next step' command.
10	Activate heave compensation	Activate the heave compensation. Start with passive heave first or start with active heave directly (DAHC).	No actions
11	Lower load to seabed level	In reduced speed, lower the load further to the seabed level. Just before the load touches the seabed, press the next step button to decrease the gas pressure.	No actions

Table 6-29: Lower load sequencer steps

Step No.	Step (SCADA)	Manual / SCADA	Auto
12	Decrease pressure	When a part of the load is handed over to the seabed: press the next step button to disconnect all the pressure vessels except one (if applicable) to make the decreasing of the pressure go faster.	The pressure in the connected pressure vessels is decreased
13	Disconnect pressure vessels except PV1	No actions	All pressure vessels except one (if applicable) are disconnected from the separator
14	Hand over load to seabed	In reduced speed, lower the load further to hand over the load to the seabed. This is to be done with reduced speed to let the system keep the pressure in the PVU in balance with the actual load in the crane.	The pressure is automatically kept in balance with the load
15	Load on seabed	When the load is on the seabed the system will stay in passive and active heave compensation. This will give time to disconnect the load from the hook.	No actions
16	Deactivate heave compensation	Deactivate the active (and passive) heave compensation by pressing the active heave compensation button. It is dependent on the setting if the passive heave should remain on or go off.	No actions
17	Cylinder to rest position	No actions	The cylinder is sent to the rest position
18	Disconnect all pressure vessels	No actions	All pressure vessels are disconnected from the system

Table 6-29: Lower load sequencer steps

6.7.1.2 Lifting a load from the seabed with overpull

Step No.	Step (SCADA)	Manual / SCADA	Auto
1	No active sequence	No actions	No actions
2	Give conditions	Give the following conditions: - Expected load - Expected depth - Expected heave Optional: press the calculate button to directly calculate the pressures	Pressing the next step button will calculate the pressure setpoints for the PVU
3	Check pressure setpoints	The pressure setpoints are shown. Check these setpoints for inconsistency.	No actions
4	Connect PV1 to separator	No actions	Pressure Vessel 1 is connected to the separator
5	Separator to mid position	No actions	The separator is sent to its mid position
6	Set pressures for PVU	No actions	The PVU sets the pressures in the vessels to their required setpoints
7	Lower hook to seabed level	Operate the crane to lower the hook to the seabed level	No actions
8	Cylinder to mid position	No actions	The cylinder is sent to its mid position (start position)
9	Activate heave compensation	Activate the heave compensation. Start with passive heave first or start with active heave directly (DAHC).	No actions
10	Connect load to hook	Connect the load to the hook. Once the hook is connected to the load and the slings are tensioned, disable the active heave compensator.	No actions
11	Increase pressure / Fast gas release	Press the button 'increase pressure on the desk'. The system will increase the pressure in PV1. When the load lifts off, press the button 'fast gas release'. The pressure vessels pre-charge on a lower pressure (max $\Delta P = 50$ bar) and detonated as fast gas release vessel will be connected to the separator with will lead to a fast decrease in gas pressure.	No actions

Table 6-30: Lift load with overpull sequencer steps

Step No.	Step (SCADA)	Manual / SCADA	Auto
12	Hoist load clear of seabed	Hoist the load with the hook until it is clear of the seabed	No actions
13	Deactivate heave compensation	Deactivate the active (and passive) heave compensation by pressing the active heave compensation button. It is dependent on the setting if the passive heave should remain on or go off.	No actions
14	Cylinder to rest position	No actions	The cylinder is sent to the rest position
15	Disconnect all pressure vessels	No actions	All pressure vessels are disconnected from the system

Table 6-30: Lift load with overpull sequencer steps

6.7.1.3 Lifting a load from the seabed normal

Step No.	Step (SCADA)	Manual / SCADA	Auto
1	No active sequence	No actions	No actions
2	Give conditions	Give the following conditions: - Expected load - Expected depth - Expected heave Optional: press the calculate button to directly calculate the pressures	Pressing the next step button will calculate the pressure setpoints for the PVU
3	Check pressure setpoints	The pressure setpoints are shown. Check these setpoints for inconsistency.	No actions
4	Connect PV1 to separator	No actions	Pressure Vessel 1 is connected to the separator
5	Separator to mid position	No actions	The separator is sent to its mid position
6	Set pressures for PVU	No actions	The PVU sets the pressures in the vessels to their required setpoints
7	Lower hook to seabed level	Operate the crane to lower the hook to the seabed level	No actions
8	Cylinder to mid position	No actions	The cylinder is sent to its mid position (start position)
9	Activate heave compensation	Activate the heave compensation. Start with passive heave first or start with active heave directly (DAHC).	No actions
10	Connect load to hook	Connect the load to the hook. Once the hook is connected to the load and the slings are tensioned, disable the active heave compensator.	No actions
11	Increase pressure / Fast gas release	Press the button 'increase pressure on the desk'. The system will increase the pressure in PV1. When the load lifts off, press the button 'fast gas release'. The pressure vessels pre-charge on a lower pressure (max $\Delta P = 50$ bar) and detonated as fast gas release vessel will be connected to the separator with will lead to a fast decrease in gas pressure.	No actions

Table 6-31: Lift load sequencer steps

Step No.	Step (SCADA)	Manual / SCADA	Auto
12	Hoist load clear of seabed	Hoist the load with the hook until it is clear of the seabed	No actions
13	Deactivate heave compensation	Deactivate the active (and passive) heave compensation by pressing the active heave compensation button. It is dependent on the setting if the passive heave should remain on or go off.	No actions
14	Cylinder to rest position	No actions	The cylinder is sent to the rest position
15	Disconnect all pressure vessels	No actions	All pressure vessels are disconnected from the system

Table 6-31: Lift load sequencer steps

6.7.1.4 Lifting a load from a supply boat

Step No.	Step (SCADA)	Manual / SCADA	Auto
1	No active sequence	No actions	No actions
2	Give conditions	Give the following conditions: - Expected load - Expected depth - Expected heave Optional: press the calculate button to directly calculate the pressures	Pressing the next step button will calculate the pressure setpoints for the PVU
3	Check pressure setpoints	The pressure setpoints are shown. Check these setpoints for inconsistency.	No actions
4	Connect PV1 to separator	No actions	Pressure Vessel 1 is connected to the separator
5	Separator to mid position	No actions	The separator is sent to its mid position
6	Set pressures for PVU	No actions	The PVU sets the pressures in the vessels to their required setpoints
7	Connect load to hook	Connect the load to the hook. Once the hook is connected to the load and the slings are tensioned, disable the active heave compensator.	No actions
8	Cylinder to mid position	No actions	The cylinder is sent to its mid position (start position)
9	Activate passive heave and hoist hook	Press the button 'passive heave compensation' to request passive heave. The passive heave valve will open at the moment the load is in balance with the pressure.	No actions
10	Increase pressure and hoist winch	Press the button 'increase pressure' on the desk to increase the pressure in PV1. The load can be hoisted until the load lifts off the supply boat.	No actions
11	Deactivate heave compensation	Deactivate the active (and passive) heave compensation by pressing the active heave compensation button. It is dependent on the setting if the passive heave should remain on or go off.	No actions

Table 6-32: Supply boat sequencer steps

Step No.	Step (SCADA)	Manual / SCADA	Auto
12	Cylinder to rest position	No actions	The cylinder is sent to the rest position
13	Disconnect all pressure vessels	No actions	All pressure vessels are disconnected from the system

Table 6-32: Supply boat sequencer steps

6.7.2 AUTO PVU CONTROLLER

The Auto PVU Controller (APV) is an automatic sequencer can be started in SCADA. The operator will be asked for the desired settings. Then the system will go through several phases:

Preparation mode

All required work vessels are brought to their desired pressures and the separator is positioned. The separator valves are opened. If needed, a pop-up screen asks the operator if the cylinder can be positioned.

Balancing mode

The operator is allowed to start passive heave compensation and/or active heave compensation. The PVU controller will stay in balancing mode until the stop button is pressed. It is possible to pause the PVU controller or to change the pressure setpoints for the work vessels (dependent on the selected mode).

In balancing mode the separator pressure is automatically kept in balance with the load when the difference moves outside the deadband. Vessels are automatically disconnected/connected. The setpoint can be changed (in advanced mode) with the increase/decrease buttons to intentionally unbalance the system. This setpoint is remembered as long as the PVU controller is active.

Parking mode

After pressing the stop button, the operator is presented with a popup with parking mode settings. After confirming the settings the PVU controller will go to parking mode. The PVU controller is stopped when parking mode is finished.

For the corresponding SCADA screens see: [Section 6.3.5.10: "Heave - APC"](#) and [Section 6.3.5.11: "Heave - APC - Pop-Up Screens"](#)

6.8 MAIN HOIST REEVING PROCEDURE

Reference drawing:

■ [A11-41800-31-1018](#): Reeving procedure main hoist

The procedure to reeve the main hoist wire from 1 fall to 2 falls and vice versa is described in [Figure 6-45](#), [Table 6-33](#), [Figure 6-46](#) and [Table 6-34](#).

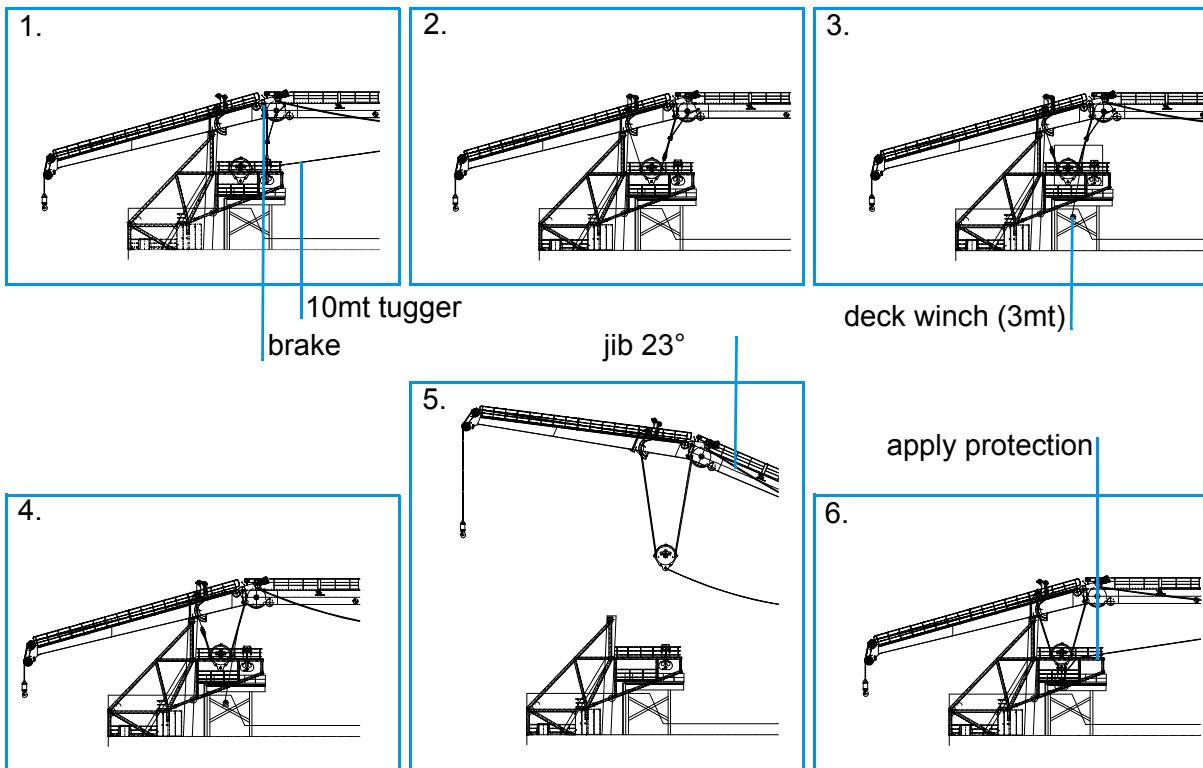


Figure 6-45: Reeving procedure main hoist single to double fall

Step	Description
1.	Start situation <ul style="list-style-type: none"> - Sheaveblock in basket, secured to basket (with 4xØ50 yard supply) & wire rope guards (4xM36) removed - Place ballweight in block basket, secure to basket - Apply brake (static holdback) (see Section 6.8.1: "Apply / lift wire brake")
2.	<ul style="list-style-type: none"> - Remove pin (Ø150) between socket and ballweight - Reeve airtugger underneath sheave and connect to MH wire tugger link
3.	<ul style="list-style-type: none"> - Connect deck tugger to MH wire (if required use extra snatch block for proper alignment) and tension - Lift brake (note deck winch is 3mt, MH linepull is 4/5mt) (see Section 6.8.1: "Apply / lift wire brake") - Pull MH wire through sheaveblock using deck winch and air tugger - If required apply brake to re-attach 3mt deck winch

Table 6-33: Reeving procedure main hoist single to double fall

Step	Description
4.	<ul style="list-style-type: none"> - Pull MH wire socket towards dead end - Continue until socket can be mounted in dead end connection - Install wire rope guards (4xM36) in sheaveblock - Disconnect tuggers - Switch crane configuration to double fall mode
5.	<ul style="list-style-type: none"> - Position sheaveblock above ballweight, use 10mt tugger as guidance <p>Note: sheaveblock is unstable, use control lines</p> <ul style="list-style-type: none"> - Insert pin ($\varnothing 150$) between sheaveblock and ballweight
6.	<ul style="list-style-type: none"> - Place MH block in basket - Place jib in jibrest

Table 6-33: Reeling procedure main hoist single to double fall

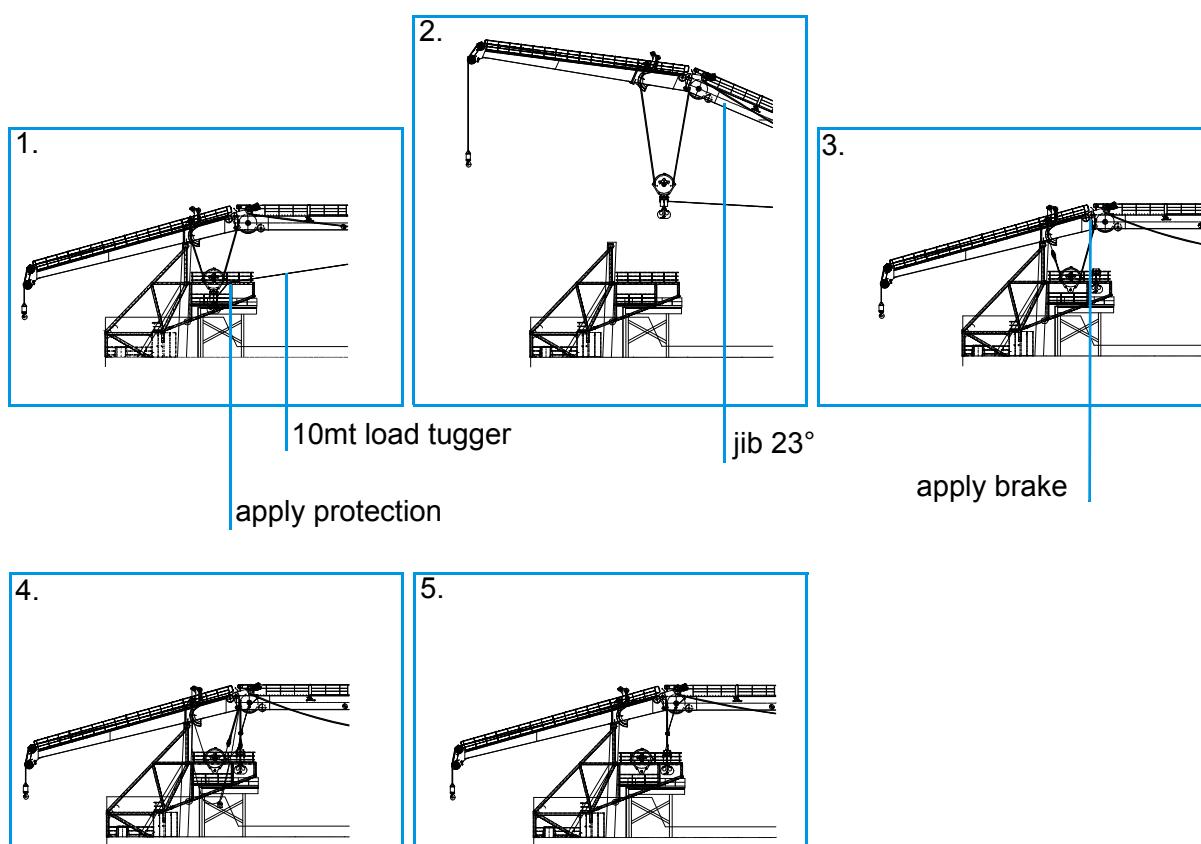


Figure 6-46: Reeling procedure main hoist double to single fall

Step	Description
1.	Start situation <ul style="list-style-type: none"> - Jib in jibrest - Lower block in block basket
2.	<ul style="list-style-type: none"> - Position and place lower block in ballweight basket, use tugger for guidance - Attach tugger to sheaveblock - Remove pin ($\varnothing 150$) <p>Note: Sheaveblock becomes unstable</p>

Table 6-34: Reeling procedure main hoist double to single fall

Step	Description
3.	<ul style="list-style-type: none">- Place sheaveblock in block basket, secure sheaveblock to basket- Apply brake (see Section 6.8.1: "Apply / lift wire brake")- Lower jib in jibrest (MH wire is slack)- Remove wire rope guards (4xM36) in sheaveblock- Attach tugger to dead end MH wire rope and tension- Remove dead end rotation pin ($\varnothing 40$) and main pin ($\varnothing 150$)
4.	<ul style="list-style-type: none">- Lower MH wire rope socket- Connect deck winch to MH wire rope and tension- Lift brake (see Section 6.8.1: "Apply / lift wire brake")- Gradually hoist up main hoist and pay out deck winch- If required, re-apply brake, re-connect deck winch and continue hoisting up main hoist socket until socket can be lifted in ballweight- Disconnect airtugger and deck winch and pull back- Re-install wire rope guards (4xM36)
5.	<ul style="list-style-type: none">- Insert pin ($\varnothing 150$) between MH socket and ballweight- Switch crane configuration to single fall mode

Table 6-34: Reeling procedure main hoist double to single fall

The main hoist jibhead sheave is equipped with a wire brake for reeling procedures. For more information about the location of the brake see [Section 2.14.5.2: "Wire brake"](#), for hydraulic information see [Section 4.2: "Wire brake system"](#).

The airtugger (2.4mt) and deck winch (3mt) for reeling procedures are both Subsea 7 delivery.

6.8.1 APPLY / LIFT WIRE BRAKE

CAUTION

The crane and especially the main hoist must not be operated when the wire brake is applied

CAUTION

There are no sensors installed on the wire brake system. The pressure in the cylinder can only be monitored with the pressure gauge.

In case the pressure drops below 310bar on the bottom side of the cylinder during operation, it should be pumped up to 320bar again. At the start, the pressure must be checked regularly, because the pressure may drop due to temperature increase while pumping. After the brake is applied it must be checked each hour.

The wire brake cylinder can be extended to press down the wire and apply the wire brake, and can be retracted to lift the wire brake after the operation is done. It will take about 6 minutes to extend or retract the cylinder.

To apply the wire brake:

1. Make sure the crane has a horizontal jib and that the crane cannot be operated.
2. Set the directional valve of the hand pump to 'extend'
3. Start pumping
4. Stop pumping when the bottom side of the cylinder is 320 bar, and the cylinder is in the correct position
5. Set the directional valve in the middle position

To lift the wire brake

1. Make sure the crane has a horizontal jib and that the crane cannot be operated.
2. Make sure there is no load in the wire
3. Set the directional valve to 'retract'
4. Start pumping
5. Stop pumping when the cylinder is in place
6. Set the directional valve in the middle position

6.9 SYSTEM OPERATIONS

6.9.1 OVERLOAD PROTECTION SYSTEM

For each setup of the crane, another load curve is applicable and visible on the SCADA screen. The load curves shown are based on:

- The value for Hsig,
- Lift type (Harbor, Internal, Supplier)
- Hoist type (Main hoist, Whip hoist on main jib, Whip hoist on fly jib)
- Number of falls (1, 2)

The current values must be entered in the main SCADA screen by the operator.

The overload protection system prevents the OMC from being loaded beyond the maximum capacity. The overload protection system incorporates:

- The load cell for the main hoist measuring the load acting on the hoist wire.
- The load cell for the low tension main hoist sheave, measuring the line pull between the traction winch and the storage winch.
- The load cell for the whip hoist, measuring the load acting on the hoist wire.
- The load cells for the tuggers, measuring the load acting on the hoist wire.
- The inclinometers in the e-cabinet crane cabin, measuring the angle relative to the horizon (heel and trim).
- The inclinometer at the jib, measuring the jib angle relative to the horizon.
- The encoder at the jib pivot measuring the jib angle relative to the crane (used as a reference).

The combined data of these measuring devices are used to calculate the Safe Working Load of the OMC according to the load charts.

When an overload of the crane occurs a message is displayed on SCADA and an audible alarm is generated in the operator cabin (buzzer) and outside the crane (deck horn).

- When the actual load has reached 90% of the SWL, a 'pre-overload' alarm is generated (intermittent buzzer sound).
This alarm is meant as a warning and has no consequences for operation.
- When the load should reach 110% of the SWL, an 'overload' alarm will be activated.
This alarm is more persistent (buzzer and deck horn).
 - In Harbor or Internal mode all movement is stopped except lowering with the main hoist, lowering with the whip hoist, moving the tuggers and slewing.
 - In Supplier mode full operation possibilities remain available until the load exceeds the comparable internal lift load curve. If this occurs lowering the boom hoist, hoisting the main hoist and hoisting the whip hoist are blocked. For the main hoist applies that hoisting the boom hoist is only allowed for jib angle $\leq 75^\circ$. All other movements remain available.

The 'buzzer disable/enable'-switch on the right-hand console [Figure 6-3/10](#) can we switched to 'disable' to silence the alarm for 15 minutes. It can be enabled again after it is disabled.

The crane's overload protection system can be temporarily disabled by activating the 'overrule loadcells' switch on the right-hand console [Figure 6-3/5](#). This disables the loadcells for maximum 30 minutes. With the overload protection system disabled, the maximum speed is limited to nominal speed. The buzzer sounds 3 beeps every 30 seconds.

WARNING

Disabling of overload protection system is hazardous, and should not be used unless absolutely necessary, and should only be used with full knowledge of the possible consequences!

WARNING

Overrule loadcells is NOT to be used to increase the load capacity.

WARNING

When loadcell failure is detected an alarm is activated and hoisting and lowering is not allowed.

This can be disabled by the 'Overrule Loadcells' switch on the right hand console of the operator chair.

This is dangerous and should not be used unless absolutely necessary!

NOTE

A failure of a sensor related to the overload protection system will result in the same limitations as overload.

6.9.2 MOVEMENT OPERATIONS

6.9.2.1 General operational conditions

The crane systems can only move if movement is operational and allowed.

Movement is operational when all of the following conditions are met:

- Crane system is ON.
- Applicable remote IO stations communication and configuration OK.
- Applicable drive(s) communication is OK.
- Applicable drive(s) does not have an alarm active
- Applicable drive(s) watchdog OK.
- Demanded drive(s) running.
- Applicable DISPS OK.

Movement is allowed when all of the following conditions are met:

- Movement is operational.
- The requirements of the overload protection system are met.
- There is no brake lift failure.

Hoist movement is allowed when all of the following conditions are met:

- Movement is allowed.
- No slack rope is detected for applicable hoist.

- Applicable slack rope sensor is OK.
- Hoist isn't at the highest (working) position when hoisting.
- Applicable highest (working) position is OK.
- Hoist does not have empty drum when lowering.

6.9.2.2 Main hoist

The main hoist is responsible for the movement of the main hook. The main hoist winch consists of a traction winch and a storage winch. As the storage winch is controlled automatically by the CT, the operation of the main hoist is actually the operation of the traction winch. A spooling device is used to ensure a proper wire spooling on the storage winch. The main hoist is also equipped with a heave compensation system, heave compensation will be described in [Chapter 4: "Hydraulic description"](#).

To operate the main hoist, assign the movement to one of the multi-function joysticks.

Depending on the sea state, reeving and the lift type, different load curves can be active, the SWL is represented by these load curves.

For the load curves see [Appendix E: "Load curves"](#). The load curves are shown on the SCADA screen.

In single mode, the traction winch and storage winch can be operated separately.

Operational conditions

The main hoist is operational and allowed to move if all of the following conditions are met:

- Hoist movement is allowed (conditions stated in [Section 6.9.2.1: "General operational conditions"](#) are met).
- Storage winch is in CT or traction winch is in single mode.
- With traction winch in single mode, load on the main hoist hook is NOT allowed.
- Spooling device on storage winch should be OK before storage winch movement is allowed.

When all conditions are OK and the speed set point $<> 0$ the PLC will enable the lifting of the brake.

Single mode

- Single mode can be activated or deactivated by 'Single mode' button on SCADA with at least 'Engineer' privilege.
- Single mode is NOT allowed to be activated when traction winch or storage winch brake test is in progress.
- Single mode is NOT allowed to be activated or deactivated when traction winch has any brake lift.
- An alarm is generated when single mode is activated.



Position limits

Activated switch	Message	Action
Empty drum	Alarm	Lowering movement stopped.
Pre-empty drum	Warning	Only storage winch lowering in single mode is allowed.
Highest position	Displayed on main screen	Hoisting movement is stopped. When operator gives a new move command, invalid command message appears.

Table 6-35: Position limits main hoist

Speed limits

Nominal speed of main hoist is defined as 50%

The speed will be reduced to nominal speed if one of the following requirements is present:

- Temperature of storage winch gearbox is >80°C.
- Temperature of traction winch gearbox is >80°C
- Traction winch drive disabled
- Traction winch motor overheated
- Storage winch motor overheated
- Traction winch DISPS brake supply on/off fail
- Traction winch DISPS self-check fail
- Overload Protection System disabled

The speed will be reduced to low speed if one of the following requirements is present:

- System is operating in single mode
- Main hoist has a pre-empty drum (lowering only)

A load dependent speed limit curve is applied when the load exceeds:

- 100mt in 1 fall, speed is limited to nominal speed 50%
- 200mt in 2 falls, speed is limited to nominal speed 50%

This speed limit curve is according to the field weakening behavior of electric motors.

6.9.2.3 Whip hoist

The whip hoist is responsible for the movement of the whip hook and for personnel lifting.

To operate the whip hoist, assign the movement to one of the multi-function joysticks.

The whip hoist winch consist of a drum, driven by two electric motors, each with a gearbox. A Load Measuring Pin (LMP) measures the load in the lowering blocks.

Depending on the sea state, reeving and the lift type, different load curves can be active, the SWL is represented by these load curves.

For the load curves see [Appendix E: "Load curves"](#). The load curves are shown on the SCADA screen.

Operational conditions

The whip hoist is operational and allowed to move if all of the following conditions are met:

- Hoist movement is allowed (conditions stated in [Section 6.9.2.1: "General operational conditions"](#) are met).

When all conditions are OK and the speed set point $<> 0$ the PLC will enable the lifting of the brake.

Position limits

Activated switch	Message	Action
Empty drum	Alarm	Lowering movement stopped.
Pre-empty drum	Warning	Lowering movement speed limited to a maximum of 10%.
Highest position	Displayed on main screen	Hoisting movement is stopped. When operator gives a new move command, invalid command message appears.
Pre-highest position	Displayed on main screen	Hoisting movement speed limited to a maximum of 10%.

Table 6-36: Position limits whip hoist

Speed limits

Nominal speed of whip hoist is defined as 50%

The speed will be reduced to nominal speed if one of the following requirements is present:

- Whip hoist drive disabled
- Whip hoist motor overheated
- Whip hoist DIPSPS brake supply on/off fail
- Whip hoist DISPS self-check fail
- Overload Protection System disabled
- Personnel lifting active

The speed will be reduced to low speed if one of the following requirements is present:

- Whip hoist has a pre-empty drum (lowering only)
- Whip hoist has a pre-highest position (hoisting only)

A load dependent speed limit curve is applied when the load exceeds:

- 10mt in 1 fall, speed is limited to nominal speed 50%
- 20mt in 2 falls, speed is limited to nominal speed 50%

This speed limit curve is according to the field weakening behavior of electric motors.

6.9.2.4 Boom hoist

The boom hoist is responsible for the movement of the jib in the vertical plane.

To hoist the system, use the left joystick on the left-hand control (Y-axis) [Figure 6-2/1](#).

The working range of the jib is -5° to 81° , the minimum working angle is 0° .

Operational conditions

The boom hoist is operational and allowed to move if all of the following conditions are met:

- Hoist movement is allowed (conditions stated in [Section 6.9.2.1: "General operational conditions"](#) are met).
- No slack rope is detected for storage winch.
- No slack rope is detected for whip hoist.
- Lowering below lowest working position is NOT allowed.

If one of the conditions is not met during operation, movement will be stopped.

Position limits

Activated switch	Message	Action
Empty drum / lowest working position	Alarm	Lowering movement stopped.
Pre lowest working position	Warning	Lowering movement speed limited to a maximum of 10%.
Highest position	Displayed on main screen	Hoisting movement is stopped. When operator gives a new move command, invalid command message appears.
Pre highest position	Displayed on main screen	Hoisting movement speed limited to a maximum of 10%.

Table 6-37: Position limits boom hoist

Speed limits

Speed	Activated at
Reduced	Pre-highest position Lowest working position
High	Values for SWL and radius as defined in overload protection document.

Table 6-38: Boom hoist speed limits

Medium speed of boom hoist is defined as 66.6%

Nominal speed of boom hoist is defined as 33.3%

The speed will be reduced to nominal speed if one of the following requirements is present:

- Boom hoist drive disabled
- Boom hoist motor overheated
- Boom hoist DIPSPS brake supply on/off fail
- Boom hoist DISPS self-check fail
- Overload Protection System disabled
- Personnel lifting active

The speed will be reduced to low speed (10%) if one of the following requirements is present:

- Boom hoist has a pre-lowest working position (lowering only)
- Boom hoist has a pre-highest position (hoisting only)

6.9.2.5 Tuggers

To operate the tuggers, assign the movement to one of the multi-function joysticks. Tuggers can also be operated by the small joystick on the left hand console [Figure 6-2/5](#) & [Figure 6-2/15](#), and foot pedal [Figure 6-4](#).

To activate constant tension, use the buttons on the left hand console [Figure 6-2/6](#) (left tugger) and [Figure 6-2/7](#) (right tugger).

To set the CT setpoint use the joysticks on the left hand console [Figure 6-2/15](#) (left tugger) and [Figure 6-2/5](#) (right tugger).

Constant tension (CT) function enables the crane to control a load automatically with a constant line-pull. If the actual value differs from the setpoint the winch will pay in or pay out wire rope to maintain the setpoint value.

Operational conditions

The tuggers are operational and allowed to move if all of the following conditions are met:

- Hoist movement is allowed (conditions stated in [Section 6.9.2.1: "General operational conditions"](#) are met).

Position limits

Activated switch	Message	Action
Empty drum	Alarm	Lowering movement stopped.
Highest position	Displayed on main screen	Hoisting movement is stopped. When operator gives a new move command, invalid command message appears.
Pre highest position	Displayed on main screen	Hoisting movement speed limited to a maximum of 10%.

Table 6-39: Position limits tuggers

Speed limits

Nominal speed of load tugger is defined as 50%

The speed will be reduced to nominal speed if one of the following requirements is present:

- Tugger motor overheated
- Overload Protection System disabled

The speed will be reduced to low speed if one of the following requirements is present:

- Tugger has a pre-highest position (hoisting only)

Speed limitations are not applicable while load tugger is in CT mode

A load dependent speed limit curve is applied when the load exceeds:

- 5 mt, speed is limited to nominal speed 50%

This speed limit curve is according to the field weakening behavior of electric motors.

6.9.2.6 Slewing operations

Slewing movement is the horizontal circular movement of the crane around the mast section.

To move the system, use the left joystick on the left-hand control (X-axis) [Figure 6-2/1](#).

Slewing range of the crane is limited to 450°. The jib of crane pointing to SB side of ship is the 0° of slewing. Slewing in CW direction is limited to 225°, in CCW direction to -225°

Operational conditions

Slewing is operational and allowed to move if all of the following conditions are met:

- Movement is allowed (conditions stated in [Section 6.9.2.1: "General operational conditions"](#) are met).
- No slack rope is detected for boom hoist.
- No slack rope is detected for storage winch.
- No slack rope is detected for whip hoist.
- Slewing isn't at the maximum right (for CW direction) or left (for CCW direction) position

Position limits

Activated switch	Message	Action
Max. left	-	CCW movement is stopped
Pre-max. left	-	CCW movement speed is limited to a maximum of 10%
Max. right	-	CW movement is stopped
Pre.-max. right	-	CW movement speed is limited to a maximum of 10%

Table 6-40: Position limits slewing platform

Speed limits

Nominal speed of slewing is defined as 50%

The speed will be reduced to nominal speed if one of the following requirements is present:

- Slewing motor overheated
- DISPS brake supply on/off fail
- DISPS self-check fail
- Overload Protection System disabled
- Whip hoist personnel lifting active

The speed will be reduced to 16.6% if one of the following requirements is present:

- Drive disabled

The speed will be reduced to low speed (10%) if one of the following requirements is present:

- Pre-maximum left (CCW direction)
- Pre-maximum right (CW direction)

Slewing speed is limited to nominal speed in man-riding mode

A load dependent speed limit curve is applied when the load exceeds:

- 310 mt, speed is limited to nominal speed 50%

This speed limit curve is according to the field weakening behavior of electric motors.

6.9.3 PERSONNEL LIFTING ON WHIP HOIST

Personnel lifting mode is activated using the key switch on the right hand console [Figure 6-3/4](#) when this is allowed. A personnel lifting indicator is visible on both SCADA screen and control desk. In personnel lifting mode, the SWL is set to 2 mt for all jib angles.

WARNING



Personnel lifting is safe only when all regulations, both local and as stated in this manual, are being observed.

WARNING



Personnel lifting operation is safe only when $H_{sig} \leq 2 m$, and load $\leq 2 mt$.

WARNING



Personnel lifting should only be used during daylight or equivalent

Operational conditions

Personnel lifting can only be activated if all of the following conditions are met:

- Whip hoist movement is allowed (conditions stated in [Section 6.9.2.3: "Whip hoist"](#) are met).
- All brakes of whip hoist, boom hoist, traction winch and slewing are applied.
- Brake tests of whip hoist, boom hoist, and slewing are passed.
- No load is detected on main hoist.
- Main hoist is at highest position.
- Overrule loadcells is not active.
- Heave system is not active.

6.9.3.1 Design measures for personnel lifting

Huisman implemented the following design features to increase safety:

1. Reduced capacity of the crane for personnel lifting to reduce the general stress level and reduce the risk of overload.
2. A second brake is added acting via a different load path and capable to carry the full load.
3. A second motor is added able to move the basket in case of motor failure.
4. A second control system is added to control the drives.
5. A second power cable can be connected to obtain power.

6. A continuous warning is generated to inform the operator that personnel lifting is activated.
7. The design fulfils the requirements for DNV lifting appliances.

6.9.3.2 Protections and interlocks

The following protections and interlocks are provided with the crane during personnel lifting:

1. Overload protection is set to 5 mt.
2. Constant tensioning is disabled.
3. Personnel lifting can only be done at nominal speed.
4. Crane motions are not stopped due to overload alarms. Only warnings are given.
5. Crane motions are stopped and warnings are given if the end positions of the motions are reached: slewing, booming/ and hoisting.
6. If the SWL for personnel lifting of 2 mt is exceeded, an alarm will go off in the crane.

6.9.3.3 Measures to be taken by the operator

The operator shall safeguard the personnel by doing the following:

1. A qualified and experienced crane operator is required for personnel lifting operations.
2. Make sure no other load is present on either main or whip hoist, or on any tugger.
3. Permission of the superintendent or captain to use the personnel lifting key.
4. Continuous attention of the crane operator during the personnel lifting operation.
5. Application of a basket and slings suitable for personnel lifting:

Type of basket	Requirements Basket should contain
For working in areas without permanent access and platforms	<ul style="list-style-type: none"> - sufficiently high hand rails. - anti-slip floor. - possibilities for securing the personnel with a safety hook. - protection against heavy objects from above (hook block!). - life vests. - sufficiently warm clothing. - food and drink. - emergency lowering gear.
For transfer of personnel from one ship to another	<ul style="list-style-type: none"> - self righting buoyancy. - frame protecting against vertical and lateral impacts/collisions. - protection against hard landings. - possibilities for securing.

Table 6-41: Personnel lifting baskets

See the examples of baskets for personnel transfer.

6. Possibilities of communication between the operator and the personnel in the basket.
7. Starting personnel lifting operations may only occur after the weather forecast is consulted.
8. Personnel lifting operations may only occur if visibility is daylight or equivalent to daylight.



Figure 6-47: Personnel lifting

9. The average wind speed may not exceed 10 m/s during personnel lifting.
10. The significant wave height may not exceed 2 m during personnel lifting.
11. The maximum number of people to be lifted is 3. Their equipment and tools can be lifted simultaneously. If more people need to be lifted, special precautions shall be taken.
12. Instruction of the personnel: before personnel lifting, inform them about risks and emergency operations when suspended in the basket by the crane.

6.9.3.4 Instructions for personnel lifting

An instruction card 'Instructions for manriding' hangs in the control cabin. This card provides instructions for personnel lifting or manriding in both normal and emergency situations and should stay in the cabin. The card can also be found in [Appendix D: "Instruction for manriding".](#)

6.9.4 HEAVE COMPENSATION SYSTEM OPERATIONS

6.9.4.1 Heave compensator

Operational conditions

The heave compensation system is operational if the following conditions are met:

- System is selected ON (keyswitch)
- Remote IO unit(s) OK
- No emergency stop
- HPU is running

AHC is operational if the following conditions are met:

- Heave system is operational
- Slewing angle measurement signal is OK
- Jib angle measurement signal is OK
- MRU signal is OK

Active heave is allowed when:

- AHC is operational
- NO valves failures
- Power available from HPU
- Passive heave compensation is ON

Starting AHC is allowed when

- Active heave is allowed

Activating/deactivating of the passive heave compensation is done from the control desk in the crane cabin. This operation is independent of the system mode of the heave compensator. When conditions are right and the button for the passive heave compensation is pressed, [Figure 6-2/11](#), the passive heave compensation will start.

Activating/deactivating of the active heave compensation is done from the control desk in the crane cabin. This operation is independent of the system mode of the heave compensator. When conditions are right and the button for the active heave compensation is pressed, [Figure 6-2/10](#), the active heave compensation will start.

Operating modes

The Heave compensation system can have the following modes:

- Idle mode:
 - In Idle mode the piston of the compensator cylinder is blocked. Idle mode is an operational state in which the system is not operated in AHC-mode or in PHC-mode. In Idle mode the system is waiting for operation or prepared for operation.
- Passive heave compensation:
 - In the PHC-mode the piston of the compensator cylinder is actuated by variations in the rope force due to drag forces that are exerted on the load.
- Active heave compensation:
 - In the AHC-mode, the position of the main hook is controlled in such a way that, independent to the hook load of the crane, within the specified operating conditions and independent to the vessel motions, the hook will remain in steady position relative to the seabed.

The relative position of the main hook to the seabed is controlled by actuating the piston of the compensator in a closed loop position control loop. The actual position of the piston is measured and compared against the required (setpoint-) position. The direction and magnitude of the oil are controlled by two servo valves.

System modes PHC

The passive heave compensator system can be placed in the following modes:

- Automatic mode
 - One of the automatic sequencers will take control of some actions of the heave compensator. The operator has to walk through several steps to control the heave compensator.
- Manual mode
 - Operator connects or disconnects necessary pressure vessels to keep the passive compensator position in balance with the load. An engineer has to calculate the required pressure in the pressure vessels and the required number of pressure vessels to be connected to the medium separator. All the pre-conditions for the passive heave compensation must be met manually to allow passive heave compensation.
- Service mode

Main valve

The main valve is operated by the operator by pressing the 'passive heave compensation' button [Figure 6-2/11](#). It can be operated in the following modes:

Manual mode

- The operator requests to open or close the passive main valve by pressing the 'passive heave compensation' button on the desk.

Semi-Automatic mode

- In the Semi-automatic mode the selected sequencer will determine the correct moment to activate/deactivate passive heave compensation. The operator still has to give the final command to open/close the valve by pressing the 'passive heave compensation' button on the desk.

Cylinder and separator fill / empty valves

Dependent on the mode, the cylinder and separator fill/empty valve is operated manually or automatically:

Manual mode

- To activate the cylinder and separator fill/empty valve manually, press the corresponding button in SCADA.
- When there is a low load, it might not be possible to retract the cylinder. The freewheel valves must be closed manually and the servo valves must actively retract the cylinder. This is done via the maintenance screen. Then it is possible to retract the cylinder with the empty valve.

Semi-Automatic mode

- The PLC will automatically move the cylinder to its mid position. The command for the automatic movement is given by the automatic sequencer.
- When there is a low load, this will be automatically detected by the system, the system will close the freewheel valves and actively retract the cylinder with the servo valves.

6.9.4.2 Hydraulic Power Unit

Operational conditions

The HPU system is operational if all of the following conditions are met:

- System is operational
- Remote IO unit OK
- No delayed emergency stop

System modes

The HPU can have the following modes:

- Automatic mode; all selected pumps are started automatically when pressing the 'start HPU' button on the SCADA screen according to a pre-programmed sequence. All pumps are stopped (except the filter pump) by pressing the 'stop HPU' button on the SCADA screen.

- Manual mode; each pump must be started and stopped individually. The pumps can be started and stopped in any order, but safety conditions are still in place.
- Service mode; same as manual mode except that safeties and interlocks are overruled.
- Interconnection mode; in case of a failure of the pipelay HPU, one of the main pumps of the crane can be used to supply hydraulic power to the pipelay equipment.

6.9.4.3 Pressure Vessel Units

Operational conditions

The PVU system is operational if the following conditions are met:

- All applicable remote IO units are OK
- No emergency stop is active
- HPU is running

System modes

Each PVU can be selected for:

- Automatic
 - In automatic mode the opening and closing commands are issued by the sequencers. The commands are checked for viability before being executed.
- Manual
 - The valves are opened and closed by pressing the corresponding buttons in SCADA.
 - Pressing a button once will start opening the valve, no button has to be pressed continuously to open or keep open a valve.
- Service mode
 - Operation is equal to manual mode except that safeties are ignored.
 - Service mode is only allowed when the passive main valve is closed

NOTE *Each pressure vessel can be selected for automatic/manual/service mode separately*

The pressure in the connected vessels must be accommodated to the submerged weight of the load in the main hook prior to activating either the active heave compensation system or the passive heave compensation system. The number of active vessels necessary for operation must be selected based on the required capacitance; lower drag forces require higher capacitance, higher drag forces require lower capacitance in order to prevent that the piston is driven into its buffers.

For certain types of operation it is necessary to switch quickly between two pressure levels. Therefore, the gas vessels can be subdivided into a high-pressure and a low-pressure section. The subdivision must be set-up by the operator.

Five different operation types exist, these are:

1. Operational vessels (vessel that are connected to the separator)
2. Increase vessels, for increasing the pressure in the operational vessels.
3. Decrease vessels, for decreasing the pressure in the operational vessels.
4. Storage pressure vessels that are not used of which the pressure level is irrelevant.

5. Fast gas release vessels, which are appointed as fast gas release vessels will be connected to the operational vessels when the fast gas release function is enabled and the button on the desk is pressed.
6. Aid vessels, these are used during automatic PVU pressurizing. These vessels are set at intermediate pressures to ensure there is always a vessel available, to pump gas to or from. This due to the max pump factor of 6.

For each operation at least one section of vessels is appointed as operational vessel. Assignment of increase- and decrease-vessels is not obligatory.

An engineer has to calculate the requested pressures in the different PVU's and select the right PVU's for operation. In automatic mode the control system will calculate the pre-set values for the PVU. An engineer has to check this. To set the PVU's on the requested pressure, automatic or manual mode can be used.

When an alarm regarding the position sensors is detected, this will be indicated by red flashing of the indication lights at the SCADA system.

When a valve is traveling from open to close or vice versa, this is represented by flashing the requested position indication light.

When using the PIU to charge gas to a vessel unit, gas is shifted from the pressure vessels which are connected to the HP an LP line. In automatic mode the discharge / charge cycle will be controlled without operator interference. Due to the limited oil pressure of 270 Bar, the maximum gas pressure that can be achieved using the compressor is limited to 270 Bar as well.

Charging / discharging of vessel sections can also be accomplished by letting gas flow from a section with a higher pressure to a section with a lower pressure. Natural flow of gas speeds up charging of the HP-bottles and is therefore beneficial. The equalizer valve will be used to enable natural gas flow.

When gas is shifted to a pressure vessel using the PIU the gas temperature will rise. Because of the temperature the vessel where the gas is shifted to gives the signal 'in setpoint' when the upper limit of the hysteresis is reached. After a time the temperature of the gas will drop and the pressure vessel will still be in it's setpoint.

When gas is shifted to a pressure vessel using the EV the gas temperature will drop. Because of the temperature the vessel where the gas is shifted to gives the signal 'in setpoint' when the lower limit of the hysteresis is reached. After a time the temperature of the gas will rise and the pressure vessel will still be in it's setpoint.

The setpoint for each PVU must be $20 < \text{setpoint} < 270$ bar

All the PVU's which need to be brought to a required pressure has to be in automatic mode also the Storage-Vessels. When a vessel is in manual mode this vessel section will not be used at all for the automatic sequence.

6.9.4.4 Pressure Intensifier Unit

Operational conditions

The PIU system is operational if the following conditions are met:

- A new target position request will only be activated if the pump is in an extreme position, not being the target position, or if the pump has not been in one of the extreme position

- for longer than 20 seconds.
- the charge pump is only allowed to run if at least one HP valve and one LP valve are opened.
- The pressure settings for the PIU can be changed via SCADA. Resetting this will set back the default values of the pressure settings.
- Requirements in [Table 6-42](#) are met

Requirement	Action
LP < 5 bar	PIU may not be operated
HP/LP < 3	PIU is allowed to operate in single stage
3 <= HP/LP <= 6	PIU is allowed to operate in double stage
HP - LP > 100	PIU is allowed to operate in double stage
HP/LP > 6	PIU may not be operated
HP > 290 bar	PIU may not be operated

Table 6-42: Operational pressures and pressure differences for the PIU

System modes

The PIU has four operating modes:

Manual

- In manual mode the valves are directly controlled by pressing the corresponding buttons on the SCADA screen. The operator is responsible for operating the 4/2 valves for the PIU and for controlling the right cylinders to achieve the needed outlet pressure.

Semi-Automatic

- When operating the PIU semi-automatic, there will be one full compression cycle consisting of one hydraulic driven extending stroke and a gas driven retracting stroke.

Automatic

- The commands are issued by the sequencers, the commands are checked for viability before being executed.
- The compression cycle is active for as long as the compression is allowed or till the required pressure in the target vessel section is reached.

Service

- Equal to manual mode, except safeties are overruled.

Equalizer valve

The equalizer valve can be operated in three modes:

Manual mode

- To open the valve, press the corresponding buttons in SCADA.

Automatic mode

- The opening is controlled by the automatic sequence.

Service mode

- Equal to manual mode except safeties are ignored.

6.10 GENERAL PROCEDURES

6.10.1 WIRE CHANGE OUT PROCEDURE

6.10.1.1 Tools needed for change out of the wires.

- Reel with messenger wire with sufficient length and strength, depending on the wire that has to be changed
- Spooling device that can handle the weight and length of the hoisting wire
- Empty reel with sufficient storage capacity
- Tugger winch for controlling messenger wire (when applicable)
- Chain blocks and slings for temporarily securing wires and movable parts.
- Reel with new wire

6.10.1.2 Guidelines for change out procedures:

- All wires have to be equipped with welded links on both dead ends. Chinese fingers are not recommended.
- Place the jib in the optimum position for changing the wire.
- To avoid dangerous situations make sure that all movable parts are correctly secured to the crane structure before wires are disconnected.
- Before disconnecting the wires, make sure that the wire is temporarily secured to the crane structure near the point of disconnection. The connection has to be strong enough to hold the weight of the wire, so it cannot slip or fall.
- When changing a wire, use a messenger wire with smaller diameter) to safely guide the old wire out of the crane and the new wire into the crane. This messenger wire can be spooled on the hoist winch or on a tugger winch. Make sure the messenger wire has sufficient length and strength.

NOTE

Read the reeving diagram:

- [Section 2.13.3: "Boom hoist reeving" on page 48](#)
 - [Section 2.14.5: "Main hoist reeving" on page 59](#)
 - [Section 2.15.3: "Whip hoist reeving" on page 69](#)
 - [Section 2.16.3: "Tuggers Reeving" on page 76](#)
-

NOTE

Set clear safety parameters around the crane with red/white band.

CAUTION

Changing out wire is a complicated and dangerous procedure. It should only be done by reeving experts with extensive knowledge and experience.

CAUTION

*Reeving a new wire must be done in service mode.
Service mode is not be used in normal operating situations, because operating with a slack rope can result in rope failure or insufficient lifting capacity.*

6.10.2 BRAKE TEST

General brake test procedure

A brake test should at least be performed in the following cases:

- After a period of 2 months of not performing a successful brake test
- After a PLC memory loss
- After a slipping brake
- After a crash stop
- Before switching to personnel lifting

However, a brake test can only be done if:

- No load is present, and no loadcell failure
- For boom hoist and slewing movement the jib must be above 70 ° (so boom hoist load is reduced and not in the jib rest)
- No empty drum alarms
- No slack-rope alarms
- No slipping brake alarms
- All drives running

Below, the general automatic procedure of testing is described for a single brake. However, it is applicable to any of the brakes.

- The system checks whether all brakes are applied.
- The correct torque limit (a positive value) is set, and the torque limit mode is set to drive.
- If 'torque limit mode active' is received from a drive, speed-setting of -2% (lowering/slew left) is applied, and move command is set. If 'torque limit mode active' is not received within 5 seconds, the brake test for that movement is aborted, and an alarm message is shown.
- All brakes of the movement are released, except for the brake that is going to be tested.
- The system verifies that the correct brakes are indeed lifted. If this is not correct, the brake test is abandoned. And a message is given.
- Although not all brakes are lifted, signal AllBrakesLifted is set true; this is needed for the drive to start.
- The speed setting is maintained, until the torque is within 5% of the torque-limit for 5 seconds. The brake is in that case approved.
- If 10 seconds are passed, the brake test fails, and the entire brake test procedure for that movement is abandoned.
- If the absolute actual speed (indicated by the inverter which is 'connected' to the brake which is currently being tested, see [Figure 6-48](#)) exceeds 0.2% of the nominal speed, the brake is disapproved.
- At the end of a single brake test, all brakes are applied, speed setting is zero, and torque limit mode is deactivated.
- Between each single brake test, a delay of 1 second is observed, to allow a brake to

fully apply before the next is lifted.

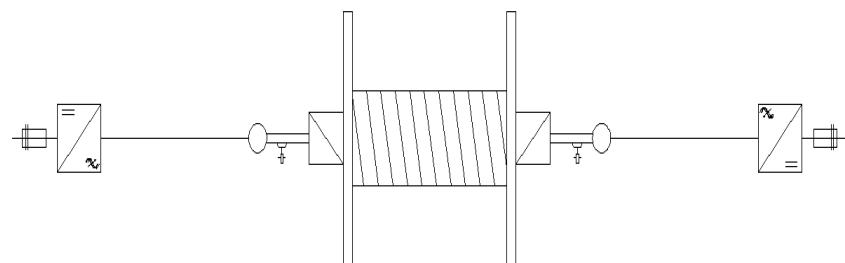


Figure 6-48: Brake test

- All movements are disabled when a brake test is in progress.

6.11 EMERGENCY PROCEDURES

6.11.1 EMERGENCY STOP PROCEDURE

The emergency stop procedure is described in [Section 6.6.5: "Emergency stop procedure".](#)

6.11.2 SLIPPING BRAKE DETECTION

If a slipping brake alarm appears on the monitor, the frequency inverter controlling the applicable crane movement detects a slipping brake. This means that the brake is not working correctly and that only the E-motor holds the load.

WARNING



DO NOT APPLY THE EMERGENCY STOP! This will cause the winch to pay out uncontrollably.

DO NOT RESET THE DRIVES!

In case of a slipping brake detection, do the following.

1. Slew into a safe position.
2. Lower the load.
3. Lower the jib onto the jib rest.
4. Shut down the drive system.
5. Check the brakes of the applicable movement.
6. Do not use the crane before the problem has been found and solved.

6.11.3 EMERGENCY LOWERING

In case of an emergency the load can be lowered by means of lifting the Pintsch Bamag brakes. See for more information the Pintsch Bamag manual in the Supplier documentation.

6.12 TROUBLESHOOTING

6.12.1 SENSOR FAILURE

All analog sensors send their information using an electrical current between 4 and 20 mA. If the current drops below 2 mA, for instance because of a wire breakage, an alarm is generated and the movements concerned are stopped. In case of a failure, check the power supply to the sensor and the current from the sensor in reference to GND in order to assess if it is the wiring or the sensor. An incorrectly mounted sensor could also produce a sensor failure.

6.12.2 INVALID SELECTION

6.12.2.1 Invalid Sea State

When the display indicates an invalid sea state, this is most often caused by the selection switch being halfway between two positions, or the combination of lift type and sea state selection being invalid. The five different sea state options each have a separate digital input on the PLC in the cabinet in the cabin.

Sea state 1	1	0	0	0	0
Sea state 2	0	1	0	0	0
Sea state 3	0	0	1	0	0
Sea state 4	0	0	0	1	0
Sea state 5	0	0	0	0	1

To prevent an invalid selection indication while switching between the different sea states, the selection is declared invalid only if it persists longer than one second. The sea state switch is located in the cabin and is connected to the PLC system in the cabin. The sea state selection is transferred to the PLC by the CAN bus. Therefore, an invalid sea state could also be caused by defective PLC hardware or the PLC program not running.

6.12.2.2 Invalid Lift Type

When the display indicates an invalid lift type, this is most often caused by the selection switch being halfway between two positions. The four different lift type options each have a separate digital input on the PLC. This means that for a valid selection exactly one input must be high. In the table below all valid combinations are given; any other combination is invalid.

Harbour	1	0	0	0
Internal	0	1	0	0
Platform	0	0	1	0
Barge / Supplier	0	0	0	1

To prevent an invalid selection indication while switching between the different lift types, a selection is declared invalid only if it persists longer than one second. The lift type switch is located in the cabin and is connected to the PLC system in the cabin. The sea state selection is transferred to the PLC by the CAN bus. Therefore, an invalid lift type could also be caused by defective PLC hardware or the PLC program not running.

6.12.3 AUTO HOOK HEIGHT

The AHH function troubleshooting can be split in two parts:

- the AHH function cannot be switched on, or
- the AHH function is not working correctly.

Several conditions are checked by the PLC before the AHH can be activated:

6.12.3.1 AHH function cannot be activated

PLC conditions:

- No faults on the main hoist drives (2)
- Brake supply not tripped
- No movement limitations on main hoist such as empty drum or highest position
- and main hoist brakes applied (this only to activate AHH)
- No main hoist load cell failure
- Main hoist load < 5T

If all conditions are met the AHH can be switched on. If it is still not possible to switch it on, there is a fault in the wiring.

6.12.3.2 AHH function is working incorrectly

If the AHH can be activated, but is not working correctly, the error message "AHH position error" will appear on the operator display. If this message appears after some time in one direction, either the main hoist is moving in the incorrect direction (hoisting when up) or it is not moving at all.

If the main hoist is moving in the wrong direction, swap the two AHH sensors.

If the main hoist is not moving at all, check the analog output together with the two direction signals (digital outputs <number> and <number>). If the analog signal remains zero, the sensors are defective or not correctly fed into the PLC. The signals from the AHH sensors are converted by NPI interface <number>. This interface also contains LEDs to indicate the status of the sensors.

6.12.4 PERSONNEL LIFTING

Personnel lifting mode is used to transport persons with the crane and is therefore extra secured. The following safeties apply in personnel lifting mode:

- High speed is never allowed for any movement (only normal speed).
- Emergency release of the main hoist brakes is disabled.
- The SWL is lower than usual. The actual SWL is displayed on the cabin monitor.

Personnel lifting mode is activated using the switch on the right-hand operator panel.

6.12.5 SUBSEA LIFT

The crane is provided with a wire rope sufficiently long such that it is suitable for subsea lifting operations. For lifts in air the stability of the hoisting tackle can be guaranteed sufficiently by means of the crane design and the rope selection. However, a warning is given for subsea lifts.

The stability of the tackle and the rope is inevitable reduced with the length of the tackle. This means that the deeper the lower block comes, the more risk will be present that the tackle and/or the rope will become twisted. Such a twist may occur by torsion in the rope, but also by loads by the waves and current as well as the shape of the load. See the pictures below.



To avoid twisting, Huisman recommends one of the following measures:

- a. In 2 fall mode the dead end should be positioned as much as possible away from the sheave in the jib head. However, this is normally already incorporated in the crane design. For deep operations, the dead end may be suspended even away from the crane.
- b. A clump weight, suspended to an auxiliary winch and connected by means of a rope to the lower block could apply an additional side force on the block
- c. Connect the lower block to an auxiliary winch via a clump weight supported by the seabed away from the load, such that a counter moment can be generated if the block tends to twist.
- d. Connect a pipe to the lower block.

If a twist may occur anyway, this may lead to bird caging or waviness of the rope, which are signs that the rope is being damaged. If these phenomena exceed the allowable values of ISO 4308, the damaged rope sections should be cut off the rope. It may also be possible that these signs are being removed.

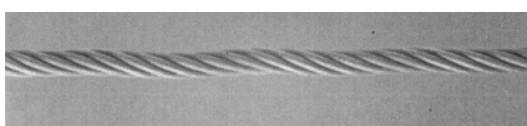


Figure. Waviness

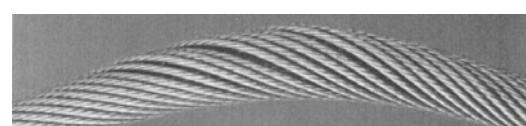


Figure. Bird cageing

7 MAINTENANCE

7.1 INTRODUCTION

WARNING

Always ensure that maintenance and inspection are carried out by qualified personnel.

WARNING

Always ensure that maintenance personnel have carefully read and fully understood all safety prescriptions stated in this manual before starting maintenance work.

WARNING

Always cut off the electrical power supply before starting maintenance or repair activities and apply the emergency stop. Ensure that all movable parts are in a safe position and secured if necessary.

WARNING

The OMC is largely made of high tensile steel which requires special heat treatment procedures in case of welding, cutting or grinding. Improper procedures can reduce the strength of the construction considerably. No heat treatment is allowed without the prior written confirmation of Huisman. Welding personnel must be in possession of the proper and valid welding certificates.

WARNING

It is always prohibited to weld cast or forged parts. Welding of these parts reduces their strength considerably.

WARNING

Use by the customer of parts from third parties for maintenance, assembly, installation, modification or repair of the system is prohibited during the warranty period without the prior and written permission of Huisman. Parts can be ordered from the drawings. Please mention the drawing number and parts number. A list of recommended spare parts is included in [Appendix M: "Spare parts lists"](#).

Proper maintenance is very important to guarantee the service life for which the system was designed. It is equally important to inspect the system regularly in order to detect any malfunction or irregularity in an early stage and to prevent damage or dangerous situations from developing. This chapter gives information on how to inspect and maintain the OMC. Additional information on some of the subsystems and third party supplier components like gearboxes etc. can be found in the supplier manuals.

Proper and regular maintenance and inspection are responsibility of the client and rely mainly on the expertise and experience of the personnel involved. This is why it is very difficult to cover all items in an extensive manner. In case of doubt or questions do not hesitate to consult Huisman. Huisman can also carry out an inspection survey.

In the following sections the general maintenance description is given for mechanical, hydraulic and electrical maintenance. Followed by the maintenance schedule for each system and the associated task descriptions.

7.1.1 APPLIED REGULATIONS

For the regulation of the OMC see the <

Maintenance tasks related to these regulation are obligatory and can be identified in the maintenance schedules.

7.1.2 SCOPE OF MAINTENANCE

The maintenance tasks are partially derived from the FMECA, but also system components with an acceptable risk (FMECA) have to be maintained. Therefore the following types of maintenance tasks are described:

- Preventive maintenance task: These tasks follow from the FMECA and serve the purpose of risk reduction by lowering the possibility of occurrence;
- Care maintenance tasks: These are the tasks one usually performs on a system (e.g. wear measurement, Non-Destructive Testing (NDT), pressures, flows, lubrication, oil sampling, resistance checks etc.);
- Regulatory maintenance tasks: These tasks follow from the regulations and standards that apply to the systems. These tasks are obligatory. Local legislation is not considered. The maintenance tasks (and intervals) described in the various deliverables apply to normal use. Normal use excludes:
 - Transit periods
 - Re-commissioning after a longer period of standstill
 - Storing the equipment for longer period (preservation)
 - Extreme weather conditions

The following is out of scope:

- Daily walk-a-rounds
- Fault finding
- Standard operating procedures (e.g. parameter check in SCADA or preventive steering of hydraulic valves)
- Work safety regulation checks and training requirements
- Software maintenance

7.1.3 DECOMPOSITION

In this maintenance chapter the maintenance schedules are given per system. The following systems are being identified:

- Sections; (section [7.5.1](#))
- 800kW HPU; (section [7.5.2](#))
- Pressure vessel unit; (section [7.5.3](#))
- Slewing system; ([7.5.4](#))
- Boom hoist winch; ([7.5.5](#))
- Main hoist traction winch; ([7.5.6](#))
- Main hoist storage winch; ([7.5.7](#))
- Heave compensation system; ([7.5.8](#))
- Whip hoist winch; ([7.5.9](#))
- Tugger winch; ([7.5.10](#))
- Wires, blocks and sheaves; ([7.5.11](#))
- Distribution and control system; ([7.5.12](#))

All systems are further decomposed into subsystems (e.g. instrumentation) or components (e.g. E-motor). The maintenance schedule is build up using this decomposition. The decomposition is taken from the TM Master structure for the systems.

7.1.4 MAINTENANCE SCHEDULE EXPLAINED

The maintenance schedule is a table containing all maintenance tasks with their most important information. For all systems a separate maintenance schedule is made. Within a maintenance schedule the maintenance tasks are listed by component or component group. The structure for the decomposition is taken from TM Master. The components are easily recognizable in the maintenance schedule, see [Figure 7-1](#).

Ref.no. §	Preventive maintenance tasks	PM intervals				Required skill types	Prescribed by/s	TM Master coded
		Days	Months	Years	Hours			
	E-motors §							
§	Perform SPM analysis for E-motors §	§	3§	§	§	Mechanical §	Huisman §	916.01.01.01.01.01.01.01.011 916.01.01.01.01.01.02.011 916.01.01.01.01.02.01.011 916.01.01.01.01.02.02.011 916.01.01.01.03.01.011 916.01.01.01.03.02.011 916.01.01.01.04.01.011 916.01.01.01.04.02.01§
§	Inspect and clean E-motor exterior §	§	3§	§	§	Electrical §	Huisman §	916.01.01.01.01.01.01.011 916.01.01.01.01.02.011 916.01.01.01.01.02.01.011 916.01.01.01.02.02.02.011 916.01.01.01.03.01.011 916.01.01.01.03.02.011 916.01.01.01.04.01.011 916.01.01.01.04.02.01§

Figure 7-1: Maintenance schedule explained - components

Per maintenance task the following information is given in the maintenance schedule, see [Figure 7-2](#).

1	2	3	4	5	6		
Ref.no.	Preventive maintenance tasks	PM intervals			Required skill types	Prescribed by	TM Master code
		Days	Months	Years			
E-motor §		§	§	§			
§	Perform SPM analysis for E-motor§	§	3§	§	Mechanical§	Huisman§	916.01.01.01.01.01.01.01§ 916.01.01.01.01.02.01§ 916.01.01.01.01.02.01.01§ 916.01.01.01.02.02.01§ 916.01.01.01.03.01.01§ 916.01.01.01.03.02.01§ 916.01.01.01.04.01.01§ 916.01.01.01.04.02.01§
§	Inspect and clean E-motor exterior§	§	3§	§	Electrical§	Huisman§	916.01.01.01.01.01.01.01§ 916.01.01.01.01.02.01§ 916.01.01.01.02.01.01§ 916.01.01.01.02.02.01§ 916.01.01.01.03.01.01§ 916.01.01.01.03.02.01§ 916.01.01.01.04.01.01§ 916.01.01.01.04.02.01§

Figure 7-2: Maintenance schedule explained - columns

1. Ref. no.: This is the reference number for the task, an unique identifier for the maintenance task. It is also the section number of the section that describes the task;
2. Preventive maintenance task: Brief description of the maintenance task;
3. PM interval: The numbers in the different maintenance interval columns represent the interval in number of weeks, months, years or operating hours for carrying out that maintenance task. When both operating hours and calendar time are given for an interval the task has to be performed at the interval which occurs first;
4. Required skill type: The dominant skill type required to perform the maintenance task;
5. Prescribed by: The origin of the maintenance task. Some tasks are taken from legislation These are the regulations tasks. Maintenance tasks prescribed by regulations are obligatory;
6. TM Master code: TM Master code for Subsea7 specific identification of the component to which the task applies.

7.2 MECHANICAL CONSTRUCTION

7.2.1 STEEL STRUCTURE

The steel structure of the OMC is subject to varying loads and stresses. This could lead to small cracks, especially in high stress zones close to welded areas. Huisman has designed the construction in such a way that stress concentrations are kept to a minimum. Nevertheless Huisman advises to regularly check for cracks, especially after an accidental overload.

On request, Huisman can perform an inspection survey. If at any time cracks are ascertained, Huisman must be notified immediately and operation must be stopped until the damage has been repaired.

7.2.2 PAINT

The paint serves as corrosion protection. A good preservation of the steelwork by regular painting is therefore essential to guarantee the reliability and working life of the OMC.

The paint must be visually inspected and repaired whenever damage is ascertained. The inspection intervals vary depending on intensity of use and environmental conditions. The paint specification is included in [Appendix G: "Paint specification"](#).

7.2.3 SHAFTS

Shafts are detachable items, which have to be checked regularly. Main item to be checked is the locking construction. The shafts are secured by one of the following methods:

7.2.3.1 Bolted cover

This locking method is often used to secure shafts in sheaves and sheave blocks. Pay attention that the bolts do not loosen. Check the tightness of the bolts. In some cases, the bolts have to be pretensioned. This is indicated on the reference drawings (see [Appendix J: "Reference drawings - Mechanical"](#)).

7.2.3.2 Bolted strip

This method is used when a bi-directional locking is preferred. It provides a better security against rotation. Check the tightness of the bolts.

7.2.3.3 Securing pin and safety clip

Safety clips are commonly used to secure the ends of round shafts such as pipes, axles and clevis pins. It is designed to be easily installed and uninstalled, and is reusable.

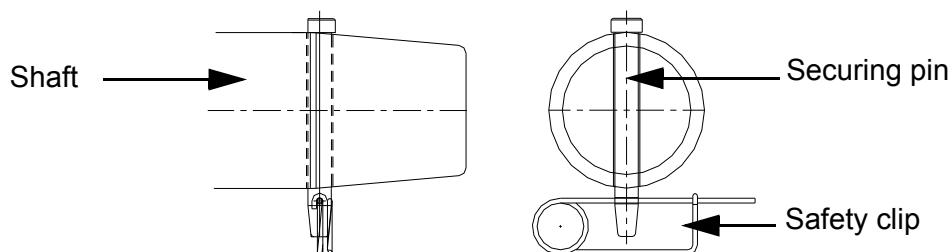


Figure 7-3: Securing pin and safety clip

Normally, the shafts are free to rotate on their axis. If a shaft is used in combination with a bearing, the bearing should rotate around the shaft. The operator must verify that these shafts do not rotate within their holes. This might indicate excessive friction on the shaft bearings. For more detailed information concerning bearings, please refer to [Section 7.2.7: "Bearings"](#).

NOTE *In case the securing of a shaft is not correct, the operator must immediately repair the construction and consult Huisman about the correct action to take.*

7.2.4 BACKLASH

By hammering and corrosion the holes of pinned connections may wear and increase in diameter. This wear will increase the backlash in pinned connections.

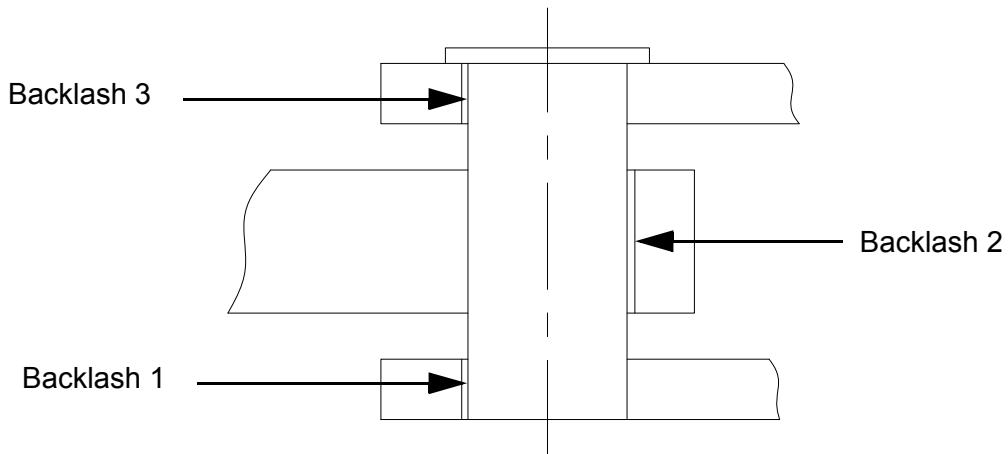


Figure 7-4: Backlash

Shafts should be inspected for backlash on a regular basis. In case of normal pinned connections, the backlash should be no more than 2% of the shaft's diameter. In case the load can change direction, the backlash should be no more than 1% of the shaft's diameter.

NOTE *For shafts in connections without loaded motion a bearing has been omitted. In these situations fretting may occur. This must be checked regularly. The shafts should be replaced if damage is ascertained. In case of doubt consult Huisman.*

7.2.5 BOLTS AND NUTS

The bolts and nuts used in the structure must be checked regularly on tightness. For some bolts, a tightening torque (pre-tension) is specified on the reference drawings. These bolts are to be tightened with the prescribed torque.

Pre-tensioned bolted connections can be checked visually by inspecting the paint on the connecting surfaces. A displacement of both surfaces indicates insufficient pre-tension. In case pre-tensioned bolts have loosened, the operator shall consult Huisman about the correct action to take.

7.2.6 ROTABOLT

Tightening Procedures with Rotabolt

Rotabols are bolts with a pin inside in a central hole. When the bolt is pretensioned, the bolt will stretch due to the load, but the pin will stay unstretched. An indicator (Rotacap) is mounted on top of the bolt.

Before installation the Rotacap spins freely. As the bolt is tightened, it stretches elastically and the Rotacap locks at the bolt's specified, load test calibrated tension value.

As soon as any tension is lost across the bolted joint, the Rotacap immediately rotates freely to give a clear indication of tension loss.

NOTE *The stud bolts of the slew bearing should be checked every 12 months or after intensive usage of crane on max capacity. This can be done by means of jacking the bolts or check the Rotabolt indicators. For more information on tightening procedures see supplier documentation.*

7.2.7 BEARINGS

The following types of bearings are used on the OMC:

7.2.7.1 Slide bearings

In general, all slide bearings need to be inspected regularly for wear and play. In the certain cases, the following guidelines apply:

Fiber reinforced plastic (FRP) bearings (Orkot)

These bearings are, in principle, maintenance free. The bearings are to be inspected by checking the shafts, the securing bolts and the covers. These bearings need regular lubrication according to the greasing schedules.

Bronze bearings

Unless indicated otherwise (self-lubricating bearings) these bearings need regular lubrication according to the greasing schedules.

Backlash in FRP and bronze bearings

The shafts of both kinds of slide bearings should be regularly checked for backlash. No more than 1% of the shaft's diameter is allowed.

7.2.7.2 Roller bearings

These bearings must be lubricated regularly by means of the grease nipples in the shafts. The grease points are indicated on the greasing schedule. The bearing should not run too heavily. Other items to be checked are the locking construction and the play/tolerance of the bearing.

For shafts in connections without loaded motion, a bearing has been omitted. In these situations fretting may occur. The operator must check if fretting or any other damage is noticeable. In case any damage is found, the operator has to inform Huisman as soon as possible. Huisman will then recommend the correct action.

7.2.7.3 Slew bearing

The slew bearing is actually a very large roller bearing. An installation and maintenance manual for the slew bearing is in the appendices, including instructions on greasing.

NOTE *For the slew bearing a separate instruction sheet from the manufacturer (Rothe Erde) is included in the supplier documentation belonging to this manual.*

An "exchange frame" is provided to exchange the slew bearing if necessary. Four supports around the pedestal enable to lift the crane house by means of four hydraulic jacks, after which the slew bearing can be exchanged. The hydraulic jacks must have a capacity of at least 60 tons; the maximum lifting height is approx. 300 mm. Refer to figure below. The jacks are not part of the Huisman scope.

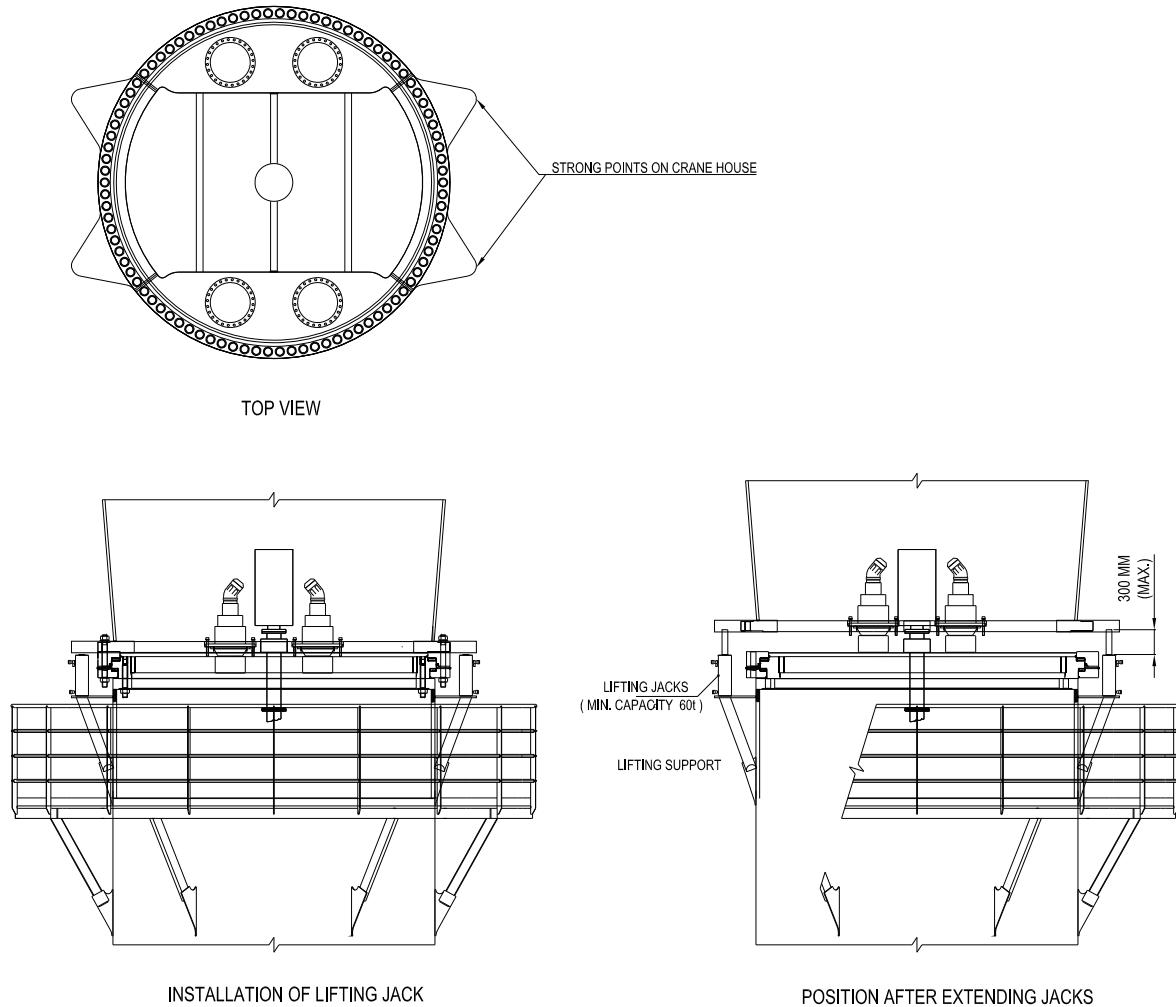


Figure 7-5: Slew bearing exchange

7.2.8 SHEAVES

Sheaves require regular inspection. Special attention should be paid to the possible presence of a "Wire rope imprint" in the grooved flange of the sheave, as this is an indication that the sheave is worn. The grooves are hardened.

This, however, is only a very thin surface hardening. Once the wear has proceeded too deep into the groove, it will increase rapidly. In case any damage is found, this must be reported to Huisman, so that the correct action can be taken. Refer also to the "wire handling and maintenance manual" in the appendices.

7.2.9 ROPE LEADING ELEMENTS

Inspection of wire guiding elements concerns the following items:

- Guide sheaves
- Wire rope (HAKORIT) protection strips (e.g. on the tip of the jib)
- Wooden wire protection blocks (along the inner and outer walls of the crane house). See figure below.
- Wire retaining bars around the sheaves. Replace bars if significant damage is observed.



Figure 7-6: Wooden blocks (rear wall crane house)

7.2.10 LOWER BLOCKS

The lower blocks of the OMC are not designed for underwater operation. However, the wire length of the aux. hoist is sufficient to enable this. If the block should be used under water, special care must be taken to properly clean and grease the block afterwards. Rinse the block thoroughly with fresh water and reapply grease at the appropriate spots.

7.2.10.1 Connection pin



WARNING *It is very important to keep the connection pins with which the lower blocks are connected to the hoist wire terminations well greased at all times. This goes especially after underwater operations, but is also a general issue to pay attention to. Ambient influences and the effects of contact with seawater otherwise cause the pin to get stuck. This leads to problems when the block must be disconnected.*

7.2.11 GREASING

Refer to the greasing schedule in [Appendix J: "Reference drawings - Mechanical"](#). All grease points, oil types and lubrication intervals are indicated on the greasing schedule. A lubrication interval of 100 hours / 3 months means that lubrication is to be carried out at least once every 3 months; during continuous operation however, the interval of 100 hours is to be maintained.

NOTE *The pawl of the luffing ratchet & pawl safety mechanism must be lubricated regularly in order to ensure that there is not too much friction for the cylinder spring to push the pawl back. Refer to the greasing schedule.*

For the jib pivots central grease lines are provided terminating at the tugger platform

The sheaves in the jib head can be reached from the boom rest

NOTE *It is vital to use the lubricants indicated on the greasing schedule. If the client prefers another lubricant, this should only be done after consultation with Huisman.*

NOTE *Check that all load measuring pins are lubricated on a regular basis. Refer to the LMP manual for details.*

7.2.12 GEARBOXES

Unless indicated otherwise (oil filling for life), the lubricating oil of the gearboxes must be changed on a regular basis. It is also important to check regularly for leakage. Refer to the supplier documentation for detailed maintenance information on the gearboxes. The lubricants and intervals are indicated on the greasing schedule.

7.2.13 BRAKES

7.2.13.1 Running-in of new brakes and friction linings

With the commissioning of the brake or after renewal of the friction lining group, the friction linings must be run-in.

CAUTION



A proper run-in procedure ensures that the specified brake torque is fully transmitted.

Several controlled braking operations should be carried out, bearing in mind that the full braking power is initially not available.

New brakes must be run-in properly by the brake supplier. If not, please carry out the following procedure:

Run-in procedure:

- Execute five (5) crash stops¹ from max. speed in rapid succession (without load application)

 1. Crash stop = sudden dynamic brake stop (uncontrolled stop).

- tion)
- Wait for 30 minutes
 - Execute another five (5) crash stops from max. speed in rapid succession (without load application)
 - Wait for another 30 minutes
 - At last, execute another five (5) crash stops in rapid succession (without load application)
 - Wait for another 30 minutes
 - Carry out a (static) brake test (see [Section 6.10.2: "Brake test"](#)), to verify if the required brake torque is met.

7.2.13.2 Brake maintenance

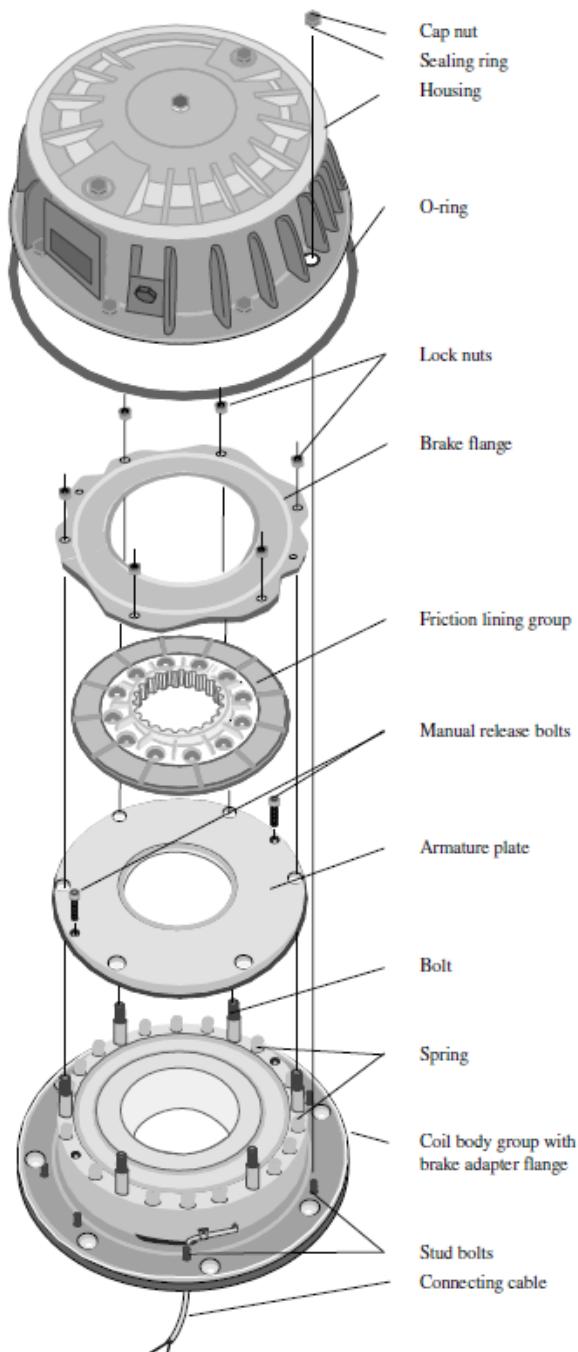


Figure 7-7: Brake (inner parts)

CAUTION

Carefully observe all safety information as described in the supplier installation and usage manual (Pintsch-Bubenzer), to prevent any accident and/or damage to the brake.

Maintenance for the brakes is limited to:

- Air gap check
- Brake flange reversal
- Friction lining group replacement
- Brake flange and armature plate replacement
- Condensation water drainage.

7.2.13.3 Checking the air gap

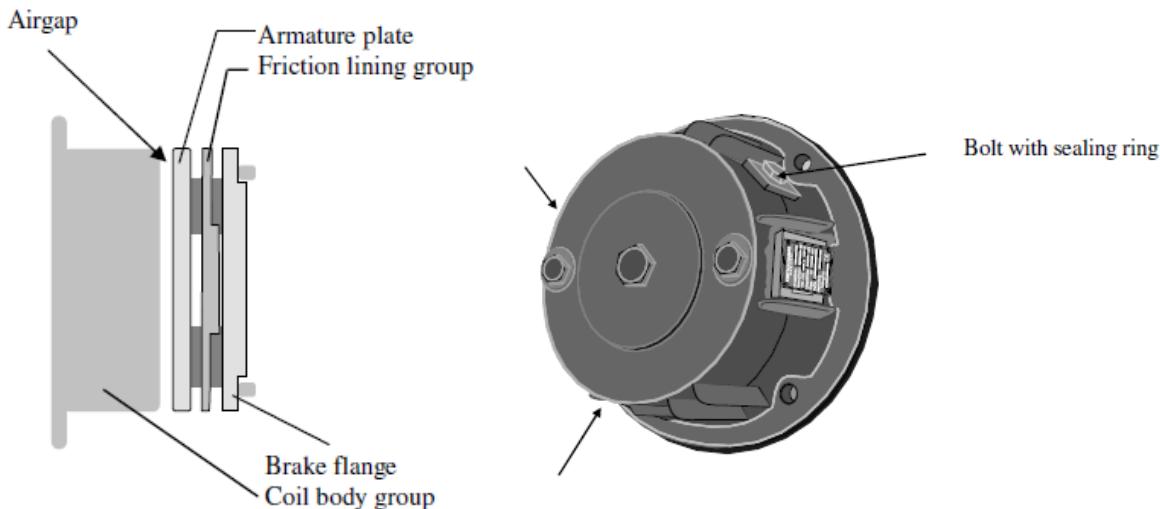


Figure 7-8: Airgap

Regular airgap (see [Figure 7-8](#)) checks are an integral part of maintenance routines. The inspection intervals vary depending on the use of the brake. Weekly inspection will ensure perfect functioning of the brake with average use.

CAUTION



Under NO circumstances a brake flange reversal must take place, BEFORE the maximum air gap is reached.

To ensure correct operation of the brake, the airgap between the coil body group and armature plate must have the prescribed size. The minimum or maximum airgap is shown on the brake rating plate (see [Figure 7-9](#)). The brake is set with the minimum airgap at the factory.

Check the airgap through the open tapped holes at three points (see [Figure 7-8](#)):

- Unscrew bolts with sealing rings from the housing
- Insert feeler gauge through the open tapped holes at all three points
- Measure the air gap between the armature plate and coil body group
- Re-insert bolts with sealing rings and tighten. Old sealing rings cannot prevent the ingress of water.

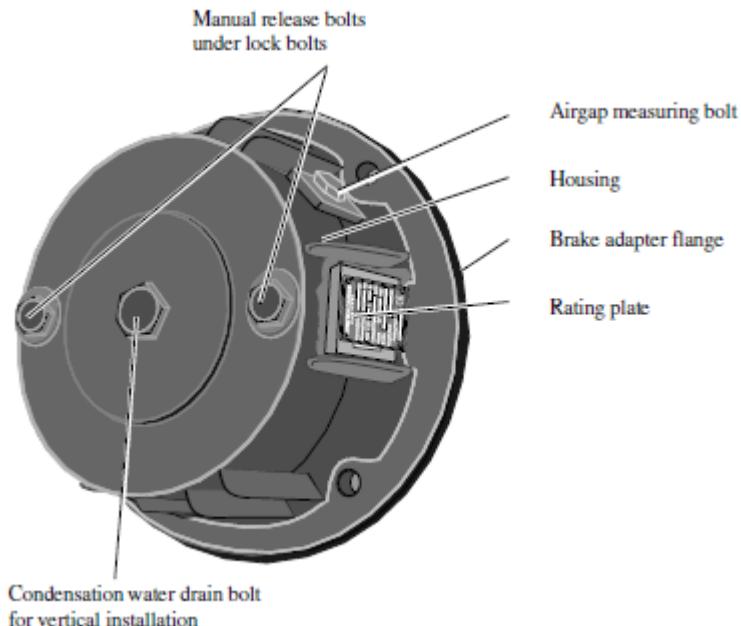


Figure 7-9: Brake (outer parts)

If the air gap between the coil body group and armature plate (see [Figure 7-8](#)) exceeds the maximum distance, the brake flange:

- must be reversed temporarily until a new friction lining is installed or
- the friction lining group must be replaced (see [Figure 7-7](#)).

For more detailed information, please refer to the suppliers documentation folder (Pintsch-Bubenzer).

7.2.13.4 Brake flange reversal (not recommended)



- The brake flange can only be reversed once! The friction lining group must subsequently be replaced and refitted.
- During replacement of the brake flange, avoid that the flange comes into contact with oil or grease.
- After reversal of a brake flange, a run-in procedure must be performed (see [Section 7.2.13.1: "Running-in of new brakes and friction linings"](#)).

7.2.13.5 Cleaning of brakes

No particular maintenance is necessary.

Abrasive dust can collect inside the brake assembly. It is recommended to clean the inside of the brake by blowing out the brakes with compressed air after the air gap has increased more than 50% of the allowable air gap dimension.

For more detailed information, please refer to the suppliers documentation folder (Pintsch-Bubenzer).

7.2.13.6 Brake flange, friction lining group and armature plates replacement

CAUTION

Prior to replacement, please observe the safety information as mentioned in the "Maintenance" chapter of the supplier (Pintsch-Bubenzer) documentation.

CAUTION

Do not replace the brake flange, friction lining group or armature plates separately. It is recommended by Huisman to replace all three parts at the same time (incl. pressure springs). In this way the brake supplier and/or Huisman can perform a running-in and a static and dynamic brake test.

CAUTION

Before replacement of the friction lining group, ensure that there is an adequate amount of spare pressure springs available.

Procedure for the replacement of all three groups (see [Figure 7-7](#)):

- Disconnect power supply
- Remove housing
- Simultaneously tighten manual release bolts evenly clockwise, the friction lining group now moves freely.
- Unscrew hexagon nuts on brake flange.

For more detailed maintenance information, please refer to the suppliers documentation folder (Pintsch-Bubenzer).

7.2.13.7 Friction lining group replacement

NOTE

It is not recommended to replace the friction lining group separately, because a running-in test and static and dynamic brake tests are not possible on a friction lining group alone.

The friction lining group consists of (see [Figure 7-7](#)):

- Friction lining plate and
- Friction lining.

This group is subject to wear due to braking operations and must be replaced when worn. The replacement time depends on the braking frequency. Replacement is also necessary if the friction lining group has come into contact with

- Oil
- Grease or similar.

Procedure for friction lining group replacement:

- Remove brake flange and clean as described in the [Section 7.2.13.5: "Cleaning of brakes"](#).
- Remove friction lining group and replace.

For more detailed maintenance information, please refer to the suppliers documentation folder (Pintsch-Bubenzer).

7.2.13.8 Brake flange and armature plate replacement

NOTE	<i>It is not recommended to replace the brake flange and armature plate separately, because a running-in test and static and dynamic brake tests are not possible on the flange and armature plate alone.</i>
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Remove brake flange and replace (see [Figure 7-7](#)). Dispose of old brake flange.



When a damaged pressure spring is found, it is recommended to replace all other pressure springs.

The brakes are spring loaded by a number of (helical steel) pressure springs (see [Figure 7-7](#)), located around the circumferences of the coil body group.

Damaged pressure springs should not be replaced separately, it is recommended by Huisman to replace all other pressure springs. The original amount of springs shall not be changed without having performed a static and dynamic brake test.

For more detailed maintenance information, please refer to the suppliers documentation folder (Pintsch-Bubenzer).

7.2.13.9 Condensation water drainage

NOTE	<i>New seals must be fitted after draining the condensation water.</i>
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The condensation water must be drained via the condensation water drain bolt (see [Figure 7-9](#)) from the brake once a year. Depending on the place of installation and the climatic conditions in which the brake is operated, more frequent drainage of the condensation water may be necessary.

The maintenance interval for a specific place of use should be determined by draining the condensation water on a trial basis.

7.2.14 STEEL WIRE ROPES

A separate manual with all necessary basic instructions on inspection, maintenance, handling, installation and storage of wire ropes is included in [Appendix O: "Wire rope documentation"](#).

WARNING



Adjust the end positions on the geared cam limit switch after any modification to, or replacement of the wire rope!

WARNING



If any damage to the wire rope is found, the operator shall consult Huisman about the correct action to take.

WARNING



Minimum amount of windings to remain on drum is 5.

7.2.15 GEARED CAM LIMIT SWITCH

After reeving a new wire into the system, the gear cam limit switch has to be readjusted.

WARNING



Adjust the end positions on the geared cam limit switch after any modification to, or replacement of the wire rope!

Generally, the adjustment can be made 'in block', meaning that all switching contacts can be adjusted in one go, using a special adjusting screw provided for this purpose and marked in black (refer to the supplier documentation in the appendices also: Stromag). As the adjustment of the switch points relative to each other has not changed, it generally suffices to re-adjust one reference point (e.g. empty drum). However, it needs to be ascertained that all other switch points and safeties still work properly, so check the function of all safety devices related to the gear cam switch before resuming operation.

7.2.16 STAIRS AND PLATFORMS

All stairs and platforms must be checked regularly for wear and tear, corrosion and tightness of bolts.

7.2.17 BRAKE TEST

Brake test should be done for all movements. Each brake is tested individually, since combined testing hides individual defects. In principle multiple (or all) movements can be tested at the same time, but it has to be examined each time if it is actually possible (for instance shared drives). If it is not possible an interlock prevents testing the brakes simultaneously.

Testing can only be done with a good working system, so all drives (of the movement) must be available. Otherwise the brake test torque will not be the required value.

Brake test is only allowed if:

- No load is present and no load cell failure.
- For boom hoist and slewing movement the jib must be above 70 degrees (so boom hoist load is reduced and not in the boom rest).
- No empty drum alarms.
- No slack-rope alarms.
- No slipping brake alarms.
- All drives running.

If any of the above mentioned conditions fails, then no brake test can be started and any brake test in progress will be aborted.

Tests are only done in the lowering direction, slewing is done in counterclockwise direction.

The brake tests are static tests, so no attempt to determine maximum torque, or trying to stop a moving drum.

NOTE

Manriding is only allowed when the brake test for all movements involved are okay.

The brake test is not to be started automatically when the manriding is activated, because the crane is not always in the correct position for the brake test. It would be impractical to enforce this correct position (jib up) each time the manriding function is activated.

Interval

When a brake test is needed, the SCADA display will display the warning "brake test is to be performed" for each separate movement. The message appears in the following cases;

- After a period of 60 days of not performing a successful brake test.
- After a PLC memory loss.
- After a slipping brake.
- After a crash stop (crash stop = |speed| > 50% AND a brake not lifted).

No performance penalties are introduced if this warning is ignored.

Control

A brake test is started from SCADA, the brake test actions and results are also recorded in SCADA. The brake test is executed automatically.

- The required brake test torque value is specified in the "drive parameter sheet" in percentage [%] and is set in the PLC.
- The brake test is used to check the holding capacity of the individual brakes. To perform this test each brake needs a separate relay to control the brake individually.
- During the entire brake test, it is checked whether the correct brakes are actually lifted. Failing to do this will hide defective brakes. If this is not correct the entire brake test for that movement is abandoned.
- All movements are disabled when a brake test is in progress.

- If a brake is disapproved the test is continued with the next brakes.
- The drive is command via the speed setpoint and the move command.
- The torque is limited via the torque limit.
- The AllBrakesLifted indication is set when the correct brakes are lifted.
- Movement is detected via the speed indication.

Procedure

Each movement has a brake test field with all controls and indicators needed for a brake test.



Figure 7-10: Example of a brake test field

The general procedure for a brake test is;

1. Before starting the brake test make sure that the 'Brake test allowed'-indicator is green.
 - If the indicator is red, press the 'i'-button for a pop-up with reasons why the brake test is not allowed.

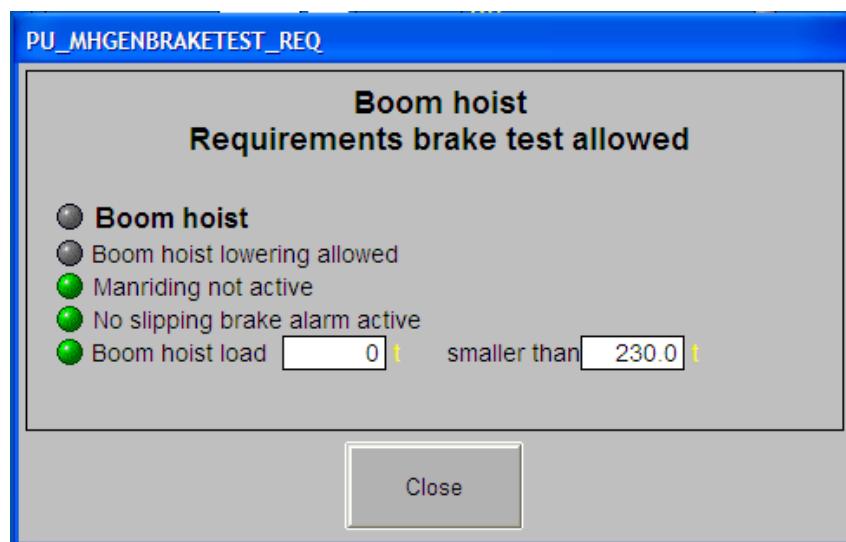


Figure 7-11: Example of a information pop-up

2. Press the 'Start'-button to start the brake test.
 - The brakes on the winch will be tested individually in an automated sequence.
 - The indicators will show the brake test sequence.
3. After a successful brake test, the 'brake test OK' indicator is green.

Brake test values

The brake test torque values are listed in the technical specification of the brakes.

7.3 HYDRAULIC SYSTEM

7.3.1 INTRODUCTION

This section of the manual provides general guidelines for maintenance of the hydraulic system. For additional information such as which valves to close for maintenance or service of a hydraulic component or subsystem refer to [Section 4: "Hydraulic description"](#).

7.3.2 GENERAL INSTRUCTIONS

Only qualified personnel

Working on a hydraulic system requires specific skills. Make sure maintenance and service are carried out by qualified personnel, with full knowledge and understanding of this manual and all its appendices.

Conservation

Rust will reduce the strength of components. Safety cannot be guaranteed if the system is not well maintained. Therefore, inspect the condition of piping, couplings, valves, cylinders, motors etc. The maintenance should be upgraded regularly. Piping, couplings and most components may be painted. Moving parts like ball valves and QC/QD couplings are best treated with greasy seawater resistant tape e.g. Denso tape.

Clean hydraulic installation

The exterior of a hydraulic installation should be kept clean, in order to be able to:

- detect leaks and inspect the condition of piping and various components
- open the hydraulic system for service or repair, without allowing dirt into the system.

NOTE *If high-pressure steam cleaning is used, care must be taken that tank covers, pipe glands, shaft seals, electric equipment, etc. are able to withstand the high pressures.*

Before commencing any repairs or maintenance on the hydraulic system, always:

WARNING



Secure system.

Make sure all hydraulically actuated systems are in a safe position and secured if necessary.

WARNING



Push emergency stop.

Disable the hydraulic power unit by pushing an emergency stop button and switch off all main switches.

WARNING



Release pressure.

Make sure pressure is released before opening the system.

WARNING

Clean surroundings.

Before opening the hydraulic system, clean the external surroundings near screw connections, couplings, valves, etc. in order to prevent dirt from entering the system.

During maintenance or repairs on the hydraulic system, special attention is to be paid to the following topics:

Work cleanly

The hydraulic system is extremely sensitive to dirt. When carrying out repairs or maintenance, always work as cleanly as possible. Even small chips of paint can cause a malfunction in the hydraulic system.

Before opening the hydraulic system, clean the external surroundings of the screw connections, couplings, valves, etc.

When the system is open, cover up all openings with protective caps and covers to prevent dirt from entering the hydraulic system.

When painting

When (spray) painting the equipment, ensure that all type plates, Mini-mess plugs, solenoids and moving parts (such as cylinder rods) are well covered.

O-rings

When changing O-rings and other seals, always take care that new seals are undamaged and clean. Before placing the seal, be sure to apply a thin layer of hydraulic oil or acid free Vaseline to prevent damage.

Installing components

When installing components, make sure the mounting surfaces are clean and the fixing bolts are uniformly tightened according to the prescribed torque value.

Pipe work

When replacing or installing new pipe work, make sure that the material and wall thickness is in accordance with the pipe work already installed. Clean piping before installation.

Hoses

When replacing hoses, make sure that these are in accordance with the hose list included in this manual. Make sure hoses are clean before installation.

Protection caps

Make sure all protection caps of Mini-mess plugs, quick connection couplings, etc. are remounted after use.

Position of ball valves

Ensure that after repair, maintenance or emergency operation all ball valves are in the correct position as indicated on the hydraulic diagram, especially low pressure valves. This must be checked prior to start-up. It is advisable to note all positions before starting maintenance.

Leakage test

After repair or maintenance of the hydraulic system and before starting operation, test for leaks at maximum pressure, as indicated in the hydraulic diagram.

7.3.3 PIPING

Examine the condition of all piping and repair when necessary. Badly rusted couplings or piping should be replaced. Inspect all couplings for leaks. When any leaks are found, first try re-tightening the coupling (with the system de-pressurized).

WARNING



Do not over-strain the coupling!

If the leaking does not stop, there are two possibilities:

- If a soft seal coupling is used, the seal may be damaged. If so, it has to be replaced.
- If a cutting ring is used and re-tightening does not stop the leakage, that coupling or pipe has to be replaced.

Clean all piping, valves etc. after an oil spillage. This is necessary in order to detect (new) leaks.

Inspect the condition of pipe supports and repair the supports if necessary. Loose pipes can eventually wear through and fittings can be over-strained or start leaking.

7.3.4 COUPLINGS

Threaded couplings

Threaded couplings (metric thread) are used in two series, the L- and S-series. The L-series (Light) is mainly used for low pressure while the S-Series (Severe) is mainly used for high pressure. The actual permissible operating pressure of a coupling depends on the size and type of the coupling.

Flanged couplings

SAE flanged couplings are most commonly applied. These couplings are used in two series, 3000 PSI-Series and 6000 PSI-Series. The names of these series are rather misleading. The actual permissible operating pressure is not 3000 or 6000 PSI, but depends on the size of the flange.

7.3.5 HOSES

Examine the condition of all hoses. Leakage of couplings or flanges should be repaired by re-tightening or replacing the O-rings. Badly rusted couplings should be replaced. Damaged hoses should be repaired.

If a hose is damaged, there are two possibilities:



- Only the outer rubber layer is damaged. There is no immediate danger for rupturing. However, it is advisable to repair such defects as soon as possible, in order to prevent damage or rust of inner steel wire layers.
- Inner steel wire layers are damaged or rusted. There is an immediate risk of rupture! The hoses should be repaired as soon as possible. If a hose is seriously damaged, it is not permitted to operate the system until this hose has been replaced.

NOTE *It is also recommended to replace all hoses periodically in order to minimize the risk of rupture. The replacement interval depends greatly on the operating conditions of the system and the state of maintenance. For this reason, the replacement interval is responsibility of the owner.*

7.3.6 CYLINDERS

Examine the condition of all cylinders regularly. Rust reduces the strength of the cylinder and the connections. Minor rust spots can be reconditioned. Major rust spots reduce the strength of the cylinder. If a cylinder is badly rusted, it is not permitted to operate the system until this cylinder has been replaced.

For some cylinders, it is vital to have an absolutely fixed position when not actuated. This means absolutely no leakage.

NOTE *The position of a cylinder can also change because of temperature effects.*

Inspect the surface of the cylinder rod for damage. Damage to the rod will damage the seal and this will cause leakage of the seal rod.

Dirt in the system can cause leakage of the piston seal. Therefore, it is very important to keep the system clean. Damage of the piston seal cannot be seen immediately.

Leakage of hydraulic connections should be repaired immediately.

NOTE *Be very careful not to damage the cylinder thread.
Be very careful not to allow dirt in the cylinder.*

7.3.7 HYDRAULIC OIL

Oil level

The oil level is to be inspected visually on a regular basis. Inspection must be done by checking the level indicator when the system is in operation and at least once a day. Oil loss is an indication of a leakage somewhere and early detection may be vital.

Most hydraulic systems are protected by electrical level switches. Possible levels are; low, too low, high and too high level. When one of these levels is detected, this will result in an alarm or an emergency stop. See the hydraulic description for the level indication in this system.

Oil replenishment

When replenishing the system, make sure to replenish with the original type of oil! See the hydraulic description or the hydraulic diagram.

NOTE *When replenishing, always use a filter to clean the oil, even new oil. The filter must have a filtration ratio of 5µm.*

Under special circumstances, it is permitted to alter the viscosity of the oil in the system. This is done by filling up with the same type of oil, but with a different viscosity coefficient. This may be necessary for working at extreme operating temperatures.

NOTE *Changing the original viscosity is only permitted with the prior written permission of HUISMAN.*

Make sure the hydraulic oil taken from drums, (storage) reservoirs etc. is not contaminated with other fluids e.g. water, grease, other types of oil etc. This can lead to serious problems in pumps, valves, filters and other parts of the system.

CAUTION *Make sure the oil level never exceeds the maximum allowable oil level, as this will result in destruction of the air breather and may result in (major) damage to the oil reservoir. Therefore, when replenishing, do this with all cylinders retracted or take the difference into account.*

Oil condition

The condition of the hydraulic oil will decrease, depending on a number of parameters. This will decrease the lifetime of the hydraulic components and the hydraulic oil must therefore be changed periodically.

The condition of the oil can be assessed from an oil sample sent to the laboratory of the oil manufacturer. An oil sample must be taken at least every 2000 operating hours, or at least once a year. The oil sample must be taken from the oil sample point when the power unit is running (ISO 4021 defines oil sampling precisely).

The cleanliness of the hydraulic oil taken from drums, (storage) reservoirs etc. generally does not comply with the requirements of the hydraulic system. Therefore, when replenishing the system, always pump the oil through a filter with a minimum filtration ratio of 5µm at $\beta_x = 70$, or better.

The following table provides an additional guide for visual examination of the hydraulic oil:

Table 7-1: Oil condition indicators

Appearance	Contaminants	Possible Causes
Dark in colour	Product of oxidation	Overheating, insufficient fluid changes.
Milky	Water or foam	Ingress of water or air.
Air bubbles	Air	Ingress of air, due to low oil level or leaky suction.
Floating or sunken contaminants	Solids	Wear, dirt, ageing
Smell of burnt oil	Products of ageing	Overheating

Oil change

Change of hydraulic oil is best decided after considering the results of the laboratory report of the oil samples. Of course preventive exchange based on experience is also an option, though less secure.

When the amount of fluid in the system is more than the capacity of the tank, it is not enough to just change the amount of fluid in the tank only. The oil tank must be cleaned out every time the oil is changed. Filter elements should be cleaned or exchanged at the same time.

NOTE *When changing oil, always use a filter to clean the new oil. The filter must have a filtration ratio of 5µm.*

7.3.8 FILTERS

Filters can be equipped with optical or electrical indicators. See the hydraulic description (chapter 3) for more details regarding the indicators used in this system.

Filters with electrical indicators do not have to be inspected.

Filters with optical indicators should be inspected regularly for clogging. The inspection interval depends on the number of operating hours and dirt intake. It is advised to check every 200 operating hours or at least once every month when the system is being used.

Filter elements must be changed at least every year. Filter elements must always be the original types (see hydraulic parts list). Most systems are equipped with ball valves in order to exchange filter elements with a minimum of oil spillage. Consult the data sheets on filters for further details about how to change the elements.

It is advised to inspect contaminated filters for the presence of metal particles, as this may be an indication of damage to the hydraulic parts in the system.

7.3.9 ACCUMULATORS

Nitrogen pressure in accumulators should be checked and re-adjusted regularly. For instructions see supplier documentation. See the hydraulic diagram for the nitrogen pre-charging pressure (P_o).

7.3.10 ADJUSTABLE PRESSURE SETTINGS

Adjustable pressure settings of valves have to be checked at least every year in order to ensure safe operation of the hydraulic equipment. See the hydraulic diagram(s) for the pressure settings.

CAUTION



The settings of sealed valves may not be modified!

7.3.11 HYDRAULIC MOTORS

General overhauls and minor repairs are often economic with this type of hydraulic equipment. Check for excessive, abnormal sounds. Regular inspection of outward temperature is recommended. Measuring the fluid leakage rate (>6% of the nominal capacity of the motor) and speed in comparison with the nominal values can assess internal wear.

The actual pressure has to be checked at least once a year. Connect a manometer to the minimess connection (high pressure side) of the motor.

When hydraulic motors are heavily damaged, check the system thoroughly on cleanliness and small parts.

7.3.12 VALVES

Check valves, non-return valves, prefill valves, logic elements

The main problem with this type of valve is internal leakage due to damaged valve seats. Foreign objects or erosion nearly always cause such damage. Internal wear can be assessed by measuring the fluid leakage rate.

Hardened seats can easily be changed or re-machined. Seat and cone can also be changed. Great care must be taken when opening up the body, because the springs inside are sometimes very strong.

Directional control / spool valves and pressure valves

Apart from fitting new seals or new solenoids, it is practically impossible for the operator to repair most directional valves. Poppet valves can be repaired by fitting a new cone and seat on the pilot side and a new bush and cone on the main side.

Control, proportional or servo valves

Repair of flow control valves is confined to the fitting of new seals. It is not advisable to attempt repairs to proportional or servo valves other than the renewal of seals, because the equipment required for repair is very expensive.

NOTE *Maintenance personnel working on proportional valves and servo valves should be trained by the manufacturer before attempting any work on actual installations.*

All service manuals can be found in the appendices.

7.4 ELECTRICAL SYSTEM

7.4.1 GENERAL INSTRUCTIONS

Before starting maintenance, always take the precautions mentioned below.

- Ensure that all electrically and hydraulically actuated systems are in a safe position and secured if necessary.
- Ensure that all electrical power is cut off before carrying out any repair / maintenance work on the system.

If working on an activated system is inevitable:

- Wear proper protective clothing.
- Use only proper measuring equipment and tools.
- Do not touch any live parts.
- Stand or sit on an unearthing underground.

WARNING

Ignoring these important safety precautions can cause fatal injuries!

7.4.2 CORROSION PREVENTION

Most electrical cabinets and control panels, especially the non-ventilated ones, are protected against corrosion by VpCI-111 Emitters. These emitters need to be replaced every 24 months.

If the enclosure is not totally air-tight or if the access doors are opened frequently, replace the VpCI-111 emitter more often than every two years.

To determine in which cabinets and boxes the corrosion prevention is used, search the electrical drawings materials lists for Anti corrosion Emitter.

For more information see supplier documentation Cortec.

7.4.3 TROUBLE SHOOTING GUIDE - POWER

The problems that can arise will fall apart in some important categories, in order of importance:

1. [Section 7.4.3.1: "Power supply failures"](#)
2. [Section 7.4.3.2: "Emergency stop failures"](#)

7.4.3.1 Power supply failures

To find the cause of a problem usually starts with checking that the power to the particular device or system is present. In general our equipment is supplied from ships switchboards. Usually the power to our equipment is divided in:

- Main power supply:

Ships supply can vary from medium voltage supplies of 1000 Vac to supplies of 10.000 Vac. The Huisman equipment is generally made for a supply voltage of 690 Vac. Therefor the ships supply is connected to the Huisman equipment through transformers. These transformers typically supply our switchboards with 690 VAC. This supply is usually distributed to our systems through a main switch that is protected with an Emergency stop (E-stop). In some cases the supply system is split in a 690 VAC and a 380-480 VAC supply. The 690 VAC supplies the rectifiers for the drive systems, and the 380-480 Vac supply is used for auxiliary purposes.

For the actual configuration of the power supply system see the Electrical Description part of this manual.

Check that of all ship supplies all phases (L1-L2-L3 or R-S-T) are available. When one or more of the phases are interrupted, this leads to either a completely "dead" system (no control supply available) or a system with failing "main power supply" which means the rectifiers get no supply and will not generate the DC voltage needed to operate the drives.

- Low voltage "main power" supply:

Usually 380 - 690 VAC. Check that of all phases (L1-L2-L3 or R-S-T) are available. The connected consumers are auxilliary equipment such as cooling fans, filter pumps, grease pumps, air conditioners, etc.

- Low voltage "lighting & control" supply.

Usually 110-240 VAC. The lighting is generally a 3 phase 240 VAC system. Check that of all phases (L1-L2-L3 or R-S-T) are available and that no breakers are tripped. The "lighting & control" supply is used for general lighting, air conditioning and supply of non critical parts of the control system.

- Low voltage "Emergency lighting" supply.

Usually 110-240 VAC. This is generally supplied directly from the ships Emergency switchboard. Check the incoming supply from the ships switchboard.

- Low voltage "standby" supply.

Usually 110-240 VAC which is used for anti condensation heating of the electric motors and cabinets. This is generally supplied directly from the ships Emergency switchboard, sometimes combined with the Emergency lighting as described above.

- 24 VDC supply system

The control system is supplied 24 VDC which is generally derived from an Uninterrupted Power Supply (UPS) part as well as a "normal" supply. The main purpose of the UPS is to provide uninterrupted power to all PLC's, critical sensors and the Scada displays. This way, the operator can see what part of the system is failing, even during a "black out" of the ships supply. The amount of time the controls stay on line depends on the requirements, but is generally 10-30 minutes. This usually is enough to do the last actions required for a safe stop. If the black out is shorter than this period, the advantage is that the system is much quicker back online as no computers need to restart etc.

7.4.3.2 Emergency stop failures

Sometimes the E-stop will not reset. A reset can only be performed if the control loop is closed. In the control loop a number of relays and switches are checked to make sure that after the reset, no equipment will start to make unwanted movements. In the larger systems the status of all E-stop mushrooms is made visible on a SCADA page. Please note that the shown status CAN be different from the actual wired E-stop. The position detection of the E-stop switches is separate circuit, which is only used for SCADA indication, and will not be used to control the drive systems etc. The SCADA E-stop overview will provide an easy way to see which E-stop mushroom is still pressed, and so helps to avoid a sometimes stiff walk around the ship.

NOTE *Usually it is also needed to reset the alarms at the SCADA system before it is possible to reset the E-stop system*

7.4.4 TROUBLE SHOOTING GUIDE - CONTROL

At the SCADA system typically the following screens are available that help to find the cause of malfunctions, in order of importance:

7.4.4.1 Remote I/O overview.

In order to find the source of profibus and remote I/O failures some pages have been added in the scada system that will provide an overview of the status of all profibus and profinet remote I/O stations. Depending on the size of the installation there might be more than one page. The actual status of each I/O station is shown on the Scada system.

7.4.4.2 Sensor pages

This pages provide the operator with the actual information of all sensors that are present in the system. It is also possible to temporarily overrule sensor values. The overrule function can only be accessed by technical support personnel and are user level protected. Only trained personnel with thorough knowledge of the system should get the password. Here it is possible to overrule digital and analogue signals in order to overrule bad sensors etc. Obviously it is easy to create unsafe working situations with overrules. The use of overrules should be restricted to getting the system back to a safe situation, and a repair of the sensors involved should be started at earliest opportunity.

7.4.4.3 Alarm page

An important feature of the alarm and warning system is that it stores all previous alarms and warnings for a year. (depending on system) The technician can refer back to old alarms and warnings. Some important things that can be done this way are:

- Trace back the sequence of events during a mishappening.
- Analyse the quantity of alarms. Sometimes this can give indication that problems are increasing in time. Keep in mind that operators tend to ignore messages and warnings that appear often. As a single event this can be right, but an expert overview every now and then is highly recommended.

7.4.4.4 Trending page

This page can display a wide variety of signals that are either actual or "history data". The trend data for a fixed set of analogue sensor signals is stored 24/7. Mostly the data will be kept for a year, after a year the oldest data gets overwritten by new data. It is the owners responsibility to retrieve this data yearly so that it can be kept for future reference. The trending page is used for the following tasks:

- Analysis of history data in order to find the sequence of events for trouble shooting etc.
- Show actual performance data which can help the operator to perform better
- Show history data that can be compared with actual data.

7.4.5 CABINETS AND JUNCTION BOXES

Regular inspection of the cabinets and junction boxes prevents the electrical system from malfunctioning. Check for dents or other damage that can cause a failure or short-circuit in the electrical system. Also check for the presence of water inside, which can be caused either by condensation or leakage.

NOTE	<i>Always remove dust with a vacuum cleaner! Never use compressed air.</i>
-------------	--

Regular inspection and adjustment of cabinets and junction boxes includes:

- Sealings of cabinet doors.
- Mounting:
 - Looseness, play (action: adjust).
 - Ingression of dust or foreign material (action: clean).
- Connections:
 - Loose connector (re-tighten)
- (Ambient) environment;
The environment in the cabinet should be regularly checked for:
 - Temperature (0 to 55°C).
 - Humidity (10 to 90 % RH).
- Distribution rails;
Check regularly that the bolts of the distribution rails have not loosened. Also check for loose screws and covers to prevent malfunctioning and short circuit.
- Earth failures;
Checking can be done by pressing the concerned button.
- Heating;
Check by sense or by measuring the current

NOTE	<i>Always keep the doors of the electrical cabinets closed in order to prevent ingress of corrosive gasses.</i>
-------------	---

7.4.6 PLCs

Regular maintenance and inspection of PLCs includes:

- Mounting.
 - Check for a solid mounting of housing and wiring screws; re-tighten screws if necessary.

WARNING

While power is supplied, do not:

- Touch terminals
- Clean or tighten screws
- Mount or dismount a module

NOTE

- Do not:
 - Change the program.
 - Tend the RUN, STOP or PAUSE switch.
 - Force outputs during CPU run without confirmation of safety.
- Disassembly or modification of PLC parts is prohibited.
- Altering of parameter settings is only permitted to HUISMAN technicians or to a board technician in close cooperation with HUISMAN.
- Always note down the parameter settings before altering them!

7.4.7 E-MOTORS

Every motor must be installed and maintained in accordance with the supplier documentation. The instructions in this chapter are meant as a guideline only.

NOTE

- Before starting maintenance or repair, take care to isolate the motor and brakes from the power supply and safeguard them against unintentional power-up.
- Shut off the standstill heating of the E-Motors. In most systems this is a separate supply line.

Regular inspection of E-motors includes:

- Standstill heating (check by measuring the current).
- Drain holes (check that holes are open; these may be blocked by paint or grease).
- Connection bolts of the E-cabling are tightened.
- Winding insulation resistance (before commissioning the motor, or when winding dampness is suspected, measure the insulation resistance). Resistance, measured at 25°C, must be greater than 440kΩ .

NOTE

- Windings should be discharged immediately after measuring in order to avoid electric shock.
- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings. The values should not be lower than 1000Ω per Volt of rated voltage, which means at least 440 kΩ at the rated voltage of 440 Volts.

The insulation resistance reference value is halved for each 20° C rise in ambient temperature. If the reference resistance value is not attained, the winding is too damp, and must be oven-dried. Refer to the documentation of the motor manufacturer.

-
- NOTE**
- *Drain hole plugs, if fitted, must always be removed before oven drying.*
 - *If the dampness is caused by seawater, the winding should be rewound.*
-

7.4.8 SENSORS

Sensors must be checked regularly.

-
- NOTE**
- Do not remove dust with compressed air as this would cause the dust to penetrate into the contacts, which would affect the switching capacity. The cap type sealing of the protective housings have to be replaced after opening of the cap and after an longer operation time.*
-

- NOTE**
- Do not use benzene or any other solvent for cleaning the sensors and switches.*
-

7.4.9 VENTILATORS

Ventilators and included filters must be inspected and cleaned regularly. Wear and dirt can be expected on the housing and impeller. The inspection and cleaning intervals have to be fixed by the operator in accordance with individual operating conditions. Regular checks is required.

-
- NOTE**
- *Do not use high-pressure cleaners (steam rod cleaners).*
 - *Flexible sleeves between the fan and the plant parts are to be checked at regular intervals.*
-

7.4.10 EMERGENCY STOP SYSTEM

A designated person* should check the emergency stop buttons for proper operation, physical damage, button looseness, and excessive environmental contamination. This should take place on a periodic schedule determined by the user, based on the severity of the operating environment and the frequency of switch actuations.

-
- NOTE**
- A designated person is identified in writing by the employer as being appropriately trained to perform a specified checkout procedure. A qualified person possesses a recognized degree or certificate or has extensive knowledge, training, and experience to solve problems relating to the emergency stop installation.*
-

If inspection reveals contamination on the switch, thoroughly clean the switch and eliminate the cause of the contamination. Replace the switch and/or appropriate components when any parts or assemblies are damaged, broken, deformed, or badly worn; or if the electrical/mechanical specifications (for the environment and operating conditions) have been exceeded.

Always test the control system for proper functioning under machine control conditions after performing maintenance, replacing the emergency stop device, or replacing any component of the device.

7.5 MAINTENANCE SCHEDULE & TASK DESCRIPTIONS

7.5.1 400 MT CRANE SECTIONS MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Structure								
7.5.1.1.1	Grease control cabin door			1	1500	Hydraulical	Huisman	331.01.01.02.01
7.5.1.1.2	Grease foundation fan and filter door			1	1500	Hydraulical	Huisman	331.01.01.07.04
7.5.1.1.3	Inspect and clean steel structure			1		Mechanical	Huisman	331.01.01.01 331.01.01.02 331.01.01.03 331.01.01.04 331.01.01.05 331.01.01.06 331.01.01.07 331.01.01.08 331.01.01.09
7.5.1.1.4	Non-destructive testing of welds and steel structure			5		Mechanical	Huisman	331.01.01.01 331.01.01.02 331.01.01.03 331.01.01.04 331.01.01.06 331.01.01.07
E-room								
7.5.1.2.1	Inspect and clean the E-room structure.		1			Mechanical & Electrical	Huisman	331.01.01.07.01
7.5.1.2.2	Inspect the E-room E-utilities		1			Electrical	Huisman	331.01.01.07.01
7.5.1.2.3	Inspect and clean the E-room light (Fluorescent)		1			Electrical	Huisman	331.01.01.07.01
Fans								
7.5.1.3.1	Inspect, clean and test cooling fan	7				Mechanical	Huisman	331.01.01.07.02 331.01.01.07.03 331.01.01.07.04
7.5.1.3.2	Inspect and clean ventilation grille		3			Hydraulical	Huisman	331.01.01.07.02 331.01.01.07.03
7.5.1.3.3	Inspect and clean filter cabinet		3			Hydraulical	Huisman	331.01.01.07.04
7.5.1.3.4	Replace filter bag		3			Hydraulical	Huisman	331.01.01.07.04

Table 7-2: Maintenance schedule crane sections

7.5.1.1 Structure

This section describes all maintenance tasks for the structure of the 400 mT Crane sections.

7.5.1.1.1 Grease control cabin door

Reference documents:

- [A11-41800-00-201](#): greasing schedule

Description	Location	Reference	Symbol code	Qty.
Control cabin door	Slew platform	A11-41800-00-201	N	1

1. Grease control cabin door according to the greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
MOBIL MOBILUX EP2	-	-

7.5.1.1.2 Grease foundation fan and filter door

Reference documents:

- [A11-41800-00-201](#): greasing schedule

Description	Location	Reference	Symbol code	Qty.
Foundation fan and filter door	Rectangular mast section	A11-41800-00-201	N	2

1. Grease foundation fan and filter door according to the greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
MOBIL MOBILUX EP2	-	-

7.5.1.1.3 Inspect and clean steel structure

Reference documents:

- [A11-41800-00-0038](#): General arrangement
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Rectangular mast section	Crane	A11-41800-00-0038	-	1
Transition section	Crane	A11-41800-00-0038	-	1
Pedestal	Crane	A11-41800-00-0038	-	1
Slew platform	Crane	A11-41800-00-0038	-	1
Mast	Crane	A11-41800-00-0038	-	1
Mast head	Crane	A11-41800-00-0038	-	1
Boom	Crane	A11-41800-00-0038	-	1
Fly-jib	Crane	A11-41800-00-0038	-	1
Boom rest	Crane	A11-41800-00-0038	-	1

NOTE When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.

1. Clean the steel structure using a cloth.
2. Visual check the steel structure for cracks, damage and corrosion.
 - If cracks or significant damage are found, take contact with Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification.
3. Check paint of steel structure.
 - If the paint is damaged, repaint the area according to the Paint Specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the Paint Specification.
4. Check for loose components of the steel structure.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the Paint Specification.

Contact Huisman for part information on steel structure.

7.5.1.1.4 Non-destructive testing of welds and steel structure

Reference documents:

- [A11-41800-09-085](#): High Stress Zones Description & Inspection Plan

Description	Location	Reference	Symbol code	Qty.
Rectangular mast section	Crane	A11-41800-09-085	-	1
Pedestal	Crane	A11-41800-09-085	-	1
Slew platform	Crane	A11-41800-09-085	-	1
Mast head	Crane	A11-41800-09-085	-	1
Boom	Crane	A11-41800-09-085	-	1
Fly-jib	Crane	A11-41800-09-085	-	1

The welds and steel structure need to be inspected by means of non-destructive techniques (NDT). Huisman recommends these inspections to be executed by a third party that is specialized in NDT inspection surveys. Huisman can provide NDT specialist if required.

1. Execute this task according to High stress zones document. The NDT test consists of Magnetic particles inspection (MPI) and Ultrasonic testing (UT).
 - If unacceptable welds are found consult Huisman.

NOTE All personnel performing Magnetic Particles Inspection shall be qualified and certified according to EN 473/PCN or EN 473 / SNT-TC-1A, level II or level III.

NOTE As an alternative for MPI, penetrant inspection (PT) can be carried out.

Contact Huisman for part information on steel structure.

Special tools

P/N	Tool	Qty.
	Phased array US	1
	AC yoke magnet	1
	Wet magnetic ink, test medium Magnaflux	-

7.5.1.2 E-room

This section describes all maintenance tasks for the E-room of the rectangular mast section.

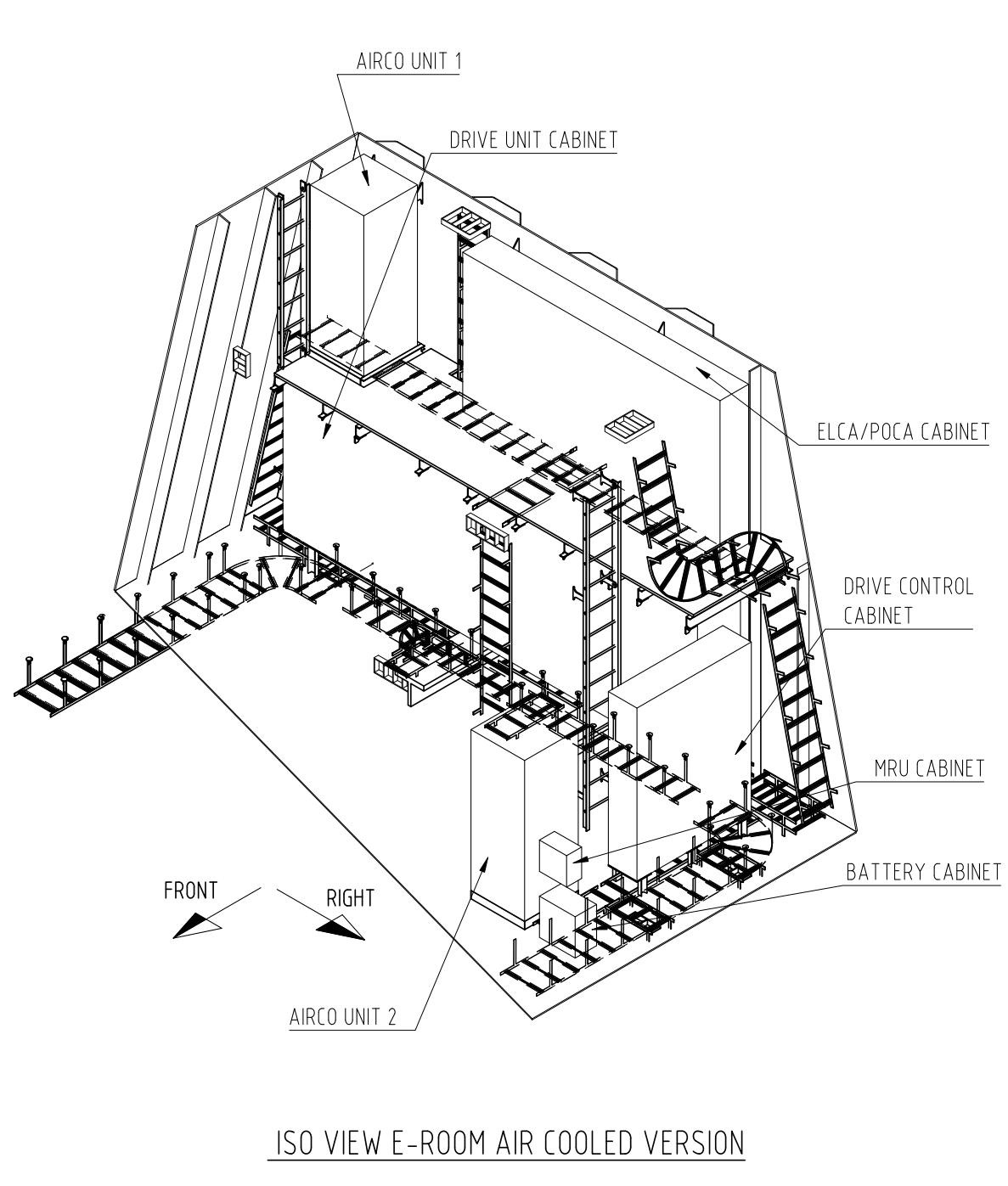


Figure 7-12: E-room

7.5.1.2.1 Inspect and clean the E-room structure.

Reference documents:

- [A11-41800-55-0108](#): E-room outfitting air cooled
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
E-room	Rectangular mast section	A11-41800-55-0108	-	1

This task is applicable to Inspect and clean the E-room and the utilities.

1. Clean the E-room using a vacuum cleaner.
2. Clean the steel structure using a cloth.
3. Inspect cabinet general condition and mounting of components.
4. Check the door.
 - Grease the door hinges and open and close the door to distribute the lubrication.
 - Grease the door lock system.
5. Visual check the steel structure for cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the steel structure.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
6. Check paint of steel structure.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
7. Check for loose components of the steel structure.
 - If components (e.g. roof railing, cable tray, mounting rails, plates) are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Spare parts

P/N	Part	Symbol code
10003365A	Earth boss	A11-41800-55-0108 / 501

7.5.1.2.2 Inspect the E-room E-utilities.

Reference documents

- [A11-41800-55-0108](#): E-room outfitting air cooled

Description	Location	Reference	Symbol code	Qty.
E-room	Rectangular mast section	A11-41800-55-0108	-	1

1. Check the mounting of the E-cabinets to the frame of the E-room.
 - If a mounting of the E-cabinets is loose, tighten the cabinet to the frame.
2. Check the mounting of the air-conditioning units (outside and inside) to the frame.
 - If a mounting of the air-conditioning units are loose, tighten the units to the frame.
 - When the cables are damaged replace the cables.
 - When the cable glands are damaged/cracked (possibility of water ingress) replace the cable glands.

Spare parts

P/N	Part	Symbol code
2025994	Air-conditioning unit	A11-41800-55-0108 / 902
2026009	Water condensor	A11-41800-55-0108 / 903

7.5.1.2.3 Inspect and clean the E-room light (Fluorescent)

Reference documents

- [A11-41800-55-0108](#): E-room outfitting air cooled

Description	Location	Reference	Symbol code	Qty.
Fluorescent light	E-room	A11-41800-55-0108	904	4
Fluorescent light	E-room	A11-41800-55-0108	905	3

1. Clean the fluorescent lights (see drawing A11-41800-55-0108 for the locations)
 - Clean the fluorescent lamp with a dry cloth.
 - Clean the lamp cover with a cleaning solution and wipe it dry with a dry clean cloth.
2. Replace the fluorescent lights (see drawing A11-41800-55-0108 for the locations)

Spare parts

P/N	Part	Symbol code
2023467	Fluorescent light (18W)	A11-41800-55-0108 / 904
2019578	Fluorescent light (36W)	A11-41800-55-0108 / 905

7.5.1.3 Cooling fan

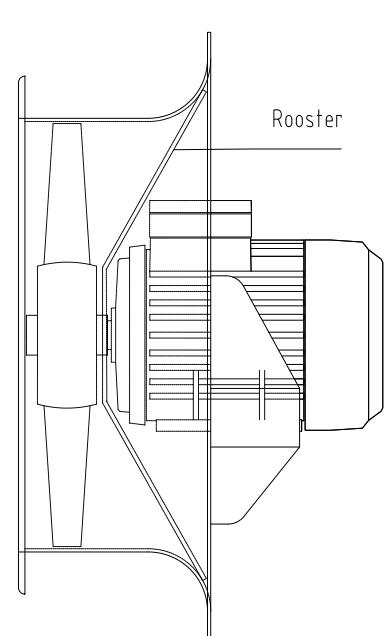
This section describes all maintenance tasks for the cooling fan of the rectangular mast section.

7.5.1.3.1 Inspect, clean and test cooling fan

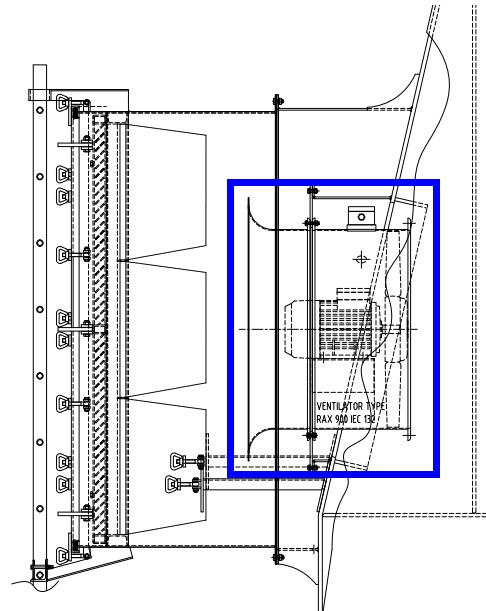
Reference documents:

- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Exhaust fan No.1	Rectangular mast section	Figure 7-13	901	1
Exhaust fan No.2	Rectangular mast section	Figure 7-13	901	1
Supply fan	Rectangular mast section	Figure 7-13	902	1



Exhaust fan (901)



Supply fan (902)

Figure 7-13: Forced cooling

1. Clean the exterior of the forced cooling on the fan using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace forced cooling.
 - If corrosion is found, repair the surfaces where the corrosion is found by cleaning and painting these surfaces, according to the paint specification.
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.
4. Test functionality of fan.
 - If a problem is found (unusual noise or vibration), investigate the cause and repair/replace the failed component.
5. Check cables of E-motor
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.
6. Check the functioning of e-motor bearings while the cooler e-motor is off. For this rotate the fan with hand.
 - If the fan does not rotate smoothly, investigate the cause (poor lubrication/malfunction of bearings, for example) and repair/replace the failed component.

Spare parts

P/N	Part	Symbol code
2025993	Exhaust fan	901
2025991	Supply fan	902

7.5.1.3.2 Inspect and clean ventilation grille

:

Description	Location	Reference	Symbol code	Qty.
Ventilation grille	Rectangular mast section	Figure 7-14	507	1

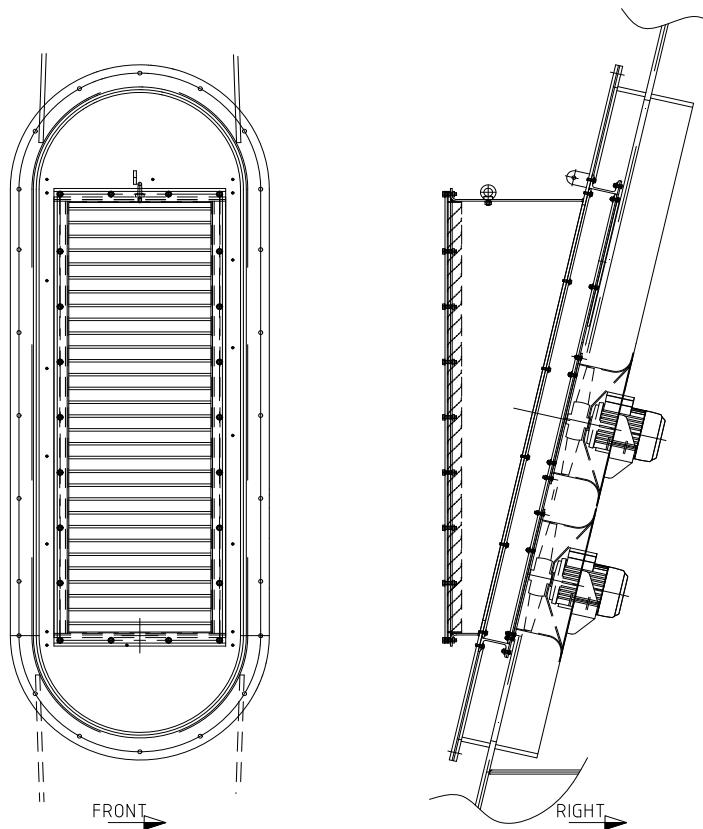


Figure 7-14: Ventilation grille

1. Clean ventilation grille.
2. Check ventilation grille for damage.
 - If significant damage is found, replace the ventilation grille.

Spare parts

P/N	Part	Symbol code
2044323	Ventilation grille	507

7.5.1.3.3 Inspect and clean filter cabinet

:

Description	Location	Reference	Symbol code	Qty.
Filter cabinet	Rectangular mast section	Figure 7-15	901	1

Filter cabinet (901)

Filter Bag (903)

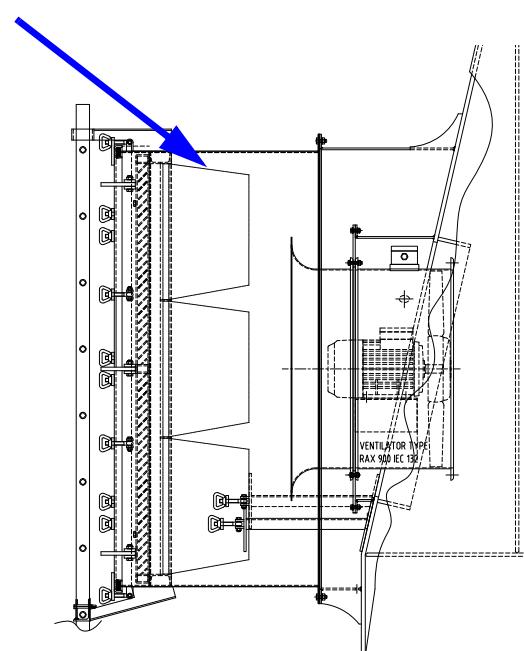


Figure 7-15: Filter cabinet

1. Clean filter cabinet.
2. Check filter cabinet for damage.
 - If significant damage is found, replace the filter cabinet.

Spare parts

P/N	Part	Symbol code
2025992	Filter cabinet	901

7.5.1.3.4 Replace filter bag

:

Description	Location	Reference	Symbol code	Qty.
Filter bag	Filter cabinet	Figure 7-15	903	1

1. Remove the old filter bag.
2. Place new filter bag.

Parts needed for task

P/N	Part	Symbol code	Qty.
2026008	Filter bag	903	1



7.5.2 800kW HPU MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Pump								
7.5.2.1.1	Daily check pump	1				Hydraulical	Huisman	331.01.02.01.01.01 331.01.02.01.01.02 331.01.02.01.02.01 331.01.02.01.02.02 331.01.02.01.02.03
7.5.2.1.2	Check bolt connections			1000		Mechanical	Huisman	331.01.02.01.01.01 331.01.02.01.01.02 331.01.02.01.02.01 331.01.02.01.02.02 331.01.02.01.02.03
7.5.2.1.3	Inspect and clean pump exterior		3			Hydraulical	Huisman	331.01.02.01.01.01 331.01.02.01.01.02 331.01.02.01.02.01 331.01.02.01.02.02 331.01.02.01.02.03
7.5.2.1.4	Inspect pump-motor coupling		6			Hydraulical	Huisman	331.01.02.01.01.01 331.01.02.01.01.02 331.01.02.01.02.01 331.01.02.01.02.02 331.01.02.01.02.03
7.5.2.1.5	Test dead head pressure			1		Hydraulical	Huisman	331.01.02.01.01.01 331.01.02.01.01.02 331.01.02.01.02.01 331.01.02.01.02.02 331.01.02.01.02.03
7.5.2.1.6	Overhaul pump			5		Mechanical	Huisman	331.01.02.01.01.01 331.01.02.01.01.02 331.01.02.01.02.01 331.01.02.01.02.02 331.01.02.01.02.03
E-motor								
7.5.2.2.1	Perform SPM analysis for E-motor		3			Mechanical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01 331.01.02.01.02.02.01 331.01.02.01.02.03.01
7.5.2.2.2	Inspect and clean E-motor exterior		3			Electrical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01 331.01.02.01.01.01.01 331.01.02.01.02.02.01 331.01.02.01.02.03.01
7.5.2.2.3	Test standstill heating		3			Electrical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01
7.5.2.2.4	Perform thermal imaging analysis for E-motor			1		Electrical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01 331.01.02.01.01.01.01 331.01.02.01.02.02.01 331.01.02.01.02.03.01
7.5.2.2.5	Test thermistor relays of E-motor		6			Electrical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01
7.5.2.2.6	Grease E-motor bearings		6			Mechanical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01 331.01.02.01.01.01.01 331.01.02.01.02.02.01 331.01.02.01.02.03.01
7.5.2.2.7	Measure insulation resistance of E-motor and cables and continuity resistance of each winding			1		Electrical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01 331.01.02.01.01.01.01 331.01.02.01.02.02.01 331.01.02.01.02.03.01

Table 7-3: Maintenance schedule 800kW HPU

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.2.2.8	Empty condensation drain holes of E-motor			1		Electrical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01 331.01.02.01.01.01.01 331.01.02.01.02.02.01 331.01.02.01.02.03.01
7.5.2.2.9	Replace bearings of E-motor			5		Electrical	Huisman	331.01.02.01.01.01.01 331.01.02.01.01.02.01 331.01.02.01.01.01.01 331.01.02.01.02.02.01 331.01.02.01.02.03.01
Hydraulic oil								
7.5.2.3.1	Perform oil analysis		3			Hydraulical	Huisman	331.01.02.01.02
Plate cooler								
7.5.2.4.1	Inspect and clean cooler		6			Hydraulical	Huisman	331.01.02.01.02
Accumulator								
7.5.2.5.1	Check nitrogen pressure of accumulator		1			Hydraulical	Huisman	331.01.02.01.02.05
7.5.2.5.2	Inspect and clean accumulator		3			Hydraulical	Huisman	331.01.02.01.02.05
Valves and filters								
7.5.2.6.1	Inspect breather filter		1			Hydraulical	Huisman	331.01.02.01.02.06.06
7.5.2.6.2	Inspect and clean filter housing		3			Hydraulical	Huisman	331.01.02.01.02.06.03 331.01.02.01.02.06.07 331.01.02.01.02.06.08 331.01.02.01.02.06.09 331.01.02.01.02.06.10
7.5.2.6.3	Inspect and clean manifold		6			Hydraulical	Huisman	331.01.02.01.02.06.01 331.01.02.01.02.06.02 331.01.02.01.02.06.03 331.01.02.01.02.06.04
7.5.2.6.4	Replace breather filter element			1		Hydraulical	Huisman	331.01.02.01.02.06.06
7.5.2.6.5	Replace filter element			1		Hydraulical	Huisman	331.01.02.01.02.06.03 331.01.02.01.02.06.07 331.01.02.01.02.06.08 331.01.02.01.02.06.09 331.01.02.01.02.06.10
7.5.2.6.6	Test pressure relief valve			5		Hydraulical	Huisman	331.01.02.01.02.06.03 331.01.02.01.02.06.04 331.01.02.01.02.06.05
Hydraulic pipes and hoses								
7.5.2.7.1	Inspect and clean hydraulic pipes and hoses		3			Hydraulical	Huisman	331.01.02.01.02.07
7.5.2.7.2	Replace hydraulic hoses			5		Hydraulical	Huisman	331.01.02.01.02.07
Emergency stop system								
7.5.2.8.1	Inspect and test functioning of emergency stop system		1			Electrical	Huisman	331.01.02.01.03.01
Cables and connections								
7.5.2.9.1	Inspect cables and connections			1		Electrical	Huisman	331.01.02.01.03.02

Table 7-3: Maintenance schedule 800kW HPU

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Structure								
7.5.2.10.1	Inspect and clean hydraulic reservoir			1		Mechanical	Huisman	331.01.02.01.04.01
7.5.2.10.2	Inspect and clean HPU frame and subframe			1		Mechanical	Huisman	331.01.02.01.04.02

Table 7-3: Maintenance schedule 800kW HPU

7.5.2.1 Pump

This section describes all maintenance tasks for the pumps of the 800 kW HPU.

7.5.2.1.1 Daily check pump

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW

Description	Location	Reference	Symbol code	Qty.
Main pump NO.1	HPU Room	A11-41810-80-0108	P104A	1
Main pump NO.2	HPU Room	A11-41810-80-0108	P104B	1
Offline filtering unit	HPU Room	A11-41810-80-0108	F401	1
Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	P201A	1
Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	P201B	1

1. Check pump for excessive noise.

- If a problem is found, investigate the cause and repair/replace the failed component.

NOTE Make sure the pump is running while performing this task.

2. Check the pump for leakage.

- If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

Spare parts

P/N	Part	Symbol code
2009530	Main pump	P104A,P104B
2013255	Offline filter unit	F401

P/N	Part	Symbol code
2013247	Oil cooling pump	P201A, P201B

7.5.2.1.2 Check bolt connections

Reference documents

- [A11-41810-88-1108](#): HPU assembly
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Bolts	HPU room	A11-41810-88-1108	-	-

1. Check torque of the bolts according to the drawing A11-41810-88-1108.
 - If bolts are not at the correct torque, tighten the bolts with the correct torque according to drawing A11-41810-88-1108 and repaint according to paint specification.
2. Check the flange holes and the bolts for wear.
 - If a problem is found, investigate the cause and repair/replace the failed component.

7.5.2.1.3 Inspect and clean pump exterior

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Main pump NO.1	HPU Room	A11-41810-80-0108	P104A	1
Main pump NO.2	HPU Room	A11-41810-80-0108	P104B	1
Offline filtering unit	HPU Room	A11-41810-80-0108	F401	1
Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	P201A	1
Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	P201B	1

1. Clean the exterior of the pump using a cloth.
2. Visual check the exterior of the pump for damage and corrosion.
 - If significant damage is found, replace pump.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.



3. Check for loose components of the pump.
 - If components are loose, tighten the loose components.
4. Check paint of pump.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.

Spare parts

P/N	Part	Symbol code
2009530	Main pump	P104A,P104B
2013255	Offline filter unit	F401
2013247	Oil cooling pump	P201A, P201B

7.5.2.1.4 Inspect pump-motor coupling

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Rexroth (Main pump)
- CC Jensen (Offline filtering unit)
- Settima (Oil cooling pump)

Description	Location	Reference	Symbol code	Qty.
Main pump NO.1 motor-pump coupling	HPU Room	A11-41810-80-0108	Z101A	1
Main pump NO.2 motor-pump coupling	HPU Room	A11-41810-80-0108	Z101B	1
Offline filtering unit	HPU Room	A11-41810-80-0108	F401	1
Oil cooling pump NO.1 motor-pump coupling	HPU Room	A11-41810-80-0108	Z202A	1
Oil cooling pump NO.2 motor-pump coupling	HPU Room	A11-41810-80-0108	Z202B	1

1. Isolate the HPU from the power supply.
2. Visual check the HPU motor-pump couplings for cracks. If cracks are found, replace the motor-pump coupling.

NOTE There is a hole in the flange adaptor, through which the coupling can be seen. This check can be done using an inspection camera.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
On request	Inspection camera	1

Spare parts

P/N	Part	Symbol code
2010730	Main pump motor-pump coupling	Z101A, Z101B
2013255	Offline filter unit	F401
2015564	Oil cooling pump motor-pump coupling	Z202A, Z202B

7.5.2.1.5 Test dead head pressure

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW

Description	Location	Reference	Symbol code	Qty.
Main pump NO.1	HPU Room	A11-41810-80-0108	P104A	1
Main pump NO.2	HPU Room	A11-41810-80-0108	P104B	1
Offline filtering unit	HPU Room	A11-41810-80-0108	F401	1
Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	P201A	1
Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	P201B	1

1. Switch off pressure enable valve(s) and close the system safety ball valve.
2. Start the motor.
3. Check the pressure.
4. If its difference is more then 10% compared to the normal dead head pressure, adjust it to its correct pressure. The normal dead head pressure can be found on the hydraulic diagram.

7.5.2.1.6 Overhaul pump

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Rexroth (Main pump)
- CC Jensen (Offline filtering unit)
- Settima (Oil cooling pump)

Description	Location	Reference	Symbol code	Qty.
Main pump NO.1	HPU Room	A11-41810-80-0108	P104A	1
Main pump NO.2	HPU Room	A11-41810-80-0108	P104B	1
Offline filtering unit	HPU Room	A11-41810-80-0108	F401	1
Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	P201A	1
Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	P201B	1

1. Overhaul pump.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2009530	Main pump	P104A,P104B
2013255	Offline filter unit	F401
2013247	Oil cooling pump	P201A, P201B

7.5.2.2 E-motor

This section describes all maintenance tasks for the E-motors of the 800 kW HPU.

7.5.2.2.1 Perform SPM analysis for E-motor

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Rexroth (Main pump)
- CC Jensen (Offline filtering unit)
- Settima (Oil cooling pump)

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump set NO.1	HPU Room	A11-41810-80-0108	710M1	1
E-motor Main pump set NO.2	HPU Room	A11-41810-80-0108	720M1	1
E-motor Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	741M1	1
E-motor Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	742M1	1

1. Inspect the E-motor by means of Shock Pulse Measurement (SPM) to monitor the condition of the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Analyze the SPM data.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in SPM analysis. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable SPM device	1

Spare parts

P/N	Part	Symbol code
On request	E-motor Main pump	710M1, 720M1
On request	Offline filter unit	743M1
On request	E-motor Oil cooling pump	741M1, 742M1

7.5.2.2.2 Inspect and clean E-motor exterior

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump set NO.1	HPU Room	A11-41810-80-0108	710M1	1
E-motor Main pump set NO.2	HPU Room	A11-41810-80-0108	720M1	1
E-motor Offline filtering pump	HPU Room	A11-41810-80-0108	743M1	1
E-motor Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	741M1	1
E-motor Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	742M1	1

1. Clean the exterior of the E-motor using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace E-motor.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of E-motor.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
 - On request if a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair/replace the cable sheaths.

Spare parts

P/N	Part	Symbol code
On request	E-motor Main pump	710M1, 720M1
On request	Offline filter unit	743M1
On request	E-motor Oil cooling pump	741M1, 742M1

7.5.2.2.3 Test standstill heating of E-motor

Reference documents:

- [10013281A](#): Electrical diagram

 Rexroth (Main pump)

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump NO.1	E-motor Main pump NO.1 or +H11	Electrical diagram (+H11)	710M1-E1	1
E-motor Main pump NO.2	E-motor Main pump NO.2 or +H12	Electrical diagram (+H12)	720M1-E1	1

1. Test the E-motor heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and repair/replace the failed component.
 - Make a record of the measured resistance values.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	E-motor Main pump	710M1, 720M1

7.5.2.2.4 Perform thermal imaging analysis for E-motor

Reference documents:

 [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump set NO.1	HPU Room	A11-41810-80-0108	710M1	1
E-motor Main pump set NO.2	HPU Room	A11-41810-80-0108	720M1	1
E-motor Offline filtering pump	HPU Room	A11-41810-80-0108	743M1	1
E-motor Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	741M1	1
E-motor Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	742M1	1

- Inspect the E-motor by means of thermal imaging to monitor the condition of the E-motor. To perform the task, the E-motor should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the E-motor is running while performing this task.

- Analyze the thermal image.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

Spare parts

P/N	Part	Symbol code
On request	E-motor Main pump	710M1, 720M1
On request	Offline filter unit	743M1
On request	E-motor Oil cooling pump	741M1, 742M1

7.5.2.2.5 Test thermistor relays of E-motor

Reference documents:

- [10013281A](#): Electrical diagram
- Rexroth (Main pump)

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump set NO.1 thermistor relay 130 degrees C	HPU Room	Electrical diagram (+H11)	710M1-B51	1
E-motor Main pump set NO.1 thermistor relay 150 degrees C	HPU Room	Electrical diagram (+H11)	710M1-B52	1
E-motor Main pump set NO.2 thermistor relay 130 degrees C	HPU Room	Electrical diagram (+H12)	720M1-B51	1
E-motor Main pump set NO.2 thermistor relay 150 degrees C	HPU Room	Electrical diagram (+H12)	720M1-B52	1

1. Start the e-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Check if the resistance is increasing while running the e-motor.
 - If the resistance is 0, infinity or is not increasing while running the e-motor, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	E-motor Main pump	710M1, 720M1

7.5.2.2.6 Grease E-motor bearings

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Rexroth (Main pump)
- CC Jensen (Offline filtering unit)
- Settima (Oil cooling pump)

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump set NO.1	HPU Room	A11-41810-80-0108	710M1	1
E-motor Main pump set NO.2	HPU Room	A11-41810-80-0108	720M1	1
E-motor Offline filtering pump	HPU Room	A11-41810-80-0108	743M1	1
E-motor Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	741M1	1
E-motor Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	742M1	1

1. Grease the E-motor bearings.

NOTE Ultrasonic measurement can be used to determine if greasing is necessary.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
On request		

Spare parts

P/N	Part	Symbol code
On request	E-motor Main pump	710M1, 720M1
On request	Offline filter unit	743M1
On request	E-motor Oil cooling pump	741M1, 742M1

7.5.2.2.7 Measure insulation resistance of E-motor and cables and continuity resistance of each winding

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Rexroth (Main pump)
- CC Jensen (Offline filtering unit)
- Settima (Oil cooling pump)

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump set NO.1	HPU Room	A11-41810-80-0108	710M1	1
E-motor Main pump set NO.2	HPU Room	A11-41810-80-0108	720M1	1
E-motor Offline filtering pump	HPU Room	A11-41810-80-0108	743M1	1
E-motor Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	741M1	1
E-motor Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	742M1	1

For performing this task on the E-motor.

1. Open the housing to access windings.
2. Megger test the E-motor windings, to find the winding insulation resistance and the insulation resistance between the coils.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For performing this task on the E-motor cables.

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

CAUTION



Windings must be discharged immediately after measuring in order to avoid electric shock.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
 - The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 690 kΩ at the rated voltage of 690 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.
 - If the winding is too damp, the winding must be over-dried.
-

Special tools

P/N	Tool	Qty.
-	Megger	1

Spare parts

P/N	Part	Symbol code
On request	E-motor Main pump	710M1, 720M1
On request	Offline filter unit	743M1
On request	E-motor Oil cooling pump	741M1, 742M1

7.5.2.2.8 Empty condensation drain holes of E-motor

Reference documents:

 [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW

Description	Location	Reference	Symbol code	Qty.
E-motor Main pump set NO.1	HPU Room	A11-41810-80-0108	710M1	1
E-motor Main pump set NO.2	HPU Room	A11-41810-80-0108	720M1	1
E-motor Offline filtering pump	HPU Room	A11-41810-80-0108	743M1	1

Description	Location	Reference	Symbol code	Qty.
E-motor Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	741M1	1
E-motor Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	742M1	1

1. Empty condensation drain holes of E-motor.
2. Clean and check the drain holes of the E-motor and make sure that holes are open and clear.
 - If excessive grease is found, remove the grease.
 - If dirt blocks the drain holes, remove the dirt.

7.5.2.2.9 Replace bearings of E-motor

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Rexroth (Main pump)
- CC Jensen (Offline filtering unit)
- Settima (Oil cooling pump)

Description	Location	Reference	Symbol code	Qty.
E-motor bearing Main pump set NO.1	HPU Room	A11-41810-80-0108	N/A	1
E-motor bearing Main pump set NO.2	HPU Room	A11-41810-80-0108	N/A	1
E-motor bearing Offline filtering pump	HPU Room	A11-41810-80-0108	N/A	1
E-motor bearing Oil cooling pump NO.1	HPU Room	A11-41810-80-0108	N/A	1
E-motor bearing Oil cooling pump NO.2	HPU Room	A11-41810-80-0108	N/A	1

1. Replace E-motor bearings.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	E-motor bearings main pump	N/A	1
On request	E-motor bearings oil cooling pump	N/A	1
On request	E-motor bearings offline filtering pump	N/A	1

7.5.2.3 Hydraulic oil

This section describes all maintenance tasks for the hydraulic oil of the 800 kW HPU.

7.5.2.3.1 Perform oil analysis

Reference documents:

Description	Location	Reference	Symbol code	Qty.
Hydraulic oil	HPU Room - sample point		-	-

1. Take oil sample at the sampling point.

NOTE When taking an oil sample follow the procedure prescribed in section [7.3.7](#).

2. Analyse oil sample for chemical and physical values as well as for wear, cleanliness and water.
 - If the results of the analysis are reason to replace the hydraulic oil, replace the oil.

Spare parts

P/N	Part	Symbol code
-	Hydraulic oil - Mobil DTE10 EXCEL 46	-

7.5.2.4 Plate cooler

This section describes all maintenance tasks for the plate cooler of the 800 kW HPU.

7.5.2.4.1 Inspect and clean cooler

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW

Description	Location	Reference	Symbol code	Qty.
Plate cooler	HPU Room	A11-41810-80-0108	Z209	1

1. Clean the exterior of the plate cooler using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage or corrosion is found, replace the cooler.
3. Check plate cooler for leakage.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

Spare parts

P/N	Part	Symbol code
2015428	Plate cooler	Z209

7.5.2.5 Accumulator

This section describes all maintenance tasks for the accumulator of the 800 kW HPU.

7.5.2.5.1 Check nitrogen pressure of accumulator

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Hydac - Universal Charging and Testing Unit FPU-1
- Hydac - Hydraulic Bladder Accumulator

Description	Location	Reference	Symbol code	Qty.
Accumulator (bladder)	HPU Room	A11-41810-80-0108	Z130	1

1. Cut off the accumulator by closing the ball valve on the accu safety and shut-off block (V131).

2. Depressurize the accumulator with the drain spindel.

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

3. Check the HPU accumulator nitrogen pressure: $P_o = 225$ bar.
 - If necessary refill the accumulator with nitrogen.
4. Check for internal leakage of the accumulator.
 - If internal leakage is found, replace the accumulator.
5. Make sure the accumulator is pressurized and the ball valve is opened after checking or refilling the nitrogen pressure of the accumulator.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
2003556	Hydac Nitrogen filling set	1

Spare parts

P/N	Part	Symbol code
2009502	Accumulator (bladder)	Z130

7.5.2.5.2 Inspect and clean accumulator

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- [A11-41000-09-002](#): Paint specification
- Hydac - Hydraulic Bladder Accumulator

Description	Location	Reference	Symbol code	Qty.
Accumulator (bladder)	HPU Room	A11-41810-80-0108	Z130	1

1. Clean the exterior of the accumulator using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace accumulator.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification.

3. Check paint of accumulator.
 - If the paint is damaged, repaint the area according to the Paint Specification.
4. Check accumulator clamp.
 - If necessary repair/ replace the accumulator clamp.
5. Check for external leakage of the accumulator.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2009502	Accumulator (bladder)	Z130
2003947	Accu console	Z133
2006116	Clamp	Z132

7.5.2.6 Valves and filters

This section describes all maintenance tasks for the hydraulic valves and filters of the 800kW HPU.

7.5.2.6.1 Inspect breather filter

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Hydac - Tank Breather Filter with Filler Strainer ELF

Description	Location	Reference	Symbol code	Qty.
Breather filter	Hydraulic reservoir	A11-41810-80-0108	F006A	1
Breather filter	Hydraulic reservoir	A11-41810-80-0108	F006B	1

1. Inspect the breather filter housing for damage.
 - If significant damage is found, replace the breather filter.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2001212	Breather filter	F006A, F006B
2005666	Breather filter element 3µm	F009A, F009B

7.5.2.6.2 Inspect and clean filter housing

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Hydac - Inline Filter LF
- Hydac - Return Line Filter RF
- CC Jensen (Offline filtering unit)
- Hydac - High Pressure Filters for Manifold Block Mounting DFP

Description	Location	Reference	Symbol code	Qty.
Inline filter	HPU Room	A11-41810-80-0108	F206	1
Return line filter	HPU Room	A11-41810-80-0108	F213	1
Offline filter unit	HPU Room	A11-41810-80-0108	F401	1
Return line filter	HPU Room	A11-41810-80-0108	F212A	1
Return line filter	HPU Room	A11-41810-80-0108	F212B	1
High pressure filter	System safety valve	A11-41810-80-0108	F121A	1
High pressure filter	System safety valve	A11-41810-80-0108	F121B	1
High pressure filter	System safety valve	A11-41810-80-0108	F121C	1
High pressure filter	System safety valve	A11-41810-80-0108	F121D	1

1. Clean filter housing exterior.
2. Check filter exterior housing for damage.
 - If significant damage is found, replace the filter housing.
3. Check filter element content.
4. Check filter clogged indicator (red when clogged, green when OK).

NOTE The filter clogged indicator needs a flow of hydraulic fluid to indicate properly, therefore the system must be running to execute this part of the task.

- If the filter is clogged replace the filter element (see replace filter element task

7.3.8).

NOTE When replacing the filter elements, also replace the breather filter element.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2016030	Inline filter	F206
2027329	Inline filter element 5µm	F207
2019531	Return line filter	F213
2026171	Return line filter element 5µm	F215
2013255	Offline filter unit	F401
2008672	Offline filter element	F402
2019530	Return line filter	F212A, F212B
2016796	Return line filter element 10µm	F214A, F214B
2010695	High Pressure filter	F121A, F121B, F121C, F121D
2015481	High Pressure filter element 20µm	F126A, F126B, F126C, F126D

7.5.2.6.3 Inspect and clean manifold

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW

Description	Location	Reference	Symbol code	Qty.
Safety block	HPU Room	A11-41810-80-0108	V131A	1
Safety block	HPU Room	A11-41810-80-0108	V131B	1
Enable valve NO.2	HPU Room	A11-41810-80-0108	V111A	1
Enable valve NO.1	HPU Room	A11-41810-80-0108	V111B	1
System safety valve	HPU Room	A11-41810-80-0108	M120A	1
System safety valve	HPU Room	A11-41810-80-0108	M120B	1

1. Clean the exterior of the manifold using a cloth.
2. Inspect the exterior of the manifold for corrosion and damage.
 - If significant damage is found, replace the component.
 - If significant corrosion is found, replace the component and repaint the area, according to the Paint Specification.
3. Inspect manifold for oil leakage.
 - If leakage is found, investigate the cause and repair/replace the failed component.

Also clean the spilled oil.

4. Check the proper mounting of components.
 - If components are loose, tighten the loose components.

Spare parts

P/N	Part	Symbol code
2016106	Safety block	V131A, V131B
2006317	Enable valve NO.2	V111A
2006317	Enable valve NO.1	V111B
10014348A	System safety valve	M120A, M120B

7.5.2.6.4 Replace breather filter element

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Hydac - Tank Breather Filter with Filler Strainer ELF

Description	Location	Reference	Symbol code	Qty.
Breather filter	Hydraulic reservoir	A11-41810-80-0108	F006A	1
Breather filter	Hydraulic reservoir	A11-41810-80-0108	F006B	1

1. Replace the breather filter element.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
2005666	Breather filter element 3µm	F009A, F009B	2

7.5.2.6.5 Replace filter element

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Hydac - Inline Filter LF
- Hydac - Return Line Filter RF

- CC Jensen (Offline filtering unit)
- Hydac - High Pressure Filters for Manifold Block Mounting DFP

Description	Location	Reference	Symbol code	Qty.
Inline filter	HPU Room	A11-41810-80-0108	F206	1
Return line filter	HPU Room	A11-41810-80-0108	F213	1
Offline filter unit	HPU Room	A11-41810-80-0108	F401	1
Return line filter	HPU Room	A11-41810-80-0108	F212A	1
Return line filter	HPU Room	A11-41810-80-0108	F212B	1
High pressure filter	System safety valve	A11-41810-80-0108	F121A	1
High pressure filter	System safety valve	A11-41810-80-0108	F121B	1
High pressure filter	System safety valve	A11-41810-80-0108	F121C	1
High pressure filter	System safety valve	A11-41810-80-0108	F121D	1

For inspecting the offline filter (F401) and cooler system filters (F213 and F206).

1. Shut off the cooling or offline filter pumps (P201A, P201B and F401).
2. Isolate the filter from the system.
3. Remove the old filter elements.

NOTE Offline filter unit contains four filter elements. All other filters contain one filter element per filter.

4. Place new filter elements.
5. Restore the cooling or offline filter system.

For inspecting the main system filters (F212A, F212B, F121A, F121B, F121C and F121D).

1. Shut off the main pumps (P104A and P104B).
2. Isolate the filter from the system.
3. Remove the old filter elements.

NOTE All filters contain one filter element per filter.

4. Place new filter elements.
5. Restore the main hydraulic system.
6. For more information, see the supplier documentation. .

NOTE When replacing the filter elements, also replace the breather filter element.

Parts needed for task

P/N	Part	Symbol code	Qty.
2027329	Inline filter element 5µm	F207	1
2026171	Return line filter element 5µm	F215	1
2008672	Offline filter element	F402	4
2016796	Return line filter element 10µm	F214A, F214B	1
2015481	High pressure filter element 20µm	F126A, F126B, F126C, F126D	2

7.5.2.6.6 Test pressure relief valve

Reference documents:

- [A11-41810-80-0108](#): Hydraulic diagram HPU 800kW
- Bucher - Stacking Pressure Relief Valve

Description	Location	Reference	Symbol code	Qty.
Safety block	HPU Room	A11-41810-80-0108	V131A	1
Safety block	HPU Room	A11-41810-80-0108	V131B	1
System safety valve	HPU Room	A11-41810-80-0108	V122A	1
System safety valve	HPU Room	A11-41810-80-0108	V122B	1
Pilot pressure relief valve	HPU Room	A11-41810-80-0108	V112	1

1. Isolate the pressure relief valve from the system and remove it from the system.
2. Test the pressure relief valve at a test bench. Test if the pressure is relieved after the test pressure is applied (see [A11-41810-80-0108](#)).

NOTE When removing and placing back the pressure relief valve follow the procedure prescribed in section [7.3.12](#).

- If necessary re-calibrate the pressure relief valve and re-test the pressure relief valve. When re-calibration does make the pressure relief valve open after the test pressure is applied, replace the pressure relief valve.

3. Place the pressure relief valve back into the system and restore the system.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2016106	Safety block	V131
2011409	Pilot pressure relief valve	V112
2008633	System safety valve	V122A, V122B

7.5.2.7 Hydraulic pipes and hoses

This section describes all maintenance tasks for the hydraulic pipes and hoses of the 800 kW HPU.

7.5.2.7.1 Inspect and clean hydraulic pipes and hoses

:

Description	Location	Reference	Symbol code	Qty.
Hydraulic pipes	HPU Room	-	-	-

For inspecting the hydraulic pipes.

1. Clean pipes and couplings.
2. Inspect pipes and couplings for damage and corrosion/paint damage

NOTE Pay special attention to corrosion around the brackets of the pipe.

- If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification. When this is not possible replace the pipe.
 - If the paint is damaged, repaint the area according to the Paint Specification.
3. Inspect hydraulic pipes and couplings for oil leakage.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

For inspecting the hydraulic hoses.

1. Clean hydraulic hoses.
2. Inspect the hydraulic hoses for cracks or other damage.
 - If a hydraulic hose is damaged, replace the hoses..
3. Inspect the hose end connections for damage, corrosion and/or leakage.
 - If a hose end connection is damaged and/or corroded, investigate the cause and repair/replace the failed component.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

4. Inspect tightness of hose ties.
 - If a hydraulic hose is not properly tightened, replace the hose ties.

7.5.2.7.2 Replace hydraulic hoses

Reference documents:

Description	Location	Reference	Symbol code	Qty.
Hydraulic hoses	HPU Room	-	-	-

1. Isolate the hydraulic hose.
2. Replace the hydraulic hose.
3. Restore the hydraulic system.

7.5.2.8 Emergency stop system

This section describes all maintenance tasks for the emergency stop system of the 800 kW HPU.

7.5.2.8.1 Inspect and test functioning of emergency stop system

Reference documents:

- [10013281A](#): Electrical diagram
- [A11-41810-88-1008](#): HPU Arrangement
- Schneider - Emergency push button

Description	Location	Reference	Symbol code	Qty.
Emergency stop button 1	HPU Room	Electrical diagram (+H13)	-061S1	1
Emergency stop button 2	HPU Room	Electrical diagram (+H13)	-061S2	1

NOTE The frequency for this task given in the maintenance schedule is an indication. The user is to determine the periodic schedule based on the severity of the operating environment and the frequency of switch actuation.

1. Check the emergency stop push button for damage, button looseness and excessive environmental contamination.
 - If damage is found, replace the damaged component.
 - If components are loose, tighten the loose components.
 - If dirt is found at the push button, clean the push button.
2. Push an emergency stop button.
3. Check if the push button relay -060K11 and the emergency stop slave relay -060K12 reacts.

WARNING

The emergency safety relay that continuously monitors the state of its inputs. When an emergency stop push button is activated, the relay will directly de-activate its direct contacts. After an adjustable time (typical is 1 second) the relay will de-activate its time-delayed outputs.

- If the relays not react correctly, replace the relay.
4. Check if SCADA gives an emergency alarm and shuts down the system.
 - If no alarm is generated and/or the system does not shut down, investigate the cause and repair/replace the failed component.
5. Reset the emergency stop button.
6. Reset the alarm in SCADA.

WARNING

Always test the emergency stop system for proper functioning under machine control conditions after performing maintenance.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Pushbutton enclosed E-stop	-061S1
2001638	Emergency pushbutton Mushroomhead	-061S2
2007867	Switch block screw conn. 1NC	-

7.5.2.9 Cables and connections

This section describes all maintenance tasks for the cables and connections of the 800 kW HPU.

7.5.2.9.1 Inspect cables and connections

Description	Location	Reference	Symbol code	Qty.
Cables	HPU Room	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correctly tightened, replace the tag, according to the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

NOTE Handle the fibre optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibres with bare hands as the fibre is extremely sensitive to dirt.

7.5.2.10 Structure

This section describes all maintenance tasks for the structure of the 800 kW HPU.

7.5.2.10.1 Inspect and clean hydraulic reservoir exterior

Reference documents:

 [A11-41810-88-1108](#): HPU reservoir

Description	Location	Reference	Symbol code	Qty.
Hydraulic reservoir	HPU Room	A11-41810-88-1108	-	1

1. Clean the exterior of the hydraulic reservoir using a cloth.
2. Check hydraulic reservoir for leakage.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.
3. Visual check the exterior of the hydraulic reservoir for damage and corrosion.
 - If significant damage is found, repair/replace the hydraulic reservoir.
 - If corrosion is found, remove the corrosion.
4. Check for loose components of the hydraulic reservoir.
 - If components are loose, tighten the loose components.

Spare parts

P/N	Part	Symbol code
-	Hydraulic reservoir	-

7.5.2.10.2 Inspect and clean HPU frame and subframe

Reference documents:

 [A11-41810-88-1108](#): HPU

Description	Location	Reference	Symbol code	Qty.
HPU Frame	HPU Room		-	-

1. Clean the HPU frame and subframe using a cloth.
2. Visual check the HPU frame and subframe for cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the frame or subframe.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of HPU frame and subframe.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the HPU frame and subframe.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

7.5.3 PRESSURE VESSEL UNIT MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Vessels								
7.5.3.1.1	Check nitrogen pressure of vessel		1			Hydraulical	Huisman	331.01.02.02.01
7.5.3.1.2	Inspect and clean vessel		3			Hydraulical	Huisman	331.01.02.02.01
Accumulators								
7.5.3.2.1	Check nitrogen pressure of piston accumulator		1			Hydraulical	Huisman	331.01.02.02.02.01.01
7.5.3.2.2	Check nitrogen pressure of bladder accumulator		1			Hydraulical	Huisman	331.01.02.02.02.02 331.01.02.02.02.03
7.5.3.2.3	Inspect and clean accumulator		3			Hydraulical	Huisman	331.01.02.02.02.01.01 331.01.02.02.02.02 331.01.02.02.02.03
Pressure intensifier								
7.5.3.3.1	Clean cylinder rod and seal		1			Hydraulical	Huisman	331.01.02.02.02.01.02
7.5.3.3.2	Inspect cylinder		6			Hydraulical	Huisman	331.01.02.02.02.01.02
7.5.3.3.3	Perform the functional test of the cylinder		1			Hydraulical	Huisman	331.01.02.02.02.01.02
Valves and filters								
7.5.3.4.1	Inspect and clean manifold		6			Hydraulical	Huisman	331.01.02.02.02.04.01 331.01.02.02.02.04.02 331.01.02.02.02.04.03 331.01.02.02.02.04.04
7.5.3.4.2	Inspect cables and connections of manifold		6			Hydraulical	Huisman	331.01.02.02.02.04.01 331.01.02.02.02.04.02 331.01.02.02.02.04.03 331.01.02.02.02.04.04
7.5.3.4.3	Test pressure relief valve			5		Hydraulical	Huisman	331.01.02.02.02.04.02 331.01.02.02.02.04.03 331.01.02.02.02.04.04
Hydraulic pipes and hoses								
7.5.3.5.1	Inspect and clean hydraulic pipes and hoses		3			Hydraulical	Huisman	331.01.02.01.02.07
7.5.3.5.2	Replace hydraulic hoses			5		Hydraulical	Huisman	331.01.02.01.02.07
Emergency stop system								
7.5.3.6.1	Inspect and test functioning of emergency stop system		1			Electrical	Huisman	331.01.02.01.03.01
Cables and connections								
7.5.3.7.1	Inspect cables and connections			1		Electrical	Huisman	331.01.02.01.03.02
Structure								
7.5.3.8.1	Inspect and clean PVU frame, PVU top frame and PIU frame			1		Mechanical	Huisman	331.01.02.02.04

Table 7-4: Maintenance schedule PVU

7.5.3.1 Vessels

This section describes all maintenance tasks for the vessels of the PVU.

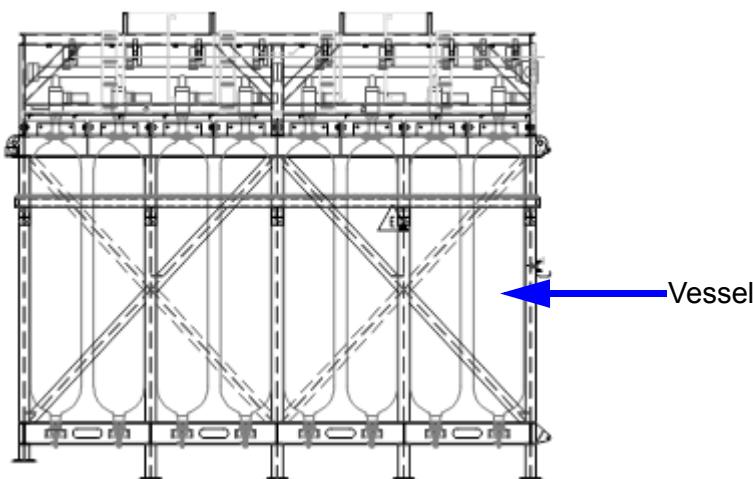


Figure 7-16: Vessel.

7.5.3.1.1 Check nitrogen pressure of vessel

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- Supplier doc.

Description	Location	Reference	Symbol code	Qty.
Vessel	HPU Room	A11-41810-80-0308	1Z060A	1
Vessel	HPU Room	A11-41810-80-0308	1Z060B	1
Vessel	HPU Room	A11-41810-80-0308	2Z060A	1
Vessel	HPU Room	A11-41810-80-0308	2Z060B	1
Vessel	HPU Room	A11-41810-80-0308	3Z060A	1
Vessel	HPU Room	A11-41810-80-0308	3Z060B	1
Vessel	HPU Room	A11-41810-80-0308	4Z060A	1
Vessel	HPU Room	A11-41810-80-0308	4Z060B	1
Vessel	HPU Room	A11-41810-80-0308	5Z060A	1
Vessel	HPU Room	A11-41810-80-0308	5Z060B	1
Vessel	HPU Room	A11-41810-80-0308	6Z060A	1
Vessel	HPU Room	A11-41810-80-0308	6Z060B	1
Vessel	HPU Room	A11-41810-80-0308	7Z060A	1
Vessel	HPU Room	A11-41810-80-0308	7Z060B	1
Vessel	HPU Room	A11-41810-80-0308	8Z060A	1

Description	Location	Reference	Symbol code	Qty.
Vessel	HPU Room	A11-41810-80-0308	8Z060B	1

1. Cut off the vessel by closing the ball valve (V010) on the vessel manifold.
2. De-pressurize the vessel with the drain spindle.

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

3. Check the PVU vessel nitrogen pressure: $P_o = 330$ bar.
 - If necessary refill the vessel with nitrogen.
4. Check for internal leakage of the vessel.
 - If internal leakage is found, replace the vessel.
5. Make sure the vessel is pressurized and the ball valve is opened after checking or refilling the nitrogen pressure of the vessel.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
2003556	Hydac Nitrogen filling set	1

Spare parts

P/N	Part	Symbol code
10013672A	Vessel	1Z060A, 1Z060B, 2Z060A, 2Z060B, 3Z060A, 3Z060B, 4Z060A, 4Z060B, 5Z060A, 5Z060B, 6Z060A, 6Z060B, 7Z060A, 7Z060B, 8Z060A, 8Z060B

7.5.3.1.2 Inspect and clean vessel

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Vessel	HPU Room	A11-41810-80-0308	1Z060A	1
Vessel	HPU Room	A11-41810-80-0308	1Z060B	1

Description	Location	Reference	Symbol code	Qty.
Vessel	HPU Room	A11-41810-80-0308	2Z060A	1
Vessel	HPU Room	A11-41810-80-0308	2Z060B	1
Vessel	HPU Room	A11-41810-80-0308	3Z060A	1
Vessel	HPU Room	A11-41810-80-0308	3Z060B	1
Vessel	HPU Room	A11-41810-80-0308	4Z060A	1
Vessel	HPU Room	A11-41810-80-0308	4Z060B	1
Vessel	HPU Room	A11-41810-80-0308	5Z060A	1
Vessel	HPU Room	A11-41810-80-0308	5Z060B	1
Vessel	HPU Room	A11-41810-80-0308	6Z060A	1
Vessel	HPU Room	A11-41810-80-0308	6Z060B	1
Vessel	HPU Room	A11-41810-80-0308	7Z060A	1
Vessel	HPU Room	A11-41810-80-0308	7Z060B	1
Vessel	HPU Room	A11-41810-80-0308	8Z060A	1
Vessel	HPU Room	A11-41810-80-0308	8Z060B	1

1. Clean the exterior of the vessel using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace vessel.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification.
3. Check paint of vessel.
 - If the paint is damaged, repaint the area according to the paint specification.
4. Check for external leakage of the vessel.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

Spare parts

P/N	Part	Symbol code
10013672A	Vessel	1Z060A, 1Z060B, 2Z060A, 2Z060B, 3Z060A, 3Z060B, 4Z060A, 4Z060B, 5Z060A, 5Z060B, 6Z060A, 6Z060B, 7Z060A, 7Z060B, 8Z060A, 8Z060B

7.5.3.2 Accumulators

This section describes all maintenance tasks for the accumulators of the PVU.

7.5.3.2.1 Check nitrogen pressure of piston accumulator

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- Hydac - SK210_350PistonMaint

Description	Location	Reference	Symbol code	Qty.
Accumulator (piston)	HPU Room	A11-41810-80-0308	Z240	1

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

1. Check the accumulator nitrogen pressure: $P_o = 1$ bar.
 - If necessary refill the accumulator with nitrogen.
2. Check for internal leakage of the accumulator.
 - If internal leakage is found, replace the accumulator.
3. Make sure the accumulator is pressurized after checking or refilling the nitrogen pressure of the accumulator.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
2003556	Hydac Nitrogen filling set	1

Spare parts

P/N	Part	Symbol code
2033935	Accumulator (piston)	Z240

7.5.3.2.2 Check nitrogen pressure of bladder accumulator

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- Hydac - Universal Charging and Testing Unit FPU-1
- Hydac - Hydraulic Bladder Accumulator

Description	Location	Reference	Symbol code	Qty.
Pilot pressure accumulator (bladder)	HPU Room	A11-41810-80-0308	Z250	1
Pressure line accumulator (bladder)	HPU Room	A11-41810-80-0308	Z252	1

1. De-pressurize the pressure line separator accumulator (Z252) as follows:
 - a) Enable valves V207 to bleed pressure out of the bottom side.
 - b) Shut off the hydraulic power by closing the ball valve on the accu safety and shut-off block (V253).
 - c) Measure the rest hydraulic pressure through the port M1.
 - d) Let the hydraulic fluid out through the port M1..

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

2. Check the accumulator nitrogen pressure: $P_0 = 110$ bar.
 - If necessary refill the accumulator with nitrogen.
3. Check for internal leakage of the accumulator.
 - If internal leakage is found, replace the accumulator.
4. Make sure the accumulator is pressurized and the ball valve V253 is opened after checking or refilling the nitrogen pressure of the accumulator.

For more information, see the supplier documentation.

1. De-pressurize the pilot pressure accumulator (Z250) as follows:
 - a) Enable valves V207 to bleed pressure out of the bottom side.
 - b) Shut off the hydraulic power by closing the ball valve on the accu safety and shut-off block (V251).
 - c) Measure the rest hydraulic pressure through the port M1.

d) Let the hydraulic fluid out through the port M1.

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

2. Check the accumulator nitrogen pressure: $P_o = 225\text{bar}$.
 - If necessary refill the accumulator with nitrogen.
3. Check for internal leakage of the accumulator.
 - If internal leakage is found, replace the accumulator.
4. Make sure the accumulator is pressurized and the ball valve V251 is opened after checking or refilling the nitrogen pressure of the accumulator.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
2003556	Hydac Nitrogen filling set	1

Spare parts

P/N	Part	Symbol code
2013306	Accumulator (bladder)	Z250
2009502	Accumulator (bladder)	Z252

7.5.3.2.3 Inspect and clean accumulator

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- [A11-41000-09-002](#): Paint specification
- Hydac - Universal Charging and Testing Unit FPU-1
- Hydac - Hydraulic Bladder Accumulator
- Hydac - SK210_350PistonMaint

Description	Location	Reference	Symbol code	Qty.
Accumulator (piston)	HPU Room	A11-41810-80-0308	Z240	1
Pilot pressure accumulator (bladder)	HPU Room	A11-41810-80-0308	Z250	1
Pressure line accumulator (bladder)	HPU Room	A11-41810-80-0308	Z252	1

1. Clean the exterior of the accumulator using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace accumulator.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of accumulator.
 - If the paint is damaged, repaint the area according to the paint specification.
4. Check accumulator clamp.
 - If necessary repair/ replace the accumulator clamp.
5. Check for external leakage of the accumulator.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2033935	Accumulator (piston)	Z240
2013306	Accumulator (bladder)	Z250
2009502	Accumulator (bladder)	Z252
2003947	Accu console	Z248A, Z248B
2045143	Clamp	Z241
2003946	Clamp	Z249A, Z249B

7.5.3.3 Pressure intensifier

This section describes all maintenance tasks for the pressure intensifier of the PVU.

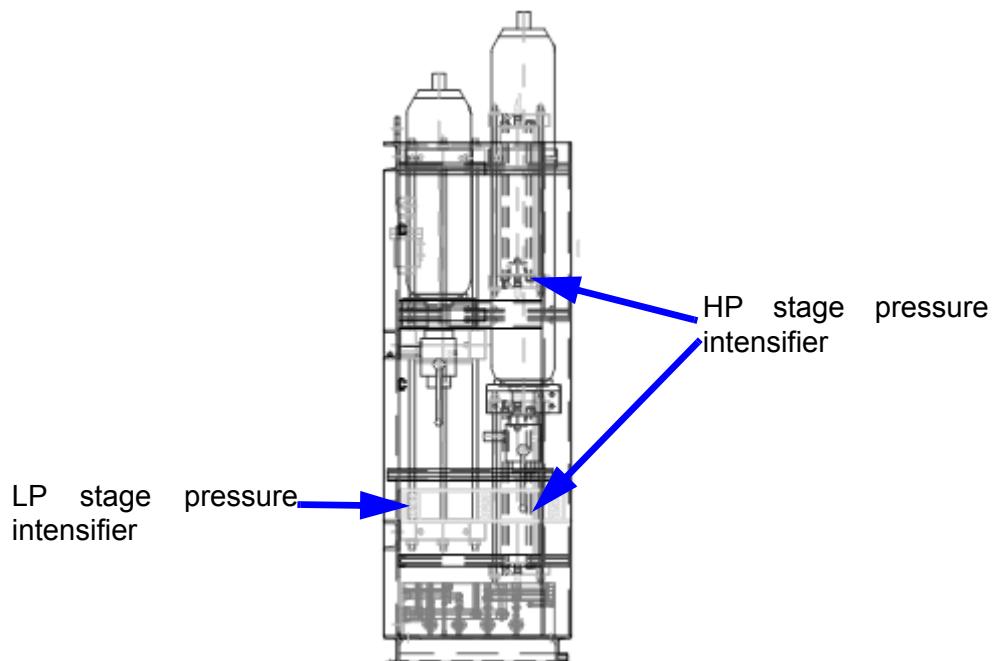


Figure 7-17: Overview location cylinder

7.5.3.3.1 Clean cylinder rod and seal

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- supplier doc.

Description	Location	Reference	Symbol code	Qty.
LP stage pressure intensifier	HPU room	A11-41810-80-0308	Z301	1
HP stage pressure intensifier	HPU room	A11-41810-80-0308	Z302A	1
HP stage pressure intensifier	HPU room	A11-41810-80-0308	Z302B	1

1. Fully extend the cylinder.
2. Clean the rod and the seal using a cloth.

NOTE Pay special attention to the rod seal, dirt on the rod seal will easily enter the cylinder and pollute the hydraulic system.

3. Fully retract the cylinder.

For more information, see the supplier documentation.

7.5.3.3.2 Inspect cylinder

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
LP stage pressure intensifier	HPU room	A11-41810-80-0308	Z301	1
HP stage pressure intensifier	HPU room	A11-41810-80-0308	Z302A	1
HP stage pressure intensifier	HPU room	A11-41810-80-0308	Z302B	1

1. Clean cylinder exterior using a cloth.
2. Check cylinder exterior for damage, corrosion and paint quality.
 - If exterior damage is found, repair or replace the cylinder.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check the cylinder rod for “running tracks” or damage. For this fully extract the rod.

NOTE *Running tracks can be an indication of a contaminated hydraulic system.*

- If the rod is damaged replace the cylinder.
 - If the coating is damaged, repair the coating or replace the cylinder.
4. Check tube seal for leakage.
 - If leakage from the seal is found, replace the seal.
 5. Check cylinder hydraulic connections and hose tails for damage and corrosion.
 - If a coupling is damaged or corroded, replace the coupling.
 - If a hose tail is damaged or corroded, replace the hose.
 6. Check the counter balance valves for leakage, corrosion, structural damage and proper mounting.
 - If a counterbalance valve contains damages or corrosions, replace the valve.
 - If a counterbalance valve leaks, replace the seal or the valve.
 - If a counterbalance valve is loose, tighten the counterbalance valve. Then repaint the bolts, according to the paint specification.
 7. Check the line mount body of the counterbalance valve for damage.
 - If the line mount body is damaged, replace the line mount body.
 8. Check mounting of cylinder.
 - If loose bolts are found, remount the cylinder.

Spare parts

P/N	Part	Symbol code
10000189A	LP stage pressure intensifier	Z301
10000190A	HP stage pressure intensifier	Z302A, Z302B
On request	Seal set	-

7.5.3.3.3 Perform the functional test of the cylinder

Reference documents:

-  [A11-41810-80-0308](#): Hydraulic diagram PVU

Description	Location	Reference	Symbol code	Qty.
LP stage pressure intensifier	HPU room	A11-41810-80-0308	Z301	1
HP stage pressure intensifier	HPU room	A11-41810-80-0308	Z302A	1
HP stage pressure intensifier	HPU room	A11-41810-80-0308	Z302B	1

1. Operate the cylinder in both directions.
 - If a problem is found, repair or replace the failed component.

Spare parts

P/N	Part	Symbol code
10000189A	LP stage pressure intensifier	Z301
10000190A	HP stage pressure intensifier	Z302A, Z302B
On request	Seal set	-

7.5.3.4 Valves and filters

This section describes all maintenance tasks for the hydraulic valves and filters of the PVU.

7.5.3.4.1 Inspect and clean manifold

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Manifold	On PVU frame	A11-41810-80-0308	M005A	1
Manifold PIU	On PIU	A11-41810-80-0308	M201A	1
Vessel Manifold	On vessel 1Z060A	A11-41810-80-0308	1M001A	1
Vessel Manifold	On vessel 1Z060B	A11-41810-80-0308	1M001B	1
Vessel Manifold	On vessel 2Z060A	A11-41810-80-0308	2M001A	1
Vessel Manifold	On vessel 2Z060B	A11-41810-80-0308	2M001B	1
Vessel Manifold	On vessel 3Z060A	A11-41810-80-0308	3M001A	1
Vessel Manifold	On vessel 3Z060B	A11-41810-80-0308	3M001B	1
Vessel Manifold	On vessel 4Z060A	A11-41810-80-0308	4M001A	1
Vessel Manifold	On vessel 4Z060B	A11-41810-80-0308	4M001B	1
Vessel Manifold	On vessel 5Z060A	A11-41810-80-0308	5M001A	1
Vessel Manifold	On vessel 5Z060B	A11-41810-80-0308	5M001B	1
Vessel Manifold	On vessel 6Z060A	A11-41810-80-0308	6M001A	1
Vessel Manifold	On vessel 6Z060B	A11-41810-80-0308	6M001B	1
Vessel Manifold	On vessel 7Z060A	A11-41810-80-0308	7M001A	1
Vessel Manifold	On vessel 7Z060B	A11-41810-80-0308	7M001B	1
Vessel Manifold	On vessel 8Z060A	A11-41810-80-0308	8M001A	1
Vessel Manifold	On vessel 8Z060B	A11-41810-80-0308	8M001B	1
Pressure vessel set manifold	On PVU frame between PV 1A and 1B	A11-41810-80-0308	1M022	1
Pressure vessel set manifold	On PVU frame between PV 2A and 2B	A11-41810-80-0308	2M022	1
Pressure vessel set manifold	On PVU frame between PV 3A and 3B	A11-41810-80-0308	3M022	1
Pressure vessel set manifold	On PVU frame between PV 4A and 4B	A11-41810-80-0308	4M022	1
Pressure vessel set manifold	On PVU frame between PV 5A and 5B	A11-41810-80-0308	5M022	1
Pressure vessel set manifold	On PVU frame between PV 6A and 6B	A11-41810-80-0308	6M022	1
Pressure vessel set manifold	On PVU frame between PV 7A and 7B	A11-41810-80-0308	7M022	1

Description	Location	Reference	Symbol code	Qty.
Pressure vessel set manifold	On PVU frame between PV 8A and 8B	A11-41810-80-0308	8M022	1
Pressure vessel set manifold	On PVU frame between PV 8A and 8B	A11-41810-80-0308	9M022	1

1. Clean the exterior of the manifold using a cloth.
2. Inspect the exterior of the manifold for corrosion and damage.
 - If significant damage is found, replace the component.
 - If significant corrosion is found, replace the component and repaint the area, according to the paint specification.
3. Inspect manifold for oil leakage.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.
4. Check the proper mounting of components.
 - If components are loose, tighten the loose components.

Spare parts

P/N	Part	Symbol code
On request	Manifold	M005A
2026914	Manifold PIU	M201A
On request	Vessel manifold	1M001A, 1M001B, 2M001A, 2M001B, 3M001A, 3M001B, 4M001A, 4M001B, 5M001A, 5M001B, 6M001A, 6M001B, 7M001A, 7M001B, 8M001A, 8M001B
2013337	Pressure vessel set manifold	1M022, 2M022, 3M022, 4M022, 5M022, 6M022, 7M022, 8M022, 9M022

7.5.3.4.2 Inspect cables and connections of manifold

Reference documents:

- [A11-41810-80-0308](#): Hydraulic diagram PVU
- Siemens manual

Description	Location	Reference	Symbol code	Qty.
Manifold	On PVU frame	A11-41810-80-0308	M005A	1
Manifold PIU	On PIU	A11-41810-80-0308	M201A	1

Description	Location	Reference	Symbol code	Qty.
Vessel Manifold	On vessel 1Z060A	A11-41810-80-0308	1M001A	1
Vessel Manifold	On vessel 1Z060B	A11-41810-80-0308	1M001B	1
Vessel Manifold	On vessel 2Z060A	A11-41810-80-0308	2M001A	1
Vessel Manifold	On vessel 2Z060B	A11-41810-80-0308	2M001B	1
Vessel Manifold	On vessel 3Z060A	A11-41810-80-0308	3M001A	1
Vessel Manifold	On vessel 3Z060B	A11-41810-80-0308	3M001B	1
Vessel Manifold	On vessel 4Z060A	A11-41810-80-0308	4M001A	1
Vessel Manifold	On vessel 4Z060B	A11-41810-80-0308	4M001B	1
Vessel Manifold	On vessel 5Z060A	A11-41810-80-0308	5M001A	1
Vessel Manifold	On vessel 5Z060B	A11-41810-80-0308	5M001B	1
Vessel Manifold	On vessel 6Z060A	A11-41810-80-0308	6M001A	1
Vessel Manifold	On vessel 6Z060B	A11-41810-80-0308	6M001B	1
Vessel Manifold	On vessel 7Z060A	A11-41810-80-0308	7M001A	1
Vessel Manifold	On vessel 7Z060B	A11-41810-80-0308	7M001B	1
Vessel Manifold	On vessel 8Z060A	A11-41810-80-0308	8M001A	1
Vessel Manifold	On vessel 8Z060B	A11-41810-80-0308	8M001B	1
Pressure vessel set manifold	On PVU frame between PV 1A and 1B	A11-41810-80-0308	1M022	1
Pressure vessel set manifold	On PVU frame between PV 2A and 2B	A11-41810-80-0308	2M022	1
Pressure vessel set manifold	On PVU frame between PV 3A and 3B	A11-41810-80-0308	3M022	1
Pressure vessel set manifold	On PVU frame between PV 4A and 4B	A11-41810-80-0308	4M022	1
Pressure vessel set manifold	On PVU frame between PV 5A and 5B	A11-41810-80-0308	5M022	1
Pressure vessel set manifold	On PVU frame between PV 6A and 6B	A11-41810-80-0308	6M022	1
Pressure vessel set manifold	On PVU frame between PV 7A and 7B	A11-41810-80-0308	7M022	1
Pressure vessel set manifold	On PVU frame between PV 8A and 8B	A11-41810-80-0308	8M022	1
Pressure vessel set manifold	On PVU frame between PV 8A and 8B	A11-41810-80-0308	9M022	1

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cables ties.
3. Check connection, tighten connections and check sheaths for damage and/or corrosion. When a torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose connection.
 - If a cable sheath is damaged or corroded, repair/replace the cable sheaths.

7.5.3.4.3 Test pressure relief valve

Reference documents:

 [A11-41810-80-0308](#) Hydraulic diagram PVU

Description	Location	Reference	Symbol code	Qty.
Equalizer valve	PIU Manifold	A11-41810-80-0308	V210	1
Separator valve	Vessel manifold 1M001A	A11-41810-80-0308	1V010A	1
Separator valve	Vessel manifold 1M001B	A11-41810-80-0308	1V010B	1
Separator valve	Vessel manifold 2M001A	A11-41810-80-0308	2V010A	1
Separator valve	Vessel manifold 2M001B	A11-41810-80-0308	2V010B	1
Separator valve	Vessel manifold 3M001A	A11-41810-80-0308	3V010A	1
Separator valve	Vessel manifold 3M001B	A11-41810-80-0308	3V010B	1
Separator valve	Vessel manifold 4M001A	A11-41810-80-0308	4V010A	1
Separator valve	Vessel manifold 4M001B	A11-41810-80-0308	4V010B	1
Separator valve	Vessel manifold 5M001A	A11-41810-80-0308	5V010A	1
Separator valve	Vessel manifold 5M001B	A11-41810-80-0308	5V010B	1
Separator valve	Vessel manifold 6M001A	A11-41810-80-0308	6V010A	1
Separator valve	Vessel manifold 6M001B	A11-41810-80-0308	6V010B	1
Separator valve	Vessel manifold 7M001A	A11-41810-80-0308	7V010A	1
Separator valve	Vessel manifold 7M001B	A11-41810-80-0308	7V010B	1

Description	Location	Reference	Symbol code	Qty.
Separator valve	Vessel manifold 8M001A	A11-41810-80-0308	8V010A	1
Separator valve	Vessel manifold 8M001B	A11-41810-80-0308	8V010B	1
HP-line valve	On pressure vessel set manifold 1M022	A11-41810-80-0308	1V021A	1
HP-line valve	On pressure vessel set manifold 2M022	A11-41810-80-0308	2V021A	1
HP-line valve	On pressure vessel set manifold 3M022	A11-41810-80-0308	3V021A	1
HP-line valve	On pressure vessel set manifold 4M022	A11-41810-80-0308	4V021A	1
HP-line valve	On pressure vessel set manifold 5M022	A11-41810-80-0308	5V021A	1
HP-line valve	On pressure vessel set manifold 6M022	A11-41810-80-0308	6V021A	1
HP-line valve	On pressure vessel set manifold 7M022	A11-41810-80-0308	7V021A	1
HP-line valve	On pressure vessel set manifold 8M022	A11-41810-80-0308	8V021A	1
HP-line valve	On pressure vessel set manifold 9M022	A11-41810-80-0308	9V021A	1
LP-line valve	On pressure vessel set manifold 1M022	A11-41810-80-0308	1V021B	1
LP-line valve	On pressure vessel set manifold 2M022	A11-41810-80-0308	2V021B	1
LP-line valve	On pressure vessel set manifold 3M022	A11-41810-80-0308	3V021B	1
LP-line valve	On pressure vessel set manifold 4M022	A11-41810-80-0308	4V021B	1
LP-line valve	On pressure vessel set manifold 5M022	A11-41810-80-0308	5V021B	1
LP-line valve	On pressure vessel set manifold 6M022	A11-41810-80-0308	6V021B	1
LP-line valve	On pressure vessel set manifold 7M022	A11-41810-80-0308	7V021B	1
LP-line valve	On pressure vessel set manifold 8M022	A11-41810-80-0308	8V021B	1
LP-line valve	On pressure vessel set manifold 9M022	A11-41810-80-0308	9V021B	1

1. Isolate the pressure relief valve from the system and remove it from the system.

2. Test the pressure relief valve at a test bench. Test if the pressure is relieved after the test pressure is applied (see A11-41810-80-030)..

NOTE When removing and placing back the pressure relief valve follow the procedure prescribed in section [7.3.12](#).

- If necessary re-calibrate the pressure relief valve and re-test the pressure relief valve. When re-calibration does make the pressure relief valve open after the test pressure is applied, replace the pressure relief valve.

3. Place the pressure relief valve back into the system and restore the system.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2006317	Equalizer valve	V210
2036041	Separator valve	1V010A, 1V010B, 2V010A, 2V010B, 3V010A, 3V010B, 4V010A, 4V010B, 5V010A, 5V010B, 6V010A, 6V010B, 7V010A, 7V010B, 8V010A, 8V010B
2011804	Directional valve	1V021A, 1V021B, 2V021A, 2V021B, 3V021A, 3V021B, 4V021A, 4V021B, 5V021A, 5V021B, 6V021A, 6V021B, 7V021A, 7V021B, 8V021A, 8V021B, 9V021A, 9V021B

7.5.3.5 Hydraulic pipes and hoses

This section describes all maintenance tasks for the hydraulic pipes and hoses of the PVU.

7.5.3.5.1 Inspect and clean hydraulic pipes and hoses

:

Description	Location	Reference	Symbol code	Qty.
Hydraulic pipes	PVU	-	-	-

For inspecting the hydraulic pipes.

1. Clean pipes and couplings.

2. Inspect pipes and couplings for damage and corrosion/paint damage

NOTE Pay special attention to corrosion around the brackets of the pipe.

- If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification. When this is not possible replace the pipe.
- If the paint is damaged, repaint the area according to the Paint Specification.

3. Inspect hydraulic pipes and couplings for oil leakage.

- If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

For inspecting the hydraulic hoses.

1. Clean hydraulic hoses.
2. Inspect the hydraulic hoses for cracks or other damage.
 - If a hydraulic hose is damaged, replace the hoses..
3. Inspect the hose end connections for damage, corrosion and/or leakage.
 - If a hose end connection is damaged and/or corroded, investigate the cause and repair/replace the failed component.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.
4. Inspect tightness of hose ties.
 - If a hydraulic hose is not properly tightened, replace the hose ties.

7.5.3.5.2 Replace hydraulic hoses

:

Description	Location	Reference	Symbol code	Qty.
Hydraulic hoses	PVU	-	-	-

1. Isolate the hydraulic hose.
2. Replace the hydraulic hose.
3. Restore the hydraulic system.

7.5.3.6 Emergency stop system

This section describes all maintenance tasks for the emergency stop system of the PVU.

7.5.3.6.1 Inspect and test functioning of emergency stop system

Reference documents:

- [10013281A](#) Electrical diagram
- [A11-41810-88-0008](#): PVU Arrangement
- Schneider - Emergency push button

Description	Location	Reference	Symbol code	Qty.
Emergency stop button 1	PVU	Electrical diagram (+P01)	-062S2	1
Emergency stop button 2	PVU	Electrical diagram (+P01)	-062S2-1	1

NOTE The frequency for this task given in the maintenance schedule is an indication. The user is to determine the periodic schedule based on the severity of the operating environment and the frequency of switch actuation.

1. Check the emergency stop push button for damage, button looseness and excessive environmental contamination.
 - If damage is found, replace the damaged component.
 - If components are loose, tighten the loose components.
 - If dirt is found at the push button, clean the push button.
2. Push an emergency stop button.
3. Check if the push button relay -060K11 and the emergency stop slave relay -060K12 reacts.

WARNING  *The emergency safety relay that continuously monitors the state of its inputs. When an emergency stop push button is activated, the relay will directly de-activate its direct contacts. After an adjustable time (typical is 1 second) the relay will de-activate its time-delayed outputs.*

- If the relays not react correctly, replace the relay.
4. Check if SCADA gives an emergency alarm and shuts down the system.
 - If no alarm is generated and/or the system does not shut down, investigate the cause and repair/replace the failed component.
5. Reset the emergency stop button.
6. Reset the alarm in SCADA.

WARNING



Always test the emergency stop system for proper functioning under machine control conditions after performing maintenance.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Pushbutton enclosed E-stop	-062S2-1
2001638	Emergency pushbutton Mushroomhead	-062S2
2007867	Switch block screw conn. 1NC	-062S2-1

7.5.3.7 Cables and connections

This section describes all maintenance tasks for the cables and connections of the PVU.

7.5.3.7.1 Inspect cables and connections

:

Description	Location	Reference	Symbol code	Qty.
Cables	PVU	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correct tightened, replace the tag, according the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

NOTE Handle the fibre optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibres with bare hands as the fibre is extremely sensitive to dirt.

7.5.3.8 Structure

This section describes all maintenance tasks for the structure of the PVU.

7.5.3.8.1 Inspect and clean PVU frame, PVU top frame and PIU frame

Reference documents:

- [A11-41810-88-0108](#): PVU frame
- [A11-41810-88-0208](#): PIU frame
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
PVU frame	PVU	A11-41810-88-0108	-	1
PVU top frame	PVU	A11-41810-88-0108	-	1
PIU frame	PVU	A11-41810-88-0208	-	1

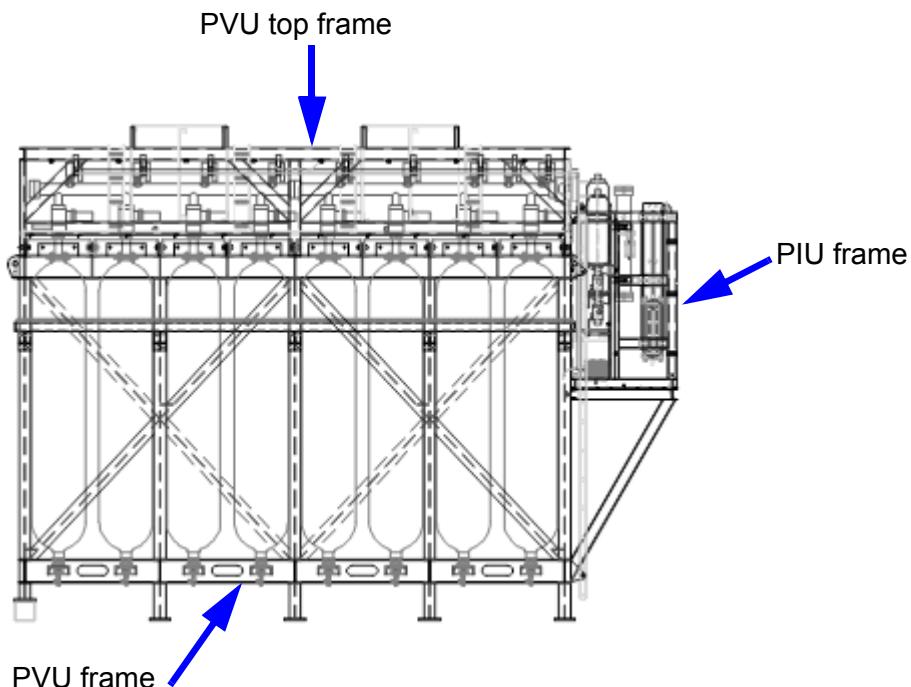


Figure 7-18: Hydraulical reservoir.

1. Clean the PVU frame, PVU top frame and PIU frame using a cloth.
2. Visual check the PVU frame, PVU top frame and PIU frame for cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the frame or top frame.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.

3. Check paint of PVU frame, PVU top frame and PIU frame.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the PVU frame, PVU top frame and PIU frame.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

7.5.4 SLEWING SYSTEM MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Gearbox								
7.5.4.1.1	Check bolt connections				1000	Mechanical	Huisman	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
7.5.4.1.2	Check leakage of gearbox and oil level	1				Mechanical	Huisman	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
7.5.4.1.3	Inspect and clean exterior of gearbox		3			Mechanical	Huisman	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
7.5.4.1.4	Perform oil analysis		3			Mechanical	Huisman	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
7.5.4.1.5	Replace the gearbox oil			1	1st 200, 2nd 1000 Further every 2000	Mechanical	Siebenhaar	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
7.5.4.1.6	Check pinion wear		6			Mechanical	Huisman	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
7.5.4.1.7	Check shafts			1		Mechanical	Siebenhaar	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
7.5.4.1.8	Perform vibration analysis for gearbox			1		Mechanical	Huisman	331.01.03.01.01.01 331.01.03.01.02.01 331.01.03.01.03.01 331.01.03.01.04.01
E-motor								
7.5.4.2.1	Perform SPM analysis for E-motor		3			Mechanical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
7.5.4.2.2	Inspect and clean E-motor exterior		3			Electrical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
7.5.4.2.3	Test standstill heating of E-motor		3			Electrical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
7.5.4.2.4	Test thermistor of E-motor		6			Electrical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
7.5.4.2.5	Perform thermal imaging analysis for E-motor			1		Electrical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
7.5.4.2.6	Measure insulation resistance of E-motor and cables and continuity resistance of each winding			1		Electrical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
7.5.4.2.7	Empty condensation drain holes of E-motor			1		Electrical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02

Table 7-5: Maintenance schedule Slewing system

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.4.2.8	Replace bearings of E-motor			5		Electrical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
7.5.4.2.9	Grease bearings of E-motor					Mechanical	Huisman	331.01.03.01.01.02 331.01.03.01.02.02 331.01.03.01.03.02 331.01.03.01.04.02
E-motor brake								
7.5.4.3.1	Perform automatic E-motor brake test		1			Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
7.5.4.3.2	Measure E-motor brake air gap		3			Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
7.5.4.3.3	Inspect and clean E-motor brake exterior		3			Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
7.5.4.3.4	Measure insulation resistance of E-motor brake cables			1		Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
7.5.4.3.5	Measure resistance of E-motor brake coil			1		Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
7.5.4.3.6	Test heating of E-motor brake			1		Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
7.5.4.3.7	Drain condensation water from E-motor brake			1		Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
7.5.4.3.8	Clean E-motor brake interior			1		Electrical	Huisman	331.01.03.01.01.03 331.01.03.01.02.03 331.01.03.01.03.03 331.01.03.01.04.03
Cables and connections								
7.5.4.4.1	Inspect cables and connections			1		Electrical	Huisman	331.01.03.03.02
Slew bearings								
7.5.4.5.1	Check bolt connections				1000	Mechanical	Huisman	331.01.03.04.02.01 331.01.03.04.03.01
7.5.4.5.2	Grease slew bearing teeth				50	Mechanical	Huisman	331.01.03.04.02
7.5.4.5.3	Grease lower slew bearing rollers				50	Mechanical	Huisman	331.01.03.04.02
7.5.4.5.4	Grease upper slew bearing rollers				50	Mechanical	Huisman	331.01.03.04.03
7.5.4.5.5	Inspect pretension of slew bolts		6			Mechanical	Huisman	331.01.03.04.02 331.01.03.04.03
7.5.4.5.6	Visual inspect and clean slew bearing		6			Mechanical	Huisman	331.01.03.04.02 331.01.03.04.03
7.5.4.5.7	Take grease sample from slew bearing			1		Mechanical	Huisman	331.01.03.04.02 331.01.03.04.03

Table 7-5: Maintenance schedule Slewing system

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.4.5.8	Replace slewing ring bolts			1		Mechanical	Huisman	331.01.03.04.02 331.01.03.04.03

Table 7-5: Maintenance schedule Slewing system

7.5.4.1 Gearbox

This section described all maintenance tasks for the gearbox of slewing system.

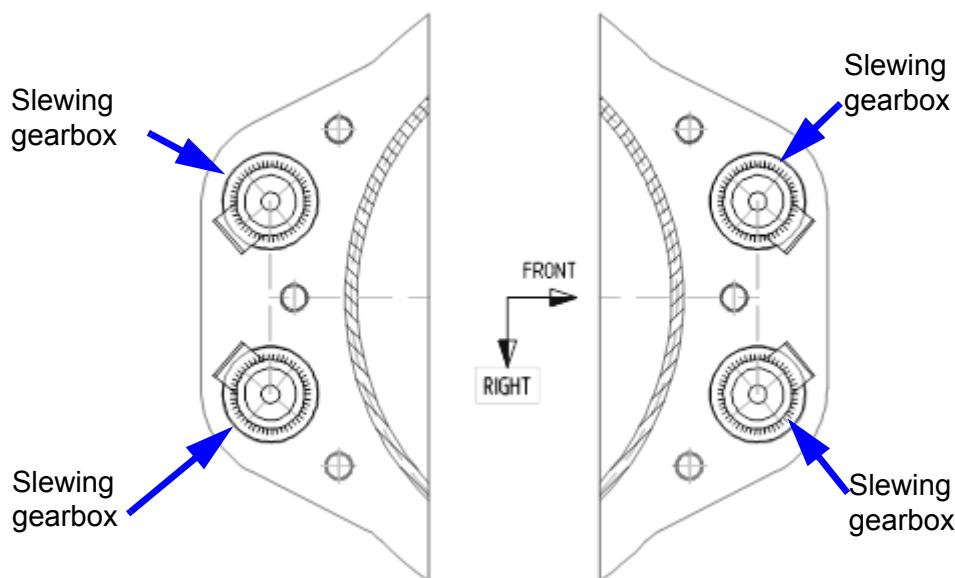


Figure 7-19: Overview gearbox location.

7.5.4.1.1 Check bolt connections

Reference documents

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41000-09-002](#): Paint Specification
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Check torque of the bolts according to the drawing A11-41800-22-0108.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque according to drawing A11-41800-22-0108 and "Tightening torques for screws" in supplier documentation, and repaint according to paint specification.
2. Check the flange holes and the bolts for wear.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information see supplier documentation.

7.5.4.1.2 Check leakage of gearbox and oil level

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-00-201](#): Greasing schedule
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Check gearbox exterior and surroundings for oil leakage.
 - If leakage occurs, investigate the cause according to supplier documentation and take appropriate measures to prevent an unsafe situation. Then clean up the leakage.
2. Check the oil level.

NOTE *Make sure the gearbox is in the proper position when checking the oil level.*

- If oil level is too low, refill oil according to the greasing schedule A11-41800-00-201 and supplier documentation.

NOTE *Check the oil level only when the gearbox is stopped!*

NOTE *Do not overfill!*

CAUTION



Do not mix oils of different types, even of the same make!

See supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517	-	-

Spare parts

P/N	Part	Symbol code
10014605A	Slewing gearbox	01
On request	Seal set	-

7.5.4.1.3 Inspect and clean exterior of gearbox

Reference documents

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41000-09-002](#): Paint Specification
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Clean the exterior of the gearbox using a cloth.
2. Visual check the exterior for cracks and corrosion.
 - If cracks are found, replace gearbox.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.
3. Check noise of the gearbox.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.

4. Check paint of gearbox.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check cables of gearbox
 - If a connection is loose, tighten loose components
 - if cable sheathes are damaged or corroded, repair the cable sheathes or replace the cables.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
10014605A	Slewing gearbox	01
On request	Seal set	-

7.5.4.1.4 Perform oil analysis

Reference documents

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Take oil sample.
2. Let a certified third party perform the oil sample analysis for chemical and physical values.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.
3. Let a certified third party perform the oil sample analysis for wear, clearness and water.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517	-	-

Spare parts

P/N	Part	Symbol code
10014605A	Slewing gearbox	01

7.5.4.1.5 Replace the gearbox oil

Reference documents

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-00-201](#): Greasing schedule
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Replace gearbox oil according to greasing schedule A11-41800-00-201. First oil change after 200 motor-hours, second oil change after 1000 motor-hours and further oil changes every 2000 motor-hours or every 12 months.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517	-	55 liters

7.5.4.1.6 Check pinion wear

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Visually check pinion for wear.
 - If the hardened layer is worn out, replace the pinion.
 - If the teeth are significantly worn out in contact places, replace the gearbox or pinion.
2. Inspect pinion teeth surface for damage (pitting).
 - If the surface is not smooth anymore because of pitting, replace the gearbox or pinion and perform an analysis on the grease of the pinion teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
10014605A	Slewing gearbox	01
On request	Pinion	-
On request	Pinion shaft	-
On request	Seal set	-

7.5.4.1.7 Check shafts

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Disassemble the motor and driving unit.

2. Inspect the shafts at the drive side.
 - If there are damages at the shaft, replace the damaged parts.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
10014605A	Slewing gearbox	01
On request	Shaft	-
On request	Seal set	-

7.5.4.1.8 Perform vibration analysis for gearbox

Reference documents:.

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Siebenhaar - Slewing gear instructions

Description	Location	Reference	Symbol code	Qty.
Slewing gearbox	Drive NO.1	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.2	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.3	A11-41800-22-0108	01	1
Slewing gearbox	Drive NO.4	A11-41800-22-0108	01	1

1. Perform measurement.
2. Analyse measurement.
 - If a problem is found, investigate the cause and repair/replace the failed component.

The internal condition of the components needs to be inspected by means of vibration analysis. Huisman recommends this analysis to be executed by a third party that is specialized in vibration analysis, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable vibration meter / analyser	1

Spare parts

P/N	Part	Symbol code
10014605A	Slewing gearbox	01

7.5.4.2 E-motor

This section describes all maintenance tasks for the E-motors of the slewing system.

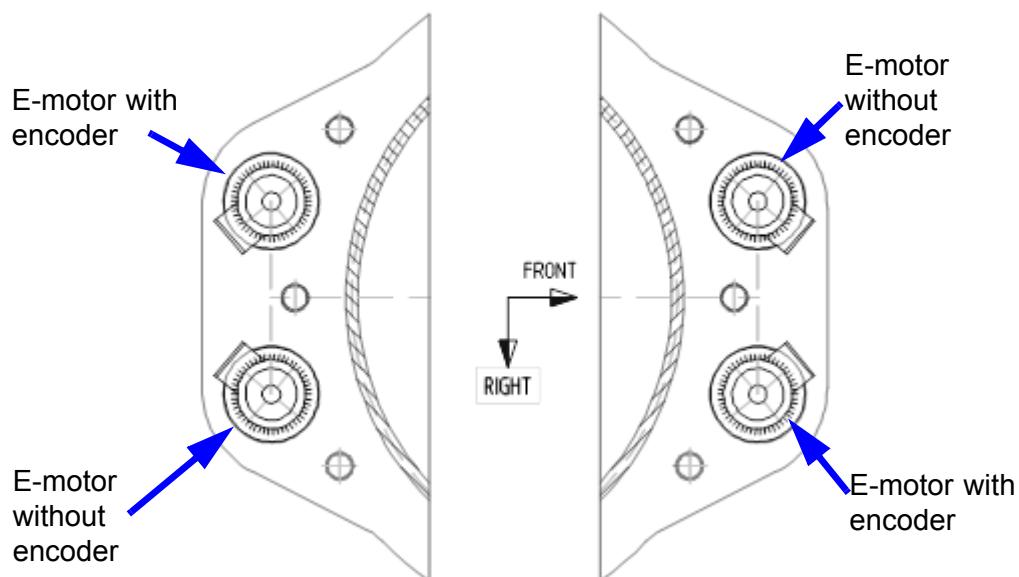


Figure 7-20: E-motor orientation (bottom view).

7.5.4.2.1 Perform SPM analysis for E-motor

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.2	A11-41800-22-0108	902	1
E-motor with encoder	Drive NO.3	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.4	A11-41800-22-0108	902	1

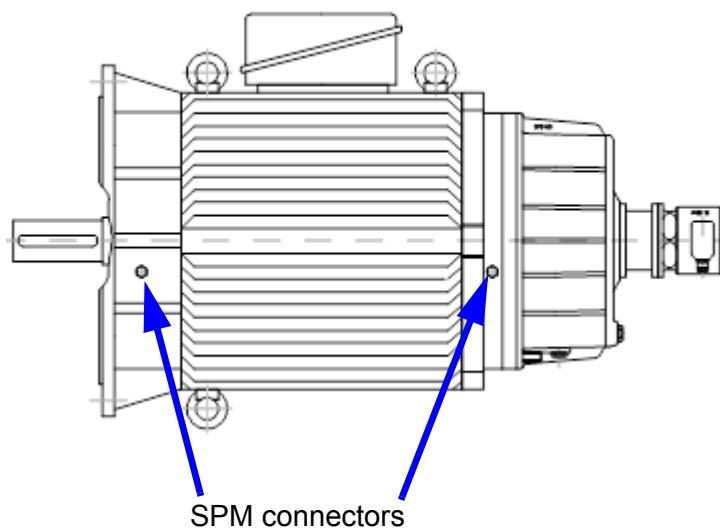


Figure 7-21: SPM points for E-motors.

1. Inspect the E-motor by means of Shock Pulse Measurement (SPM) to monitor the condition of the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the SPM data.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in SPM analysis. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable SPM device	1

Spare parts

P/N	Part	Symbol code
10014627A	E-motor with encoder	901
10014628A	E-motor without encoder	902

7.5.4.2.2 Inspect and clean E-motor exterior

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.2	A11-41800-22-0108	902	1
E-motor with encoder	Drive NO.3	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.4	A11-41800-22-0108	902	1

1. Clean the exterior of the E-motor using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace E-motor.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification.
3. Check paint of E-motor.
 - If the paint is damaged, repaint the area according to the Paint Specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the Paint Specification.
4. Check cables and terminal box(es) of E-motor
 - If a connection is loose, tighten the loose components.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cables.
 - If a terminal box is damaged or corroded, replace the terminal box.
 - If a terminal box suffers from water ingress, replace the terminal box.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014627A	E-motor with encoder	901
10014628A	E-motor without encoder	902
On request	Terminal box of e-motor	-

7.5.4.2.3 Test standstill heating of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	Electrical drawing (+M22)	-200M1	1
E-motor without encoder	Drive NO.2	Electrical drawing (+M22)	-200M2	1
E-motor with encoder	Drive NO.3	Electrical drawing (+M22)	-200M3	1
E-motor without encoder	Drive NO.4	Electrical drawing (+M22)	-200M4	1

1. Test the E-motor heating by measuring the resistance of the heating element.

- If the resistance is zero or infinity, investigate the cause and repair/replace the failed component.
- Make the record of the measured resistance values.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014627A	E-motor with encoder	901
10014628A	E-motor without encoder	902

7.5.4.2.4 Test thermistor of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	Electrical drawing (+M22)	-200M1	1
E-motor without encoder	Drive NO.2	Electrical drawing (+M22)	-200M2	1
E-motor with encoder	Drive NO.3	Electrical drawing (+M22)	-200M3	1
E-motor without encoder	Drive NO.4	Electrical drawing (+M22)	-200M4	1

1. Switch on the e-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Check if the resistance is increasing while running the e-motor.
 - If the resistance is 0, infinity or is not increasing while running the e-motor, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014627A	E-motor with encoder	901
10014628A	E-motor without encoder	902

7.5.4.2.5 Perform thermal imaging analysis for E-motor

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.2	A11-41800-22-0108	902	1
E-motor with encoder	Drive NO.3	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.4	A11-41800-22-0108	902	1

1. Inspect the E-motor by means of thermal imaging to monitor the condition of the E-motor. To perform the task, the E-motor should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the thermal image.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

Spare parts

P/N	Part	Symbol code
10014627A	E-motor with encoder	901
10014628A	E-motor without encoder	902

7.5.4.2.6 Measure insulation resistance of E-motor and cables and continuity resistance of each winding

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.2	A11-41800-22-0108	902	1
E-motor with encoder	Drive NO.3	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.4	A11-41800-22-0108	902	1

For performing this task on the E-motor.

1. Open the cover on e-motor to access windings.
2. Megger test the E-motor windings, to find the winding insulation resistance and the insulation resistance between the coils.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For performing this task on the E-motor cables.

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and

repair/replace the failed component.

For more information, see supplier documentation

CAUTION



Disconnect e-motor from the power source (Inverter) while performing Megger-test!

CAUTION



Windings must be discharged immediately after measuring in order to avoid electric shock.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $690 \text{ k}\Omega$ at the rated voltage of 690 Volts, if measured at 25°C . The insulation resistance reference value is halved for each 20°C increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
10014627A	E-motor with encoder	901
10014628A	E-motor without encoder	902

7.5.4.2.7 Empty condensation drain holes of E-motor

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	A11-41800-22-0108	901	1

Description	Location	Reference	Symbol code	Qty.
E-motor without encoder	Drive NO.2	A11-41800-22-0108	902	1
E-motor with encoder	Drive NO.3	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.4	A11-41800-22-0108	902	1

1. Empty condensation drain holes of E-motor.
2. Clean and check the drain holes of the E-motor and make sure that holes are open and clear.
 - If excessive grease is found, remove the grease.
 - If dirt blocks the drain holes, remove the dirt.

For more information, see the supplier documentation.

7.5.4.2.8 Replace bearings of E-motor

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.2	A11-41800-22-0108	902	1
E-motor with encoder	Drive NO.3	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.4	A11-41800-22-0108	902	1

1. Replace E-motor bearings.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	E-motor bearings		

7.5.4.2.9 Grease bearings of E-motor

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor with encoder	Drive NO.1	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.2	A11-41800-22-0108	902	1
E-motor with encoder	Drive NO.3	A11-41800-22-0108	901	1
E-motor without encoder	Drive NO.4	A11-41800-22-0108	902	1

1. Grease the E-motor bearings.

NOTE Ultrasonic measurement can be used to determine if greasing is necessary.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
On request		

7.5.4.3 E-motor brake

This section describes all maintenance tasks for the E-motor brakes of the slewing system.

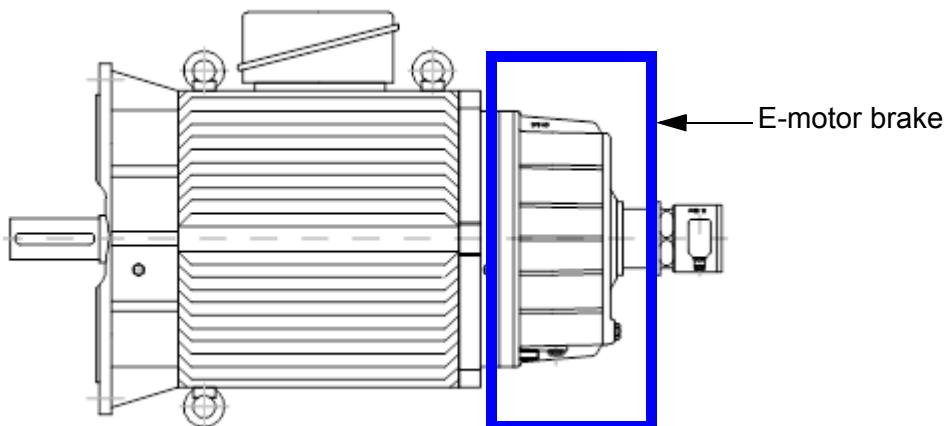


Figure 7-22: E-motor brake

7.5.4.3.1 Perform automatic E-motor brake test

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.2	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.3	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.4	A11-41800-22-0108	N/A	1

1. Perform brake test according to section [7.2.13](#) for each individual brake.
 - If the brake holds the rated load without slipping, SCADA pop-up will display “Brake test passed”.
 - If an alarm is generated, investigate the cause and repair/replace the failed component.

NOTE It is important to run in the new brake liners after installation.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049842	E-motor brake	-

7.5.4.3.2 Measure E-motor brake air gap

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.2	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.3	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.4	A11-41800-22-0108	N/A	1

1. Execute this task according to [7.2.13 Brake section in general maintenance](#).
 - If the value exceeds the maximum as shown on the brake plate, reverse the brake flange (as temporary solution) or replace the brake set (Brake flange, armature plate and friction plate).

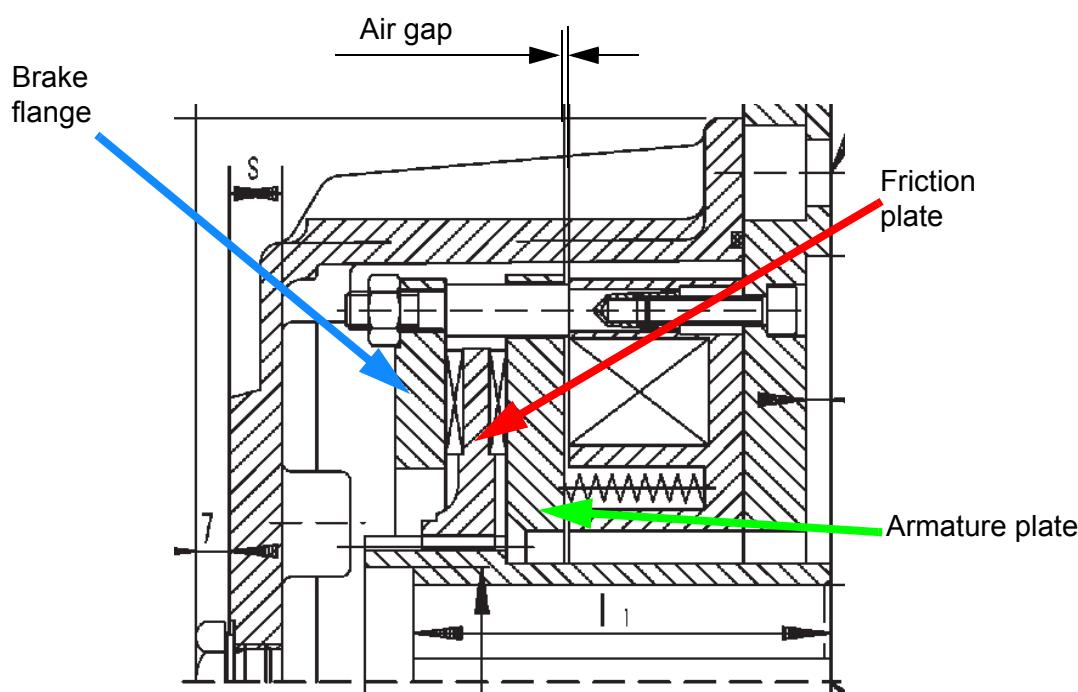


Figure 7-23: E-motor brake

NOTE When installing a new brake, adjust the air gap according to the [7.2.13 Brake section in general maintenance](#).

NOTE *It is important to run in the new brake liners after installation. Run-in procedure is described in [7.2.13](#) Brake section in general maintenance.*

For more information, see the supplier documentation.

Air gap

Minimum (mm)	Maximum (mm)
0.4	1.8

Special tools

P/N	Tool	Qty.
On request	Feeler gauge (required accuracy ±0.05mm)	1

Spare parts

P/N	Part	Symbol code
2049842	E-motor brake	-
On request	Brake flange	-
On request	Armature plate	-
On request	Friction plate	-

7.5.4.3.3 Inspect and clean E-motor brake exterior

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.2	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.3	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.4	A11-41800-22-0108	N/A	1

1. Clean the exterior of the E-motor brake using a cloth.
2. Visual check the exterior of the E-motor brake for damage and excessive corrosion.
 - If significant damage or corrosion is found, replace E-motor brake.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049842	E-motor brake	-

7.5.4.3.4 Measure insulation resistance of E-motor brake and cables

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.2	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.3	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.4	A11-41800-22-0108	N/A	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE	<ul style="list-style-type: none"> • <i>The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 110 kΩ at the rated voltage of 110 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.</i> • If the winding is too damp, the winding must be over-dried.
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Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2049842	E-motor brake	-

7.5.4.3.5 Measure resistance of E-motor brake coil

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108		1
E-motor brake	Drive NO.2	A11-41800-22-0108		1
E-motor brake	Drive NO.3	A11-41800-22-0108		1
E-motor brake	Drive NO.4	A11-41800-22-0108		1

1. Connect the resistance meter to the terminals of the coil.
2. Make a record of the measured resistance.
 - If the resistance is not in accordance with the supplier specification replace the coil.

Spare parts

P/N	Part	Symbol code
2049842	E-motor brake	-

7.5.4.3.6 Test heating of E-motor brake

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.2	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.3	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.4	A11-41800-22-0108	N/A	1

1. Test the E-motor brake heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049842	E-motor brake	-

7.5.4.3.7 Drain condensation water from E-motor brake

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.2	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.3	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.4	A11-41800-22-0108	N/A	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

For more information, see the supplier documentation.

7.5.4.3.8 Clean E-motor brake interior

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.2	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.3	A11-41800-22-0108	N/A	1
E-motor brake	Drive NO.4	A11-41800-22-0108	N/A	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

For more information, see the supplier documentation.

7.5.4.4 Cables and connections

This section describes all maintenance tasks for the cables and connections of the slewing system.

7.5.4.4.1 Inspect cables and connections

:

Description	Location	Reference	Symbol code	Qty.
Cables	Slewing system	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correctly tightened, replace the tag, according to the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

7.5.4.5 Slew bearing

This section describes all maintenance tasks for the slew bearing of the slewing system.

7.5.4.5.1 Check bolt connections

Reference documents

- [A11-41800-22-0108](#): Lower slew system Bolts
- [A11-41800-22-0208](#): Upper slew system Bolts
- [A11-41000-09-002](#): Paint Specification

Description	Location	Reference	Symbol code	Qty.
Bolts	Lower slew system	A11-41800-22-0108	-	-

Description	Location	Reference	Symbol code	Qty.
Bolts	Upper slew system	A11-41800-22-0208	-	-

1. Check torque of the bolts according to drawings A11-41800-22-0108 and A11-41800-22-0208.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque and repaint according to paint specification.

7.5.4.5.2 Grease slew bearing teeth

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Lower slew bearing teeth	Slew system	A11-41800-22-0108	-	130

1. If necessary, remove old grease.
2. Grease slew bearing teeth according to greasing schedule.

NOTE *Check the amount of excessive grease extruded from the teeth contact area after every job and replenish the grease!*

Lubrication

Lubrication type	Type of grease nipple	Qty.
MOBIL MOBILGEAR OGL 461	-	-

7.5.4.5.3 Grease lower slew bearing rollers

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Lower slew bearing rollers	Slew system	A11-41800-22-0108	-	13

1. If necessary, remove old grease.
2. Grease slew bearing according to greasing schedule.

NOTE *Check the amount of excessive grease extruded from the bearing after every job and replenish the grease!*

Lubrication

Lubrication type	Type of grease nipple	Qty.
MOBIL MOBILUX EP2	G1/8" DIN 3404	-

7.5.4.5.4 Grease upper slew bearing rollers

Reference documents:

- [A11-41800-22-0208](#): Upper slewsystem Bolts
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Upper slew bearing rollers	Slew system	A11-41800-22-0208	-	10

1. If necessary, remove old grease.
2. Grease slew bearing according to greasing schedule.

NOTE *Check the amount of excessive grease extruded from the bearing after every job and replenish the grease!*

Lubrication

Lubrication type	Type of grease nipple	Qty.
MOBIL MOBILUX EP2	G1/4" DIN 71412 TYPE A	-

7.5.4.5.5 Inspect pretension of slew bolts

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-22-0208](#): Upper slewsystem Bolts

Description	Location	Reference	Symbol code	Qty.
Slew bolts	Lower slew system	A11-41800-22-0108	106	195
Slew bolts	Upper slew system	A11-41800-22-0208	102	150

During mounting of slew bearing, each bolt is pre-tensioned to a load of 800 kN, which corresponds to a hydraulic pressure of 1174 bar with ITH hydraulic equipment.

The pre-tension inspection procedure is as follows:

1. Remove Denso-tape or Radolit cover of lower nut.
2. Mount jack on bolt.
3. Put hydraulic pressure on jack, and verify at which pressure the nut is released from contact surface by putting light pressure on hand wrench. When nut can be released from contact surface between 1125 and 1174 bar (allowable loss of pretension 4% by setting conduct due to static and dynamic loads), pretension of bolt is subject for acceptance.
4. Set pressure at 1174 bar and rotate nut back on contact surface.
5. Apply Denso tape or Radolit cover on the lower nut.

Spare parts

P/N	Part	Symbol code
2015002	Protection cover "Radolid"	A11-41800-22-0108 / 102 A11-41800-22-0208 / 100
2003390	Hex nut, DIN 934	A11-41800-22-0108 / 106 A11-41800-22-0208 / 102

7.5.4.5.6 Visual inspect and clean slew bearing

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-22-0208](#): Upper slewsystem Bolts
- [A11-41000-09-002](#): Paint Specification
- Rothe Erde_Large Diameter Slewing Bearing
- Rothe Erde_Large Diameter Slewing Upper Bearing

Description	Location	Reference	Symbol code	Qty.
Lower bearing	Slewing system	A11-41800-22-0108	200	1
Upper bearing	Slewing system	A11-41800-22-0208	201	1

1. Clean the exterior and the surroundings of the slew bearing.
2. Check the slew bearing exterior for cracks and corrosion.
 - If cracks are found, replace slew bearing.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.
3. Check noise of the slew bearing.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of slew bearing.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check and clean the slew bearing seal.
 - If excessive wear or damage occurs, replace the seal.
6. Inspect gear teeth surface for damage, wear and pitting.
 - If the hardened layer of gear teeth is worn out, replace the slew bearing.
 - If the surface is not smooth anymore because of pitting, replace the slew bearing and perform an analysis on the grease of the gear teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2008661	Lower slew bearing	200

P/N	Part	Symbol code
2008660	Upper slew bearing	201
On request	Slew bearing seal	

7.5.4.5.7 Take grease sample from slew bearing

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-22-0208](#): Upper slewsystem Bolts
- Rothe Erde_Large Diameter Slewing Bearing
- Rothe Erde_Large Diameter Slewing Upper Bearing

Description	Location	Reference	Symbol code	Qty.
Lower bearing	Slewing system	A11-41800-22-0108	200	1
Upper bearing	Slewing system	A11-41800-22-0208	201	1

1. Take grease sample according to supplier documentation.
2. Analyse grease sample for chemical and physical values.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Special tools

P/N	Tool	Qty.
	Grease sampling set	

Spare parts

P/N	Part	Symbol code
2008661	Lower slew bearing	200
2008660	Upper slew bearing	201

7.5.4.5.8 Replace slewing ring bolts

Reference documents:

- [A11-41800-22-0108](#): Lower slewsystem Bolts
- [A11-41800-22-0208](#): Upper slewsystem Bolts

Description	Location	Reference	Symbol code	Qty.
Slew bolts	Lower slew system	A11-41800-22-0108	106	195
Slew bolts	Upper slew system	A11-41800-22-0208	102	150

NOTE *This procedure provides the replacement of all slew ring bolts within a period of 5 years. The 5 year period crane testing is performed with a new set of bolts.*

1. Check tightening of bolts and where necessary apply proper pre-tension value (see A11-41800-22-0108 and A11-41800-22-0208), see paragraph "Inspect pretension of slew bolts".
2. Replace 20% of the slew ring bolts. Check which bolts need to be replaced (where bolts have been replaced within the last 4 years, they are to be of the same type and quality as previously fitted).
3. Document which bolts have been replaced.
4. Subject the removed bolts to an examination on stress corrosion cracks. In case of (severe) cracks, immediately consult Huisman about the correct action to be taken.

Spare parts

P/N	Part	Symbol code
2015002	Protection cover "Radolid"	A11-41800-22-0108 / 102 A11-41800-22-0208 / 100
2003390	Hex nut, DIN 934	A11-41800-22-0108 / 106 A11-41800-22-0208 / 102



7.5.5 BOOM HOIST WINCH MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
E-motor								
7.5.5.1.1	Perform SPM analysis for E-motor		3			Mechanical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.2	Inspect and clean E-motor exterior		3			Electrical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.3	Test standstill heating of E-motor		3			Electrical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.4	Test thermistor of E-motor		6			Electrical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.5	Perform thermal imaging analysis for E-motor			1		Electrical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.6	Measure insulation resistance of E-motor and cables and continuity resistance of each winding			1		Electrical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.7	Empty condensation drain holes of E-motor			1		Electrical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.8	Replace bearings of E-motor			5		Electrical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
7.5.5.1.9	Grease bearings of E-motor			1		Mechanical	Huisman	331.01.04.01.01.01.01 331.01.04.01.01.02.01
E-motor cooler								
7.5.5.2.1	Check filter element of E-motor cooler	7				Electrical	Huisman	331.01.04.01.01.01.01.01 331.01.04.01.01.02.01.01
7.5.5.2.2	Inspect, clean and test E-motor cooler		3			Electrical	Huisman	331.01.04.01.01.01.01.01 331.01.04.01.01.02.01.01
7.5.5.2.3	Measure insulation resistance of cooler e-motor and cables			1		Electrical	Huisman	331.01.04.01.01.01.01.01 331.01.04.01.01.02.01.01
Gearbox								
7.5.5.3.1	Check bolt connections				1000	Mechanical	Huisman	331.01.04.01.01.01.02 331.01.04.01.01.02.02
7.5.5.3.2	Check leakage of gearbox and oil level	1				Mechanical	Huisman	331.01.04.01.01.01.02 331.01.04.01.01.02.02
7.5.5.3.3	Inspect and clean exterior of gearbox		3			Mechanical	Huisman	331.01.04.01.01.01.02 331.01.04.01.01.02.02
7.5.5.3.4	Perform oil analysis		3			Mechanical	Huisman	331.01.04.01.01.01.02 331.01.04.01.01.02.02
7.5.5.3.5	Replace the gearbox oil			1	200, 1000, each 2000	Mechanical	Siebenhaar	331.01.04.01.01.01.02 331.01.04.01.01.02.02
7.5.5.3.6	Check pinion wear		6			Mechanical	Huisman	331.01.04.01.01.01.02 331.01.04.01.01.02.02
7.5.5.3.7	Perform vibration analysis for gearbox			1		Mechanical	Huisman	331.01.04.01.01.01.02 331.01.04.01.01.02.02

Table 7-6: Maintenance schedule boom hoist winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
E-motor brake								
7.5.5.4.1	Perform automatic E-motor brake test		1			Electrical	Huisman	331.01.04.01.01.01.03 331.01.04.01.01.02.03
7.5.5.4.2	Measure E-motor brake air gap		3			Electrical	Huisman	331.01.04.01.01.01.03 331.01.04.01.01.02.03
7.5.5.4.3	Inspect and clean E-motor brake exterior		3			Electrical	Huisman	331.01.04.01.01.01.03 331.01.04.01.01.02.03
7.5.5.4.4	Measure insulation resistance of E-motor brake cables			1		Electrical	Huisman	331.01.04.01.01.01.03 331.01.04.01.01.02.03
7.5.5.4.5	Test heating of E-motor brake			1		Electrical	Huisman	331.01.04.01.01.01.03 331.01.04.01.01.02.03
7.5.5.4.6	Drain condensation water from E-motor brake			1		Electrical	Huisman	331.01.04.01.01.01.03 331.01.04.01.01.02.03
7.5.5.4.7	Clean E-motor brake interior			1		Electrical	Huisman	331.01.04.01.01.01.03 331.01.04.01.01.02.03
Emergency stop system								
7.5.5.5.1	Inspect and test functioning of emergency stop system		1			Electrical	Huisman	331.01.04.01.03.01
Cables and connections								
7.5.5.6.1	Inspect cables and connections			1		Electrical	Huisman	331.01.04.01.03.03
Drum								
7.5.5.7.1	Check spooling behaviour of drum		6			Mechanical	Huisman	331.01.04.01.04.01
7.5.5.7.2	Apply specified torque for wire rope end connection			1		Mechanical	Huisman	331.01.04.01.04.01
7.5.5.7.3	Inspect drum structure and lebus shell			1		Mechanical	Huisman	331.01.04.01.04.01
Structure								
7.5.5.8.1	Inspect and clean winch frame			1		Mechanical	Huisman	331.01.04.01.04.02

Table 7-6: Maintenance schedule boom hoist winch

7.5.5.1 E-motor

This section describes all maintenance tasks for the E-motors of the boom hoist winch.

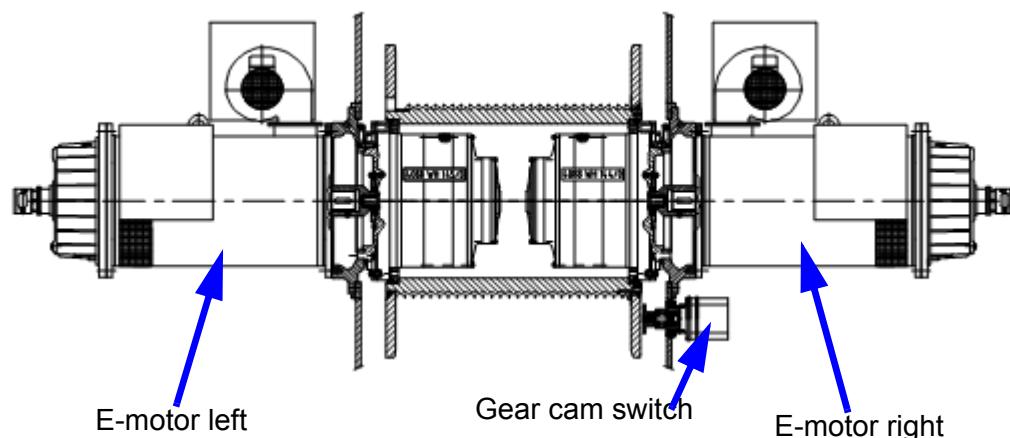


Figure 7-24: E-motor orientation

7.5.5.1.1 Perform SPM analysis for E-motor

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0208	903	1
E-motor left	Drive NO.2	A11-41800-21-0208	904	1

1. Inspect the E-motor by means of Shock Pulse Measurement (SPM) to monitor the condition of the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the SPM data.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in SPM analysis. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable SPM device	1

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	903
10014631A	E-motor left	904

7.5.5.1.2 Inspect and clean E-motor exterior

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41000-09-002](#): Paint Specification
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0208	903	1
E-motor left	Drive NO.2	A11-41800-21-0208	904	1

1. Clean the exterior of the E-motor using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace E-motor.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of E-motor.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check cables and terminal box(es) of E-motor.
 - If a connection is loose, tighten the loose components.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cables.
 - If a terminal box is damaged or corroded, replace the terminal box.
 - If a terminal box suffers from water ingress, replace the terminal box.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	903
10014631A	E-motor left	904

P/N	Part	Symbol code
On request	Terminal box of e-motor	-

7.5.5.1.3 Test standstill heating of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	Electrical drawing (+M22)	-300M1	1
E-motor left	Drive NO.2	Electrical drawing (+M22)	-300M2	1

1. Test the E-motor heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and repair/replace the failed component.
 - Make a record of the measured resistance values.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	903
10014631A	E-motor left	904

7.5.5.1.4 Test thermistor of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	Electrical drawing (+M22)	-300M1	1
E-motor left	Drive NO.2	Electrical drawing (+M22)	-300M2	1

1. Switch on the e-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Check if the resistance is increasing while running the e-motor.
 - If the resistance is 0, infinity or is not increasing while running the e-motor, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	903
10014631A	E-motor left	904

7.5.5.1.5 Perform thermal imaging analysis for E-motor

Reference documents:

-  [A11-41800-21-0208](#): Boom hoist winch
-  Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0208	903	1
E-motor left	Drive NO.2	A11-41800-21-0208	904	1

1. Inspect the E-motor by means of thermal imaging to monitor the condition of the E-motor. To perform the task, the E-motor should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the thermal image.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	903
10014631A	E-motor left	904

7.5.5.1.6 Measure insulation resistance of E-motor and cables and continuity resistance of each winding

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0208	903	1
E-motor left	Drive NO.2	A11-41800-21-0208	904	1

For performing this task on the E-motor.

1. Open the cover on e-motor to access windings.
2. Megger test the E-motor windings, to find the winding insulation resistance and the insulation resistance between the coils.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For performing this task on the E-motor cables.

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation

CAUTION



Disconnect e-motor from the power source (Inverter) while performing Megger-test!

CAUTION



Windings must be discharged immediately after measuring in order to avoid electric shock.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $690 k\Omega$ at the rated voltage of 690 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	903
10014631A	E-motor left	904

7.5.5.1.7 Empty condensation drain holes of E-motor

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0208	903	1
E-motor left	Drive NO.2	A11-41800-21-0208	904	1

1. Empty condensation drain holes of E-motor.

2. Clean and check the drain holes of the E-motor and make sure that holes are open and clear.
 - If excessive grease is found, remove the grease.
 - If dirt blocks the drain holes, remove the dirt.

For more information, see the supplier documentation.

7.5.5.1.8 Replace bearings of E-motor

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0208	903	1
E-motor left	Drive NO.2	A11-41800-21-0208	904	1

1. Replace E-motor bearings.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	E-motor bearings		

7.5.5.1.9 Grease bearings of E-motor

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0208	903	1
E-motor left	Drive NO.2	A11-41800-21-0208	904	1

1. Grease the E-motor bearings.

NOTE Ultrasonic measurement can be used to determine if greasing is necessary.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
On request		

7.5.5.2 E-motor cooler

This section describes all maintenance tasks for the E-motor coolers of the boom hoist winch.

7.5.5.2.1 Check filter element of E-motor cooler

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor cooler right	Drive NO.1	A11-41800-21-0208	903	1
E-motor cooler left	Drive NO.2	A11-41800-21-0208	904	1

1. Check filter element of E-motor cooler.
 - If the filter element is clogged, replace the filter element.

Spare parts

P/N	Part	Symbol code	Qty.
On request	E-motor cooling fan filter element	N/A	-

7.5.5.2.2 Inspect, clean and test E-motor cooler

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch

■ Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor cooler right	Drive NO.1	A11-41800-21-0208	903	1
E-motor cooler left	Drive NO.2	A11-41800-21-0208	904	1

1. Clean air passage and cooling fan.
2. Inspect E-motor cooler exterior for damage and corrosion.
 - If significant damage is found, replace E-motor cooling fan.
 - If corrosion is found, repair the surfaces where the corrosion is found by cleaning and painting these surfaces, according to the paint specification.
 - If the blades are severely damaged, replace the cooling fan (blades).
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the Paint Specification.
4. Test functionality of cooling fan.
 - If a problem is found, investigate the cause and repair/replace the failed component.
5. Check the functioning of E-motor bearings while the cooler E-motor is off. For this rotate the fan with hand.
 - If the fan does not rotate smoothly, investigate the cause (malfunction of bearings, for example) and repair/replace the failed component.
6. Check cables of E-motor.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Cooling fan assembly	-
On request	Cooling fan E-motor	-
On request	Cooling fan blades	-

7.5.5.2.3 Measure insulation resistance of cooler E-motor and cables

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch

■ Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor cooler right	Drive NO.1	A11-41800-21-0208	903	1
E-motor cooler left	Drive NO.2	A11-41800-21-0208	904	1

1. Disconnect the E-motor cooler from the power source.
2. Connect the Megger to the terminals.
3. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE

- *If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.*
- *The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 440 kΩ at the rated voltage of 440 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.*
- *If the winding is too damp, the winding must be over-dried.*

CAUTION



The E-motor cooler must be disconnected from the power source when performing these measurements!

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
On request	E-motor cooler	-
On request	Cooling fan E-motor	-

7.5.5.3 Gearbox

This section described all maintenance tasks for the gearbox of the boom hoist winch.

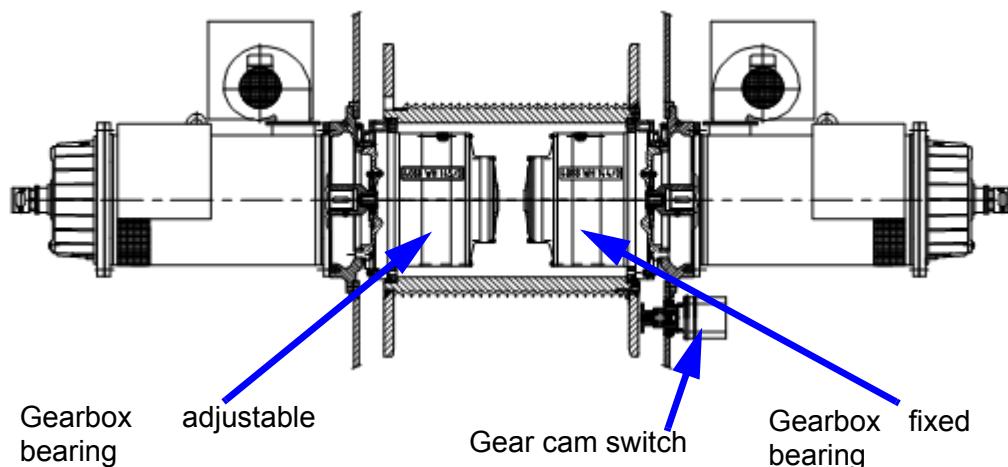


Figure 7-25: Overview gearbox location.

7.5.5.3.1 Check bolt connections

Reference documents

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41000-09-002](#): Paint Specification
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0208	02	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0208	03	1

1. Check torque of the bolts according to the drawing A11-41800-21-0208.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque according to drawing A11-41800-21-0208 and repaint according to paint specification.
2. Check the flange holes and the bolts for wear.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information see supplier documentation.

7.5.5.3.2 Check leakage of gearbox and oil level

Reference documents

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41000-09-002](#): Paint Specification
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0208	02	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0208	03	1

1. Check gearbox exterior and surroundings for oil leakage.
 - If leakage occurs, investigate the cause according to supplier documentation and take appropriate measures to prevent an unsafe situation. Then clean up the leakage.

NOTE *In the e-motor/gearbox spline connection a slight leakage can appear*

2. Check the oil level.

NOTE *Make sure the gearbox is in the proper position when checking the oil level.*

- If oil level is too low, refill oil according to the greasing schedule A11-41800-00-201 and supplier documentation.

NOTE *Check the oil level only when the gearbox is stopped!*

NOTE *Do not overfill!*

CAUTION



Do not mix oils of different types, even of the same make!

See Siebenhaar supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 / T3	-	-

Spare parts

P/N	Part	Symbol code
2042352	Gearbox fixed bearing	02
2042353	Gearbox adjustable bearing	03
On request	Seal set	-

7.5.5.3.3 Inspect and clean exterior of gearbox

Reference documents

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41000-09-002](#): Paint Specification
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0208	02	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0208	03	1

1. Clean the exterior of the gearbox using a cloth.
2. Visual check the exterior for cracks and corrosion.
 - If cracks are found, replace gearbox.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.
3. Check noise of the gearbox.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of gearbox.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check hose end connections of gearbox
 - If a connection is loose, tighten loose components
 - If hose end connections are damaged or corroded, repair the hose end connections or replace the hose.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2042352	Gearbox fixed bearing	02
2042353	Gearbox adjustable bearing	03
On request	Seal set	-

7.5.5.3.4 Perform oil analysis

Reference documents

- [A11-41800-21-0208](#): Boom hoist winch
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0208	02	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0208	03	1

1. Take oil sample.
2. Let a certified third party perform the oil sample analysis for chemical and physical values.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.
3. Let a certified third party perform the oil sample analysis for wear, clearness and water.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 T3	-	-

Spare parts

P/N	Part	Symbol code
2042352	Gearbox fixed bearing	02
2042353	Gearbox adjustable bearing	03

7.5.5.3.5 Replace the gearbox oil

Reference documents

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41800-00-201](#): Greasing schedule
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0208	02	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0208	03	1

1. Replace gearbox oil according to greasing schedule A11-41800-00-201. First oil change after 200 motor-hours, second oil change after 1000 motor-hours and further oil changes every 2000 motor-hours or every 12 months.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 / T3	-	25 liters

7.5.5.3.6 Check pinion wear

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0208	02	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0208	03	1

1. Visually check pinion for wear.
 - If the hardened layer is worn out, replace the gearbox or pinion.
 - if the teeth are significantly worn out in contact places, replace the gearbox or pinion.

2. Inspect pinion teeth surface for damage (pitting).
 - If the surface is not smooth anymore because of pitting, replace the gearbox or pinion and perform an analysis on the grease of the pinion teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2042352	Gearbox fixed bearing	02
2042353	Gearbox adjustable bearing	03
On request	Pinion	-
On request	Pinion shaft	-
On request	Seal set	-

7.5.5.3.7 Perform vibration analysis for gearbox

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0208	02	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0208	03	1

1. Perform measurement.
2. Analyse measurement.
 - If a problem is found, investigate the cause and repair/replace the failed component.

The internal condition of the components needs to be inspected by means of vibration analysis. Huisman recommends this analysis to be executed by a third party that is specialized in vibration analysis, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable vibration meter / analyser	1

Spare parts

P/N	Part	Symbol code
2042352	Gearbox fixed bearing	02
2042353	Gearbox adjustable bearing	03

7.5.5.4 E-motor brake

This section describes all maintenance tasks for the E-motor brakes of the boom hoist winch.

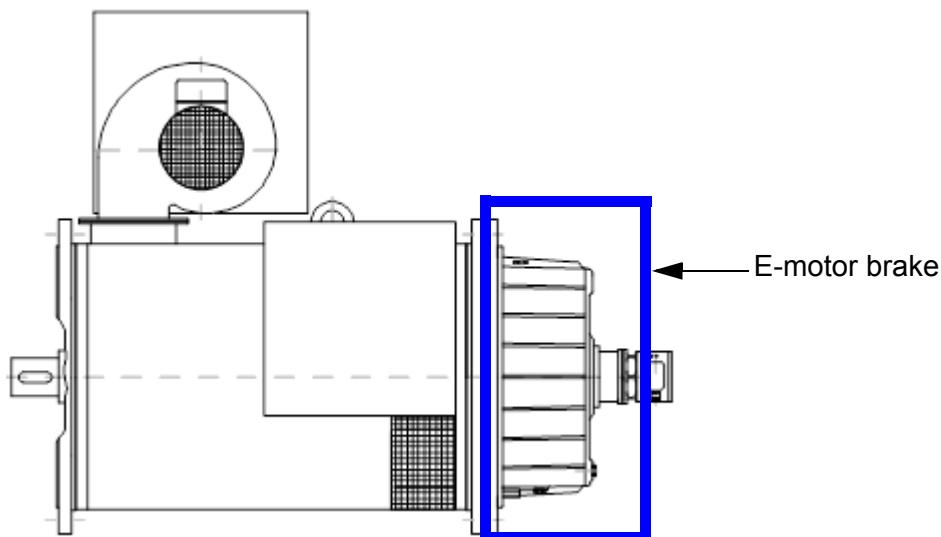


Figure 7-26: E-motor brake

7.5.5.4.1 Perform automatic E-motor brake test

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0208	-	1
E-motor brake	Drive NO.2	A11-41800-21-0208	-	1

1. Perform brake test according to section [7.2.13](#) for each individual brake.
 - If the brake holds the rated load without slipping, SCADA pop-up will display “Brake test passed”.
 - If an alarm is generated, investigate the cause and repair/replace the failed component.

nent.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.5.4.2 Measure E-motor brake air gap

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0208	-	1
E-motor brake	Drive NO.2	A11-41800-21-0208	-	1

1. Execute this task according to [7.2.13 Brake section in general maintenance](#).
 - If the value exceeds the maximum as shown on the brake plate, reverse the brake flange (as temporary solution) or replace the brake set (Brake flange, armature plate and friction plate).

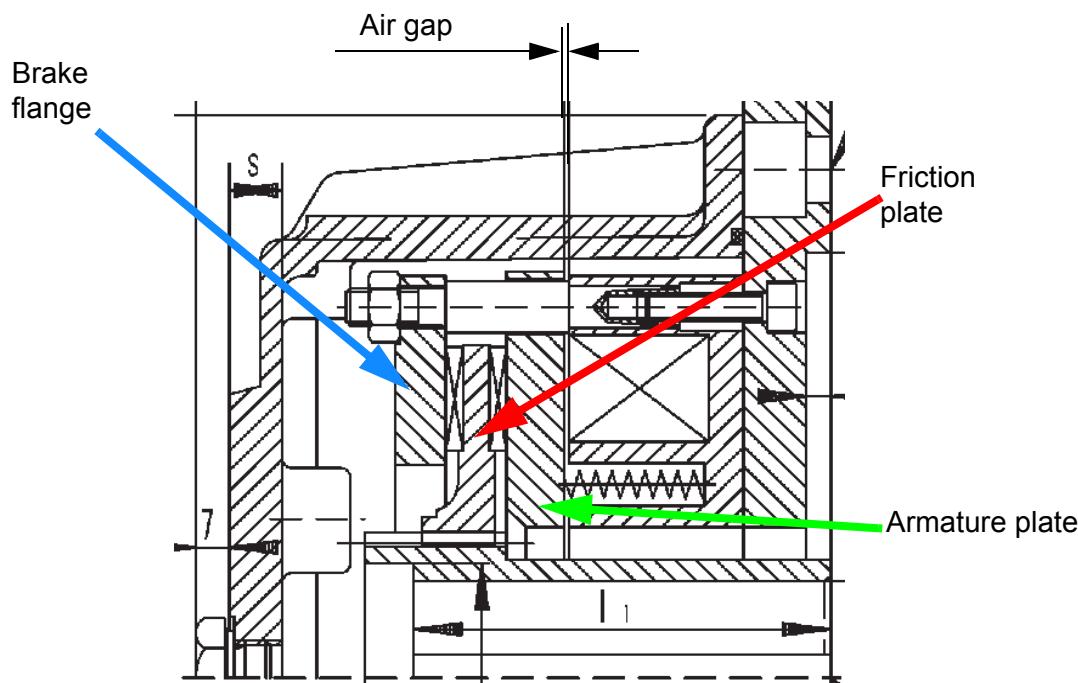


Figure 7-27: E-motor brake

NOTE When installing a new brake, adjust the air gap according to the [7.2.13](#) Brake section in general maintenance.

NOTE It is important to run in the new brake liners after installation. Run-in procedure is described in [7.2.13](#) Brake section in general maintenance.

For more information, see the supplier documentation.

Air gap

Minimum (mm)	Maximum (mm)
0.4	2.5

Special tools

P/N	Tool	Qty.
On request	Feeler gauge (required accuracy $\pm 0.05\text{mm}$)	1

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-
On request	Brake flange	

P/N	Part	Symbol code
On request	Armature plate	
On request	Friction plate	

7.5.5.4.3 Inspect and clean E-motor brake exterior

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0208	-	1
E-motor brake	Drive NO.2	A11-41800-21-0208	-	1

1. Clean the exterior of the E-motor brake using a cloth.
2. Visual check the exterior of the E-motor brake for damage and excessive corrosion.
 - If significant damage or corrosion is found, replace E-motor brake.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.5.4.4 Measure insulation resistance of E-motor brake and cables

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0208	-	1
E-motor brake	Drive NO.2	A11-41800-21-0208	-	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE	<ul style="list-style-type: none"> • <i>The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 110 kΩ at the rated voltage of 110 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.</i> • If the winding is too damp, the winding must be over-dried.
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Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.5.4.5 Test heating of E-motor brake

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0208	-	1
E-motor brake	Drive NO.2	A11-41800-21-0208	-	1

1. Test the E-motor brake heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.5.4.6 Drain condensation water from E-motor brake

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0208	-	1
E-motor brake	Drive NO.2	A11-41800-21-0208	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.5.4.7 Clean E-motor brake interior

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0208	-	1
E-motor brake	Drive NO.2	A11-41800-21-0208	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.5.5 Emergency stop system

This section describes all maintenance tasks for the emergency stop system of the boom hoist winch.

7.5.5.1 Inspect and test functioning of emergency stop system

Reference documents:

- [10013281A](#): Electrical drawing
- Schneider - Emergency push button

Description	Location	Reference	Symbol code	Qty.
Emergency stop button	Boom hoist winch	Electrical drawing (+M22)	-061S15	1
Safety relay	E-cabinet +M22	Electrical drawing (+M22)	-061K1	1

NOTE The frequency for this task given in the maintenance schedule is an indication. The user is to determine the periodic schedule based on the severity of the operating environment and the frequency of switch actuation.

1. Check the emergency stop push button for damage, button looseness and excessive environmental contamination.
 - If damage is found, replace the damaged component.
 - If components are loose, tighten the loose components.
 - If dirt is found at the push button, clean the push button.
2. Check for water ingress in the push button.
 - If water is present, replace the push button.
3. Push an emergency stop button.
4. Check if the push button relay -061K1 reacts.

WARNING  *The emergency safety relay that continuously monitors the state of its inputs. When an emergency stop push button is activated, the relay will directly de-activate its direct contacts. After an adjustable time (typical is 1 second) the relay will de-activate its time-delayed outputs.*

- If the relays not react correctly, replace the relay.
5. Check if SCADA gives an emergency alarm and shuts down the system.
 - If no alarm is generated and/or the system does not shut down, investigate the cause and repair/replace the failed component.
6. Reset the emergency stop button.
7. Reset the alarm in SCADA.

WARNING  *Always test the emergency stop system for proper functioning under machine control conditions after performing maintenance.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2014302	Emergency stop relay	-061K1
2007868	Pushbutton, sub-assembly	-061S15

7.5.5.6 Cables and connections

This section describes all maintenance tasks for the cables and connections of the boom hoist winch.

7.5.5.6.1 Inspect cables and connections:

Description	Location	Reference	Symbol code	Qty.
Cables	Boom hoist winch	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correct tightened, replace the tag, according the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

7.5.5.7 Drum

This section describes all maintenance tasks for the drum of the boom hoist winch.

7.5.5.7.1 Check spooling behavior of drum

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Drum	Boom hoist winch	A11-41800-21-0208	-	1

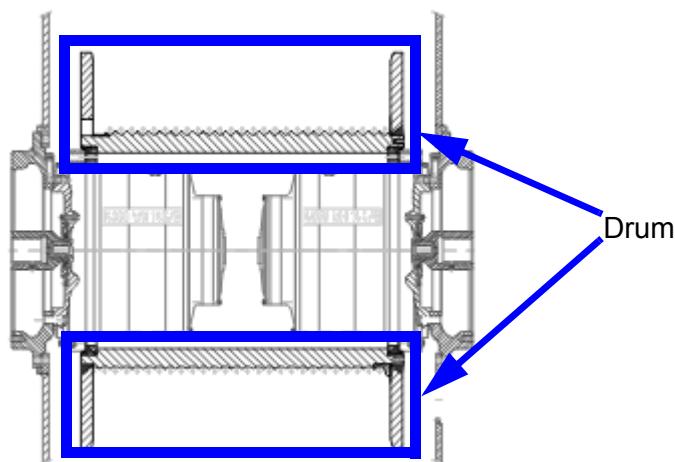


Figure 7-28: Drum

1. Check spooling behaviour of the drum according to the Huisman wire rope manual.
 - If a problem is found, investigate the cause and repair/replace the failed component.

7.5.5.7.2 Apply specified torque for wire rope end connection

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Wire rope end connection	Boom hoist winch	A11-41800-21-0208	13	1

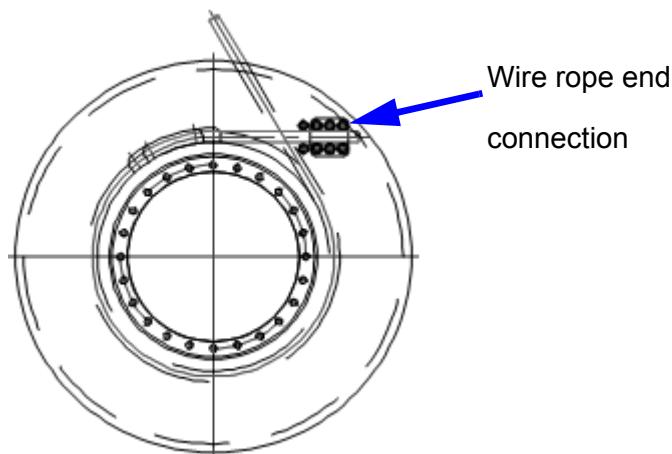


Figure 7-29: Wire rope end connection

1. Apply the specified torque for wire rope end connection according to specification.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information, see the steel wire ropes manual.

Specified torque

Description	Torque
Hex head bolt	617 Nm

Spare parts

P/N	Part	Symbol code
10003938A	Wire rope end connection block	13
2007028	Bolts	115

7.5.5.7.3 Inspect drum structure and lebus shell

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Drum	Boom hoist winch	A11-41800-21-0208	-	1

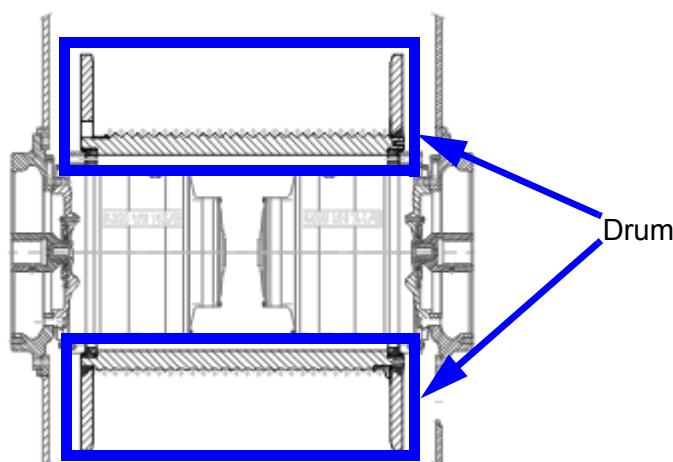


Figure 7-30: Drum

1. Unwind the wire rope from the drum.
2. Clean drum structure.
3. Visual check the drum structure for wear, cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the drum.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
4. Check paint of drum structure.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
5. Check for loose components of the drum structure (including wire rope end connection).
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on lebus shell.

7.5.5.8 Structure

This section describes all maintenance tasks for the winch frame of the boom hoist winch.

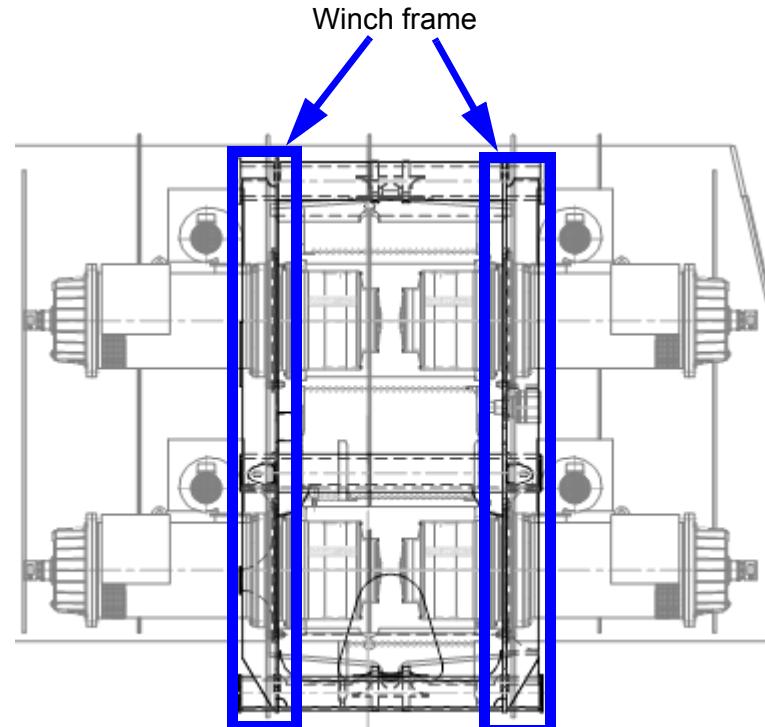


Figure 7-31: Winch frame

7.5.5.8.1 Inspect and clean steel structure

Reference documents:

- [A11-41800-21-0108](#): Winch frame
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Winch frame	Rectangular mast section	A11-41800-21-0108	-	1

NOTE *When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.*

1. Clean the winch frame using a cloth.
2. Visual check the winch frame for cracks, damage and corrosion.
 - If cracks or significant damage are found, take contact with Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according

to the paint specification.

3. Check paint of winch frame.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the winch frame.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on the winch frame.

7.5.6 MAIN HOIST TRACTION WINCH MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
E-motor								
7.5.6.1.1	Perform SPM analysis for E-motor		3			Mechanical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.2	Inspect and clean E-motor exterior		3			Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.3	Test standstill heating of E-motor		3			Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.4	Test thermistor of E-motor		6			Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.5	Perform thermal imaging analysis for E-motor			1		Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.6	Measure insulation resistance of E-motor and cables and continuity resistance of each winding			1		Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.7	Empty condensation drain holes of E-motor			1		Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.8	Replace bearings of E-motor			5		Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
7.5.6.1.9	Grease bearings of E-motor			1		Mechanical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01 331.01.04.02.01.03.01 331.01.04.02.01.05.01 331.01.04.02.01.06.01 331.01.04.02.01.07.01
E-motor cooler								
7.5.6.2.1	Check filter element of E-motor cooler	7				Electrical	Huisman	331.01.04.02.01.01.01.01 331.01.04.02.01.02.01.01 331.01.04.02.01.03.01.01 331.01.04.02.01.05.01.01 331.01.04.02.01.06.01.01 331.01.04.02.01.07.01.01
7.5.6.2.2	Inspect, clean and test E-motor cooler		3			Electrical	Huisman	331.01.04.02.01.01.01.01 331.01.04.02.01.02.01.01 331.01.04.02.01.03.01.01 331.01.04.02.01.05.01.01 331.01.04.02.01.06.01.01 331.01.04.02.01.07.01.01

Table 7-7: Maintenance schedule main hoist traction winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.6.2.3	Measure insulation resistance of cooler E-motor and cables			1		Electrical	Huisman	331.01.04.02.01.01.01 331.01.04.02.01.02.01.01 331.01.04.02.01.03.01.01 331.01.04.02.01.05.01.01 331.01.04.02.01.06.01.01 331.01.04.02.01.07.01.01
Gearbox								
7.5.6.3.1	Check bolt connections			1000		Mechanical	Huisman	331.01.04.02.01.01.02 331.01.04.02.01.02.02 331.01.04.02.01.03.02 331.01.04.02.01.05.02 331.01.04.02.01.06.02 331.01.04.02.01.07.02
7.5.6.3.2	Check leakage of gearbox and oil level	1				Mechanical	Huisman	331.01.04.02.01.01.02 331.01.04.02.01.02.02 331.01.04.02.01.03.02 331.01.04.02.01.05.02 331.01.04.02.01.06.02 331.01.04.02.01.07.02
7.5.6.3.3	Inspect and clean exterior of gearbox		3			Mechanical	Huisman	331.01.04.02.01.01.02 331.01.04.02.01.02.02 331.01.04.02.01.03.02 331.01.04.02.01.05.02 331.01.04.02.01.06.02 331.01.04.02.01.07.02
7.5.6.3.4	Perform oil analysis		3			Mechanical	Huisman	331.01.04.02.01.01.02 331.01.04.02.01.02.02 331.01.04.02.01.03.02 331.01.04.02.01.05.02 331.01.04.02.01.06.02 331.01.04.02.01.07.02
7.5.6.3.5	Replace the gearbox oil		2	500, further each 1000		Mechanical	Liebherr	331.01.04.02.01.01.02 331.01.04.02.01.02.02 331.01.04.02.01.03.02 331.01.04.02.01.05.02 331.01.04.02.01.06.02 331.01.04.02.01.07.02
7.5.6.3.6	Check pinion wear		6			Mechanical	Huisman	331.01.04.02.01.01.02 331.01.04.02.01.02.02 331.01.04.02.01.03.02 331.01.04.02.01.05.02 331.01.04.02.01.06.02 331.01.04.02.01.07.02
7.5.6.3.7	Perform vibration analysis for gearbox		1			Mechanical	Huisman	331.01.04.02.01.01.02 331.01.04.02.01.02.02 331.01.04.02.01.03.02 331.01.04.02.01.05.02 331.01.04.02.01.06.02 331.01.04.02.01.07.02
Gearbox oil cooler								
7.5.6.4.1	Check oil leakage	1				Mechanical	Huisman	331.01.04.02.01.01.02.01 331.01.04.02.01.02.02.01 331.01.04.02.01.03.02.01 331.01.04.02.01.05.02.01 331.01.04.02.01.06.02.01 331.01.04.02.01.07.02.01
7.5.6.4.2	Inspect, clean and test gearbox cooler		1			Mechanical	Huisman	331.01.04.02.01.01.02.01 331.01.04.02.01.02.02.01 331.01.04.02.01.03.02.01 331.01.04.02.01.05.02.01 331.01.04.02.01.06.02.01 331.01.04.02.01.07.02.01
7.5.6.4.3	Check oil level	7				Mechanical	Huisman	331.01.04.02.01.01.02.01 331.01.04.02.01.02.02.01 331.01.04.02.01.03.02.01 331.01.04.02.01.05.02.01 331.01.04.02.01.06.02.01 331.01.04.02.01.07.02.01

Table 7-7: Maintenance schedule main hoist traction winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.6.4.4	Inspect oil filter element	7				Mechanical	Huisman	331.01.04.02.01.01.02.01 331.01.04.02.01.02.02.01 331.01.04.02.01.03.02.01 331.01.04.02.01.05.02.01 331.01.04.02.01.06.02.01 331.01.04.02.01.07.02.01
7.5.6.4.5	Replace filter element			1		Mechanical	Huisman	331.01.04.02.01.01.02.01 331.01.04.02.01.02.02.01 331.01.04.02.01.03.02.01 331.01.04.02.01.05.02.01 331.01.04.02.01.06.02.01 331.01.04.02.01.07.02.01
7.5.6.4.6	Measure insulation resistance of cooler E-motor and cables			1		Electrical	Huisman	331.01.04.02.01.01.02.01 331.01.04.02.01.02.02.01 331.01.04.02.01.03.02.01 331.01.04.02.01.05.02.01 331.01.04.02.01.06.02.01 331.01.04.02.01.07.02.01
E-motor brake								
7.5.6.5.1	Perform automatic E-motor brake test		1			Electrical	Huisman	331.01.04.02.01.01.03 331.01.04.02.01.02.03 331.01.04.02.01.03.03 331.01.04.02.01.05.03 331.01.04.02.01.06.03 331.01.04.02.01.07.03
7.5.6.5.2	Measure E-motor brake air gap		3			Electrical	Huisman	331.01.04.02.01.01.03 331.01.04.02.01.02.03 331.01.04.02.01.03.03 331.01.04.02.01.05.03 331.01.04.02.01.06.03 331.01.04.02.01.07.03
7.5.6.5.3	Inspect and clean E-motor brake exterior		3			Electrical	Huisman	331.01.04.02.01.01.03 331.01.04.02.01.02.03 331.01.04.02.01.03.03 331.01.04.02.01.05.03 331.01.04.02.01.06.03 331.01.04.02.01.07.03
7.5.6.5.4	Measure insulation resistance of E-motor brake cables			1		Electrical	Huisman	331.01.04.02.01.01.03 331.01.04.02.01.02.03 331.01.04.02.01.03.03 331.01.04.02.01.05.03 331.01.04.02.01.06.03 331.01.04.02.01.07.03
7.5.6.5.5	Test heating of E-motor brake			1		Electrical	Huisman	331.01.04.02.01.01.03 331.01.04.02.01.02.03 331.01.04.02.01.03.03 331.01.04.02.01.05.03 331.01.04.02.01.06.03 331.01.04.02.01.07.03
7.5.6.5.6	Drain condensation water from E-motor brake			1		Electrical	Huisman	331.01.04.02.01.01.03 331.01.04.02.01.02.03 331.01.04.02.01.03.03 331.01.04.02.01.05.03 331.01.04.02.01.06.03 331.01.04.02.01.07.03
7.5.6.5.7	Clean E-motor brake interior			1		Electrical	Huisman	331.01.04.02.01.01.03 331.01.04.02.01.02.03 331.01.04.02.01.03.03 331.01.04.02.01.05.03 331.01.04.02.01.06.03 331.01.04.02.01.07.03
Gear ring								
7.5.6.6.1	Check bolt connections				1000	Mechanical	Huisman	331.01.04.02.01.04 331.01.04.02.01.08
7.5.6.6.2	Grease gear ring teeth				After every main hoist job	Mechanical	Huisman	331.01.04.02.01.04 331.01.04.02.01.08

Table 7-7: Maintenance schedule main hoist traction winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.6.6.3	Visual inspect and clean gear ring		6			Mechanical	Huisman	331.01.04.02.01.04 331.01.04.02.01.08
Automatic greasing system								
7.5.6.7.1	Inspect, clean and test the grease pump		3			Mechanical	Huisman	331.01.04.02.01.09 331.01.04.02.01.09.01
7.5.6.7.2	Visual inspect grease lines		6			Mechanical	Huisman	331.01.04.02.01.09
7.5.6.7.3	Check functioning of pump element		6			Mechanical	Huisman	331.01.04.02.01.09
7.5.6.7.4	Refill automatic grease pump reservoir		6			Mechanical	Huisman	331.01.04.02.01.09
7.5.6.7.5	Measure insulation resistance of E-motor and cables			1		Electrical	Huisman	331.01.04.02.01.09.01
Emergency stop system								
7.5.6.8.1	Inspect and test functioning of emergency stop system		1			Electrical	Huisman	331.01.04.02.03.01
Cables and connections								
7.5.6.9.1	Inspect cables and connections			1		Electrical	Huisman	331.01.04.02.03.03
Drum								
7.5.6.10.1	Grease drum main shaft		3		200	Mechanical	Huisman	331.01.04.02.04.01 331.01.04.02.04.02
7.5.6.10.2	Check spooling behaviour of drum		6			Mechanical	Huisman	331.01.04.02.04.01 331.01.04.02.04.02
7.5.6.10.3	Inspect drum bearing		6			Mechanical	Huisman	331.01.04.02.04.01 331.01.04.02.04.02
7.5.6.10.4	Inspect drum structure			1		Mechanical	Huisman	331.01.04.02.04.01 331.01.04.02.04.02
Structure								
7.5.6.11.1	Inspect and clean winch frame			1		Mechanical	Huisman	331.01.04.02.04.03
7.5.6.11.2	Inspect and clean platforms			1		Mechanical	Huisman	331.01.04.02.04.04

Table 7-7: Maintenance schedule main hoist traction winch

7.5.6.1 E-motor

This section describes all maintenance tasks for the E-motors of the main hoist traction winch.

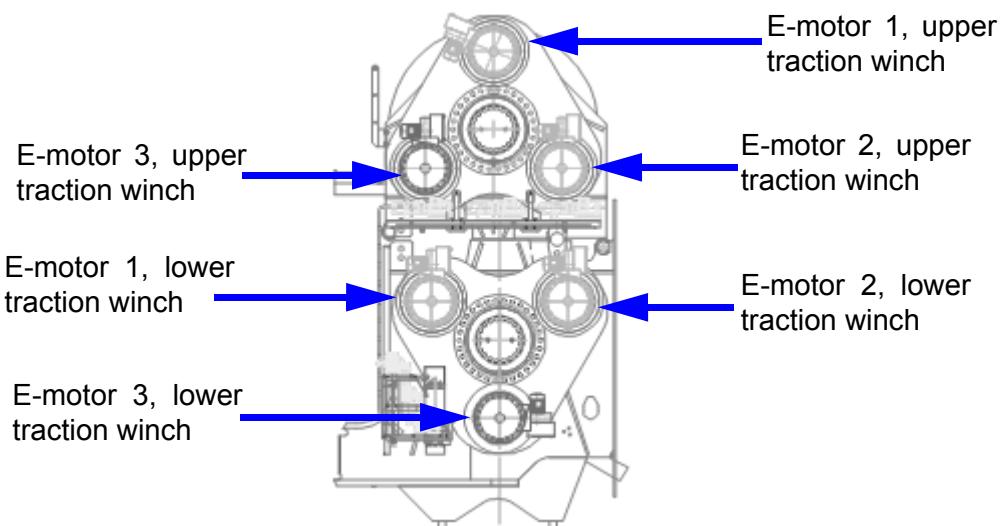


Figure 7-32: E-motor orientation

7.5.6.1.1 Perform SPM analysis for E-motor

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	A11-41820-14-0108	901	1
E-motor 2	Upper traction winch, right	A11-41820-14-0108	901	1
E-motor 3	Upper traction winch, left	A11-41820-14-0108	902	1
E-motor 1	Lower traction winch, left	A11-41820-13-0108	901	1
E-motor 2	Lower traction winch, right	A11-41820-13-0108	901	1
E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	902	1

1. Inspect the E-motor by means of Shock Pulse Measurement (SPM) to monitor the condition of the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the SPM data.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in SPM analysis. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable SPM device	1

Spare parts

P/N	Part	Symbol code
2011130	E-motor	901
2012144	E-motor	902

7.5.6.1.2 Inspect and clean E-motor exterior

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- [A11-41000-09-002](#): Paint Specification
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	A11-41820-14-0108	901	1
E-motor 2	Upper traction winch, right	A11-41820-14-0108	901	1
E-motor 3	Upper traction winch, left	A11-41820-14-0108	902	1
E-motor 1	Lower traction winch, left	A11-41820-13-0108	901	1
E-motor 2	Lower traction winch, right	A11-41820-13-0108	901	1
E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	902	1

1. Clean the exterior of the E-motor using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace E-motor.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of E-motor.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check cables and terminal box(es) of E-motor.
 - If a connection is loose, tighten the loose components.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cables.
 - If a terminal box is damaged or corroded, replace the terminal box.
 - If a terminal box suffers from water ingress, replace the terminal box.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2011130	E-motor	901
2012144	E-motor	902
On request	Terminal box of E-motor	-

7.5.6.1.3 Test standstill heating of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	Electrical drawing (+M22)	-110M1	1
E-motor 2	Upper traction winch, right	Electrical drawing (+M22)	-110M2	1
E-motor 3	Upper traction winch, left	Electrical drawing (+M22)	-110M3	1
E-motor 1	Lower traction winch, left	Electrical drawing (+M22)	-120M1	1

Description	Location	Reference	Symbol code	Qty.
E-motor 2	Lower traction winch, right	Electrical drawing (+M22)	-120M2	1
E-motor 3	Lower traction winch, bottom	Electrical drawing (+M22)	-120M3	1

1. Test the E-motor heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and repair/replace the failed component.
 - Make a record of the measured resistance values.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2011130	E-motor	901
2012144	E-motor	902

7.5.6.1.4 Test thermistor of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	Electrical drawing (+M22)	-110M1	1
E-motor 2	Upper traction winch, right	Electrical drawing (+M22)	-110M2	1
E-motor 3	Upper traction winch, left	Electrical drawing (+M22)	-110M3	1
E-motor 1	Lower traction winch, left	Electrical drawing (+M22)	-120M1	1
E-motor 2	Lower traction winch, right	Electrical drawing (+M22)	-120M2	1
E-motor 3	Lower traction winch, bottom	Electrical drawing (+M22)	-120M3	1

1. Switch on the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Check if the resistance is increasing while running the E-motor.
 - If the resistance is 0, infinity or is not increasing while running the E-motor, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2011130	E-motor	901
2012144	E-motor	902

7.5.6.1.5 Perform thermal imaging analysis for E-motor

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	A11-41820-14-0108	901	1
E-motor 2	Upper traction winch, right	A11-41820-14-0108	901	1
E-motor 3	Upper traction winch, left	A11-41820-14-0108	902	1
E-motor 1	Lower traction winch, left	A11-41820-13-0108	901	1
E-motor 2	Lower traction winch, right	A11-41820-13-0108	901	1
E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	902	1

1. Inspect the E-motor by means of thermal imaging to monitor the condition of the E-motor. To perform the task, the E-motor should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the thermal image.

- If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

Spare parts

P/N	Part	Symbol code
2011130	E-motor	901
2012144	E-motor	902

7.5.6.1.6 Measure insulation resistance of E-motor and cables and continuity resistance of each winding

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	A11-41820-14-0108	901	1
E-motor 2	Upper traction winch, right	A11-41820-14-0108	901	1
E-motor 3	Upper traction winch, left	A11-41820-14-0108	902	1
E-motor 1	Lower traction winch, left	A11-41820-13-0108	901	1
E-motor 2	Lower traction winch, right	A11-41820-13-0108	901	1
E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	902	1

For performing this task on the E-motor.

1. Open the cover on E-motor to access windings.

2. Megger test the E-motor windings, to find the winding insulation resistance and the insulation resistance between the coils.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For performing this task on the E-motor cables.

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation

CAUTION



Disconnect E-motor from the power source (Inverter) while performing Megger-test!

CAUTION



Windings must be discharged immediately after measuring in order to avoid electric shock.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $690 k\Omega$ at the rated voltage of 690 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2011130	E-motor	901
2012144	E-motor	902

7.5.6.1.7 Empty condensation drain holes of E-motor

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	A11-41820-14-0108	901	1
E-motor 2	Upper traction winch, right	A11-41820-14-0108	901	1
E-motor 3	Upper traction winch, left	A11-41820-14-0108	902	1
E-motor 1	Lower traction winch, left	A11-41820-13-0108	901	1
E-motor 2	Lower traction winch, right	A11-41820-13-0108	901	1
E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	902	1

1. Empty condensation drain holes of E-motor.
2. Clean and check the drain holes of the E-motor and make sure that holes are open and clear.
 - If excessive grease is found, remove the grease.
 - If dirt blocks the drain holes, remove the dirt.

For more information, see the supplier documentation.

7.5.6.1.8 Replace bearings of E-motor

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	A11-41820-14-0108	901	1
E-motor 2	Upper traction winch, right	A11-41820-14-0108	901	1

Description	Location	Reference	Symbol code	Qty.
E-motor 3	Upper traction winch, left	A11-41820-14-0108	902	1
E-motor 1	Lower traction winch, left	A11-41820-13-0108	901	1
E-motor 2	Lower traction winch, right	A11-41820-13-0108	901	1
E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	902	1

1. Replace E-motor bearings.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	E-motor bearings		

7.5.6.1.9 Grease bearings of E-motor

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Upper traction winch, top	A11-41820-14-0108	901	1
E-motor 2	Upper traction winch, right	A11-41820-14-0108	901	1
E-motor 3	Upper traction winch, left	A11-41820-14-0108	902	1
E-motor 1	Lower traction winch, left	A11-41820-13-0108	901	1
E-motor 2	Lower traction winch, right	A11-41820-13-0108	901	1
E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	902	1

1. Grease the E-motor bearings.

NOTE Ultrasonic measurement can be used to determine if greasing is necessary.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
On request		

7.5.6.2 E-motor cooler

This section describes all maintenance tasks for the E-motor coolers of the main hoist traction winch.

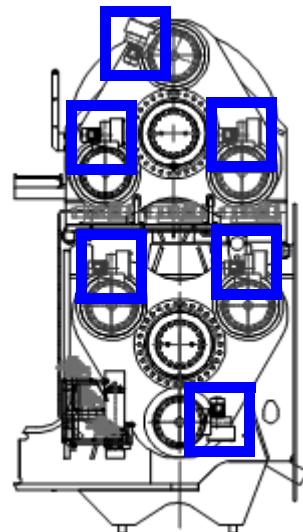


Figure 7-33: E-motor coolers

7.5.6.2.1 Check filter element of E-motor cooler

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor 1	Upper traction winch, middle	A11-41820-14-0108	-	1
Cooler E-motor 2	Upper traction winch, right	A11-41820-14-0108	-	1
Cooler E-motor 3	Upper traction winch, left	A11-41820-14-0108	-	1
Cooler E-motor 1	Lower traction winch, top	A11-41820-13-0108	-	1
Cooler E-motor 2	Lower traction winch, middle	A11-41820-13-0108	-	1
Cooler E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	-	1

1. Check filter element of E-motor cooler.
 - If the filter element is clogged, replace the filter element.

Spare parts

P/N	Part	Symbol code	Qty.
On request	E-motor cooling fan filter element	N/A	-

7.5.6.2.2 Inspect, clean and test E-motor cooler

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- [A11-41000-09-002](#): Paint Specification
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor 1	Upper traction winch, middle	A11-41820-14-0108	-	1

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor 2	Upper traction winch, right	A11-41820-14-0108	-	1
Cooler E-motor 3	Upper traction winch, left	A11-41820-14-0108	-	1
Cooler E-motor 1	Lower traction winch, top	A11-41820-13-0108	-	1
Cooler E-motor 2	Lower traction winch, middle	A11-41820-13-0108	-	1
Cooler E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	-	1

1. Clean air passage and cooling fan.
2. Inspect E-motor cooler exterior for damage and corrosion.
 - If significant damage is found, replace E-motor cooling fan.
 - If corrosion is found, repair the surfaces where the corrosion is found by cleaning and painting these surfaces, according to the paint specification.
 - If the blades are severely damaged, replace the cooling fan (blades).
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.
4. Test functionality of cooling fan.
 - If a problem is found, investigate the cause and repair/replace the failed component.
5. Check the functioning of E-motor bearings while the cooler E-motor is off. For this rotate the fan with hand.
 - If the fan does not rotate smoothly, investigate the cause (malfunction of bearings, for example) and repair/replace the failed component.
6. Check cables of E-motor.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Cooling fan assembly	-
On request	Cooling fan E-motor	-
On request	Cooling fan blades	-

7.5.6.2.3 Measure insulation resistance of cooler E-motor and cables

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor 1	Upper traction winch, middle	A11-41820-14-0108	-	1
Cooler E-motor 2	Upper traction winch, right	A11-41820-14-0108	-	1
Cooler E-motor 3	Upper traction winch, left	A11-41820-14-0108	-	1
Cooler E-motor 1	Lower traction winch, top	A11-41820-13-0108	-	1
Cooler E-motor 2	Lower traction winch, middle	A11-41820-13-0108	-	1
Cooler E-motor 3	Lower traction winch, bottom	A11-41820-13-0108	-	1

1. Disconnect the E-motor cooler from the power source.
2. Connect the Megger to the terminals.
3. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $440 k\Omega$ at the rated voltage of 440 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

CAUTION



The E-motor cooler must be disconnected from the power source when performing these measurements!

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
On request	E-motor cooler	-
On request	Cooling fan E-motor	-

7.5.6.3 Gearbox

This section described all maintenance tasks for the gearbox of the main hoist traction winch.

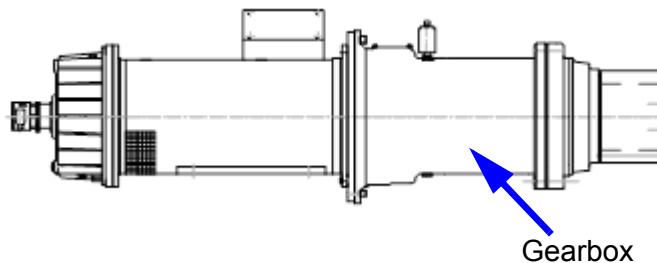


Figure 7-34: Gearbox.

7.5.6.3.1 Check bolt connections

Reference documents

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- [A11-41000-09-002](#): Paint specification
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 1	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 2	A11-41820-14-0108	200	1

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 3	A11-41820-14-0108	200	1
Gearbox	Lower traction winch, motor 1	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 2	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 3	A11-41820-13-0108	200	1

1. Check torque of the bolts according to the drawing A11-41820-13-0108 and A11-41820-14-0108.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque according to drawing A11-41820-13-0108, A11-41820-14-0108 and repaint according to paint specification.
2. Check the flange holes and the bolts for wear.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information see supplier documentation.

7.5.6.3.2 Check leakage of gearbox and oil level

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- [A11-41800-00-201](#): Greasing schedule
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 1	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 2	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 3	A11-41820-14-0108	200	1
Gearbox	Lower traction winch, motor 1	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 2	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 3	A11-41820-13-0108	200	1

1. Check gearbox exterior and surroundings for oil leakage.
 - If leakage occurs, investigate the cause according to supplier documentation and take appropriate measures to prevent an unsafe situation. Then clean up the leakage.

NOTE *In the E-motor/gearbox spline connection a slight leakage can appear*

2. Check the oil level.

NOTE *Make sure the gearbox is in the proper position when checking the oil level.*

- If oil level is too low, refill oil according to the greasing schedule A11-41800-00-201 and supplier documentation.

NOTE *Check the oil level only when the gearbox is stopped!*

NOTE *Do not overfill!*

CAUTION



Do not mix oils of different types, even of the same make!

See supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
API GL 5	-	-

Spare parts

P/N	Part	Symbol code
2012391	Gearbox	200
On request	Seal set	-

7.5.6.3.3 Inspect and clean exterior of gearbox

Reference documents

 [A11-41820-13-0108](#): Lower winch frame

- [A11-41820-14-0108](#): Upper winch frame
- [A11-41000-09-002](#): Paint specification
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 1	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 2	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 3	A11-41820-14-0108	200	1
Gearbox	Lower traction winch, motor 1	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 2	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 3	A11-41820-13-0108	200	1

1. Clean the exterior of the gearbox using a cloth.
2. Visual check the exterior for cracks and corrosion.
 - If cracks are found, replace gearbox.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.
3. Check noise of the gearbox.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of gearbox.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check cables of gearbox
 - If a connection is loose, tighten loose components
 - if cable sheathes are damaged or corroded, repair the cable sheathes or replace the cables.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2012391	Gearbox	200

P/N	Part	Symbol code
On request	Seal set	-

7.5.6.3.4 Perform oil analysis

Reference documents

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 1	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 2	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 3	A11-41820-14-0108	200	1
Gearbox	Lower traction winch, motor 1	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 2	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 3	A11-41820-13-0108	200	1

1. Take oil sample.
2. Let a certified third party perform the oil sample analysis for chemical and physical values.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.
3. Let a certified third party perform the oil sample analysis for wear, clearness and water.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.

Lubrication

Lubrication type	Type of grease nipple	Qty.
API GL 5	-	-

Spare parts

P/N	Part	Symbol code
2012391	Gearbox	200

7.5.6.3.5 Replace the gearbox oil

Reference documents

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- [A11-41800-00-201](#): Greasing schedule
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 1	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 2	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 3	A11-41820-14-0108	200	1
Gearbox	Lower traction winch, motor 1	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 2	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 3	A11-41820-13-0108	200	1

1. Replace gearbox oil according to greasing schedule A11-41800-00-201. First oil change after 500 motor-hours and further oil changes every 1000 motor-hours or every 24 months.

Lubrication

Lubrication type	Type of grease nipple	Qty.
API GL 5	-	-

7.5.6.3.6 Check pinion wear

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame

- [A11-41820-14-0108](#): Upper winch frame
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 1	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 2	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 3	A11-41820-14-0108	200	1
Gearbox	Lower traction winch, motor 1	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 2	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 3	A11-41820-13-0108	200	1

1. Visually check pinion for wear.
 - If the hardened layer is worn out, replace the gearbox.
 - if the teeth are significantly worn out in contact places, replace the gearbox or pinion.
2. Inspect pinion teeth surface for damage (pitting).
 - If the surface is not smooth anymore because of pitting, replace the gearbox or pinion and perform an analysis on the grease of the pinion teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2012391	Gearbox	200
On request	Pinion	-
On request	Pinion shaft	-
On request	Seal set	-

7.5.6.3.7 Perform vibration analysis for gearbox

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Upper traction winch, motor 1	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 2	A11-41820-14-0108	200	1
Gearbox	Upper traction winch, motor 3	A11-41820-14-0108	200	1
Gearbox	Lower traction winch, motor 1	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 2	A11-41820-13-0108	200	1
Gearbox	Lower traction winch, motor 3	A11-41820-13-0108	200	1

1. Perform measurement.
2. Analyse measurement.
 - If a problem is found, investigate the cause and repair/replace the failed component.

The internal condition of the components needs to be inspected by means of vibration analysis. Huisman recommends this analysis to be executed by a third party that is specialized in vibration analysis, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable vibration meter / analyser	1

Spare parts

P/N	Part	Symbol code
2012391	Gearbox	200

7.5.6.4 Gearbox cooler

This section describes all maintenance tasks for the gearbox cooler of the main hoist traction winch.

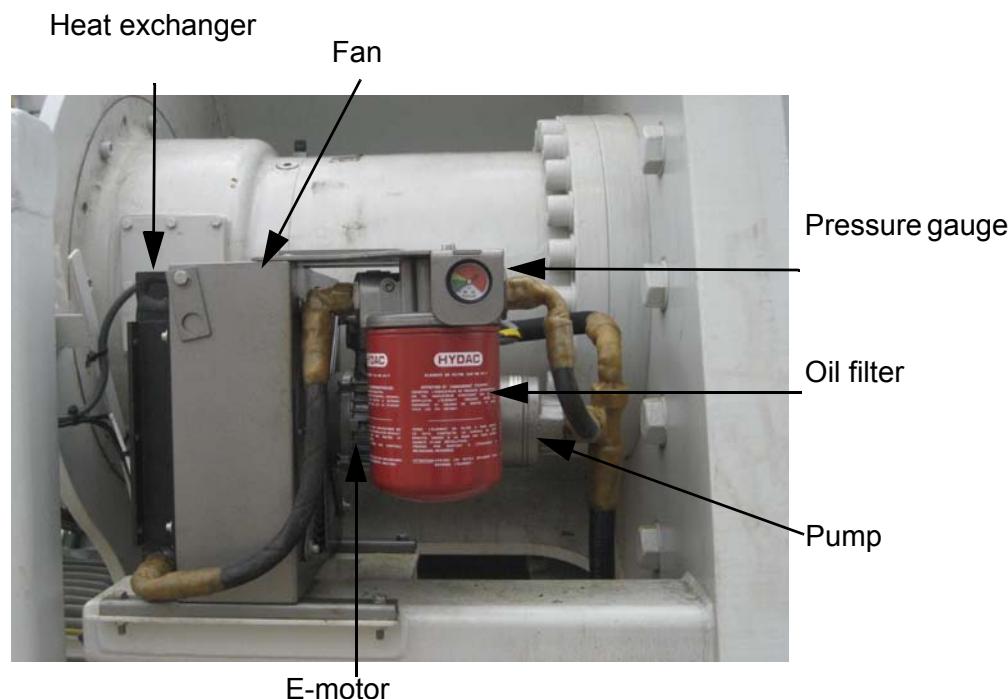


Figure 7-35: Forced cooling

7.5.6.4.1 Check oil leakage

Reference documents:

- [A11-41820-80-0108](#): Hydraulic diagram gearbox cooling traction winch
- Hydac - Pump-Transfer Cooler Filtration Unit

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Upper traction winch, motor 1	A11-41820-80-0108	Z201A	1
Gearbox cooler	Upper traction winch, motor 2	A11-41820-80-0108	Z201C	1
Gearbox cooler	Upper traction winch, motor 3	A11-41820-80-0108	Z201B	1
Gearbox cooler	Lower traction winch, motor 1	A11-41820-80-0108	Z201D	1
Gearbox cooler	Lower traction winch, motor 2	A11-41820-80-0108	Z201E	1

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Lower traction winch, motor 3	A11-41820-80-0108	Z201F	1

1. Check for oil leakage in potential oil leakage areas.
 - If oil leakage is found, investigate the cause and repair / replace the failed component.

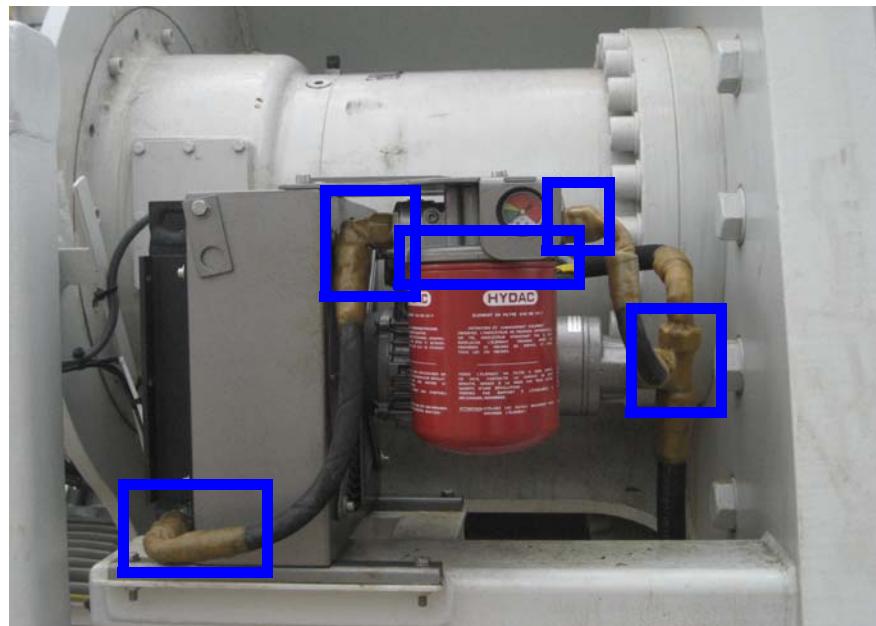


Figure 7-36: Potential oil leakage areas

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2044321	Gearbox cooler	Z201A, Z201B, Z201C, Z201D, Z201E, Z201F

7.5.6.4.2 Inspect, clean and test gearbox cooler

Reference documents:

- [A11-41820-80-0108](#): Hydraulic diagram gearbox cooling traction winch

- [A11-41000-09-002](#): Paint specification
- Hydac - Pump-Transfer Cooler Filtration Unit

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Upper traction winch, motor 1	A11-41820-80-0108	Z201A	1
Gearbox cooler	Upper traction winch, motor 2	A11-41820-80-0108	Z201C	1
Gearbox cooler	Upper traction winch, motor 3	A11-41820-80-0108	Z201B	1
Gearbox cooler	Lower traction winch, motor 1	A11-41820-80-0108	Z201D	1
Gearbox cooler	Lower traction winch, motor 2	A11-41820-80-0108	Z201E	1
Gearbox cooler	Lower traction winch, motor 3	A11-41820-80-0108	Z201F	1

1. Clean the exterior of the forced cooling on the gearbox using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace forced air cooling.
 - If corrosion is found, repair the surfaces where the corrosion is found by cleaning and painting these surfaces, according to the paint specification.
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.
4. Test functionality of fan.
 - If a problem is found (unusual noise or vibration), investigate the cause and repair/replace the failed component.
5. Test functionality of pump and E-motor(s).
 - If a problem is found, investigate the cause and repair/replace the failed component.
6. Inspect the breather filter for damage and contamination.
 - If the breather filter is damaged or contaminated replace the breather filter.
7. Check cables of E-motor.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.
8. Check the functioning of E-motor bearings while the cooler E-motor is off. For this rotate the fan with hand.
 - If the fan does not rotate smoothly, investigate the cause (poor lubrication/malfunction of bearings, for example) and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2044321	Gearbox cooler	Z201A, Z201B, Z201C, Z201D, Z201E, Z201F
On request	Cooling fan/pump E-motor	
On request	Cooling pump	

7.5.6.4.3 Check oil level

Reference documents:

- [A11-41820-80-0108](#): Hydraulic diagram gearbox cooling traction winch
- Hydac - Pump-Transfer Cooler Filtration Unit

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Upper traction winch, motor 1	A11-41820-80-0108	Z201A	1
Gearbox cooler	Upper traction winch, motor 2	A11-41820-80-0108	Z201C	1
Gearbox cooler	Upper traction winch, motor 3	A11-41820-80-0108	Z201B	1
Gearbox cooler	Lower traction winch, motor 1	A11-41820-80-0108	Z201D	1
Gearbox cooler	Lower traction winch, motor 2	A11-41820-80-0108	Z201E	1
Gearbox cooler	Lower traction winch, motor 3	A11-41820-80-0108	Z201F	1

1. Check oil level.
 - If the oil level is too low, refill oil of gearbox cooler.

CAUTION



Do not overfill.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51524	-	-

7.5.6.4.4 Inspect oil filter element

Reference documents:

- [A11-41820-80-0108](#): Hydraulic diagram gearbox cooling traction winch
- Hydac - Pump-Transfer Cooler Filtration Unit

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler filter	Upper traction winch, motor 1	A11-41820-80-0108	Z208A	1
Gearbox cooler filter	Upper traction winch, motor 2	A11-41820-80-0108	Z208C	1
Gearbox cooler filter	Upper traction winch, motor 3	A11-41820-80-0108	Z208B	1
Gearbox cooler filter	Lower traction winch, motor 1	A11-41820-80-0108	Z208D	1
Gearbox cooler filter	Lower traction winch, motor 2	A11-41820-80-0108	Z208E	1
Gearbox cooler filter	Lower traction winch, motor 3	A11-41820-80-0108	Z208F	1

1. Inspect oil filter element for damage.
 - If oil filter is damaged, replace the oil filter.

NOTE *Huisman recommends to send the filter element for analysis when replaced.*

2. Inspect oil filter element for contamination using the contamination indicator.
 - If oil filter is clogged, replace the oil filter.

NOTE *Huisman recommends to send the filter element for analysis when replaced.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2042362	Gearbox cooler oil filter element	Z208A,Z208B, Z208C, Z208D, Z208E, Z208F

7.5.6.4.5 Replace filter element

Reference documents:

- [A11-41820-80-0108](#): Hydraulic diagram gearbox cooling traction winch
- Hydac - Pump-Transfer Cooler Filtration Unit

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler filter	Upper traction winch, motor 1	A11-41820-80-0108	Z208A	1
Gearbox cooler filter	Upper traction winch, motor 2	A11-41820-80-0108	Z208C	1
Gearbox cooler filter	Upper traction winch, motor 3	A11-41820-80-0108	Z208B	1
Gearbox cooler filter	Lower traction winch, motor 1	A11-41820-80-0108	Z208D	1
Gearbox cooler filter	Lower traction winch, motor 2	A11-41820-80-0108	Z208E	1
Gearbox cooler filter	Lower traction winch, motor 3	A11-41820-80-0108	Z208F	1

1. Shut off the gearbox cooler.
2. Isolate the filter from the system.
3. Remove the old filter elements.
4. Place new filter elements.
5. Restore the cooling system.

For more information, see the supplier documentation.

NOTE *Filters have to be replaced according to maintenance schedule and every time the gearbox oil is changed!*

Parts needed for task

P/N	Part	Symbol code	Qty.
2042362	Gearbox cooler oil filter element	Z208A,Z208B, Z208C, Z208D, Z208E, Z208F	6

7.5.6.4.6 Measure insulation resistance of cooler E-motor and cables

Reference documents:

- [A11-41820-80-0108](#): Hydraulic diagram gearbox cooling traction winch
- Hydac - Pump-Transfer Cooler Filtration Unit

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor	Upper traction winch, motor 1	A11-41820-80-0108	110M1-M2	1
Cooler E-motor	Upper traction winch, motor 2	A11-41820-80-0108	110M2-M2	1
Cooler E-motor	Upper traction winch, motor 3	A11-41820-80-0108	110M3-M2	1
Cooler E-motor	Lower traction winch, motor 1	A11-41820-80-0108	120M1-M2	1
Cooler E-motor	Lower traction winch, motor 2	A11-41820-80-0108	120M2-M2	1
Cooler E-motor	Lower traction winch, motor 3	A11-41820-80-0108	120M3-M2	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

- NOTE**
- *If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.*
 - *The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 440 kΩ at the rated voltage of 440 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.*
 - *If the winding is too damp, the winding must be over-dried.*

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
On request	E-motor cooler	110M1-M2, 110M2-M2, 110M3-M2, 120M1-M2, 120M2-M2, 120M3-M2

7.5.6.5 E-motor brake

This section describes all maintenance tasks for the E-motor brakes of the main hoist traction winch.

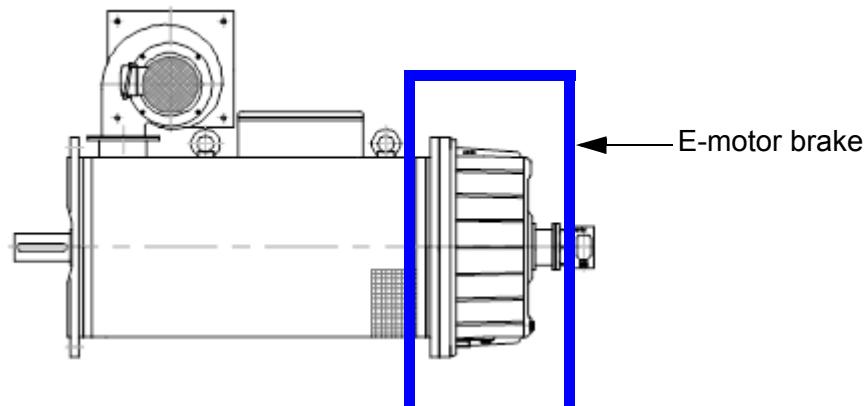


Figure 7-37: E-motor brake

7.5.6.5.1 Perform automatic E-motor brake test

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Upper traction winch, E-motor 1	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 2	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 3	A11-41820-14-0108	-	1
E-motor brake	Lower traction winch, E-motor 1	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 2	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 3	A11-41820-13-0108	-	1

1. Perform brake test according to section [7.2.13](#) for each individual brake.
 - If the brake holds the rated load without slipping, SCADA pop-up will display "Brake

- test passed".
- If an alarm is generated, investigate the cause and repair/replace the failed component.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049841	E-motor brake	-

7.5.6.5.2 Measure E-motor brake air gap

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Upper traction winch, E-motor 1	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 2	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 3	A11-41820-14-0108	-	1
E-motor brake	Lower traction winch, E-motor 1	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 2	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 3	A11-41820-13-0108	-	1

1. Execute this task according to [7.2.13 Brake section in general maintenance](#).
 - If the value exceeds the maximum as shown on the brake plate, reverse the brake flange (as temporary solution) or replace the brake set (Brake flange, armature plate and friction plate).

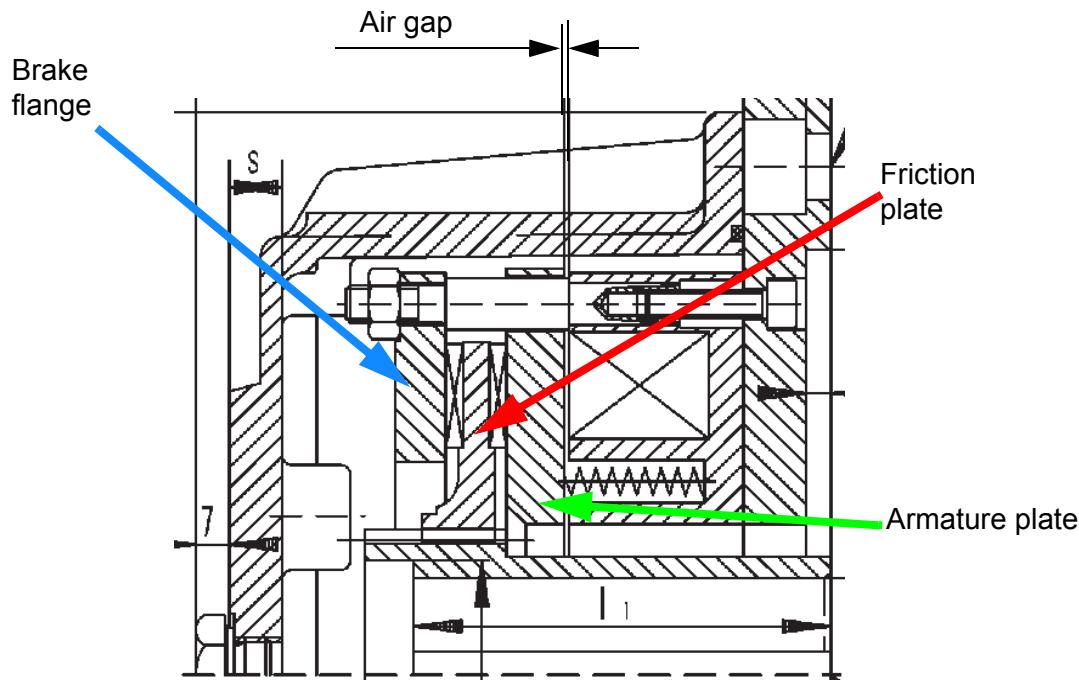


Figure 7-38: E-motor brake

NOTE When installing a new brake, adjust the air gap according to the [7.2.13](#) Brake section in general maintenance.

NOTE It is important to run in the new brake liners after installation. Run-in procedure is described in [7.2.13](#) Brake section in general maintenance.

For more information, see the supplier documentation.

Air gap

Minimum (mm)	Maximum (mm)
0.4	2.3

Special tools

P/N	Tool	Qty.
On request	Feeler gauge (required accuracy $\pm 0.05\text{mm}$)	1

Spare parts

P/N	Part	Symbol code
2049841	E-motor brake	-
On request	Brake flange	

P/N	Part	Symbol code
On request	Armature plate	
On request	Friction plate	

7.5.6.5.3 Inspect and clean E-motor brake exterior

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Upper traction winch, E-motor 1	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 2	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 3	A11-41820-14-0108	-	1
E-motor brake	Lower traction winch, E-motor 1	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 2	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 3	A11-41820-13-0108	-	1

1. Clean the exterior of the E-motor brake using a cloth.
2. Visual check the exterior of the E-motor brake for damage and excessive corrosion.
 - If significant damage or corrosion is found, replace E-motor brake.

NOTE It is important to run in the new brake liners after installation.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049841	E-motor brake	-

7.5.6.5.4 Measure insulation resistance of E-motor brake and cables

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Upper traction winch, E-motor 1	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 2	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 3	A11-41820-14-0108	-	1
E-motor brake	Lower traction winch, E-motor 1	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 2	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 3	A11-41820-13-0108	-	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE • *The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 110 kΩ at the rated voltage of 110 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.*
• If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2049841	E-motor brake	-



7.5.6.5.5 Test heating of E-motor brake

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Upper traction winch, E-motor 1	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 2	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 3	A11-41820-14-0108	-	1
E-motor brake	Lower traction winch, E-motor 1	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 2	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 3	A11-41820-13-0108	-	1

1. Test the E-motor brake heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049841	E-motor brake	-

7.5.6.5.6 Drain condensation water from E-motor brake

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Upper traction winch, E-motor 1	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 2	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 3	A11-41820-14-0108	-	1
E-motor brake	Lower traction winch, E-motor 1	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 2	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 3	A11-41820-13-0108	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.6.5.7 Clean E-motor brake interior

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Upper traction winch, E-motor 1	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 2	A11-41820-14-0108	-	1
E-motor brake	Upper traction winch, E-motor 3	A11-41820-14-0108	-	1
E-motor brake	Lower traction winch, E-motor 1	A11-41820-13-0108	-	1
E-motor brake	Lower traction winch, E-motor 2	A11-41820-13-0108	-	1

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Lower traction winch, E-motor 3	A11-41820-13-0108	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.6.6 Gear ring

This section describes all maintenance tasks for the gear ring of the main hoist traction winch.

7.5.6.6.1 Check bolt connections

Reference documents

- [A11-41820-22-0108](#): Gear ring traction winch
- [A11-41000-09-002](#): Paint specification
- Liebherr - Ball slewing ring

Description	Location	Reference	Symbol code	Qty.
Main gearbox upper	Upper drum winch	A11-41820-22-0108	200	1
Main gearbox lower	Lower drum winch	A11-41820-22-0108	200	1

1. Check torque of the bolts according to drawing A11-41820-22-0108.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque and repaint according to paint specification.

7.5.6.6.2 Grease gear ring teeth

Reference documents:

- [A11-41820-22-0108](#): Gear ring traction winch
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Main gearbox upper	Upper drum winch	A11-41820-22-0108	200	1
Main gearbox lower	Lower drum winch	A11-41820-22-0108	200	1

1. If necessary, remove old grease.

2. Grease main gearbox teeth according to greasing schedule.

NOTE *Check the amount of excessive grease extruded from the teeth contact area after every job and replenish the grease!*

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	-	168

7.5.6.6.3 Visual inspect and clean gear ring

Reference documents:

- [A11-41820-22-0108](#): Gear ring traction winch
- [A11-41000-09-002](#): Paint specification
- Liebherr - Ball slewing ring

Description	Location	Reference	Symbol code	Qty.
Main gearbox upper	Upper drum winch	A11-41820-22-0108	200	1
Main gearbox lower	Lower drum winch	A11-41820-22-0108	200	1

1. Clean the exterior and the surroundings of the gear ring.
2. Check the gear ring exterior for cracks and corrosion.
 - If cracks are found, replace gear ring.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.
3. Check noise of the gear ring.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of gear ring.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check and clean the gear ring bearing seal.
 - If excessive wear or damage occurs, replace the seal.
6. Inspect gear teeth surface for damage, wear and pitting.
 - If the hardened layer of gear teeth is worn out, replace the main gearbox.
 - If the surface is not smooth anymore because of pitting, replace the main gearbox

and perform an analysis on the grease of the gear teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2009796	Gear ring	200
On request	Gear ring seal	N/A

7.5.6.7 Automatic greasing system

This section describes all maintenance tasks for the automatic greasing system of the main hoist traction winch.

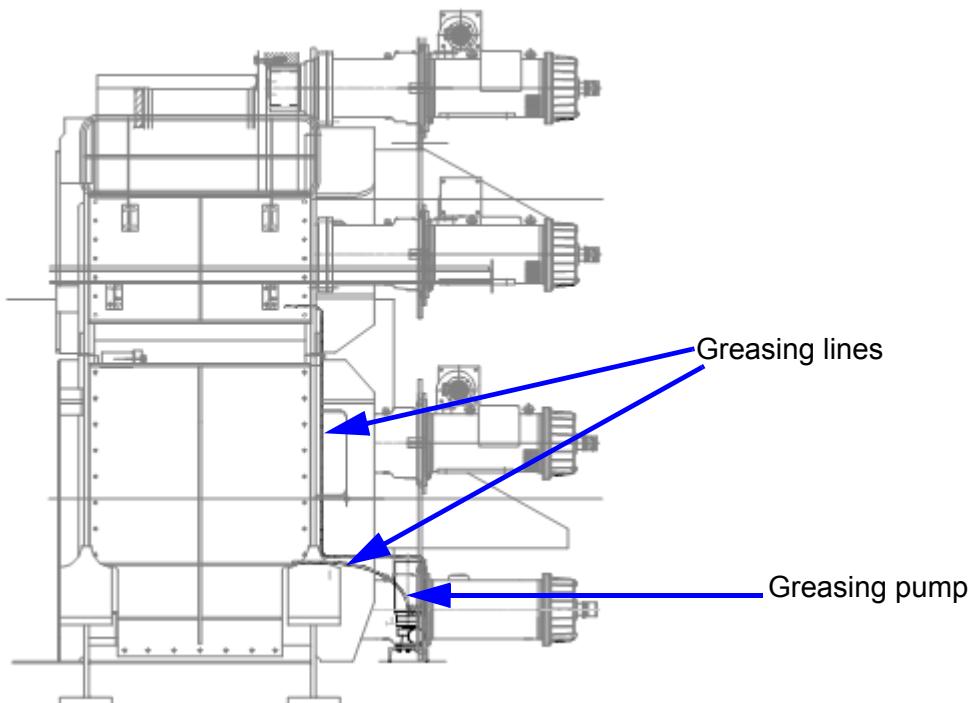


Figure 7-39: Automatic greasing system

7.5.6.7.1 Inspect, clean and test grease pump

Reference documents:

- [A11-41820-13-0208](#): Grease system

- [A11-41000-09-002](#): Paint specification
- SKF - FF Multiline Pump Unit

Description	Location	Reference	Symbol code	Qty.
Lubrication pump	Lower winch frame	A11-41820-13-0208	200	1

1. Clean the exterior of the grease pump assembly using a cloth.
2. Visual inspect the grease pump for damage.
 - If a significant damage on the pump is found, repair/replace the grease pump.
 - If the fill level switch is damaged, replace the pump.
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.
4. Visual inspect the grease pump E-motor.
 - If the grease pump E-motor is damaged, replace the grease pump assembly.
5. Check the functioning of E-motor bearings. For this disassemble the E-motor from the pump assembly, thereby leave the cables connected. Activate the E-motor via SCADA and check if the E-motor shaft rotates smoothly.
 - If the E-motor shaft does not rotate smoothly, investigate the cause (poor lubrication/malfunction of bearings, for example).
 - If the lubrication pump E-motor bearings are poorly lubricated, grease the bearings.
 - If the lubrication pump E-motor bearings are defective, replace the pump assembly.
6. Check cables of E-motor.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2015397	Grease pump	200

Lubrication

Lubrication type	Type of grease nipple	Qty.
Mobil Mobilith SHC 460	-	-

7.5.6.7.2 Visual inspect grease lines

Reference documents:

- [A11-41820-13-0208](#): Grease system
- SKF - FF Multiline Pump Unit

Description	Location	Reference	Symbol code	Qty.
Lubrication pump	Lower winch frame	A11-41820-13-0208	200	1

1. Visual inspect grease lines for damage and correct position according to the reference drawing.
 - In case the grease lines are out of position, adjust the position of grease lines.
 - In case of a damaged grease line, repair/replace the grease line.
2. Visual inspect grease lines fastening clamps for damage and corrosion.
 - If a clamp is damaged or corroded, repair/replace the clamp.

For more information, see the supplier documentation.

7.5.6.7.3 Check functioning of pump element

Reference documents:

- [A11-41820-13-0208](#): Grease system
- SKF - FF Multiline Pump Unit

Description	Location	Reference	Symbol code	Qty.
Lubrication pump	Lower winch frame	A11-41820-13-0208	200	1



Figure 7-40: Pump elements

1. Check if the grease is coming out of the grease lines shown at the drawing A11-41820-13-020.
 - If no grease is flowing through the dosing unit, investigate the cause and repair/replace the failed component.
2. Check if there is excessive grease on the gear teeth (bearing).
 - If too much excessive grease is found on the gearing teeth, check the electrical circuit of the greasing pump.
 - If the electrical circuit of the greasing pump is alright, adjust the grease supply rate at pump element. For the adjustment procedure see the supplier manual (SKF).

NOTE

Before performing this task make sure that the reservoir is fully filled!

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2015397	Grease pump	200

7.5.6.7.4 Refill automatic grease pump reservoir

Reference documents:

- [A11-41820-13-0208](#): Grease system
- SKF - FF Multiline Pump Unit

Description	Location	Reference	Symbol code	Qty.
Lubrication pump	Lower winch frame	A11-41820-13-0208	200	1

1. Check level of reservoir.

- Refill reservoir according to greasing schedule to maximum level with the appropriate grease type.

NOTE Proper tracking of grease consumption can aid in indicating problems.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
Mobil Mobilith SHC 460	-	-

7.5.6.7.5 Measure insulation resistance of E-motor and cables

Reference documents:

- [A11-41820-13-0208](#): Grease system
- SKF - FF Multiline Pump Unit

Description	Location	Reference	Symbol code	Qty.
Lubrication pump	Lower winch frame	A11-41820-13-0208	200	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $400 k\Omega$ at the rated voltage of 400 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2015397	Grease pump	A11-41820-13-020 / 200

7.5.6.8 Emergency stop system

This section describes all maintenance tasks for the emergency stop system of the main hoist traction winch.

7.5.6.8.1 Inspect and test functioning of emergency stop system

Reference documents:

- [10013281A](#): Electrical drawing
- Schneider - Emergency push button

Description	Location	Reference	Symbol code	Qty.
Emergency stop button	Traction winch	Electrical drawing (+M22)	-061S14	1
Safety relay	E-cabinet +M22	Electrical drawing (+M22)	-061K1	1

NOTE The frequency for this task given in the maintenance schedule is an indication. The user is to determine the periodic schedule based on the severity of the operating environment and the frequency of switch actuation.

1. Check the emergency stop push button for damage, button looseness and excessive environmental contamination.
 - If damage is found, replace the damaged component.
 - If components are loose, tighten the loose components.
 - If dirt is found at the push button, clean the push button.
2. Check for water ingress in the push button.
 - If water is present, replace the push button.
3. Push an emergency stop button.

4. Check if the push button relay -061K1.

WARNING *The emergency safety relay that continuously monitors the state of its inputs. When an emergency stop push button is activated, the relay will directly de-activate its direct contacts. After an adjustable time (typical is 1 second) the relay will de-activate its time-delayed outputs.*

- If the relays not react correctly, replace the relay.
5. Check if SCADA gives an emergency alarm and shuts down the system.
 - If no alarm is generated and/or the system does not shut down, investigate the cause and repair/replace the failed component.
 6. Reset the emergency stop button.
 7. Reset the alarm in SCADA.

WARNING



Always test the emergency stop system for proper functioning under machine control conditions after performing maintenance.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2014302	Emergency stop relay	-061K1
2007868	Pushbutton, sub-assembly	-061S14

7.5.6.9 Cables and connections

This section describes all maintenance tasks for the cables and connections of the main hoist traction winch.

7.5.6.9.1 Inspect cables and connections

Description	Location	Reference	Symbol code	Qty.
Cables	Traction winch	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.

3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correct tightened, replace the tag, according the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

NOTE Handle the fibre optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibres with bare hands as the fibre is extremely sensitive to dirt.

7.5.6.10 Drum

This section describes all maintenance tasks for the drums of the main hoist traction winch.

7.5.6.10.1 Grease drum main shaft

Reference documents:

- [A11-41820-11-0508](#): Traction winch main shaft
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Drum main shaft	Upper traction winch	A11-41820-11-0508	1	1
Drum main shaft	Lower traction winch	A11-41820-11-0508	1	1

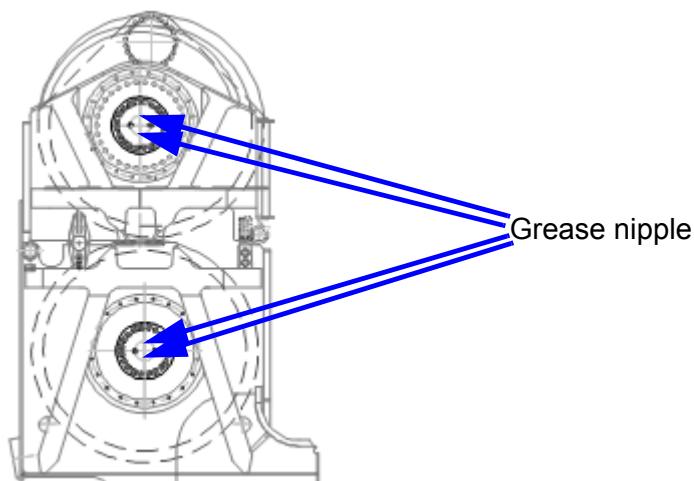


Figure 7-41: Grease points main shaft

1. Grease drum main shaft according to the greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2K-20	DIN 3404	8

7.5.6.10.2 Check spooling behavior of drum

Reference documents:

- [A11-41820-11-0108](#): Drum traction winch
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Upper drum	Traction winch	A11-41820-11-0108	-	1
Lower drum	Traction winch	A11-41820-11-0108	-	1

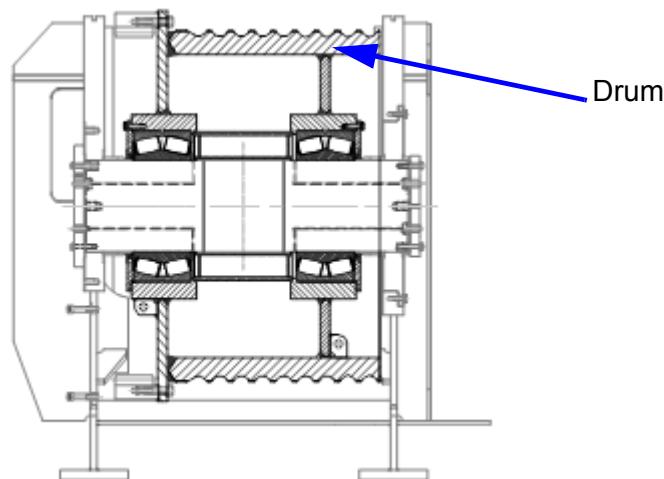


Figure 7-42: Drum

1. Check spooling behaviour of the drum according to the Huisman wire rope manual.
 - If a problem is found, investigate the cause and repair/replace the failed component.

7.5.6.10.3 Inspect drum bearing

Reference documents:

 [A11-41820-11-0108](#): Drum traction winch

Description	Location	Reference	Symbol code	Qty.
Upper drum	Traction winch	A11-41820-11-0108	-	1
Lower drum	Traction winch	A11-41820-11-0108	-	1

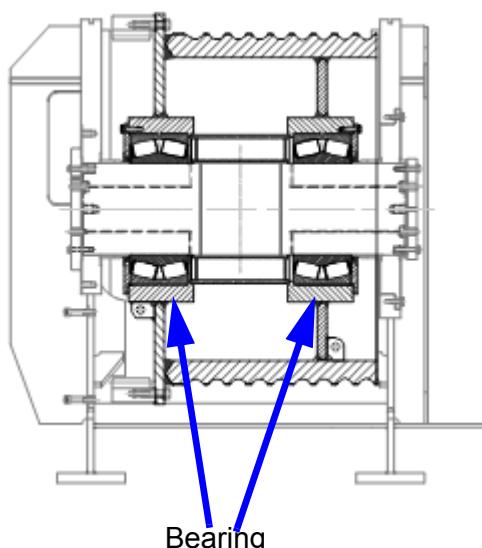


Figure 7-43: Drum bearing

1. Operate the winch.
2. Inspect functioning of drum bearing by visual and auditory inspection.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Spare parts

P/N	Part	Symbol code
2009254	Drum bearing	104
2005627	Drum bearing seal	103
On request	Drum bearing covers	-

7.5.6.10.4 Inspect drum structure

Reference documents:

- [A11-41820-11-0108](#): Drum traction winch
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Upper drum	Traction winch	A11-41820-11-0108	-	1

Description	Location	Reference	Symbol code	Qty.
Lower drum	Traction winch	A11-41820-11-0108	-	1

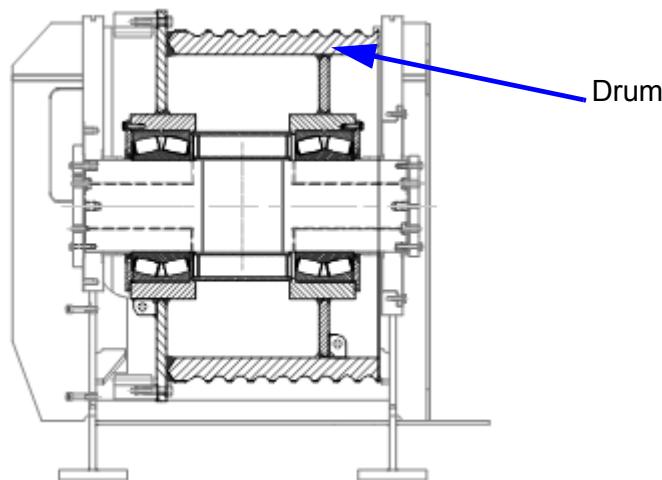


Figure 7-44: Drum

1. Unwind the wire rope from the drum.
2. Clean drum structure.
3. Visual check the drum structure for wear, cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the drum.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
4. Check paint of drum structure.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
5. Check for loose components of the drum structure.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information.

7.5.6.11 Structure

This section describes all maintenance tasks for the structure of the main hoist traction winch.

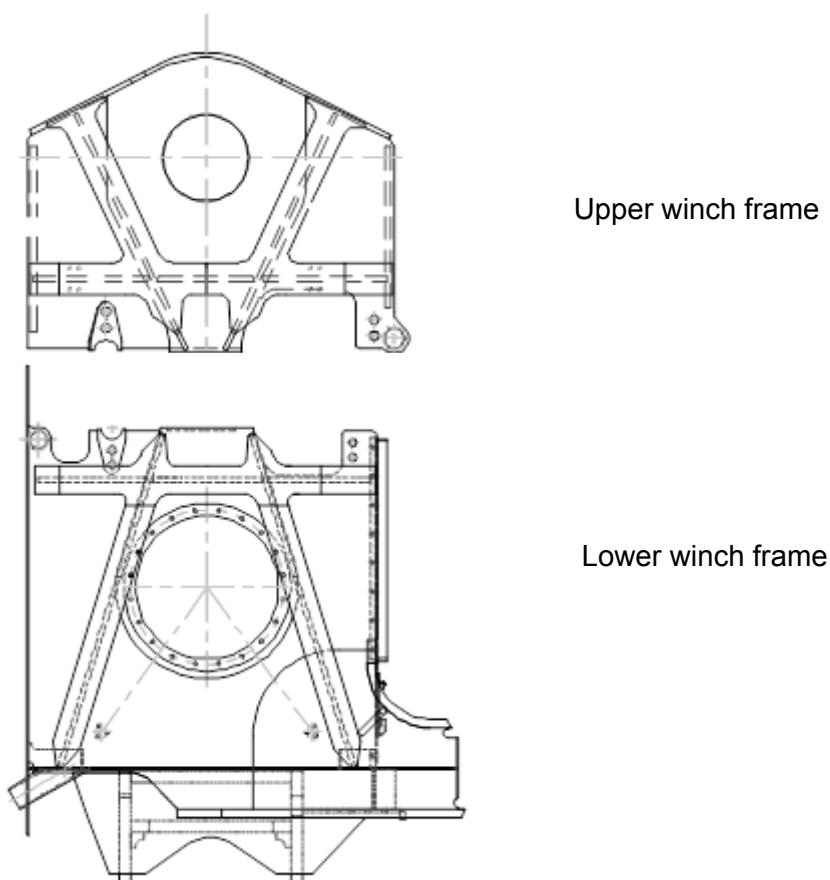


Figure 7-45: Winch frame

7.5.6.11.1 Inspect and clean winch frame

Reference documents:

- [A11-41820-13-0108](#): Lower winch frame
- [A11-41820-14-0108](#): Upper winch frame
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Upper winch frame	Rectangular mast section	A11-41820-14-0108	-	1
Lower winch frame	Rectangular mast section	A11-41820-13-0108	-	1

NOTE When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.

1. Clean the winch frame using a cloth.

2. Visual check the winch frame for cracks, damage and corrosion.
 - If cracks or significant damage are found, take contact with Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of winch frame.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the winch frame.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on the winch frame.

7.5.6.11.2 Inspect and clean platforms

Reference documents:

-  [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Platforms	Main hoist traction winch	A11-41820-56-0008	-	1

NOTE *When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.*

1. Clean the winch frame using a cloth.
2. Visual check the winch frame for cracks, damage and corrosion.
 - If cracks or significant damage are found, take contact with Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of winch frame.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the winch frame.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on the winch frame.



7.5.7 MAIN HOIST STORAGE WINCH MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
E-motor								
7.5.7.1.1	Perform SPM analysis for E-motor		3			Mechanical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.2	Inspect and clean E-motor exterior		3			Electrical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.3	Test standstill heating of E-motor		3			Electrical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.4	Test thermistor of E-motor		6			Electrical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.5	Perform thermal imaging analysis for E-motor			1		Electrical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.6	Measure insulation resistance of E-motor and cables and continuity resistance of each winding			1		Electrical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.7	Empty condensation drain holes of E-motor			1		Electrical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.8	Replace bearings of E-motor			5		Electrical	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
7.5.7.1.9	Grease bearings of E-motor			1		Hydraulic	Huisman	331.01.04.03.01.01.01 331.01.04.03.01.02.01
E-motor cooler								
7.5.7.2.1	Check filter element of E-motor cooler	7				Electrical	Huisman	331.01.04.03.01.01.01.01 331.01.04.03.01.02.01.01
7.5.7.2.2	Inspect, clean and test E-motor cooler		3			Electrical	Huisman	331.01.04.03.01.01.01.01 331.01.04.03.01.02.01.01
7.5.7.2.3	Measure insulation resistance of E-motor cooler and cables			1		Electrical	Huisman	331.01.04.03.01.01.01.01 331.01.04.03.01.02.01.01
Gearbox								
7.5.7.3.1	Check bolt connections				1000	Mechanical	Huisman	331.01.04.03.01.01.02 331.01.04.03.01.02.02
7.5.7.3.2	Check leakage of gearbox and oil level	1				Mechanical	Huisman	331.01.04.03.01.01.02 331.01.04.03.01.02.02
7.5.7.3.3	Inspect and clean exterior of gearbox		3			Mechanical	Huisman	331.01.04.03.01.01.02 331.01.04.03.01.02.02
7.5.7.3.4	Perform oil analysis		3			Mechanical	Huisman	331.01.04.03.01.01.02 331.01.04.03.01.02.02
7.5.7.3.5	Replace the gearbox oil			2	500, further each 1000	Mechanical	Liebherr	331.01.04.03.01.01.02 331.01.04.03.01.02.02
7.5.7.3.6	Check pinion wear		6			Mechanical	Huisman	331.01.04.03.01.01.02 331.01.04.03.01.02.02
7.5.7.3.7	Perform vibration analysis for gearbox			1		Mechanical	Huisman	331.01.04.03.01.01.02 331.01.04.03.01.02.02

Table 7-8: Maintenance schedule main hoist storage winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Gearbox oil cooler								
7.5.7.4.1	Check oil leakage	1				Mechanical	Huisman	331.01.04.03.01.01.02.01 331.01.04.03.01.02.02.01
7.5.7.4.2	Inspect, clean and test gearbox cooler		1			Mechanical	Huisman	331.01.04.03.01.01.02.01 331.01.04.03.01.02.02.01
7.5.7.4.3	Check oil level	7				Mechanical	Huisman	331.01.04.03.01.01.02.01 331.01.04.03.01.02.02.01
7.5.7.4.4	Inspect oil filter element	7				Mechanical	Huisman	331.01.04.03.01.01.02.01 331.01.04.03.01.02.02.01
7.5.7.4.5	Replace filter element			1		Mechanical	Huisman	331.01.04.03.01.01.02.01 331.01.04.03.01.02.02.01
7.5.7.4.6	Measure insulation resistance of cooler E-motor and cables			1		Electrical	Huisman	331.01.04.03.01.01.02.01 331.01.04.03.01.02.02.01
E-motor brake								
7.5.7.5.1	Perform automatic E-motor brake test		1			Electrical	Huisman	331.01.04.03.01.01.03 331.01.04.03.01.02.03
7.5.7.5.2	Measure E-motor brake air gap		3			Electrical	Huisman	331.01.04.03.01.01.03 331.01.04.03.01.02.03
7.5.7.5.3	Inspect and clean E-motor brake exterior		3			Electrical	Huisman	331.01.04.03.01.01.03 331.01.04.03.01.02.03
7.5.7.5.4	Measure insulation resistance of E-motor brake cables			1		Electrical	Huisman	331.01.04.03.01.01.03 331.01.04.03.01.02.03
7.5.7.5.5	Test heating of E-motor brake			1		Electrical	Huisman	331.01.04.03.01.01.03 331.01.04.03.01.02.03
7.5.7.5.6	Drain condensation water from E-motor brake			1		Electrical	Huisman	331.01.04.03.01.01.03 331.01.04.03.01.02.03
7.5.7.5.7	Clean E-motor brake interior			1		Electrical	Huisman	331.01.04.03.01.01.03 331.01.04.03.01.02.03
Slew bearing								
7.5.7.6.1	Check bolt connections				1000	Mechanical	Huisman	331.01.04.03.01.03
7.5.7.6.2	Grease slew bearing teeth			1		Mechanical	Huisman	331.01.04.03.01.03
7.5.7.6.3	Grease slew bearing		3			Mechanical	Huisman	331.01.04.03.01.03
7.5.7.6.4	Visual inspect and clean slew bearing		6			Mechanical	Huisman	331.01.04.03.01.03
7.5.7.6.5	Take grease sample from slew bearing			1		Mechanical	Huisman	331.01.04.03.01.03
Emergency stop system								
7.5.7.7.1	Inspect and test functioning of emergency stop system		1			Electrical	Huisman	331.01.04.03.03.01
Sounder beacon								

Table 7-8: Maintenance schedule main hoist storage winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.7.8.1	Inspect sounder & beacon		3			Electrical	Huisman	331.01.04.03.03.02
Cables and connections								
7.5.7.9.1	Inspect cables and connections			1		Electrical	Huisman	331.01.04.03.03.03
Drum								
7.5.7.10.1	Grease drum main shaft		3		200	Mechanical	Huisman	331.01.04.03.04.01
7.5.7.10.2	Check spooling behaviour of drum		6			Mechanical	Huisman	331.01.04.03.04.01
7.5.7.10.3	Inspect drum bearing		6			Mechanical	Huisman	331.01.04.03.04.01
7.5.7.10.4	Apply specified torque for wire rope end connection			1		Mechanical	Huisman	331.01.04.03.04.01
7.5.7.10.5	Inspect drum structure and lebus shell			1		Mechanical	Huisman	331.01.04.03.04.01
Structure								
7.5.7.11.1	Inspect and clean winch frame			1		Mechanical	Huisman	331.01.04.03.04.02
Roller chain								
7.5.7.12.1	Grease chain				Before every job	Mechanical	Huisman	331.01.04.03.05.01
7.5.7.12.2	Grease chain wheels		3			Mechanical	Huisman	331.01.04.03.05.01
7.5.7.12.3	Inspect chain		6			Mechanical	Huisman	331.01.04.03.05.01
7.5.7.12.4	Inspect and clean chain wheels			1		Electrical	Huisman	331.01.04.03.05.01
Diamond screw shaft								
7.5.7.13.1	Grease shaft bearing		3			Mechanical	Huisman	331.01.04.03.05.02
7.5.7.13.2	Check functioning of shaft bearing		6			Mechanical	Huisman	331.01.04.03.05.02
7.5.7.13.3	Inspect and clean shaft			1		Mechanical	Huisman	331.01.04.03.05.02
Grease pump								
7.5.7.14.1	Inspect, clean and test the grease pump		3			Mechanical	Huisman	331.01.04.03.05.03
7.5.7.14.2	Check functioning of pump element		6			Mechanical	Huisman	331.01.04.03.05.03
7.5.7.14.3	Refill automatic grease pump reservoir		6			Mechanical	Huisman	331.01.04.03.05.03
7.5.7.14.4	Measure insulation resistance of E-motor and cables			1		Electrical	Huisman	331.01.04.03.05.03

Table 7-8: Maintenance schedule main hoist storage winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Guide wheels								
7.5.7.15.1	Grease guide wheels		3		200	Mechanical	Huisman	331.01.04.03.05.04
7.5.7.15.2	Inspect and clean guide wheel			1		Mechanical	Huisman	331.01.04.03.05.04
Wire rollers								
7.5.7.16.1	Grease wire rollers		3			Mechanical	Huisman	331.01.04.03.05.05
7.5.7.16.2	Check functioning of wire roller bearing		6			Mechanical	Huisman	331.01.04.03.05.05
7.5.7.16.3	Inspect and clean wire rollers			1		Mechanical	Huisman	331.01.04.03.05.05
Drag chain								
7.5.7.17.1	Inspect drag chain		3			Electrical	Huisman	331.01.04.03.05.06

Table 7-8: Maintenance schedule main hoist storage winch

7.5.7.1 E-motor

This section describes all maintenance tasks for the E-motors of the main hoist storage winch.

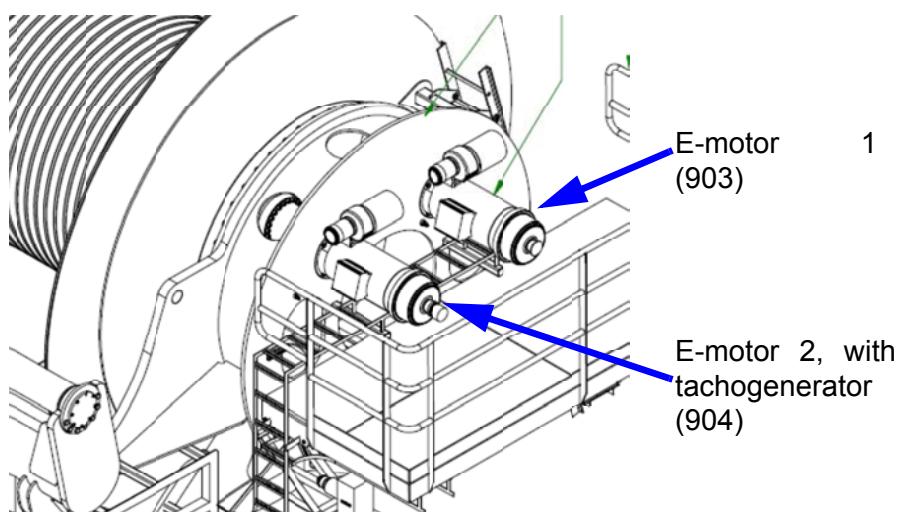


Figure 7-46: E-motor orientation

7.5.7.1.1 Perform SPM analysis for E-motor

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	A11-41830-21-0308	903	1
E-motor 2, with tacho	Storage winch, right	A11-41830-21-0308	904	1

1. Inspect the E-motor by means of Shock Pulse Measurement (SPM) to monitor the condition of the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the SPM data.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in SPM analysis. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable SPM device	1

Spare parts

P/N	Part	Symbol code
2010492	E-motor	903
2019039	E-motor with tacho	904

7.5.7.1.2 Inspect and clean E-motor exterior

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- [A11-41000-09-002](#): Paint Specification
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	A11-41830-21-0308	903	1
E-motor 2, with tacho	Storage winch, right	A11-41830-21-0308	904	1

1. Clean the exterior of the E-motor using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace E-motor.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of E-motor.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check cables and terminal box(es) of E-motor.
 - If a connection is loose, tighten the loose components.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cables.
 - If a terminal box is damaged or corroded, replace the terminal box.
 - If a terminal box suffers from water ingress, replace the terminal box.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2010492	E-motor	903
2019039	E-motor with tacho	904
On request	Terminal box of E-motor	-

7.5.7.1.3 Test standstill heating of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	Electrical drawing (+B10)	130M1	1
E-motor 2, with tacho	Storage winch, right	Electrical drawing (+B10)	130M2	1

1. Test the E-motor heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and repair/replace the failed component.
 - Make a record of the measured resistance values.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2010492	E-motor	903
2019039	E-motor with tacho	904

7.5.7.1.4 Test thermistor of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	Electrical drawing (+B10)	130M1	1
E-motor 2, with tacho	Storage winch, right	Electrical drawing (+B10)	130M2	1

1. Switch on the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Check if the resistance is increasing while running the E-motor.
 - If the resistance is 0, infinity or is not increasing while running the E-motor, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2010492	E-motor	903
2019039	E-motor with tacho	904

7.5.7.1.5 Perform thermal imaging analysis for E-motor

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	A11-41830-21-0308	903	1
E-motor 2, with tacho	Storage winch, right	A11-41830-21-0308	904	1

1. Inspect the E-motor by means of thermal imaging to monitor the condition of the E-motor. To perform the task, the E-motor should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the thermal image.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

Spare parts

P/N	Part	Symbol code
2010492	E-motor	903
2019039	E-motor with tacho	904

7.5.7.1.6 Measure insulation resistance of E-motor and cables and continuity resistance of each winding

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	A11-41830-21-0308	903	1
E-motor 2, with tacho	Storage winch, right	A11-41830-21-0308	904	1

For performing this task on the E-motor.

1. Open the cover on E-motor to access windings.
2. Megger test the E-motor windings, to find the winding insulation resistance and the insulation resistance between the coils.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For performing this task on the E-motor cables.

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation

CAUTION



Disconnect E-motor from the power source (Inverter) while performing Megger-test!

CAUTION



Windings must be discharged immediately after measuring in order to avoid electric shock.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
 - The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $690 k\Omega$ at the rated voltage of 690 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
 - If the winding is too damp, the winding must be over-dried.
-

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2010492	E-motor	903
2019039	E-motor with tacho	904

7.5.7.1.7 Empty condensation drain holes of E-motor

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	A11-41830-21-0308	903	1
E-motor 2, with tacho	Storage winch, right	A11-41830-21-0308	904	1

1. Empty condensation drain holes of E-motor.
2. Clean and check the drain holes of the E-motor and make sure that holes are open and clear.
 - If excessive grease is found, remove the grease.
 - If dirt blocks the drain holes, remove the dirt.

For more information, see the supplier documentation.

7.5.7.1.8 Replace bearings of E-motor

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	A11-41830-21-0308	903	1
E-motor 2, with tacho	Storage winch, right	A11-41830-21-0308	904	1

1. Replace E-motor bearings.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	E-motor bearings		

7.5.7.1.9 Grease bearings of E-motor

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor 1	Storage winch, left	A11-41830-21-0308	903	1
E-motor 2, with tacho	Storage winch, right	A11-41830-21-0308	904	1

1. Grease the E-motor bearings.

NOTE Ultrasonic measurement can be used to determine if greasing is necessary.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
On request		

7.5.7.2 E-motor cooler

This section describes all maintenance tasks for the E-motor coolers of the main hoist storage winch.

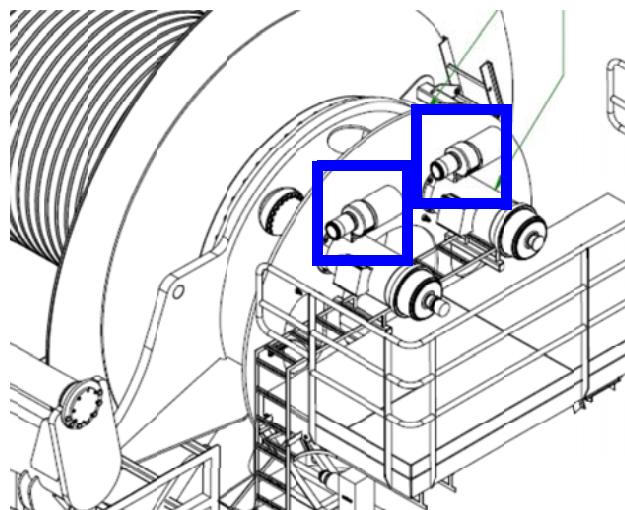


Figure 7-47: E-motor coolers

7.5.7.2.1 Check filter element of E-motor cooler

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor 1	Storage winch, left	A11-41830-21-0308	-	1
Cooler E-motor 2	Storage winch, right	A11-41830-21-0308	-	1

1. Check filter element of E-motor cooler.
 - If the filter element is clogged, replace the filter element.

Spare parts

P/N	Part	Symbol code	Qty.
On request	E-motor cooling fan filter element		

7.5.7.2.2 Inspect, clean and test E-motor cooler

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- [A11-41000-09-002](#): Paint specification
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor 1	Storage winch, left	A11-41830-21-0308	-	1
Cooler E-motor 2	Storage winch, right	A11-41830-21-0308	-	1

1. Clean air passage and cooling fan.
2. Inspect E-motor cooler exterior for damage and corrosion.
 - If significant damage is found, replace E-motor cooling fan.
 - If corrosion is found, repair the surfaces where the corrosion is found by cleaning and painting these surfaces, according to the paint specification.
 - If the blades are severely damaged, replace the cooling fan (blades).
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the Paint Specification.
4. Test functionality of cooling fan.
 - If a problem is found, investigate the cause and repair/replace the failed component.
5. Check the functioning of E-motor bearings while the cooler E-motor is off. For this rotate the fan with hand.
 - If the fan does not rotate smoothly, investigate the cause (malfunction of bearings, for example) and repair/replace the failed component.
6. Check cables of E-motor.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Cooling fan assembly	-
On request	Cooling fan E-motor	-
On request	Cooling fan blades	-

7.5.7.2.3 Measure insulation resistance of cooler E-motor and cables

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor 1	Storage winch, left	Electrical drawing (+B10)	-130M1-M1	1
Cooler E-motor 2	Storage winch, right	Electrical drawing (+B10)	-130M1-M2	1

1. Disconnect the E-motor cooler from the power source.
2. Connect the Megger to the terminals.
3. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

- NOTE**
- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
 - The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $440 k\Omega$ at the rated voltage of 440 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
 - If the winding is too damp, the winding must be over-dried.

CAUTION



The E-motor cooler must be disconnected from the power source when performing these measurements!

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
On request	E-motor cooler	-
On request	Cooling fan E-motor	-

7.5.7.3 Gearbox

This section described all maintenance tasks for the gearbox of the main hoist storage winch.

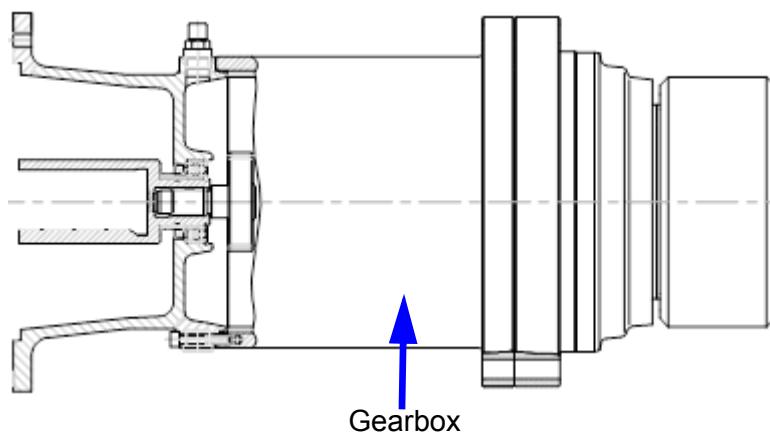


Figure 7-48: Gearbox.

7.5.7.3.1 Check bolt connections

Reference documents

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- [A11-41000-09-002](#): Paint specification
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, left	A11-41830-21-0308	101	1

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, right	A11-41830-21-0308	101	1

1. Check torque of the bolts according to the drawing A11-41830-21-0308.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque according to drawing A11-41830-21-0308 and repaint according to paint specification.
2. Check the flange holes and the bolts for wear.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information see supplier documentation.

7.5.7.3.2 Check leakage of gearbox and oil level

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- [A11-41830-00-2018](#): Greasing schedule storage winch
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, left	A11-41830-21-0308	101	1
Gearbox	Storage winch, right	A11-41830-21-0308	101	1

1. Check gearbox exterior and surroundings for oil leakage.
 - If leakage occurs, investigate the cause according to supplier documentation and take appropriate measures to prevent an unsafe situation. Then clean up the leakage.

NOTE *In the E-motor/gearbox spline connection a slight leakage can appear*

2. Check the oil level.

NOTE *Make sure the gearbox is in the proper position when checking the oil level.*

- If oil level is too low, refill oil according to the greasing schedule A11-41830-00-2018 and supplier documentation.

NOTE *Check the oil level only when the gearbox is stopped!*

NOTE

Do not overfill!

CAUTION


Do not mix oils of different types, even of the same make!

See Liebherr supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
API GL 5	-	-

Spare parts

P/N	Part	Symbol code
2012385	Gearbox	101
On request	Seal set	-

7.5.7.3.3 Inspect and clean exterior of gearbox

Reference documents

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- [A11-41000-09-002](#): Paint specification
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, left	A11-41830-21-0308	101	1
Gearbox	Storage winch, right	A11-41830-21-0308	101	1

1. Clean the exterior of the gearbox using a cloth.
2. Visual check the exterior for cracks and corrosion.
 - If cracks are found, replace gearbox.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.

3. Check noise of the gearbox.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of gearbox.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check cables of gearbox
 - If a connection is loose, tighten loose components
 - if cable sheathes are damaged or corroded, repair the cable sheathes or replace the cables.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2012385	Gearbox	101
On request	Seal set	-

7.5.7.3.4 Perform oil analysis

Reference documents

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, left	A11-41830-21-0308	101	1
Gearbox	Storage winch, right	A11-41830-21-0308	101	1

1. Take oil sample.
2. Let a certified third party perform the oil sample analysis for chemical and physical values.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.
3. Let a certified third party perform the oil sample analysis for wear, clearness and water.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.

Lubrication

Lubrication type	Type of grease nipple	Qty.
API GL 5	-	-

Spare parts

P/N	Part	Symbol code
2012385	Gearbox	101

7.5.7.3.5 Replace the gearbox oil

Reference documents

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- [A11-41830-00-2018](#): Greasing schedule storage winch
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, left	A11-41830-21-0308	101	1
Gearbox	Storage winch, right	A11-41830-21-0308	101	1

1. Replace gearbox oil according to greasing schedule A11-41830-00-2018. Change the oil every 1000 motor-hours or every 12 months.

Lubrication

Lubrication type	Type of grease nipple	Qty.
API GL 5	N/A	5,5 Liters

7.5.7.3.6 Check pinion wear

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, left	A11-41830-21-0308	101	1
Gearbox	Storage winch, right	A11-41830-21-0308	101	1

1. Visually check pinion for wear.
 - If the hardened layer is worn out, replace the gearbox.
 - if the teeth are significantly worn out in contact places, replace the gearbox or pinion.
2. Inspect pinion teeth surface for damage (pitting).
 - If the surface is not smooth anymore because of pitting, replace the gearbox or pinion and perform an analysis on the grease of the pinion teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2012385	Gearbox	101
On request	Pinion	-
On request	Pinion shaft	-
On request	Seal set	-

7.5.7.3.7 Perform vibration analysis for gearbox

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Liebherr - Slewing gear drive

Description	Location	Reference	Symbol code	Qty.
Gearbox	Storage winch, left	A11-41830-21-0308	101	1
Gearbox	Storage winch, right	A11-41830-21-0308	101	1

1. Perform measurement.
2. Analyse measurement.
 - If a problem is found, investigate the cause and repair/replace the failed component.

The internal condition of the components needs to be inspected by means of vibration analysis. Huisman recommends this analysis to be executed by a third party that is specialized in vibration analysis, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable vibration meter / analyser	1

Spare parts

P/N	Part	Symbol code
2012385	Gearbox	101

7.5.7.4 Gearbox cooler

This section describes all maintenance tasks for the gearbox cooler of the main hoist storage winch.

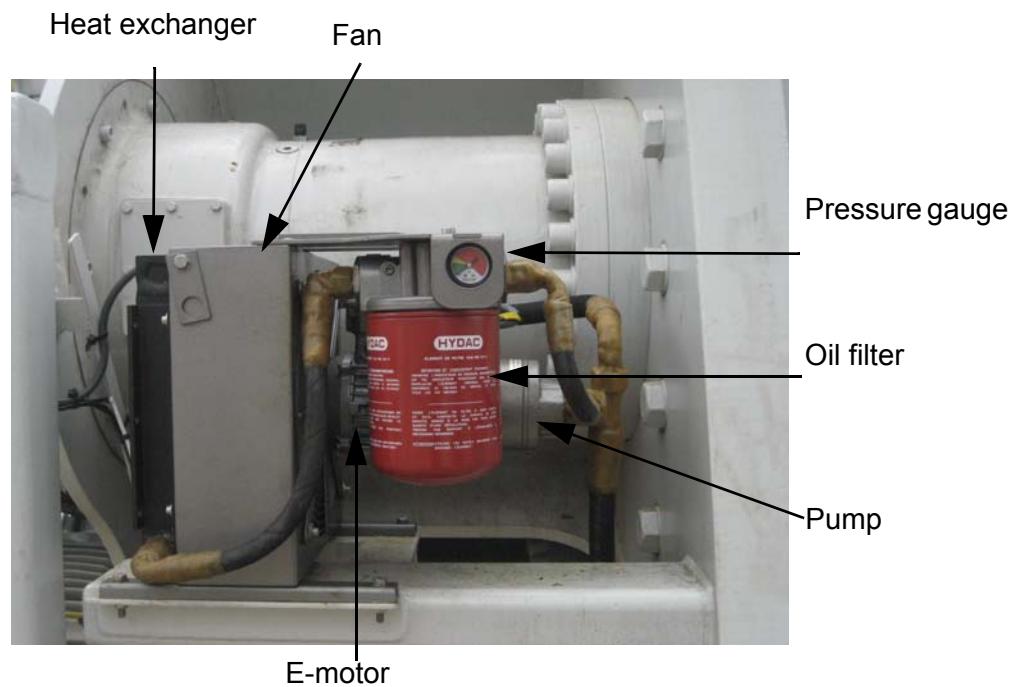


Figure 7-49: Forced cooling

7.5.7.4.1 Check oil leakage

Reference documents:

- [A11-41830-80-0108](#): Hydraulic diagram gearbox cooling storage winch
- Hydac - Oil/Air Cooler Units

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Storage winch, gearbox left	A11-41830-80-0108	Z201A	1
Gearbox cooler	Storage winch, gearbox right	A11-41830-80-0108	Z201B	1

1. Check for oil leakage in potential oil leakage areas.
 - If oil leakage is found, investigate the cause and repair / replace the failed component.

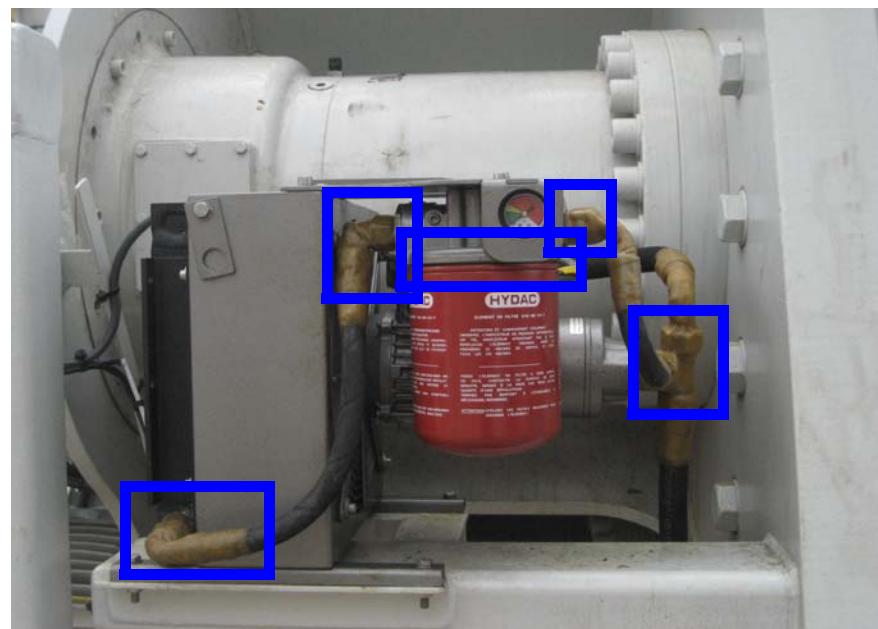


Figure 7-50: Potential oil leakage areas

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2026832	Gearbox cooler	Z201A, Z201B

7.5.7.4.2 Inspect, clean and test gearbox cooler

Reference documents:

- [A11-41830-80-0108](#): Hydraulic diagram gearbox cooling storage winch
- [A11-41000-09-002](#): Paint specification
- Hydac - Oil/Air Cooler Units

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Storage winch, gearbox left	A11-41830-80-0108	Z201A	1
Gearbox cooler	Storage winch, gearbox right	A11-41830-80-0108	Z201B	1

1. Clean the exterior of the forced cooling on the gearbox using a cloth.

2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace forced air cooling.
 - If corrosion is found, repair the surfaces where the corrosion is found by cleaning and painting these surfaces, according to the paint specification.
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.
4. Test functionality of fan.
 - If a problem is found (unusual noise or vibration), investigate the cause and repair/replace the failed component.
5. Test functionality of pump and E-motor(s).
 - If a problem is found, investigate the cause and repair/replace the failed component.
6. Inspect the breather filter for damage and contamination.
 - If the breather filter is damaged or contaminated replace the breather filter.
7. Check cables of E-motor.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.
8. Check the functioning of E-motor bearings while the cooler E-motor is off. For this rotate the fan with hand.
 - If the fan does not rotate smoothly, investigate the cause (poor lubrication/malfunction of bearings, for example) and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2026832	Gearbox cooler	Z201A, Z201B
On request	Cooling fan/pump E-motor	130M1-M2, 130M2-M2

7.5.7.4.3 Check oil level

Reference documents:

- [A11-41830-80-0108](#): Hydraulic diagram gearbox cooling storage winch
- Hydac - Oil/Air Cooler Units

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Storage winch, gearbox left	A11-41830-80-0108	Z201A	1

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler	Storage winch, gearbox right	A11-41830-80-0108	Z201B	1

1. Check oil level.
 - If the oil level is too low, refill oil of gearbox cooler.

CAUTION



Do not overfill.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51524	-	-

7.5.7.4.4 Inspect oil filter element

Reference documents:

- [A11-41830-80-0108](#): Hydraulic diagram gearbox cooling storage winch
- Hydac - Oil/Air Cooler Units

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler filter	Storage winch, gearbox cooler left	A11-41830-80-0108	N/A	1
Gearbox cooler filter	Storage winch, gearbox cooler right	A11-41830-80-0108	N/A	1

1. Inspect oil filter element for damage.
 - If oil filter is damaged, replace the oil filter.

NOTE *Huisman recommends to send the filter element for analysis when replaced.*

2. Inspect oil filter element for contamination using the contamination indicator.
 - If oil filter is clogged, replace the oil filter.

NOTE *Huisman recommends to send the filter element for analysis when replaced.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Gearbox cooler oil filter element	N/A

7.5.7.4.5 Replace filter element

Reference documents:

- [A11-41830-80-0108](#): Hydraulic diagram gearbox cooling storage winch
- Hydac - Oil/Air Cooler Units

Description	Location	Reference	Symbol code	Qty.
Gearbox cooler filter	Storage winch, gearbox cooler left	A11-41830-80-0108	N/A	1
Gearbox cooler filter	Storage winch, gearbox cooler right	A11-41830-80-0108	N/A	1

1. Shut off the gearbox cooler.
2. Isolate the filter from the system.
3. Remove the old filter elements.
4. Place new filter elements.
5. Restore the cooling system.

For more information, see the supplier documentation.

NOTE *Filters have to be replaced according to maintenance schedule and every time the gearbox oil is changed!*

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	Gearbox cooler oil filter element	N/A	6

7.5.7.4.6 Measure insulation resistance of cooler E-motor and cables

Reference documents:

- [A11-41830-80-0108](#): Hydraulic diagram gearbox cooling storage winch
- Hydac - Oil/Air Cooler Units

Description	Location	Reference	Symbol code	Qty.
Cooler E-motor	Storage winch, gearbox left	A11-41830-80-0108	130M1-M2	1
Cooler E-motor	Storage winch, gearbox right	A11-41830-80-0108	130M2-M2	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE

- *If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.*
- *The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 440 kΩ at the rated voltage of 440 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.*
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
On request	Cooler E-motor	130M1-M2, 130M2-M2

7.5.7.5 E-motor brake

This section describes all maintenance tasks for the E-motor brakes of the main hoist storage winch.

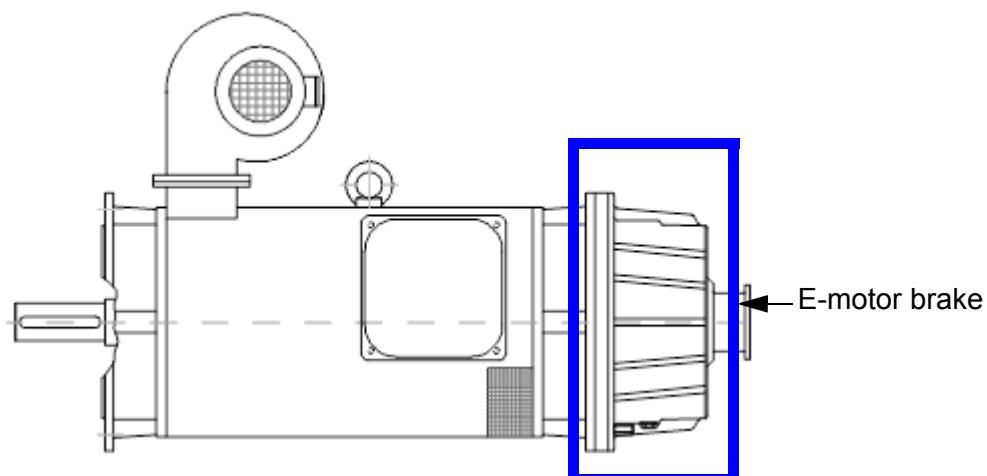


Figure 7-51: E-motor brake

7.5.7.5.1 Perform automatic E-motor brake test

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Storage winch, E-motor left	A11-41830-24-0308	-	1
E-motor brake	Storage winch, E-motor right	A11-41830-24-0308	-	1

1. Perform brake test according to section [7.2.13](#) for each individual brake.
 - If the brake holds the rated load without slipping, SCADA pop-up will display "Brake test passed".
 - If an alarm is generated, investigate the cause and repair/replace the failed component.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049840	E-motor brake	-

7.5.7.5.2 Measure E-motor brake air gap

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Storage winch, E-motor left	A11-41830-24-0308	-	1
E-motor brake	Storage winch, E-motor right	A11-41830-24-0308	-	1

1. Execute this task according to [7.2.13 Brake section in general maintenance](#).
 - If the value exceeds the maximum as shown on the brake plate, reverse the brake flange (as temporary solution) or replace the brake set (Brake flange, armature plate and friction plate).

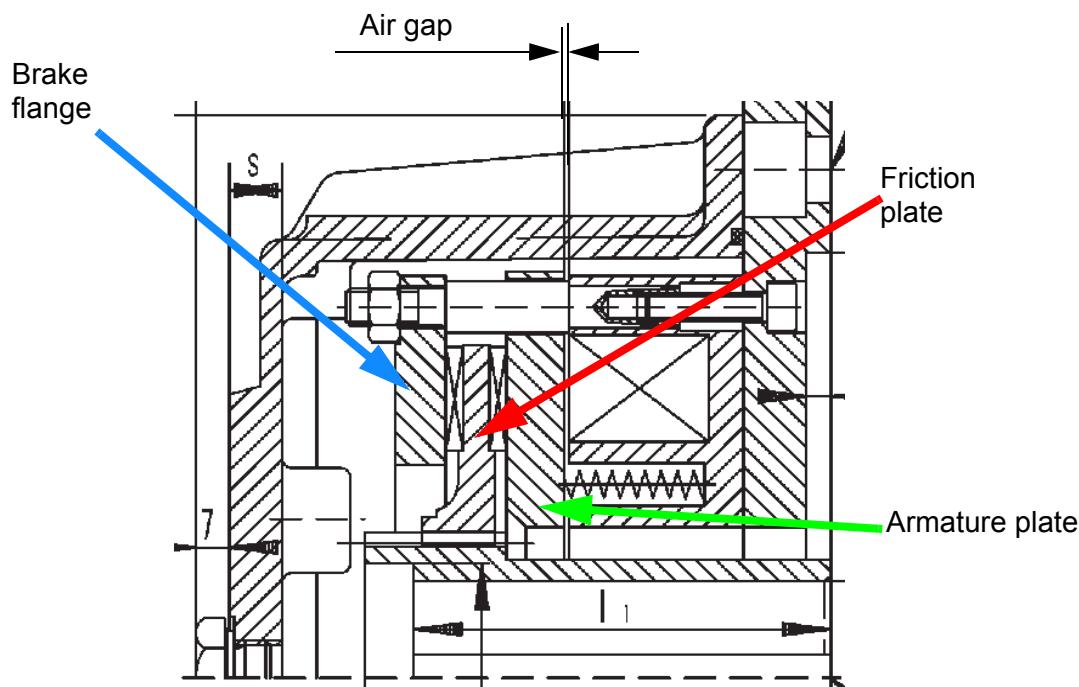


Figure 7-52: E-motor brake

NOTE When installing a new brake, adjust the air gap according to the [7.2.13 Brake section in general maintenance](#).

NOTE *It is important to run in the new brake liners after installation. Run-in procedure is described in [7.2.13](#) Brake section in general maintenance.*

For more information, see the supplier documentation.

Air gap

Minimum (mm)	Maximum (mm)
0.4	1.4

Special tools

P/N	Tool	Qty.
On request	Feeler gauge (required accuracy ±0.05mm)	1

Spare parts

P/N	Part	Symbol code
2049840	E-motor brake	-
On request	Brake flange	
On request	Armature plate	
On request	Friction plate	

7.5.7.5.3 Inspect and clean E-motor brake exterior

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Storage winch, E-motor left	A11-41830-24-0308	-	1
E-motor brake	Storage winch, E-motor right	A11-41830-24-0308	-	1

1. Clean the exterior of the E-motor brake using a cloth.
2. Visual check the exterior of the E-motor brake for damage and excessive corrosion.
 - If significant damage or corrosion is found, replace E-motor brake.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049840	E-motor brake	-

7.5.7.5.4 Measure insulation resistance of E-motor brake and cables

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Storage winch, E-motor left	A11-41830-24-0308	-	1
E-motor brake	Storage winch, E-motor right	A11-41830-24-0308	-	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

-
- NOTE**
- *The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 110 kΩ at the rated voltage of 110 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.*
 - If the winding is too damp, the winding must be over-dried.
-

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2049840	E-motor brake	-

7.5.7.5.5 Test heating of E-motor brake

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Storage winch, E-motor left	A11-41830-24-0308	-	1
E-motor brake	Storage winch, E-motor right	A11-41830-24-0308	-	1

1. Test the E-motor brake heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049840	E-motor brake	-

7.5.7.5.6 Drain condensation water from E-motor brake

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Storage winch, E-motor left	A11-41830-24-0308	-	1
E-motor brake	Storage winch, E-motor right	A11-41830-24-0308	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.7.5.7 Clean E-motor brake interior

Reference documents:

- [A11-41830-21-0308](#): Slewing Bearing, Chain- & Mainshaft
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Storage winch, E-motor left	A11-41830-24-0308	-	1
E-motor brake	Storage winch, E-motor right	A11-41830-24-0308	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.7.6 Slew bearing

This section describes all maintenance tasks for the slew bearing of the main hoist storage winch.

7.5.7.6.1 Check bolt connections

Reference documents

- [A11-41830-21-0108](#): Winch frame
- [A11-41830-21-0308](#): Slew bearing, chain & main shaft
- [A11-41000-09-002](#): Paint specification
- Liebherr - Ball slewing ring

Description	Location	Reference	Symbol code	Qty.
Slew bearing	Storage winch	A11-41830-21-0108	200	1

1. Check torque of the bolts according to drawing A11-41830-21-0308.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque and repaint according to paint specification.

7.5.7.6.2 Grease slew bearing teeth

Reference documents:

- [A11-41830-21-0108](#): Winch frame
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Slew bearing	Storage winch	A11-41830-21-0108	200	1

1. If necessary, remove old grease.
2. Grease main gearbox teeth according to greasing schedule.

NOTE *Check the amount of excessive grease extruded from the teeth contact area after every job and replenish the grease!*

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51825 KPHC 1-2N-40	-	N/A

7.5.7.6.3 Grease main gearbox slew bearing

Reference documents:

- [A11-41830-21-0108](#): Winch frame
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Slew bearing	Storage winch	A11-41830-21-0108	200	1

1. If necessary, remove old grease.
2. Grease main gearbox bearing according to greasing schedule.

There are 6 greasing points foreseen on the bearing.

NOTE *Check the amount of excessive grease extruded from the bearing after every job and replenish the grease!*

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	N/A	N/A

7.5.7.6.4 Visual inspect and clean slew bearing

Reference documents:

- [A11-41830-21-0108](#): Winch frame
- [A11-41000-09-002](#): Paint specification
- Liebherr - Ball slewing ring

Description	Location	Reference	Symbol code	Qty.
Slew bearing	Storage winch	A11-41830-21-0108	200	1

1. Clean the exterior and the surroundings of the slew bearing.
2. Check the slew bearing exterior for cracks and corrosion.
 - If cracks are found, replace slew bearing.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.
3. Check noise of the slew bearing.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of slew bearing.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check and clean the slew bearing seal.
 - If excessive wear or damage occurs, replace the seal.
6. Inspect gear teeth surface for damage, wear and pitting.
 - If the hardened layer of gear teeth is worn out, replace the slew bearing.
 - If the surface is not smooth anymore because of pitting, replace the slew bearing and perform an analysis on the grease of the gear teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2016264	Slew bearing	200
On request	Slew bearing seal	-

7.5.7.6.5 Take grease sample from slew bearing

Reference documents:

- [A11-41830-21-0108](#): Winch frame
- [A11-41000-09-002](#): Paint specification
- Liebherr - Ball slewing ring

Description	Location	Reference	Symbol code	Qty.
Slew bearing	Storage winch	A11-41830-21-0108	200	1

1. Take grease sample according to supplier documentation.
2. Analyse grease sample for chemical and physical values.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Special tools

P/N	Tool	Qty.
On request	Grease sampling set	

Spare parts

P/N	Part	Symbol code
2016264	Slew bearing	200

7.5.7.7 Emergency stop system

This section describes all maintenance tasks for the emergency stop system of the main hoist storage winch.

7.5.7.7.1 Inspect and test functioning of emergency stop system

Reference documents:

- [10013281A](#): Electrical drawing
- Schneider - Emergency push button

Description	Location	Reference	Symbol code	Qty.
Emergency stop button	E-cabinet storage winch	Electrical drawing (+B20)	-061S3	1
Safety relay	E-cabinet +M22	Electrical drawing (+M22)	-061K1	1

NOTE The frequency for this task given in the maintenance schedule is an indication. The user is to determine the periodic schedule based on the severity of the operating environment and the frequency of switch actuation.

1. Check the emergency stop push button for damage, button looseness and excessive environmental contamination.
 - If damage is found, replace the damaged component.
 - If components are loose, tighten the loose components.
 - If dirt is found at the push button, clean the push button.
2. Check for water ingress in the push button.
 - If water is present, replace the push button.
3. Push an emergency stop button.
4. Check if the push button relay -061K1.

WARNING  *The emergency safety relay that continuously monitors the state of its inputs. When an emergency stop push button is activated, the relay will directly de-activate its direct contacts. After an adjustable time (typical is 1 second) the relay will de-activate its time-delayed outputs.*

- If the relays not react correctly, replace the relay.
5. Check if SCADA gives an emergency alarm and shuts down the system.
 - If no alarm is generated and/or the system does not shut down, investigate the cause and repair/replace the failed component.
6. Reset the emergency stop button.
7. Reset the alarm in SCADA.

WARNING  *Always test the emergency stop system for proper functioning under machine control conditions after performing maintenance.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2014302	Emergency stop relay	-061K1
2007883	Pushbutton, sub-assembly	-061S3
2001638	Mushroomhead red	-061S3
2007885	Mushroom protection guard	-061S3
2013243	Fastening clamp	-061S3

7.5.7.8 Sounder and beacon

This section describes all maintenance tasks for the sounder and beacon of the main hoist traction winch.



Figure 7-53: Sounder & Beacon (typical)

7.5.7.8.1 Inspect sounder & beacon

Reference documents:

- Cooper - Product Manual Standard Asserta Sounder

Description	Location	Reference	Symbol code	Qty.
Sounder & beacon	Storage winch	-	-	1

1. Check the function of the sounder & beacon.
 - If a problem occurs, check the connections (terminals) or replace the failed component.
 - When replacing a sounder & beacon unit, apply the correct sound setting and volume of the sounder.
 - Check if the sounder & beacon is watertight (no water ingress present), if water, inside the unit is present replace the unit.

Spare parts

P/N	Part	Symbol code
On request	Sounder & Beacon (Cooper, Asserta)	-

7.5.7.9 Cables and connections

This section describes all maintenance tasks for the cables and connections of the main hoist storage winch.

7.5.7.9.1 Inspect cables and connections:

Description	Location	Reference	Symbol code	Qty.
Cables	Storage winch	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correctly tightened, replace the tag, according to the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

7.5.7.10 Drum

This section describes all maintenance tasks for the drums of the main hoist storage winch.

7.5.7.10.1 Grease drum main shaft

Reference documents:

- [A11-41830-00-2018](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Drum main shaft	Storage winch	A11-41830-00-2018	1	1

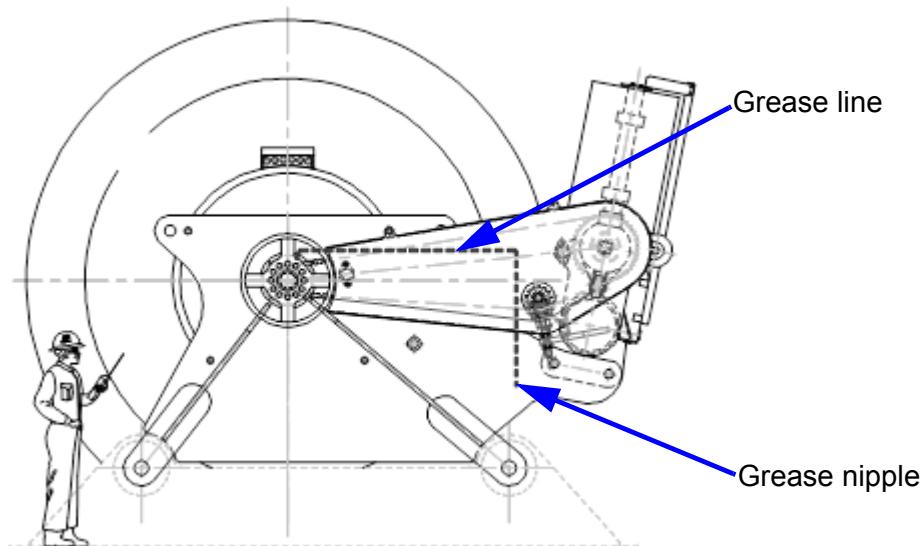


Figure 7-54: Grease point main shaft

1. Grease drum main shaft according to the greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2K-20	G1/4" DIN 3404	-

7.5.7.10.2 Check spooling behavior of drum

Reference documents:

- [A11-41830-21-0208](#): Winch drum storage winch
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Winch drum	Storage winch	A11-41830-21-0208	-	1

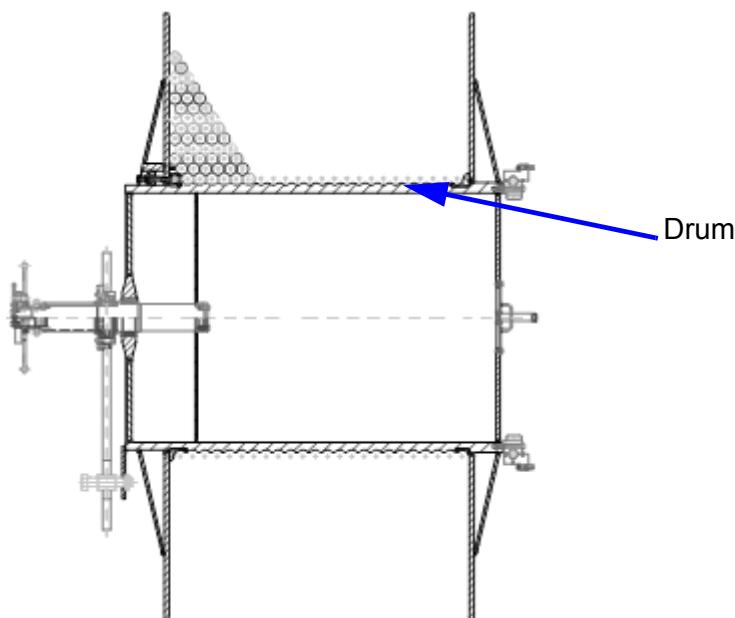


Figure 7-55: Drum

1. Check spooling behaviour of the drum according to the Huisman wire rope manual.
 - If a problem is found, investigate the cause and repair/replace the failed component.

7.5.7.10.3 Inspect drum bearing

Reference documents:

- [A11-41830-21-0308](#): Slewing bearing, chain- & mainshaft

Description	Location	Reference	Symbol code	Qty.
Drum bearing	Storage winch	A11-41830-21-0308	703	1

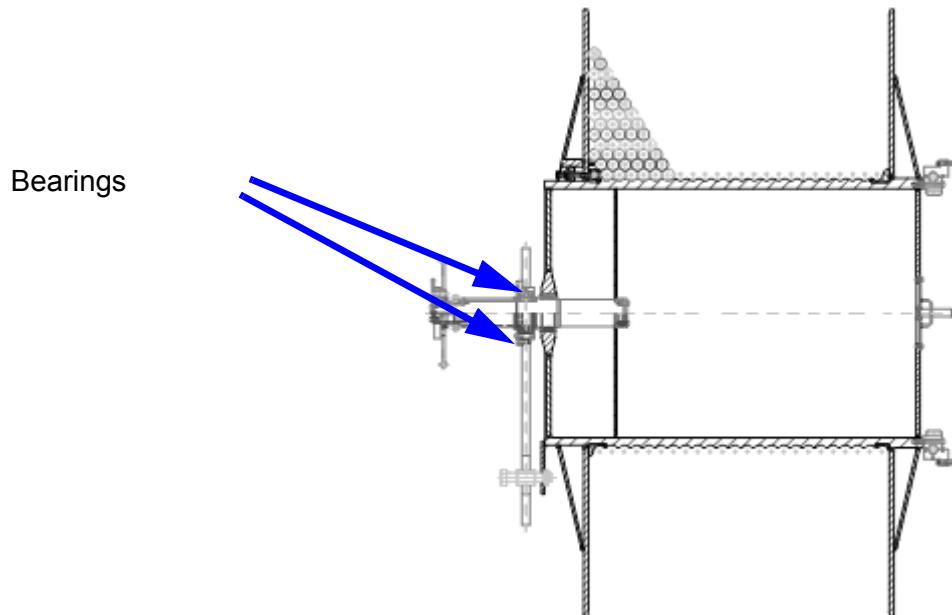


Figure 7-56: Drum bearing

1. Operate the winch.
2. Inspect functioning of drum bearing by visual and auditory inspection.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Spare parts

P/N	Part	Symbol code
2006958	Drum bearing	703
2003835	V-ring	702

7.5.7.10.4 Apply specified torque for wire rope end connection

Reference documents:

- [A11-41830-21-0208](#): Winch drum storage winch
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Wire rope end connection	Storage winch	A11-41830-21-0208	18	1

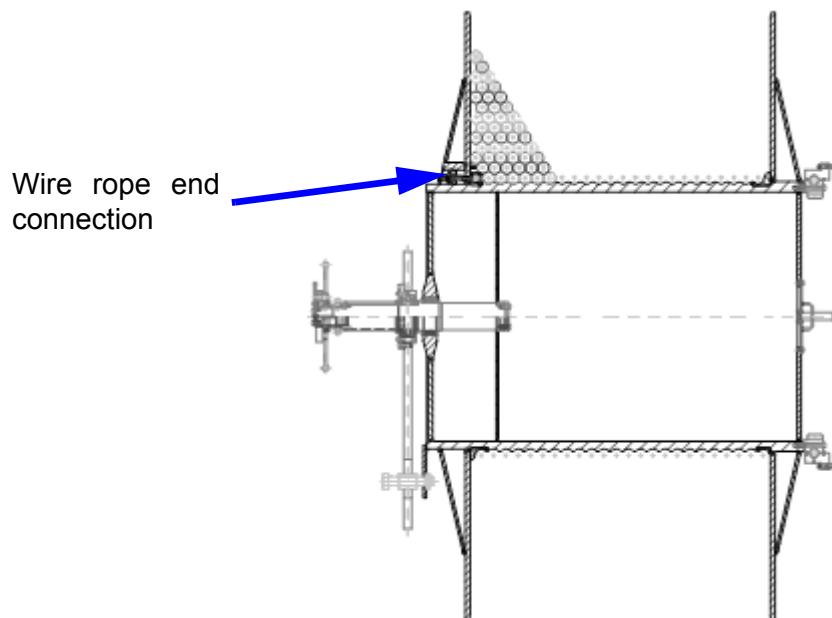


Figure 7-57: Wire rope end connection

1. Apply the specified torque for wire rope end connection according to specification.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Specified torque

Description	Torque
Wire rope end connection bolts	1759 Nm

Spare parts

P/N	Part	Symbol code
On request	Wire rope end connection plates	18
2036080	Hex head bolt	28
2000557	Hex nut	501

7.5.7.10.5 Inspect drum structure

Reference documents:

- [A11-41830-21-0208](#): Winch drum storage winch

 [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Winch drum	Storage winch	A11-41830-21-0208	-	1

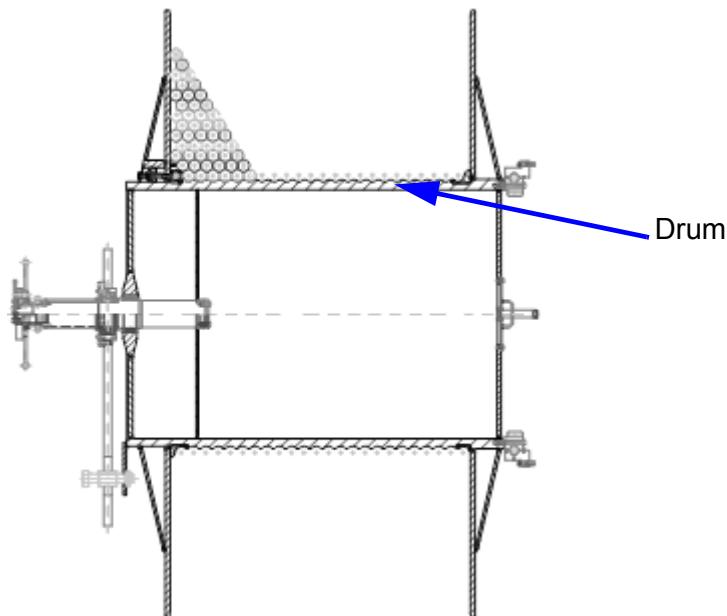


Figure 7-58: Drum

1. Unwind the wire rope from the drum.
2. Clean drum structure.
3. Visual check the drum structure for wear, cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the drum.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
4. Check paint of drum structure.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
5. Check for loose components of the drum structure (including wire rope end connection).
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information.

7.5.7.11 Structure

This section describes all maintenance tasks for the structure of the main hoist storage winch.

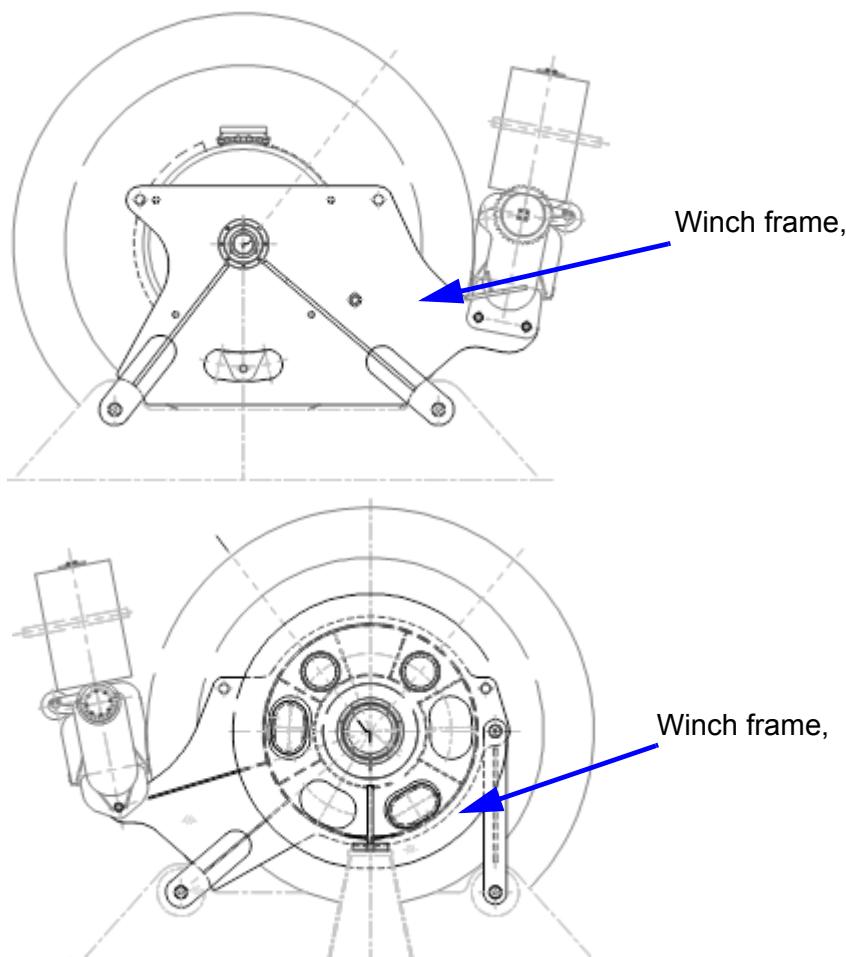


Figure 7-59: Winch frame

7.5.7.11.1 Inspect and clean winch frame

Reference documents:

- [A11-41830-21-0108](#): Storage winch frame
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Winch frame	Storage winch	A11-41830-21-0108	-	1

NOTE When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.

1. Clean the winch frame using a cloth.
2. Visual check the winch frame for cracks, damage and corrosion.
 - If cracks or significant damage are found, take contact with Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of winch frame.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the winch frame.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on the winch frame.

7.5.7.12 Roller chain

This section describes all maintenance tasks for the roller chain of the main hoist storage winch.

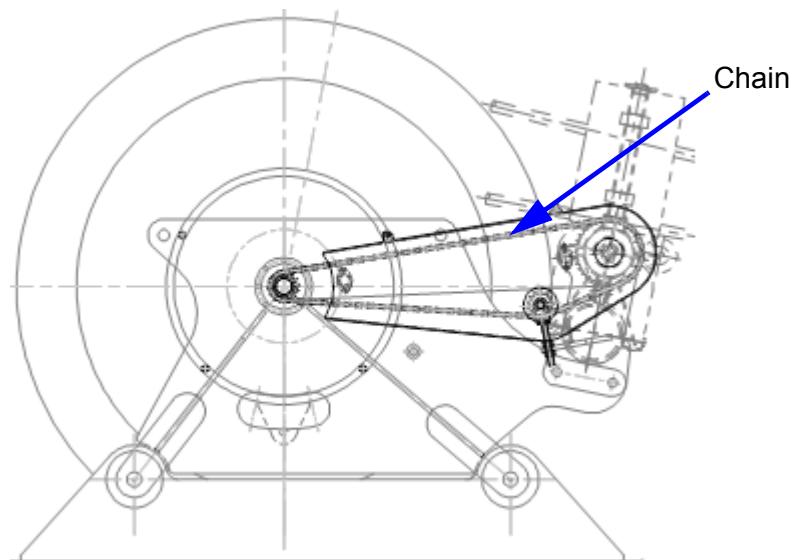


Figure 7-60: Roller chain

7.5.7.12.1 Grease roller chain

Reference documents:

- [A11-41830-00-2018](#): Grease schedule

Description	Location	Reference	Symbol code	Qty.
Roller chain	Storage winch	A11-41830-00-2018	101	1

1. Grease roller chain according to the grease schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
Mobil Mobilux EP2	-	-

7.5.7.12.2 Grease chain wheels

Reference documents:

- [A11-41830-00-2018](#): Grease schedule

Description	Location	Reference	Symbol code	Qty.
Chain wheel on main shaft	Storage winch	A11-41830-00-2018	-	1
Chain wheel on chain tensioner	Storage winch	A11-41830-00-2018	-	1

1. Grease chain wheels according to the grease schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
Mobil Mobilux EP2	-	-

7.5.7.12.3 Inspect roller chain

Reference documents:

- [A11-41830-21-0608](#): Chain tensioner spool. device drive

Description	Location	Reference	Symbol code	Qty.
Roller chain	Storage winch	A11-41830-21-0608	101	1

1. Check if chain stays in contact with the chain tensioner.
 - If the chain does not stay in contact, adjust the chain tensioner.
 - If the chain tensioner cannot be further adjusted, replace the chain.
2. Check the chain for cracks, damage and corrosion.
 - If cracks, significant damage or corrosion is found, replace the roller chain.

Spare parts

P/N	Part	Symbol code
2014008	Roller chain	101

7.5.7.12.4 Inspect and clean chain wheels

Reference documents:

- [A11-41830-21-0308](#): Slewing bearing, chain- & main shaft
- [A11-41830-21-0508](#): Spooling device frame and shaft

Description	Location	Reference	Symbol code	Qty.
Chain wheel on main shaft	Storage winch	A11-41830-21-0308	9	1
Chain wheel on chain tensioner	Storage winch	A11-41830-21-0508	59	1

1. Clean chain wheels.
2. Check the chain wheels for cracks, damage and corrosion.
 - If cracks, significant damage or corrosion is found, replace the chain wheel.

Spare parts

P/N	Part	Symbol code
9134250	Chain wheel	9
9134237	Chain wheel	59

7.5.7.13 Diamond screw shaft

This section describes all maintenance tasks for the diamond screw shaft of the main hoist storage winch.

7.5.7.13.1 Grease shaft bearings

Reference documents:

■ [A11-41830-00-2018](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Shaft bearings	Storage winch	A11-41830-00-2018	-	2

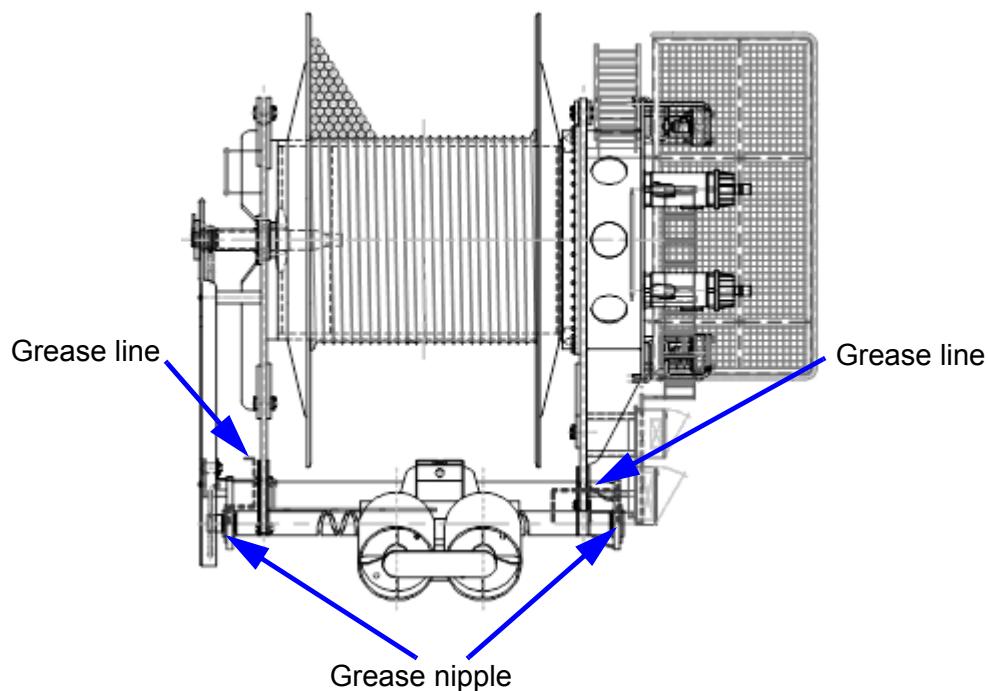


Figure 7-61: Grease points shaft bearing

1. Grease diamond screw shaft bearings according to the greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2K-20	G1/4" DIN 3404	-

7.5.7.13.2 Inspect bearing

Reference documents:

- [A11-41830-21-0508](#): Spooling device frame and shaft

Description	Location	Reference	Symbol code	Qty.
Shaft bearings	Storage winch, non-drive side	A11-41830-21-0508	106	1
Shaft bearings	Storage winch, drive side	A11-41830-21-0508	106	1

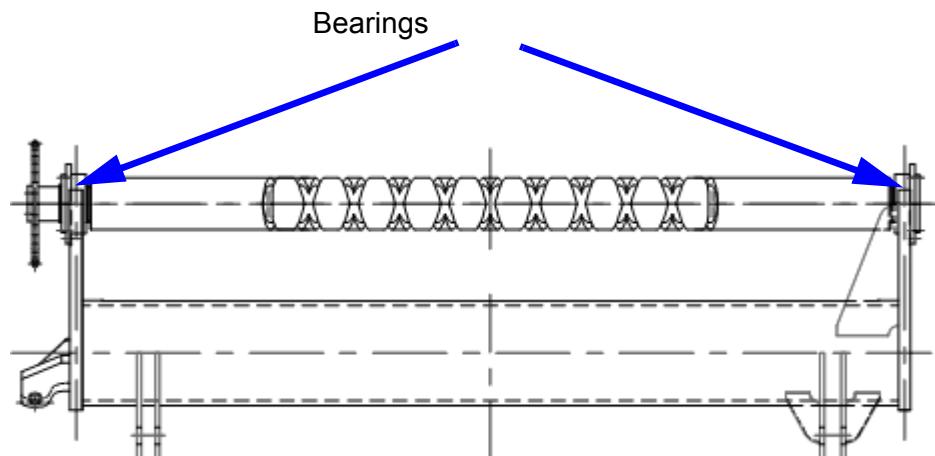


Figure 7-62: Diamond screw shaft bearing

1. Operate the winch.
2. Inspect functioning of diamond screw shaft bearing by visual and auditory inspection.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Spare parts

P/N	Part	Symbol code
2008110	Drum bearing	A11-41830-21-050 / 106
2003121	V-ring	A11-41830-21-050 / 105

7.5.7.13.3 Inspect and clean shaft

Reference documents:

- [A11-41830-21-0508](#): Spooling device frame and shaft

Description	Location	Reference	Symbol code	Qty.
Winch drum	Storage winch	A11-41830-21-0508	-	1

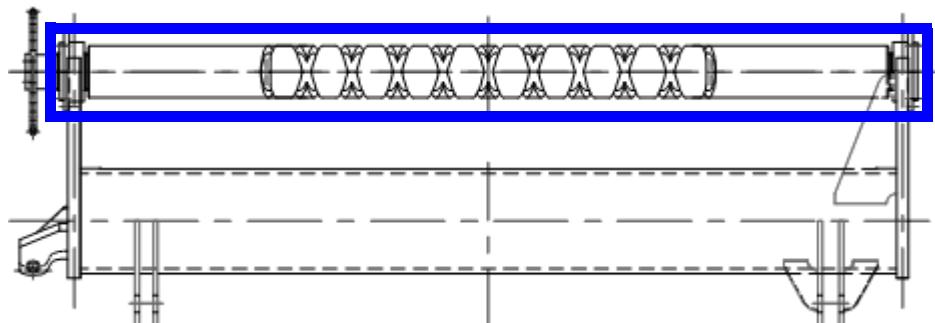


Figure 7-63: Diamond screw shaft

1. Clean diamond screw shaft.
2. Visual check the diamond screw shaft for wear, cracks, damage and corrosion.
 - If cracks, corrosion or significant damage is found, repair/replace the diamond screw shaft.

Contact Huisman for part information.

7.5.7.14 Grease pump

This section describes all maintenance tasks for the grease pump of the main hoist storage winch.

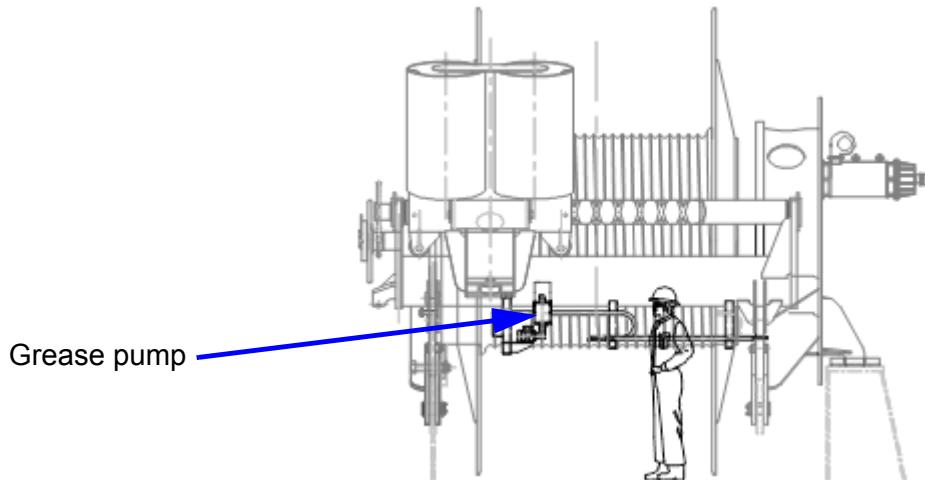


Figure 7-64: Automatic grease pump

7.5.7.14.1 Inspect, clean and test grease pump

Reference documents:

- [A11-41830-21-0708](#): Drag chain for grease pump
- [A11-41000-09-002](#): Paint specification
- Vogel - Grease pump

Description	Location	Reference	Symbol code	Qty.
Grease pump	Spooling device	A11-41830-21-0708	103	1

1. Clean the exterior of the grease pump assembly using a cloth.
2. Visual inspect the grease pump for damage.
 - If a significant damage on the pump is found, repair/replace the grease pump.
 - If the fill level switch is damaged, replace the pump.
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.
4. Visual inspect the grease pump E-motor.
 - If the grease pump E-motor is damaged, replace the grease pump assembly.
5. Check the functioning of E-motor bearings. For this disassemble the E-motor from the pump assembly, thereby leave the cables connected. Activate the E-motor via SCADA and check if the E-motor shaft rotates smoothly.
 - If the E-motor shaft does not rotate smoothly, investigate the cause (poor lubrication).

- tion/malfunction of bearings, for example).
- If the grease pump E-motor bearings are poorly lubricated, grease the bearings.
 - If the grease pump E-motor bearings are defective, replace the pump assembly.
6. Check cables of E-motor.
- If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2010441	Grease pump	A11-41830-21-070 / 103

Lubrication

Lubrication type	Type of grease nipple	Qty.
Mobil Mobilith SHC 460	-	4.5 liters

7.5.7.14.2 Check functioning of pump element

Reference documents:

- [A11-41830-21-0708](#): Drag chain for grease pump
- Vogel - Grease pump

Description	Location	Reference	Symbol code	Qty.
Grease pump	Spooling device	A11-41830-21-0708	103	1



Figure 7-65: Pump elements

1. Check if the grease is coming out of the grease lines.
 - If no grease is flowing through the dosing unit, investigate the cause and repair/replace the failed component.
2. Check if there is excessive grease.
 - If too much excessive grease is found, check the electrical circuit of the greasing pump.
 - If the electrical circuit of the greasing pump is alright, adjust the grease supply rate at pump element. For the adjustment procedure see the supplier manual (Vogel).

NOTE

Before performing this task make sure that the reservoir is fully filled!

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2010441	Grease pump	103

7.5.7.14.3 Refill automatic grease pump reservoir

Reference documents:

- [A11-41830-21-0708](#): Drag chain for grease pump
- Vogel - Grease pump

Description	Location	Reference	Symbol code	Qty.
Grease pump	Spooling device	A11-41830-21-0708	103	1

1. Check level of reservoir.
 - Refill reservoir according to greasing schedule to maximum level with the appropriate grease type.

NOTE Proper tracking of grease consumption can aid in indicating problems.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
MOBIL MOBILUX EP2	-	4.5 liters

7.5.7.14.4 Measure insulation resistance of E-motor and cables

Reference documents:

- [A11-41830-21-0708](#): Drag chain for grease pump
- Vogel - Grease pump

Description	Location	Reference	Symbol code	Qty.
Grease pump	Spooling device	A11-41830-21-0708	103	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $400 k\Omega$ at the rated voltage of 400 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2010441	Grease pump	103

7.5.7.15 Guide wheels

This section describes all maintenance tasks for the guide wheels of the main hoist storage winch.

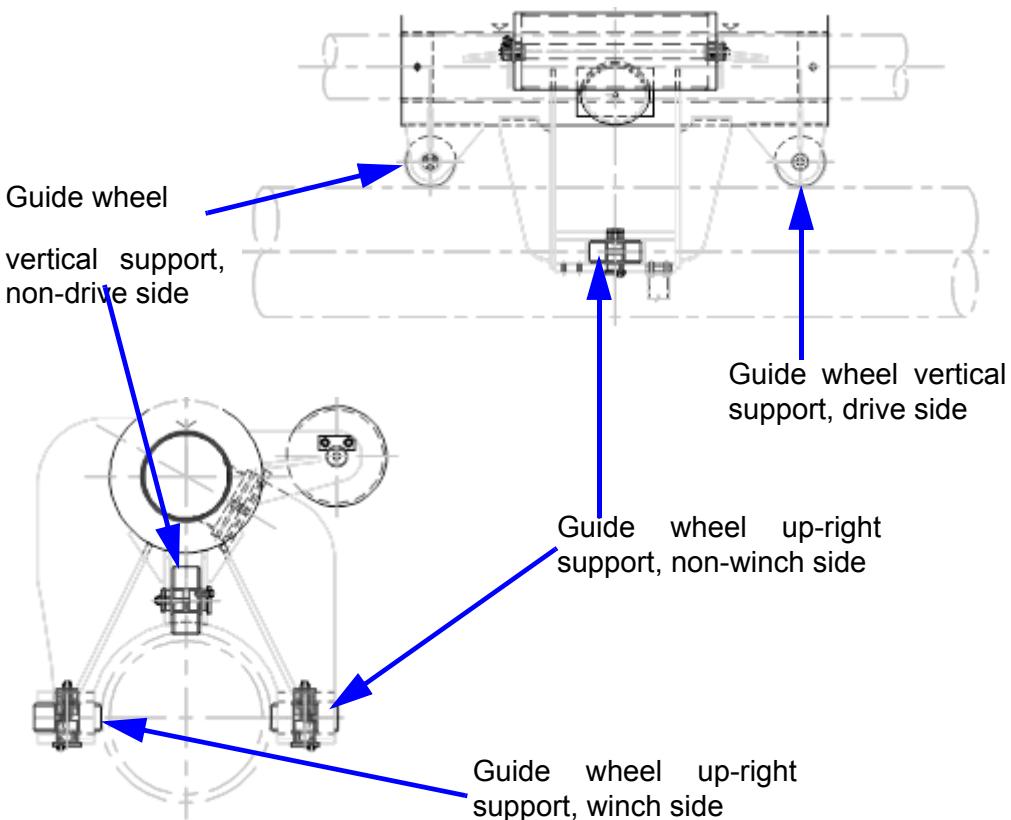


Figure 7-66: Guide wheels

7.5.7.15.1 Grease guide wheels

Reference documents:

- [A11-41830-21-0408](#): Spooling device diamond screw block
- [A11-41830-00-2018](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Guide wheel vertical support	Storage winch, non-drive side	A11-41830-21-040	57	1
Guide wheel vertical support	Storage winch, drive side	A11-41830-21-040	57	1
Guide wheel up-right support	Storage winch, non-winch side	A11-41830-21-040	57	1
Guide wheel up-right support	Storage winch, winch side	A11-41830-21-040	57	1

1. Grease guide wheels according to the greasing schedule.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 52501 KP 2 K-20	-	-

7.5.7.15.2 Inspect and clean guide wheels

Reference documents:

-  [A11-41830-21-0408](#): Spooling device diamond screw block

Description	Location	Reference	Symbol code	Qty.
Guide wheel vertical support	Storage winch, non-drive side	A11-41830-21-040	57	1
Guide wheel vertical support	Storage winch, drive side	A11-41830-21-040	57	1
Guide wheel up-right support	Storage winch, non-winch side	A11-41830-21-040	57	1
Guide wheel up-right support	Storage winch, winch side	A11-41830-21-040	57	1

1. Clean the guide wheels using a cloth.
2. Visual check the guide wheels for cracks, damage and corrosion.
 - If cracks, corrosion or significant damage is found, replace the guide wheel.

Spare parts

P/N	Part	Symbol code
9120002	Guide wheel	57

7.5.7.16 Wire rollers

This section describes all maintenance tasks for the wire rollers of the main hoist storage winch.

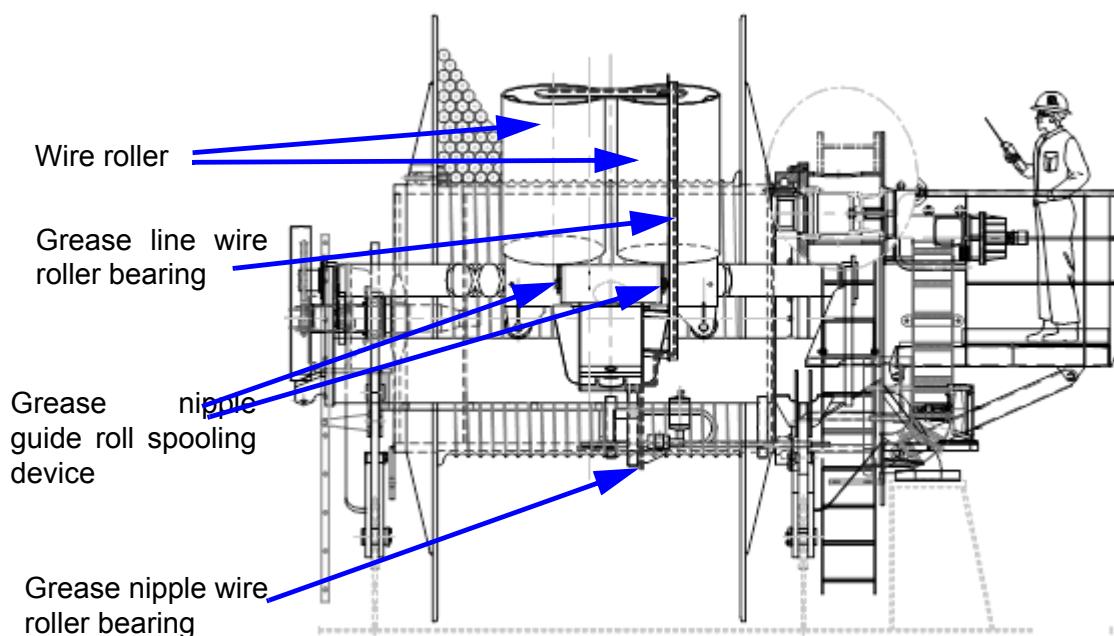


Figure 7-67: wire rollers

7.5.7.16.1 Grease roller

Reference documents:

- [A11-41830-21-0408](#): Spooling device diamond screw block
- [A11-41830-00-2018](#): Grease schedule

Description	Location	Reference	Symbol code	Qty.
Wire roller	Storage winch, non-drive side	A11-41830-21-0408	N/A	1
Wire roller	Storage winch, drive side	A11-41830-21-0408	N/A	1

1. Grease the wire roller bearing according to the greasing schedule A11-41830-00-2018.
2. Grease the guide roller spooling device according to the greasing schedule A11-41830-00-2018.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	-

7.5.7.16.2 Inspect wire roller bearing

Reference documents:

- [A11-41830-21-0408](#): Spooling device diamond screw block

Description	Location	Reference	Symbol code	Qty.
Wire roller bearings	Top of roller, non-drive side	A11-41830-21-0408	101	1
Wire roller bearings	Bottom of roller, non-drive side	A11-41830-21-0408	101	1
Wire roller bearings	Top of roller, drive side	A11-41830-21-0408	101	1
Wire roller bearings	Bottom of roller, drive side	A11-41830-21-0408	101	1

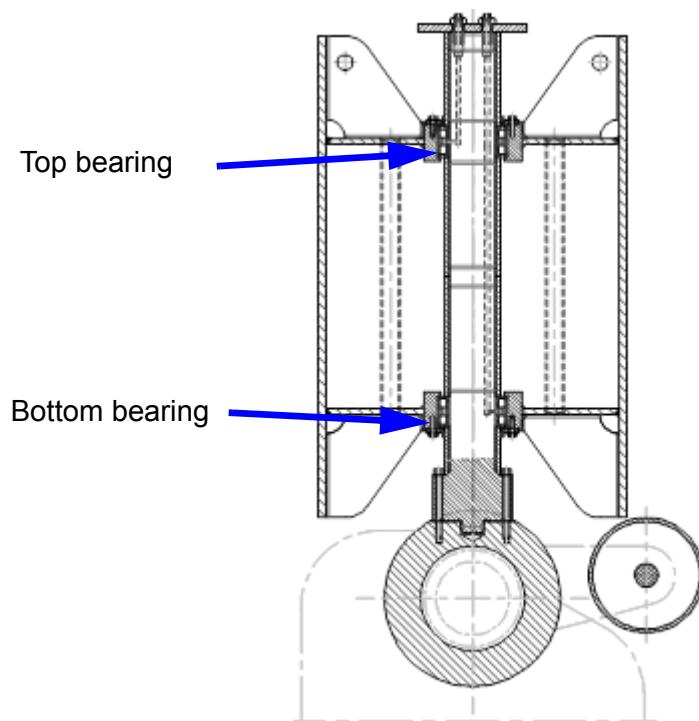


Figure 7-68: Wire roller bearings

1. Operate the winch.
2. Inspect functioning of wire roller bearing by visual and auditory inspection.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Spare parts

P/N	Part	Symbol code
2002929	Wire roller bearing	101
2006864	V-ring	102

7.5.7.16.3 Inspect and clean wire roller

Reference documents:

- [A11-41830-21-0408](#): Spooling device diamond screw block

Description	Location	Reference	Symbol code	Qty.
Wire roller	Storage winch, non-drive side	A11-41830-21-0408	N/A	1
Wire roller	Storage winch, drive side	A11-41830-21-0408	N/A	1

1. Clean the wire roller.
2. Inspect the roller for structural integrity.
 - If significant damage to the roller structure is found, repair or replace the roller.

Spare parts

P/N	Part	Symbol code
2002929	Wire roller bearing	101
On request	Roller assembly	N/A

7.5.7.17 Drag chain

This section describes all maintenance tasks for the drag chain of the spooling device of the main hoist storage winch.



Figure 7-69: Drag chain

7.5.7.17.1 Inspect drag chain

Reference documents:

- [A11-41830-21-0708](#): Drag chain for grease pump
- Brevetti - Nylon cable Chain SR325

Description	Location	Reference	Symbol code	Qty.
Drag chain	Spooling device storage winch	A11-41830-21-070	101	1

1. Check for excessive wear and structural integrity.
 - If excessive wear or damage is found, repair/replace the drag chain.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
On request	Tool to remove the connecting pivots (PZ010)	1



Figure 7-70: Tool PZ010

Spare parts

P/N	Part	Symbol code
2018073	Drag chain	101
2013974	End bracket	102

7.5.8 HEAVE COMPENSATION SYSTEM MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Main heave cylinder								
7.5.8.1.1	Clean cylinder rod and seal		1			Hydraulical	Huisman	331.01.04.04.01.01
7.5.8.1.2	Perform the functional test of the cylinder		1			Hydraulical	Huisman	331.01.04.04.01.01
7.5.8.1.3	Inspect cylinder		6			Hydraulical	Huisman	331.01.04.04.01.01
7.5.8.1.4	Test cylinder for internal leakage and rod leakage			1		Hydraulical	Huisman	331.01.04.04.01.01
7.5.8.1.5	Test cylinder for internal tube wear			2		Hydraulical	Huisman	331.01.04.04.01.01
7.5.8.1.6	Perform non destructive testing of cylinder			5		NDT specialist	Huisman	331.01.04.04.01.01
Active heave cylinder								
7.5.8.2.1	Clean cylinder rod and seal		1			Hydraulical	Huisman	331.01.04.04.01.02 331.01.04.04.01.03
7.5.8.2.2	Perform the functional test of the cylinder		1			Hydraulical	Huisman	331.01.04.04.01.02 331.01.04.04.01.03
7.5.8.2.3	Grease cylinder mounting		3		100	Hydraulical	Huisman	331.01.04.04.01.02 331.01.04.04.01.03
7.5.8.2.4	Inspect cylinder		6			Hydraulical	Huisman	331.01.04.04.01.02 331.01.04.04.01.03
7.5.8.2.5	Test cylinder for internal leakage and rod leakage			1		Hydraulical	Huisman	331.01.04.04.01.02 331.01.04.04.01.03
7.5.8.2.6	Test cylinder for internal tube wear			2		Hydraulical	Huisman	331.01.04.04.01.02 331.01.04.04.01.03
7.5.8.2.7	Perform non destructive testing of cylinder			5		NDT specialist	Huisman	331.01.04.04.01.02 331.01.04.04.01.03
Heave compensator sheave								
7.5.8.3.1	Grease sheave bearing		3		100	Mechanical	Huisman	331.01.04.04.01.05
7.5.8.3.2	Inspect sheave		3			Mechanical	Huisman	331.01.04.04.01.05
Medium separator								
7.5.8.4.1	Check nitrogen pressure of accumulator		1			Hydraulical	Huisman	331.01.04.04.02.01
7.5.8.4.2	Inspect and clean accumulator		3			Hydraulical	Huisman	331.01.04.04.02.01
Accumulators								
7.5.8.5.1	Check nitrogen pressure of pilot circuit diaphragm accumulator		1			Hydraulical	Huisman	331.01.04.04.02.02

Table 7-9: Maintenance schedule heave compensation system

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.8.5.2	Check nitrogen pressure of boost circuit bladder accumulator		1			Hydraulical	Huisman	331.01.04.04.02.03
7.5.8.5.3	Inspect and clean accumulator		3			Hydraulical	Huisman	331.01.04.04.02.02 331.01.04.04.02.03
Manifolds								
7.5.8.6.1	Inspect and clean manifold		6			Hydraulical	Huisman	331.01.04.04.02.04.01 331.01.04.04.02.04.02 331.01.04.04.02.04.03
7.5.8.6.2	Inspect cables and connections of manifold		6			Electrical	Huisman	331.01.04.04.02.04.01 331.01.04.04.02.04.02 331.01.04.04.02.04.03
Hydraulic pipes and hoses								
7.5.8.7.1	Inspect and clean hydraulic pipes and hoses		3			Hydraulical	Huisman	331.01.04.04.02.05
7.5.8.7.2	Replace hydraulic hoses			5		Hydraulical	Huisman	331.01.04.04.02.05
Emergency stop system								
7.5.8.8.1	Inspect and test functioning of emergency stop system		1			Electrical	Huisman	331.01.04.04.03.01 331.01.04.04.03.02
Cables and connections								
7.5.8.9.1	Inspect cables and connections			1		Electrical	Huisman	331.01.04.04.03.03
Structure								
7.5.8.10.1	Grease guide wheels		3		100	Hydraulical	Huisman	331.01.04.04.04.02
7.5.8.10.2	Inspect and clean sheave and head frame			1		Mechanical	Huisman	331.01.04.04.04.01
7.5.8.10.3	Inspect and clean guide wheels			1		Mechanical	Huisman	331.01.04.04.04.02

Table 7-9: Maintenance schedule heave compensation system

7.5.8.1 Main heave cylinder

This section describes all maintenance tasks for the main heave cylinder of the heave compensation system.

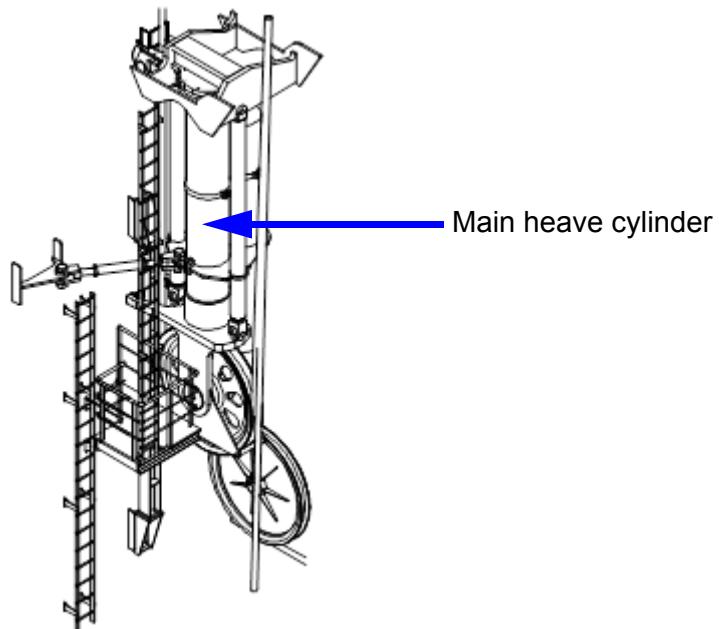


Figure 7-71: Overview location cylinder

7.5.8.1.1 Clean cylinder rod and seal

Reference documents:

- [A11-41810-86-0108](#): Passive heave compensator cylinder

Description	Location	Reference	Symbol code	Qty.
Main heave cylinder	Heave compensation system	A11-41810-86-0108	N/A	1

1. Fully extend the cylinder.
2. Clean the rod and the seal using a cloth.

NOTE *Ensure that the piston rod is free of contamination which could damage the O-ring. Dirt on the rod seal can enter the cylinder and pollute it.*

3. Fully retract the cylinder.

7.5.8.1.2 Perform the functional test of the cylinder

Reference documents:

- [A11-41810-86-0108](#): Passive heave compensator cylinder
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Main heave cylinder	Heave compensation system	A11-41810-80-0208	A150	1

1. Operate the cylinder in both directions.
 - If a problem is found, repair or replace the failed component.

Spare parts

P/N	Part	Symbol code
10021062A	Cylinder	A150
9141738	Seal set	N/A

7.5.8.1.3 Inspect cylinder

Reference documents:

- [A11-41000-09-002](#): Paint specification
- [A11-41810-86-0108](#): Passive heave compensator cylinder
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Main heave cylinder	Heave compensation system	A11-41810-80-0208	A150	1

1. Clean cylinder exterior using a cloth.
2. Check cylinder exterior for damage, corrosion and paint quality.
 - If exterior damage is found, repair or replace the cylinder.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paints specification.

3. Check the cylinder rod for "running tracks" or damage. For this fully extract the rod.

NOTE *Running tracks can be an indication of a contaminated hydraulic system.*

- If the rod is damaged replace the cylinder.
 - If the coating is damaged, repair the coating or replace the cylinder.
4. Check tube seal for leakage.
 - If leakage from the seal is found, replace the seal.
 5. Check cylinder hydraulic connections and hose tails for damage and corrosion.
 - If a coupling is damaged or corroded, replace the coupling.
 - If a hose tail is damaged or corroded, replace the hose.
 6. Check mounting of cylinder.
 - If loose bolts are found, remount the cylinder.

Spare parts

P/N	Part	Symbol code
10021062A	Cylinder	A150
9141738	Seal set	N/A

7.5.8.1.4 Test cylinder for internal leakage and rod leakage

Reference documents:

- [A11-41810-86-0108](#): Passive heave compensator cylinder
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Main heave cylinder	Heave compensation system	A11-41810-80-0208	A150	1

1. Bring the cylinder rod into the bottom dead (fully retracted) position.
2. Connect a drain to IN (bottom) line.
3. Keep the system pressurized.

4. Check if hydraulic fluid comes out of the drain.
 - If a lot of hydraulic fluid is leaking from the drain, replace the cylinder.
 - If hydraulic fluid is leaking from the rod seal, replace the cylinder.

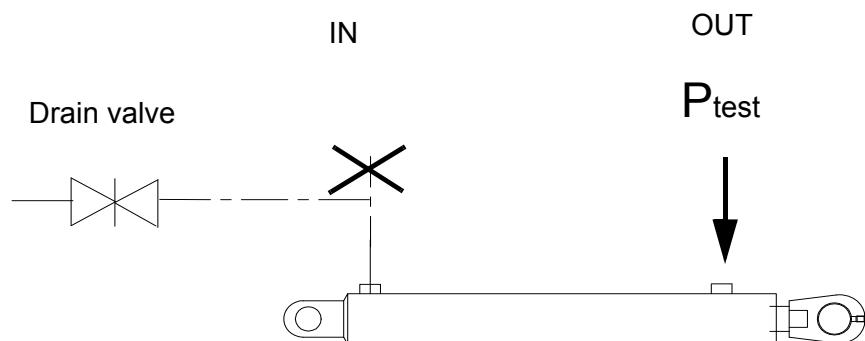


Figure 7-72: Cylinder test - Bottom pressurized

5. Bring the cylinder rod into the top dead (fully extended) position.
6. Connect a drain to OUT (top) line.
7. Keep the system pressurized.
8. Check if hydraulic fluid comes out of the drain.
 - If a lot of hydraulic fluid is leaking from the drain, replace the cylinder.

WARNING

Keep pressure within the specifications of the cylinder!

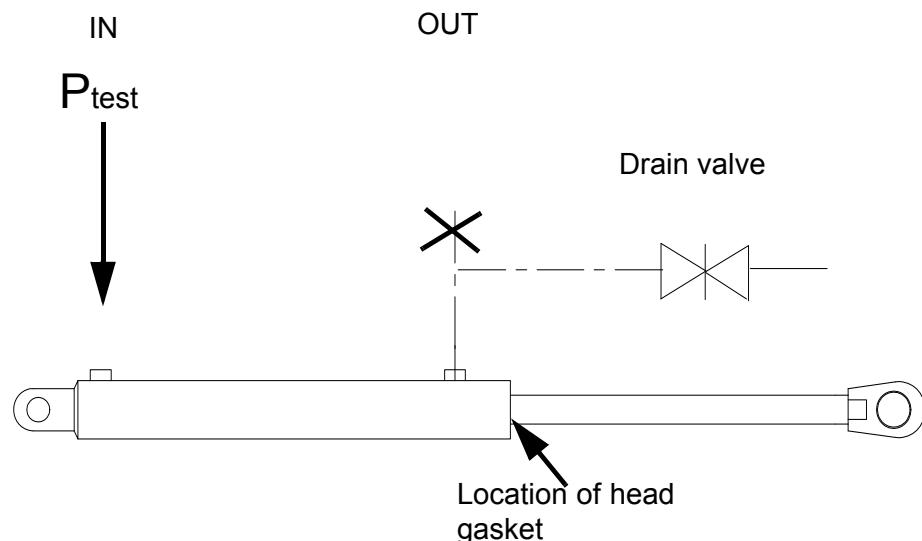


Figure 7-73: Cylinder test - Head pressurized

Spare parts

P/N	Part	Symbol code
10021062A	Cylinder	A150
9141738	Seal set	N/A

7.5.8.1.5 Test cylinder for internal tube wear

Reference documents:

- [A11-41810-86-0108](#): Passive heave compensator cylinder
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Main heave cylinder	Heave compensation system	A11-41810-80-0208	A150	1

NOTE This cylinder test procedure should be performed at a cylinder test bench only by qualified personnel!

1. Take the cylinder out of the system and place it on a test bench.
2. Bring the cylinder rod into the bottom dead position (fully retracted).

3. Fit a calibrated pressure gauge and a calibrated flow gauge on IN (bottom) line.
4. Fit a calibrated pressure gauge and a calibrated flow gauge on OUT (head) line.
5. Attach a power source that is able to provide a steady flow at system pressure. Apply pressure, so that the cylinder moves to the dead top position (fully extended).
6. Check if the flow and pressure is linear during the entire movement of the cylinder. Also pay attention if the ratio between the flows IN and OUT is as expected.
 - If there is suspected leak between rod and bottom section of the cylinder (see the Note) investigate the cause and replace the failed component.
7. Do the same for the cylinder movement from dead top (fully extended) to dead bottom position (fully retracted).

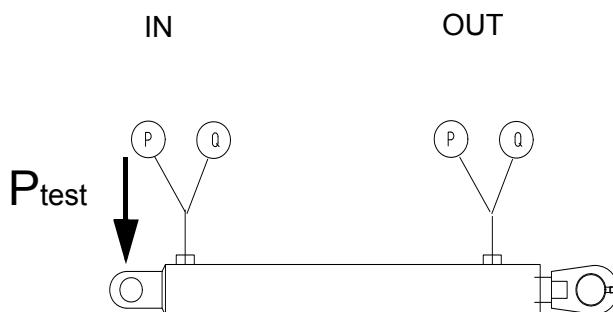


Figure 7-74: Cylinder test - Body damages

NOTE *If there is a suspected leak between the rod and bottom sections of the cylinder, pressure/flow drop will be registered. The control direction of the cylinder must be kept in mind!*

WARNING



Test pressure must not exceed 150 bar (half system pressure)!

Spare parts

P/N	Part	Symbol code
10021062A	Cylinder	A150
9141738	Seal set	N/A

7.5.8.1.6 Perform non destructive testing of cylinder

Reference documents:

- [A11-41810-86-0108](#): Passive heave compensator cylinder
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Main heave cylinder	Heave compensation system	A11-41810-80-0208	A150	1

The welds and steel structure of the cylinder body and cylinder mounting heads need to be inspected by means of non-destructive techniques (NDT). Huisman recommends these inspections to be executed by a third party that is specialized in NDT inspection surveys. Huisman can provide NDT specialist if required.

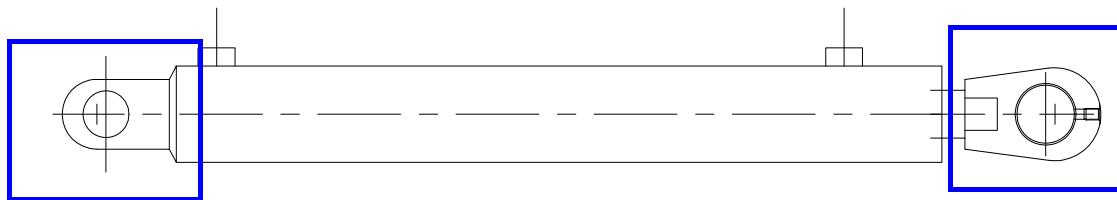


Figure 7-75: Cylinder mounting heads location

1. Execute NDT test which consists of magnetic particles inspection (MPI) and Ultrasonic testing (UT).
 - If unacceptable welds or surfaces are found, replace the cylinder and send it to Huisman for repair.

NOTE All personnel performing Magnetic Particles Inspection shall be qualified and certified according to EN 473/PCN or EN 473 / SNT-TC-1A, level II or level III.

NOTE As an alternative for MPI, penetrant inspection (PT) can be carried out.

Special tools

P/N	Tool	Qty.
On request	Phased array US	
On request	AC yoke magnet	
On request	Wet magnetic ink, test medium Magnaflux	

Spare parts

P/N	Part	Symbol code
10021062A	Cylinder	A150

7.5.8.2 Active heave cylinder

This section describes all maintenance tasks for the active heave cylinders of the heave compensation system.

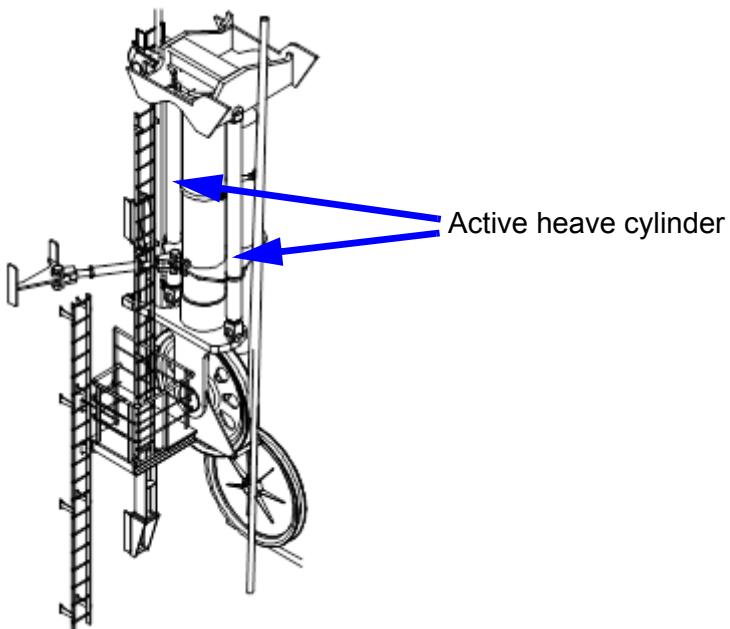


Figure 7-76: Overview location cylinders

7.5.8.2.1 Clean cylinder rod and seal

Reference documents:

- [A11-41810-10-0508](#): Cylinder Mounting
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, turn buckle side	A11-41810-80-0208	A160A	1
Active heave compensator cylinder	Heave compensation system, winch room side	A11-41810-80-0208	A160B	1

1. Fully extend the cylinder.
2. Clean the rod and the seal using a cloth.

NOTE *Ensure that the piston rod is free of contamination which could damage the O-ring. Dirt on the rod seal can enter the cylinder and pollute it.*

3. Fully retract the cylinder.

For more information, see the supplier documentation.

7.5.8.2.2 Perform the functional test of the cylinder

Reference documents:

- [A11-41810-10-0508](#): Cylinder Mounting
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, turn buckle side	A11-41810-80-0208	A160A	1
Active heave compensator cylinder	Heave compensation system, winch room side	A11-41810-80-0208	A160B	1

1. Operate the cylinder in both directions.
 - If a problem is found, repair or replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10015773A	Cylinder	A160A, A160B
9141662	Seal set	N/A

7.5.8.2.3 Grease cylinder mounting

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

[A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, turn buckle side	A11-41810-80-0208	A160A	1
Active heave compensator cylinder	Heave compensation system, winch room side	A11-41810-80-0208	A160B	1

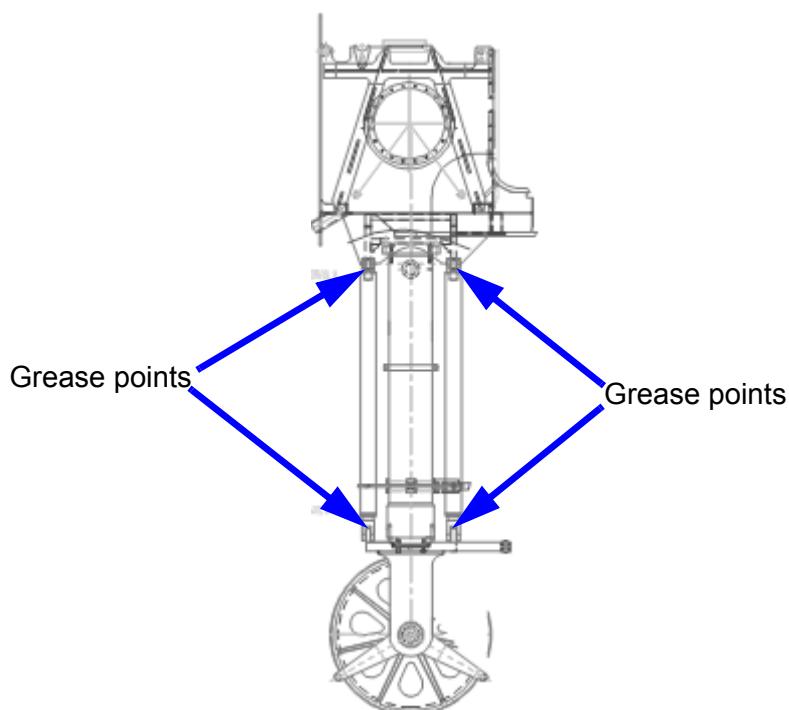


Figure 7-77: Cylinder grease points

- Grease the cylinder mounting according to the greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	AISI 316 DIN 3404	-

7.5.8.2.4 Inspect cylinder

Reference documents:

[A11-41810-10-0508](#): Cylinder Mounting

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, turn buckle side	A11-41810-80-0208	A160A	1
Active heave compensator cylinder	Heave compensation system, winch room side	A11-41810-80-0208	A160B	1

1. Clean cylinder exterior using a cloth.
2. Check cylinder exterior for damage, corrosion and paint quality.
 - If exterior damage is found, repair or replace the cylinder.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paints specification.
3. Check the cylinder rod for "running tracks" or damage. For this fully extract the rod.

NOTE *Running tracks can be an indication of a contaminated hydraulic system.*

- If the rod is damaged replace the cylinder.
- If the coating is damaged, repair the coating or replace the cylinder.
4. Check tube seal for leakage.
 - If leakage from the seal is found, replace the seal.
5. Check cylinder hydraulic connections and hose tails for damage and corrosion.
 - If a coupling is damaged or corroded, replace the coupling.
 - If a hose tail is damaged or corroded, replace the hose.
6. Check mounting of cylinder.
 - If loose bolts are found, remount the cylinder.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10015773A	Cylinder	A160A, A160B
9141662	Seal set	N/A

7.5.8.2.5 Test cylinder for internal leakage and rod leakage

Reference documents:

- [A11-41810-86-0108](#): Passive heave compensator cylinder
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, turn buckle side	A11-41810-80-0208	A160A	1
Active heave compensator cylinder	Heave compensation system, winch room side	A11-41810-80-0208	A160B	1

1. Bring the cylinder rod into the bottom dead (fully retracted) position.
2. Connect a drain to IN (bottom) line.
3. Keep the system pressurized.
4. Check if hydraulic fluid comes out of the drain.
 - If a lot of hydraulic fluid is leaking from the drain, replace the cylinder.
 - If hydraulic fluid is leaking from the rod seal, replace the cylinder.

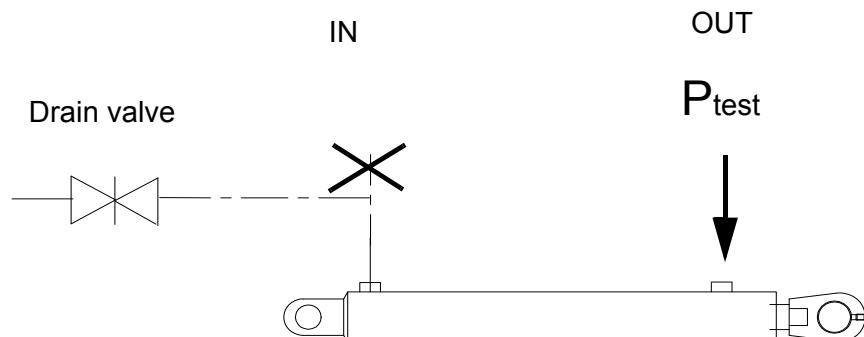


Figure 7-78: Cylinder test - Bottom pressurized

5. Bring the cylinder rod into the top dead (fully extended) position.
6. Connect a drain to OUT (top) line.
7. Keep the system pressurized.
8. Check if hydraulic fluid comes out of the drain.
 - If a lot of hydraulic fluid is leaking from the drain, replace the cylinder.

WARNING



Keep pressure within the specifications of the cylinder!

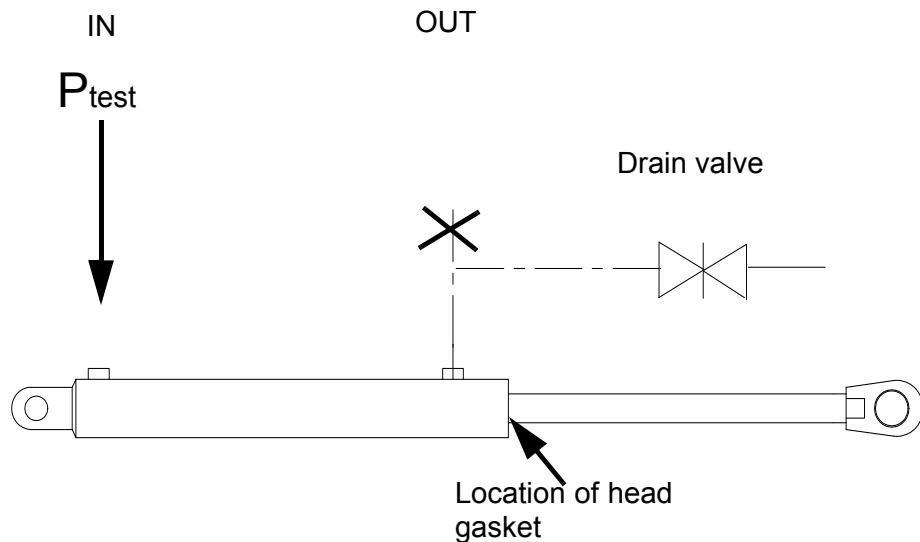


Figure 7-79: Cylinder test - Head pressurized

Spare parts

P/N	Part	Symbol code
10015773A	Cylinder	A160A, A160B
9141662	Seal set	N/A

7.5.8.2.6 Test cylinder for internal tube wear

Reference documents:

- [A11-41810-86-0108](#): Passive heave compensator cylinder
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, turn buckle side	A11-41810-80-0208	A160A	1

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, winch room side	A11-41810-80-0208	A160B	1

NOTE *This cylinder test procedure should be performed at a cylinder test bench only by qualified personnel!*

1. Take the cylinder out of the system and place it on a test bench.
2. Bring the cylinder rod into the bottom dead position (fully retracted).
3. Fit a calibrated pressure gauge and a calibrated flow gauge on IN (bottom) line.
4. Fit a calibrated pressure gauge and a calibrated flow gauge on OUT (head) line.
5. Attach a power source that is able to provide a steady flow at system pressure. Apply pressure, so that the cylinder moves to the dead top position (fully extended).
6. Check if the flow and pressure is linear during the entire movement of the cylinder. Also pay attention if the ratio between the flows IN and OUT is as expected.
 - If there is suspected leak between rod and bottom section of the cylinder (see the Note) investigate the cause and replace the failed component.
7. Do the same for the cylinder movement from dead top (fully extended) to dead bottom position (fully retracted).

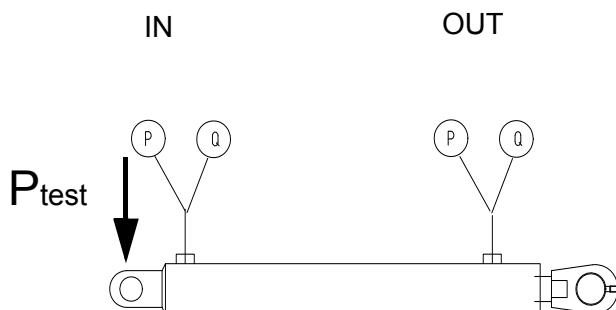


Figure 7-80: Cylinder test - Body damages

NOTE *If there is a suspected leak between the rod and bottom sections of the cylinder, pressure/flow drop will be registered. The control direction of the cylinder must be kept in mind!*

WARNING



Test pressure must not exceed 150 bar (half system pressure)!

Spare parts

P/N	Part	Symbol code
10015773A	Cylinder	A160A, A160B
9141662	Seal set	N/A

7.5.8.2.7 Perform non destructive testing of cylinder

Reference documents:

- [A11-41810-10-0508](#): Cylinder Mounting
- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Active heave compensator cylinder	Heave compensation system, turn buckle side	A11-41810-80-0208	A160A	1
Active heave compensator cylinder	Heave compensation system, winch room side	A11-41810-80-0208	A160B	1

The welds and steel structure of the cylinder body and cylinder mounting heads need to be inspected by means of non-destructive techniques (NDT). Huisman recommends these inspections to be executed by a third party that is specialized in NDT inspection surveys. Huisman can provide NDT specialist if required.

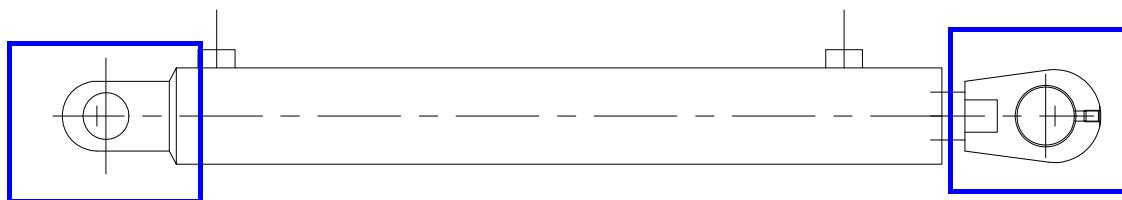


Figure 7-81: Cylinder mounting heads location

1. Execute NDT test which consists of magnetic particles inspection (MPI) and Ultrasonic testing (UT).
 - If unacceptable welds or surfaces are found, replace the cylinder and send it to Huisman for repair.

NOTE *All personnel performing Magnetic Particles Inspection shall be qualified and certified according to EN 473/PCN or EN 473 / SNT-TC-1A, level II or level III.*

NOTE *As an alternative for MPI, penetrant inspection (PT) can be carried out.*

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
On request	Phased array US	
On request	AC yoke magnet	
On request	Wet magnetic ink, test medium Magnaflux	

Spare parts

P/N	Part	Symbol code
10015773A	Cylinder	A160A, A160B

7.5.8.3 Heave compensator sheave

This section describes all maintenance tasks for the heave compensator sheave of the heave compensation system.

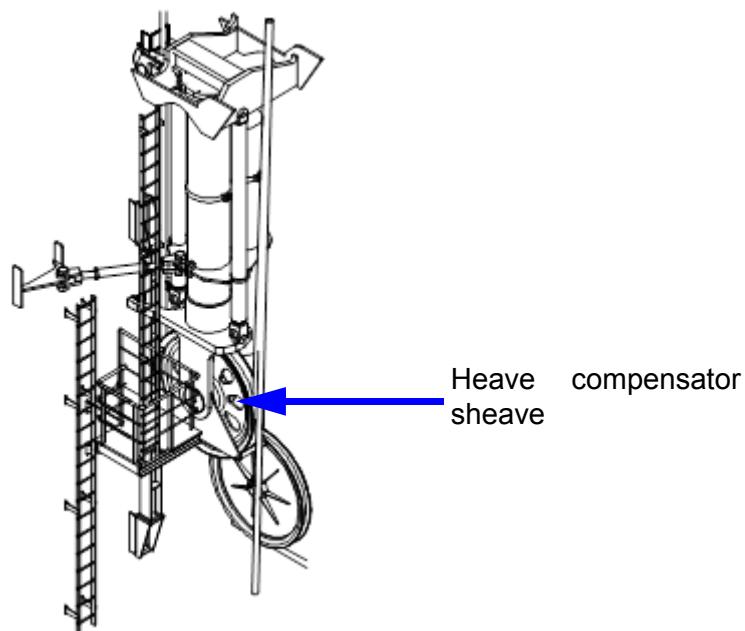


Figure 7-82: Heave compensator sheave

7.5.8.3.1 Grease sheave bearing

Reference documents:

- [A11-41800-00-201](#): Grease schedule
- [A11-41810-32-0108](#): Sheave for Wire ø92 P.C.D. 2132

Description	Location	Reference	Symbol code	Qty.
Heave compensator sheave	Heave compensation system	A11-41810-32-0108	01	1

1. Grease the sheave roller bearing according to the greasing schedule A11-41800-00-201.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	AISI 316 DIN 71412A	-

7.5.8.3.2 Inspect sheave

Reference documents:

- [A11-41810-32-0108](#): Sheave for Wire ø92 P.C.D. 2132
- [A11-41000-09-002](#): Paint specification
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Heave compensator sheave	Heave compensation system	A11-41810-32-0108	01	1

1. Check axial and radial play of sheave.
 - If excessive play is found, investigate the cause and repair/replace the failed component.
2. Check if the sheave can rotate freely and does not make unusual noise.
 - If sheave does not rotate freely, replace the bearing.
 - If an unusual noise is heard, replace the bearing.
3. Check groove for wire rope imprint according to document "Steel wire ropes" in Appendix "Wire rope manual".
 - If significant wire rope imprint is found, consult Huisman.

NOTE *Once the wear has proceeded too deep into the groove, it will increase rapidly.*

4. Check groove for excessive wear. For this measure the groove radius (R) and the groove breadth (B).

Table 7-10: Dimensions of the new sheave and wire rope

Groove radius R (mm)	Wire rope diameter D (mm)	Sheave wall breadth B (mm)
43.8	92	31.5

- If the groove radius R (see [Figure 7-83](#)) is larger than 50.8 mm, replace the sheave.
- If the groove breadth B (see [Figure 7-83](#)) is less than 29.9 mm, replace the sheave.

NOTE *If the sheave dimensions are less than specified above, the sheave wear will accelerate rapidly!*

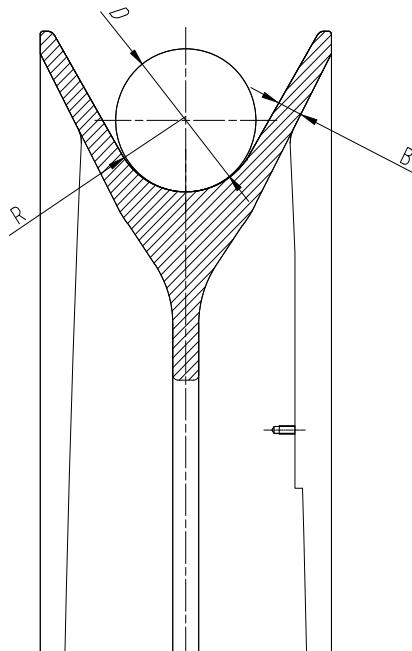


Figure 7-83: Sheave dimensions

- If a wear groove is found under the feeler gauge while measuring the sheave radius, replace the sheave. For more information see Wire rope manual.
5. Inspect sheave for structural integrity and loose connections.
- If a problem is found, consult Huisman.
 - Tighten the loose connections.
6. Inspect the paint of sheave
- If the paint is damaged, repair the paint of the sheave according to paint specification.

For more information on code of practice and discard, see International Standard ISO4309.

Special tools

P/N	Tool	Qty.
On request	Sheave gauge set	

Spare parts

P/N	Part	Symbol code
2004648	Bearing	100
10012978A	Sheave	01
On request	Bearing seals	N/A
On request	Bearing caps	N/A

P/N	Part	Symbol code
On request	Sheave assembly	N/A

7.5.8.4 Medium separator

This section describes all maintenance tasks for the medium separator of the heave compensation system.

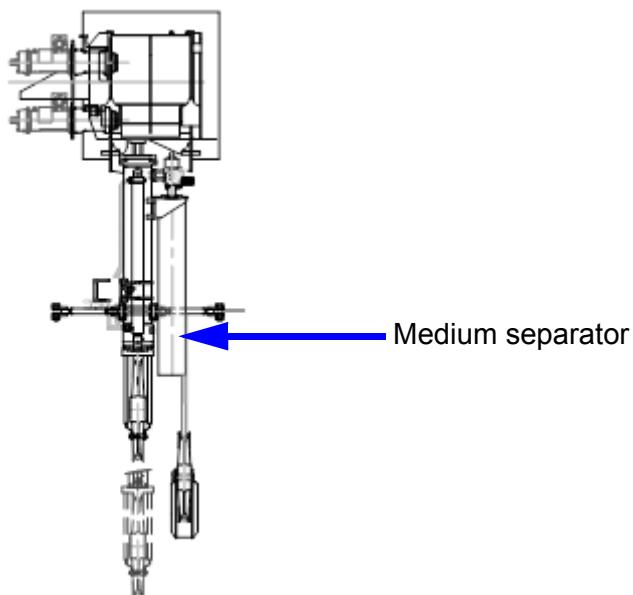


Figure 7-84: Medium separator

7.5.8.4.1 Check nitrogen pressure of accumulator

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram
- Hydac - SK210_350PistonMaint

Description	Location	Reference	Symbol code	Qty.
Medium separator	Heave compensator	A11-41810-80-0208	Z170	1

1. De-pressurize the accumulator as follows:
 - a) Enable directional control valves V140 to bleed pressure out of the bottom side.
 - b) Completely retract the main cylinder.

c) Measure the rest hydraulic pressure through the transmitter S084F.

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

2. Check the accumulator nitrogen pressure: $P_o = 5$ bar.
 - If necessary refill the accumulator with nitrogen.
3. Check for internal leakage of the accumulator.
 - If internal leakage is found, replace the accumulator.
4. Make sure the accumulator is pressurized and the valve V140 is opened after checking or refilling the nitrogen pressure of the accumulator.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
On request	Hydac Nitrogen filling set	1

Spare parts

P/N	Part	Symbol code
10015830A	Piston accumulator	Z170

7.5.8.4.2 Inspect and clean accumulator

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram
- [A11-41810-10-0208](#): Turnbuckle Frame
- [A11-41000-09-002](#): Paint specification
- Hydac - SK210_350PistonMaint

Description	Location	Reference	Symbol code	Qty.
Medium separator	Heave compensator	A11-41810-80-0208	Z170	1

1. Clean the exterior of the accumulator using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace accumulator.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.

3. Check paint of accumulator.
 - If the paint is damaged, repaint the area according to the paint specification.
4. Check accumulator clamp.
 - If necessary repair/ replace the accumulator clamp.
5. Check for external leakage of the accumulator.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10015830A	Accumulator	Z170

7.5.8.5 Accumulators

This section describes all maintenance tasks for the accumulator of the heave compensation system.

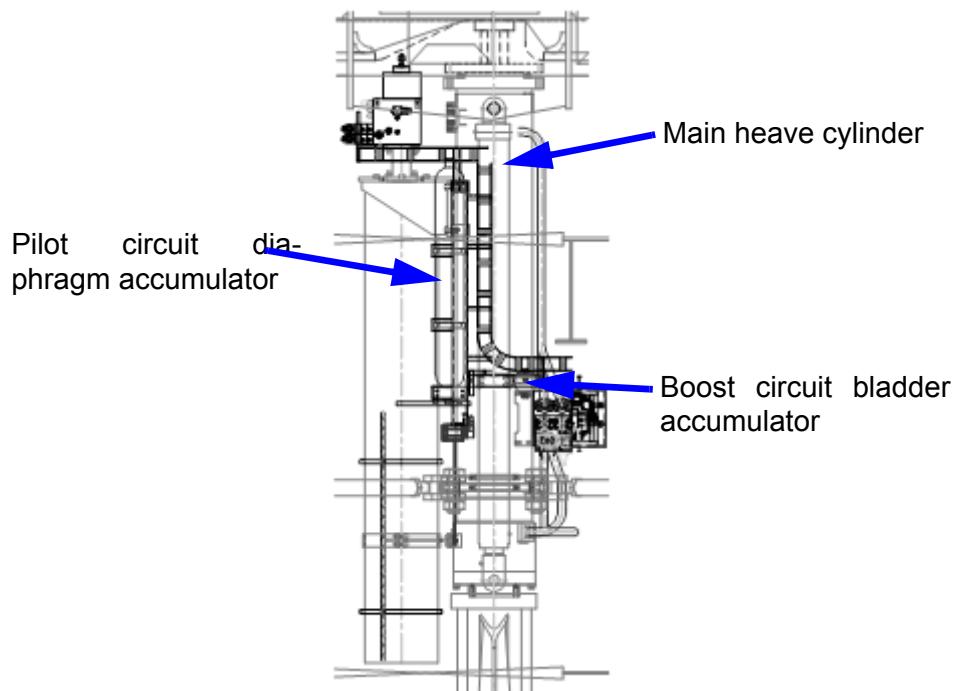


Figure 7-85: Accumulator

7.5.8.5.1 Check nitrogen pressure of pilot circuit diaphragm accumulator

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram
- Hydac - Hydraulic Diaphragm Accumulators

Description	Location	Reference	Symbol code	Qty.
Pilot circuit bladder accumulator	Heave compensator	A11-41810-80-0208	Z050	1

1. De-pressurize the accumulator as follows:
 - a) Enable valves V093A/B to bleed pressure out of the bottom side.
 - b) Completely retract the active heave cylinders.
 - c) Measure the rest hydraulic pressure through the port M-AC1.
 - d) Let the hydraulic fluid out through the port AC1..

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

2. Check the accumulator nitrogen pressure: $P_o = 220$ bar.
 - If necessary refill the accumulator with nitrogen.
3. Check for internal leakage of the accumulator.
 - If internal leakage is found, replace the accumulator.
4. Make sure the accumulator is pressurized after checking or refilling the nitrogen pressure of the accumulator.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
On request	Hydac Nitrogen filling set	1

Spare parts

P/N	Part	Symbol code
2014695	Diaphragm accumulator	Z050

7.5.8.5.2 Check nitrogen pressure of boost circuit bladder accumulator

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram
- Hydac - Hydraulic Bladder Accumulators

Description	Location	Reference	Symbol code	Qty.
Boost circuit bladder accumulator	Heave compensator	A11-41810-80-020	Z052	1

1. De-pressurize the accumulator as follows:
 - a) Enable valves V096A/B to bleed pressure out of the bottom side.
 - b) Completely retract the active heave cylinders.
 - c) Shut off the hydraulic power by closing the ball valve V081.
 - d) Measure the rest hydraulic pressure through the port MAC-2.
 - e) Let the hydraulic fluid out through the port AC2..

NOTE Close and drain the accumulator and be sure there is no hydraulic pressure during the nitrogen pressure check. This influences the measured value!

2. Check the accumulator nitrogen pressure: $P_o = 85$ bar.
 - If necessary refill the accumulator with nitrogen.
3. Check for internal leakage of the accumulator.
 - If internal leakage is found, replace the accumulator.
4. Make sure the accumulator is pressurized and the ball valve V081 is opened after checking or refilling the nitrogen pressure of the accumulator.

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
On request	Hydac Nitrogen filling set	1

Spare parts

P/N	Part	Symbol code
2008623	Bladder accumulator	Z052

7.5.8.5.3 Inspect and clean accumulator

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram
- [A11-41000-09-002](#): Paint specification
- Hydac - Hydraulic Diaphragm Accumulators
- Hydac - Hydraulic Bladder Accumulators

Description	Location	Reference	Symbol code	Qty.
Pilot circuit bladder accumulator	Heave compensator	A11-41810-80-0208	Z050	1
Boost circuit bladder accumulator	Heave compensator	A11-41810-80-0208	Z052	1

1. Clean the exterior of the accumulator using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace accumulator.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of accumulator.
 - If the paint is damaged, repaint the area according to the paint specification.
4. Check accumulator clamp.
 - If necessary repair/ replace the accumulator clamp.
5. Check for external leakage of the accumulator.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2014695	Bladder accumulator	A11-41810-80-020 / Z050
2008623	Bladder accumulator	A11-41810-80-020 / Z052
2003947	Accumulator console	A11-41810-80-020 / Z054
2002129	Accumulator clamp	A11-41810-80-020 / Z051
2003946	Accumulator clamp	A11-41810-80-020 / Z053

7.5.8.6 Manifold

This section describes all maintenance tasks for the manifolds of the heave compensation system.

7.5.8.6.1 Inspect and clean manifold

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram

Description	Location	Reference	Symbol code	Qty.
Active heave manifold	Heave compensator	A11-41810-80-0208	M070	1
Passive heave manifold	Heave compensator	A11-41810-80-0208	M100	1
Retract manifold	Heave compensator	A11-41810-80-0208	M200	1

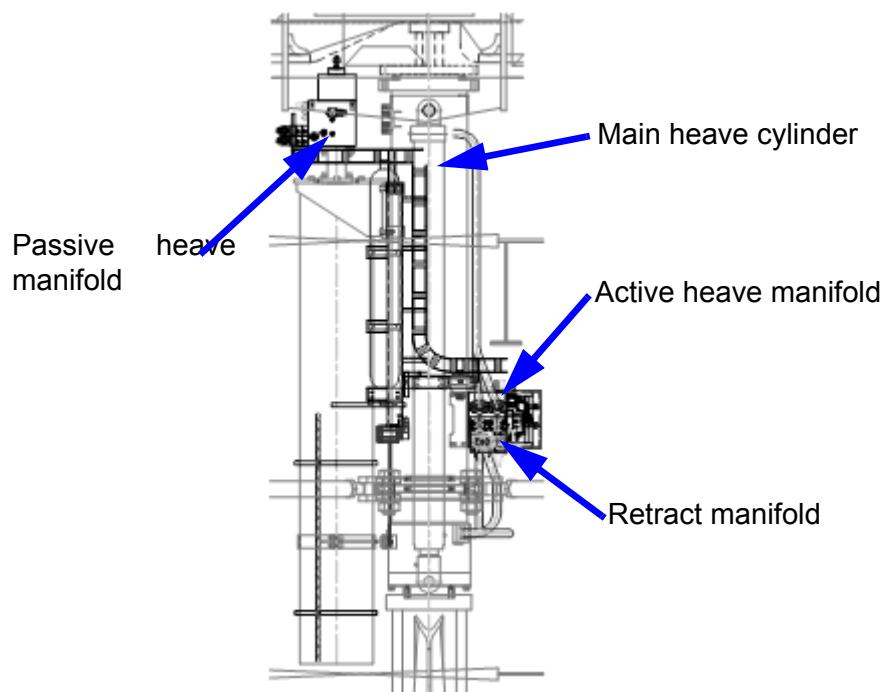


Figure 7-86: Manifolds

1. Clean the exterior of the manifold using a vacuum cleaner or a firm brush.
2. Inspect the exterior of the manifold for corrosion and damage.
 - If significant damage is found, replace the component.
 - If significant corrosion is found, replace the component and repaint the area, according to the paint specification.
3. Inspect manifold for oil leakage.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.
4. Check the proper mounting of components.
 - If components are loose, tighten the loose components.

5. Check the functioning of the ball valve V081 (applicable for the active heave manifold).
 - If the ball valve does not work properly, replace the ball valve.
 - If the locking device does not work properly, replace the ball valve.

Spare parts

P/N	Part	Symbol code
10004830A	Active heave manifold + valves	M070
2013836	Active heave manifold	M070
10014424A	Passive heave manifold + valves	M100
10009971A	Passive heave manifold	M100
10016773A	Retract manifold + valves	M200
10016772A	Retract manifold	M200
2024487	Cartridge cover	V071A, V071B
2015547	Sandwich valve	V072
2005910	Poppet valve 3/2 way NG6	V073
2011058	Sandwich valve	V074
2014786	Cartridge NG40 Xseal	V075
2013839	Cartridge cover NG40	V076
2013840	Poppet valve 3/2 way NG6	V077
2010920	Throttle valve	V078
2014788	2/2 poppet cartridge valve	V079
2008633	Pressure relief valve	V080A, V080B
2019457	Plate mounted ball valve	V081
2015427	Sandwich plate NG6	V085
2006055	Check valve 12S	V086
2013844	Cartridge valve	V090A, V090B
2013845	Cartridge cover	V091A, V091B
2013846	4/3 servo-proportional valve NG25	V093A, V093B
2014982	2-way pressure reducing valve	V094
2005096	Insert check valve	V095
2009749	2/2 way poppet valve	V096A, V096B
2011652	Insert check valve	V097A, V097B
2017213	Cartridge valve NG50	V098
2013843	Cartridge cover NG50	V099
2003667	Throttle valve NG10	V101A, V101B
2034309	Cartridge valve	V115
2017042	Cartridge cover	V116
2017576	Pressure relief valve	V117
2008633	Pressure relief valve	V118
2005983	Pressure relief valve	V119
2013640	Cartridge, active position monitored NG100	V120

P/N	Part	Symbol code
2041498	3/2 poppet valve	V121
2003664	Check cartridge valve	V125A, V125B, V125C
2007580	Directional control valve	V130
2009978	Sandwich pilot operated check valve NG10	V131
2025047	Sandwich flowcontrol valve A NG10	V132
2026431	Sandwich flowcontrol valve A NG10	V133
2026421	Flowcontrol	V134A, V134B
2027786	Throttle/check valve NG06 AB	V135
2007580	Directional control valve	V140
2009978	Sandwich pilot operated check valve NG10	V141
2025047	Sandwich flowcontrol valve A NG10	V142
2026431	Sandwich flowcontrol valve A NG10	V143
2026421	Flowcontrol	V144A, V144B
2027786	Throttle/check valve NG06 AB	V145
2014153	Poppet valve	V181
2041499	Poppet valve	V182
2033313	Poppet valve 2/2 way pilot operated	V183
2014153	Poppet valve	V184
2034371	Cartridge valve	V201
2017042	Cartridge cover	V202
2047525	3/2 poppet valve	V203
2012284	Pressure relief valve	V204
On request	Standard seal roll	N/A

7.5.8.6.2 Inspect cables and connections of manifold

Reference documents:

- [A11-41810-80-0208](#): Heave compensator hydraulic diagram
- [10013281A](#): Electrical drawing

Description	Location	Reference	Symbol code	Qty.
Active heave manifold	Heave compensator	A11-41810-80-0208	M070	1
Passive heave manifold	Heave compensator	A11-41810-80-0208	M100	1
Retract manifold	Heave compensator	A11-41810-80-0208	M200	1

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cables ties.
3. Inspect if the cable code tags and solenoid code tags are present.
 - If a code tag is not present or not correct suited, replace the tag, according the electrical schematics (E-plan).
4. Check connection, tighten connections and check sheaths for damage and/or corrosion. When a torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose connection.
 - If a cable sheath is damaged or corroded, repair the cable sheaths or replace the cables.
5. Check earth connection,
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

7.5.8.7 Hydraulic pipes and hoses

This section describes all maintenance tasks for the hydraulic pipes and hoses of the heave compensation system.

7.5.8.7.1 Inspect and clean hydraulic pipes and hoses

 [A11-41000-09-002](#): Paint Specification

Description	Location	Reference	Symbol code	Qty.
Hydraulic pipes and hoses	Heave compensation system	-	-	-

For inspecting the hydraulic pipes.

1. Clean pipes and couplings.
2. Inspect pipes and couplings for damage and corrosion/paint damage

NOTE Pay special attention to corrosion around the brackets of the pipe.

- If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification. When this is not possible replace the pipe.
 - If the paint is damaged, repaint the area according to the Paint Specification.
3. Inspect hydraulic pipes and couplings for oil leakage.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.

For inspecting the hydraulic hoses.

1. Clean hydraulic hoses.
2. Inspect the hydraulic hoses for cracks or other damage.
 - If a hydraulic hose is damaged, replace the hoses..
3. Inspect the hose end connections for damage, corrosion and/or leakage.
 - If a hose end connection is damaged and/or corroded, investigate the cause and repair/replace the failed component.
 - If leakage is found, investigate the cause and repair/replace the failed component. Also clean the spilled oil.
4. Inspect tightness of hose ties.
 - If a hydraulic hose is not properly tightened, tighten or replace the hose ties.

7.5.8.7.2 Replace hydraulic hoses

Description	Location	Reference	Symbol code	Qty.
Hydraulic pipes and hoses	Heave compensation system	-	-	-

1. Isolate the hydraulic hose.
2. Replace the hydraulic hose.
3. Restore the hydraulic system.

7.5.8.8 Emergency stop system

This section describes all maintenance tasks for the emergency stop system of the heave compensation system.

7.5.8.8.1 Inspect and test functioning of emergency stop system

Reference documents:

- [10013281A](#): Electrical drawing
- Schneider - Emergency push button

Description	Location	Reference	Symbol code	Qty.
Emergency stop button	Heave compensator	Electrical drawing (+L11)	-062S2	1
Safety relay active heave	E-cabinet	Electrical drawing (+M22)	-061K1	1

Description	Location	Reference	Symbol code	Qty.
Safety relay passive heave	E-cabinet	Electrical drawing (+M22)	-062K2	1

NOTE The frequency for this task given in the maintenance schedule is an indication. The user is to determine the periodic schedule based on the severity of the operating environment and the frequency of switch actuation.

1. Check the emergency stop push button for damage, button looseness and excessive environmental contamination.
 - If damage is found, replace the damaged component.
 - If components are loose, tighten the loose components.
 - If dirt is found at the push button, clean the push button.
2. Check for water ingress in the push button.
 - If water is present, replace the push button.
3. Push an emergency stop button.
4. Check if the push button relays -061K1 and -062K2 react.

WARNING  *The emergency safety relay that continuously monitors the state of its inputs. When an emergency stop push button is activated, the relay will directly de-activate its direct contacts. After an adjustable time (typical is 1 second) the relay will de-activate its time-delayed outputs.*

- If the relays not react correctly, replace the relay.
5. Check if SCADA gives an emergency alarm and shuts down the system.
 - If no alarm is generated and/or the system does not shut down, investigate the cause and repair/replace the failed component.
6. Reset the emergency stop button.
7. Reset the alarm in SCADA.

WARNING



Always test the emergency stop system for proper functioning under machine control conditions after performing maintenance.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2007868	Pushbutton, sub-assembly	-062S2
2014302	Emergency stop relay	-061K1

P/N	Part	Symbol code
On request	Emergency stop relay	-062K2

7.5.8.9 Cables and connections

This section describes all maintenance tasks for the cables and connections of the heave compensation system.

7.5.8.9.1 Inspect cables and connections

Description	Location	Reference	Symbol code	Qty.
Cables and connections	Heave compensator	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correctly tightened, replace the tag, according to the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection,
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

7.5.8.10 Structure

This section describes all maintenance tasks for the structure of the heave compensation system.

7.5.8.10.1 Grease guide wheels

Reference documents:

 [A11-41810-10-0408](#): Sheave and head frame

■ [A11-41800-00-201](#): greasing schedule

Description	Location	Reference	Symbol code	Qty.
Guide wheels	Heave compensator	A11-41810-10-0408	10	2

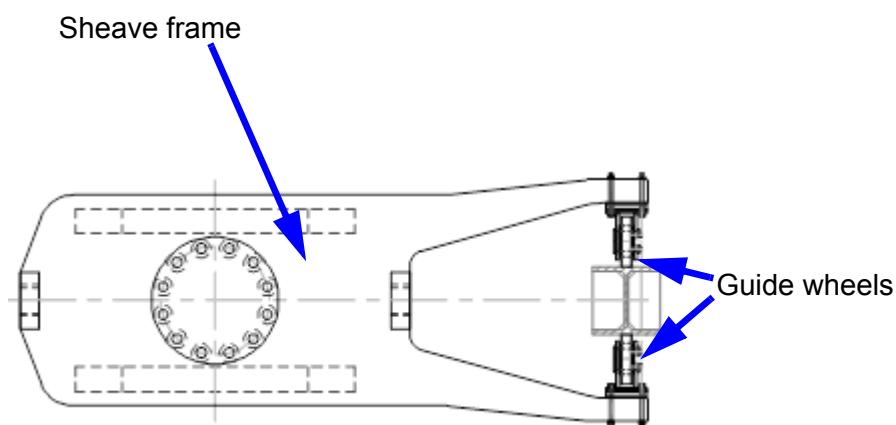


Figure 7-87: Guide wheels

1. Grease guide wheels according to the greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	AISI 316 DIN 71412A	-

7.5.8.10.2 Inspect and clean sheave and head frame

Reference documents:

- [A11-41810-10-0408](#): Sheave and head frame
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Sheave and head frame	Heave compensation system	A11-41810-10-0408	-	1

NOTE When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.

1. Clean the steel structure using a cloth.
2. Visual check the steel structure for cracks, damage and corrosion.
 - If cracks or significant damage are found, take contact with Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of steel structure.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the steel structure.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on steel structure.

7.5.8.10.3 Inspect and clean guide wheels

Reference documents:

- [A11-41810-10-0408](#): Sheave and head frame
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Guide wheels	Heave compensation system	A11-41810-10-0408	9	1

NOTE When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.

1. Clean the guide wheels using a cloth.
2. Visual check the guide wheels for cracks, damage and corrosion.
 - If cracks or significant damage are found, contact Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.

7.5.9 WHIP HOIST WINCH MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
E-motor								
7.5.9.1.1	Perform SPM analysis for E-motor		3			Mechanical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.2	Inspect and clean E-motor exterior		3			Electrical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.3	Test standstill heating of E-motor		3			Electrical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.4	Test thermistor of E-motor		6			Electrical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.5	Perform thermal imaging analysis for E-motor			1		Electrical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.6	Measure insulation resistance of E-motor and cables and continuity resistance of each winding			1		Electrical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.7	Empty condensation drain holes of E-motor			1		Electrical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.8	Replace bearings of E-motor			5		Electrical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
7.5.9.1.9	Grease bearings of E-motor			1		Mechanical	Huisman	331.01.04.05.01.01.01 331.01.04.05.01.02.01
E-motor cooler								
7.5.9.2.1	Check filter element of E-motor cooler	7				Electrical	Huisman	331.01.04.05.01.01.01.01 331.01.04.05.01.02.01.01
7.5.9.2.2	Inspect, clean and test E-motor cooler		3			Electrical	Huisman	331.01.04.05.01.01.01.01 331.01.04.05.01.02.01.01
7.5.9.2.3	Measure insulation resistance of cooler e-motor and cables			1		Electrical	Huisman	331.01.04.05.01.01.01.01 331.01.04.05.01.02.01.01
Gearbox								
7.5.9.3.1	Check bolt connections				1000	Mechanical	Huisman	331.01.04.05.01.01.02 331.01.04.05.01.02.02
7.5.9.3.2	Check leakage of gearbox and oil level	1				Mechanical	Huisman	331.01.04.05.01.01.02 331.01.04.05.01.02.02
7.5.9.3.3	Inspect and clean exterior of gearbox		3			Mechanical	Huisman	331.01.04.05.01.01.02 331.01.04.05.01.02.02
7.5.9.3.4	Perform oil analysis		3			Mechanical	Huisman	331.01.04.05.01.01.02 331.01.04.05.01.02.02
7.5.9.3.5	Replace the gearbox oil			1	200, 1000, each 2000	Mechanical	Siebenhaar	331.01.04.05.01.01.02 331.01.04.05.01.02.02
7.5.9.3.6	Check pinion wear		6			Mechanical	Huisman	331.01.04.05.01.01.02 331.01.04.05.01.02.02
7.5.9.3.7	Perform vibration analysis for gearbox			1		Mechanical	Huisman	331.01.04.05.01.01.02 331.01.04.05.01.02.02

Table 7-11: Maintenance schedule whip hoist winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
E-motor brake								
7.5.9.4.1	Perform automatic E-motor brake test		1			Electrical	Huisman	331.01.04.05.01.01.03 331.01.04.05.01.02.03
7.5.9.4.2	Measure E-motor brake air gap		3			Electrical	Huisman	331.01.04.05.01.01.03 331.01.04.05.01.02.03
7.5.9.4.3	Inspect and clean E-motor brake exterior		3			Electrical	Huisman	331.01.04.05.01.01.03 331.01.04.05.01.02.03
7.5.9.4.4	Measure insulation resistance of E-motor brake cables			1		Electrical	Huisman	331.01.04.05.01.01.03 331.01.04.05.01.02.03
7.5.9.4.5	Test heating of E-motor brake			1		Electrical	Huisman	331.01.04.05.01.01.03 331.01.04.05.01.02.03
7.5.9.4.6	Drain condensation water from E-motor brake			1		Electrical	Huisman	331.01.04.05.01.01.03 331.01.04.05.01.02.03
7.5.9.4.7	Clean E-motor brake interior			1		Electrical	Huisman	331.01.04.05.01.01.03 331.01.04.05.01.02.03
Cables and connections								
7.5.9.5.1	Inspect cables and connections			1		Electrical	Huisman	331.01.04.05.03.03
Drum								
7.5.9.6.1	Check spooling behaviour of drum		6			Mechanical	Huisman	331.01.04.05.04.01
7.5.9.6.2	Apply specified torque for wire rope end connection			1		Mechanical	Huisman	331.01.04.05.04.01
7.5.9.6.3	Inspect drum structure and lebus shell			1		Mechanical	Huisman	331.01.04.05.04.01

Table 7-11: Maintenance schedule whip hoist winch

7.5.9.1 E-motor

This section describes all maintenance tasks for the E-motors of the whip hoist winch.

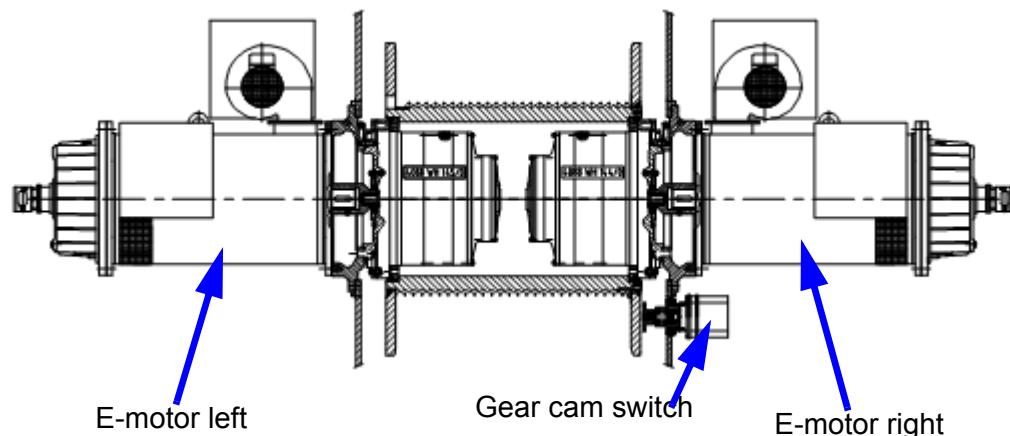


Figure 7-88: E-motor orientation

7.5.9.1.1 Perform SPM analysis for E-motor

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0308	905	1
E-motor left	Drive NO.2	A11-41800-21-0308	906	1

1. Inspect the E-motor by means of Shock Pulse Measurement (SPM) to monitor the condition of the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the SPM data.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in SPM analysis. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable SPM device	1



Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	905
10014631A	E-motor left	906

7.5.9.1.2 Inspect and clean E-motor exterior

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- [A11-41000-09-002](#): Paint Specification
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0308	905	1
E-motor left	Drive NO.2	A11-41800-21-0308	906	1

1. Clean the exterior of the E-motor using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace E-motor.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of E-motor.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check cables and terminal box(es) of E-motor.
 - If a connection is loose, tighten the loose components.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cables.
 - If a terminal box is damaged or corroded, replace the terminal box.
 - If a terminal box suffers from water ingress, replace the terminal box.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	905
10014631A	E-motor left	906

P/N	Part	Symbol code
On request	Terminal box of e-motor	-

7.5.9.1.3 Test standstill heating of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	Electrical drawing (+M22)	-600M1	1
E-motor left	Drive NO.2	Electrical drawing (+M22)	-600M2	1

1. Test the E-motor heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and repair/replace the failed component.
 - Make a record of the measured resistance values.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	905
10014631A	E-motor left	906

7.5.9.1.4 Test thermistor of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	Electrical drawing (+M22)	-600M1	1
E-motor left	Drive NO.2	Electrical drawing (+M22)	-600M2	1

1. Switch on the e-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Check if the resistance is increasing while running the e-motor.
 - If the resistance is 0, infinity or is not increasing while running the e-motor, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	905
10014631A	E-motor left	906

7.5.9.1.5 Perform thermal imaging analysis for E-motor

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0308	905	1
E-motor left	Drive NO.2	A11-41800-21-0308	906	1

1. Inspect the E-motor by means of thermal imaging to monitor the condition of the E-motor. To perform the task, the E-motor should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the thermal image.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	905
10014631A	E-motor left	906

7.5.9.1.6 Measure insulation resistance of E-motor and cables and continuity resistance of each winding

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0308	905	1
E-motor left	Drive NO.2	A11-41800-21-0308	906	1

For performing this task on the E-motor.

1. Open the cover on e-motor to access windings.
2. Megger test the E-motor windings, to find the winding insulation resistance and the insulation resistance between the coils.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For performing this task on the E-motor cables.

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation

CAUTION


Disconnect e-motor from the power source (Inverter) while performing Megger-test!

CAUTION


Windings must be discharged immediately after measuring in order to avoid electric shock.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $690 k\Omega$ at the rated voltage of 690 Volts, if measured at $25^\circ C$. The insulation resistance reference value is halved for each $20^\circ C$ increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
10014632A	E-motor right	905
10014631A	E-motor left	906

7.5.9.1.7 Empty condensation drain holes of E-motor

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0308	905	1
E-motor left	Drive NO.2	A11-41800-21-0308	906	1

1. Empty condensation drain holes of E-motor.

2. Clean and check the drain holes of the E-motor and make sure that holes are open and clear.
 - If excessive grease is found, remove the grease.
 - If dirt blocks the drain holes, remove the dirt.

For more information, see the supplier documentation.

7.5.9.1.8 Replace bearings of E-motor

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0308	905	1
E-motor left	Drive NO.2	A11-41800-21-0308	906	1

1. Replace E-motor bearings.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	E-motor bearings		

7.5.9.1.9 Grease bearings of E-motor

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor right	Drive NO.1	A11-41800-21-0308	905	1
E-motor left	Drive NO.2	A11-41800-21-0308	906	1

1. Grease the E-motor bearings.

NOTE Ultrasonic measurement can be used to determine if greasing is necessary.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
On request		

7.5.9.2 E-motor cooler

This section describes all maintenance tasks for the E-motor coolers of the whip hoist winch.

7.5.9.2.1 Check filter element of E-motor cooler

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor cooler right	Drive NO.1	A11-41800-21-0308	N/A	1
E-motor cooler left	Drive NO.2	A11-41800-21-0308	N/A	1

1. Check filter element of E-motor cooler.
 - If the filter element is clogged, replace the filter element.

Spare parts

P/N	Part	Symbol code	Qty.
On request	E-motor cooling fan filter element		

7.5.9.2.2 Inspect, clean and test E-motor cooler

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor cooler right	Drive NO.1	A11-41800-21-0308	N/A	1
E-motor cooler left	Drive NO.2	A11-41800-21-0308	N/A	1

1. Clean air passage and cooling fan.
2. Inspect E-motor cooler exterior for damage and corrosion.
 - If significant damage is found, replace E-motor cooling fan.
 - If corrosion is found, repair the surfaces where the corrosion is found by cleaning and painting these surfaces, according to the paint specification.
 - If the blades are severely damaged, replace the cooling fan (blades).
3. Check for loose components.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the Paint Specification.
4. Test functionality of cooling fan.
 - If a problem is found, investigate the cause and repair/replace the failed component.
5. Check the functioning of E-motor bearings while the cooler E-motor is off. For this rotate the fan with hand.
 - If the fan does not rotate smoothly, investigate the cause (malfunction of bearings, for example) and repair/replace the failed component.
6. Check cables of E-motor.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cable.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Cooling fan assembly	-
On request	Cooling fan E-motor	-
On request	Cooling fan blades	-

7.5.9.2.3 Measure insulation resistance of cooler E-motor and cables

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor cooler right	Drive NO.1	A11-41800-21-0308	N/A	1
E-motor cooler left	Drive NO.2	A11-41800-21-0308	N/A	1

1. Disconnect the E-motor cooler from the power source.
2. Connect the Megger to the terminals.
3. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE

- *If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.*
- *The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 440 kΩ at the rated voltage of 440 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.*
- *If the winding is too damp, the winding must be over-dried.*

CAUTION



The E-motor cooler must be disconnected from the power source when performing these measurements!

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
On request	E-motor cooler	-
On request	Cooling fan E-motor	-

7.5.9.3 Gearbox

This section described all maintenance tasks for the gearbox of the whip hoist winch.

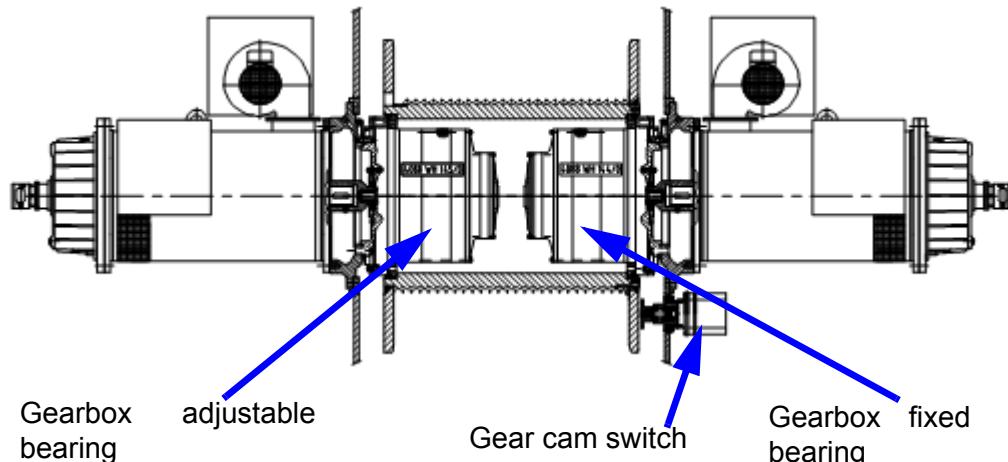


Figure 7-89: Overview gearbox location.

7.5.9.3.1 Check bolt connections

Reference documents

- [A11-41800-21-0308](#): Whip Hoist Winch
- [A11-41000-09-002](#): Paint specification
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0308	04	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0308	05	1

1. Check torque of the bolts according to the drawing A11-41800-21-0308.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque according to drawing A11-41800-21-0308 and repaint according to paint specification.
2. Check the flange holes and the bolts for wear.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information see supplier documentation.

7.5.9.3.2 Check leakage of gearbox and oil level

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- [A11-41800-00-201](#): Greasing schedule
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0308	04	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0308	05	1

1. Check gearbox exterior and surroundings for oil leakage.
 - If leakage occurs, investigate the cause according to supplier documentation and take appropriate measures to prevent an unsafe situation. Then clean up the leakage.

NOTE *In the e-motor/gearbox spline connection a slight leakage can appear*

2. Check the oil level.

NOTE *Make sure the gearbox is in the proper position when checking the oil level.*

- If oil level is too low, refill oil according to the greasing schedule A11-41800-00-201 and supplier documentation.

NOTE *Check the oil level only when the gearbox is stopped!*

NOTE *Do not overfill!*

CAUTION



Do not mix oils of different types, even of the same make!

See Siebenhaar supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 / T3	-	-

Spare parts

P/N	Part	Symbol code
2042354	Gearbox fixed bearing	04
2042355	Gearbox adjustable bearing	05
On request	Seal set	-

7.5.9.3.3 Inspect and clean exterior of gearbox

Reference documents

- [A11-41800-21-0308](#): Whip Hoist Winch
- [A11-41000-09-002](#): Paint specification
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0308	04	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0308	05	1

1. Clean the exterior of the gearbox using a cloth.
2. Visual check the exterior for cracks and corrosion.
 - If cracks are found, replace gearbox.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the Paint Specification.
3. Check noise of the gearbox.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of gearbox.
 - If the paint is damaged, repaint the damaged area according to the Paint Specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to Paint Specification.
5. Check cables of gearbox
 - If a connection is loose, tighten loose components.
 - If cable sheathes are damaged or corroded, repair the cable sheathes or replace the cables.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2042354	Gearbox fixed bearing	04
2042355	Gearbox adjustable bearing	05
On request	Seal set	-

7.5.9.3.4 Perform oil analysis

Reference documents

- [A11-41800-21-0308](#): Whip Hoist Winch
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0308	04	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0308	05	1

1. Take oil sample.
2. Let a certified third party perform the oil sample analysis for chemical and physical values.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.
3. Let a certified third party perform the oil sample analysis for wear, clearness and water.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 T3	-	-

Spare parts

P/N	Part	Symbol code
2042354	Gearbox fixed bearing	04
2042355	Gearbox adjustable bearing	05

7.5.9.3.5 Replace the gearbox oil

Reference documents

- [A11-41800-21-0308](#): Whip Hoist Winch
- [A11-41800-00-201](#): Greasing schedule
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0308	04	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0308	05	1

1. Replace gearbox oil according to greasing schedule A11-41800-00-201. First oil change after 200 motor-hours, second oil change after 1000 motor-hours and further oil changes every 2000 motor-hours or every 12 months.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 / T3	-	25 liters

7.5.9.3.6 Check pinion wear

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0308	04	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0308	05	1

1. Visually check pinion for wear.
 - If the hardened layer is worn out, replace the gearbox or pinion.
 - if the teeth are significantly worn out in contact places, replace the gearbox or pinion.

2. Inspect pinion teeth surface for damage (pitting).

- If the surface is not smooth anymore because of pitting, replace the gearbox or pinion and perform an analysis on the grease of the pinion teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
2042354	Gearbox fixed bearing	04
2042355	Gearbox adjustable bearing	05
On request	Pinion	-
On request	Pinion shaft	-
On request	Seal set	-

7.5.9.3.7 Perform vibration analysis for gearbox

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox fixed bearing	Drive NO.1	A11-41800-21-0308	04	1
Gearbox adjustable bearing	Drive NO.2	A11-41800-21-0308	05	1

1. Perform measurement.
2. Analyse measurement.
 - If a problem is found, investigate the cause and repair/replace the failed component.

The internal condition of the components needs to be inspected by means of vibration analysis. Huisman recommends this analysis to be executed by a third party that is specialized in vibration analysis, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable vibration meter / analyser	1

Spare parts

P/N	Part	Symbol code
2042354	Gearbox fixed bearing	04
2042355	Gearbox adjustable bearing	05

7.5.9.4 E-motor brake

This section describes all maintenance tasks for the E-motor brakes of the whip hoist winch.

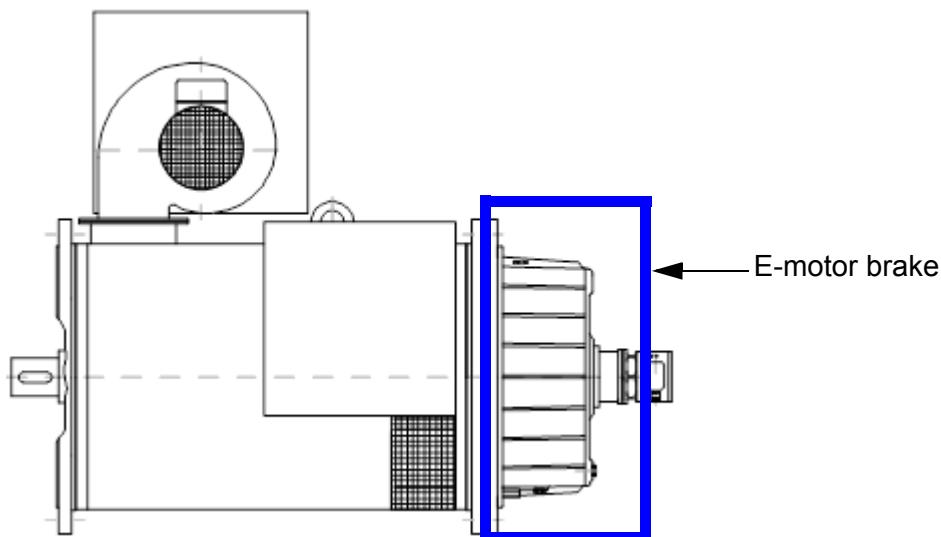


Figure 7-90: E-motor brake

7.5.9.4.1 Perform automatic E-motor brake test

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0308	-	1
E-motor brake	Drive NO.2	A11-41800-21-0308	-	1

1. Perform brake test according to section [7.2.13](#) for each individual brake.
 - If the brake holds the rated load without slipping, SCADA pop-up will display "Brake test passed".
 - If an alarm is generated, investigate the cause and repair/replace the failed compo-

nent.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.9.4.2 Measure E-motor brake air gap

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0308	-	1
E-motor brake	Drive NO.2	A11-41800-21-0308	-	1

1. Execute this task according to [7.2.13](#) Brake section in general maintenance.
 - If the value exceeds the maximum as shown on the brake plate, reverse the brake flange (as temporary solution) or replace the brake set (Brake flange, armature plate and friction plate).

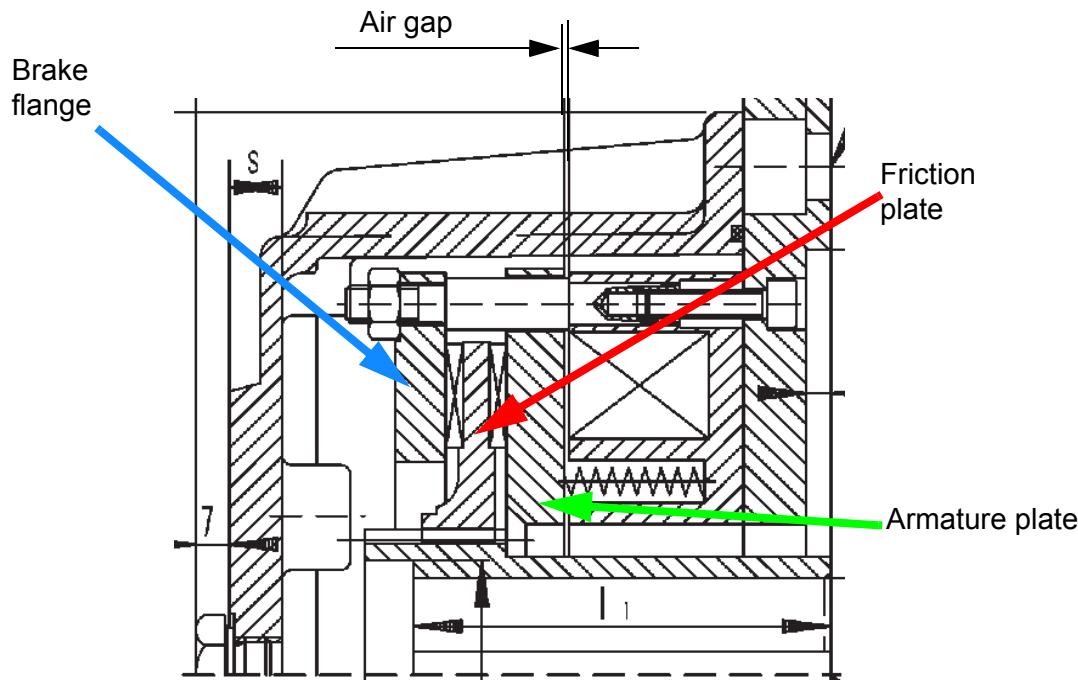


Figure 7-91: E-motor brake

NOTE When installing a new brake, adjust the air gap according to the [7.2.13](#) Brake section in general maintenance.

NOTE It is important to run in the new brake liners after installation. Run-in procedure is described in [7.2.13](#) Brake section in general maintenance.

For more information, see the supplier documentation.

Air gap

Minimum (mm)	Maximum (mm)
0.4	2.5

Special tools

P/N	Tool	Qty.
On request	Feeler gauge (required accuracy $\pm 0.05\text{mm}$)	1

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-
On request	Brake flange	

P/N	Part	Symbol code
On request	Armature plate	
On request	Friction plate	

7.5.9.4.3 Inspect and clean E-motor brake exterior

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0308	-	1
E-motor brake	Drive NO.2	A11-41800-21-0308	-	1

1. Clean the exterior of the E-motor brake using a cloth.
2. Visual check the exterior of the E-motor brake for damage and excessive corrosion.
 - If significant damage or corrosion is found, replace E-motor brake.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.9.4.4 Measure insulation resistance of E-motor brake and cables

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0308	-	1
E-motor brake	Drive NO.2	A11-41800-21-0308	-	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE	<ul style="list-style-type: none">• <i>The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 110 kΩ at the rated voltage of 110 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.</i>• If the winding is too damp, the winding must be over-dried.
-------------	--

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.9.4.5 Test heating of E-motor brake

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0308	-	1
E-motor brake	Drive NO.2	A11-41800-21-0308	-	1

1. Test the E-motor brake heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049844	E-motor brake	-

7.5.9.4.6 Drain condensation water from E-motor brake

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0308	-	1
E-motor brake	Drive NO.2	A11-41800-21-0308	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.9.4.7 Clean E-motor brake interior

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Drive NO.1	A11-41800-21-0308	-	1
E-motor brake	Drive NO.2	A11-41800-21-0308	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.9.5 Cables and connections

This section describes all maintenance tasks for the cables and connections of the whip hoist winch.

7.5.9.5.1 Inspect cables and connections:

Description	Location	Reference	Symbol code	Qty.
Cables	Whip hoist winch	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correct tightened, replace the tag, according the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

7.5.9.6 Drum

This section describes all maintenance tasks for the drum of the whip hoist winch.

7.5.9.6.1 Check spooling behavior of drum

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Drum	Whip hoist winch	A11-41800-21-0308	-	1

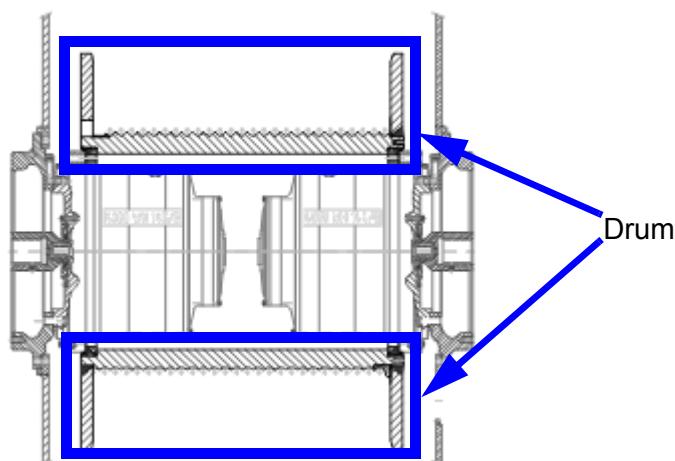


Figure 7-92: Drum

1. Check spooling behaviour of the drum according to the Huisman wire rope manual.
 - If a problem is found, investigate the cause and repair/replace the failed component.

7.5.9.6.2 Apply specified torque for wire rope end connection

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Wire rope end connection	Whip hoist winch	A11-41800-21-0308	13	1

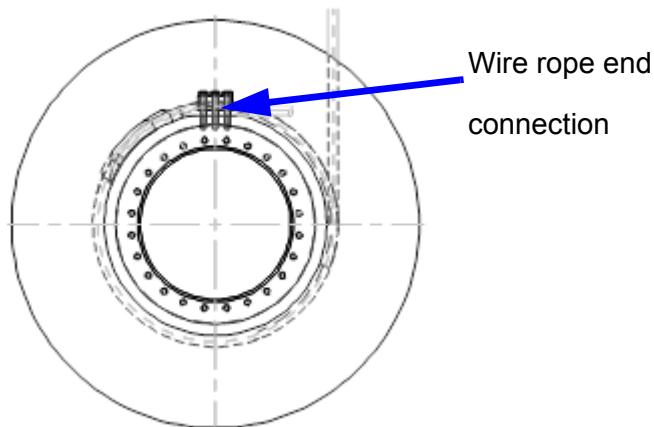


Figure 7-93: Wire rope end connection

1. Apply the specified torque for wire rope end connection according to specification.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Specified torque

Description	Torque
Hex head bolt	617 Nm

Spare parts

P/N	Part	Symbol code
9134237	Wire rope end connection plate	13
2007028	Bolts	115

7.5.9.6.3 Inspect drum structure and lebus shell

Reference documents:

- [A11-41800-21-0308](#): Whip Hoist Winch
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Drum	Whip hoist winch	A11-41800-21-0308	-	1

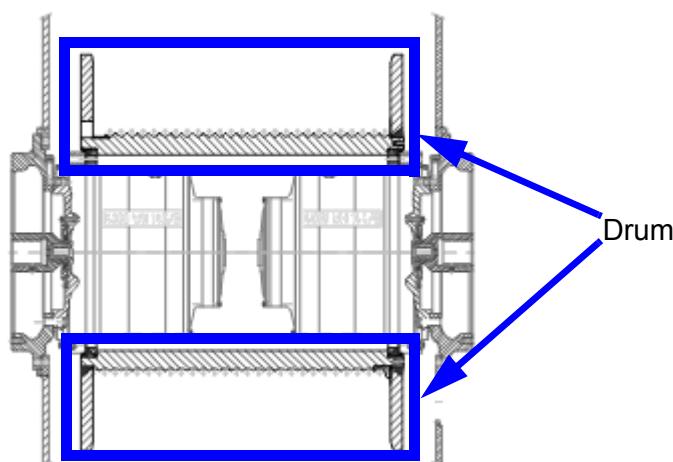


Figure 7-94: Drum

1. Unwind the wire rope from the drum.
2. Clean drum structure.
3. Visual check the drum structure for wear, cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the drum.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
4. Check paint of drum structure.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
5. Check for loose components of the drum structure (including wire rope end connection).
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on lebus shell.

7.5.10 TUGGER WINCH MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
E-motor								
7.5.10.1.1	Perform SPM analysis for E-motor		3			Mechanical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.2	Inspect and clean E-motor exterior		3			Electrical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.3	Test standstill heating of E-motor		3			Electrical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.4	Test thermistor of E-motor		6			Electrical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.5	Perform thermal imaging analysis for E-motor			1		Electrical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.6	Measure insulation resistance of E-motor and cables and continuity resistance of each winding			1		Electrical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.7	Empty condensation drain holes of E-motor			1		Electrical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.8	Replace bearings of E-motor			5		Electrical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
7.5.10.1.9	Grease bearings of E-motor			1		Mechanical	Huisman	331.01.04.06.01.01 331.01.04.08.01.01
Gearbox								
7.5.10.2.1	Check bolt connections				1000	Mechanical	Huisman	331.01.04.06.01.02 331.01.04.08.01.02
7.5.10.2.2	Check leakage of gearbox and oil level	1				Mechanical	Huisman	331.01.04.06.01.02 331.01.04.08.01.02
7.5.10.2.3	Inspect and clean exterior of gearbox		3			Mechanical	Huisman	331.01.04.06.01.02 331.01.04.08.01.02
7.5.10.2.4	Perform oil analysis		3			Mechanical	Huisman	331.01.04.06.01.02 331.01.04.08.01.02
7.5.10.2.5	Replace the gearbox oil			1	200, 1000, each 2000	Mechanical	Siebenhaar	331.01.04.06.01.02 331.01.04.08.01.02
7.5.10.2.6	Check pinion wear		6			Mechanical	Huisman	331.01.04.06.01.02 331.01.04.08.01.02
7.5.10.2.7	Perform vibration analysis for gearbox			1		Mechanical	Huisman	331.01.04.06.01.02 331.01.04.08.01.02
E-motor brake								
7.5.10.3.1	Perform automatic E-motor brake test		1			Electrical	Huisman	331.01.04.06.01.03 331.01.04.08.01.03
7.5.10.3.2	Measure E-motor brake air gap		3			Electrical	Huisman	331.01.04.06.01.03 331.01.04.08.01.03
7.5.10.3.3	Inspect and clean E-motor brake exterior		3			Electrical	Huisman	331.01.04.06.01.03 331.01.04.08.01.03

Table 7-12: Maintenance schedule tugger winch

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.10.3.4	Measure insulation resistance of E-motor brake cables			1		Electrical	Huisman	331.01.04.06.01.03 331.01.04.08.01.03
7.5.10.3.5	Test heating of E-motor brake			1		Electrical	Huisman	331.01.04.06.01.03 331.01.04.08.01.03
7.5.10.3.6	Drain condensation water from E-motor brake			1		Electrical	Huisman	331.01.04.06.01.03 331.01.04.08.01.03
7.5.10.3.7	Clean E-motor brake interior			1		Electrical	Huisman	331.01.04.06.01.03 331.01.04.08.01.03
Cables and connections								
7.5.10.4.1	Inspect cables and connections			1		Electrical	Huisman	331.01.04.06.03.03 331.01.04.08.03.02
Drum								
7.5.10.5.1	Grease drum bearing		3		100	Mechanical	Huisman	331.01.04.06.04.01 331.01.04.08.04.01
7.5.10.5.2	Check spooling behaviour of drum		6			Mechanical	Huisman	331.01.04.06.04.01 331.01.04.08.04.01
7.5.10.5.3	Inspect drum bearing		6			Mechanical	Huisman	331.01.04.06.04.01 331.01.04.08.04.01
7.5.10.5.4	Apply specified torque for wire rope end connection			1		Mechanical	Huisman	331.01.04.06.04.01 331.01.04.08.04.01
7.5.10.5.5	Inspect drum structure and lebus shell			1		Mechanical	Huisman	331.01.04.06.04.01 331.01.04.08.04.01
Structure								
7.5.10.6.1	Inspect and clean winch frame			1		Mechanical	Huisman	331.01.04.06.04.02

Table 7-12: Maintenance schedule tugger winch

7.5.10.1 E-motor

This section describes all maintenance tasks for the E-motor of the tugger winch.

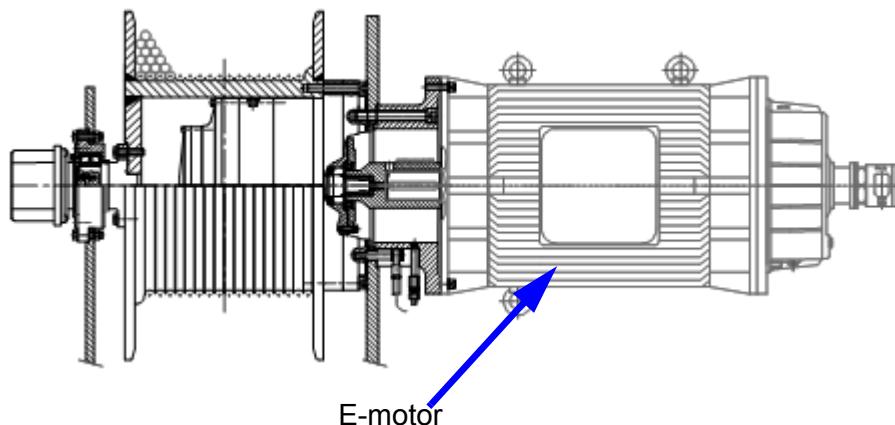


Figure 7-95: E-motor orientation

7.5.10.1.1 Perform SPM analysis for E-motor

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	A11-41800-21-0408	907	1

1. Inspect the E-motor by means of Shock Pulse Measurement (SPM) to monitor the condition of the E-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the SPM data.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in SPM analysis. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable SPM device	1

Spare parts

P/N	Part	Symbol code
10015344A	E-motor	907

7.5.10.1.2 Inspect and clean E-motor exterior

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	A11-41800-21-0408	907	1

1. Clean the exterior of the E-motor using a cloth.
2. Visual check the exterior for damage and corrosion.
 - If significant damage is found, replace E-motor.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of E-motor.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check cables and terminal box(es) of E-motor.
 - If a connection is loose, tighten the loose components.
 - If cable sheaths are damaged or corroded, repair the cable sheaths or replace the cables.
 - If a terminal box is damaged or corroded, replace the terminal box.
 - If a terminal box suffers from water ingress, replace the terminal box.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10015344A	E-motor	907
On request	Terminal box of e-motor	-

7.5.10.1.3 Test standstill heating of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	Electrical drawing (+M51)	-800M1	1

1. Test the E-motor heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and repair/replace the failed component.
 - Make a record of the measured resistance values.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10015344A	E-motor	907

7.5.10.1.4 Test thermistor of E-motor

Reference documents:

- [10013281A](#): Electrical drawing
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	Electrical drawing (+M51)	-800M1	1

1. Switch on the e-motor.

NOTE Make sure the E-motor is running while performing this task.

2. Check if the resistance is increasing while running the e-motor.
 - If the resistance is 0, infinity or is not increasing while running the e-motor, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
10015344	E-motor	907

7.5.10.1.5 Perform thermal imaging analysis for E-motor

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	A11-41800-21-0408	907	1

1. Inspect the E-motor by means of thermal imaging to monitor the condition of the E-motor. To perform the task, the E-motor should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the E-motor is running while performing this task.

2. Analyse the thermal image.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

Spare parts

P/N	Part	Symbol code
10015344A	E-motor	907

7.5.10.1.6 Measure insulation resistance of E-motor and cables and continuity resistance of each winding

Reference documents:

■ [A11-41800-21-0408](#):Tugger Winch Drum

■ Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	A11-41800-21-0408	907	1

For performing this task on the E-motor.

1. Open the cover on e-motor to access windings.
2. Megger test the E-motor windings, to find the winding insulation resistance and the insulation resistance between the coils.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For performing this task on the E-motor cables.

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation

CAUTION



Disconnect e-motor from the power source (Inverter) while performing Megger-test!

CAUTION



Windings must be discharged immediately after measuring in order to avoid electric shock.

NOTE

- If a motor is commissioned or reactivated after a longer period of storage, it is necessary to measure the insulation resistance of the windings.
- The values may not be lower than 1000Ω per Volt of rated voltage, which means at least $690 \text{ k}\Omega$ at the rated voltage of 690 Volts, if measured at 25°C . The insulation resistance reference value is halved for each 20°C increase in ambient temperature.
- If the winding is too damp, the winding must be over-dried.

Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
10015344A	E-motor	907

7.5.10.1.7 Empty condensation drain holes of E-motor

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	A11-41800-21-0408	907	1

1. Empty condensation drain holes of E-motor.
2. Clean and check the drain holes of the E-motor and make sure that holes are open and clear.
 - If excessive grease is found, remove the grease.
 - If dirt blocks the drain holes, remove the dirt.

For more information, see the supplier documentation.

7.5.10.1.8 Replace bearings of E-motor

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	A11-41800-21-0408	907	1

1. Replace E-motor bearings.

For more information, see the supplier documentation.

Parts needed for task

P/N	Part	Symbol code	Qty.
On request	E-motor bearings		

7.5.10.1.9 Grease bearings of E-motor

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Woelfer - Motor operating manual

Description	Location	Reference	Symbol code	Qty.
E-motor	Tugger winch	A11-41800-21-0408	907	1

1. Grease the E-motor bearings.

NOTE Ultrasonic measurement can be used to determine if greasing is necessary.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
On request		

7.5.10.2 Gearbox

This section described all maintenance tasks for the gearbox of the tugger winch.

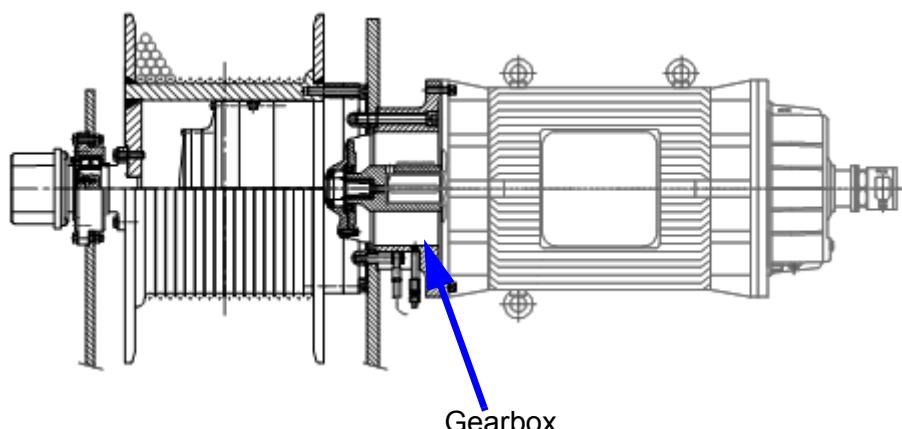


Figure 7-96: Overview gearbox location.

7.5.10.2.1 Check bolt connections

Reference documents

- [A11-41800-21-0408](#):Tugger Winch Drum
- [A11-41000-09-002](#): Paint specification
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox	Tugger winch	A11-41800-21-0408	106	1

1. Check torque of the bolts according to the drawing A11-41800-21-0408.
 - If bolts are loose or not at the correct torque, tighten the bolts with the correct torque according to drawing A11-41800-21-0408 and repaint according to paint specification.
2. Check the flange holes and the bolts for wear.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information see supplier documentation.

7.5.10.2.2 Check leakage of gearbox and oil level

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum

- [A11-41800-00-201](#): Greasing schedule
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox	Tugger winch	A11-41800-21-0408	106	1

1. Check gearbox exterior and surroundings for oil leakage.
 - If leakage occurs, investigate the cause according to supplier documentation and take appropriate measures to prevent an unsafe situation. Then clean up the leakage.

NOTE *In the e-motor/gearbox spline connection a slight leakage can appear*

2. Check the oil level.

NOTE *Make sure the gearbox is in the proper position when checking the oil level.*

- If oil level is too low, refill oil according to the greasing schedule A11-41800-00-201 and supplier documentation.

NOTE *Check the oil level only when the gearbox is stopped!*

NOTE *Do not overfill!*

CAUTION



Do not mix oils of different types, even of the same make!

See Siebenhaar supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 / T3	-	-

Spare parts

P/N	Part	Symbol code
10013827A	Gearbox	106

P/N	Part	Symbol code
On request	Seal set	-

7.5.10.2.3 Inspect and clean exterior of gearbox

Reference documents

- [A11-41800-21-0408](#): Tugger Winch Drum
- [A11-41000-09-002](#): Paint specification
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox	Tugger winch	A11-41800-21-0408	106	1

1. Clean the exterior of the gearbox using a cloth.
2. Visual check the exterior for cracks and corrosion.
 - If cracks are found, replace gearbox.
 - If corrosion is found, repair the surfaces where the corrosion is found by removing the corrosion and paint these surfaces, according to the paint specification.
3. Check noise of the gearbox.
 - If excessive noise is found, investigate the cause and repair/replace the failed component.
4. Check paint of gearbox.
 - If the paint is damaged, repaint the damaged area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts according to paint specification.
5. Check cables of gearbox
 - If a connection is loose, tighten loose components
 - if cable sheathes are damaged or corroded, repair the cable sheathes or replace the cables.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
10013827A	Gearbox	106
On request	Seal set	-

7.5.10.2.4 Perform oil analysis

Reference documents

- [A11-41800-21-0408](#):Tugger Winch Drum
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox	Tugger winch	A11-41800-21-0408	106	1

1. Take oil sample.
2. Let a certified third party perform the oil sample analysis for chemical and physical values.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.
3. Let a certified third party perform the oil sample analysis for wear, clearness and water.
 - Follow the recommendations in the oil analysis report, and replace the gearbox when stated in the report.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 T3	-	-

Spare parts

P/N	Part	Symbol code
10013827A	Gearbox	106

7.5.10.2.5 Replace the gearbox oil

Reference documents

- [A11-41800-21-0408](#):Tugger Winch Drum
- [A11-41800-00-201](#): Greasing schedule
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox	Tugger winch	A11-41800-21-0408	106	1

- Replace gearbox oil according to greasing schedule A11-41800-00-201. First oil change after 200 motor-hours, second oil change after 1000 motor-hours and further oil changes every 2000 motor-hours or every 12 months.

Lubrication

Lubrication type	Type of grease nipple	Qty.
ISO VG220 CLP DIN 51517 / T3	-	9 liters

7.5.10.2.6 Check pinion wear

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox	Tugger winch	A11-41800-21-0408	106	1

- Visually check pinion for wear.
 - If the hardened layer is worn out, replace the gearbox or pinion.
 - if the teeth are significantly worn out in contact places, replace the gearbox or pinion.
- Inspect pinion teeth surface for damage (pitting).
 - If the surface is not smooth anymore because of pitting, replace the gearbox or pinion and perform an analysis on the grease of the pinion teeth.

For more information see supplier documentation.

Spare parts

P/N	Part	Symbol code
10013827A	Gearbox	106
On request	Pinion	-
On request	Pinion shaft	-
On request	Seal set	-

7.5.10.2.7 Perform vibration analysis for gearbox

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Siebenhaar - Winch gear instructions

Description	Location	Reference	Symbol code	Qty.
Gearbox	Tugger winch	A11-41800-21-0408	106	1

1. Perform measurement.
2. Analyse measurement.
 - If a problem is found, investigate the cause and repair/replace the failed component.

The internal condition of the components needs to be inspected by means of vibration analysis. Huisman recommends this analysis to be executed by a third party that is specialized in vibration analysis, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Portable vibration meter / analyser	1

Spare parts

P/N	Part	Symbol code
10013827A	Gearbox	106

7.5.10.3 E-motor brake

This section describes all maintenance tasks for the E-motor brakes of the tugger winch.

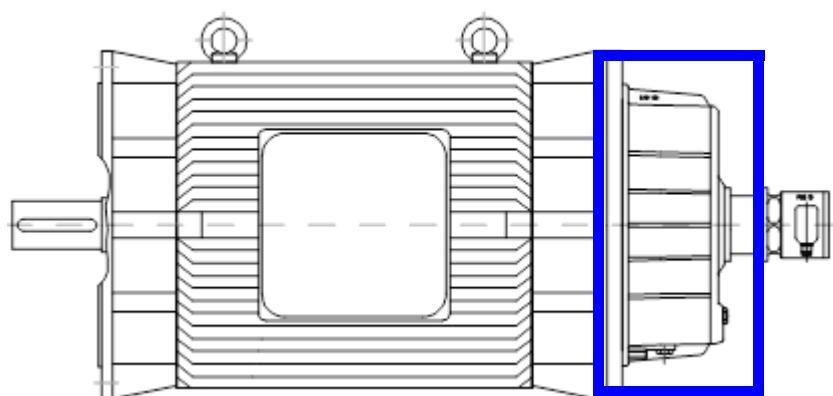


Figure 7-97: E-motor brake

7.5.10.3.1 Perform automatic E-motor brake test

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Tugger winch	A11-41800-21-0408	-	1

1. Perform brake test according to section [7.2.13](#) for each individual brake.
 - If the brake holds the rated load without slipping, SCADA pop-up will display “Brake test passed”.
 - If an alarm is generated, investigate the cause and repair/replace the failed component.

NOTE *It is important to run in the new brake liners after installation.*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049845	E-motor brake	-

7.5.10.3.2 Measure E-motor brake air gap

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Tugger winch	A11-41800-21-0408	-	1

1. Execute this task according to [7.2.13 Brake section in general maintenance](#).
 - If the value exceeds the maximum as shown on the brake plate, reverse the brake flange (as temporary solution) or replace the brake set (Brake flange, armature plate and friction plate).

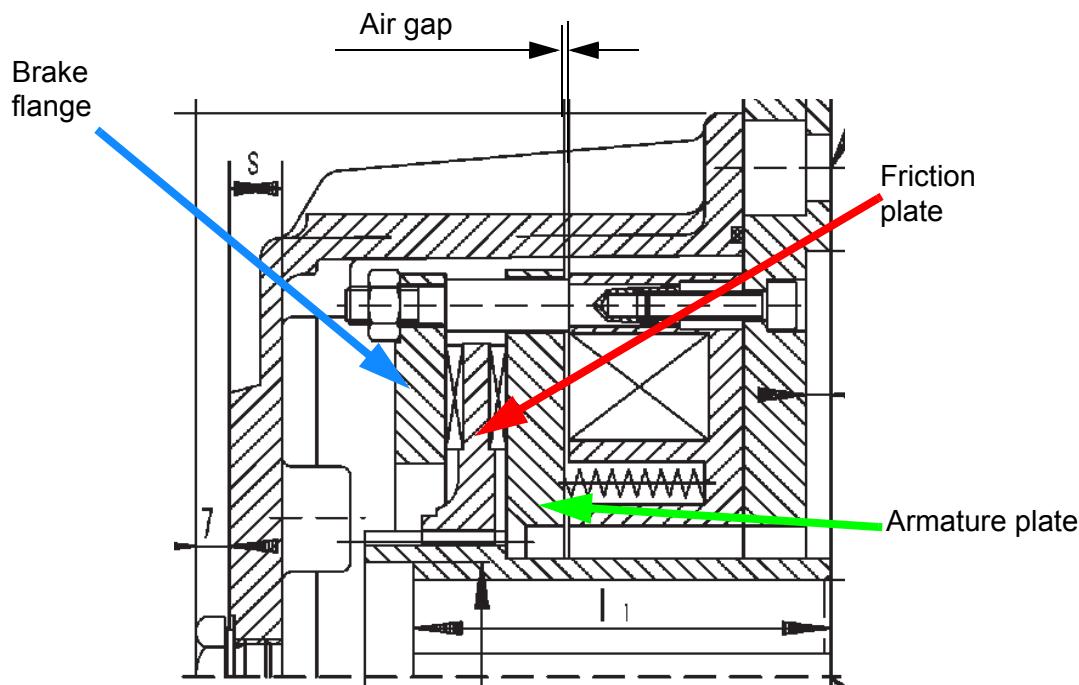


Figure 7-98: E-motor brake

NOTE When installing a new brake, adjust the air gap according to the [7.2.13 Brake section in general maintenance](#).

NOTE It is important to run in the new brake liners after installation. Run-in procedure is described in [7.2.13 Brake section in general maintenance](#).

For more information, see the supplier documentation.

Air gap

Minimum (mm)	Maximum (mm)
0.6	1.8

Special tools

P/N	Tool	Qty.
On request	Feeler gauge (required accuracy ±0.05mm)	1

Spare parts

P/N	Part	Symbol code
2049845	E-motor brake	-
On request	Brake flange	
On request	Armature plate	
On request	Friction plate	

7.5.10.3.3 Inspect and clean E-motor brake exterior

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Tugger winch	A11-41800-21-0408	-	1

1. Clean the exterior of the E-motor brake using a cloth.
2. Visual check the exterior of the E-motor brake for damage and excessive corrosion.
 - If significant damage or corrosion is found, replace E-motor brake.

NOTE It is important to run in the new brake liners after installation.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049845	E-motor brake	-

7.5.10.3.4 Measure insulation resistance of E-motor brake and cables

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Tugger winch	A11-41800-21-0408	-	1

1. Connect the Megger to the terminals.
2. Check the insulation resistance.
 - If the measured value is less than the threshold value, investigate the cause and repair/replace the failed component.

For more information, see supplier documentation.

NOTE	<i>• The values may not be lower than 1000 Ω per Volt of rated voltage, which means at least 110 kΩ at the rated voltage of 110 Volts, if measured at 25 °C. The insulation resistance reference value is halved for each 20 °C increase in ambient temperature.</i> <i>• If the winding is too damp, the winding must be over-dried.</i>
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Special tools

P/N	Tool	Qty.
On request	Megger	1

Spare parts

P/N	Part	Symbol code
2049845	E-motor brake	-



7.5.10.3.5 Test heating of E-motor brake

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Tugger winch	A11-41800-21-0408	-	1

1. Test the E-motor brake heating by measuring the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and replace the failed component.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2049845	E-motor brake	-

7.5.10.3.6 Drain condensation water from E-motor brake

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Tugger winch	A11-41800-21-0408	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.10.3.7 Clean E-motor brake interior

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Pintsch Bamag_SFB - SFB H user manual

Description	Location	Reference	Symbol code	Qty.
E-motor brake	Tugger winch	A11-41800-21-0408	-	1

1. Execute this task according to the Pintsch Bamag supplier documentation.

7.5.10.4 Cables and connections

This section describes all maintenance tasks for the cables and connections of the tugger winch.

7.5.10.4.1 Inspect cables and connections

Reference documents:

- -

Description	Location	Reference	Symbol code	Qty.
Cables	Tugger winch	-	-	-

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cable ties.
3. Check if the cable code tags are present and readable.
 - If a cable code tags are not present or not correct tightened, replace the tag, according the electrical schematics (E-plan).
4. Check connections, tighten connections and check cable sheaths for damage and/or corrosion. When a tightening torque is specified, check the tightening torque.
 - If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace the cables.
5. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.

7.5.10.5 Drum

This section describes all maintenance tasks for the drum of the tugger winch.

7.5.10.5.1 Grease drum bearing

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Drum	Tugger winch	A11-41800-21-0408	-	1

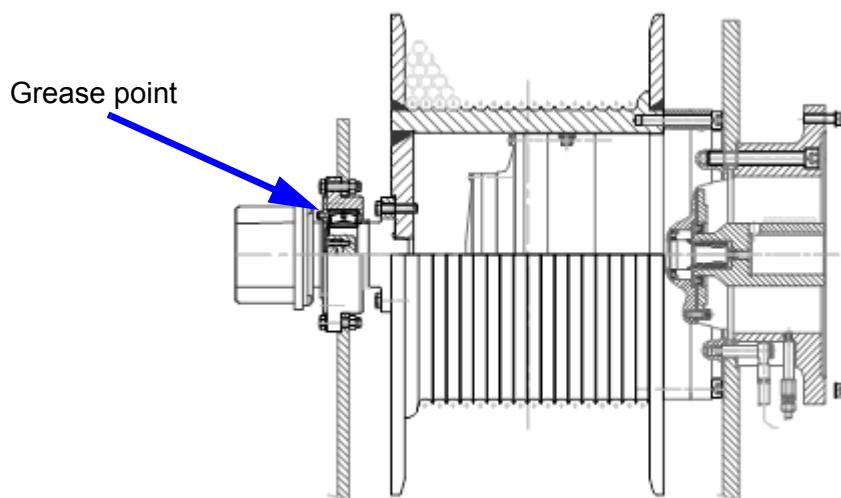


Figure 7-99: Grease point drum

1. Grease drum bearing according to the greasing schedule.

For more information, see the supplier documentation.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	AISI 316 DIN 71412A CONED	-

7.5.10.5.2 Check spooling behavior of drum

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Drum	Tugger winch	A11-41800-21-0408	-	1

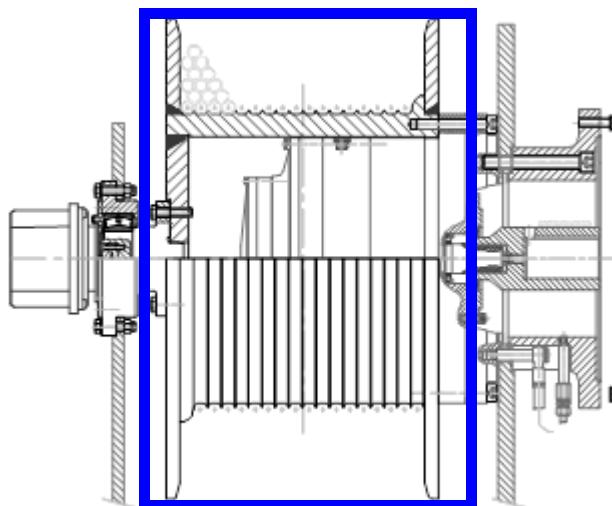


Figure 7-100: Drum

1. Check spooling behaviour of the drum according to the Huisman wire rope manual.
 - If a problem is found, investigate the cause and repair/replace the failed component.

7.5.10.5.3 Inspect drum bearing

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum

Description	Location	Reference	Symbol code	Qty.
Drum bearing	Tugger winch	A11-41800-21-0408	208	1

1. Operate the winch.
2. Inspect functioning of drum bearing by visual and auditory inspection.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Spare parts

P/N	Part	Symbol code
2005669	Drum bearing	208
On request	Drum bearing seal	N/A
On request	Drum bearing covers	N/A

7.5.10.5.4 Apply specified torque for wire rope end connection

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Wire rope end connection	Tugger winch	A11-41800-21-0408	08	1

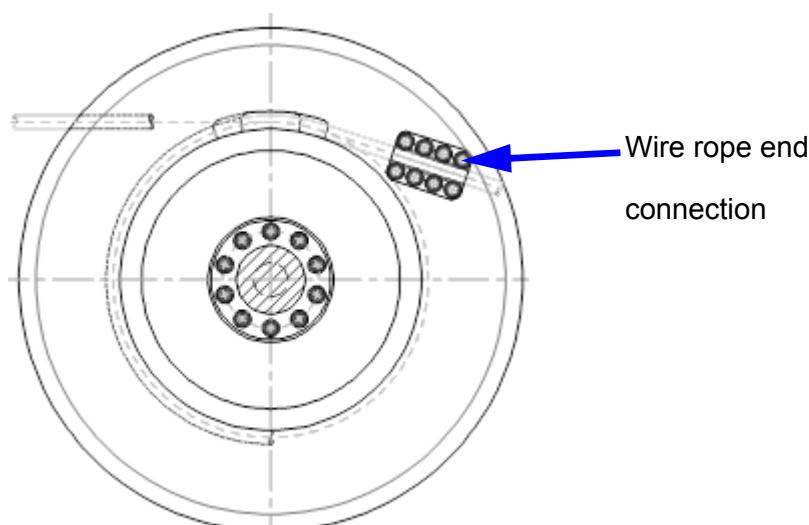


Figure 7-101: Wire rope end connection

1. Apply the specified torque for wire rope end connection according to specification.
 - If a problem is found, investigate the cause and repair/replace the failed component.

For more information, see the supplier documentation.

Specified torque

Description	Torque
Hex head bolt	216 Nm

Spare parts

P/N	Part	Symbol code
9134237	Wire rope end connection plate	08
2000766	Bolts	200

7.5.10.5.5 Inspect drum structure and lebus shell

Reference documents:

- [A11-41800-21-0408](#):Tugger Winch Drum
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Drum	Tugger winch	A11-41800-21-0408	-	1

1. Unwind the wire rope from the drum.
2. Clean drum structure.
3. Visual check the drum structure for wear, cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the drum.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
4. Check paint of drum structure.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
5. Check for loose components of the drum structure (including wire rope end connection).
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on lebus shell.

7.5.10.6 Structure

This section describes all maintenance tasks for the winch frame of the boom hoist winch.

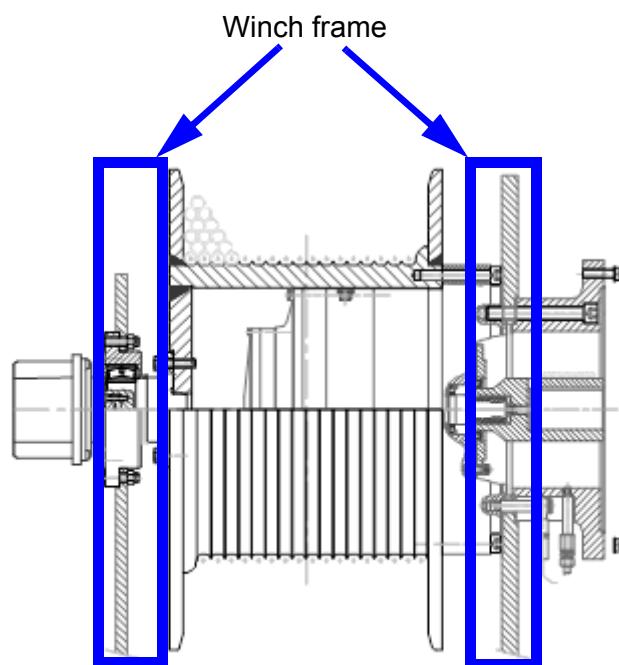


Figure 7-102: Winch frame

7.5.10.6.1 Inspect and clean winch frame

Reference documents:

- [A11-41800-21-0408](#): Tugger Winch Drum
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Tugger frame	Tugger winch	A11-41800-14-0308	-	1

NOTE When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.

1. Clean the winch frame using a cloth.
2. Visual check the winch frame for cracks, damage and corrosion.
 - If cracks or significant damage are found, take contact with Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.

3. Check paint of winch frame.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the winch frame.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on the winch frame.

7.5.11 WIRES, BLOCKS AND SHEAVES MAINTENANCE

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
Wire rope								
7.5.11.1.1	Inspect wire rope	7				Mechanical	Huisman	331.01.05.01.01 331.01.05.02.01 331.01.05.03.01 331.01.05.04.01 331.01.05.05.01
7.5.11.1.2	Grease wire rope		3		100	Mechanical	Huisman	331.01.05.01.01 331.01.05.02.01 331.01.05.03.01 331.01.05.04.01 331.01.05.05.01
7.5.11.1.3	Perform electromagnetic testing on wire rope		3			Mechanical	Huisman	331.01.05.01.01 331.01.05.02.01 331.01.05.03.01 331.01.05.04.01 331.01.05.05.01
7.5.11.1.4	Check wire rope diameter		6			Mechanical	Huisman	331.01.05.01.01 331.01.05.02.01 331.01.05.03.01 331.01.05.04.01 331.01.05.05.01
Sockets								
7.5.11.2.1	Inspect socket		1			Mechanical	Huisman	331.01.05.01.01.01 331.01.05.02.01.01 331.01.05.03.01.01 331.01.05.04.01.01 331.01.05.05.01.01
7.5.11.2.2	Non-destructive testing of closed-spelter socket			5		NDT specialist	Huisman	331.01.05.01.01.01 331.01.05.02.01.01 331.01.05.03.01.01 331.01.05.04.01.01 331.01.05.05.01.01
Lower blocks								
7.5.11.3.1	Grease block bearings		3		100 or after being submerged	Hydraulical	Huisman	331.01.05.02.02 331.01.05.03.02
7.5.11.3.2	Inspect lower block bearing		6			Mechanical	Huisman	331.01.05.02.02 331.01.05.03.02
7.5.11.3.3	Inspect and clean block			1		Mechanical	Huisman	331.01.05.02.02 331.01.05.03.02
7.5.11.3.4	Non-destructive testing of welds and block			5		NDT specialist	Huisman	331.01.05.02.02 331.01.05.03.02
Boom hoist sheaves								
7.5.11.4.1	Grease boom hoist sheave bearings		3		100	Mechanical	Huisman	331.01.05.01.02.01 331.01.05.01.02.02 331.01.05.01.02.03 331.01.05.01.02.04 331.01.05.01.02.05 331.01.05.01.02.06 331.01.05.01.02.07 331.01.05.01.02.08 331.01.05.01.02.09 331.01.05.01.02.10 331.01.05.01.02.11 331.01.05.01.02.12 331.01.05.01.02.13 331.01.05.01.02.14 331.01.05.01.02.15 331.01.05.01.02.16

Table 7-13: Maintenance schedule wires, blocks and sheaves

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.11.4.2	Inspect boom hoist sheaves		3			Mechanical	Huisman	331.01.05.01.02.01 331.01.05.01.02.02 331.01.05.01.02.03 331.01.05.01.02.04 331.01.05.01.02.05 331.01.05.01.02.06 331.01.05.01.02.07 331.01.05.01.02.08 331.01.05.01.02.09 331.01.05.01.02.10 331.01.05.01.02.11 331.01.05.01.02.12 331.01.05.01.02.13 331.01.05.01.02.14 331.01.05.01.02.15 331.01.05.01.02.16
Main hoist sheaves								
7.5.11.5.1	Grease main hoist sheave bearings		3		100 or after being submerged	Mechanical	Huisman	331.01.05.02.02.01 331.01.05.02.04.01 331.01.05.02.04.02 331.01.05.02.04.03 331.01.05.02.04.04 331.01.05.02.04.05 331.01.05.02.04.06
7.5.11.5.2	Inspect main hoist sheaves		3			Mechanical	Huisman	331.01.05.02.02.01 331.01.05.02.04.01 331.01.05.02.04.02 331.01.05.02.04.03 331.01.05.02.04.04 331.01.05.02.04.05 331.01.05.02.04.06
Whip hoist sheaves								
7.5.11.6.1	Grease main hoist sheave bearings		3		100 or after being submerged	Mechanical	Huisman	331.01.05.03.02.01 331.01.05.03.04.01 331.01.05.03.04.02 331.01.05.03.04.03 331.01.05.03.04.04 331.01.05.03.04.05 331.01.05.03.04.06 331.01.05.03.04.07 331.01.05.03.04.08 331.01.05.03.04.09
7.5.11.6.2	Inspect main hoist sheaves		3			Mechanical	Huisman	331.01.05.03.02.01 331.01.05.03.04.01 331.01.05.03.04.02 331.01.05.03.04.03 331.01.05.03.04.04 331.01.05.03.04.05 331.01.05.03.04.06 331.01.05.03.04.07 331.01.05.03.04.08 331.01.05.03.04.09
Tugger sheaves								
7.5.11.7.1	Grease main hoist sheave bearings		3		100	Mechanical	Huisman	331.01.05.04.03.02 331.01.05.05.03.03 331.01.05.05.03.04 331.01.05.05.03.05 331.01.05.05.03.06
7.5.11.7.2	Inspect main hoist sheaves		3			Mechanical	Huisman	331.01.05.04.03.01 331.01.05.04.03.02 331.01.05.05.03.01 331.01.05.05.03.03 331.01.05.05.03.04 331.01.05.05.03.05 331.01.05.05.03.06
Tugger fairlead								
7.5.11.8.1	Grease fairlead bearings		3		100	Mechanical	Huisman	331.01.05.04.03.03 331.01.05.05.03.02

Table 7-13: Maintenance schedule wires, blocks and sheaves

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Days	Months	Years	Hours			
7.5.11.8.2	Inspect sheave		3			Mechanical	Huisman	331.01.05.04.03.03 331.01.05.05.03.02
7.5.11.8.3	Inspect and clean fairlead sheave box			1		Mechanical	Huisman	331.01.05.04.03.03 331.01.05.05.03.02
Load measuring pin								
7.5.11.9.1	Grease load measuring pin		3		100	Mechanical	Huisman	331.01.05.04.03.01.01 331.01.05.05.03.01.01
7.5.11.9.2	Perform 6 month periodic load measuring pin check		6			Electrical	Huisman	331.01.05.02.04.05.01 331.01.05.03.04.04.01 331.01.05.04.03.01.01 331.01.05.05.03.01.01
7.5.11.9.3	Perform 12 month periodic load measuring pin check			1		Electrical	Huisman	331.01.05.02.04.05.01 331.01.05.03.04.04.01 331.01.05.04.03.01.01 331.01.05.05.03.01.01

Table 7-13: Maintenance schedule wires, blocks and sheaves

7.5.11.1 Wire rope

This section describes all maintenance tasks for the wire ropes of the 400mT Crane.

7.5.11.1.1 Inspect wire rope

Reference documents:

- [A11-41800-31-0108](#): Reaving diagram
- Steel wire ropes manual
- Redaelli - Manual wire rope

Description	Location	Reference	Symbol code	Qty.
Wire rope Ø92	Main hoist system	A11-41800-31-0108	01	1
Wire rope Ø36	Boom hoist system	A11-41800-31-0108	02	1
Wire rope Ø36	Whip hoist system	A11-41800-31-0108	03	1
Wire rope Ø24	Tugger STBD	A11-41800-31-0108	04	1
Wire rope Ø24	Tugger PORT	A11-41800-31-0108	04	1

1. Check wire rope for broken wires. For discard criteria see the supplier documentation.
 - If there are too many broken wires, replace/cut back the wire rope.
2. Visual inspect wire rope for corrosion, bird caging, kinks and bends.
 - If there is significant damage to the wire rope, replace or cut back the wire rope.
3. Check the amount of grease.
 - If there is insufficient grease on the wire rope, grease the wire rope according to

- Huisman's "Wire rope manual".
- If there is old or excessive grease on the wire rope, remove the old or excessive grease.

NOTE *After replacing the wire rope the gear cam limit switch must be set up!*

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2017546	Wire rope Ø92	01
2017548	Wire rope Ø36	02
2017547	Wire rope Ø36	03
2017549	Wire rope Ø24	04

7.5.11.1.2 Grease wire rope

Reference documents:

- [A11-41800-31-0108](#): Reaving diagram
- [A11-41800-00-201](#): Greasing schedule
- Steel wire ropes manual
- Redaelli - Manual wire rope

Description	Location	Reference	Symbol code	Qty.
Wire rope Ø92	Main hoist system	A11-41800-31-0108	01	1
Wire rope Ø36	Boom hoist system	A11-41800-31-0108	02	1
Wire rope Ø36	Whip hoist system	A11-41800-31-0108	03	1
Wire rope Ø24	Tugger STBD	A11-41800-31-0108	04	1
Wire rope Ø24	Tugger PORT	A11-41800-31-0108	04	1

1. Grease wire rope according to the supplier documentation and Huisman "Wire rope manual".

For more information, see the supplier documentation.



Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	N/A	N/A

7.5.11.1.3 Perform electromagnetic testing on wire rope

Reference documents:

- [A11-41800-31-0108](#): Reaving diagram
- Steel wire ropes manual
- Redaelli - Manual wire rope

Description	Location	Reference	Symbol code	Qty.
Wire rope Ø92	Main hoist system	A11-41800-31-0108	01	1
Wire rope Ø36	Boom hoist system	A11-41800-31-0108	02	1
Wire rope Ø36	Whip hoist system	A11-41800-31-0108	03	1
Wire rope Ø24	Tugger STBD	A11-41800-31-0108	04	1
Wire rope Ø24	Tugger PORT	A11-41800-31-0108	04	1

Huisman recommends these inspections to be executed by a third party that is specialized in electromagnetic wire rope surveys. Huisman can provide this specialist if required.

1. Perform electromagnetic testing on wire rope.
 - If there is a problem with the wire rope, replace/cut back the wire rope.

NOTE *After replacing the wire rope the gear cam limit switch must be set up!*

For more information, see the supplier documentation.

Special tools

P/N	Tool	Qty.
On request	Manual wire rope monitor device	1

Spare parts

P/N	Part	Symbol code
2017546	Wire rope Ø92	01

P/N	Part	Symbol code
2017548	Wire rope Ø36	02
2017547	Wire rope Ø36	03
2017549	Wire rope Ø24	04

7.5.11.1.4 Check wire rope diameter

Reference documents:

- [A11-41800-31-0108](#): Reaving diagram
- Steel wire ropes manual
- Redaelli - Manual wire rope

Description	Location	Reference	Symbol code	Qty.
Wire rope Ø92	Main hoist system	A11-41800-31-0108	01	1
Wire rope Ø36	Boom hoist system	A11-41800-31-0108	02	1
Wire rope Ø36	Whip hoist system	A11-41800-31-0108	03	1
Wire rope Ø24	Tugger STBD	A11-41800-31-0108	04	1
Wire rope Ø24	Tugger PORT	A11-41800-31-0108	04	1

1. Check the spooling behaviour of the wire rope on the drum. For this watch the wire rope winding up on the drum and make sure there is no distance between separate wire rope windings.
 - If the spooling behavior of the winch is poor (distance between the separate wire windings) perform the wire rope measurement.
2. If the spooling behaviour of the winch is poor, measure the wire rope diameter according to the Huisman wire rope manual.
 - If there is a problem with the wire rope, replace/cut back the wire rope.

For more information, see the supplier documentation.

NOTE At wire rope sections which come in contact with sheaves and other metallic parts, the distance between the neighboring diameter measurement points must not exceed 10 m.

NOTE After replacing the wire rope the gear cam limit switch must be set up!

Spare parts

P/N	Part	Symbol code
2017546	Wire rope Ø92	01
2017548	Wire rope Ø36	02
2017547	Wire rope Ø36	03
2017549	Wire rope Ø24	04

7.5.11.2 Sockets

This section describes all maintenance tasks for the sockets of the 400mT Crane.

7.5.11.2.1 Inspect socket

Reference documents:

- [A11-41800-31-0108](#): Reaving diagram

Description	Location	Reference	Symbol code	Qty.
Open wedge socket	Fly-jib, whip hoist wire	A11-41800-31-0108	05	1
Open spelter socket	Mast head, boom hoist wire	A11-41800-31-0108	08	1
Closed spelter socket	Fly-jib, main hoist wire	A11-41800-31-0108	09	1
Open wedge socket	STBD tugger wire	A11-41800-31-0108	10	1
Open wedge socket	PORT tugger wire	A11-41800-31-0108	10	1

1. Clean the socket using a cloth.
2. Visually check the socket for wear, damage and corrosion.
 - If cracks, damage or corrosion is found, replace the failed component.
3. Visually check welds for cracks.
 - If cracks in welds are found, replace the failed component.

Spare parts

P/N	Part	Symbol code
2003546	Open wedge socket	A11-41800-31-010 / 05
2002675	Open spelter socket	A11-41800-31-010 / 08
2026858	Closed spelter socket	A11-41800-31-010 / 09

P/N	Part	Symbol code
2002206	Open wedge socket	A11-41800-31-010 / 10

7.5.11.2.2 Non-destructive testing of socket

Reference documents:

- [A11-41800-31-0108](#): Reaving diagram
- [A11-41800-09-085](#): High Stress Zones Description & Inspection Plan

Description	Location	Reference	Symbol code	Qty.
Open wedge socket	Fly-jib, whip hoist wire	A11-41800-31-0108	05	1
Open spelter socket	Mast head, boom hoist wire	A11-41800-31-0108	08	1
Closed spelter socket	Fly-jib, main hoist wire	A11-41800-31-0108	09	1
Open wedge socket	STBD tugger wire	A11-41800-31-0108	10	1
Open wedge socket	PORT tugger wire	A11-41800-31-0108	10	1

The socket needs to be inspected by means of non-destructive techniques (NDT). Huisman recommends these inspections to be executed by a third party that is specialized in NDT inspection surveys. Huisman can provide NDT specialist if required.

1. Execute this task according to High stress zones document. The NDT test consists of Magnetic particles inspection (MPI) and Ultrasonic testing (UT).
 - If unacceptable damage is found consult Huisman.

NOTE All personnel performing Magnetic Particles Inspection shall be qualified and certified according to EN 473/PCN or EN 473 / SNT-TC-1A, level II or level III.

NOTE As an alternative for MPI, penetrant inspection (PT) can be carried out.

Contact Huisman for part information on steel structure.

Special tools

P/N	Tool	Qty.
On request	Phased array US	1
On request	AC yoke magnet	1
On request	Wet magnetic ink, test medium Magnaflux	-

Spare parts

P/N	Part	Symbol code
2003546	Open wedge socket	05
2002675	Open spelter socket	08
2026858	Closed spelter socket	09
2002206	Open wedge socket	10

7.5.11.3 Lower blocks

This section describes all maintenance tasks for the lower blocks of the 400mT Crane.

7.5.11.3.1 Grease lower block bearing

Reference documents:

- [A11-41800-33-0108](#): Main hoist lower block 400 mT
- [A11-41800-35-0308](#): Whip hoist lower block 40 mT
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
400mT lower block	Main hoist	A11-41800-33-0108	N/A	1
40mT lower block	Whip hoist	A11-41800-33-0308	N/A	1

- Grease lower blocks according to the greasing schedule and the lubricating instructions in the stated drawings.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	AISI 316 DIN 3404	N/A

7.5.11.3.2 Inspect lower block bearing

Reference documents:

- [A11-41800-33-0108](#): Main hoist lower block 400 mT
- [A11-41800-35-0308](#): Whip hoist lower block 40 mT

Description	Location	Reference	Symbol code	Qty.
400mT lower block bearing	Main hoist	A11-41800-33-0108	N/A	1
40mT lower block bearing	Whip hoist	A11-41800-33-0308	N/A	1

1. Rotate the lower block by hand.
2. Inspect functioning of lower block bearing by visual and auditory inspection.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Spare parts

P/N	Part	Symbol code
2006571	Cylindrical roller thrust bearing	A11-41800-33-0108 / 100
2006578	Spherical roller thrust bearing	A11-41800-33-0308 / 101

7.5.11.3.3 Inspect and clean lower blocks

Reference documents:

- [A11-41800-33-0108](#): Main hoist lower block 400 mT
- [A11-41800-35-0308](#): Whip hoist lower block 40 mT
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
400mT lower block	Main hoist	A11-41800-33-0108	N/A	1
40mT lower block	Whip hoist	A11-41800-33-0308	N/A	1

NOTE When this task is part of a survey prescribed by a regulatory body, the task must be carried out according to the requirements of this regulatory body.

1. Clean the lower blocks using a cloth.

2. Visual check the lower blocks for cracks, damage and corrosion.
 - If cracks or significant damage are found, contact Huisman.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check paint of lower blocks.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
4. Check for loose components of the lower blocks.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.

Contact Huisman for part information on lower blocks.

7.5.11.3.4 Non-destructive testing of welds and steel structure

Reference documents:

- [A11-41800-33-0108](#): Main hoist lower block 400 mT
- [A11-41800-35-0308](#): Whip hoist lower block 40 mT
- [A11-41800-09-085](#): High Stress Zones Description & Inspection Plan

Description	Location	Reference	Symbol code	Qty.
400mT lower block	Main hoist	A11-41800-33-0108	N/A	1
40mT lower block	Whip hoist	A11-41800-33-0308	N/A	1

The welds and steel structure need to be inspected by means of non-destructive techniques (NDT). Huisman recommends these inspections to be executed by a third party that is specialized in NDT inspection surveys. Huisman can provide NDT specialist if required.

1. Execute this task according to High stress zones document. The NDT test consists of Magnetic particles inspection (MPI) and Ultrasonic testing (UT).
 - If unacceptable welds are found consult Huisman.

NOTE *All personnel performing Magnetic Particles Inspection shall be qualified and certified according to EN 473/PCN or EN 473 / SNT-TC-1A, level II or level III.*

NOTE *As an alternative for MPI, penetrant inspection (PT) can be carried out.*

Contact Huisman for part information on lower blocks.

Special tools

P/N	Tool	Qty.
On request	Phased array US	1
On request	AC yoke magnet	1
On request	Wet magnetic ink, test medium Magnaflux	-

7.5.11.4 Boom hoist sheaves

This section describes all maintenance tasks for the sheaves of the boom hoist system.

7.5.11.4.1 Grease boom hoist sheave bearings

Reference documents:

- [A11-41800-00-201](#): Greasing schedule
- [A11-41800-32-0208](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0308](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0908](#): Sheaves for rope leading

Description	Location	Reference	Symbol code	Qty.
Sheave NO.1 bearing	Mast	A11-41800-32-0208	101	1
Sheave NO.2 bearing	Mast	A11-41800-32-0208	101	1
Guide sheave NO.1 bearing	Mast head	A11-41800-32-0908	104	1
Guide sheave NO.2 bearing	Mast head	A11-41800-32-0308	100	1
Sheave mast head NO.1 bearing	Mast head	A11-41800-32-0208	101	1
Sheave jib head NO.1 bearing	Jib head	A11-41800-32-0208	101	1
Sheave mast head NO.2 bearing	Mast head	A11-41800-32-0208	101	1
Sheave jib head NO.2 bearing	Jib head	A11-41800-32-0208	101	1
Sheave mast head NO.3 bearing	Mast head	A11-41800-32-0208	101	1
Sheave jib head NO.3 bearing	Jib head	A11-41800-32-0208	101	1
Sheave mast head NO.4 bearing	Mast head	A11-41800-32-0208	101	1
Sheave jib head NO.4 bearing	Jib head	A11-41800-32-0208	101	1
Sheave mast head NO.5 bearing	Mast head	A11-41800-32-0208	101	1

Description	Location	Reference	Symbol code	Qty.
Sheave jib head NO.5 bearing	Jib head	A11-41800-32-0208	101	1
Sheave mast head NO.6 bearing	Mast head	A11-41800-32-0208	101	1
Sheave jib head NO.6 bearing	Jib head	A11-41800-32-0208	101	1

- Grease the sheaves according to the greasing schedule. (For the location of grease nipples see [Figure 7-103](#)).

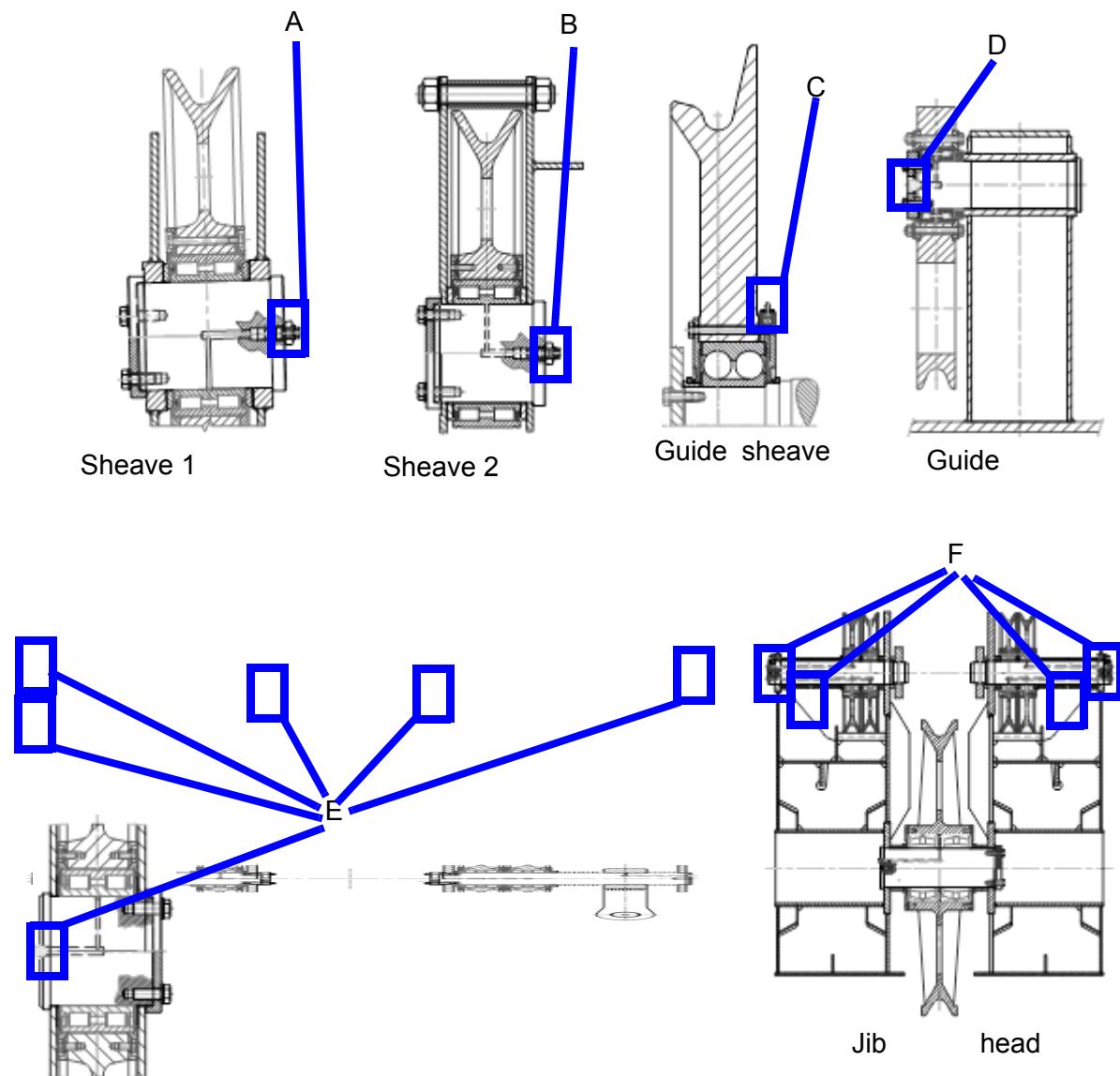


Figure 7-103: Boom hoist sheaves - Greasing points

Lubrication

Grease point	Lubrication type	Type of grease nipple	Qty.
A	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A
B	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A
C	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A
D	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A
E	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A
F	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A

7.5.11.4.2 Inspect main hoist sheaves

Reference documents:

- [A11-41800-32-0208](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0308](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0908](#): Sheaves for rope leading
- Steel wire ropes manual
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Sheave NO.1	Mast	A11-41800-32-0208	701	1
Sheave NO.2	Mast	A11-41800-32-0208	701	1
Guide sheave NO.1	Mast head	A11-41800-32-0908	06	1
Guide sheave NO.2	Mast head	A11-41800-32-0308	01	1
Sheave mast head NO.1	Mast head	A11-41800-32-0208	701	1
Sheave jib head NO.1	Jib head	A11-41800-32-0208	701	1
Sheave mast head NO.2	Mast head	A11-41800-32-0208	701	1
Sheave jib head NO.2	Jib head	A11-41800-32-0208	701	1
Sheave mast head NO.3	Mast head	A11-41800-32-0208	701	1
Sheave jib head NO.3	Jib head	A11-41800-32-0208	701	1
Sheave mast head NO.4	Mast head	A11-41800-32-0208	701	1
Sheave jib head NO.4	Jib head	A11-41800-32-0208	701	1
Sheave mast head NO.5	Mast head	A11-41800-32-0208	701	1
Sheave jib head NO.5	Jib head	A11-41800-32-0208	701	1
Sheave mast head NO.6	Mast head	A11-41800-32-0208	701	1
Sheave jib head NO.6	Jib head	A11-41800-32-0208	701	1

1. Check axial and radial play of sheave.
 - If excessive play is found, investigate the cause and repair/replace the failed component.
2. Check if the sheave can rotate freely and does not make unusual noise.
 - If sheave does not rotate freely, replace the bearing.
 - If an unusual noise is heard, replace the bearing.
3. Check groove for wire rope imprint according to document "Steel wire ropes" in Appendix "Wire rope manual".
 - If significant wire rope imprint is found, consult Huisman.

NOTE *Once the wear has proceeded too deep into the groove, it will increase rapidly.*

4. Check groove for excessive wear. For this measure the groove radius (R) and the groove breadth (B).

Table 7-14: Dimensions of the new sheave and wire rope

Groove radius R (mm)	Wire rope diameter D (mm)	Sheave wall breadth B (mm)
18.9	36	15.1

- If the groove radius R (see [Figure 7-83](#)) is larger than 19.9 mm, replace the sheave.
- If the groove breadth B (see [Figure 7-83](#)) is less than 14.3 mm, replace the sheave.

NOTE *If the sheave dimensions are less than specified above, the sheave wear will accelerate rapidly!*

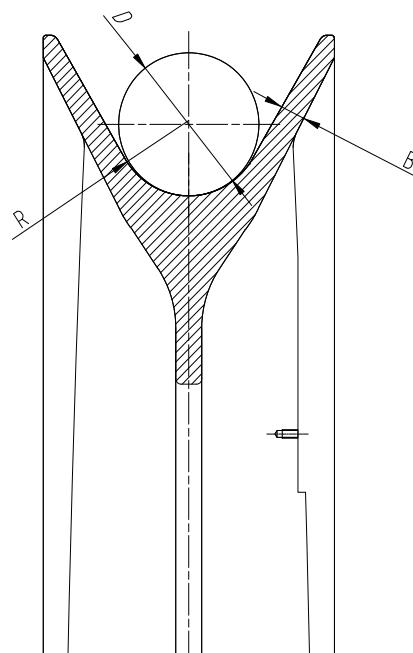


Figure 7-104: Sheave dimensions

- If a wear groove is found under the feeler gauge while measuring the sheave radius, replace the sheave. For more information see Wire rope manual.
5. Inspect sheave for structural integrity and loose connections.
 - If a problem is found, consult Huisman.
 - Tighten the loose connections.
 6. Inspect the paint of sheave
 - If the paint is damaged, repair the paint of the sheave according to paint specification.

For more information on code of practice and discard, see International Standard ISO4309.

Special tools

P/N	Tool	Qty.
On request	Sheave gauge set	1

Spare parts

P/N	Part	Symbol code
2003256	Cylindrical roller bearing	A11-41800-32-0208 / 101
2004217	Cylindrical roller bearing	A11-41800-32-0308 / 100
2007764	Cylindrical roller bearing	A11-41800-32-0908 / 101
10012847A	Sheave	A11-41800-32-0208 / 701

P/N	Part	Symbol code
9134370	Guide sheave	A11-41800-32-0308 / 01
9134377	Guide sheave	A11-41800-32-0908 / 06

7.5.11.5 Main hoist sheaves

This section describes all maintenance tasks for the sheaves of the main hoist system.

7.5.11.5.1 Grease main hoist sheave bearings

Reference documents:

- [A11-41800-00-201](#): Greasing schedule
- [A11-41800-32-0108](#): Sheave for wire Ø92 - P.C.D. 1842

Description	Location	Reference	Symbol code	Qty.
Lower block sheave bearing	Lower block sheave	A11-41800-32-0108	100	1
Below deck sheave 1 bearing	Below deck sheave	A11-41800-32-0108	115	1
Below deck sheave 2 bearing	Below deck sheave	A11-41800-32-0108	115	1
Below deck sheave 3 bearing	Below deck sheave	A11-41800-32-0108	115	1
Mast head sheave bearing	Mast head sheave	A11-41800-32-0108	100	1
Jib sheave bearing	Jib sheave	A11-41800-32-0108	100	1
Jib head sheave bearing	Jib head sheave	A11-41800-32-0108	111	1

- Grease the sheaves according to the greasing schedule. (For the location of grease nipples see [Figure 7-105](#)).

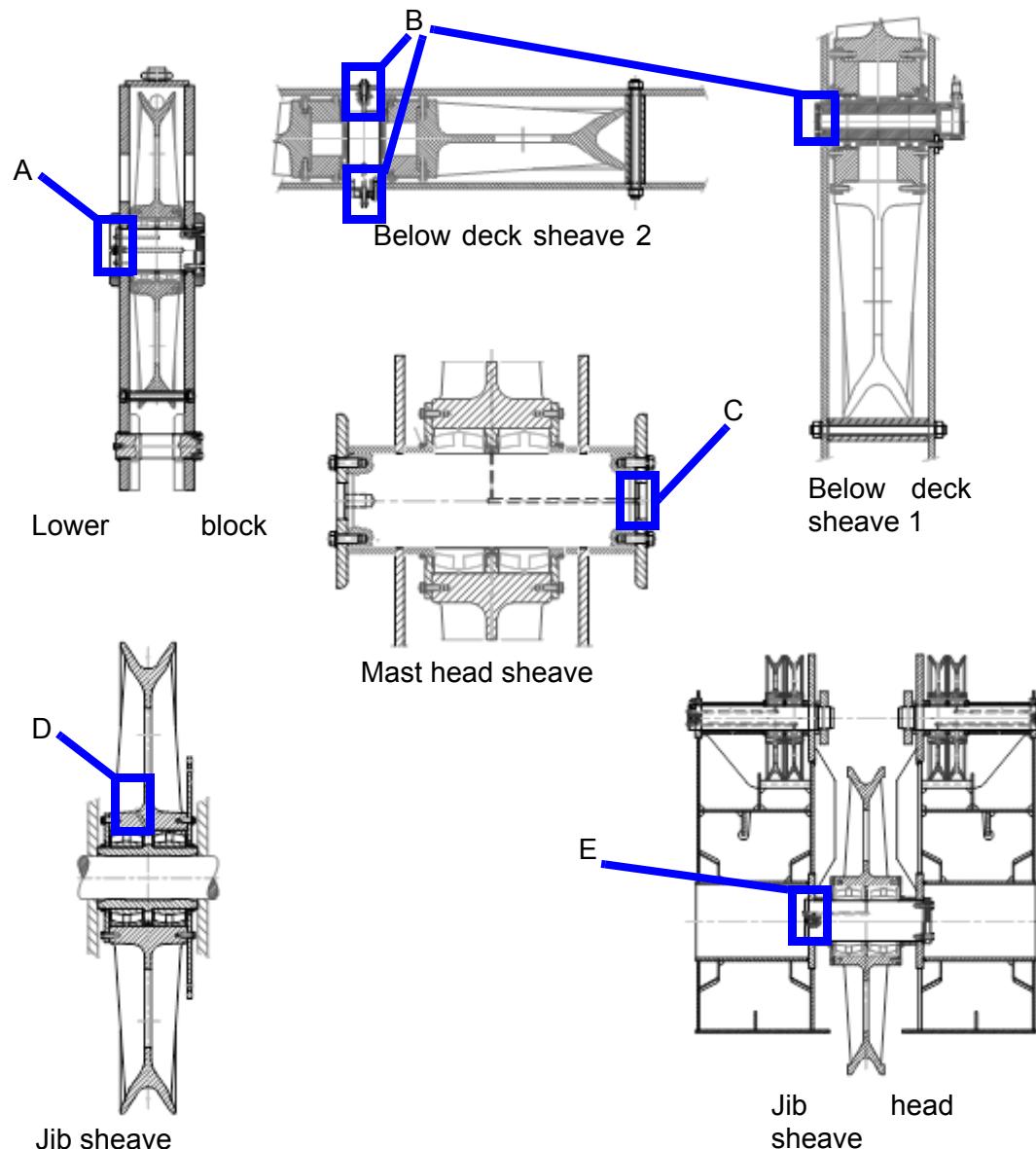


Figure 7-105: main hoist sheaves - Greasing points

Lubrication

Grease point	Lubrication type	Type of grease nipple	Qty.
A	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A
B	DIN 51502 KP 2 K-20	G1/4" extension, AISI 316 D00000062	N/A
C	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A
D	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A
E	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A

7.5.11.5.2 Inspect main hoist sheaves

Reference documents:

- [A11-41800-32-0108](#): Sheave for wire Ø92 - P.C.D. 1842
- Steel wire ropes manual
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Lower block sheave	Main hoist sheave	A11-41800-32-0108	701	1
Below deck sheave 1	Storage winch	A11-41800-32-0108	705	1
Below deck sheave 2	Storage winch	A11-41800-32-0108	705	1
Below deck sheave 3	Storage winch	A11-41800-32-0108	705	1
Mast head sheave	Mast head	A11-41800-32-0108	702	1
Jib sheave	Jib	A11-41800-32-0108	703	1
Jib head sheave	Jib head	A11-41800-32-0108	704	1

1. Check axial and radial play of sheave.
 - If excessive play is found, investigate the cause and repair/replace the failed component.
2. Check if the sheave can rotate freely and does not make unusual noise.
 - If sheave does not rotate freely, replace the bearing.
 - If an unusual noise is heard, replace the bearing.
3. Check groove for wire rope imprint according to document "Steel wire ropes" in Appendix "Wire rope manual".
 - If significant wire rope imprint is found, consult Huisman.

NOTE *Once the wear has proceeded too deep into the groove, it will increase rapidly.*

4. Check groove for excessive wear. For this measure the groove radius (R) and the groove breadth (B).

Table 7-15: Dimensions of the new sheave and wire rope

Groove radius R (mm)	Wire rope diameter D (mm)	Sheave wall breadth B (mm)
48.3	92	39.5

- If the groove radius R (see [Figure 7-83](#)) is larger than 50.8 mm, replace the sheave.
- If the groove breadth B (see [Figure 7-83](#)) is less than 37.5 mm, replace the sheave.

NOTE *If the sheave dimensions are less than specified above, the sheave wear will accelerate rapidly!*

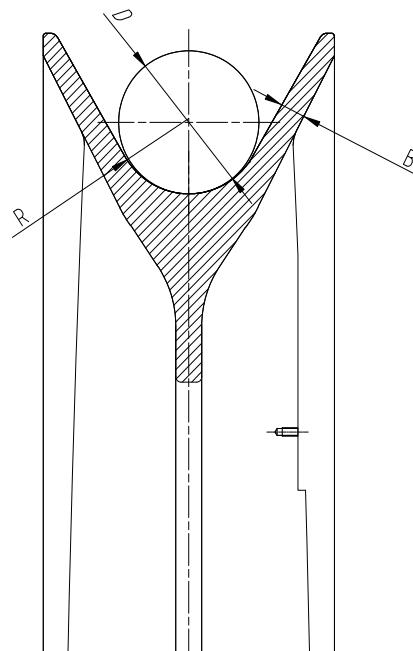


Figure 7-106: Sheave dimensions

- If a wear groove is found under the feeler gauge while measuring the sheave radius, replace the sheave. For more information see Wire rope manual.
5. Inspect sheave for structural integrity and loose connections.
 - If a problem is found, consult Huisman.
 - Tighten the loose connections.
 6. Inspect the paint of sheave
 - If the paint is damaged, repair the paint of the sheave according to paint specification.

For more information on code of practice and discard, see International Standard ISO4309.

Special tools

P/N	Tool	Qty.
On request	Sheave gauge set	1

Spare parts

P/N	Part	Symbol code
2004648	Spherical roller bearing	A11-41800-32-0108 / 100
2007800	Spherical roller bearing	A11-41800-32-0108 / 111
2002929	Cylindrical roller bearing	A11-41800-32-0108 / 115
10012842A	Lower block sheave	A11-41800-32-0108 / 701

P/N	Part	Symbol code
10012843A	Mast head sheave	A11-41800-32-0108 / 702
10012844A	Jib sheave	A11-41800-32-0108 / 703
10012845A	Jib head sheave	A11-41800-32-0108 / 704
10012846A	Below deck sheave	A11-41800-32-0108 / 705

7.5.11.6 Whip hoist sheaves

This section describes all maintenance tasks for the sheaves of the whip hoist system.

7.5.11.6.1 Grease whip hoist sheave bearings

Reference documents:

- [A11-41800-00-201](#): Greasing schedule
- [A11-41800-32-0208](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0408](#): Sheave for wire Ø36 - P.C.D. 386
- [A11-41800-32-0508](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0608](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0908](#): Sheaves for rope leading

Description	Location	Reference	Symbol code	Qty.
Lower block sheave bearing	Lower block sheave	A11-41800-32-0608	100	1
Guide sheave bearing	Mast	A11-41800-32-0908	104	1
Mast head sheave NO.1 bearing	Mast head	A11-41800-32-0208	101	1
Mast head sheave NO.2 bearing	Mast head	A11-41800-32-0208	101	1
Slewing platform sheave bearing	Slewing platform	A11-41800-32-0208	101	1
Sheave jib bearing	Jib	A11-41800-32-0408	100	1
Sheave fly jib NO.1 bearing	Fly jib	A11-41800-32-0508	102	1
Sheave fly jib NO.2 bearing	Fly jib	A11-41800-32-0208	101	1
Sheave fly jib NO.3 bearing	Fly jib	A11-41800-32-0208	101	1
Jib head sheave bearing	Jib head sheave	A11-41800-32-0208	101	1

- Grease the sheaves according to the greasing schedule. (For the location of grease nipples see [Figure 7-107](#)).

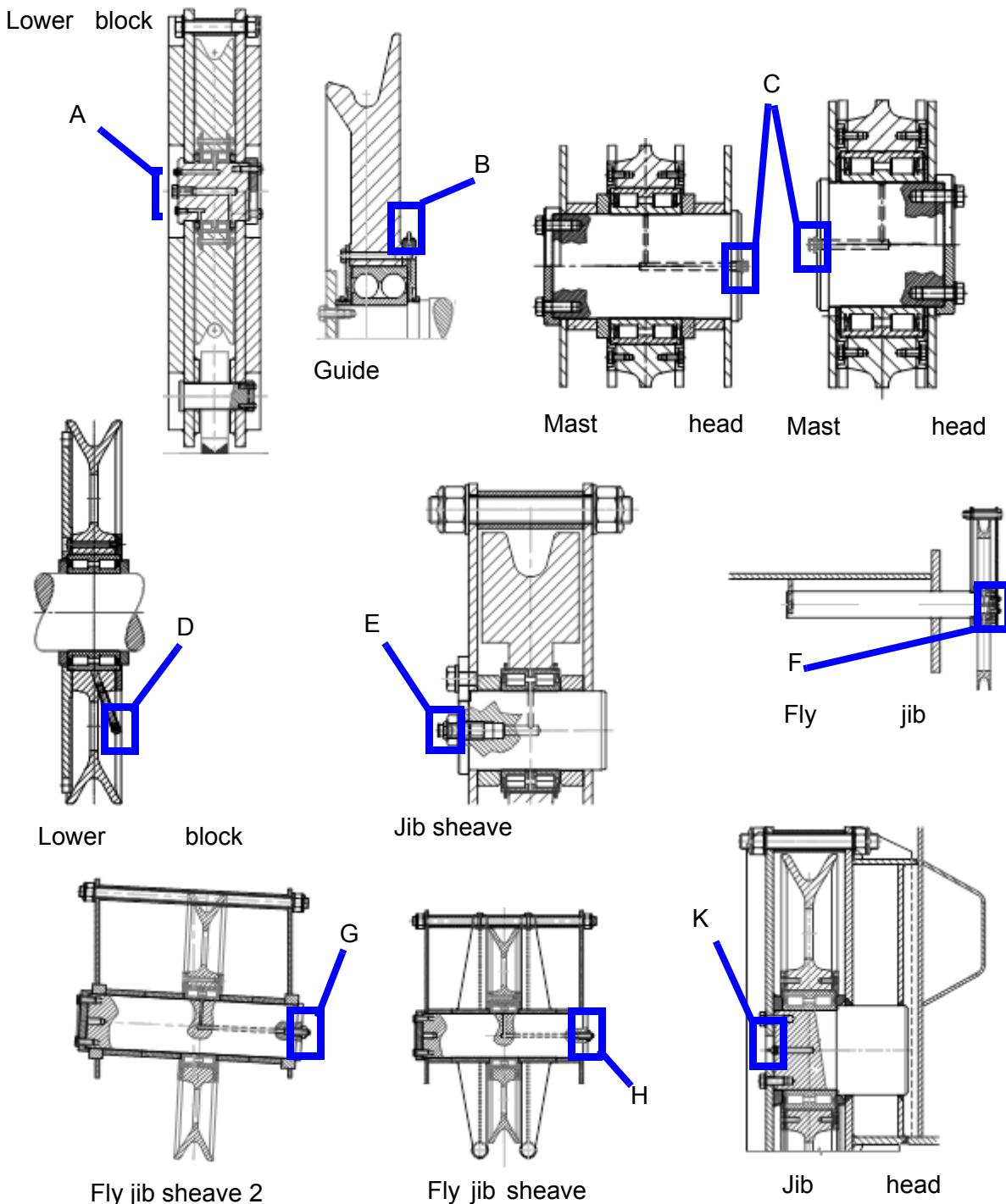


Figure 7-107: whip hoist sheaves - Greasing points

Lubrication

Grease point	Lubrication type	Type of grease nipple	Qty.
A	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A

Grease point	Lubrication type	Type of grease nipple	Qty.
B	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 71412A	N/A
C	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A
D	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 3404	N/A
E	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 3404	N/A
F	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A
G	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A
H	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A
K	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 71412A	N/A

7.5.11.6.2 Inspect whip hoist sheaves

Reference documents:

- [A11-41800-32-0208](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0408](#): Sheave for wire Ø36 - P.C.D. 386
- [A11-41800-32-0508](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0608](#): Sheave for wire Ø36 - P.C.D. 720
- [A11-41800-32-0908](#): Sheaves for rope leading
- Steel wire ropes manual
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Lower block sheave	Lower block sheave	A11-41800-32-0608	01	1
Guide sheave	Mast	A11-41800-32-0908	02	1
Mast head sheave NO.1	Mast head	A11-41800-32-0208	701	1
Mast head sheave NO.2	Mast head	A11-41800-32-0208	701	1
Slewing platform sheave	Slewing platform	A11-41800-32-0208	702	1
Sheave jib	Jib	A11-41800-32-0408	01	1
Sheave fly jib NO.1	Fly jib	A11-41800-32-0508	01	1
Sheave fly jib NO.2	Fly jib	A11-41800-32-0208	701	1
Sheave fly jib NO.3	Fly jib	A11-41800-32-0208	701	1
Jib head sheave	Jib head sheave	A11-41800-32-0208	701	1

1. Check axial and radial play of sheave.

- If excessive play is found, investigate the cause and repair/replace the failed component.

2. Check if the sheave can rotate freely and does not make unusual noise.
 - If sheave does not rotate freely, replace the bearing.
 - If an unusual noise is heard, replace the bearing.
3. Check groove for wire rope imprint according to document "Steel wire ropes" in Appendix "Wire rope manual".
 - If significant wire rope imprint is found, consult Huisman.

NOTE *Once the wear has proceeded too deep into the groove, it will increase rapidly.*

4. Check groove for excessive wear. For this measure the groove radius (R) and the groove breadth (B).

Table 7-16: Dimensions of the new sheave and wire rope

Groove radius R (mm)	Wire rope diameter D (mm)	Sheave wall breadth B (mm)
18.9	36	15.1

- If the groove radius R (see [Figure 7-108](#)) is larger than 19.9 mm, replace the sheave.
- If the groove breadth B (see [Figure 7-108](#)) is less than 14.3 mm, replace the sheave.

NOTE *If the sheave dimensions are less than specified above, the sheave wear will accelerate rapidly!*

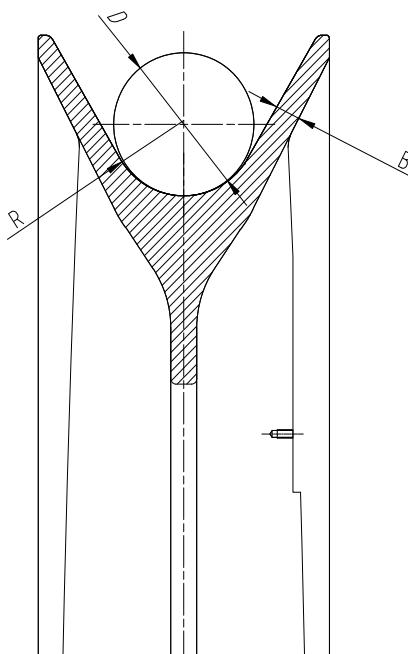


Figure 7-108: Sheave dimensions

- If a wear groove is found under the feeler gauge while measuring the sheave

radius, replace the sheave. For more information see Wire rope manual.

5. Inspect sheave for structural integrity and loose connections.
 - If a problem is found, consult Huisman.
 - Tighten the loose connections.
6. Inspect the paint of sheave
 - If the paint is damaged, repair the paint of the sheave according to paint specification.

For more information on code of practice and discard, see International Standard ISO4309.

Special tools

P/N	Tool	Qty.
On request	Sheave gauge set	1

Spare parts

P/N	Part	Symbol code
2003256	Cylindrical roller bearing	A11-41800-32-0208 / 101
2013536	Cylindrical roller bearing	A11-41800-32-0408 / 100
2002172	Cylindrical roller bearing	A11-41800-32-0508 / 102
2005599	Cylindrical roller bearing	A11-41800-32-0608 / 101
2002938	Angular contact ball bearing	A11-41800-32-0908 / 104
10012847A	Sheave	A11-41800-32-0108 / 701
10012848A	Sheave with grease nipple	A11-41800-32-0108 / 702
9120001	Sheave	A11-41800-32-0408 / 01
9134370	Sheave	A11-41800-32-0508 / 01
9134370	Lower block sheave	A11-41800-32-0608 / 01
9134377	Guide sheave	A11-41800-32-0908 / 02

7.5.11.7 Tugger sheaves

This section describes all maintenance tasks for the sheaves of the tugger system.

7.5.11.7.1 Grease tugger sheave bearings

Reference documents:

- [A11-41800-00-201](#): Greasing schedule
- [A11-41800-32-0808](#): Sheave for wire Ø24 - P.C.D. 424

Description	Location	Reference	Symbol code	Qty.
Sheave NO.2 bearing	Tugger STBD	A11-41800-32-0808	101	1

Description	Location	Reference	Symbol code	Qty.
Sheave NO.3 bearing	Tugger PORT	A11-41800-32-0808	101	1
Sheave NO.4 bearing	Tugger PORT	A11-41800-32-0808	101	1
Fly jib sheave NO.1 bearing	Tugger PORT	A11-41800-32-0808	101	1
Fly jib sheave NO.1 bearing	Tugger PORT	A11-41800-32-0808	101	1

- Grease the sheaves according to the greasing schedule. (For the location of grease nipples see [Figure 7-109](#)).

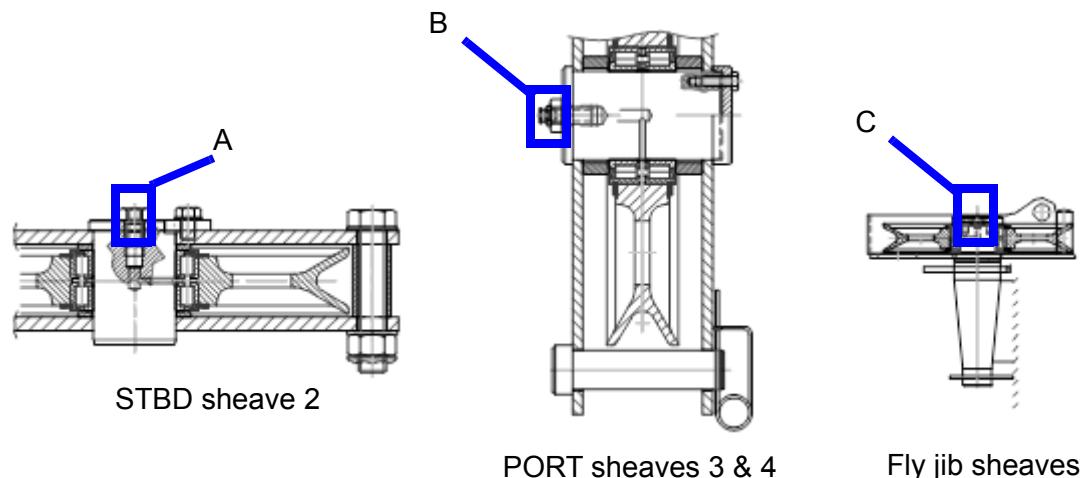


Figure 7-109: Tugger sheaves - Greasing points

Lubrication

Grease point	Lubrication type	Type of grease nipple	Qty.
A	DIN 51502 KP 2 K-20	G1/4", STEEL DIN 3404	N/A
B	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A
C	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A

7.5.11.7.2 Inspect tugger sheaves

Reference documents:

- [A11-41800-32-0808](#): Sheave for wire Ø24 - P.C.D. 424
- Steel wire rope manual
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Sheave NO.1	Jib	A11-41800-32-0808	101	1
Sheave NO.2	Jib	A11-41800-32-0808	101	1
Sheave NO.1	Jib	A11-41800-32-0808	101	1
Sheave NO.3	Mast head dead end	A11-41800-32-0808	101	1
Sheave NO.4	Mast head dead end	A11-41800-32-0808	101	1
Fly jib sheave NO.1	Fly jib	A11-41800-32-0808	101	1
Fly jib sheave NO.1	Fly jib	A11-41800-32-0808	101	1

1. Check axial and radial play of sheave.
 - If excessive play is found, investigate the cause and repair/replace the failed component.
2. Check if the sheave can rotate freely and does not make unusual noise.
 - If sheave does not rotate freely, replace the bearing.
 - If an unusual noise is heard, replace the bearing.
3. Check groove for wire rope imprint according to document "Steel wire ropes" in Appendix "Wire rope manual".
 - If significant wire rope imprint is found, consult Huisman.

NOTE Once the wear has proceeded too deep into the groove, it will increase rapidly.

4. Check groove for excessive wear. For this measure the groove radius (R) and the groove breadth (B).

Table 7-17: Dimensions of the new sheave and wire rope

Groove radius R (mm)	Wire rope diameter D (mm)	Sheave wall breadth B (mm)
13	24	8

- If the groove radius R (see [Figure 7-83](#)) is larger than 14 mm, replace the sheave.
- If the groove breadth B (see [Figure 7-83](#)) is less than 7.6 mm, replace the sheave.

NOTE If the sheave dimensions are less than specified above, the sheave wear will accelerate rapidly!

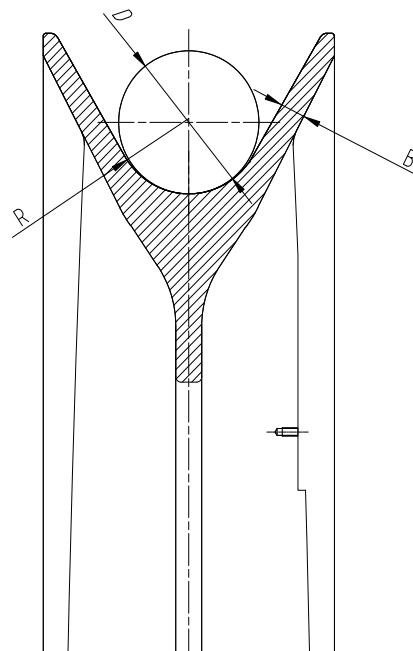


Figure 7-110: Sheave dimensions

- If a wear groove is found under the feeler gauge while measuring the sheave radius, replace the sheave. For more information see Wire rope manual.
5. Inspect sheave for structural integrity and loose connections.
- If a problem is found, consult Huisman.
 - Tighten the loose connections.
6. Inspect the paint of sheave
- If the paint is damaged, repair the paint of the sheave according to paint specification.

For more information on code of practice and discard, see International Standard ISO4309.

Special tools

P/N	Tool	Qty.
On request	Sheave gauge set	1

Spare parts

P/N	Part	Symbol code
2013536	Cylindrical roller bearing	A11-41800-32-0808 / 101
10013231A	Sheave	A11-41800-32-0808 / 01

7.5.11.8 Fairlead

This section describes all maintenance tasks for the fairlead of the tuggers.

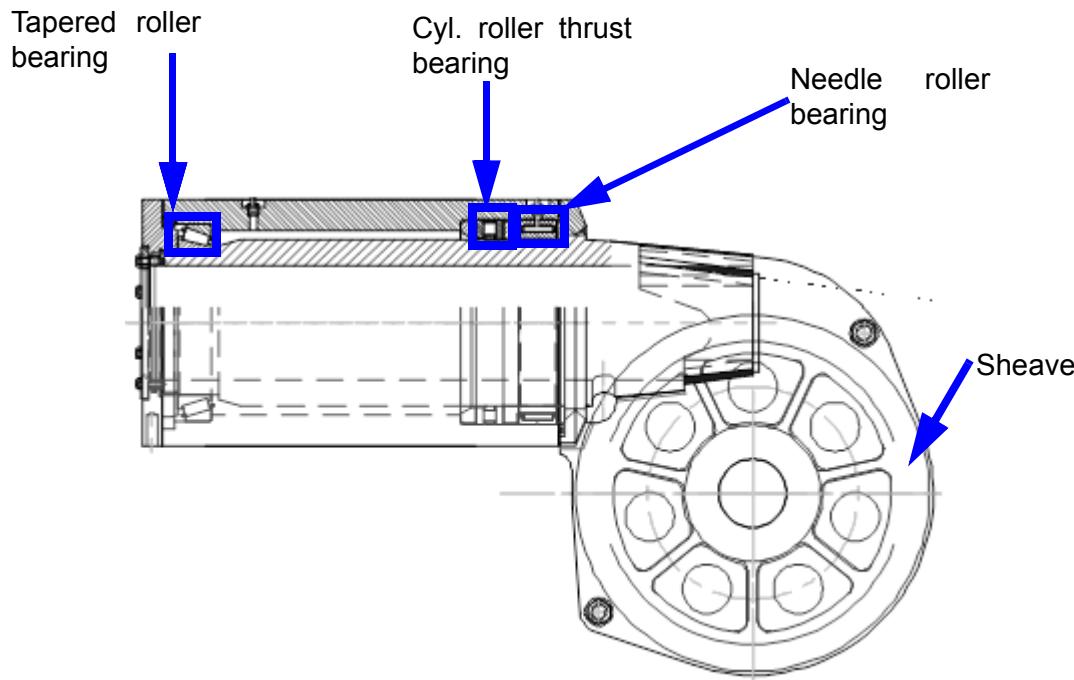


Figure 7-111: Fairlead

7.5.11.8.1 Grease fairlead bearings

Reference documents:

- [A11-41800-32-0708](#): Sheave for wire Ø24 - P.C.D. 424
- [A11-41800-33-0808](#): Fairlead
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
Fairlead sheave bearing	STBD fairlead	A11-41800-32-0708	101	1
Fairlead sheave bearings	PORT fairlead	A11-41800-32-0708	101	1
Cylindrical roller thrust bearing	STBD fairlead	A11-41800-33-0808	100	1
Cylindrical roller thrust bearing	PORT fairlead	A11-41800-33-0808	100	1
Needle roller bearing	STBD fairlead	A11-41800-33-0808	101	1
Needle roller bearing	PORT fairlead	A11-41800-33-0808	101	1
Tapered roller bearing	STBD fairlead	A11-41800-33-0808	104	1
Tapered roller bearing	PORT fairlead	A11-41800-33-0808	104	1

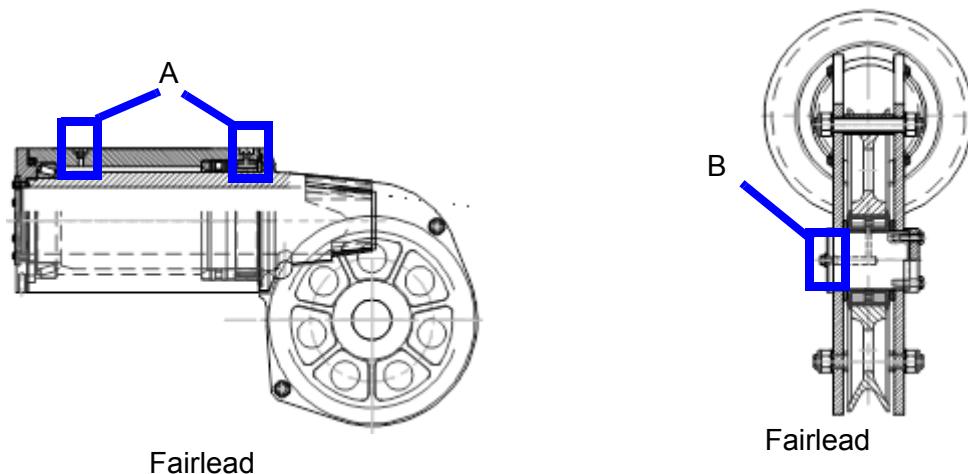


Figure 7-112: Fairlead - Greasing points

1. Grease the sheave bearing according to the greasing schedule.
2. Grease the fairlead frame bearings according to greasing schedule.

For more information, see the supplier documentation.

Lubrication

Grease point	Lubrication type	Type of grease nipple	Qty.
A	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 71412A	N/A
B	DIN 51502 KP 2 K-20	G1/4", AISI 316 DIN 3404	N/A

7.5.11.8.2 Inspect sheave

Reference documents:

- [A11-41800-32-0708](#): Sheave for wire Ø24 - P.C.D. 424
- [A11-41000-09-002](#): Paint specification
- Steel wire ropes manual

Description	Location	Reference	Symbol code	Qty.
Fairlead sheave	STBD fairlead	A11-41800-32-0708	01	1
Fairlead sheave	PORT fairlead	A11-41800-32-0708	01	1

1. Check axial and radial play of sheave.
 - If excessive play is found, investigate the cause and repair/replace the failed component.
3. Check if the sheave can rotate freely and does not make unusual noise.
 - If sheave does not rotate freely, replace the bearing.
 - If an unusual noise is heard, replace the bearing.
4. Check groove for wire rope imprint according to document "Steel wire ropes" in Appendix "Wire rope manual".
 - If significant wire rope imprint is found, consult Huisman.

NOTE *Once the wear has proceeded too deep into the groove, it will increase rapidly.*

5. Check groove for excessive wear. For this measure the groove radius (R) and the groove breadth (B).

Table 7-18: Dimensions of the new sheave and wire rope

Groove radius R (mm)	Wire rope diameter D (mm)	Sheave wall breadth B (mm)
13	24	8

- If the groove radius R (see [Figure 7-113](#)) is larger than 14, replace the sheave.
- If the groove breadth B (see [Figure 7-113](#)) is less than 7.6 mm, replace the sheave.

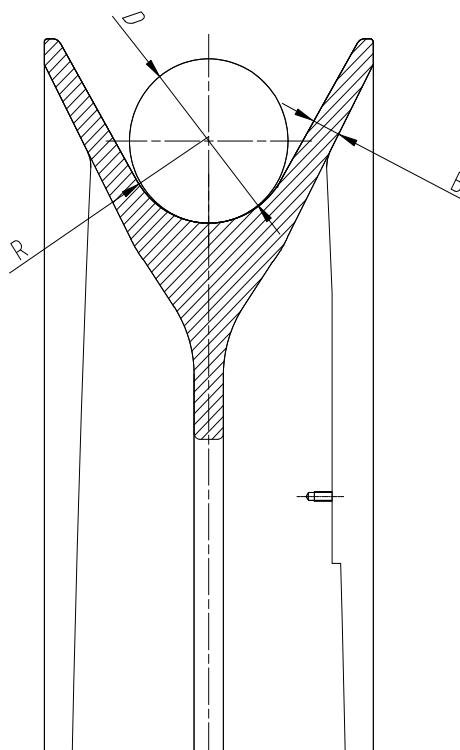


Figure 7-113: Sheave

NOTE *If the sheave dimensions are less than specified above, the sheave wear will accelerate rapidly!*

- If a wear groove is found under the feeler gauge while measuring the sheave radius, replace the sheave. For more information see Wire rope manual.
6. Inspect sheave for structural integrity and loose connections.
- If a problem is found, consult Huisman.
 - Tighten the loose connections.
7. Inspect the paint of sheave
- If the paint is damaged, repair the paint of the sheave according to paint specification.

For more information on code of practice and discard, see International Standard ISO4309.

Special tools.

P/N	Tool	Qty.
On request	Sheave gauge set	

Spare parts

P/N	Part	Symbol code
2013536	Cylindrical roller bearing	A11-41800-32-0708 / 101
10013232A	Sheave	A11-41800-32-0708 / 01

7.5.11.8.3 Inspect and clean fairlead sheave box

Reference documents:

- [A11-41800-32-0708](#): Sheave for wire Ø24 - P.C.D. 424
- [A11-41000-09-002](#): Paint specification

Description	Location	Reference	Symbol code	Qty.
Sheave NO.3	Fairlead	A11-41800-32-0708	101	1
Sheave NO.2	Fairlead	A11-41800-32-0708	101	1

1. Clean the fairlead sheave box using a cloth.

2. Visual check the fairlead sheave box for cracks, damage and corrosion.
 - If cracks or significant damage are found, repair/replace the fairlead sheave box.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the paint specification.
3. Check extension spring functionality and structural integrity.
 - If cracks or corrosion is found on springs, replace the springs.
4. Check paint of fairlead sheave box.
 - If the paint is damaged, repaint the area according to the paint specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the paint specification.
5. Check for loose components of the fairlead sheave box.
 - If components are loose, tighten the loose components. Then repaint the bolts, according to the paint specification.
6. Check the functioning of fairlead frame bearings.
 - If the fairlead frame does not rotate freely or a large radial play is found, replace the failed bearing.

Contact Huisman for part information on steel structure.

Spare parts

P/N	Part	Symbol code
2013536	Cylindrical roller bearing	A11-41800-32-0708 / 101

7.5.11.9 Load measuring pin

This section describes all maintenance tasks for the load measuring pins of the 400mT Crane.

7.5.11.9.1 Grease load measuring pin

Reference documents:

- [A11-41800-46-0308](#): LMP 11-1964 (Left)/LMP 11-1965 (Right)
- [A11-41800-00-201](#): Greasing schedule

Description	Location	Reference	Symbol code	Qty.
LMP 11-1964 (Left)	Jib	A11-41800-46-0308	N/A	1
LMP 11-1965 (Right)	Jib	A11-41800-46-0308	N/A	1

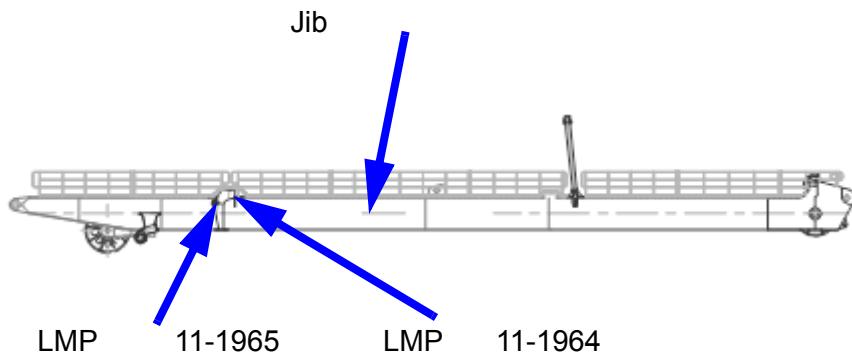


Figure 7-114: Load measuring pin overview

1. Grease load measuring pin according to greasing schedule.

Lubrication

Lubrication type	Type of grease nipple	Qty.
DIN 51502 KP 2 K-20	AISI 316 DIN 71412A	N/A

7.5.11.9.2 Perform 6 month periodic load measuring pin check

Reference documents:

- [10013281A](#): Electrical drawing
- Huisman Load Measurement Pin manual
- Huisman calibration certificate H-C LMP11-1962
- Huisman calibration certificate H-C LMP11-1963
- Huisman calibration certificate H-C LMP11-1964
- Huisman calibration certificate H-C LMP11-1965

Description	Location	Reference	Symbol code	Qty.
LMP 11-1962	Jib, main hoist	Electrical drawing (+M22)	130B10	1
LMP 11-1963	Slewing platform, whip hoist sheave	Electrical drawing (+M52)	-600B10	1
LMP 11-1964 (Left)	Jib	Electrical drawing (+J12)	-800M1-B10	1
LMP 11-1965 (Right)	Jib	Electrical drawing (+J12)	-800M2-B10	1

1. Check the load measuring pin, according the Huisman load measuring pin manual.
 - If LMP has to be replaced, contact Huisman.

For more information, see the supplier documentation.

NOTE	<i>The operator can keep a log file with the load given by the load measuring pin and weight given on a cargo manifest or calculations by engineers. By keeping this simple log any abnormalities are directly noticed.</i>
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NOTE	<i>If the amplifier has to be replaced, it has to be first programmed by Huisman!</i>
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Special tools

P/N	Tool	Qty.
2001373	Gisma connector - Shrink Endbell: 24.80.2.00.2.00.0	1
2001294	Gisma connector - Receptacle, male: 24.02.2.P.07.2.00.0	1
2001887	Gisma connector - Plug, female: 24.06.2.S.07.2.00.0	1

Spare parts

P/N	Part	Symbol code
2001286	Amplifier (programmed)	N/A

7.5.11.9.3 Perform 12 month periodic load measuring pin check

Reference documents:

- [10013281A](#): Electrical drawing
- Huisman Load Measurement Pin manual
- Huisman calibration certificate H-C LMP11-1962
- Huisman calibration certificate H-C LMP11-1963
- Huisman calibration certificate H-C LMP11-1964
- Huisman calibration certificate H-C LMP11-1965

Description	Location	Reference	Symbol code	Qty.
LMP 11-1962	Jib, main hoist	Electrical drawing (+M22)	130B10	1
LMP 11-1963	Slewing platform, whip hoist sheave	Electrical drawing (+M52)	-600B10	1
LMP 11-1964 (Left)	Jib	Electrical drawing (+J12)	-800M1-B10	1
LMP 11-1965 (Right)	Jib	Electrical drawing (+J12)	-800M2-B10	1

1. Check the load measuring pin, according the Huisman load measuring pin manual.
 - If LMP has to be replaced, contact Huisman.

For more information, see the supplier documentation.

NOTE	<i>The operator can keep a log file with the load given by the load measuring pin and weight given on a cargo manifest or calculations by engineers. By keeping this simple log any abnormalities are directly noticed.</i>
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NOTE	<i>If the amplifier has to be replaced, it has to be first programmed by Huisman!</i>
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Special tools

P/N	Tool	Qty.
2001373	Gisma connector - Shrink Endbell: 24.80.2.00.2.00.0	1
2001294	Gisma connector - Receptacle, male: 24.02.2.P.07.2.00.0	1
2001887	Gisma connector - Plug, female: 24.06.2.S.07.2.00.0	1

Spare parts

P/N	Part	Symbol code
2001286	Amplifier (programmed)	N/A

7.5.12 400T DISTRIBUTION AND CONTROL SYSTEM

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
Cabinet +M21.1								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.01.04
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.10.01.04
7.5.12.1.12	Check function of the current and volt indicator		1			Electrical	Huisman	331.01.06.10.01.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.01.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.01
Cabinet +M21.2								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.02
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.02.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.02.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.02.
7.5.12.3.3	<i>Yearly maintenance inverter- ABB ACS800 manual</i>			1		Electrical	Huisman	311.01.06.10.02.01 311.01.06.10.02.02
7.5.12.3.4	<i>3 years maintenance - ABB ACS manual</i>			3		Electrical	Huisman	311.01.06.10.02.01 311.01.06.10.02.02
7.5.12.3.5	<i>6 years maintenance - ABB ACS manual</i>			6		Electrical	Huisman	311.01.06.10.02.01 311.01.06.10.02.02
7.5.12.3.6	<i>9 years maintenance - ABB ACS manual</i>			9		Electrical	Huisman	311.01.06.10.02.01 311.01.06.10.02.02
Cabinet +M21.3								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.03
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.03.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.03.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.03.
7.5.12.3.3	<i>Yearly maintenance inverter- ABB ACS800 manual</i>			1		Electrical	Huisman	311.01.06.10.03.01 311.01.06.10.03.02

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.3.4	3 years maintenance - ABB ACS manual			3		Electrical	Huisman	311.01.06.10.03.01 311.01.06.10.03.02
7.5.12.3.5	6 years maintenance - ABB ACS manual			6		Electrical	Huisman	311.01.06.10.03.01 311.01.06.10.03.02
7.5.12.3.6	9 years maintenance - ABB ACS manual			9		Electrical	Huisman	311.01.06.10.03.01 311.01.06.10.03.02
Cabinet +M21.4								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.04
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.04.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.04.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.04.
7.5.12.3.3	Yearly maintenance inverter- ABB ACS800 manual			1		Electrical	Huisman	311.01.06.10.04.01 311.01.06.10.04.02
7.5.12.3.4	3 years maintenance - ABB ACS manual			3		Electrical	Huisman	311.01.06.10.04.01 311.01.06.10.04.02
7.5.12.3.5	6 years maintenance - ABB ACS manual			6		Electrical	Huisman	311.01.06.10.04.01 311.01.06.10.04.02
7.5.12.3.6	9 years maintenance - ABB ACS manual			9		Electrical	Huisman	311.01.06.10.04.01 311.01.06.10.04.02
Cabinet +M21.5								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.05
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.05.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.05.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.05
7.5.12.3.3	Yearly maintenance inverter- ABB ACS800 manual			1		Electrical	Huisman	311.01.06.10.05.01 311.01.06.10.05.02
7.5.12.3.4	3 years maintenance - ABB ACS manual			3		Electrical	Huisman	311.01.06.10.05.01 311.01.06.10.05.02
7.5.12.3.5	6 years maintenance - ABB ACS manual			6		Electrical	Huisman	311.01.06.10.05.01 311.01.06.10.05.02
7.5.12.3.6	9 years maintenance - ABB ACS manual			9		Electrical	Huisman	311.01.06.10.05.01 311.01.06.10.05.02
Cabinet +M21.6								

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.06
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.06.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.06.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.06
7.5.12.3.3	<i>Yearly maintenance inverter- ABB ACS800 manual</i>			1		Electrical	Huisman	311.01.06.10.06.01 311.01.06.10.06.02
7.5.12.3.4	<i>3 years maintenance - ABB ACS manual</i>			3		Electrical	Huisman	311.01.06.10.06.01 311.01.06.10.06.02
7.5.12.3.5	<i>6 years maintenance - ABB ACS manual</i>			6		Electrical	Huisman	311.01.06.10.06.01 311.01.06.10.06.02
7.5.12.3.6	<i>9 years maintenance - ABB ACS manual</i>			9		Electrical	Huisman	311.01.06.10.06.01 311.01.06.10.06.02
Cabinet +M21.7								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.07
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.07.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.07.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.07.
7.5.12.3.3	<i>Yearly maintenance inverter- ABB ACS800 manual</i>			1		Electrical	Huisman	311.01.06.10.07.01 311.01.06.10.07.02
7.5.12.3.4	<i>3 years maintenance - ABB ACS manual</i>			3		Electrical	Huisman	311.01.06.10.07.01 311.01.06.10.07.02
7.5.12.3.5	<i>6 years maintenance - ABB ACS manual</i>			6		Electrical	Huisman	311.01.06.10.07.01 311.01.06.10.07.02
7.5.12.3.6	<i>9 years maintenance - ABB ACS manual</i>			9		Electrical	Huisman	311.01.06.10.07.01 311.01.06.10.07.02
Cabinet +M21.8								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.08
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.08.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.08.03
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.08.

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.3.3	<i>Yearly maintenance inverter-ABB ACS800 manual</i>			1		Electrical	Huisman	311.01.06.10.08.01 311.01.06.10.08.02
7.5.12.3.4	<i>3 years maintenance - ABB ACS manual</i>			3		Electrical	Huisman	311.01.06.10.08.01 311.01.06.10.08.02
7.5.12.3.5	<i>6 years maintenance - ABB ACS manual</i>			6		Electrical	Huisman	311.01.06.10.08.01 311.01.06.10.08.02
7.5.12.3.6	<i>9 years maintenance - ABB ACS manual</i>			9		Electrical	Huisman	311.01.06.10.08.01 311.01.06.10.08.02
Cabinet +M21.9								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	311.01.06.10.09
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	311.01.06.10.09.20
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.10.09.25.01 331.01.06.10.09.25.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	311.01.06.10.09.23
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	311.01.06.10.09.23
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.09.24
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	311.01.06.10.09
7.5.12.3.1	<i>Inspect the drive control unit</i>		1			Electrical	Huisman	311.01.06.10.09.01 311.01.06.10.09.05 311.01.06.10.09.07 311.01.06.10.09.13 311.01.06.10.09.15 311.01.06.10.09.17
7.5.12.3.2	<i>Inspect the control panel</i>		1			Electrical	Huisman	311.01.06.10.09.01 311.01.06.10.09.05 311.01.06.10.09.07 311.01.06.10.09.13 311.01.06.10.09.15 311.01.06.10.09.17
Cabinet +M51								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.10.10
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.10.10
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.10.10
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.10.10
7.5.12.3.1	<i>Inspect the drive control unit</i>		1			Electrical	Huisman	331.01.06.10.10

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.3.2	<i>Inspect the control panel</i>		1			Electrical	Huisman	331.01.06.10.10
7.5.12.3.3	<i>Yearly maintenance inverter- ABB ACS800 manual</i>			1		Electrical	Huisman	331.01.06.10.10
7.5.12.3.4	<i>3 years maintenance - ABB ACS manual</i>			3		Electrical	Huisman	331.01.06.10.10
7.5.12.3.5	<i>6 years maintenance - ABB ACS manual</i>			6		Electrical	Huisman	331.01.06.10.10
7.5.12.3.6	<i>9 years maintenance - ABB ACS manual</i>			9		Electrical	Huisman	331.01.06.10.10
Cabinet +B10								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.10.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.10.01.04
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.20.10.01.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.10.01.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.10.01
Cabinet +B20								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.10.02
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.10.02.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.10.02.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	311.01.06.20.10.02.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.10.02
Cabinet +H11								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.20.01
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.20.01.01
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.20.20.01.06.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.20.01.04

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.1.11	Check the transformer		1			Electrical	Huisman	331.01.06.20.20.01.07
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.20.20.01.04
7.5.12.1.8	Check function of the hour counter		1			Electrical	Huisman	331.01.06.20.20.01.03
7.5.12.1.12	Check function of the current and volt indicator		1			Electrical	Huisman	331.01.06.20.20.01.03
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	311.01.06.20.20.01.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.20.01
Cabinet +H12								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.20.02
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	311.01.06.20.20.02.01
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.20.20.02.06.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.20.02.04
7.5.12.1.11	Check the transformer		1			Electrical	Huisman	331.01.06.20.20.02.07
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.20.20.02.04
7.5.12.1.8	Check function of the hour counter		1			Electrical	Huisman	331.01.06.20.20.02.03
7.5.12.1.12	Check function of the current and volt indicator		1			Electrical	Huisman	331.01.06.20.20.02.03
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.20.02.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.20.02
Cabinet +H13								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.20.03
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.20.03.01
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.20.20.03.06.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.20.03.04

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.20.20.03.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.20.03.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.20.03
Cabinet +J11								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.30.01
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.30.01
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.30.01
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.30.01
Cabinet +J12								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.30.02
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.30.02
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.30.02
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.30.02
Cabinet +L11								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.40.01
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.40.01.01
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.20.40.01.04
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.40.01.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.40.01.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.40.01
Cabinet +M22								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.50

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.50.01
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.20.50.06.
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.50.04
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.20.50.04
7.5.12.1.7	Check function of the DISPS		1			Electrical	Huisman	331.01.06.20.50.03
7.5.12.1.8	Check function of the hour counter		1			Electrical	Huisman	331.01.06.20.50.03
7.5.12.1.9	Check function of the brake rectifier		1			Electrical	Huisman	331.01.06.20.50.03
7.5.12.1.10	Check function of the relay for PTC-thermistor		1			Electrical	Huisman	331.01.06.20.50.03
7.5.12.1.11	Check the transformer		1			Electrical	Huisman	311.01.06.20.50.07
7.5.12.1.12	Check function of the current and volt indicator		1			Electrical	Huisman	331.01.06.20.50.03
7.5.12.5.1	Inspect and clean of the PLC (SCADA)		1			Electrical	Huisman	331.01.06.20.50.08 331.01.06.20.50.09
7.5.12.4.3	Inspect and clean the UPS battery charger		1			Electrical	Huisman	331.01.06.20.50.08 331.01.06.20.50.09
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.50.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.50
Cabinet +M23								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.51
7.5.12.4.1	Inspect and clean the battery		1			Electrical	Huisman	331.01.06.20.51
7.5.12.4.2	Replace the battery			2		Electrical	Huisman	331.01.06.20.51
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.51
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.51
Cabinet +M32								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.52

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.52.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.52.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.52
Cabinet +M40								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.53
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.54 331.01.06.20.55
7.5.12.1.11	Check the transformer		1			Electrical	Huisman	331.01.06.20.53.03
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.53.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	33.01.06.20.53
Cabinet +M54								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.56
7.5.12.4.1	Inspect and clean the battery		1			Electrical	Huisman	331.01.06.20.56
7.5.12.4.2	Replace the battery			2		Electrical	Huisman	331.01.06.20.56
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.56
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.56
Cabinet +P01								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.60.01
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.60.01.01
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.20.60.01.04
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.60.01.04
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.20.60.01.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.60.01.05

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.60.01
Cabinet +P02								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.60.02
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.60.02.01
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.20.60.02.04
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.60.02.04
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.20.60.02.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.60.02.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.60.02
Cabinet +P10								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.20.61
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.20.61
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.20.61.04
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.20.61.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.20.61
SCADA +C14								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.30.01
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.30.01.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.30.01
7.5.12.6.1	<i>Clean and check function of the computer (PC system)</i>		1			Electrical	Huisman	331.01.06.30.01.06
7.5.12.6.2	<i>Replace the backup battery of the computer</i>			2		Electrical	Huisman	331.01.06.30.01.06
Cabinet +M52								

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.30.01
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.30.01.01
7.5.12.1.3	Replace the anti corrosion emitter			1		Electrical	Huisman	331.01.06.30.01.04
7.5.12.1.4	Check function of the temperature control, cooling		1			Electrical	Huisman	331.01.06.30.01.04
7.5.12.1.5	Check function of the temperature control, heating		1			Electrical	Huisman	331.01.06.30.01.04
7.5.12.1.6	Check function of the cabinet lighting		1			Electrical	Huisman	331.01.06.30.01.04
7.5.12.1.9	Check function of the brake rectifier		1			Electrical	Huisman	331.01.06.30.02.03
7.5.12.1.10	Check function of the relay for PTC-thermistor		1			Electrical	Huisman	331.01.06.30.02.03
7.5.12.1.11	Check the transformer		1			Electrical	Huisman	331.01.06.30.02.03
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.30.02.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.30.02
7.5.12.4.3	<i>Inspect and clean the UPS battery charger</i>		1			Electrical	Huisman	331.01.06.30.02.03
7.5.12.4.4	<i>Inspect and clean the UPS sinewave inverter</i>		1			Electrical	Huisman	331.01.06.30.02.03
7.5.12.6.1	<i>Clean and check function of the computer (PC system)</i>		1			Electrical	Huisman	331.01.06.30.02.06 331.01.06.30.02.07
7.5.12.6.2	<i>Replace the backup battery of the computer</i>			2		Electrical	Huisman	331.01.06.30.02.06 331.01.06.30.02.07
Cabinet +M53								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.30.03 331.01.06.30.04
7.5.12.1.2	Check function of the I/O module		1			Electrical	Huisman	331.01.06.30.03.01 331.01.06.30.04.01
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.30.03.05 331.01.06.30.04.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.30.03 331.01.06.30.04
+E10 WAB								
7.5.12.1.1	Inspect and clean the E-cabinet		1			Electrical	Huisman	331.01.06.30.05

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.8.1	Inspect and clean the WAB		1			Electrical	Huisman	331.01.06.30.05
7.5.12.1.13	Inspect cables and connections		1			Electrical	Huisman	331.01.06.30.05
7.5.12.2.1	Perform thermal imaging analysis for E-cabinet			1		Electrical	Huisman	331.01.06.30.05
Encoders (Instrumentation)								
7.5.12.9.1	Check mounting of E-motor encoder		1			Electrical	Huisman	331.01.06.50.02.01 331.01.06.50.02.02 331.01.06.50.02.04 331.01.06.50.03.01 331.01.06.50.04. 331.01.06.50.05.01
Inclinometers (Instrumentation)								
7.5.12.10.1	Check the inclinometer		1			Electrical	Huisman	331.01.06.50.01.02 331.01.06.50.01.03 331.01.06.50.05.02
Gear cam limit switch (Instrumentation)								
7.5.12.11.1	Grease follow gear of gearcam limit switch		3		200	Electrical	Huisman	331.01.06.50.01.04 331.01.06.50.02.06 331.01.06.50.03.02 331.01.06.50.04.02 331.01.06.50.05.03
7.5.12.11.2	Inspect and clean gearcam limit switch		3			Electrical	Huisman	331.01.06.50.01.04 331.01.06.50.02.06 331.01.06.50.03.02 331.01.06.50.04.02 331.01.06.50.05.03
7.5.12.11.3	Test gearcam limit switch		6			Electrical	Huisman	331.01.06.50.01.04 331.01.06.50.02.06 331.01.06.50.03.02 331.01.06.50.04.02 331.01.06.50.05.03
7.5.12.11.4	Test heater of gearcam limit switch		6			Electrical	Huisman	331.01.06.50.01.04 331.01.06.50.02.06 331.01.06.50.03.02 331.01.06.50.04.02 331.01.06.50.05.03
Slack rope switch (Instrumentation)								
7.5.12.12.1	Test slack rope switch	7				Mechanical	Huisman	331.01.06.50.01.05 331.01.06.50.02.07 331.01.06.50.03.03
7.5.12.12.2	Inspect and clean slack rope switch		3			Mechanical	Huisman	331.01.06.50.01.05 331.01.06.50.02.07 331.01.06.50.03.03
Proximity switch (Instrumentation)								
7.5.12.13.1	Inspect proximity switch		1			Electrical	Huisman	331.01.06.50.01.06 331.01.06.50.02.08 331.01.06.50.03.04
Loadcell								
7.5.12.14.1	Grease load measuring pin		1			Electrical	Huisman	331.01.06.50.02.03 331.01.06.50.02.03
7.5.12.14.2	6 mount periodic check		6			Electrical	Huisman	331.01.06.50.02.03 331.01.06.50.02.03

Table 7-19: Maintenance schedule Video, Control and Monitoring

Ref. no.	Preventive maintenance task	PM interval				Required skill type	Prescribed by	TM Master code
		Weeks	Months	Years	Hours			
7.5.12.14.3	12 month periodic check			1		Electrical	Huisman	331.01.06.50.02.03 331.01.06.50.02.03
7.5.12.14.4	5 years periodic check			5		Electrical	Huisman	331.01.06.50.02.03 331.01.06.50.02.03

Table 7-19: Maintenance schedule Video, Control and Monitoring

7.5.12.1 E-cabinet

7.5.12.1.1 Inspect and clean the E-cabinet

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Supplier documentation; Rittal (Cabinet TS8, assembly guides).

Cabinets & Junction Boxes

Description	Location	Reference	Symbol code	Qty.
Junction box storage winch OMC		Electrical diagram (+B10).	+B10	1
Control cabinet, storage winch OMC		Electrical diagram (+B20).	+B20	1
Emergency control box		Electrical diagram (+E10).	+E10	1
Cabinet main pump 1 HPU		Electrical diagram (+H11).	+H11	1
Cabinet main pump 1 HPU		Electrical diagram (+H12).	+H12	1
Control cabinet HPU		Electrical diagram (+H13).	+H13	1
Power junction box		Electrical diagram (+J11).	+J11	1
Signal junction box 1		Electrical diagram (+J12).	+J12	1
Heave cylinder cabinet		Electrical diagram (+L11).	+L11	1
Drive cabinet, panel 1		Electrical diagram (+M12.1)	+M21.1	1
Drive cabinet, panel 2		Electrical diagram (+M12.2)	+M21.2	1
Drive cabinet, panel 3		Electrical diagram (+M12.3)	+M21.3	1
Drive cabinet, panel 4		Electrical diagram (+M12.4)	+M21.4	1
Drive cabinet, panel 5		Electrical diagram (+M12.5)	+M21.5	1
Drive cabinet, panel 6		Electrical diagram (+M12.6)	+M21.6	1
Drive cabinet, panel 7		Electrical diagram (+M12.7)	+M21.7	1
Drive cabinet, panel 8		Electrical diagram (+M12.8)	+M21.8	1
Drive cabinet, panel 9		Electrical diagram (+M12.9)	+M21.9	1
Electrical and power cabinet (POCA)		Electrical diagram (+M22).	+M22	1
Battery box		Electrical diagram (+M23).	+M23	1
Junction box mast 1		Electrical diagram (+M32).	+M32	1
Slipring		Electrical diagram (+M40).	+M40	1
Drive cabinet, tuggers		Electrical diagram (+M51).	+M51	1
Electrical and power cabinet (ELCA)		Electrical diagram (+M52).	+M52	1
Cabin chair		Electrical diagram (+M53).	+M53	1

Description	Location	Reference	Symbol code	Qty.
Battery box		Electrical diagram (+M54).	+M54	1
Pressure vessel unit cabinet 1		Electrical diagram (+P01).	+P01	1
Pressure vessel unit cabinet 2		Electrical diagram (+P02).	+P02	1
Motion reference unit junction box		Electrical diagram (+P10).	+P10	1

Description	Location	Reference	Symbol code	Qty.
Control desk		Electrical diagram (+C14).	+C14	1

This task is applicable to Inspect and clean the cabinet and its ancillaries and instruments

1. Clean E-cabinet using a vacuum cleaner or a soft brush.
2. Check the cabinet for damage.
 - If cabinet is significantly damaged, repair the cabinet.
3. Inspect cabinet general condition and mounting of the components.
 - If a component is not properly tightened, tighten the component.
4. Check rubber seals of the E-cabinet.
 - If the rubber seals of the E-cabinet is damaged or aged, check for water ingress in cabinet, replace the rubber seal and affected components.
 - The seal must be replaced as a whole when damaged.

NOTE Common agents such as talcum powder, Vaseline or wax can be used to prevent damage due to seals freezing in cold conditions.

5. Check for water ingress in e-cabinet.
 - If water ingress is found, replace the affected components.
6. Check the baying clamps (connections between E-cabinets).
 - Check the mounting of the baying clamps, tighten the bolts when they are loose.
7. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.
8. Check the cam lock.
 - If the cabinet does not close correctly, investigate the cause and repair/replace the failed component.
 - The lock need to be check for ease of movement, if necessary lubricate the lock with a suitable, water-free lubricant.

Spare parts

P/N	Part	Symbol code
On request	Cabinet door seal	-
On request	Cam lock (Rittal SZ2304.000) 2 x	-

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

NOTE The given tasks are general, see electrical schematics (E-plan) for the exact contents of the several cabinets.

7.5.12.1.2 Check function of the I/O module

This task is applicable to Inspect and clean the I/O module.

Reference documents

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation: Siemens (Simatic CPU IM 151-7).
- Supplier documentation: Siemens (Simatic ET200S Power Module).
- Supplier documentation: Siemens (Simatic ET200S Terminal modules).
- Supplier documentation: Siemens (Simatic NET Profibus networks).
- Supplier documentation: Profibus DP.

I/O module

Description	Location	Reference	Symbol code	Qty.
I/O module	Cabinet +B20	Electrical diagram (+B20) and Siemens manual.	A42A0	1
I/O module	Cabinet +H11	Electrical diagram (+H11) and Siemens manual.	A42A0	
I/O module	Cabinet +H12	Electrical diagram (+H12) and Siemens manual.	A42A0	
I/O module	Cabinet +H13	Electrical diagram (+H13) and Siemens manual.	A42A0	
I/O module	Cabinet +L11	Electrical diagram (+L11) and Siemens manual.	A42A0	
I/O module	Cabinet +M21.9	Electrical diagram (+M21.9) and Siemens manual.	A41A1	
I/O module	Cabinet +M22	Electrical diagram (+M22) and Siemens manual.	041A1	
I/O module	Cabinet +M22	Electrical diagram (+M22) and Siemens manual.	041A30	
I/O module	Cabinet +M22	Electrical diagram (+M22) and Siemens manual.	041A101	
I/O module	Cabinet +M52	Electrical diagram (+M52) and Siemens manual.	041A1	
I/O module	Cabinet +M53.1	Electrical diagram (+M53.1) and Siemens manual.	041A1	
I/O module	Cabinet +M53.2	Electrical diagram (M53.2) and Siemens manual.	041A1	

Description	Location	Reference	Symbol code	Qty.
I/O module	Cabinet +P01	Electrical diagram (+P01) and Siemens manual.	042A0	
I/O module	Cabinet +P02	Electrical diagram (+P02) and Siemens manual.	042A0	
I/O module	Cabinet +P10	Electrical diagram (+P10) and Siemens manual.	041A1	
I/O module	Cabinet +C14	Electrical diagram (+C14) and Siemens manual.	041A1	

1. Perform a functional test, by checking the LED's on the I/O module, concerning the status of the Profibus module, see Siemens manual.
 - If a problem is found, investigate the cause and replace the failed component.

WARNING


The housing can only be opened for a short time (e.g. for visual diagnostics). If you do this, do not operate any switches, remove or install any modules or disconnect any electrical cables (plug-in connections).

2. Check if all sensors and actuators are connected in the I/O module and working properly. Measure the Analog Input (AI) on the I/O module, the electrical current must be between the range of 4..20 mA.
 - If the electrical current is beyond the range of 4...20 mA investigate the cause.
 - For I/O check use the maintenance overrule page in SCADA.

NOTE

Before starting it is important to know how the overrule page works. First read the explanation given in the maintenance page of SCADA.

NOTE

Each sensor or actuator must be individually actuated / triggered to validate the correct signal is received in the (via the I/O module) PLC as well in SCADA.

Spare parts

P/N	Part	Symbol code
2001598	Profibus DP connector	
2001443	Power module ET200S (PM-E DC24v)	
2010360	Digital electronic module (4DI DC24v ST)	
2007948	Digital electronic module (4DI NAMUR)	
2013044	Analog electronic module (2AI 1 4wire ST)	
2208795	Terminal module (TM-E15C24-01)	
2031738	Terminal module (TM-P15C23-A0)	

NOTE

For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.3 Replace the anti corrosion emitter (ancillary component)

This task is applicable to Inspect the ancillaries.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation; Cortec, VPCI-111.

Anti-corrosion emitter

Description	Location	Reference	Symbol code	Qty.
Anti-corrosion emitter	Cabinet +M52	Electrical diagram (+M52) and Siemens manual.	-CAB1	1

1. Replace the anti corrosion emitter of the E-cabinet.
 - Strip the protective strip off the bottom and attach it on a clean surface and free of debris

Spare parts

P/N	Part	Symbol code (location)
2024554	Anti-corrosion Emitter (Cortec, VPCI-111)	CAB1 (+M52)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.4 Check function of the temperature control, cooling (ancillary component)

This task is applicable to Inspect the ancillaries.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation; Rittal (Cooling fan & Filter, SK-series).
- Supplier documentation; Rittal (Cooling fan, SK series).
- Supplier documentation; Rittal (Thermostat, SK series).

Cooling

Description	Location	Reference	Symbol code	Qty.
Cooling	Cabinet +H11	Electrical diagram (+H11).	022B51 022M1	2
Cooling	Cabinet +H12	Electrical diagram (+H12).	022B51 022M1	2

Description	Location	Reference	Symbol code	Qty.
Cooling	Cabinet +H13	Electrical diagram (+H13).	022B51 022M1	2
Cooling	Cabinet +L11	Electrical diagram (+L11).	022B51 022M1	2
Cooling	Cabinet +M21.9	Electrical diagram (+M21.9).	022B51 022M1 022M2 022M3 022M4	5
Cooling	Cabinet +M22	See electrical diagram (+M22).	022B51 022M1 022M2 022M3	4
Cooling	Cabinet +M52	See electrical diagram (+M52).	022B51 022M1 022M2	3
Cooling	Cabinet +P01	See electrical diagram (+P01).	023B51 023M1	2
Cooling	Cabinet +P02	See electrical diagram (+P02).	023B51 023M1	2

1. Functional test cabinet cooler by increasing the cooling set point temperature to activate the cabinet cooling (when necessary) and check if the cooling fan can rotate freely.
 - If a problem is found, investigate the cause and repair/replace the failed component (cooling fan or thermostat), see the electrical diagram (E-plan) for the correct terminal point.
2. Check the cabinet cooling fan.
 - When the fan is visual dirty, clean the fan using a vacuum cleaner or compressed air.
 - The presence of stubborn oil stains, may be removed using a non-flammable detergent, such as a degreaser.
3. Set the correct temperature on 30 degrees Celsius, after this task have been performed.
4. Replace the air filter (only when the air filter is present).

Spare parts

P/N	Part	Symbol code (location)
2009385	Cabinet thermostat (Rittal 3110-000).	022B51 (+H11, +H12, +H13, +L11, +M21.9, +M22 and +M52)
2009385	Cabinet thermostat (Rittal 3110-000).	023B51 (+P01 and +P02)
On request	Cabinet cooling fan (Rittal SK3240.100).	022M1 (+H11, +H12 and +H13)
2042438	Cabinet cooling fan (Rittal SK3238.100).	022M1 (+L11))
On request	Cabinet cooling fan (Rittal SK3237.100).	022M1 (+M21.9) 022M2 (+M21.9) 022M3 (+M21.9) 022M4 (+M21.9)

P/N	Part	Symbol code (location)
2012895	Cabinet cooling fan (Rittal SK3324.107).	022M1 (+M22) 022M2 (+M22) 022M3 (+M22)
2012895	Cabinet cooling fan (Rittal SK3324.107).	022M1 (+M52) 022M2 (+M52)
2042438	Cabinet cooling fan (Rittal SK3338.100).	023M1 (+P01)
2042438	Cabinet cooling fan (Rittal SK3338.100).	023M1 (+P02)
2012896	Filter (Rittal).	(Fit all fans)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.5 Check function of the temperature control, heating (ancillary component)

This task is applicable to Inspect the ancillaries.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation; Rittal (Heater, SK3105)
- Supplier documentation; Rittal (Hygrostat, SK3118)
- Supplier documentation; Eldon (Heater, EHG045)

Heating

Description	Location	Reference	Symbol code	Qty.
Heating	Cabinet +B10	Electrical diagram (+B10) and Rittal manual.	021E1	1
Heating	Cabinet +B20	Electrical diagram (+B20) and Rittal manual.	021E1	1
Heating	Cabinet +H11	Electrical diagram (+H11) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +H12	Electrical diagram (+H12) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +H13	Electrical diagram (+H13) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +J11	Electrical diagram (+J11) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +J12	Electrical diagram (+J12) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +L11	Electrical diagram (+L11) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +M21.1	Electrical diagram (+M21.1) and Eldon manual.	021E1 021E2	2
Heating	Cabinet +M21.2	Electrical diagram (+M21.2) and Eldon manual.	021E1 021E2	2

Description	Location	Reference	Symbol code	Qty.
Heating	Cabinet +M21.3	Electrical diagram (+M21.3) and Eldon manual.	021E1 021E2	2
Heating	Cabinet +M21.4	Electrical diagram (+M21.4) and Eldon manual.	021E1 021E2	2
Heating	Cabinet +M21.5	Electrical diagram (+M21.5) and Eldon manual.	021E1 021E2	2
Heating	Cabinet +M21.6	Electrical diagram (+M21.6) and Eldon manual.	021E1 021E2	2
Heating	Cabinet +M21.7	Electrical diagram (+M21.7) and Eldon manual.	021E1 021E2	2
Heating	Cabinet +M21.8	Electrical diagram (+M21.8) and Eldon manual.	021E1 021E2	2
Heating	Cabinet +M21.9	Electrical diagram (+M21.9) and Eldon manual.	021B91 021E1	2
Heating	Cabinet +M22	Electrical diagram (+M22) and Rittal manual.	021B91 021E1 021E2 021E3	4
Heating	Cabinet +M32	Electrical diagram (+M32) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +M40	Electrical diagram (+M40) and Rittal manual.	000E1 000E2 000E3 000E4 000E5	5
Heating	Cabinet +M51	Electrical diagram (+M51) and Eldon manual.	021B91 021E1 021E2	3
Heating	Cabinet +M52	Electrical diagram (+M52) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +P01	Electrical diagram (+P01) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +P02	Electrical diagram (+P02) and Rittal manual.	021B91 021E1	2
Heating	Cabinet +P10	Electrical diagram (+P10) and Rittal manual.	021E1	1

Heater (Rittal)

Functional test:

1. Perform a functional test, to check if the heater is working correctly (heat dispersion).

NOTE Do not touch heater, only check the temperature from a save distance.

When the heater is not working correctly:

2. Check the cable connection.
 - If the cable is not connected correctly, re-connect the cable correctly to the heater.

NOTE	<i>See electrical diagram for the correct connections!</i>
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3. Check the e-cabinet circuit breaker.
 - When the circuit breaker is not tripped, investigate the cause, before resetting the circuit breaker.
4. Check the internal slow-blowing fuse (2 A or 4 A, type depending).
 - When the fuse is broken, investigate the cause and replace the fuse.
5. Measure the voltage. The measured voltage should be 230 Vac.
 - If the measured voltage is below this value, investigate the cause and replace the failed component.
6. Measure the current.
 - The measured (approximately) current, should be in accordance with the rated power of the unit.
7. Measure the resistance of the heating element.
 - If the resistance is zero or infinity, investigate the cause and replace the failed component.

NOTE	The heater must not be touched while switched on, risks of burns from hot surfaces. The heater must be allowed to cool for approx. 15 minutes after switching off.
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8. Set via the hygrostat, the humidity on 70 percent, after this task have been performed.

Heater (Eldon)

Functional test:

1. Perform a functional test, to check if the heater is working correctly (heat dispersion).

NOTE	Do not touch heater, only check the temperature from a save distance.
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When the heater is not working correctly:

2. Check the cable connection.
 - If the cable is not connected correctly, re-connect the cable correctly to the heater.

NOTE	<i>See electrical diagram for the correct connections!</i>
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3. Check the e-cabinet circuit breaker
 - When the circuit breaker is not tripped, investigate the cause, before resetting the circuit breaker.
4. Measure the voltage. The measured voltage should be 230 Vac.
 - If the measured voltage is below is below this value, investigate the cause and replace the failed component.

5. Measure the current. The measured (approximately) current should be;

Type (heater)	Heating status	Energy (Heater)	Current (Average)	Power (Average)
EHG045	Continuous heating	45 W	0,19 A	230 Vac

6. Measure the resistance of the heating element.

- If the resistance is zero or infinity, investigate the cause and replace the failed component.

NOTE The heater must not be touched while switched on, risks of burns from hot surfaces. The heater must be allowed to cool for approx. 15 minutes after switching off.

7. Set via the hygrostat, the humidity on 70 percent, after this task have been performed.

Spare parts

P/N	Part	Symbol code
2012893	Cabinet hygrostat (Rittal 3118-000).	021B91 (all cabinets)
On request	Cabinet heater (Rittal SK3105.370).	021E1 (+H11)
On request	Cabinet heater (Rittal SK3105.370).	021E1 (+H12)
2015039	Cabinet heater (Rittal SK3116.000).	021E1 (+H13)
2036094	Cabinet heater (Rittal SK3105.310).	021E1 (+J11)
2036094	Cabinet heater (Rittal SK3105.310).	021E1 (+J12)
2022689	Cabinet heater (Rittal SK3106.000).	021E1 (+L11)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.1) 021E2 (+M21.1)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.2) 021E2 (+M21.2)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.3) 021E2 (+M21.3)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.4) 021E2 (+M21.4)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.5) 021E2 (+M21.5)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.6) 021E2 (+M21.6)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.7) 021E2 (+M21.7)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.8) 021E2 (+M21.8)
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M21.9)
On request	Cabinet heater (Rittal SK3105.370).	021E1 (+M22) 021E2 (+M22) 021E3 (+M22)
2036094	Cabinet heater (Rittal SK3105.310).	021E1 (+M32)
On request	Cabinet (Slipring) heater .	000A1-E1...E5 (+M40)

P/N	Part	Symbol code
2015809	Cabinet heater (Eldon EHG045).	021E1 (+M51) 021E2 (+M51)
2015039	Cabinet heater (Rittal SK3116.000).	021E1 (+M52)
2036094	Cabinet heater (Rittal SK3105.310).	021E1 (+P01)
2036094	Cabinet heater (Rittal SK3105.310).	021E1 (+P02)
2036094	Cabinet heater (Rittal SK3105.310).	021E1 (+P10)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.6 Check function of the cabinet lighting (ancillary component)

This task is applicable to Inspect the ancillaries.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation; Rittal (PS4155).

Lighting

Description	Location	Reference	Symbol code	Qty.
Cabinet lighting (1x).	Cabinet +H11	Electrical diagram (+H11).	011E1	1
Cabinet lighting (1x).	Cabinet +H12	Electrical diagram (+H12).	011E1	1
Cabinet lighting (1x).	Cabinet +H13	Electrical diagram (+H13).	011E1	1
Cabinet lighting (1x).	Cabinet +M21.1	Electrical diagram (+M21.1).	011E1	1
Cabinet lighting (1x).	Cabinet +M21.9	Electrical diagram (+M21.9).	011E1	1
Cabinet lighting (3x).	Cabinet +M22	Electrical diagram (+M22).	010E1, 010E2, 010E3	1
Cabinet lighting (1x).	Cabinet +M52	Electrical diagram (+M52).	010E1	1
Cabinet lighting (1x).	Cabinet +P01	Electrical diagram (+P01).	011E1	1
Cabinet lighting (1x).	Cabinet +P02	Electrical diagram (+P02).	011E1	1

Functional test:

1. Perform a functional test, to check if the light and light switch is working.
2. Check the cabinet light.
 - If a problem occurs, check the electrical connection on the terminals and the connecting cable or replace the cable.
 - If a problem occurs, check the electrical connection on the terminals and replace the light.

Spare parts

P/N	Part	Symbol (E-) code
2006221	Cabinet light (Rittal SK4155.100).	-010E1, -010E2, -010E3 and -011E1
2012906	Cable connection.	-010E1, -010E2, -010E3 and -011E1

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.7 Check function of the DISPS (instrumentation component)

This task is applicable to Inspect the ancillaries.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Huisman; Manual DISPS, version 6.2.

DISPS

Description	Location	Reference	Symbol code	Qty.
Speed protection (Upper traction)	Cabinet +M22	Electrical diagram (+M22).	110A1	1
Speed protection (Lower traction)	Cabinet +M22	Electrical diagram (+M22).	120A1	1
Speed protection (Slewing)	Cabinet +M22	Electrical diagram (+M22).	200A1	1
Speed protection (Luffing)	Cabinet +M22	Electrical diagram (+M22).	300A1	1
Speed protection (Whip hoist)	Cabinet +M22	Electrical diagram (+M22).	600A1	1

1. Check during running conditions the Electro Magnetic Interference (EMC).
 - Use the EMC-mode (press 2 seconds on the pushbutton on the DISPS), the display must show 0%. If not contact Huisman for further assistance.
2. Check if the speed is correct displaying by running the movement at several speeds and compare it with SCADA.
3. Check the function of the DISPS.
 - If a problem occurs investigate the cause and repair, replace or program the DISPS, contact Huisman for further assistance.

NOTE Every DISPS board has a different parameter setting and therefore they are not interchangeable.

Spare parts

P/N	Part	Symbol code (location)
2016888	DISPS	110A1 (M22)
2016888	DISPS	120A1 (M22)

P/N	Part	Symbol code (location)
2016888	DISPS	200A1 (M22)
2016888	DISPS	300A1 (M22)
2016888	DISPS	600A1 (M22)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.8 Check function of the hour counter (instrumentation component)

This task is applicable to Inspect the ancillaries.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier manual; Crompton (Hour meter).

Hour counter

Description	Location	Reference	Symbol code	Qty.
E-motor hour counter (HPU pump set 1)	Cabinet +H11	Electrical diagram (+H11).	710P2	1
E-motor hour counter (HPU cooling pump)	Cabinet +H11	Electrical diagram (+H11).	710P3	1
E-motor hour counter (HPU pump set 2)	Cabinet +H12	Electrical diagram (+H12).	720P2	1
E-motor hour counter (HPU cooling pump)	Cabinet +H12	Electrical diagram (+H12).	720P3	1
E-motor hour counter (Upper traction)	Cabinet +M22	Electrical diagram (+M22).	110P1	1
E-motor hour counter (Lower traction)	Cabinet +M22	Electrical diagram (+M22).	120P1	1
E-motor hour counter (Storage winch)	Cabinet +M22	Electrical diagram (+M22).	130P1	1
E-motor hour counter (Slewing)	Cabinet +M22	Electrical diagram (+M22).	200P1	1
E-motor hour counter (Boom hoist winch)	Cabinet +M22	Electrical diagram (+M22).	300P1	1
E-motor hour counter (Whip hoist winch)	Cabinet +M22	Electrical diagram (+M22).	600P1	1
E-motor hour counter (Tugger left)	Cabinet +M22	Electrical diagram (+M22).	800P1	1
E-motor hour counter (Tugger right)	Cabinet +M22	Electrical diagram (+M22).	800P2	1

1. Check the function of the hour counter
 - Make a record (interval) if the hour counter is working correctly.
 - If a problem occurs replace the hour counter.

Spare parts

P/N	Part	Symbol code (location)
On request	Hour counter	710P2 (+H11)
On request	Hour counter	710P3 (+H11)
On request	Hour counter	720P2 (+H12)
On request	Hour counter	720P3 (+H12)
On request	Hour counter	110P1 (+M22)
On request	Hour counter	120P1 (+M22)
On request	Hour counter	130P1 (+M22)
On request	Hour counter	200P1 (+M22)
On request	Hour counter	300P1 (+M22)
On request	Hour counter	600P1 (+M22)
On request	Hour counter	800P1 (+M22)
On request	Hour counter	800P2 (+M22)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.9 Check function of the brake rectifier (instrumentation component)

This task is applicable to Inspect the ancillaries.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation; Binder (33 43310A03).

Brake rectifier

Description	Location	Reference	Symbol code	Qty.
Brake rectifier (Upper traction, M1)	Cabinet +M22	Electrical diagram (+M22).	110A711	1
Brake rectifier (Upper traction, M2)	Cabinet +M22	Electrical diagram (+M22).	110A712	1
Brake rectifier (Upper traction, M3)	Cabinet +M22	Electrical diagram (+M22).	110A713	1
Brake rectifier (Lower traction, M1)	Cabinet +M22	Electrical diagram (+M22).	120A711	1
Brake rectifier (Lower traction, M2)	Cabinet +M22	Electrical diagram (+M22).	120A712	1
Brake rectifier (Lower traction), M3	Cabinet +M22	Electrical diagram (+M22).	120A713	1
Brake rectifier (Storage winch, M1)	Cabinet +M22	Electrical diagram (+M22).	130A711	1
Brake rectifier (Storage winch, M2)	Cabinet +M22	Electrical diagram (+M22).	130A712	1
Brake rectifier (Slewing, M1)	Cabinet +M22	Electrical diagram (+M22).	200A711	1
Brake rectifier (Slewing, M2)	Cabinet +M22	Electrical diagram (+M22).	200A712	1

Description	Location	Reference	Symbol code	Qty.
Brake rectifier (Slewing, M3)	Cabinet +M22	Electrical diagram (+M22).	200A713	1
Brake rectifier (Slewing, M4)	Cabinet +M22	Electrical diagram (+M22).	200A714	1
Brake rectifier (Boom hoist, M1)	Cabinet +M22	Electrical diagram (+M22).	300A711	1
Brake rectifier (Boom hoist, M2)	Cabinet +M22	Electrical diagram (+M22).	300A712	1
Brake rectifier (Whip hoist, M1)	Cabinet +M22	Electrical diagram (+M22).	600A711	1
Brake rectifier (Whip hoist, M2)	Cabinet +M22	Electrical diagram (+M22).	600A712	1
Brake rectifier (Tugger, left, M1)	Cabinet +M52	Electrical diagram (+M52).	800A711	1
Brake rectifier (Tugger, right, M2)	Cabinet +M52	Electrical diagram (+M52).	800A712	1

1. Perform a functional test, to check if the brake rectifier is powered, see "red" LED indicator.
2. Check the function of the brake rectifier.
 - If a problem occurs investigate the cause and repair/replace the brake rectifier.

Spare parts

P/N	Part	Symbol code (location)
20044322	Brake rectifier (Binder).	110A711 (+M22)
20044322	Brake rectifier (Binder).	110A712 (+M22)
20044322	Brake rectifier (Binder).	110A713 (+M22)
20044322	Brake rectifier (Binder).	120A711 (+M22)
20044322	Brake rectifier (Binder).	120A712 (+M22)
20044322	Brake rectifier (Binder).	120A713 (+M22)
20044322	Brake rectifier (Binder).	130A711 (+M22)
20044322	Brake rectifier (Binder).	130A712 (+M22)
20044322	Brake rectifier (Binder).	200A711 (+M22)
20044322	Brake rectifier (Binder).	200A712 (+M22)
20044322	Brake rectifier (Binder).	200A713 (+M22)
20044322	Brake rectifier (Binder).	200A714 (+M22)
20044322	Brake rectifier (Binder).	300A711 (+M22)
20044322	Brake rectifier (Binder).	300A712 (+M22)
20044322	Brake rectifier (Binder).	600A711 (+M22)
20044322	Brake rectifier (Binder).	600A712 (+M22)
20044322	Brake rectifier (Binder).	800A711 (+M52)
20044322	Brake rectifier (Binder).	800A712 (+M52)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.10 Check function of the relay for PTC-thermistor (instrumentation component)

Reference documents

- Supplier documentation: Schneider Electronics (PTC probe relay, LT3SA00M).
- [10013281A](#): Electrical diagram (E-plan).

Description	Location	Reference	Symbol code	Qty.
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	110F51	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	110F52	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	110F53	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	120F51	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	120F52	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	120F53	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	130F51	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	130F52	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	200F51	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	200F52	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	200F53	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	200F54	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	300F51	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	300F52	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	600F51	1
Relay for PTC-thermistor	Cabinet +M22	Electrical diagram (+M22).	600F52	1
Relay for PTC-thermistor	Cabinet +H11	Electrical diagram (+H11).	710F51	1
Relay for PTC-thermistor	Cabinet +H12	Electrical diagram (+H12).	720F51	1
Relay for PTC-thermistor	Cabinet +M52	Electrical diagram (+M52).	800F51	1
Relay for PTC-thermistor	Cabinet +M52	Electrical diagram (+M52).	800F52	1

1. Perform a functional test, by checking the LED's on the display (Fault Indication & voltage indication).
 - When the "fault" LED is activated, investigate the cause or replace the failed relay.
2. The relay have an automatic reset, when a failure occurs the relay will reset itself.
3. Check the mounting of the component on the mounting rail.
 - If loose or not properly connected, tighten the component on the mounting rail.

Spare parts

P/N	Part	Symbol code
2005315	Relay for PTC thermistor	110F51 (+M22)
2005315	Relay for PTC thermistor	110F52 (+M22)
2005315	Relay for PTC thermistor	110F53 (+M22)
2005315	Relay for PTC thermistor	120F51 (+M22)
2005315	Relay for PTC thermistor	120F52 (+M22)

P/N	Part	Symbol code
2005315	Relay for PTC thermistor	120F53 (+M22)
2005315	Relay for PTC thermistor	130F51 (+M22)
2005315	Relay for PTC thermistor	130F52 (+M22)
2005315	Relay for PTC thermistor	200F51 (+M22)
2005315	Relay for PTC thermistor	200F52 (+M22)
2005315	Relay for PTC thermistor	200F53 (+M22)
2005315	Relay for PTC thermistor	200F54 (+M22)
2005315	Relay for PTC thermistor	300F51 (+M22)
2005315	Relay for PTC thermistor	300F52 (+M22)
2005315	Relay for PTC thermistor	600F51 (+M22)
2005315	Relay for PTC thermistor	600F52 (+M22)
2005315	Relay for PTC thermistor	710F51 (+H11)
2005315	Relay for PTC thermistor	720F51 (+H12)
2005315	Relay for PTC thermistor	800F51 (+M52)
2005315	Relay for PTC thermistor	800F52 (+M52)

7.5.12.1.11 Check the transformer

This task is applicable to Inspect the transformers

Reference documents:

■ [10013281A](#): Electrical diagram (E-plan).

Transformer

Description	Location	Reference	Symbol code	Qty.
Transformer.	Winch room (M10)	Electrical diagram (+M10).	002T1	1
Transformer.	Cabinet +M22.	Electrical diagram (+M22).	002T2	1
Transformer.	Cabinet +M40.	Electrical diagram (+M40).	003T1	1
Transformer.	Cabinet +M52.	Electrical diagram (+M52).	003T1	1
Transformer.	Cabinet +M52.	Electrical diagram (+M52).	003T2	1
Transformer.	Cabinet +H11.	Electrical diagram (+H11).	710T2	1
Transformer.	Cabinet +H12.	Electrical diagram (+H12).	720T2	1

1. Clean the transformer.
 - Clean the transformer with a clean, soft and dry cloth.
1. Check the voltage.
 - Measure the in and out-put voltage of the transformer (See E-plan for correct voltage).
 - When measured voltage is incorrect replace the transformer.

Spare parts

P/N	Part	Symbol code (location)
2047041	Transformer.	002T1 (Winch room M10)
2044210	Transformer.	002T2 (+M22)
2023450	Transformer.	003T1 (+M40)
On request	Transformer.	003T1 (+M52)
On request	Transformer.	003T2 (+M52)
On request	Transformer.	710T2 (+H11)
On request	Transformer.	720T2 (+H12)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.12 Check function of the current and volt indicator (instrumentation component)

This task is applicable to Inspect the instrumentation.

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation, Faget
- Supplier documentation, Crompton
- Supplier documentation, Tyco electronics

Indicator (meter)

Description	Location	Reference	Symbol code	Qty.
Current indicator (analogue meter)	Cabinet +H11	Electrical diagram (+H11).	710P1	1
Current indicator (analogue meter)	Cabinet +H12	Electrical diagram (+H12).	720P1	1
Volt indicator (analogue meter)	Cabinet +M21.1	Electrical diagram (+M21.1).	001P3	1
Volt indicator (analogue meter)	Cabinet +M21.1	Electrical diagram (+M21.1).	001P4	1
Volt indicator (analogue meter)	Cabinet +M22	Electrical diagram (+M22).	002P440	1
Volt indicator (analogue meter)	Cabinet +M22	Electrical diagram (+M22).	003P230	1

1. Check the current / volt indicator

- If a problem is found (not working correctly), replace the indicator.
- Remove dust and check connections for tightness and corrosion.
- When repair or calibrating is necessary return the indicator to Huisman.
- When a new indicator is placed the main terminal screw should be tightened to 1,35 Nm only. When fitted the terminal covers are held in place by miniature self tapping

screws into plastic. These screws should be tightened by hand only, sufficiently to secure the terminal cover and prevent it vibrating.

- Check value with the SCADA system.

2. Placing the indicator in cabinet door.

- When a new indicator is placed the main terminal screw should be tightened to 1,35 Nm only. When fitted the terminal covers are held in place by miniature self tapping screws into plastic. These screws should be tightened by hand only, sufficiently to secure the terminal cover and prevent it vibrating.

Spare parts

P/N	Part	Symbol code (location)
2024709	Indicator, current meter (Crompton)	710P1 (+H11)
2024709	Indicator, current meter (Crompton)	720P1 (+H12)
On request	Indicator, volt meter (Faget)	001P3 (+M21.1)
On request	Indicator, volt meter (Faget)	001P4 (+M21.1)
2024585	Indicator, volt meter (Tyco)	002P440 (+M22)
2024585	Indicator, volt meter (Tyco)	003P230 (+M22)

NOTE For the exact parts number per cabinet consult the electrical diagram (E-plan)

7.5.12.1.13 Inspect cables and connections in E-cabinets

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).

Cables & connections

Description	Location	Reference	Symbol code	Qty.
Junction box storage winch OMC	Cabinet +B10	Electrical diagram (+B10).	-	1
Control cabinet, storage winch OMC	Cabinet +B20	Electrical diagram (+B20).	-	1
Emergency control box	Cabinet +E10	Electrical diagram (+E10).	-	1
Cabinet main pump 1 HPU	Cabinet +H11	Electrical diagram (+H11).	-	1
Cabinet main pump 1 HPU	Cabinet +H12	Electrical diagram (+H12).	-	1
Control cabinet HPU	Cabinet +H13	Electrical diagram (+H13).	-	1
Power junction box	Cabinet +J11	Electrical diagram (+J11).	-	1
Signal junction box 1	Cabinet +J12	Electrical diagram (+J12).	-	1
Heave cylinder cabinet	Cabinet +L11	Electrical diagram (+L11).	-	1
Drive cabinet, panel 1	Cabinet +M21.1	Electrical diagram (+M12.1)	-	1
Drive cabinet, panel 2	Cabinet +M21.2	Electrical diagram (+M12.2)	-	1
Drive cabinet, panel 3	Cabinet +M21.3	Electrical diagram (+M12.3)	-	1
Drive cabinet, panel 4	Cabinet +M21.4	Electrical diagram (+M12.4)	-	1
Drive cabinet, panel 5	Cabinet +M21.5	Electrical diagram (+M12.5)	-	1

Description	Location	Reference	Symbol code	Qty.
Drive cabinet, panel 6	Cabinet +M21.6	Electrical diagram (+M12.6)	-	1
Drive cabinet, panel 7	Cabinet +M21.7	Electrical diagram (+M12.7)	-	1
Drive cabinet, panel 8	Cabinet +M21.8	Electrical diagram (+M12.8)	-	1
Drive cabinet, panel 9	Cabinet +M21.9	Electrical diagram (+M12.9)	-	1
Electrical and power cabinet	Cabinet +M22	Electrical diagram (+M22).	-	1
Battery box	Cabinet +M23	Electrical diagram (+M23).	-	1
Junction box mast 1	Cabinet +M32	Electrical diagram (+M32).	-	1
Slipring	Cabinet +M40	Electrical diagram (+M40).	-	1
Drive cabinet, tuggers	Cabinet +M51	Electrical diagram (+M51).	-	1
Electrical and power cabinet	Cabinet +M52	Electrical diagram (+M52).	-	1
Cabin chair	Cabinet +M53	Electrical diagram (+M53).	-	1
Battery box	Cabinet +M54	Electrical diagram (+M54).	-	1
Pressure vessel unit cabinet 1	Cabinet +P01	Electrical diagram (+P01).	-	1
Pressure vessel unit cabinet 2	Cabinet +P02	Electrical diagram (+P02).	-	1
Motion reference unit junction box	Cabinet+P10	Electrical diagram (+P10).	-	1
Control desk	Cabinet +C14	Electrical diagram (+C14).	-	1

This task is applicable to inspect the cables (power, signal, fibre optic, Profibus and Ethernet) and their connection.

General

1. Inspect cables for cracks or other damage.
 - If damage is found, replace the cable.
2. Inspect tightness of cable ties.
 - If a cable is not properly tightened, replace the cables ties.
3. Inspect if the cable code tags are present.
 - If a cable code tags are not present or not correct tightened, replace the tag, according the electrical schematics (E-plan).
4. Check earth connection.
 - If a problem is found, investigate the cause and repair/replace the connection or cable.
5. Check cable connection, tighten connections and check sheaths for damage and/or corrosion. When a torque is specified, check the tightening torque.
6. If a connection is loose, tighten the loose connection.
7. If a cable sheaths is damaged or corroded, repair the cable sheaths or replace the cables
8. Inspect and clean the fibre optic cables connections, using an alcohol-free micro-fibre dry cloth with cleaning solution.

Special tools

P/N	Tool	Qty.
-	-	-

Spare parts

P/N	Part	Symbol code
On request	Cable ties	

7.5.12.2 Thermal imaging

7.5.12.2.1 Perform thermal imaging analysis for E-cabinet

Reference documents

■ [10013281A](#): Electrical diagram (E-plan).

Thermal imaging

Description	Location	Reference	Symbol code	Qty.
Junction box storage winch OMC	Cabinet +B10	Electrical diagram (+B10).	-	1
Control cabinet, storage winch OMC	Cabinet +B20	Electrical diagram (+B20).	-	1
Emergency control box	Cabinet +E10	Electrical diagram (+E10).	-	1
Cabinet main pump 1 HPU	Cabinet +H11	Electrical diagram (+H11).	-	1
Cabinet main pump 1 HPU	Cabinet +H12	Electrical diagram (+H12).	-	1
Control cabinet HPU	Cabinet +H13	Electrical diagram (+H13).	-	1
Power junction box	Cabinet +J11	Electrical diagram (+J11).	-	1
Signal junction box 1	Cabinet +J12	Electrical diagram (+J12).	-	1
Heave cylinder cabinet	Cabinet +L11	Electrical diagram (+L11).	-	1
Drive cabinet, panel 1	Cabinet +M21.1	Electrical diagram (+M21.1)	-	1
Drive cabinet, panel 2	Cabinet +M21.2	Electrical diagram (+M21.2)	-	1
Drive cabinet, panel 3	Cabinet +M21.3	Electrical diagram (+M21.3)	-	1
Drive cabinet, panel 4	Cabinet +M21.4	Electrical diagram (+M21.4)	-	1
Drive cabinet, panel 5	Cabinet +M21.5	Electrical diagram (+M21.5)	-	1
Drive cabinet, panel 6	Cabinet +M21.6	Electrical diagram (+M21.6)	-	1
Drive cabinet, panel 7	Cabinet +M21.7	Electrical diagram (+M21.7)	-	1
Drive cabinet, panel 8	Cabinet +M21.8	Electrical diagram (+M21.8)	-	1
Drive cabinet, panel 9	Cabinet +M21.9	Electrical diagram (+M21.9)	-	1
Electrical and power cabinet (POCA)	Cabinet +M22	Electrical diagram (+M22).	-	1
Battery box	Cabinet +M23	Electrical diagram (+M23).	-	1
Junction box mast 1	Cabinet +M32	Electrical diagram (+M32).	-	1
Slipring	Cabinet +M40	Electrical diagram (+M40).	-	1
Drive cabinet, tuggers	Cabinet +M51	Electrical diagram (+M51).	-	1

Description	Location	Reference	Symbol code	Qty.
Electrical and power cabinet (ELCA)	Cabinet +M52	Electrical diagram (+M52).	-	1
Cabin chair	Cabinet +M53	Electrical diagram (+M53).	-	1
Battery box	Cabinet +M54	Electrical diagram (+M54).	-	1
Pressure vessel unit cabinet 1	Cabinet +P01	Electrical diagram (+P01).	-	1
Pressure vessel unit cabinet 2	Cabinet +P02	Electrical diagram (+P02).	-	1
Motion reference unit junction box	Cabinet+P10	Electrical diagram (+P10).	-	1
Control desk	Cabinet +C14	Electrical diagram (+C14).	-	1

1. Inspect the E-cabinet and all components (inverters, fans, transformers, bus-bars) and cables and connectors by means of thermal imaging to monitor the condition of the E-cabinet. To perform the task, the system should be operated for at least one hour to acquire a proper image of the component condition.

NOTE Make sure the system is running while performing this task.

2. Analyse the thermal image.
 - If a problem is found, investigate the cause and repair/replace the failed component.

Huisman recommends these inspections to be executed by a third party that is specialized in Thermal Imaging inspections. If required, Huisman can provide this service.

Special tools

P/N	Tool	Qty.
On request	Thermal image camera	1

7.5.12.3 Inverter

7.5.12.3.1 Inspect the Drive control unit

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation; ABB (RDCU, Rev.C)
- Supplier documentation; ABB (Application Guide, Rev.C)
- Supplier documentation; ABB (Standard firmware, Rev.C)

Drive control units

Description	Location	Reference	Symbol code	Qty.
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	130A1	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	200A1	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	200A2	1

Description	Location	Reference	Symbol code	Qty.
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	300A1	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	300A2	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	600A1	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	600A2	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	110A1	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	110A2	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	110A3	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	120A1	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	120A2	1
Drive control unit	Cabinet +M21.9	Electrical diagram (+M12.9)	120A3	1
Drive control unit	Cabinet +M51	Electrical diagram (+M51)	801A1	1
Drive control unit	Cabinet +M51	Electrical diagram (+M51)	802A1	1

1. Check the function of the RDCU-12C.

- If a problem occurs, see LED "Red" indicator on panel, investigate the cause and repair/replace the failed component.

Special tools

P/N	Tool	Qty.
-	-	-

Spare parts

P/N	Part	Symbol code
2011302	Drive control unit RDCU-12C	130A1 (M21.9)
2011302	Drive control unit RDCU-12C	200A1 (M21.9)
2011302	Drive control unit RDCU-12C	200A2 (M21.9)
2011302	Drive control unit RDCU-12C	300A1 (M21.9)
2011302	Drive control unit RDCU-12C	300A2 (M21.9)
2011302	Drive control unit RDCU-12C	600A1 (M21.9)
2011302	Drive control unit RDCU-12C	600A2 (M21.9)
2011302	Drive control unit RDCU-12C	110A1 (M21.9)
2011302	Drive control unit RDCU-12C	110A2 (M21.9)
2011302	Drive control unit RDCU-12C	110A3 (M21.9)
2011302	Drive control unit RDCU-12C	120A1 (M21.9)
2011302	Drive control unit RDCU-12C	120A2 (M21.9)
2011302	Drive control unit RDCU-12C	120A3 (M21.9)
2011302	Drive control unit RDCU-12C	801A1 (M51)
2011302	Drive control unit RDCU-12C	802A1 (M51)

7.5.12.3.2 Inspect the control panel

Reference documents:

- [10013281A](#): Electrical diagram (E-plan).
- Supplier documentation; ABB (CDP-312R Control panel Mounting, Rev.A)
- Supplier documentation: ABB (CDP-312R Installation guide, control panel mounting platform kit, Rev. C)
- Supplier documentation; ABB (Application Guide, Rev.C)
- Supplier documentation; ABB (Standard firmware, Rev.C)

Control panel

Description	Location	Reference	Symbol code	Qty.
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	130A1	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	200A1	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	200A2	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	300A1	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	300A2	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	600A1	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	600A2	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	110A1	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	110A2	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	110A3	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	120A1	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	120A2	1
Control panel	Cabinet +M21.9	Electrical diagram (+M12.9)	120A3	1
Control panel	Cabinet +M51	Electrical diagram (+M51)	801A1	1
Control panel	Cabinet +M51	Electrical diagram (+M51)	802A1	1

1. Check the function of the control panel CDP-312R, according the parameters.
2. Clean the display, with a lint-free cloth (do not use water or a cleaning solvent).
3. Check the display for damages.
 - If the display is damaged or cracked, replace the display.
4. Check the cable connection (between the RDCU and CDP).
 - If cable (shielded flat-oval cable) not properly connected, investigate the cause and replace the cable, see also the ABB supplier manual "Installation Guide".
5. Check the cable connection (grounding wire).
 - If cable loose or not properly connected, investigate the cause and replace cable, see also the ABB supplier manual "Installation Guide".

Special tools

P/N	Tool	Qty.
-	-	-

Spare parts

P/N	Part	Symbol code
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	130A1 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	200A1 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	200A2 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	300A1 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	300A2 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	600A1 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	600A2 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	110A1 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	110A2 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	110A3 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	120A1 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	120A2 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	120A3 (M21.9)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	801A1 (M51)
2011305 2022113	Control panel CDP-312R Connection cable (Between RDCU<>CDP)	802A1 (M51)

7.5.12.3.3 Yearly maintenance inverter

WARNING  *Never work on the drive, the motor cable or the motor when main power is applied. After switching off the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, the motor or the motor cable. Measure the voltage between terminals UDC+ and UDC- (L+ and L-) with a multimeter (impedance at least 1 Mohm) to ensure that the drive is discharged before beginning work.*

WARNING  *Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1,4" inch)*

WARNING  *Before any work is carried out at the power section of the drive panel (such as replacing the unit) the several supplies to the applicable drive panel must be turned off and each individual DC bus must be completely discharged. Therefore wait at least 10 minutes after the main power is switched off before carrying out any work on the applicable part of the installation.*

WARNING  *Do not change the electrical installation of the drive except for the essential control and power connections. Changes may affect the safety performance or operation of the drive unexpectedly. All customers made changes are on the customers responsibility.*

WARNING  *The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily, see following symbol.*



WARNING  *Every drive module has been tested for insulation between the main circuit end the chassis (2.500 V rms 50 Hz for 1 second) at the factory. Therefore, do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or Megger) on any part of the drive,*

Reference documents

-  [10013281A](#): Electrical diagram (E-plan).
-  Electrical description
-  Supplier documentation; ABB (Capacitor reforming instruction, Rev.E)
-  Supplier documentation; ABB (Application Guide, Rev.C)
-  Supplier documentation; ABB (Standard firmware, Rev.L)
-  Supplier documentation; ABB (Firmware manual application program template, Rev.D)
-  Supplier documentation; ABB (ACS800, Safety instruction. Rev.B)

- Supplier documentation; ABB (ACS800 Application Guide, Rev.C)
- Supplier documentation; ABB (ACS800-104, Hardware manual, inverter manual, Rev.A)
- Supplier documentation; ABB (Profibus, RPBA01, Rev.F)
- Supplier documentation; ABB (ACS800, Pulse encoder interface module, RTAC-10, Rev.A)
- Supplier documentation; ABB (ACS800 Maintenance schedule, Rev.H)

Inverter

Description	Location	Reference	Symbol code	Qty.
Inverter	Cabinet +M21.2	Electrical diagram (+M12.2)	130A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A2	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A1	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A2	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A1	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A2	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A1	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A2	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	110A3	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	120A1	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A2	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A3	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	801A1	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	802A1	1

Execute the following tasks according the ABB-manual.

1. Inspect the internal and external cooling fans.
2. Replace air filter.
3. Check for dust and corrosion.

WARNING



By cleaning inside the inverter, there can occur an electrostatic discharge.

4. Check room temperature.
5. Check quality of supply voltage.
 - The voltage quality is monitored via SCADA (via ABB actual signals 01), see ABB standard firmware manual.
6. Check ABB form product improvements.

7. Measure supply voltage.
 - The voltage supply is monitored via SCADA (via ABB actual signals 01), see ABB standard firmware manual.
8. Check spare parts stock.
 - It's advisable that the recommended (ABB recommendation) spare parts are ordered when they are needed to be replaced (for preventive maintenance) see yearly maintenance corrections.

Recommended spare parts

P/N	Part	Symbol code
On request	ABB airfilter	-
On request	ABB, internal cooling fan	-
On request	ABB, TSU cooling fan	-
On request	ABB, enclosure extension	-
On request	ABB, Electrolytic capacitors in DC circuit	-
On request	ABB, AINT+ flat cable	-
On request	ABB, CINT (unit)	-
On request	ABB, NRED	-
On request	ABB, Discharging resistors	-
On request	ABB, Electrolytic capacitors in DC circuit	-

9. Check DC circuit capacitors.

WARNING



After maintaining or modifying a drive safety circuit or changing circuit boards inside the module, retest the functioning of the safety circuit according to the start-up instruction, see ABB manual.

- Check the capacitors according the ABB manual "Capacitor reforming guide" (ABB code 64059629).

10. Check heatsink temperature and clean the heatsink.

NOTE

The heatsink remain hot for a while after disconnection of the electrical supply.

- Blow dry clean compressed air from bottom to top and use a vacuum cleaner at the air outlet to trap the dust. Prevent the dust from entering the adjoining equipment.

11. Inspect the tightness of the terminals.

- Inspect the connection bolts of the terminals. When loose tighten the bolts.

Special tools

P/N	Tool	Qty.
-		-

Spare parts

P/N	Part	Symbol code
On request	ABB airfilter	-

7.5.12.3.4 3 years maintenance

WARNING  Never work on the drive, the motor cable or the motor when main power is applied. After switching off the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, the motor or the motor cable. Measure the voltage between terminals |UDC+ and UDC- (L+ and L-) with a multimeter (impedance at least 1 Mohm) to ensure that the drive is discharged before beginning work.

WARNING  Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1,4" inch)

WARNING  Before any work is carried out at the power section of the drive panel (such as replacing the unit) the several supplies to the applicable drive panel must be turned off and each individual DC bus must be completely discharged. Therefore wait at least 10 minutes after the main power is switched off before carrying out any work on the applicable part of the installation.

WARNING  Do not change the electrical installation of the drive except for the essential control and power connections. Changes may affect the safety performance or operation of the drive unexpectedly. All customers made changes are on the customers responsibility.

WARNING  The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily, see following symbol.



WARNING  Every drive module has been tested for insulation between the main circuit end the chassis (2.500 V rms 50 Hz for 1 second) at the factory. Therefore, do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or Megger) on any part of the drive,

Reference documents

-  [10013281A](#): Electrical diagram (E-plan).

- Electrical description
- Supplier documentation; ABB (Capacitor reforming instruction, Rev.E)
- Supplier documentation; ABB (Application Guide, Rev.C)
- Supplier documentation; ABB (Standard firmware, Rev.L)
- Supplier documentation; ABB (Firmware manual application program template, Rev.D)
- Supplier documentation; ABB (ACS800, Safety instruction. Rev.B)
- Supplier documentation; ABB (ACS800 Application Guide, Rev.C)
- Supplier documentation; ABB (ACS800-104, Hardware manual, inverter manual, Rev.A)
- Supplier documentation; ABB (Profibus, RPBA01, Rev.F)
- Supplier documentation; ABB (ACS800, Pulse encoder interface module, RTAC-10, Rev.A)
- Supplier documentation; ABB (ACS800 Maintenance schedule, Rev.H)

Cabinets (Drive cabinet +M21)

Description	Location	Reference	Symbol code	Qty.
Inverter	Cabinet +M21.2	Electrical diagram (+M12.2)	130A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A2	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A1	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A2	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A1	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A2	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A1	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A2	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	110A3	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	120A1	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A2	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A3	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	801A1	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	802A1	1

Execute the following tasks according the ABB-manual.

NOTE Cooling fans may continue to rotate for a while after the disconnection of the electrical supply.

1. Replace the internal cooling fans (kit).
 - Replace cooling fan, according the ABB manual.
2. Replace the cooling fan for the TSU.
 - Replace cooling fan, according the manual.
3. Replace the enclosure extension for the cooling fan.

4. Inspect the voltage supply by basic measurement.
 - Consult the ABB manual for the correct voltage supply.
5. Inspect and clean the power connectors (copper cables).

NOTE See the ABB hardware manual to perform the above given tasks.

Special tools

P/N	Tool	Qty.
-		-

Spares

P/N	Part	Symbol code
On request	ABB, internal cooling fan	-
On request	ABB, TSU cooling fan	-
On request	ABB, enclosure extension	-

7.5.12.3.5 6 years maintenance

WARNING  *Never work on the drive, the motor cable or the motor when main power is applied. After switching off the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, the motor or the motor cable. Measure the voltage between terminals |UDC+ and UDC- (L+ and L-) with a multimeter (impedance at least 1 Mohm) to ensure that the drive is discharged before beginning work.*

WARNING  *Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1,4" inch)*

WARNING  *Before any work is carried out at the power section of the drive panel (such as replacing the unit) the several supplies to the applicable drive panel must be turned off and each individual DC bus must be completely discharged. Therefore wait at least 10 minutes after the main power is switched off before carrying out any work on the applicable part of the installation.*

WARNING  *Do not change the electrical installation of the drive except for the essential control and power connections. Changes may affect the safety performance or operation of the drive unexpectedly. All customers made changes are on the customers responsibility.*

WARNING  *The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily, see following symbol.*



WARNING  *Every drive module has been tested for insulation between the main circuit end the chassis (2.500 V rms 50 Hz for 1 second) at the factory. Therefore, do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or Megger) on any part of the drive,*

Reference documents

-  [10013281A](#): Electrical diagram (E-plan).
-  Electrical description
-  Supplier documentation; ABB (Capacitor reforming instruction, Rev.E)
-  Supplier documentation; ABB (Application Guide, Rev.C)
-  Supplier documentation; ABB (Standard firmware, Rev.L)
-  Supplier documentation; ABB (Firmware manual application program template, Rev.D)
-  Supplier documentation; ABB (ACS800, Safety instruction. Rev.B)

- Supplier documentation; ABB (ACS800 Application Guide, Rev.C)
- Supplier documentation; ABB (ACS800-104, Hardware manual, inverter manual, Rev.A)
- Supplier documentation; ABB (Profibus, RPBA01, Rev.F)
- Supplier documentation; ABB (ACS800, Pulse encoder interface module, RTAC-10, Rev.A)
- Supplier documentation; ABB (ACS800 Maintenance schedule, Rev.H)

Cabinets (Drive cabinet +M21)

Description	Location	Reference	Symbol code	Qty.
Inverter	Cabinet +M21.2	Electrical diagram (+M12.2)	130A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A2	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A1	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A2	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A1	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A2	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A1	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A2	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	110A3	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	120A1	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A2	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A3	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	801A1	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	802A1	1

Execute the following tasks according the ABB-manual.

1. Check the tightness of the terminals.
 - Inspect the connection bolts of the terminals. When loose tighten the bolts.

7.5.12.3.6 9 years maintenance

WARNING  *Never work on the drive, the motor cable or the motor when main power is applied. After switching off the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, the motor or the motor cable. Measure the voltage between terminals |UDC+ and UDC- (L+ and L-) with a multimeter (impedance at least 1 Mohm) to ensure that the drive is discharged before beginning work.*

WARNING  *Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1,4" inch)*

WARNING  *Before any work is carried out at the power section of the drive panel (such as replacing the unit) the several supplies to the applicable drive panel must be turned off and each individual DC bus must be completely discharged. Therefore wait at least 10 minutes after the main power is switched off before carrying out any work on the applicable part of the installation.*

WARNING  *Do not change the electrical installation of the drive except for the essential control and power connections. Changes may affect the safety performance or operation of the drive unexpectedly. All customers made changes are on the customers responsibility.*

WARNING  *The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily, see following symbol.*



WARNING  *Every drive module has been tested for insulation between the main circuit end the chassis (2.500 V rms 50 Hz for 1 second) at the factory. Therefore, do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or Megger) on any part of the drive.*

Reference documents

-  [10013281A](#): Electrical diagram (E-plan).
-  Electrical description
-  Supplier documentation; ABB (Capacitor reforming instruction, Rev.E)
-  Supplier documentation; ABB (Application Guide, Rev.C)
-  Supplier documentation; ABB (Standard firmware, Rev.L)
-  Supplier documentation; ABB (Firmware manual application program template, Rev.D)
-  Supplier documentation; ABB (ACS800, Safety instruction. Rev.B)

- Supplier documentation; ABB (ACS800 Application Guide, Rev.C)
- Supplier documentation; ABB (ACS800-104, Hardware manual, inverter manual, Rev.A)
- Supplier documentation; ABB (Profibus, RPBA01, Rev.F)
- Supplier documentation; ABB (ACS800, Pulse encoder interface module, RTAC-10, Rev.A)
- Supplier documentation; ABB (ACS800 Maintenance schedule, Rev.H)

Cabinets (Drive cabinet)

Description	Location	Reference	Symbol code	Qty.
Inverter	Cabinet +M21.2	Electrical diagram (+M12.2)	130A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A1	1
Inverter	Cabinet +M21.3	Electrical diagram (+M12.3)	200A2	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A1	1
Inverter	Cabinet +M21.4	Electrical diagram (+M12.4)	300A2	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A1	1
Inverter	Cabinet +M21.5	Electrical diagram (+M12.5)	600A2	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A1	1
Inverter	Cabinet +M21.6	Electrical diagram (+M12.6)	110A2	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	110A3	1
Inverter	Cabinet +M21.7	Electrical diagram (+M12.7)	120A1	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A2	1
Inverter	Cabinet +M21.8	Electrical diagram (+M12.8)	120A3	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	801A1	1
Inverter	Cabinet +M51	Electrical diagram (+M51)	802A1	1

Execute the following tasks according the ABB manual.

1. Replace the electrolytic capacitors in DC circuit
2. Replace the AINT+ flat cables, CINT, NRED and the discharging resistors.

Spares

P/N	Part	Symbol code
On request	ABB, Electrolytic capacitors in DC circuit	-
On request	ABB, AINT+ flat cable	-
On request	ABB, CINT (unit)	-
On request	ABB, NRED	-
On request	ABB, Discharging resistors	-
On request	ABB, Electrolytic capacitors in DC circuit	-

7.5.12.4 Uninterrupted Power Supply (UPS)

7.5.12.4.1 Inspect and clean the UPS battery

WARNING



Do not open the batteries.

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Supplier documentation; Mastervolt (Gel battery)

Supplier documentation; Mastervolt (Cycle life time of discharge)

Supplier documentation; Mastervolt (Cycle life time versus temperature)

Battery

Description	Location	Reference	Symbol code	Qty.
Battery 1	Crane E-room (Cabinet +M23)	Electrical diagram (+M23)	006E1	1
Battery 2	Crane E-room (Cabinet +M23)	Electrical diagram (+M23)	006E2	1
Battery 1	Crane E-room (Cabinet +M54)	Electrical diagram (+M54)	006E1	1
Battery 2	Crane E-room (Cabinet +M54)	Electrical diagram (+M54)	006E2	1

NOTE Check batteries and connections on a regular base, at least every three months. Defect such as loose or corroded connections must be corrected immediately.

1. Check the connections.
 - When loose, tighten the connections to the batteries.
 - When the connections are corroded, clean directly the connections with sandpaper or replace the cables & connections. Use properly sized and reliable cable lugs and battery terminals.
 - Clear the terminals before connection.
 - Use properly sized and reliable cable lugs and battery terminals.
2. Clean the batteries with a clean, soft and dry cloth.

Spares

P/N	Part	Symbol code
-?	Battery charger (Mastervolt, MVG 12/55)	006E1 & 006E2

7.5.12.4.2 Replace the UPS battery

WARNING



Do not open the batteries.

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Supplier documentation; Mastervolt (Gel battery)

Supplier documentation; Mastervolt (Cycle life time of discharge)

Supplier documentation; Mastervolt (Cycle life time versus temperature)

Battery

Description	Location	Reference	Symbol code	Qty.
Battery 1	Crane E-room (Cabinet +M23)	Electrical diagram (+M23)	006E1	1
Battery 2	Crane E-room (Cabinet +M23)	Electrical diagram (+M23)	006E2	1
Battery 1	Crane E-room (Cabinet +M54)	Electrical diagram (+M54)	006E1	1
Battery 2	Crane E-room (Cabinet +M54)	Electrical diagram (+M54)	006E2	1

1. Replace the batteries.

Spares

P/N	Part	Symbol code
-?	Battery charger (Mastervolt, MVG 12/55)	006E1 & 006E2

7.5.12.4.3 Inspect and clean the UPS battery charger.

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Supplier documentation; Mastervolt (MASS charger)

UPS battery charger

Description	Location	Reference	Symbol code	Qty.
UPS system battery charger	Cabinet +M22	Electrical diagram (+M22)	007U3	1
UPS system, battery charger	Cabinet +M52	Electrical diagram (+M52)	007U3	1

1. Clean the exterior of the battery charger, using a dry and clean cloth.
2. Clean the battery charger cooling fan filters.
3. Check the LEDs situated on the front panel, if there are fault conditions, see Mastervolt manual to solve the problem.
4. Check the status of the battery charger via SCADA.

Spares

P/N	Part	Symbol code
2004194	Battery charger (Mastervolt, Mass-24/50-2)	007U3

7.5.12.4.4 Inspect and clean the UPS sinewave inverter

Reference documents

[10013281A](#): Electrical diagram (E-plan).
Supplier documentation; Mastervolt (inverter)

UPS battery charger

Description	Location	Reference	Symbol code	Qty.
UPS sine wave inverter	Cabinet +M52	Electrical diagram (+M52)	022A1	1

1. Clean the exterior of the sinewave inverter, using a dry and clean cloth.

Spares

P/N	Part	Symbol code
2018444	Sine wave inverter	022A1

7.5.12.5 SCADA

7.5.12.5.1 Inspect and clean the PLC

Reference documents

[10013281A](#): Electrical diagram (E-plan).

PLC

Description	Location	Reference	Symbol code	Qty.
PLC (OMC)	Cabinet +M22	Electrical diagram (+M22)	040A1	1

Description	Location	Reference	Symbol code	Qty.
PLC (Heave)	Cabinet +M22	Electrical diagram (+M22)	040A2	1

1. Clean the exterior of the CPU/PLC, using a dry, lint-free and clean cloth. Do not use water or solvent.
2. Check the LEDs situated on the front, when there are fault conditions, see Siemens manual to solve the problem.

WARNING


When cleaning the device, make sure that no dirt enters the optical transmission path or gets onto the optical components. This means either that the fibre optic cables remain connected or fit protective caps.

7.5.12.6 PC SYSTEM

7.5.12.6.1 Clean and check function of the computer

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Supplier documentation; Siemens (IPC627C, operation instruction)

Supplier documentation; Siemens (IPC627C, guide manual)

Supplier documentation; Siemens (X308-2 IE Ethernet switch)

Supplier documentation; Newstar (FPMA-D910)

Supplier documentation; HPC Industries (DT190)

Supplier documentation; Cherry (G84-4100)

Computer

Description	Location	Reference	Symbol code	Qty.
Computer	Cabinet +C14	Electrical diagram (+C14)	044PC1	1
Computer	Cabinet +M52	Electrical diagram (+M52)	044PC1	1
Computer	Cabinet +M52	Electrical diagram (+M52)	044PC2	1

1. Clean the exterior of the PC, using a dry, lint-free and clean cloth. Do not use water or solvent.
2. Inspect the PC cooling fan.
 - If a problem is found, investigate the cause or replace the cooling fan.
3. Clean the keyboard using a vacuum cleaner.
4. Clean the exterior of the monitor, using a dry cloth and a non-aggressive cleaning fluid.

5. Check the mounting of the monitor arm-rest.
 - Check the desk clamp setting, if loose fasten the screws.
 - Check the cable routing.
 - Check the monitor setting of the monitor, by adjusting the torque (nylon nut).

Spares

P/N	Part	Symbol code
On request	SCADA Monitor (DT190)	044MON1 044MON2
2042517	SCADA PC (Siemens, SIMATIC, IPC627C)	044PC1 and 044PC2
On request	Mouse	044PC1-mouse
On request	Keyboard (Cherry, G84-4100)	044PC1-key

7.5.12.6.2 Replace the backup battery of the computer

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Siemens manual

Computer

Description	Location	Reference	Symbol code	Qty.
Computer	Cabinet +C14	Electrical diagram (+C14)	044PC1	1
Computer	Cabinet +M52	Electrical diagram (+M52)	044PC1	1
Computer	Cabinet +M52	Electrical diagram (+M52)	044PC2	1

1. Replace the battery according the Siemens manual, Simantic Box PC 627C.

7.5.12.7 Cabin chair

7.5.12.7.1 Inspect and clean the cabin chair and consoles

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Cabin chair

Description	Location	Reference	Symbol code	Qty.
Cabin chair		Electrical diagram (+M53)	M53	1
Console left hand		Electrical diagram (+M53.1)	M53.1	1

Description	Location	Reference	Symbol code	Qty.
Console right hand		Electrical diagram (+M53.1)	M53.2	1

1. Check the emergency stop switch functionality.
2. Check the push button for damage, button looseness and excessive environmental contamination.
 - If damage is found, replace the damaged component.
 - If components are loose, tighten the loose components.
 - If dirt is found at the push button, clean the push button.
3. Check the switch and lamp functionality.
 - Replace the switches or lamps when they are not working correctly
4. Clean the console and seat.
 - Remove dirt by using a clean cloth.

Spare parts (Right hand console)

P/N	Part	Symbol code
2007882	Signal light white	013SH1
2007881	Pushbutton assembly	013SH1
2007882	Signal light white	021SH1
2007881	Pushbutton assembly	021SH1
2007874	Keyswitch	085S3
2001583	Key switch assembly	085S3
On request	Switch assembly	085SH8
On request	Light LED	085SH8
2013243	Fastening clamp	085SH8
2013242	sub assembly	085SH8
On request	Switch assembly	085SH7
On request	Light LED	085SH7
2013243	Fastening clamp	085SH7
2013242	sub assembly	085SH7
2006950	Light sub assembly	085H4
2014706	Light LED assembly	085H4
2027062	Wiper control	019E1 and 019E2

Spare parts (Left hand console)

P/N	Part	Symbol code
2001638	Emergency push button sub-assembly	061S10
2013243	Fastening clamp	061S10
2011985	Contact sub-assembly	061S10
2007885	Mushroom protection guard	061S10

P/N	Part	Symbol code
2001638	Emergency push button sub-assembly	062S1
2013243	Fastening clamp	062S1
2011985	Contact sub-assembly	062S1
2007885	Mushroom protection guard	062S1
2014719	Head for momentary illuminated push button	061SH2
2014714	Assembly	061SH2
2014382	Lighted push button assembly	085SH1
2014381	Push button lighted	085SH1
2001584	Push button sub assembly	085S2
2013243	Fastening clamp	085S2
2013242	Contact sub assembly	085S2
2014382	Lighted push button sub-assembly	800SH1
2013243	Fastening clamp	800SH1
2013242	Contact sub-assembly	800SH1
On request	Light LED, White	800SH1
2014382	Lighted push button sub-assembly	800SH2
2013243	Fastening clamp	800SH2
2013242	Contact sub-assembly	800SH2
On request	Light LED, White	800SH2
2007882	Signal light, White	950SH4
2007881	Light assembly	950SH4
2014382	Light push button assembly	953SH1
2014381	Assembly	953SH1
2014382	Light push button assembly	954SH1
2014381	Assembly	954SH1
2012583	Key switch	950S1
2001583	Push button assembly	950S1

7.5.12.8 Walk Around Box

7.5.12.8.1 Inspect and clean the WAB (transmitter)

Reference documents

[10013281A](#): Electrical diagram (E-plan).

Supplier documentation: Spohn Burkhardt T022

Walk Around Box

Description	Location	Reference	Symbol code	Qty.
Walk around box		Electrical diagram (+E10)	+E10	1
Walk around box		Electrical diagram (+E10)	+E10	1

1. Perform a lamp test.
 - Replace the lamps inside the illuminated pushbuttons when lamps is not functioning.
2. Check the emergency stop switch functionality each time before starting work.
3. Check the rubbers bellows or rubber seals of the operating element on a regular time.
 - Replace the rubber seals when cracks appear.
4. Clean the Walk Around Box.
 - Remove dirt and grease by using a clean cloth...

WARNING



Never operate a machine with a faulty or defective walk around box.

Spare parts

P/N	Part	Symbol code
2010424	Walk around box	
2023974	Controller ST0	R1
2001638 2015297	Emergency push button, sub assembly	006S1
2014581	Emergency push button, label	006S1
2007885	Mushroom protection guard	006S1
2014382	Lighted push button	SH1
2014381	Push button led assembly	SH1
On request	Push button	SH2
2001583	Push button	SH2
On request	Sealing	-

7.5.12.9 Encoder (Instrumentation)

7.5.12.9.1 Check mounting of E-motor encoder

Reference documents:

- Supplier documentation: Hubner (Pog10)
- [10013281A](#): Electrical diagram (E-plan).

Description	Location	Reference	Symbol code	Qty.
E-motor encoder (Upper traction winch1)	Winch room (M10)	Electrical diagram (+M10).	110M1-B61	1
E-motor encoder (Upper traction winch2)	Winch room (M10)	Electrical diagram (+M10).	110M2-B61	1
E-motor encoder (Upper traction winch3)	Winch room (M10)	Electrical diagram (+M10).	110M3-B61	1

Description	Location	Reference	Symbol code	Qty.
E-motor encoder (Lower traction winch1)	Winch room (M10)	Electrical diagram (+M10).	120M1-B61	1
E-motor encoder (Lower traction winch2)	Winch room (M10)	Electrical diagram (+M10).	120M2-B61	1
E-motor encoder (Lower traction winch3)	Winch room (M10)	Electrical diagram (+M10).	120M3-B61	1
E-motor encoder (Storage winch OMC)	General storage (B00)	Electrical diagram (+B00).	130M1-B61	1
E-motor encoder (Slewing 1 & 2)	Winch room (M10)	Electrical diagram (+M10).	200M1-B61	
E-motor encoder (Slewing 3& 4)	Winch room (M10)	Electrical diagram (+M10).	200M3-B61	
E-motor encoder (Boom hoist winch 1)	Winch room (M10)	Electrical diagram (+M10).	300M1-B61	
E-motor encoder (Boom hoist winch 2)	Winch room (M10)	Electrical diagram (+M10).	300M2-B61	
E-motor encoder (Whip hoist winch 1)	Winch room (M10)	Electrical diagram (+M10).	600M1-B61	
E-motor encoder (Whip hoist winch 2)	Winch room (M10)	Electrical diagram (+M10).	600M2-B61	
E-motor encoder (Tugger winch 1)	Winch room (M10)	Electrical diagram (+M10).	800M1-B61	
E-motor encoder (Tugger winch 2)	Winch room (M10)	Electrical diagram (+M10).	800M2-B61	

1. Inspect cable for cracks or other damage. Check cable sheaths (and cable shield) for damage and/or corrosion.
 - If damage is found, replace the cable.
 - If a cable sheath is damaged or corroded, repair the cable sheath.
2. Check mounting of the E-motor encoder.
 - Check the mounting of the encoder, if loose tighten the bolts.
3. Check the spring disk coupling (between motor drive shaft and encoder)
 - If spring disk coupling is loose, tighten the hex bolts (2,5mm) with a maximum tightening torque of 2-3 Nm (see installation and operating instructions)

NOTE *Coupling components must not be driven onto shaft with improper force (e.g. hammer impacts) because of the risk of damaging the ball bearing.*

NOTE *The encoder must be mounted on the drive shaft with the least possible angular error and parallel misalignment.*

4. Inspect if the cable code tags are present.
 - If a cable code tags are not present or not correctly tightened, replace the tag,

- according the electrical schematics (E-plan).
 - if not correct tightened, replace the tag, according the electrical schematics (E-plan).
5. Check connections, tighten connections and check cable sheaths (and cable shield) for damage and/or corrosion. When a tightening torque is specified, check the tightening torque. See supplier specification.
- If a connection is loose, tighten the loose components.
 - If a cable sheath is damaged or corroded, repair the cable sheath or replace cable.
6. Check for water ingress in the terminal box.
- If the encoder suffers from water ingress, replace the encoder.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	E-motor encoder	110M1-B61
On request	E-motor encoder	110M2-B61
On request	E-motor encoder	110M3-B61
On request	E-motor encoder	120M1-B61
On request	E-motor encoder	120M2-B61
On request	E-motor encoder	120M3-B61
On request	E-motor encoder	130M1-B61
On request	E-motor encoder	200M1-B61
On request	E-motor encoder	200M3-B61
On request	E-motor encoder	300M1-B61
On request	E-motor encoder	300M2-B61
On request	E-motor encoder	600M1-B61
On request	E-motor encoder	600M2-B61
On request	E-motor encoder	800M1-B61
On request	E-motor encoder	800M2-B61

7.5.12.10 Inclinometer (Instrumentation)

7.5.12.10.1 Check the inclinometer

Reference documents:

- Supplier documentation: Seika SB1I
- Supplier documentation: Seika SB2I
- [10013281A](#): Electrical diagram (E-plan).

Description	Location	Reference	Symbol code	Qty.
Inclinometer (Boom angle sensor)		See electrical diagram.	200B71	1
Inclinometer (Sidelead & Offlead-sensor)	Jib (J00)	Electrical diagram (+J00).	300B72	1

1. Check if the meter cable is connected in the I/O module and working properly.
2. Measure the analog output of the meter, the electrical current must be between the range of 4...20 mA.
 - If the electrical current is beyond the range of 4...20 mA investigate the cause.
3. Check for water ingress in the meter.
 - If the meter suffers from water ingress, replace the encoder.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
On request	Inclinometer	200B71
On request	Inclinometer	300B72

7.5.12.11 Gear cam limit switch (Instrumentation)

This section describes all maintenance tasks for the gear cam limit switch of the 400mT crane.

7.5.12.11.1 Grease follow gear of gear cam limit switch

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41800-21-0308](#): Whip hoist winch
- [A11-41800-21-0408](#): Tugger winch drum
- [A11-41800-45-0108](#): Slew drive sensor foundation

[A11-41830-21-0308](#): Slewing bearing, chain- & main shaft

Description	Location	Reference	Symbol code	Qty.
Gear cam limit switch	Boom hoist	A11-41800-21-0208	900	1
Gear cam limit switch	Whip hoist	A11-41800-21-0308	900	1
Gear cam limit switch	Tugger winch	A11-41800-21-0408	900	1
Gear cam limit switch	Slew drive right	A11-41800-45-0108	900	1
Gear cam limit switch	Slew drive left	A11-41800-45-0108	902	1
Gear cam limit switch	Storage winch	A11-41830-21-0308	901	1

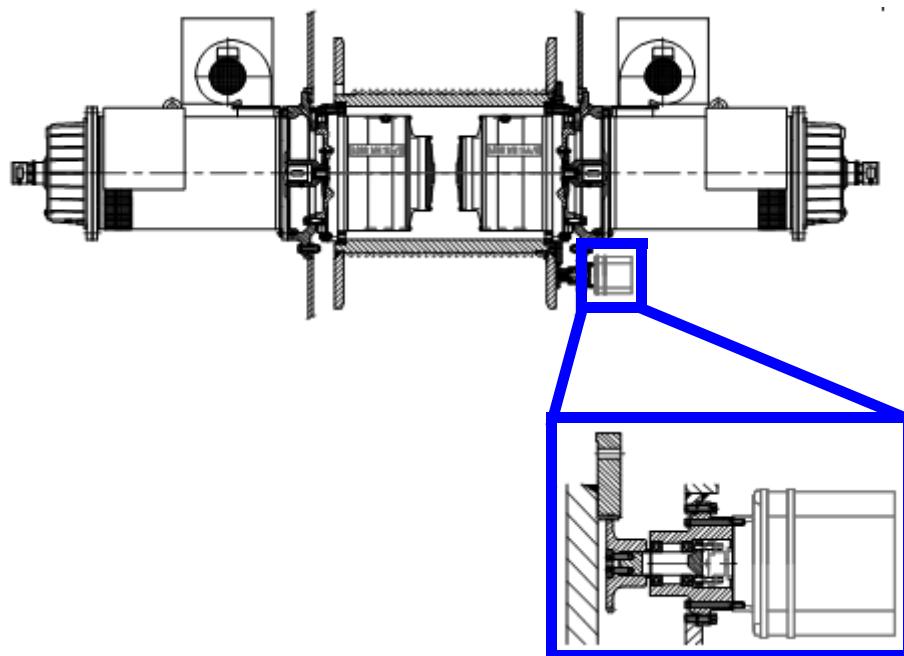


Figure 7-115: Boom hoist gear cam limit switch

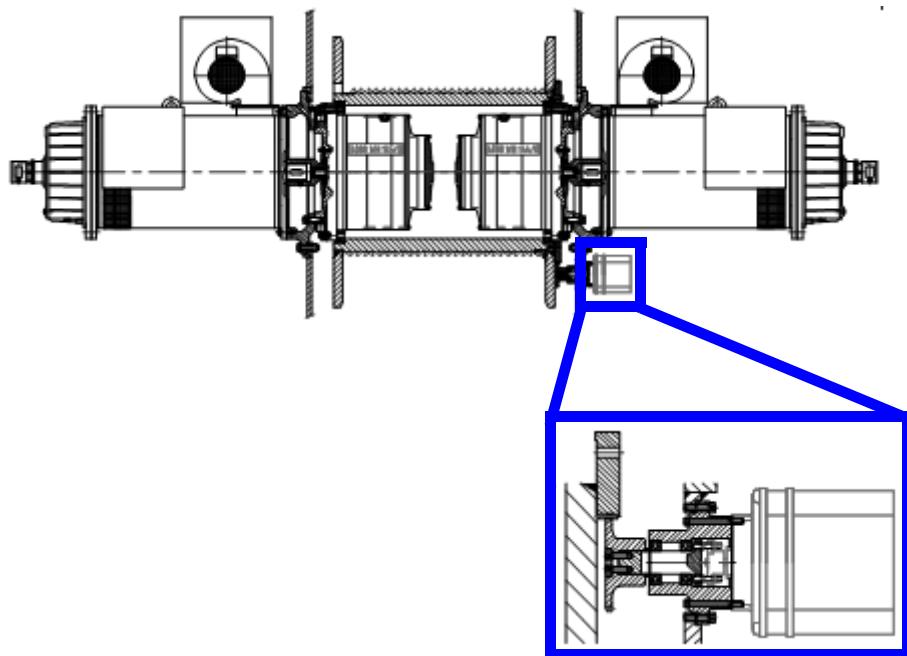


Figure 7-116: Whip hoist gear cam limit switch

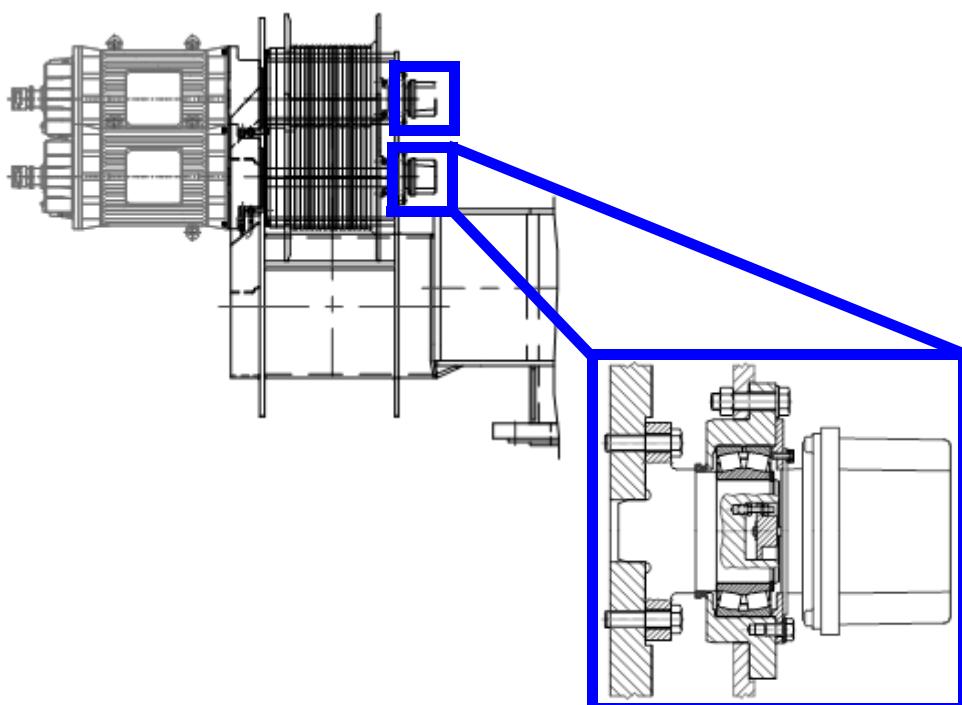


Figure 7-117: Tuggers gear cam limit switch

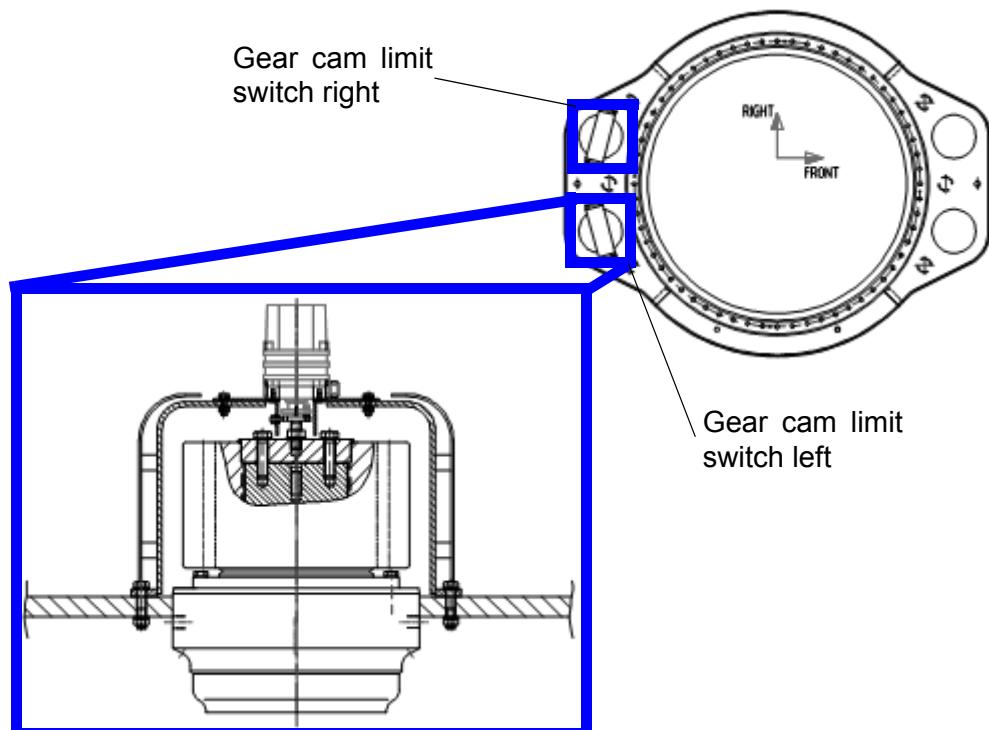


Figure 7-118: Slew system gear cam limit switch

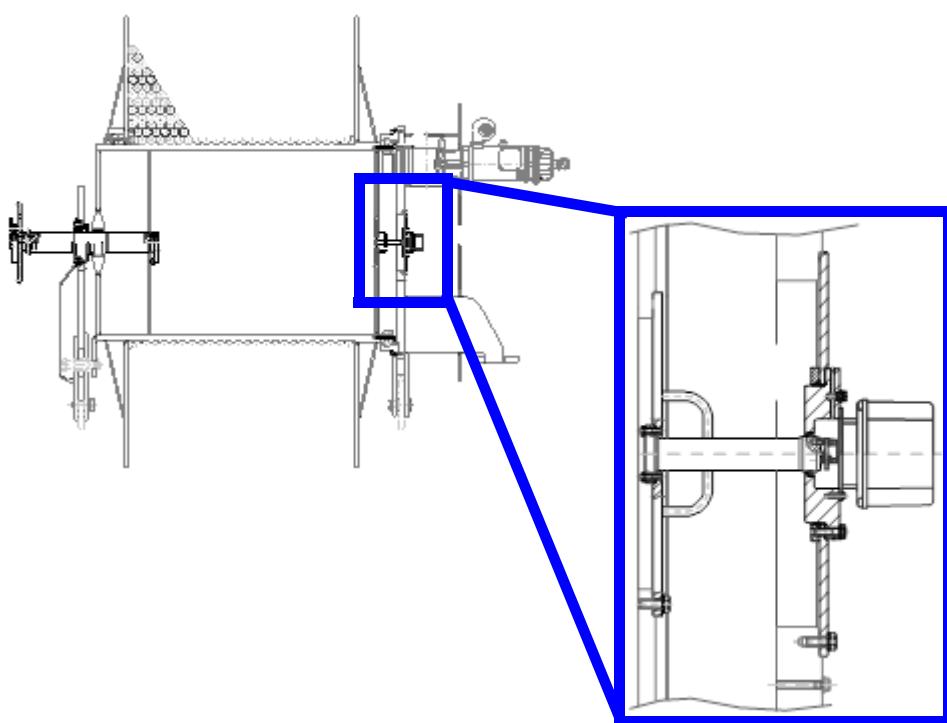


Figure 7-119: Storage winch gear cam limit switch

1. Grease the follow gear of the gear cam limit switch.

For more information, see the supplier documentation.

7.5.12.11.2 Inspect and clean gear cam limit switch

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41800-21-0308](#): Whip hoist winch
- [A11-41800-21-0408](#): Tugger winch drum
- [A11-41800-45-0108](#): Slew drive sensor foundation
- [A11-41830-21-0308](#): Slewing bearing, chain- & main shaft

Description	Location	Reference	Symbol code	Qty.
Gear cam limit switch	Boom hoist	A11-41800-21-0208	900	1
Gear cam limit switch	Whip hoist	A11-41800-21-0308	900	1
Gear cam limit switch	Tugger winch	A11-41800-21-0408	900	1
Gear cam limit switch	Slew drive right	A11-41800-45-0108	900	1
Gear cam limit switch	Slew drive left	A11-41800-45-0108	902	1
Gear cam limit switch	Storage winch	A11-41830-21-0308	901	1

1. Clean gear cam limit switch exterior using a cloth.

NOTE *Do not remove dust deposits on the limit switches by means of compressed air. The dust would penetrate into the contacts and would affect the switching capacity.*

2. Check mounting of gear cam limit switch and incremental encoder.
 - If components are loose, tighten the loose components.
3. Check for damage and corrosion.
 - If significant damage and/or corrosion is found, replace damaged and/or corroded component(s).

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2021845	Gear cam limit switch	A11-41800-21-020 / 900 A11-41800-21-030 / 900
2005350	Gear cam limit switch	A11-41800-21-040 / 900
2012759	Gear cam limit switch	A11-41800-45-010 / 900

P/N	Part	Symbol code
2040913	Gear cam limit switch	A11-41800-45-010 / 902
2010415	Gear cam limit switch	A11-41830-21-030 / 901
2014130	Incremental encoder	A11-41800-21-020 / 901 A11-41800-21-030 / 901 A11-41800-45-010 / 901
2041484	Absolute encoder	A11-41800-45-010 / 903
2019166	Encoder	A11-41800-45-010 / 904
2041026	Incremental encoder	A11-41830-21-030 / 902

7.5.12.11.3 Test gear cam limit switch

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41800-21-0308](#): Whip hoist winch
- [A11-41800-21-0408](#): Tugger winch drum
- [A11-41800-45-0108](#): Slew drive sensor foundation
- [A11-41830-21-0308](#): Slewing bearing, chain- & main shaft

Description	Location	Reference	Symbol code	Qty.
Gear cam limit switch	Boom hoist	A11-41800-21-0208	900	1
Gear cam limit switch	Whip hoist	A11-41800-21-0308	900	1
Gear cam limit switch	Tugger winch	A11-41800-21-0408	900	1
Gear cam limit switch	Slew drive right	A11-41800-45-0108	900	1
Gear cam limit switch	Slew drive left	A11-41800-45-0108	902	1
Gear cam limit switch	Storage winch	A11-41830-21-0308	901	1

1. Test the functioning of the gear cam limit switch.

- If necessary adjust the gear cam limit switch settings according to section [7.2.15](#).

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2021845	Gear cam limit switch	A11-41800-21-020 / 900 A11-41800-21-030 / 900
2005350	Gear cam limit switch	A11-41800-21-040 / 900
2012759	Gear cam limit switch	A11-41800-45-010 / 900
2040913	Gear cam limit switch	A11-41800-45-010 / 902

P/N	Part	Symbol code
2010415	Gear cam limit switch	A11-41830-21-030 / 901
2014130	Incremental encoder	A11-41800-21-020 / 901 A11-41800-21-030 / 901 A11-41800-45-010 / 901
2041484	Absolute encoder	A11-41800-45-010 / 903
2019166	Encoder	A11-41800-45-010 / 904
2041026	Incremental encoder	A11-41830-21-030 / 902

7.5.12.11.4 Test heater of gear cam limit switch

Reference documents:

- [A11-41800-21-0208](#): Boom hoist winch
- [A11-41800-21-0308](#): Whip hoist winch
- [A11-41800-21-0408](#): Tugger winch drum
- [A11-41800-45-0108](#): Slew drive sensor foundation
- [A11-41830-21-0308](#): Slewing bearing, chain- & main shaft

Description	Location	Reference	Symbol code	Qty.
Gear cam limit switch	Boom hoist	A11-41800-21-0208	900	1
Gear cam limit switch	Whip hoist	A11-41800-21-0308	900	1
Gear cam limit switch	Tugger winch	A11-41800-21-0408	900	1
Gear cam limit switch	Slew drive right	A11-41800-45-0108	900	1
Gear cam limit switch	Slew drive left	A11-41800-45-0108	902	1
Gear cam limit switch	Storage winch	A11-41830-21-030	901	1

Functional test:

1. Perform a functional test, to check if the heater is working correctly (heat dispersion).

NOTE Do not touch heater, only check the temperature from a save distance.

When the heater is not working correctly:

2. Check the cable connection.
 - If the cable is not connected correctly, re-connect the cable correctly to the heater.
3. Measure the voltage. The measured voltage should be 24 V.
 - If the measured voltage is below this value, investigate the cause and replace the failed component.
4. Measure the current of the heating element. The maximum current is 0.10 A.
 - If the measured current is beyond specifications, investigate the cause and replace

the failed component.

5. Measure the resistance of the heating element.

- If the resistance is zero or infinity, investigate the cause and replace the failed component.

NOTE The heater must not be touched while switched on, risks of burns from hot surfaces. The heater must be allowed to cool for approx. 15 minutes after switching off.

For more information, see the supplier documentation.

Spare parts

P/N	Part	Symbol code
2021845	Gear cam limit switch	A11-41800-21-020 / 900 A11-41800-21-030 / 900
2005350	Gear cam limit switch	A11-41800-21-040 / 900
2012759	Gear cam limit switch	A11-41800-45-010 / 900
2040913	Gear cam limit switch	A11-41800-45-010 / 902
2010415	Gear cam limit switch	A11-41830-21-030 / 901
2014130	Incremental encoder	A11-41800-21-020 / 901 A11-41800-21-030 / 901 A11-41800-45-010 / 901
2041484	Absolute encoder	A11-41800-45-010 / 903
2019166	Encoder	A11-41800-45-010 / 904
2041026	Incremental encoder	A11-41830-21-030 / 902

7.5.12.12 Slack rope switch (Instrumentation)

This section describes all maintenance tasks for the slack rope switch of the 400 mT crane.

7.5.12.12.1 Test slack rope switch

Reference documents:

- [A11-41800-44-0108](#): Slack rope switches
- [A11-41830-41-0108](#): Slack rope switch

Description	Location	Reference	Symbol code	Qty.
Slack rope switch	Boom hoist winch	A11-41800-44-0108	N/A	1
Slack rope switch	Whip hoist winch	A11-41800-44-0108	N/A	1
Slack rope switch	Storage winch	A11-41830-41-0108	N/A	1

WARNING



Do not manually operate the slack rope bar when the winch is spooling.

1. Manually push the slack rope bar downwards.
The detection plate is lifted up and undetected from the proximity switch.
2. Check if an alarm is generated in SCADA.
 - If no alarm is generated, investigate the cause and repair/replace the failed component.
3. Operate the winch. Spooling should not occur.
 - If spooling does occur, contact Huisman for correct action to take.
4. Reset the slack rope bar manually into its original position by pulling the proximity switch bar away from the detection plate, the detection plate will fall back to the working position and reset the alarm in SCADA.

Spare parts

P/N	Part	Symbol code
On request	Slack rope switch boom/whip hoist winch	N/A
On request	Slack rope switch storage winch	N/A
2001093	Proximity sensor EEX	900

7.5.12.12.2 Inspect and clean slack rope switch

Reference documents:

- [A11-41800-44-0108](#): Slack rope switches
- [A11-41830-41-0108](#): Slack rope switch

Description	Location	Reference	Symbol code	Qty.
Slack rope switch	Boom hoist winch	A11-41800-44-0108	N/A	1
Slack rope switch	Whip hoist winch	A11-41800-44-0108	N/A	1
Slack rope switch	Storage winch	A11-41830-41-0108	N/A	1

1. Clean slack rope switch using a cloth.

2. Clean proximity sensor of slack rope switch using a damp cloth or vacuum.

CAUTION


Do not remove dust with compressed air as this would cause the dust to penetrate into the contacts, which would affect the switching capacity. The cap type seals of the protective housings have to be replaced after opening of the cap and after an longer operation time.

CAUTION


Do not use benzene or any other solvent for cleaning the sensors.

3. Check the slack rope switch for damage and corrosion.
 - If significant damage is found, repair/replace the slack rope switch.
 - If corrosion is found, remove the corrosion and repaint the corroded area, according to the Paint Specification.
4. Check paint of the slack rope switch.
 - If the paint is damaged, repaint the area according to the Paint Specification.
 - If paint cracks are visible around bolts, check the torque of the bolts and if necessary tighten the bolts. Then repaint the bolts, according to the Paint Specification.
5. Check for loose components of the slack rope switch.
 - If components are loose, tighten the loose components.

Spare parts

P/N	Part	Symbol code
On request	Slack rope switch boom/whip hoist winch	N/A
On request	Slack rope switch storage winch	N/A
2001093	Proximity sensor EEX	900

7.5.12.13 Proximity switch (Instrumentation)

This section describes all maintenance tasks for the proximity switch of the 400 mT crane.

7.5.12.13.1 Inspect proximity switch

Reference documents:

- [A11-41800-44-0108](#): Slack rope switches
- [A11-41830-41-0108](#): Slack rope switch

Description	Location	Reference	Symbol code	Qty.
Proximity switch	Boom hoist winch	A11-41800-44-0108	900	1
Proximity switch	Whip hoist winch	A11-41800-44-0108	900	1

Description	Location	Reference	Symbol code	Qty.
Proximity switch	Storage winch	A11-41830-41-0108	900	1

1. Check the mounting of the proximity switch.
 - If the switch is not correctly mounted, remount it.
2. Check if the proximity switch is positioned perpendicular to the mounting plate.
 - If the switch is not correctly positioned, reposition it.
3. Activate or deactivate the switch, check in SCADA if the switch indicator indicates correctly.
 - When the switch is not functioning properly, investigate the cause and replace/repair failed component.

Spare parts

P/N	Part	Symbol code
2001093	Proximity sensor EEX	900

7.5.12.14 Load measuring pin (Instrumentation)

This section describes all maintenance tasks for the load measuring pins of the 400 mT crane.

7.5.12.14.1 Grease load measuring pin

Reference documents:

- [A11-41800-00-201](#): Grease schedule (400t OMC)
- [A11-41830-00-201](#): Grease schedule (Storage winch)

Description	Location	Reference	Symbol code	Qty.
Load measuring pin	main hoist winch	A11-41800-00-2018 Grease schedule	100B10	1
Load measuring pin	storage winch	A11-41830-00-2018 Grease schedule	130B10	1
Load measuring pin	whip hoist winch	A11-41800-00-2018 Grease schedule	600B10	1

1. If necessary, remove old grease.
2. Grease load measuring pin according to grease schedule.

There is one greasing points foreseen on the LMP.

Lubrication

Lubrication type	Type of grease nipple	Qty.
Mobil Mobilux EP2	G1/4" DIN 3404 / AISI 316	

7.5.12.14.2 6 month periodic load measuring pin check (see Huisman LMP manual)

Reference documents:

- Huisman: Load Measurement Pin Manual
- [10013281A](#): Electrical diagram (E-plan).

Description	Location	Reference	Symbol code	Qty.
Load measurement	Load measuring pin, in main hoist winch (LMP11-1966)	Electrical diagram	100B10	1
Load measurement	Load measuring pin, in storage winch(LMP11-1963)	Electrical diagram	130B10	1
Load measurement	Load measuring pin, in whip hoist winch(LMP11-1962)	Electrical diagram	600B10	1

1. Check the load measuring pin, according to the Huisman load measuring pin manual.
 - If LMP has to be replaced, contact Huisman.

NOTE *The operator can keep a log file with the load given by the load measuring pin and weight given on a cargo manifest or calculations by engineers. By keeping this simple log any abnormalities are directly noticed.*

NOTE *If the LMP or the amplifier has to be replaced, contact Huisman!*

Special tools

P/N	Tool	Qty.
2001373	Gisma connector - Straight Endbell	1
2001294	Gisma connector - Receptacle	
2001887	Gisma connector - Plug	

Spare parts

P/N	Part	Symbol code
2001286	Amplifier (programmed)	

7.5.12.14.3 Perform 12 month periodic load measuring pin check

Reference documents:

- Huisman: Load Measurement Pin Manual
- [10013281A](#): Electrical diagram (E-plan).

Description	Location	Reference	Symbol code	Qty.
Load measurement	Load measuring pin, in main hoist winch (LMP11-1966)	Electrical diagram	100B10	1
Load measurement	Load measuring pin, in storage winch(LMP11-1963)	Electrical diagram	130B10	1
Load measurement	Load measuring pin, in whip hoist winch(LMP11-1962)	Electrical diagram	600B10	1

1. Check the load measuring pin, according to the Huisman load measuring pin manual.
 - If LMP has to be replaced, contact Huisman.

NOTE *The operator can keep a log file with the load given by the load measuring pin and weight given on a cargo manifest or calculations by engineers. By keeping this simple log any abnormalities are directly noticed.*

NOTE *If the LMP or the amplifier has to be replaced, contact Huisman!*

Special tools

P/N	Tool	Qty.
2001373	Gisma connector - Straight Endbell	1
2001294	Gisma connector - Receptacle	
2001887	Gisma connector - Plug	

Spare parts

P/N	Part	Symbol code
2001286	Amplifier (programmed)	

7.5.12.14.4 Perform 5 year periodic load measuring pin inspection

Reference documents:

- Huisman: Load Measurement Pin Manual
- [10013281A](#): Electrical diagram (E-plan).

Description	Location	Reference	Symbol code	Qty.
Load measurement	Load measuring pin, in main hoist winch (LMP11-1966)	Electrical diagram	100B10	1
Load measurement	Load measuring pin, in storage winch(LMP11-1963)	Electrical diagram	130B10	1
Load measurement	Load measuring pin, in whip hoist winch(LMP11-1962)	Electrical diagram	600B10	1

1. Check the load measuring pin, according to the Huisman load measuring pin manual.
 - If LMP has to be replaced, contact Huisman.

NOTE *This inspection job is only applicable if LMP cannot be properly tested as mounted using a known weight or when test results are doubtful.*

NOTE *If the LMP or the amplifier has to be replaced, contact Huisman!*

Special tools

P/N	Tool	Qty.
2001373	Gisma connector - Straight Endbell	1
2001294	Gisma connector - Receptacle	
2001887	Gisma connector - Plug	

Spare parts

P/N	Part	Symbol code
2001286	Amplifier (programmed)	N/A

7.6 SPARE PARTS

A list with recommended spare parts is provided in [Appendix M: "Spare parts lists"](#).

APPENDIX A: ABB DOCUMENTATION

Document ID	Document title
<u>Guide</u>	Capacitor reform guide
<u>Manual</u>	Huisman Application Manual ABB drives ACS800
<u>RDCU</u>	Replacing failing RDCU



APPENDIX B: DISPS DOCUMENTATION

Document
<u>Manual DISPS version 6.2</u>



APPENDIX C: LOAD CELL DOCUMENTATION

Document ID	Document title
<u>Manual</u>	Manual load measuring pin
<u>LMP 11-1962</u>	Certificate
<u>LMP 11-1963</u>	Certificate
<u>LMP 11-1964</u>	Certificate
<u>LMP 11-1965</u>	Certificate



APPENDIX D: INSTRUCTION FOR MANRIDING

Document
<u>Instructions for manriding</u>



APPENDIX E: LOAD CURVES

Document
<u>Load Curves</u>



APPENDIX F: NITROGEN RELATED SAFETY GUIDELINES

Document
<u>Nitrogen related safety guidelines</u>



APPENDIX G: PAINT SPECIFICATION

Document
<u>Paint Specification</u>



APPENDIX H: REFERENCE DRAWINGS - ELECTRICAL

Document ID	Document title
10013281A	Electrical drawing
A11-41800-00-003	400mt OMC (layout)
A11-41800-95-130	STORAGE WINCH
A11-41800-95-700	HPU
A11-41800-95-900	PVU
A11-41800-98-001	400MT OMC - E-ROOM
A11-41800-98-002	400MT OMC - CABIN E-ROOM
A11-41800-98-010	MAST E-ROOM PANEL M22
A11-41800-98-011	MAST E-ROOM PANEL M22
A11-41800-98-012	MAST E-ROOM PANEL P10&M23
A11-41800-98-013	MAST E-ROOM PANEL M21.1...M21.4
A11-41800-98-014	MAST E-ROOM PANEL M21.5...M21.8
A11-41800-98-015	MAST E-ROOM PANEL M21.9
A11-41800-98-016	E-ROOM PANEL M51
A11-41800-98-017	E-ROOM PANEL M52
A11-41800-98-030	M10, WINCH ROOM
A11-41800-98-040	MAST
A11-41800-98-041	PANEL M32
A11-41800-98-050	BOOM
A11-41800-98-051	FLY JIB
A11-41800-98-052	JUNCTION BOXES J11 & J12
A11-41800-98-080	TUGGER WINCH DRUM
A11-41800-98-090	MAST LIGHTING
A11-41800-98-100	CONDUCTOR RAILS
A11-41800-98-110	400mt OMC (slew)
A11-41800-98-120	400mt OMC (Slipring)
Electrical coding system	Electrical coding system

NOTE

For the electrical drawings see attached CD.



APPENDIX I: REFERENCE DRAWINGS - HYDRAULIC

Document ID	Document title
A11-41800-80-0008	OMC Single Line Hydraulic Diagram
A11-41800-80-0108	Wire Brake System - hydraulic diagram
A11-41810-80-0108	Hydraulic Power Unit 800KW - hydraulic diagram
A11-41810-80-0208	Heave Compensator - hydraulic diagram
A11-41810-80-0308	Pressure Vessel Unit - hydraulic diagram
A11-41820-80-0108	Gearbox Cooling Traction Winch
A11-41800-80-019	Wire Brake System - parts list
A11-41810-80-019	Hydraulic Power Unit - parts list
A11-41810-80-029	Heave Compensator - parts list
A11-41810-80-039	Pressure Vessel Unit - parts list
A11-41820-80-019	Gearbox Cooling Traction Winch - parts list
A11-41830-80-019	Gearbox Cooling Storage Winch - parts list



APPENDIX J: REFERENCE DRAWINGS - MECHANICAL

Document ID	Document title
A11-41800-00-0038	General Arrangement
A11-41800-00-010	Interface Drawing
A11-41800-00-011	Boomrest Interface
A11-41800-00-012	Interface Free Space
A11-41800-00-201	Greasing Diagram
A11-41800-00-4018	Sensor Arrangement - crane
A11-41800-00-4028	Sensor Arrangement - under deck equipment
A11-41800-12-0108	Rectangular Mast Section
A11-41800-13-0108	Masthead
A11-41800-13-0208	Mast head shafts
A11-41800-13-0418	Rope guides on masthead
A11-41800-14-0208	Found. Cabin / Whip H. Sheave
A11-41800-14-0308	Tugger Frame
A11-41800-15-0108	Cranejib
A11-41800-15-0208	Foundation Fairlead and Sheaves
A11-41800-15-0308	Pivot shaft
A11-41800-15-0418	Preventer on Cranejib
A11-41800-15-0508	Sheavebox on Jibhead
A11-41800-15-0618	Tugger Guide Sheaves for Reaving
A11-41800-16-0108	Jibhead
A11-41800-17-0108	Fly-jib
A11-41800-17-0208	MH Dead-end
A11-41800-17-0308	WH Dead-end
A11-41800-21-0108	Winch Frame
A11-41800-21-0208	Boomhoist Winch
A11-41800-21-0308	Whip Hoist Winch
A11-41800-21-0408	Tugger Winch Drum
A11-41800-21-0508	Winch covers
A11-41800-22-0108	Lower Slewsystem Bolts
A11-41800-22-0208	Upper Slewsystem Bolts
A11-41800-31-0108	Reeving Diagram
A11-41800-31-1018	Reeving Procedure Main Hoist
A11-41800-32-0108	Sheave for Wire ø92 P.C.D. 1842
A11-41800-32-0208	Sheave for Wire ø36 P.C.D. 720
A11-41800-32-0308	Sheave for Wire ø36 P.C.D. 720
A11-41800-32-0408	Sheave for Wire ø36 P.C.D. 386
A11-41800-32-0508	Sheave for Wire ø36 P.C.D. 720

Document ID	Document title
A11-41800-32-0608	Sheave for Wire ø36 P.C.D. 720
A11-41800-32-0708	Sheave for Wire ø24 P.C.D. 424
A11-41800-32-0808	Sheave for Wire ø24 P.C.D. 424
A11-41800-32-0908	Sheaves for Rope Leading
A11-41800-33-0108	Main Hoist Lowerblock 400mT
A11-41800-33-0208	Main Hoist Sheave Block
A11-41800-33-0308	Whip Hoist Lower Block 40mT
A11-41800-33-0408	Sheave Box Whip Hoist 40t
A11-41800-33-0608	BH Sheaveblock Jibhead
A11-41800-33-0808	Fairlead
A11-41800-34-0408	Tugger Weights
A11-41800-35-0108	Rope Leading Mainh. + Whiph.
A11-41800-35-0208	Rope Leading Guide Sheaves
A11-41800-35-0308	Rope Leading Topping Sheavebox
A11-41800-35-0408	Rope Leading Topping Sheave
A11-41800-42-0108	MH Highest Position Switch
A11-41800-42-0208	Jib Highest Position Switch
A11-41800-42-0308	WH Highest Position Switch
A11-41800-44-0108	Slack Rope Switches
A11-41800-45-0108	Slewdrive Sensor Foundation
A11-41800-45-0308	Angle Measuring Jib
A11-41800-46-0108	Loadpin LMP 11-1962
A11-41800-46-0208	Loadpin LMP 11-1963
A11-41800-46-0308	LMP 11-1964 (Left) / LMP 11-1965 (Right)
A11-41800-53-0108	Cable Protection M.H. Sheave
A11-41800-53-0218	Guide Roller For Mainhoist
A11-41800-53-0318	Cable Protection Jibhead
A11-41800-54-0408	Mast Head Warning Lamps
A11-41800-54-0508	Lamp Foundations on Jib
A11-41800-54-0608	Lamp Foundations for Fly Jib
A11-41810-10-0018	General Arrangement
A11-41810-10-0208	Turnbuckle Frame
A11-41810-10-0308	Guide Frame
A11-41810-10-0408	Sheave and Head Frame
A11-41810-10-0508	Cylinder Mounting
A11-41810-32-0108	Sheave for Wire ø92 P.C.D. 2132
A11-41810-35-0508	Rope Leading
A11-41810-38-0108	Lifting and Placing Equipment
A11-41810-86-0108	Passive Heave Compensator Cylinder
A11-41810-88-0008	Pressure Vessel Unit (PVU)
A11-41810-88-0108	PVU

Document ID	Document title
A11-41810-88-1008	HPU
A11-41810-88-1108	HPU
A11-41810-88-1708	HPU Service Tools
A11-41810-88-1808	HPU Step
A11-41810-88-1908	Seafastening HPU E-Cabinet
A11-41820-10-0018	210 M. TS. Traction Winch
A11-41820-11-0108	Drum
A11-41820-11-0508	Main Shaft
A11-41820-13-0108	Lower Winch Frame
A11-41820-13-0208	Grease System
A11-41820-14-0108	Upper Winch Frame
A11-41820-15-0108	Connections Winch Frame
A11-41820-16-0108	Support Frames Drive System
A11-41820-17-0108	Cable Guiding
A11-41820-22-0108	Gear Ring
A11-41830-00-011	O.M.C Storage Winch
A11-41830-00-2018	Grease Schedule
A11-41830-21-0008	General Arrangement
A11-41830-21-0108	Winch Frame
A11-41830-21-0208	Winch Drum
A11-41830-21-0308	Slewing Bearing, Chain- & Mainshaft
A11-41830-21-0408	Spooling Device Diamond Screw Block
A11-41830-21-0508	Spooling Device Frame and Shaft
A11-41830-21-0608	Chain Tensioner Spool. Device Drive
A11-41830-21-0708	Drag Chain for Grease Pump
A11-41830-21-0808	Shafts for Guide Sheaves
A11-41830-41-0108	Slackrope Switch
A11-41830-46-0108	Loadpin Fairlead LMP 11-1966
A11-41830-53-0108	Cable Trays / Strips - Earth Bolts
A11-41830-53-0208	Foundations for Oil Coolers

APPENDIX K: SAFETY DIAGRAMS

Document ID	Document title
<u>Crane</u>	Safety Diagram Crane
<u>HPU</u>	Safety Diagram HPU
<u>PVU</u>	Safety Diagram PVU



APPENDIX L: SCADA DOCUMENTATION

Document
<u>Huisman SCADA Standard - User Manual</u>



APPENDIX M: SPARE PARTS LISTS

Document
<u>Spare parts list</u>



APPENDIX N: TECHNICAL SPECIFICATION

Document ID	Document title
<u>High Stress Zones</u>	High Stress Zones Description & Inspection Plan



APPENDIX O: WIRE ROPE DOCUMENTATION

Document
<u>Steel wire ropes</u>

