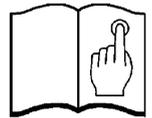


VOLUME 1

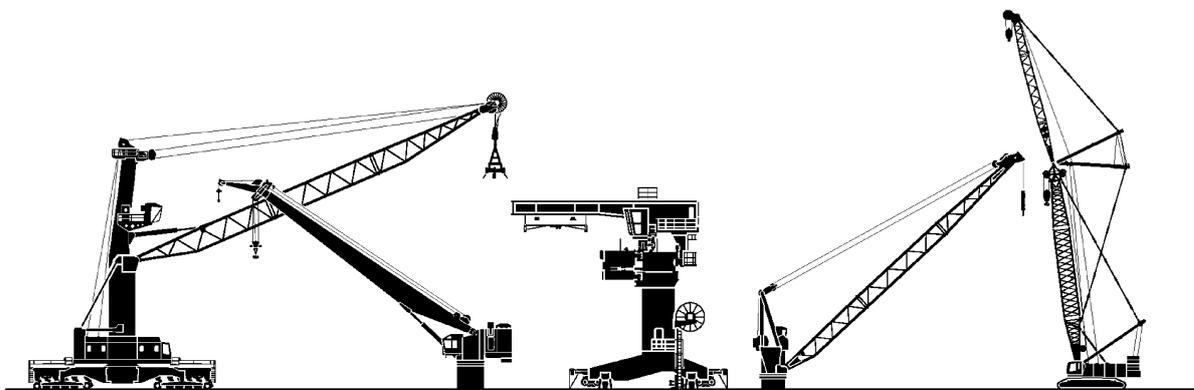


OPERATING MANUAL

TYPE
FCC-CBW 12/32

SERIAL NUMBER
162 731

VERSION
001 - 05.12.2006



LIEBHERR

INDEX - VOLUME 1

1. INTRODUCTION	1.3
1.1. FOREWORD	1.4
1.2. USING THE DOCUMENTATION	1.5
2. PRODUCT DESCRIPTION	2.3
2.1. UTILIZATION AS DIRECTED	2.3
2.2. MACHINE PASSPORT	2.4
2.3. TECHNICAL DATA	2.6
2.4. GENERAL ARRANGEMENT	2.9
2.5. SAFETY AND RESCUE EQUIPMENT	2.17
3. SAFETY GUIDELINE	3.3
3.1. GENERAL	3.3
3.2. UTILIZATION AS DIRECTED	3.5
3.3. AREAS OF RESPONSIBILITY	3.6
3.4. PERSONAL REQUIREMENTS OF THE CRANE OPERATOR	3.7
3.5. PERSONAL PROTECTIVE GEAR	3.8
3.6. WORK AREA	3.9
3.7. SAFETY AND MONITORING DEVICES	3.9
3.8. SAFETY SIGNS ON THE MACHINE	3.10
3.9. MACHINE SPECIFIC DANGERS	3.14
3.10. ADDITIONAL DANGERS	3.17
3.11. NOTES ON SAFETY FOR THE MACHINE OPERATOR	3.21
3.12. NOTES ON SAFETY FOR THE BUILDING-SITE PERSONAL	3.21
4. CONTROL AND OPERATING ELEMENTS	4.3
4.1. GENERAL	4.3
4.2. LAYOUT OF THE OPERATOR'S CONTROLSTAND	4.3
4.3. CONTROL LEVER	4.4
4.4. CONTROL PANELS	4.5
4.5. CONTROL PANEL FOR AIR CONDITION	4.11
4.6. SWITCH CABINET	4.13

5. CRANE OPERATION	5.3
5.1. GENERAL	5.3
5.2. CHECKS BEFORE DAILY START UP	5.5
5.3. DAILY START-UP	5.6
5.4. START/STOP FOR A WORK BREAK	5.8
5.5. SHUT DOWN THE CRANE	5.9
5.6. CRANE OPERATION	4.25
6. EMERGENCY OPERATION	6.3
6.1. GENERAL	6.3
6.2. ARRANGEMENT OF EMERGENCY DEVICES	6.3
6.3. EMERGENCY HAND PUMP	6.4
6.4. PROCEDURE TO LOWER THE LOAD	6.5
6.5. PROCEDURE TO RELEASE THE SLEWING BRAKES	6.6
6.6. PROCEDURE TO LOWER THE BOOM	6.7
7. MAINTENANCE	7.3
7.1. QUALIFIED PERSONS	7.3
7.2. SERVICE SPARE-PARTS AND STANDARD TOOLS	7.4
7.3. MAINTENANCE INTERVALS	7.5
7.4. ELECTRIC MOTOR	7.15
7.5. GEARBOXES	7.17
7.6. MULTIPLE DISC BRAKES	7.19
7.7. CABLE REEL	7.20
7.8. CRANE ROPES	7.23
7.9. ROPE PULLEYS	7.27
7.10. HYDRAULIC LINES AND HOSES	7.31
7.11. HYDRAULIC OIL TANK	7.32
7.12. LIEBHERR CONDITION MONITORING	7.36
7.13. PRESSURE ACCUMULATORS	7.41
7.14. MAINTENANCE OF OIL COOLERS	7.41
7.15. ELECTRICAL SYSTEM	7.43
7.16. SLIP RING UNIT	7.44
7.17. AIR CONDITIONING SYSTEM	7.45

INDEX

1.	INTRODUCTION	1.3
1.1.	FOREWORD	1.4
1.2.	USING THE DOCUMENTATION	1.5
1.2.1.	STORING THE DOCUMENTATION	1.5
1.2.2.	HOW IS THE OPERATING MANUAL IN VOLUME 1 COMPILED	1.6
1.2.3.	COMPUTER SYSTEM REQUIREMENTS TO USE THE CD-ROMS	1.6
1.2.4.	CURRENT STATUS OF THE DOCUMENTATION	1.6

1. INTRODUCTION

On our own behalf

The Liebherr name does not only represent products and performances, but has also become synonymous with ideas and innovations. For progress that has already been proven in the market.

We are continuously expanding and improving our already wide range of technical products and performances with great vigor. For this reason, constant collaboration and swapping of experiences with our customers and business partners throughout the world is a prerequisite.

We are therefore grateful for all proposals and every improvement suggested.

Please contact:

LIEBHERR-WERK NENZING GMBH

P.O. 10,
Dr. Hans Liebherr Strasse 1
A-6710 Nenzing
Austria / Europe

Telephone: +43 5525 606-0
Fax: +43 5525 606-445
Email: deck.crane@liebherr.com

The documentation for this crane was compiled to customer specifications.

After-sales service should therefore be informed if the machine

- is to be sold on,
- was purchased from a previous owner.

Copyright notice

The documentation is protected by copyright. The documentation may not be duplicated, reproduced, micro-filmed, translated or converted for storage and processing in computer systems, either wholly or partially, without the written consent of LIEBHERR-WERK NENZING GMBH.

© 2006 Copyright by

LIEBHERR-WERK NENZING GMBH

A-6710 Nenzing

All rights reserved

1.1. FOREWORD

The LIEBHERR electro-hydraulic cargo crane, type CBW is the synergy of wide experience, research and development for customer's success and benefit. As such, it is provided with the following features:

- reliable hydraulic load sensing control system, designed and tested by LIEBHERR
- low center of gravity and height
- maintenance free hydraulic luffing rams, nickel-chromium plated
- firmly supported boom at all boom angles due to double acting hydraulic rams
- extremely short minimum radius and low height
- components tested and proven for extreme conditions and performance
- continuously variable speed control from zero to maximum speed
- operation of all 3 motions simultaneously
- designed with focus on low maintenance and life-cycle costs
- subjected to rigid testing and inspection
- backed up by worldwide service and spare parts supply
- 24-hours service around the world
- delivered with comprehensive instruction books and manuals
- preventative maintenance arrangements
- built to last and to retain its value

1.2. USING THE DOCUMENTATION

The documentation for the machine should enable you to,

- safely operate it,
- use it competently for all permitted applications,
- maintain it regularly.

This means you have to be able to navigate your way through this multiple chapter documentation:

- o the operating manual consists of volume 1



Volume 1 - Operating manual

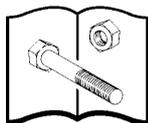
This volume contains information for start-up, operation and maintenance.

- o The technical documentation for the maintenance and service personnel are in volume 2 and volume 3.



Volume 2 - Technical information

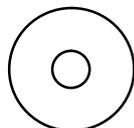
Information concerning the electrical and hydraulics systems of the machine can be found here.



Volume 3 - Spare parts catalogue

This book contains information for the provision of spare parts.

- o The complete documentation from volume 1 to 3 is stored on CD-ROM.



CD-ROM - Documentation (optional)

This CD-ROM contains
 volume 1 and 2 stored as PDF-files,
 volume 3 as HTML-version with easy search and order functions.

Printed on each CD-ROM

- the crane type,
- the machine's serial number,
- the version number of the CD-ROM.

1.2.1. STORING THE DOCUMENTATION

Volumen 1+2 "Operating manual" and "Technical information" are to be on hand in the operator's cab.

Volume 3 "Spare parts catalogue" must be available to the maintenance and service personnel.

The CD-ROM should be kept in the office and should be used for ordering spare parts.

1.2.2. HOW IS THE OPERATING MANUAL IN VOLUME 1 COMPILED

The operating manual consists of individual continuously numbered chapters. These chapters are arranged in the yellow register of the bound file.

A summary of the chapter at the beginning of the operating manual enables a rapid orientation. The subsequent list of contents gives information about the compilation of the individual chapters.

At the beginning of the following chapters under "General" you will find a short description of content.

Page numbers contains the current chapter number as a prefix.

For example page "-2.10-" designates the tenth page of chapter two "Product description".

1.2.3. COMPUTER SYSTEM REQUIREMENTS TO USE THE CD-ROMS

- WIN 2000, XP operating system or newer
- Internet Explorer 5.5 or newer version
- Acrobat Reader 7.0 or newer version
- ISOView, installed from CD-ROM



IMPORTANT !

For the optional functions of the spare parts catalogue to work, special safety settings must be made in the Internet Explorer: Active Scripting must be activated.

1.2.4. CURRENT STATUS OF THE DOCUMENTATION

The documentation delivered is specially compiled for the machine indicated in the machine's passport and is therefore not transferable to other machines from the same range.

In order that the documentation is always complete and up-to-date

- do not remove individual pages,
- replace unreadable pages by reprinting them from the CD-ROM,
- immediately insert the new pages that are delivered after modification work or upgrades
- always replace modified documents and eliminate the invalid documents exchange,
- always replace old CD-ROMs against the newer versions e.g. delivered along with modifications (dispose of old CD-ROMs),
- With multilingual documents, always update all languages.

INDEX

2. PRODUCT DESCRIPTION	2.3
2.1. UTILIZATION AS DIRECTED	2.3
2.1.1. PURPOSE	2.3
2.1.2. CORRECT USAGE OF CRANE	2.3
2.1.3. INCORRECT USAGE OF CRANE	2.4
2.1.4. LIMITS OF THE OPERATIONAL AREA	2.4
2.2. MACHINE PASSPORT	2.4
2.2.1. MACHINE IDENTIFICATION	2.5
2.3. TECHNICAL DATA	2.6
2.3.1. PROOF OF ORIGIN	2.6
2.3.2. DESIGN CONDITIONS	2.6
2.3.3. WORKING RANGE	2.6
2.3.4. PERMISSIBLE CAPACITIES / SPEEDS	2.6
2.3.5. ELECTRIC POWER SUPPLY	2.6
2.3.6. WEIGHT	2.7
2.3.7. LOAD CHART	2.7
2.4. GENERAL ARRANGEMENT	2.9
2.4.1. SLEWING COLUMN	2.11
2.4.2. CABIN	2.13
2.4.3. BOOM	2.15
2.5. SAFETY AND RESCUE EQUIPMENT	2.17
2.5.1. EMERGENCY RESCUE DEVICE	2.17

2. PRODUCT DESCRIPTION

This chapter

- gives information about the machine application possibilities and warns against incorrect or improper use,
- describes assembly and the main components,
- gives important technical data.



NOTE !

The illustrations in the product description serve only to give general information and do not necessarily correspond with the actual setting-up stage of the machine.

2.1. UTILIZATION AS DIRECTED

2.1.1. PURPOSE

In principal the machine may only be used for applications as stipulated in the operating manual.

The machine is used as intended when

- national safety regulations are adhered to,
- all safety instructions in this operating manual are kept,
- when all required safety devices are in place and operational,
- when the operating conditions described in chapter "Technical data" are adhered to and all the recommended oils and lubricants are used.

Included in use as intended is also timely and complete service and maintenance works by qualified and authorized personnel.

Special application not listed here

- are to be cleared with the manufacturer,
- may only be carried out with the written consent of the manufacturer.

The machine is used for every kind of crane application and is designed for optimal economic operations.

Operational modes

The following operational modes of the machine are possible:

- General cargo handling
- Fast container and pallet handling on reefer vessels
- Break bulk, container and project cargo handling on multi purpose vessels
- Bulk handling on bulk carriers
- Container handling on container vessels

Every other application or applications beyond the described ones are **not intended uses** of the machine and without an explicit agreement in writing by the manufacturer, the crane operator is responsible for any damage incurred.

2.1.2. CORRECT USAGE OF CRANE

The crane is fixed installed and serves to load and unload vessel using the lifting equipment supplied and approved by the manufacturer (hooks, cargo rotator etc.)

The ship must be anchor/lashed at the quay in a harbour and equiped with fully ballast for un/loading procedure.

The crane is to be operated only by appropriately trained personnel, in a competent physical and psychological condition!

GENERAL DESCRIPTION

2.1.3. INCORRECT USAGE OF CRANE

- Mechanical modifications of the crane which influence the operational safety.
- Using the crane to tear/rip away loads that are fixed down, by using the hook or the slewing gear.
- Lifting a load that is laying on the ground by only using the luffing winch/gear.
- Dragging a load across the ground.
- Lifting loads where the lifting ropes are not perpendicular.
- Using the crane without complying to the relevant load chart (in regards to load and outreach).
- Installation and use of spare parts, equipment and fluids that are not approved by the original equipment manufacturer.
- Cooperative operation with other cranes for lifting loads
- Duty cycle operation without reducing safe working load
- The loading and unloading of other ships without reducing the safe working load.
- The lifting/handling of life boots.
- Carrying of personnel through the hoisting gear

2.1.4. LIMITS OF THE OPERATIONAL AREA

The limits of the operational area, is the maximum working area of the crane, plus the distance covered by a swinging load. This area is also to be known as the area of danger.

2.2. MACHINE PASSPORT

As delivered this machine is fitted with the following options marked by the [x]:

- 12 t Main hoist system
- xx t Auxiliary hoist system
- Spreader rotator
- MIPEG load indication system

- Hook Block Parking System Main Hoist
- Hook Block Parking System Auxiliary Hoist
- Slew interlock system
- Sector limitation system

- Flood lights slewing column
- Flood lights boom
- Helicopter warning light slewing column
- Helicopter warning light boom

- Video monitoring system
- Air condition

- _____
- _____
- _____

2.2.1. MACHINE IDENTIFICATION

Please write into the space below

- the serial number,
- crane type
- the year of manufacture,
- the date of its first start-up.

Serial / Order no.: _____

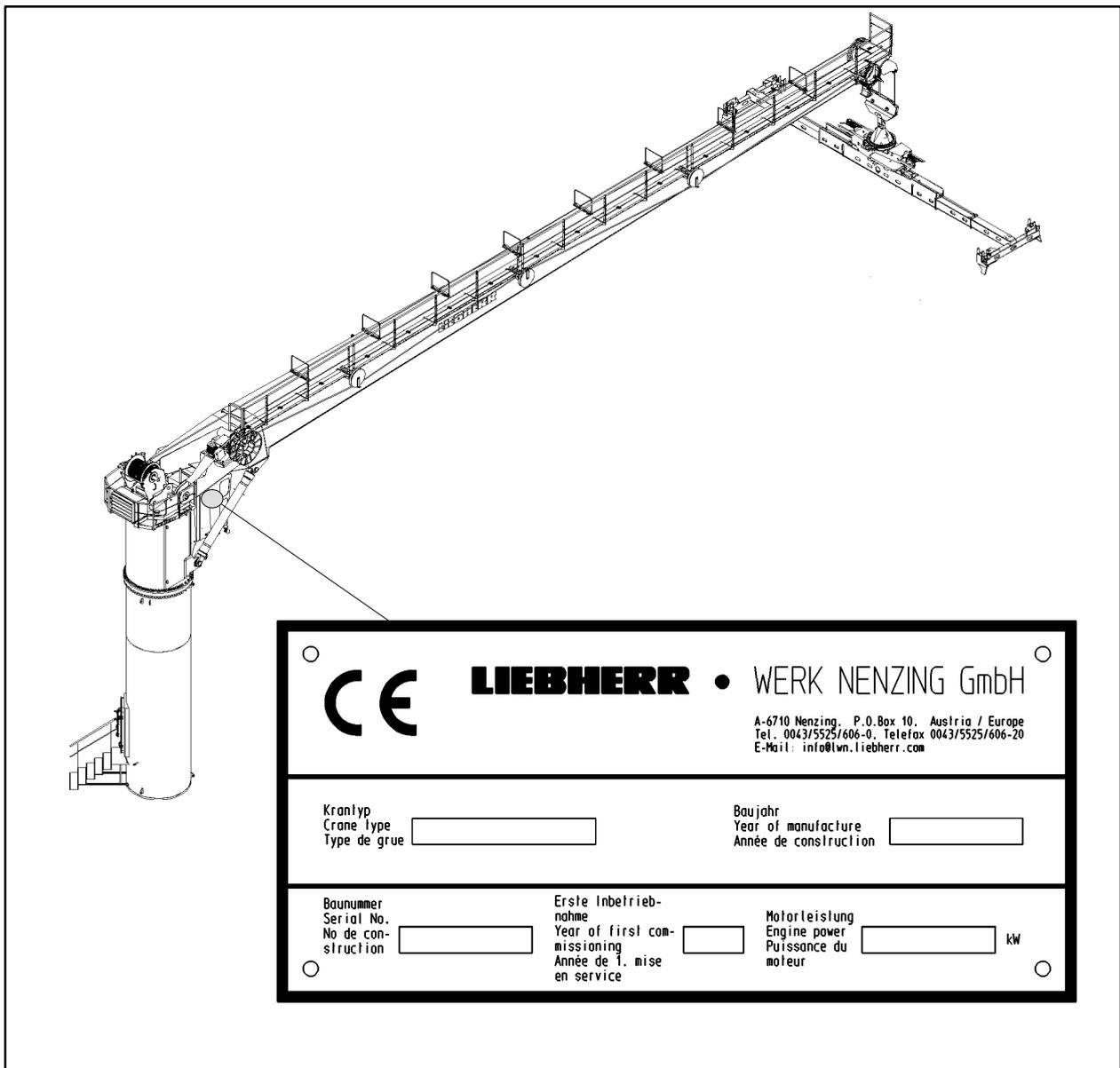
Type: _____

Year built: _____

First start-up(day/month /year): _____

This information is required for e.g. ordering spare parts.

The name plate is arranged on the operator's cabin door.



GENERAL DESCRIPTION

2.3. TECHNICAL DATA

2.3.1. PROOF OF ORIGIN

This Liebherr crane was designed by LIEBHERR-WERK NENZING GMBH in Austria and manufactured in LIEBHERR-SUNDERLAND WORKS, England.



IMPORTANT !

Machinery and Component Data:

In some cases machinery and component-specific data will be recorded by the electronic system. These data serve the manufacturer for the ongoing improvement of function and reliability.

2.3.2. DESIGN CONDITIONS

Certification / Certification society	Liebherr Works Certificate
Ambient temperature	-25 °C to +45°C

2.3.3. WORKING RANGE

- Outreach hoist gear

Minimum radius	3,5 m
Maximum radius	32 m (at 15° boom inclination)

2.3.4. PERMISSIBLE CAPACITIES / SPEEDS

- Main hoisting gear

Maximal hoisting capacity	12 metric tonnes SWL
Reeving	2-fall
Hoisting speed	0 - 30 m/min with full load
	0 - 41 m/min with empty hook
Hoisting height (hook travel)	approx. 30 m

- Luffing gear

Luffing speed	60 seconds (from maximum to minimum radius and full load)
---------------	--

- Slewing gears

Slewing speed	0 - 1,2 rpm with full load
---------------	----------------------------

- Rotator

Slewing speed	1,0 rpm
---------------	---------

2.3.5. ELECTRIC POWER SUPPLY

Main power supply	400 V, 50 Hz, 3 phase
Auxiliary power supply	230 V, 50 Hz, 3 phase

2.3.6. WEIGHT

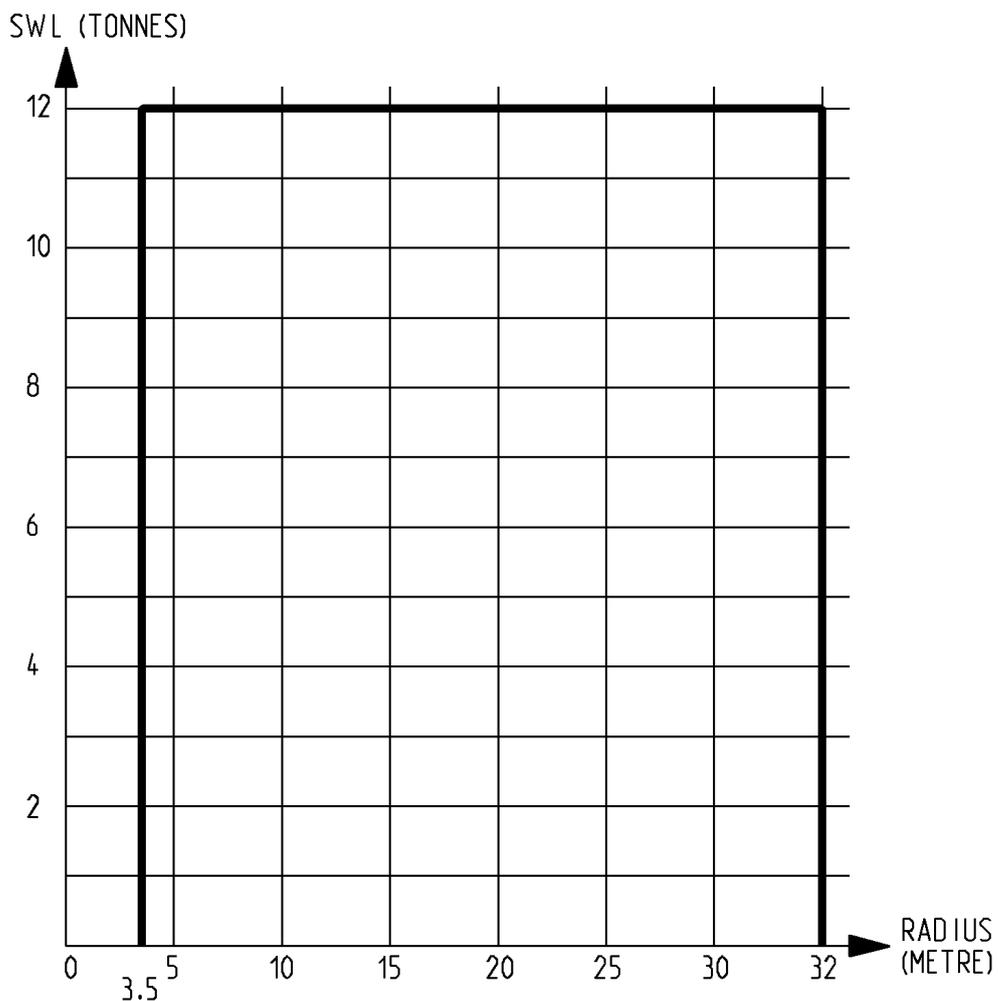
Base column	9,0 tonnes
Slewing column	15,8 tonnes
Boom + spreader	10,6 tonnes
Total weight of crane	approx. 36 tonnes

2.3.7. LOAD CHART

LIEBHERR

CARGO CRANE
 FCC CBW 12/32 ST
 LOAD DIAGRAM

2-FALL OPERATION

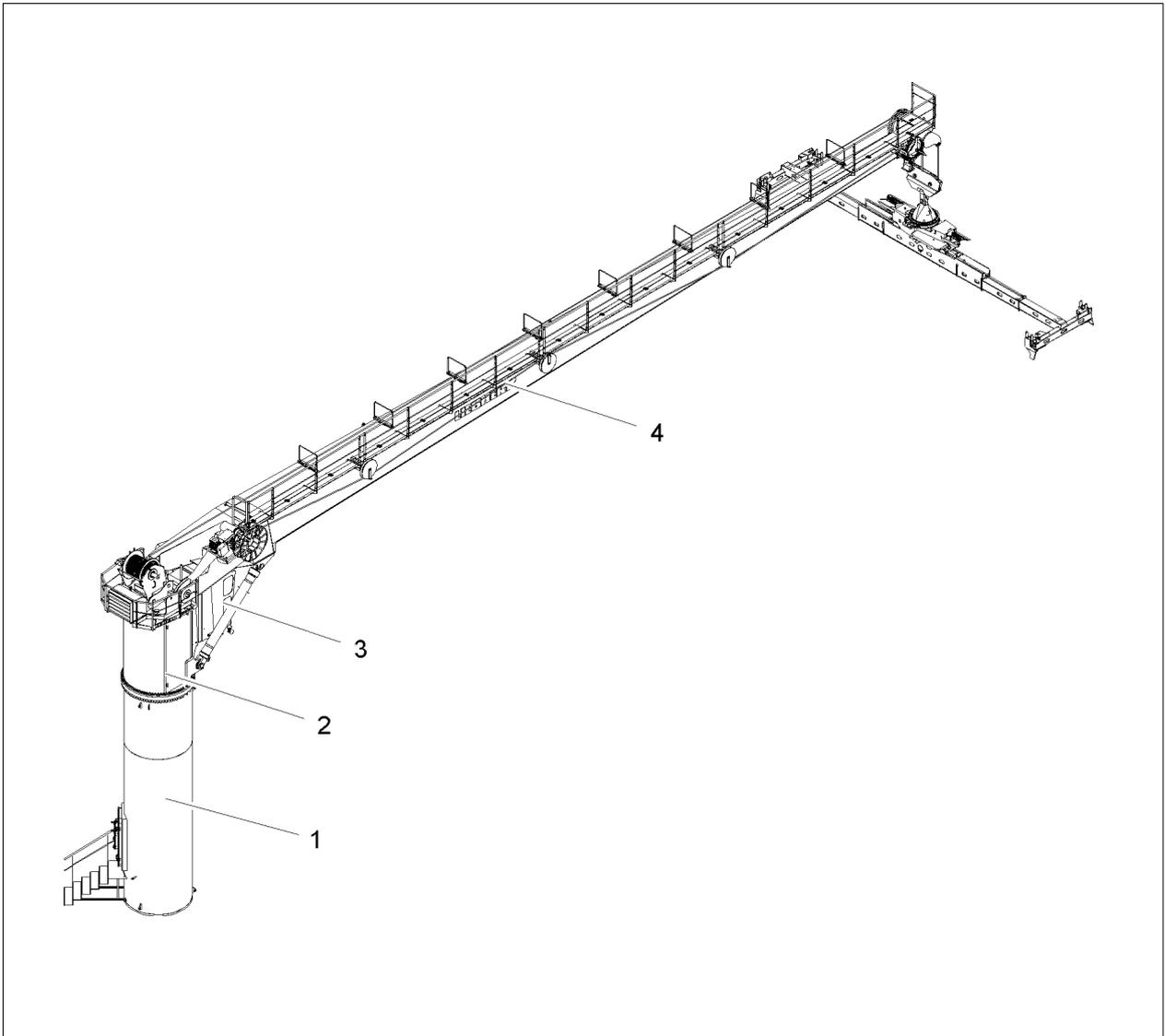


ID.NO.: 959814214 DRAW.NO.: 5107 490 00 00 010 000

2.4. GENERAL ARRANGEMENT

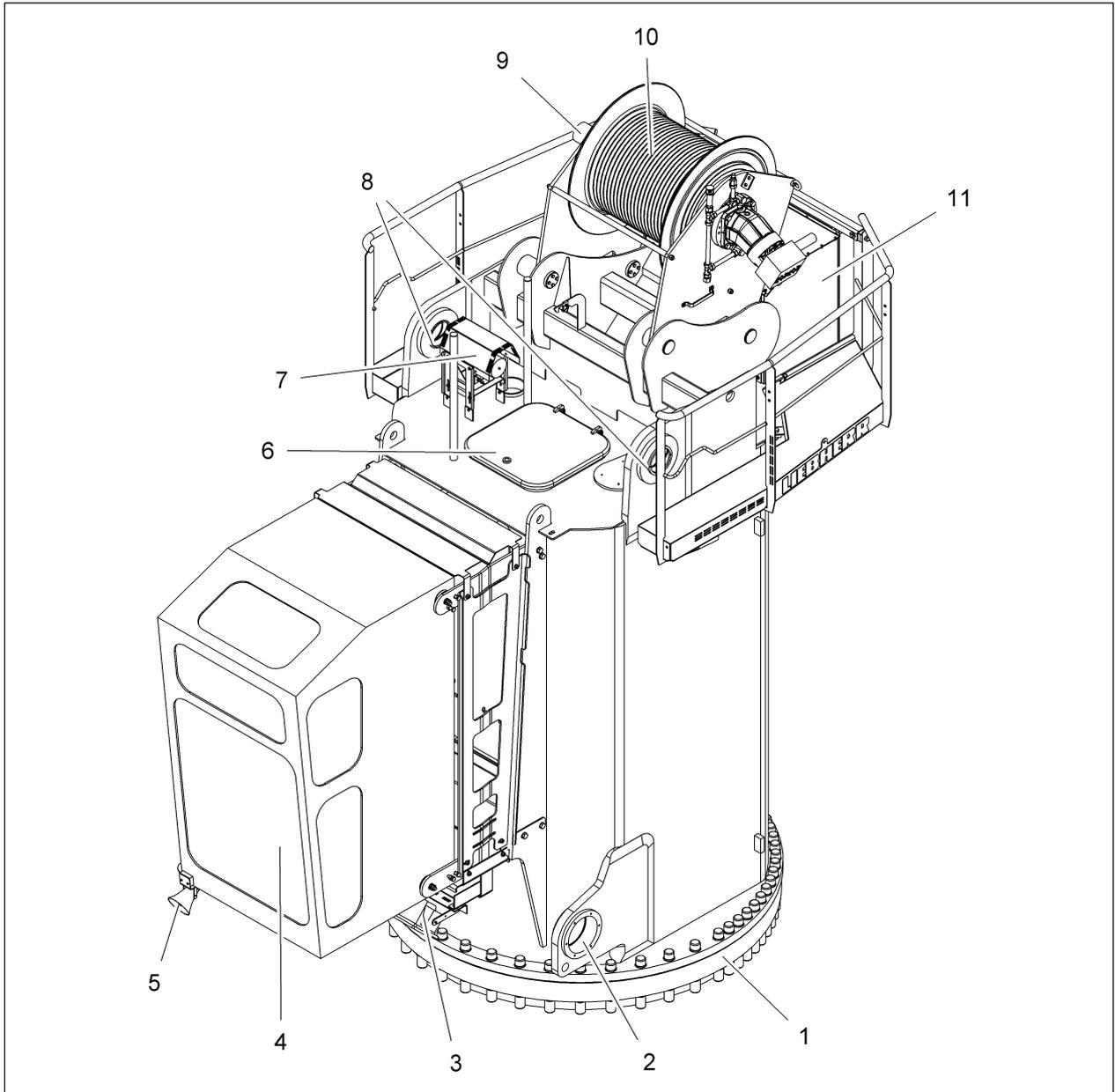
At the following pages the main components of the crane are described generally.

There may be differences to the actual crane configurations because of customized features!



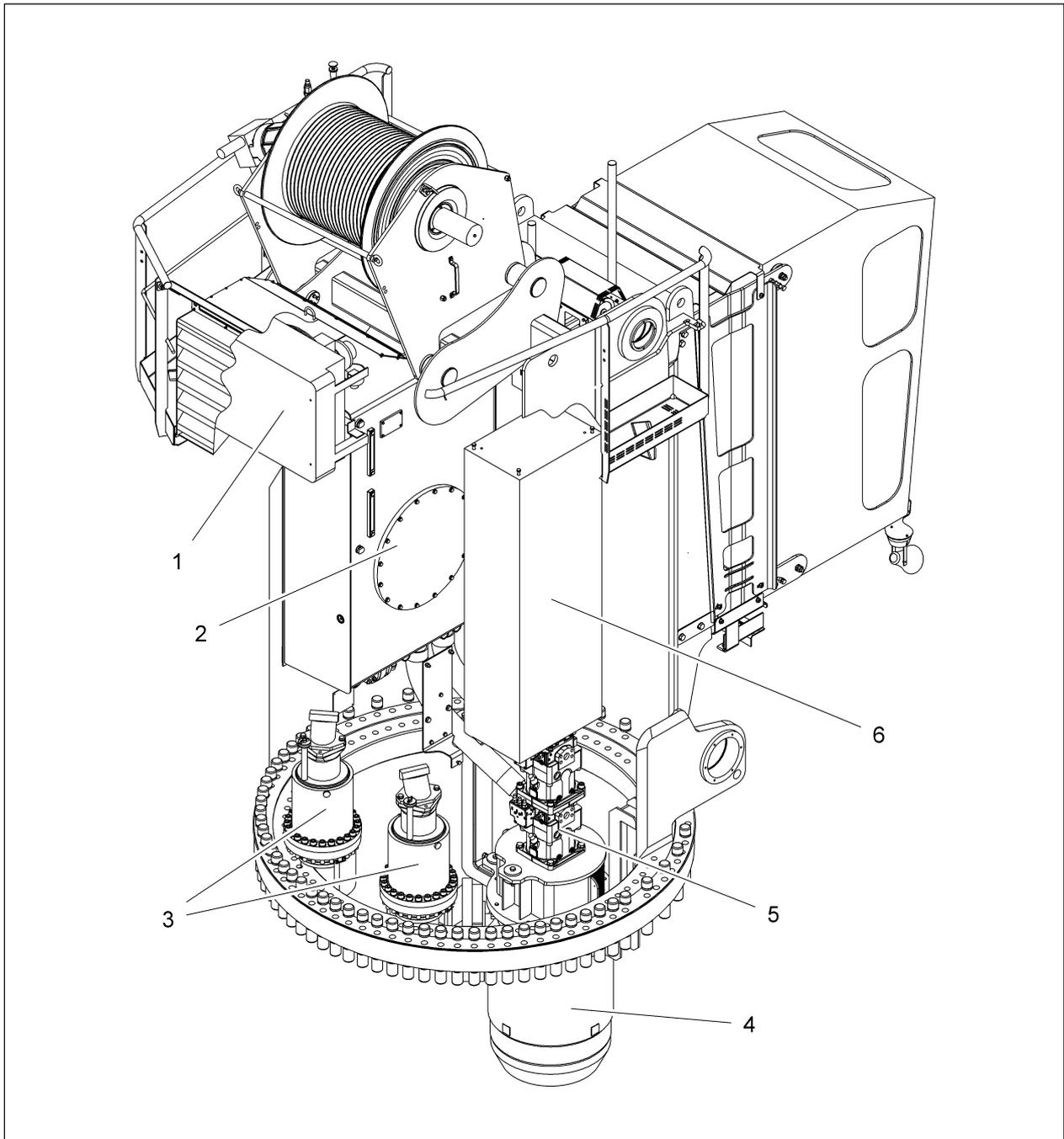
- 1 Base column
- 2 Slewing column
- 3 Operator's cabin
- 4 Boom

2.4.1. SLEWING COLUMN



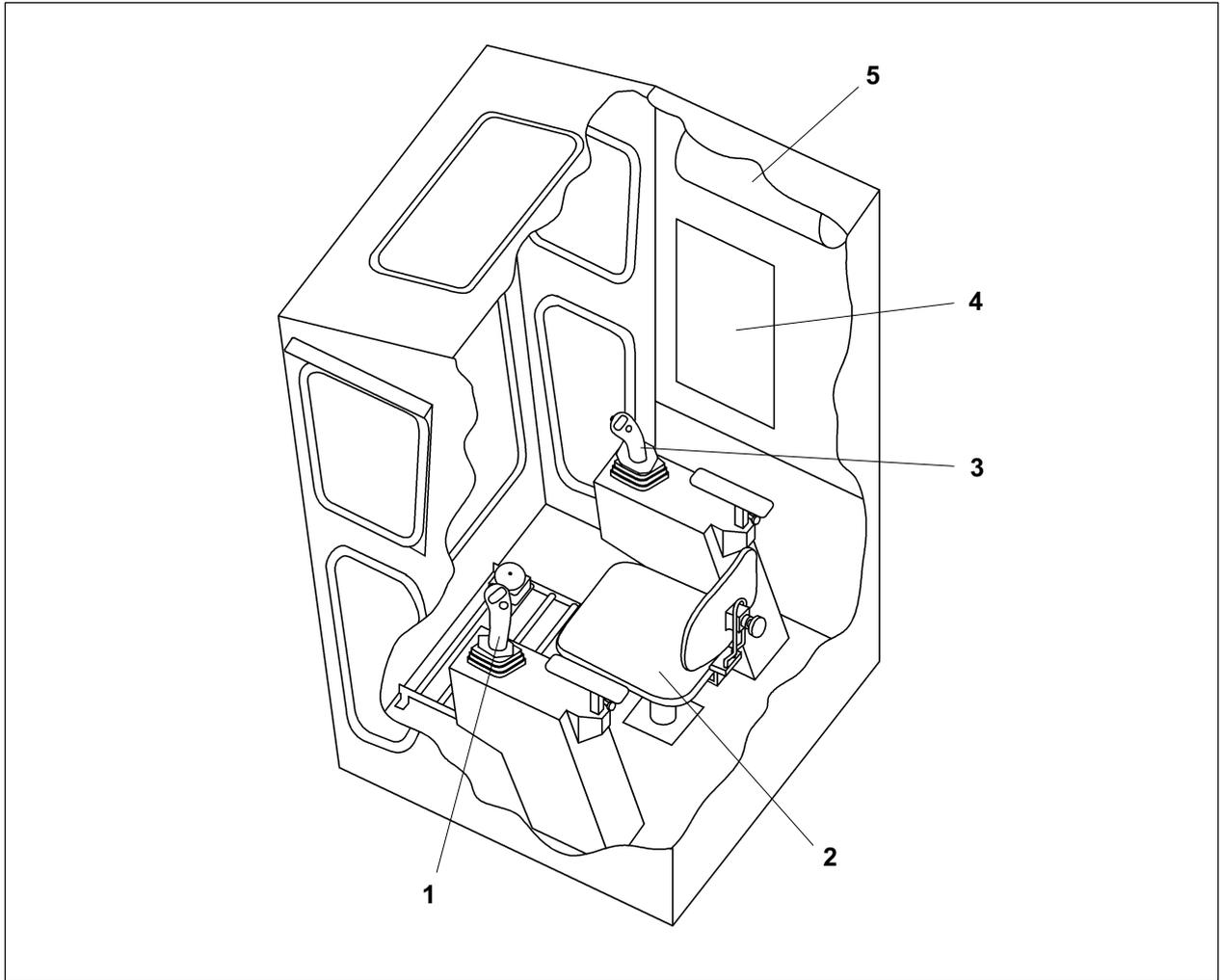
- 1 Slewing bearing
- 2 Pivot bearing for luffing cylinder
- 3 Flood light
- 4 Cabin
- 5 Warning horn
- 6 Hatch
- 7 Limit switch luffing gear
- 8 Boom pivot bearing
- 9 Limit switch hoisting gear
- 10 Hoisting winch
- 11 Oil cooler cover

PRODUCT DESCRIPTION



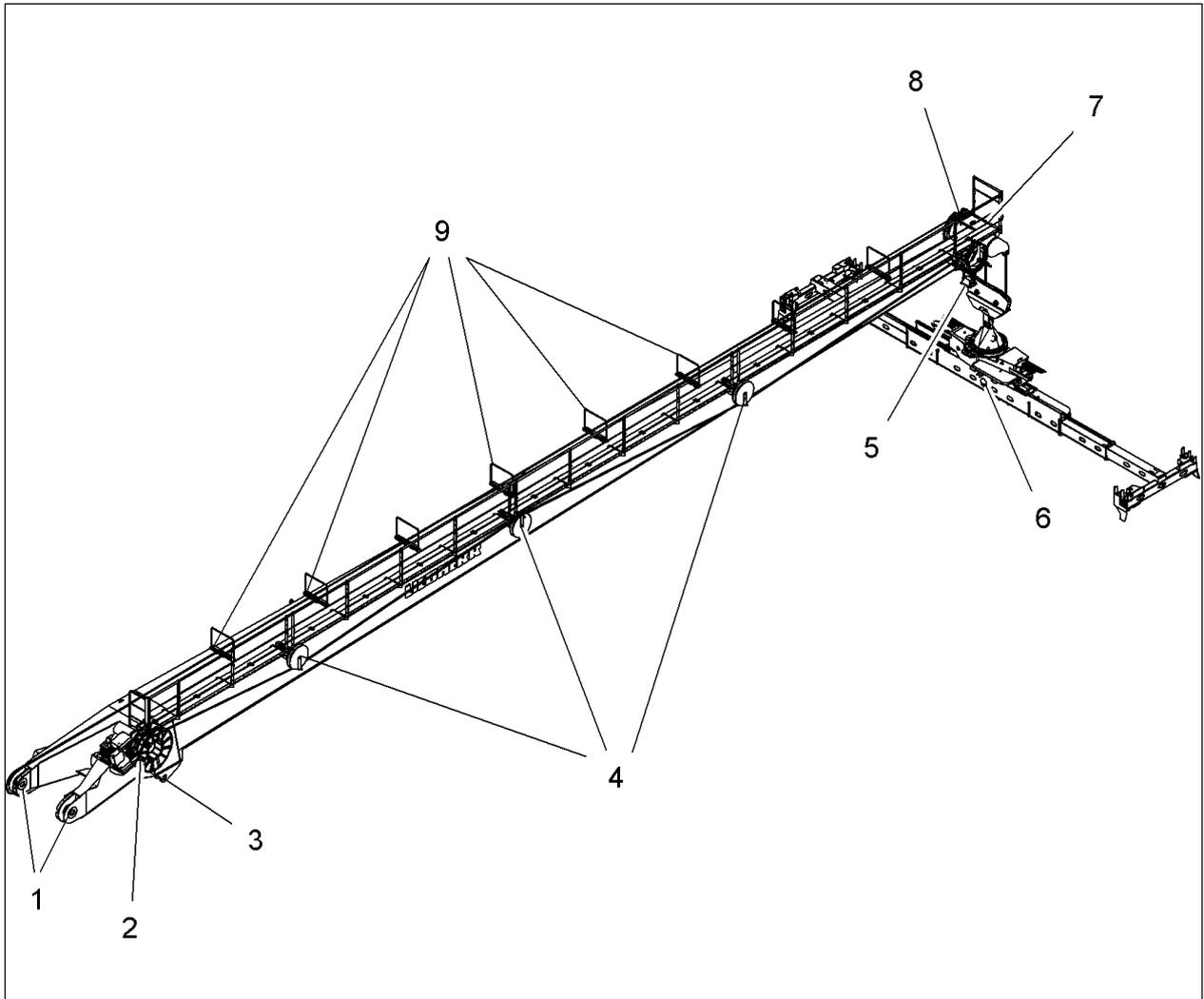
- 1 Oil cooler
- 2 Hydraulic oil tank
- 3 Slewing gears
- 4 Main motor
- 5 Hydraulic pump assembly
- 6 Switch cabinet X1

2.4.2. CABIN



- 1 Lefthanded control lever
- 2 Operators seat
- 3 Righthanded control lever
- 4 Control panel
- 5 Emergency rescue device

2.4.3. BOOM



- 1 Boom pivot bearing
- 2 Cable reel
- 3 Luffing cylinder pivot bearing
- 4 Cable pulleys
- 5 Flood light
- 6 Hook block with spreader rotator
- 7 Boom rest
- 8 Hoisting rope pulley
- 9 Rope guide and protection

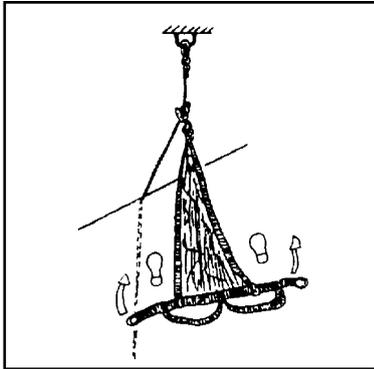
2.5. SAFETY AND RESCUE EQUIPMENT

2.5.1. EMERGENCY RESCUE DEVICE

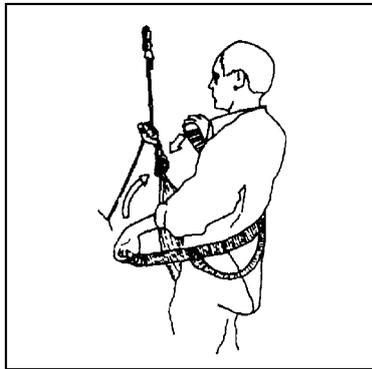
In case of an fire an emergency descent outside the crane is possible.

Procedure of descent:

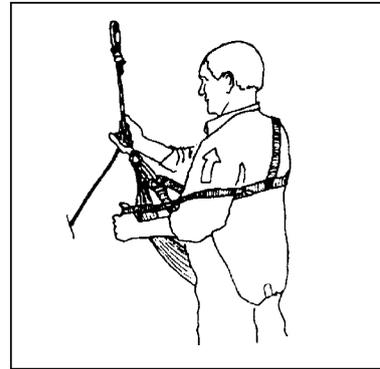
1. Unlock the emergency window (front window) in the cabin by the provided handle
2. Push the window out of the frame (the window can't fall down, it is secured by steel wire)



3. Pull out the complete rescue-device from the box, hang up at special hook and throw the rope outside.
4. Stand with straddled legs over the harness



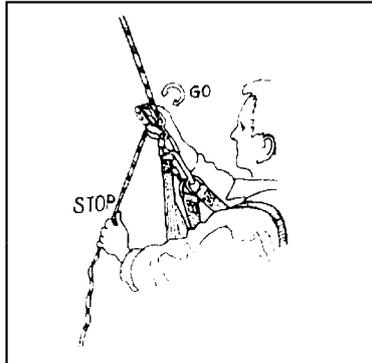
5. Take the harness at the D-rings, lift the harness up to the shoulders and latch the D-rings in the carabiner.



6. Pull over the shoulder-straps.



7. Sitting in the harness, climb out of the window



8. Incoming rope in one hand, brake lever in other hand. Open the brake carefully and regulate the speed with the incoming rope.

STOP: Keep the incoming rope tight and / or release the brake lever !

ATTENTION
Don't use damaged or incomplete equipment !

WARNING !

The procedure of rescue device shall be trained before an emergency case!

MAINTENANCE

- Don't twist the safety rope in order to avoid damages on the rope !
- Brush out dirty rope or clean it with tepid water or fine washing agent (Rinse clear afterwards) !
- A visual inspection has to be done after every use of the rescue device !

ATTENTION !

The rescue equipment must be inspected by a qualified person once a year !

INDEX

3. SAFETY GUIDELINE	3.3
3.1. GENERAL	3.3
3.1.1. DANGER SYMBOLS	3.4
3.2. UTILIZATION AS DIRECTED	3.5
3.2.1. PURPOSE	3.5
3.3. AREAS OF RESPONSIBILITY	3.6
3.4. PERSONAL REQUIREMENTS OF THE CRANE OPERATOR	3.7
3.5. PERSONAL PROTECTIVE GEAR	3.8
3.6. WORK AREA	3.9
3.7. SAFETY AND MONITORING DEVICES	3.9
3.8. SAFETY SIGNS ON THE MACHINE	3.10
3.8.1. MEANING OF THE SAFETY SIGNS	3.10
3.8.2. SAFETY LABEL INSIDE CABIN	3.13
3.9. MACHINE SPECIFIC DANGERS	3.14
3.9.1. INJURIES CAUSED BY MECHANICAL PARTS	3.14
3.9.2. INJURIES DUE TO HYDRAULIC ENERGY	3.15
3.9.3. DANGER OF BURNS	3.15
3.9.4. DANGER OF FIRE AND EXPLOSION	3.16
3.9.5. ENVIRONMENTAL PROTECTION	3.17
3.10. ADDITIONAL DANGERS	3.17
3.10.1. EFFECTS FROM WIND AND STORM	3.17
3.10.2. SNOW AND ICE LOADS	3.19
3.10.3. LIGHTNING STRIKES	3.20
3.11. NOTES ON SAFETY FOR THE MACHINE OPERATOR	3.21
3.12. NOTES ON SAFETY FOR THE BUILDING-SITE PERSONAL	3.21
3.12.1. BANKSMAN	3.21
3.12.2. SLINGER	3.22
3.12.3. HAND SIGNALS	3.23

3. SAFETY GUIDELINE

3.1. GENERAL

Your safety - as machine operator or maintenance technician - is of utmost priority. Any number of occurring situations, problems or malfunctions on the machine can represent serious risk to safety, if you are not fully aware of the measures to take to avoid and prevent possible dangers.

This chapter

- contains information on intended uses,
- contains generally valid information on safety and safety guidelines,
- explains the meaning of symbols and pictograms used in this operating manual and the signs on the machine
- gives information about the necessary protective equipment and which requirements apply to the operating and maintenance personnel,
- gives information concerning dangers and other risks which can also occur during operation of the machine as directed.

Special handling and situation related notes on safety are specified in the following chapters of this operating manual and in further sections of the documentation included in delivery.

State-of-the-art technology

Upon delivery the machine features technology that is currently considered state-of-the-art.

Nevertheless, dangers around the machine must be taken into consideration if the notes on safety in this operating manual are not observed and implemented.

3.1.1. DANGER SYMBOLS

In the operating manual hazards, important information and tips on utilization are characterized with special symbols and signal words. They are always in front of the relevant work step and are marked as follows:



DANGER !

The notes on safety **DANGER**

- indicate **an imminent threat of danger**
- relates to operating and maintenance procedures,
- includes **WARNING** and **CAUTION**.

Disregarding this notice will lead to **severe injuries (disability) or death**.



WARNING !

The notes on safety **WARNING**

- indicate **a dangerous situation**
- relates to operating and maintenance procedures,
- includes **CAUTION**.

Disregarding this notice will lead to **severe injuries or death**.



CAUTION !

The notes on safety **CAUTION**

- indicate **a possibly dangerous situation**
- relates to operating and maintenance procedures,

Disregarding this notice will lead to **severe injuries or serious damages to the machine** and/or otherwise **serious property and environmental damages**.



IMPORTANT !

IMPORTANT indicates tips on readiness of operation that the user has to adhere to. Disregarding these hints **may lead to property and other knock on damages**.



NOTE !

The **NOTE**

- relates to operating and maintenance procedures,
- relates to technical aspects that are helpful and that the user must adhere to.

3.2. UTILIZATION AS DIRECTED

3.2.1. PURPOSE

In principal the machine may only be used for applications as stipulated in the operating manual.

The machine is used as intended when

- national safety regulations are adhered to,
- all safety instructions in this operating manual are kept,
- when all required safety devices are in place and operational,
- when the operating conditions described in chapter 2. "Technical data" are adhered to and all the recommended oils and lubricants are used (see chapter 7.).

Included in use as intended is also timely and complete service and maintenance works by qualified and authorized personnel.

Special application not listed here

- are to be cleared with the manufacturer,
- may only be carried out with the written consent of the manufacturer.

The machine is used for every kind of crane application and is designed for optimal economic operations.

3.3. AREAS OF RESPONSIBILITY

The **operator** or an **authorized person**

- assures that only trained and qualified personnel that has read the operating manual and has especially understood chapter 3 "Safety guidelines" operates and services the machine,
- delegates competence and assigns clear responsibilities to the individual operating and maintenance personnel,
- places the required protective equipment and gear at the disposal of the operating and maintenance personnel,
- regularly checks the safety-oriented work by the personnel,
- is responsible for the safety aspects and condition of the machine,
- shuts down the machine as soon as there is a safety risk involved in its operations,
- performs inspections on the machine based on national regulations in addition to the inspections, stipulated by Liebherr, in the prescribed time and manner,
- assures that the machine is serviced and maintained in the prescribed intervals,
- reports every accident, injury or sizable property damage caused by the machine,
- grants Liebherr-personnel unimpeded access to the machine in connection with their duty of keeping abreast with monitoring the product's performance,
- carefully carries out work plans for the machine.

The **machine operator** has to

- wear the necessary protective gear for his personal safety,
- makes a visual inspection of the machine every day before operating it,
- checks the brakes and emergency equipment daily before starting the machine,
- is responsible for the safe operation of the machine,
- operates the machine within the limits specified in the load chart,
- reports every irregularity that affects the safe operation of the machine to his superior or to the owner of the crane,
- stops operations at once when safe operation is no longer possible,
- after operation lock
 - the operator's cab and the entrance door and
 - safeguards the ignition keys and the key for the operator's cab to prevent any unauthorized use of the machine,
- keeps the operator's cab, wind shields, platforms and steps clean,
- makes sure that
 - before powering up any moving parts, all controls are set to zero or neutral,
 - before powering down all moving parts are set to zero or neutral then switch off the power,
 - securing the emergency controls against unintended start up.

3.4. PERSONAL REQUIREMENTS OF THE CRANE OPERATOR

The crane operator

- must be physically and mentally fit for the job,
- must be trained and qualified to operate the machine,
- must show the owner of the machine proof of his ability to operate it,
- must have read and understood these instructions,
- must know how to administer first aid treatment and know how to use a fire extinguisher,
- must have reached the legal age, as a rule 18 years old, to operate this crane,
- must have passed the prescribed health examination.

Physical demands:

- Adequate vision with unlimited field of view
- Spatial vision must be up to standard
- No color blindness
- Sufficient hearing ability
- Sufficient physical fitness
- Quick reaction times
- Manual dexterity

Mental and character demands:

- Sufficient intellectual abilities
- Spatially imaginative
- Attentive
- Reliable under stress
- Patient
- Generally reliable

The following persons **must not operate** the crane

- alcoholics or drug addicts
- persons who take reflex inhibiting medication

Persons with the following physical symptoms may not resp. if under special medical care only operate the machine in a limited way:

- those who have suffered from epileptic spells or dizziness,
- heart attack
- electronic implants e.g. pacemakers
- Physical impairments e.g. the loss of fingers that limit the ability to operate the machine.

3.5. PERSONAL PROTECTIVE GEAR

Always wear tight fitting protective clothing when operating, maintaining or starting up the machine as well as the correct personal protective gear for each respective task.



WARNING !

There is serious danger of injury from getting stuck in, caught up in or pulled into moving machine parts.

Preventive measures:

- Do not wear loose clothing, scarves, open jackets or open shirt sleeves.
- Do not wear jewelry (rings, bracelets, earrings or similar).

The personal protective gear may comprise of:

- **Protective helmet**, if head injuries can be expected due to
 - bumping into something,
 - objects swinging, dropping, falling over or flying around,
 - long, loose hair.
- **Protective glasses**, if eye injuries are possible due to
 - searing or pressurized liquids,
 - loose flying parts.
- **Ear protectors**, if the sound level is expected to exceed 85 dB(A).
- **Dust filter mask**, for health damaging gases, steam, mist or dust collecting in the vicinity of operation.
- **Protective gloves**, if injuries to the hand are possible due to
 - burns,
 - pointed or sharp edged objects,
 - searing or pressurized liquids.
- **Safety boots**, if injuries to the feet are possible due to
 - banging them into something or jamming them somewhere,
 - stepping on pointed or sharp objects,
 - objects falling down or rolling around.
- **Wearing reflective clothing of striking colors**, if immediate recognition by other personnel is necessary.
- **Special protective clothing**, against danger from burns, freezing, chemical burns, stabbing or cutting injuries to the body.



NOTE !

- The crane operator is responsible himself for
- wearing the required personal protective gear,
 - also for regularly washing and caring for it,
 - for replacing damaged and useless pieces of the protective gear.

3.6. WORK AREA

In accordance with the rules of machine guidance the following guidelines were determined for the operations of the machine:

required operating personnel 1 crane operator

Prescribed working area operator's cab on the slewing column

While operating the machine

- no one beside the crane operator may be on the crane,
- the crane operator may not leave the cab -not even for a brief spell.

The controls may only be used from the operator's seat. Activating any controls through the door of the cab is strictly prohibited.

The requirements for a safe working environment:

- Keep the operator's cab clean: empty ash trays regularly, only place drinking bottles in the provided holders.
- Do not place magazines or other objects on the control panel.
- Do not keep tools in the operator's cab.
- Clothing or parts of the protective gear must not block the exit doors nor limit access to the control panel of the machine.
- Keep the entrance to the operator's cab clean, free from snow and ice and do not block it off with any object.
- Keep the windows of the operator's cab clean, free of condensation and ice.

3.7. SAFETY AND MONITORING DEVICES

- Helicopter warning light (optional)
- Emergency stop keys
- Horn and acoustic signal transmitter outside
- Acoustic signal transmitter inside cabin
- Fire extinguisher (optional)
- Shut-off valve for hydraulic tank

Functions of the signaling devices:

- The warning lights (optional) signal an obstacle in the darkness for air traffic.
- The horn can be sounded by the crane operator.

The fire extinguishers are filled with powder and are approved for fire classification

- firm materials(incl. cable fires)
- liquid and liquefied materials
- burning gases and gaseous materials.

3.8. SAFETY SIGNS ON THE MACHINE

Important safety signs are mounted on the machine. If they are not followed it could lead to serious injuries or even to deaths.



WARNING !

There is a bridge in safety if any safety signs are missing, damaged or illegible.

Preventive measures:

- Constantly check safety signals for their completeness and legibility.
- Immediately replace missing or illegible safety signs with original ones.
- At the delivery of the machine the safety signs are in the language of the relevant country.

If the crane is sold to another country the buyer is obligated to acquire new safety signs in the language of that country from the manufacturer and to mount them on the crane.

3.8.1. MEANING OF THE SAFETY SIGNS

The symbols on the safety signs

- have an exact meaning,
- are divided into three groups with different shapes and colors.

Prohibition signs

These symbols

- are round and have a red signal color,
- are located wherever an action is prohibited that would create dangerous situations.



Fire, naked flames and smoking prohibited.



Access for unauthorized personnel prohibited.



Access for persons with pacemakers prohibited.

Warning signs

These symbols

- are triangular and have a yellow signal color,
- should draw attention to obstacles and situations that could bring about danger to life and limb.



Warning of hovering load.



Warning of dangerous machine drives.



Warning of hot surfaces.



Warning of danger of slipping.



Warning of danger from batteries.



Warning of electromagnetic fields.



Warning of high tension.



Warning of dangerous spot.

Fire protection signs

These symbols

- are rectangular and have a red signal color,
- should draw attention to objects and how to use them in case of fire.



Fire extinguisher

Command signs

These symbols

- are round and blue,
- command wearing personal protective clothing to protect against dangers.



General command signs.



Wear protective helmet.



Wear ear protection.



Wear protective gloves.



Wear protective glasses.



Wear breath protection.



Wear protective boots.

Environmental sign



Keep the environment in mind.

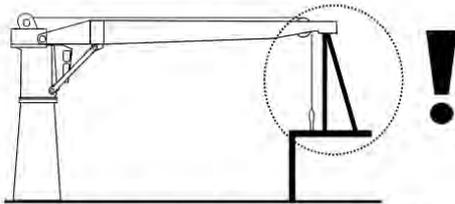
3.8.2. SAFETY LABEL INSIDE CABIN



READ OPERATION MANUAL PRIOR TO CRANE OPERATION ! FOLLOW INSTRUCTIONS IN OPERATION MANUAL !

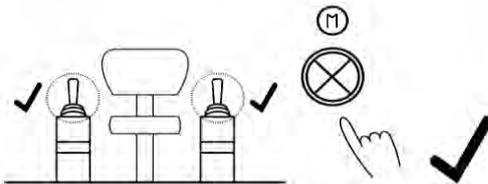


1. UNLASH JIB

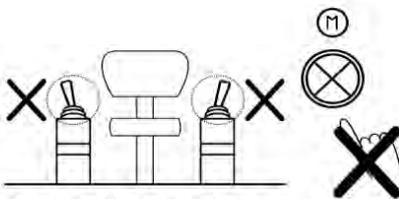


Unlash jib before start-up of crane !

2. MOTOR START-UP

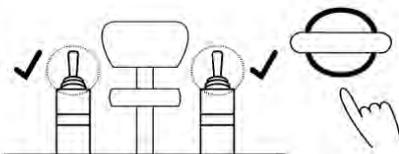


1. Control levers in zero position
2. Press motor start



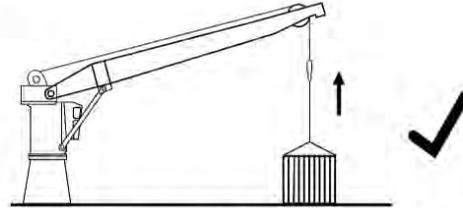
Do not start motor !

3. CRANE IS OUT OF CONTROL

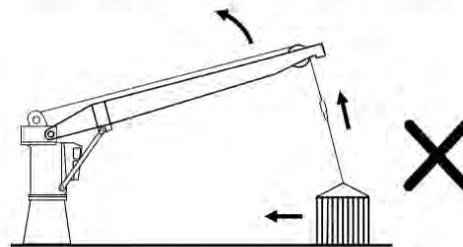


1. Release control levers to zero position immediately
2. Press **EMERGENCY STOP**

4. LOAD LIFTING

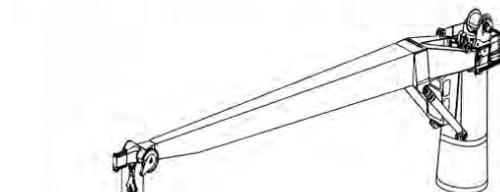


Lift load only with 100% vertical ropes !



Do not drag load in any direction !

5. SIDELEAD / OFFLEAD



Working area

max.sidelead angle
standard lift 5° / 2°
heavy lift 4° / 2°

max.offlead angle 2° / 5°

Do not exceed side pull values stated !

ID.NO. 790528514 DRAW.NO. 0201-725.00.00.899-001

3.9. MACHINE SPECIFIC DANGERS

3.9.1. INJURIES CAUSED BY MECHANICAL PARTS



WARNING !

Numerous areas on and around and situations working with the machine can cause injuries.

Therefore keep the following safety instructions and preventive measures in mind:

- Do not stand under a hovering load!
- No one may stand in the danger zones of the machine.
- Do not reach into moving drives or parts of the machine.
- Only remove protective and safety covers
 - when the machine is at a total standstill **and**
 - secured against accidental restart.
- Access to the slewing column is only permitted
 - to carry out assembly, maintenance or service work,
 - with appropriate safety measures such as wearing slip-free protective boots.
- Do not walk on the roof of the operator's cab.
- Before starting operation, check if all
 - protective covers and casings are mounted correctly,
 - safety devices are functional.
- Do not use damaged cables or cables and chains that are not up to lifting the specified load.
- Always wear protective gloves when handling cables.
- When driving in bolts and pins
 - never align the bolt connections by hand,
 - always use appropriate specialized tools (mandrel, stud wrench, etc.),
 - always wear protective glasses; there is always danger of chipped-off particles of the hardened metal surface hitting the eyes.
- Do not let any object come into contact with the main motor or cooler ventilator. Objects that fall into the ventilator or are dropped into it are shredded and hurled back and can cause severe injuries.

3.9.2. INJURIES DUE TO HYDRAULIC ENERGY

**WARNING !**

Hydraulic oil spraying out under high pressure penetrates clothing and the skin and causes severe injuries.

First aid for injuries:

Bandage injured area with anti-bacterial bandage and call on a medical doctor.

Preventive measures:

- Repairs to hydraulic systems may only be carried out by experienced and specialized technicians.
- Before starting the repairs depressurize all system sections to be opened and all pressure hoses.
- Do not attempt to locate hydraulic oil leakage from small, hard to see orifices by hand but by using a piece of cardboard or wood.
- Check all hoses, hose connections and fittings regularly, at least however **1x annually**, for possible leakage and damages.
- Damages hoses and hose connections are
 - to be replaced by original Liebherr-spare parts,
 - basically **not to be repaired**.

3.9.3. DANGER OF BURNS

**WARNING !**

Certain surfaces and operating units of the machine attain an operating temperature of over 65 °C.

First aid for burns:

First

- run cold water over the burn and cool it down, then
- cover the burn with anti-bacterial bandage and call on a medical doctor.

These safety instructions and preventive measures protect against burns:

- Always wear protective gloves when working on hot components.
- Avoid touching
 - coolant and hydraulic oil bearing parts,
 - hot hydraulic or gear oil,
- Carry out cleaning and maintenance work on the cooled down machine.

3.9.4. DANGER OF FIRE AND EXPLOSION



WARNING !

**While tanking the machine an explosive mixture of gases may be created.
Leaking gear oil or hydraulic oil may ignite on hot surfaces**

Procedure in case of fire:

1. Stop main motor.
2. If possible call for help over the radio.
3. Switch off main power supply and leave the operator's cab.
4. Evaluate the situation:
 - In a dangerous situation leave the machine and call the fire brigade.
 - Only if there is no danger to your person should you start to fight the fire.
5. To fight the fire remove the fire extinguisher from its mount on the machine and prepare it for use.



DANGER !

Hydraulic oil that has caught fire

- can only be successfully put out with the fire extinguisher at the very start of the fire,
- mostly leads after a short time to a full fledged fire and to the total loss of the machine!

6. Finding the seat of the fire. Fight the fire with several short bursts from the fire extinguisher. Only spray the fire from below.
7. While fighting the fire call on the coworkers to
 - alarm the fire brigade,
 - help with putting out the fire by bringing in more fire extinguishers filled with appropriate substances.

Follow these safety instructions and preventive measures:

- Inform yourself on the number and location of the fire extinguishers, familiarize yourself with their usage.
- Before filling the hydraulic tank
 - turn off the main motor,
 - turn off the cab heater.
- While filling the hydraulic tank
 - smoking and any kind of handling of fire or open flame is prohibited,
 - no one may remain in the operator's cab (they might start the machine by accident).
- After tanking only start the diesel engine when
 - the tank cover is closed,
 - the hose of the rig has been removed ,
 - no personnel is in the vicinity of the machine.
- No containers with combustible liquids may be carried on the machine!
- To clean the machine no combustible liquids may be used!
- In the platform area
 - no cleaning towels, rags, etc. may be stored,
 - flammable residues must be removed regularly (e.g. oily spots, dry leaves, fir needles, ashes, waste paper, etc.).
- At the site where the machine is being used, only the amount oil may be stored as is required for the work at hand.

3.9.5. ENVIRONMENTAL PROTECTION

WARNING !

Environmental protection!
Hydraulic and gear oil, cleaning agents or similar mustn't reach the ground, the waters, or the canalization!
Run out oil has to be immediately neutralized by a binder.

3.10. ADDITIONAL DANGERS

3.10.1. EFFECTS FROM WIND AND STORM

The permissible wind speeds within which unlimited operation of the machine or with only reduced load only is possible, depend on the selected operation type and the set-up stage.

This also applies for the maximum permissible wind speeds which when exceeded, operation of the machine should be shut down immediately.

WARNING !

There is great danger of injury if the maximum permissible wind speeds are neglected during operation of the machine!

Wind load on the rear side of the boom

- has the effect of an additional load on the rope hook.

Effects of wind at the rear side of the load

- increase the tail radius,
- possibly lead to oscillation of the load.

Effects of the wind from behind

WARNING !

Optionally mounted walkways on the boom sections reinforce the wind load on the boom.

Wind load on the front side of the boom

- is especially dangerous with maximum boom angle without load.

Effects of the wind on the front side of the load can lead to oscillation of the load. If the load comes into contact with the boom, the boom could be damaged or destroyed.

Effects of wind from the front side

WARNING !

Optionally mounted walkways on the boom sections reinforce the wind load on the boom.

Wind load on the boom and load

- has the effect of an additional inclined hoist

SAFETY GUIDELINES

If it is possible to estimate wind forces and wind speeds using the following charts, if the machine is not in operation.

Wind force		Description of the state of the sea	Wind speed	range	Sea state	Wave height
Beau- fort	Description		knots			m
0	Calm	Sea like a mirror	0	<1	Calm	0
1	Light air	Ripples with the appearance of scales are formed, but without foam crests.	2	1-3	Smooth	0,1
2	Light breeze	Small wavelets, still short but more pronounced. Crests have a glassy appearance and do not break.	5	4-6	Smooth	0,2
3	Gentle breeze	Large wavelets. Crests begin to break. Foam of glassy appearance. Scattered white horses.	9	7-10	Slight	0,6
4	Moderate breeze	Small waves, becoming longer, fairly frequent white horses.	13	11-16	Moderate	1
5	Fresh breeze	Moderate waves, taking a more pronounced long form; many white horses are formed. Chance of some spray.	19	17-21	Rough	2
6	Strong breeze	Large waves begin to form; white foam crests are more extensive everywhere. Probably some spray.	24	22-27	Very rough	3
7	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.	30	28-33	High	4
8	Gale	Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.	37	34-40	Very high	5,5
9	Strong gale	High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.	44	41-47	Very high	7
10	Storm	Very high waves with long over-hanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of wind. On the whole the surface of the sea takes a white appearance. The 'tumbling' of the sea becomes heavy and shock-like. Visibility is affected.	52	48-55	Phenom- enal	9
11	Violent storm	Exceptionally high waves (small & medium sized ships might be lost to view for a time behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility is affected.	60	56-63	Phenom- enal	11,5
12	Hurricane	The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected	64+			14

⚠ CAUTION !

Please note in particular all wind-related safety guidelines and protective measures in the initial pages of the valid load chart, as well as the following additional points:

- o Even before the application planning, the wind conditions for the job site and the weather predictions for the period of operation planned must be known and taken into consideration.
- o The machine operator must be aware of the weather report and the actual wind speed at the machine's job site before beginning work. If impermissibly high wind speeds are expected in the next few hours, operation should be aborted and protective measures against the storm damage should be taken.
- o During operation of the machine with permissible wind speeds
 - respect dangerously high gusts of wind,
 - if large items with expansive surfaces with reduced load only (e.g. prefabricated limits),
 - move the loads carefully and slowly and avoid every oscillation.

⚠ DANGER !

If the maximum permissible wind speed is exceeded, shut down operation immediately:
Lower the load and leave the machine in the parking position.

The parking position

- is suitable for conditions above the maximum permissible wind speed during crane operation, up to a wind speed of 25 m/s; corresponding to wind force 10,
- is determined for the different main operation types under point "Parking position".

⚠ DANGER !

It is hazardous to remain in the immediate vicinity of the machine during wind speeds of over 25 m/s!

The occurring wind loads could lead to partial or complete destruction of the boom and could tip the machine.

Countermeasures:

With wind speeds exceeding 25 m/s or Beaufort 10, the complete boom must be laid down in rest position.

3.10.2. SNOW AND ICE LOADS**⚠ DANGER !**

Danger of accident due to chunks of ice breaking loose and falling down.

Increased danger of damage due of frozen hoist limit switch on the boom.

Countermeasures:

- o Lay down the boom and carefully chip off the larger deposits of ice.
- o Remove ice from all sensitive parts, such as hoist limit switches, guides, etc.

⚠ CAUTION !

Deposits of snow and ice on the boom

- increase the weight of the boom,
- enlarge the surfaces susceptible to wind.

These factors lead to a premature shutting down of the load moment limitation (LMB) - it can no longer be operated with the maximum permissible load.

Considerable amounts of snow can accumulate on the optionally mounted walkways on the boom.

The load moment limitation (LMB)

- should only be engaged in the event of an emergency,

SAFETY GUIDELINES

- may not be used operationally as a safety measure against overloading,
- is no replacement for faulty assessment properties during crane operation or as inadequate work experience for the machine operator.

3.10.3. LIGHTNING STRIKES

 **WARNING !**

When lightning strikes, there is danger of injury to all persons in the immediate vicinity of the machine from electric shocks or dangerous level of voltage.

Countermeasures:

- o Lay down the boom of the machine punctually before the storm begins.
- o Do not remain or leave any large metal objects in the immediate vicinity of the machine during the thunderstorm.

 **NOTE !**

Within the interior of the locked operator's cab, the machine operator is largely protected from the direct affects of the lightning. The operator's cab acts as a Faraday cage and channels the lightning charge safely over the machine.

Laying down the main boom is discretionary and is the responsibility of the machine operator, especially at sites with regular thunder storms or restricted working area.

The manufacturer expressly recommends that the main boom be lain down punctually when a thunderstorm is brewing

- with long boom lengths,
- on exposed terrain,
- near riverbanks.

 **CAUTION !**

A strike can cause major damage to the machine, including:

- o Total shut-down of the Litronic-control.
 - o Local welds and damage to bearings on the rotary connection between slewing platform and mast.
- Measures in accordance with a confirmed or suspected lightning strike to the machine:
- o Thoroughly inspect the machine. Especially for damaged cables or lines and check for leaks
 - o Check functioning of the entire control.
 - o Move the swing gear slowly listening for distinct noises coming from the rotary connection, especially in the swing.
 - o Lay down the boom and inspect for damage. Repair any damage to the paintwork at the point of impact.

3.11. NOTES ON SAFETY FOR THE MACHINE OPERATOR

Due to the numerous options of the machine, the operating manual can not describe all situations and dangers that may occur during operation.

It is therefore important for the machine operator,

- to know the performance capabilities and operating limitations of the machine off by heart
- to know all safety devices of the machine,
- to request information from the manufacturer immediately, if an undocumented, dangerous situation concerning the machine occurs.

As machine operator, be aware of all details that come within your area of responsibility.

Be aware of all local safety regulations for the machine's job site.

Please note the special safety regulations in the following chapters of this operating manual:

Chapter 5 - for start-up and operation of the machine

Chapter 7 - for maintenance work on the machine to be carried out by yourself!

3.12. NOTES ON SAFETY FOR THE BUILDING-SITE PERSONAL

No persons may remain in the danger area of the machine during operation.

The danger area is the area around the machine within which persons may be injured via

- working movements of the machine,
- a falling or swinging load,
- optional accessories on the machine.

All boundaries bordering the danger area around the machine can neither be climbed over, repositioned or removed.

Instructions of the machine operator are to be administered as follows and the acoustic warning signals of the machine have to be observed.

Standing in the immediate vicinity of the machine can be especially dangerous

- during a storm or thunderstorm.

3.12.1. BANKSMAN

The national guidelines for utilization of a banksman and the signals to be used should be adhered to.

An banksman should generally be available to the operator of the machine

- whenever the working or travel area is no longer completely visible from the operator's cab,
- when operating the machine and load in confined areas

Only one banksman may work with the machine operator at a time. Should several banksmans be in the vicinity of the machine, the banksman that is actually giving the instructions must be clearly noticeable (for example, wearing a luminous vest).

The banksman may not stand in the danger area of in the immediate vicinity of the machine's path of travel.

The danger area around the machine, or the path of travel should be monitored by the banksman. The load may never be directed above the heads of persons below. Persons should therefore be requested to leave the danger area immediately.

the banksman may not carry any other tasks during his instruction duties that may distract him.

Notes on safety of assisting with radio

Before operation

- Check the battery capacity of the radio equipment, and if necessary, have replacement batteries ready,
- Check the radio connection to the machine operator and in the event of a fault arrange a different transmission frequency.

SAFETY GUIDELINES

Handle the radio equipment with care and protect against humidity.

Notes on safety for assisting with hand signals.



WARNING !

Misunderstood hand signals between banksman, slinger and machine operator can lead to serious accidents!

Countermeasures:

- o When assisting, always remain in visual contact with the machine operator and always stand in a good viewing position. Arrange for sufficient lighting for night-work.
- o For signalling, wear clearly visible (e.g.) white gloves.
- o The hand signals
 - should be given slowly and clearly,
 - are to be arranged with the machine operator and slinger beforehand, especially with special applications.
- o When working together with the slinger, the banksman relays his hand signals to the machine operator.
- o Machine operator, banksman and slinger always carry an overview of all hand signals used about their person.



NOTE !

A compilation of common hand signals can be found in the following pages.

3.12.2. SLINGER

During operation of the machine, the slinger is responsible for the safety-technical, faultless and careful slinging for releasing of the load.

The slinger, therefore, only uses suitable, undamaged lifting and slinging equipment, preventing the load from either sliding or falling.

The slinger always wears gloves when carrying out his tasks. He may only approach the load with the consent of either the assistant or the machine operator. Standing under a raised load is prohibited.

The slinger

- remains in view or in radio contact with the assistant and follows his instructions,
 - reports his accessing of leaving of the danger area around the machine operator.
- Standing under a raised load is prohibited.

If there is no assistant available, the slinger works together with the machine operator directly.

When using hand signals, the same notes on safety as those for the assistant apply.

3.12.3. HAND SIGNALS

The hand signals

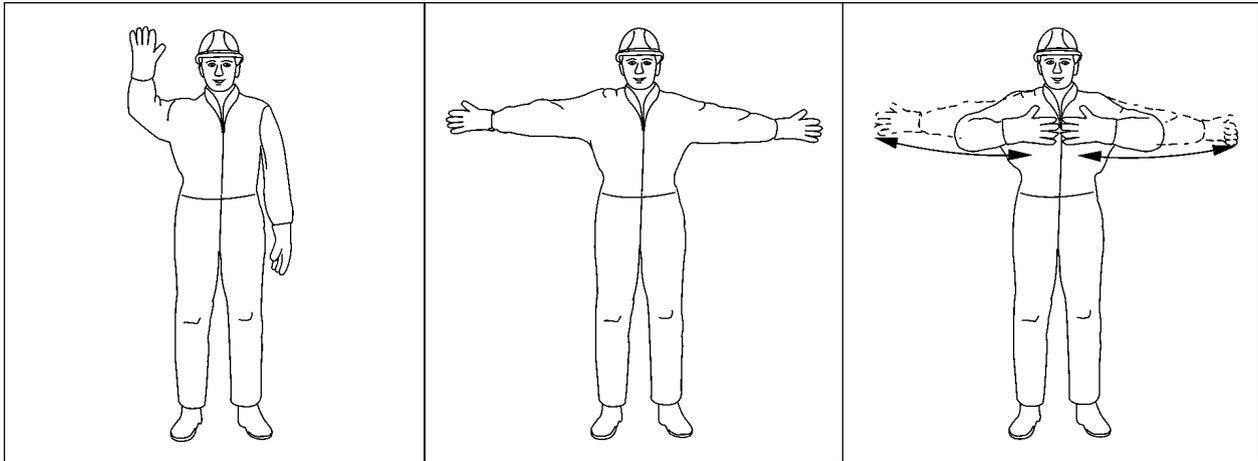
- serve as communication with visual contact between machine operator and ship's crew, e.g. assistant and slinger,
- are clearly stipulated in their configuration in certain national standards.

It must therefore be agreed between all persons involved which hand signals are to be used.

The following summary is limited to common hand signals in

- Germany in accordance with BGV A8,
- the United States of America in accordance with ASME/ANSI B30.5.
- special hand signals for lifting gear operation.

General hand signals in accordance with BGV A8



Caution, Start, Attention

Hold the right arm stretched upwards.
The palm faces forward.

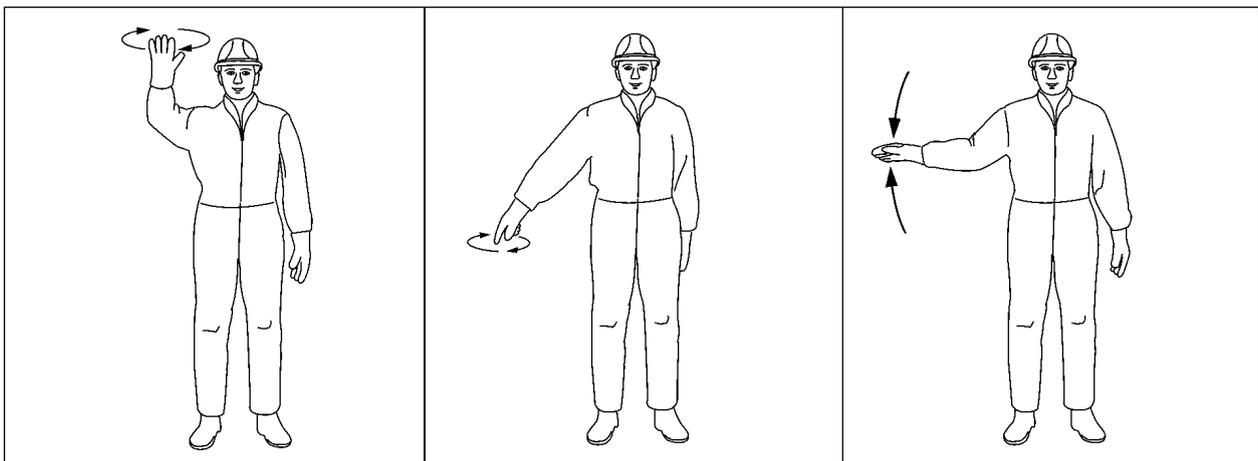
Stop, Interruption, do not continue movement

Stretch out both arms to the side, horizontally.
The palms face forward.

Stop - Danger

First stretch out both arms to the side, horizontally.
The palms face forward.
Now bend in and stretch out the arms alternatively.

Hand signs, vertical movements



Lift, Up

Hold the right arm upwards.

The palm faces forward making a slow circling motion.

Lower, Down

Hold the right arm down.

The palm faces inwards making a slow circling motion.

Slowly

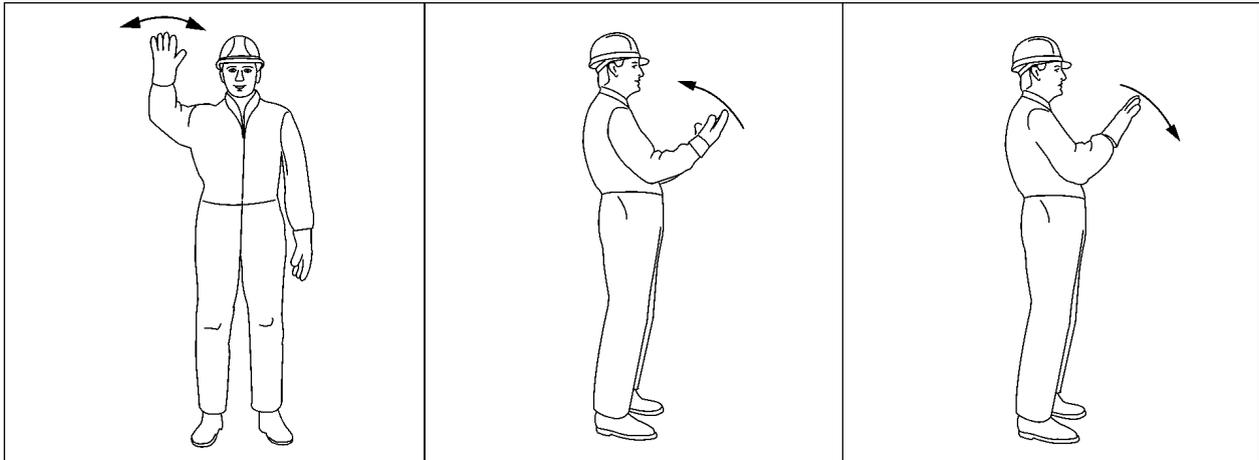
Stretch out the right arm horizontally

The palm faces down and is moved slowly up and down.

SAFETY GUIDELINES

General hand signals in accordance to BGV A8, continuation

Hand signals, horizontal motions

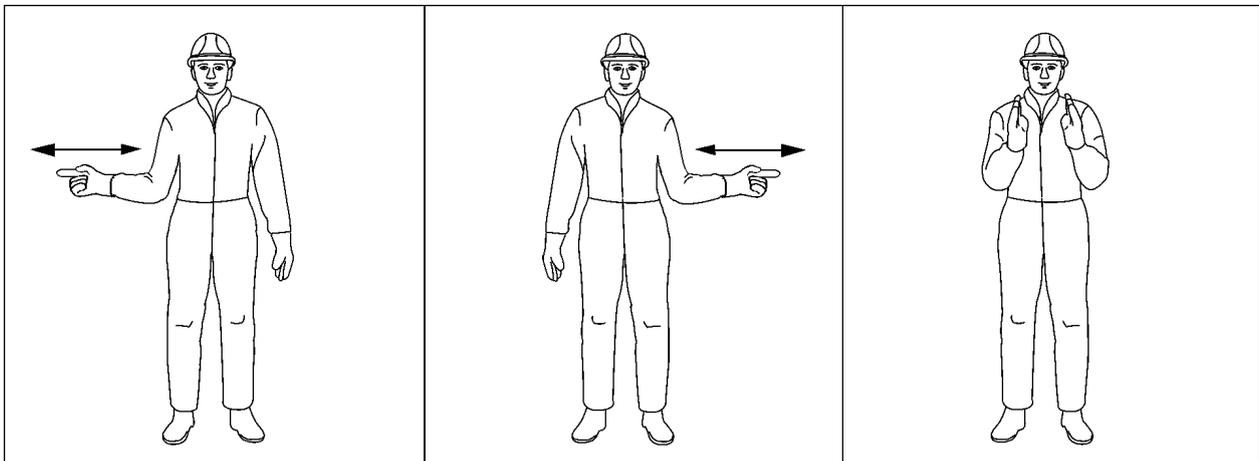


Coast down
 Hold the right arm upwards.
 The palm faces forwards.
 Move the arm back and forth
 to the side.

Approach
 Bend both arms.
 The palms face inwards.
 Wave in with the forearms.

Leave
 Bend both arms.
 The palms face outwards.
 Wave out with the forearms.

Hand signals, horizontal motions

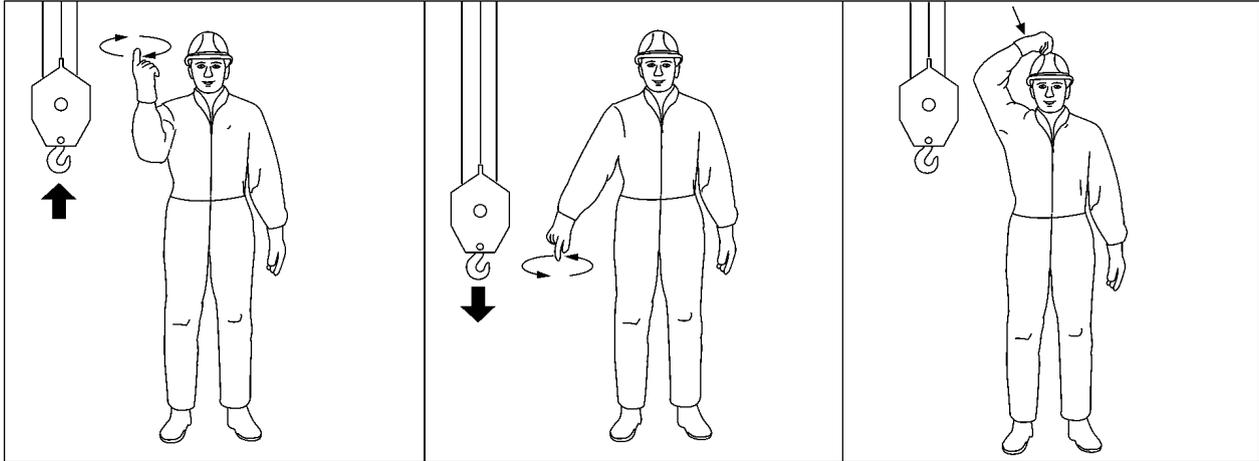


Travel right (from the assistant's angle)
 Gently wave in the right arm
 while move back and forward to
 to the side

Travel left (from the assistant's angle)
 Gently wave in the left arm while
 holding up horizontally and move
 back and forward to the side

Indicate reduction of distance
 Hold both palms parallel and
 bring together to the correspond-
 ing distance.

Hand signals for lifting operation in accordance with ASME/ANSI B30.5

**Lift load**

Bend out the right arm and hold it upwards.
The stretched out index finger points upwards.
The hand makes small, circular movements.

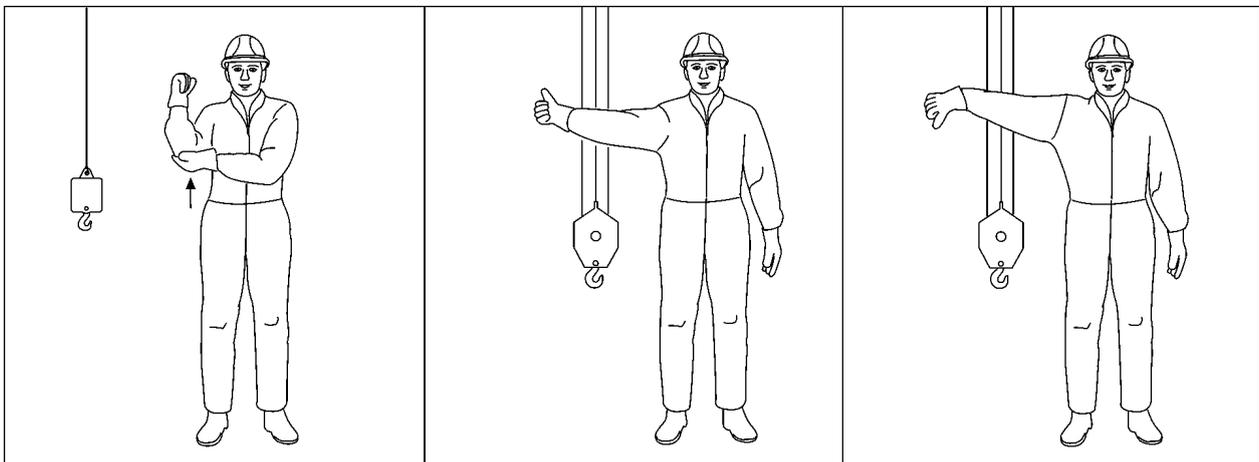
Lower load

Hold the right arm downwards.
The stretched out index finger points downwards.
The hand makes small, circular movements.

Use main winch

Rap on the protective helmet with the fist.
Then give further hand signals.

Hand signals ASME/ANSI B30.5

**Use auxiliary winch**

Bend out the right arm and hold upwards.
Rap on the elbow from underneath with the left hand.
Then give further hand signals.

Raise main boom

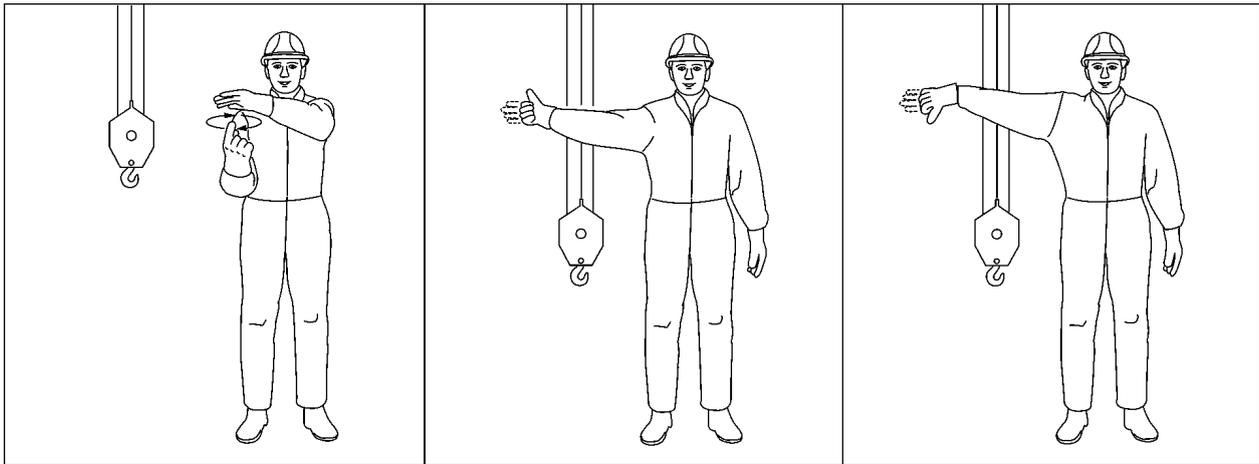
Stretch out the right arm horizontally.
The thumb points upwards, all other fingers remain closed.

Lower main boom

Stretch out the right arm horizontally.
The thumb points downwards, all other fingers remain closed.

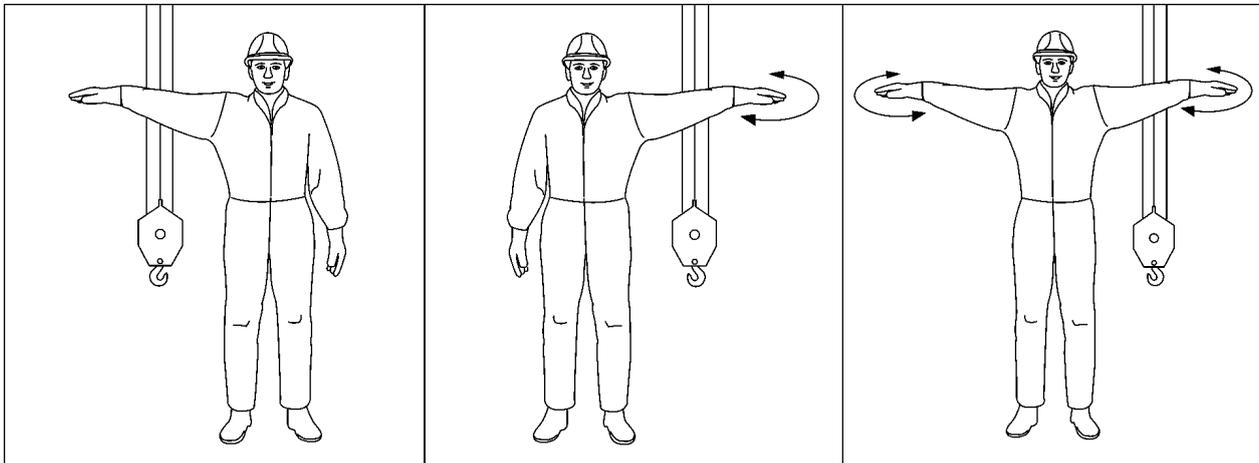
SAFETY GUIDELINES

Hand signals in accordance with ASME/ANSI B30.5, continuation



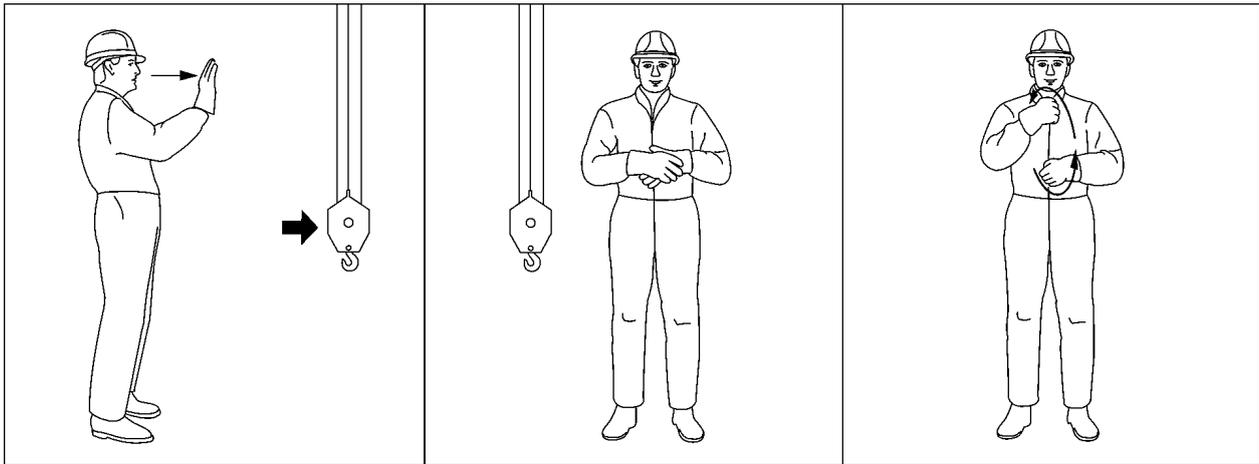
<p>Move slowly Give the hand signal for the desired movement with one hand. Hold the other hand above it or below it. Example: Raise load slowly.</p>	<p>Lift main boom and lower load Stretch out the right arm horizontally. The thumb points upwards. Stretch and bend in the remaining fingers alternatively for as long the load has to be lowered.</p>	<p>Lower main boom and lift load Stretch out the right arm horizontally. The thumb points downwards. Stretch and bend in the remaining fingers alternatively for as long as the load has to be lifted.</p>
---	--	--

Hand signals in accordance with ASME/ANSI B30.5



<p>Swinging Stretch out the right or left arm horizontally. The palm faces downwards. The pointed fingers point in the swing direction.</p>	<p>Stop Stretch out one arm horizontally. The palm faces downwards. Swing the arm back and forwards horizontally.</p>	<p>Emergency stop Stretch both arms horizontally. The palms face downwards. Swing both arms back and forwards horizontally.</p>
--	--	--

Hand signals for lifting operation in accordance with ASME/ANSI B30.5, continuation

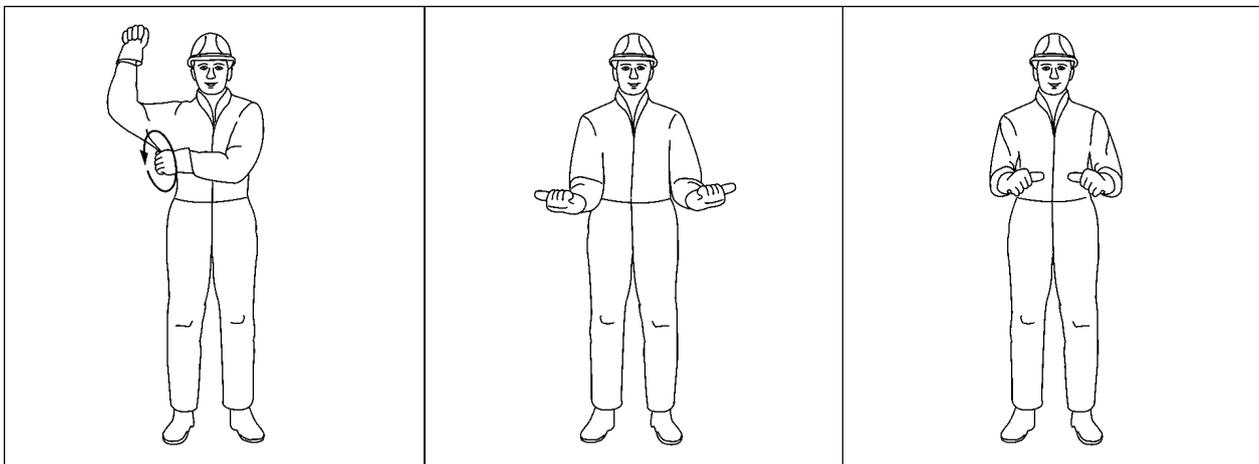


Travel
Stretch out one arm forwards.
The palm faces forward and is gently raised.
Make a movement in the travel direction with the open hand.

Shut down and lock machine
Hook in your hands in front of your body.

Travel with both crawler tracks
Hold both fists in front of the body.
Indicate travel direction with circular movements (forwards or backwards).

Hand signals in accordance with ASME/ANSI B30.5



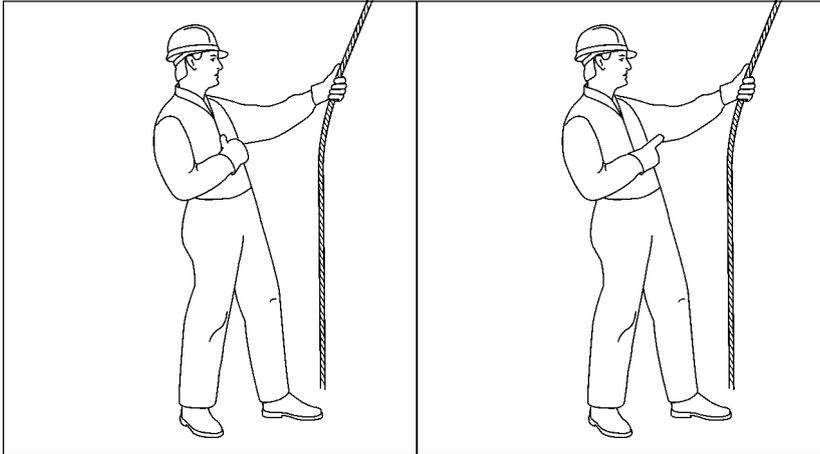
Travel with one crawler track
Bend out the arm with the fist raised on the side of the crawler track that has stopped.
Bend out the other arm in front of the body.
Indicate the travel direction via circular movements with the fist (forwards and backwards).

Extend boom (Telescopic arm)
Hold both fists in front of the body.
The thumbs point outwards.

Retract boom (Telescopic arm)
Hold both fists in front of the body.
The thumbs point toward each other.

SAFETY GUIDELINES

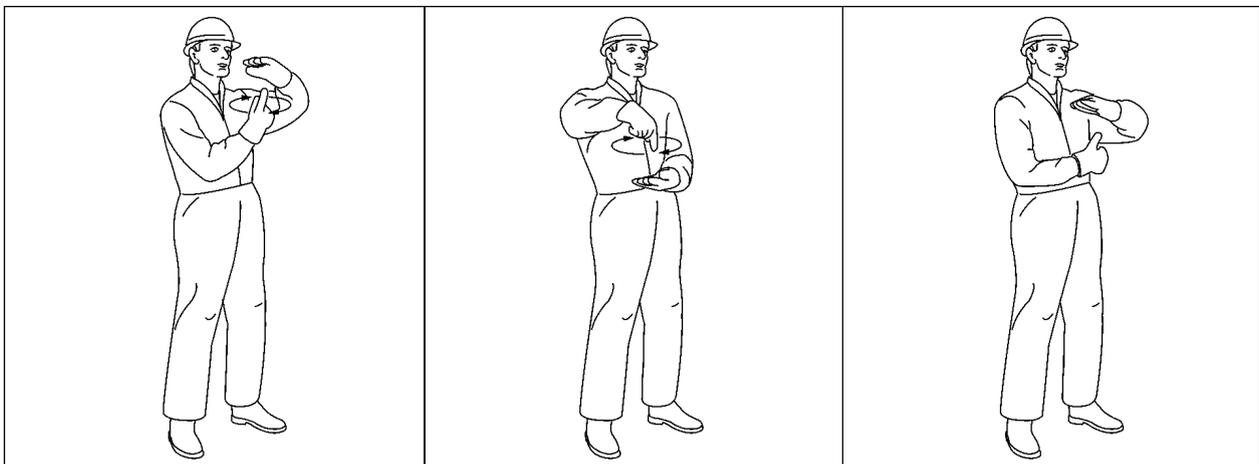
Hand signals for lifting operation in accordance with ASME/ANSI B30.5, continuation



<p>Extend boom (Telescopic arm) One-handed signal: Hold one fist in front of your chest. The thumbs point to your chest.</p>	<p>Retract boom (Telescopic arm) One-handed signal: Hold one fist in front of your chest. The thumbs point outwards.</p>
--	--

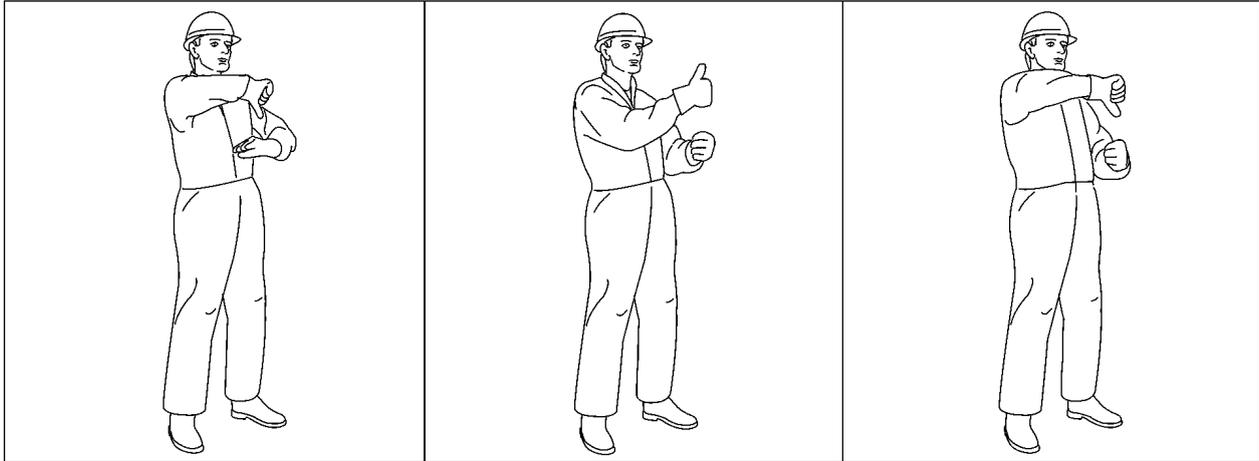
Special hand signals for lifting operation

No special standards have been allocated to these hand signals and they complete the quoted hand signals.



<p>Lift load slowly Bend out the right arm and hold it upwards. The pointed index finger points upwards. The right hand makes small, circular movements. Stretch out the left hand and hold it over the right hand.</p>	<p>Lower load slowly Hold the right arm downwards. The pointed index finger points downwards. The hand makes small, circular movements. Hold the left hand down. The palm faces upwards.</p>	<p>Lift main boom slowly Bend out the right arm. The thumb points upwards. Hold the left hand above it.</p>
--	---	---

Special signals for lifting operation, continuation

**Lower main boom slowly**

Bend out the right arm.
The thumb points downwards.
Hold the left hand down. The back of the hand faces upwards.

Lift main boom and hold load

Bend out the right arm.
The thumb points upwards.
The left hand makes a fist under the right hand.

Lower main boom and hold load

Bend out the right arm.
The thumb points downwards.
The left hand makes a fist under the right hand.

Special signals

**Lift main boom and lower load**

Bend out the right arm.
The thumb points upwards.
Bend out the left arm.
The index finger points downwards.
Hold the left hand under the right hand and rotate.

Lower main boom and lift load

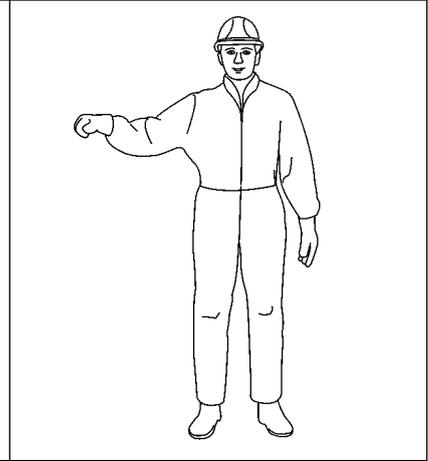
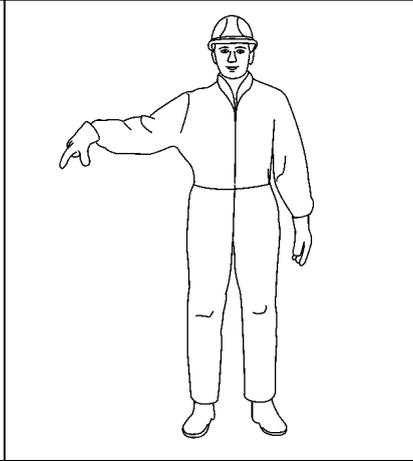
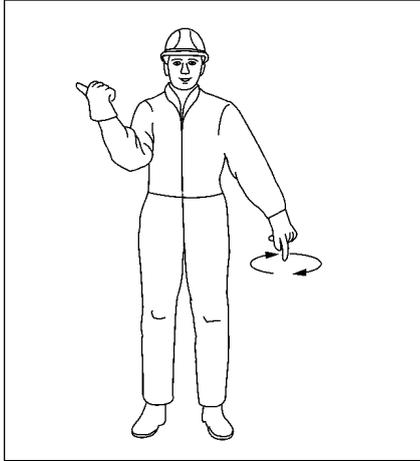
Bend out the right arm.
The thumb points downwards.
Bend out the left arm.
The index finger points upwards.
Hold the left hand under the right hand and rotate.

Swing slewing platform to the right

Bend out left arm and hold up.
The thumb points outwards with the direction of swing.
Stretch out the right arm downwards.
The index finger points downwards. The hand makes small, circular movements.

SAFETY GUIDELINES

Special hand signals for lifting operation, continuation



Swing slewing platform to the left

Bend out the left arm and hold up.
The thumb points outwards with the direction of turn. Stretch out the left arm downwards.

The index finger points downwards. The hand makes small, circular movements.

Open grapple

Stretch out the right arm horizontally.
Hold the hand downwards with fingers semi-open.

Close grapple

Stretch out the right arm horizontally.
Close the hand into a fist.

INDEX

4.	CONTROL AND OPERATING ELEMENTS	4.3
4.1.	GENERAL	4.3
4.2.	LAYOUT OF THE OPERATOR'S CONTROLSTAND	4.3
4.3.	CONTROL LEVER	4.4
4.4.	CONTROL PANELS	4.5
4.4.1.	CONTROL PANEL X20	4.5
4.5.	CONTROL PANEL FOR AIR CONDITION	4.11
4.6.	SWITCH CABINET	4.13

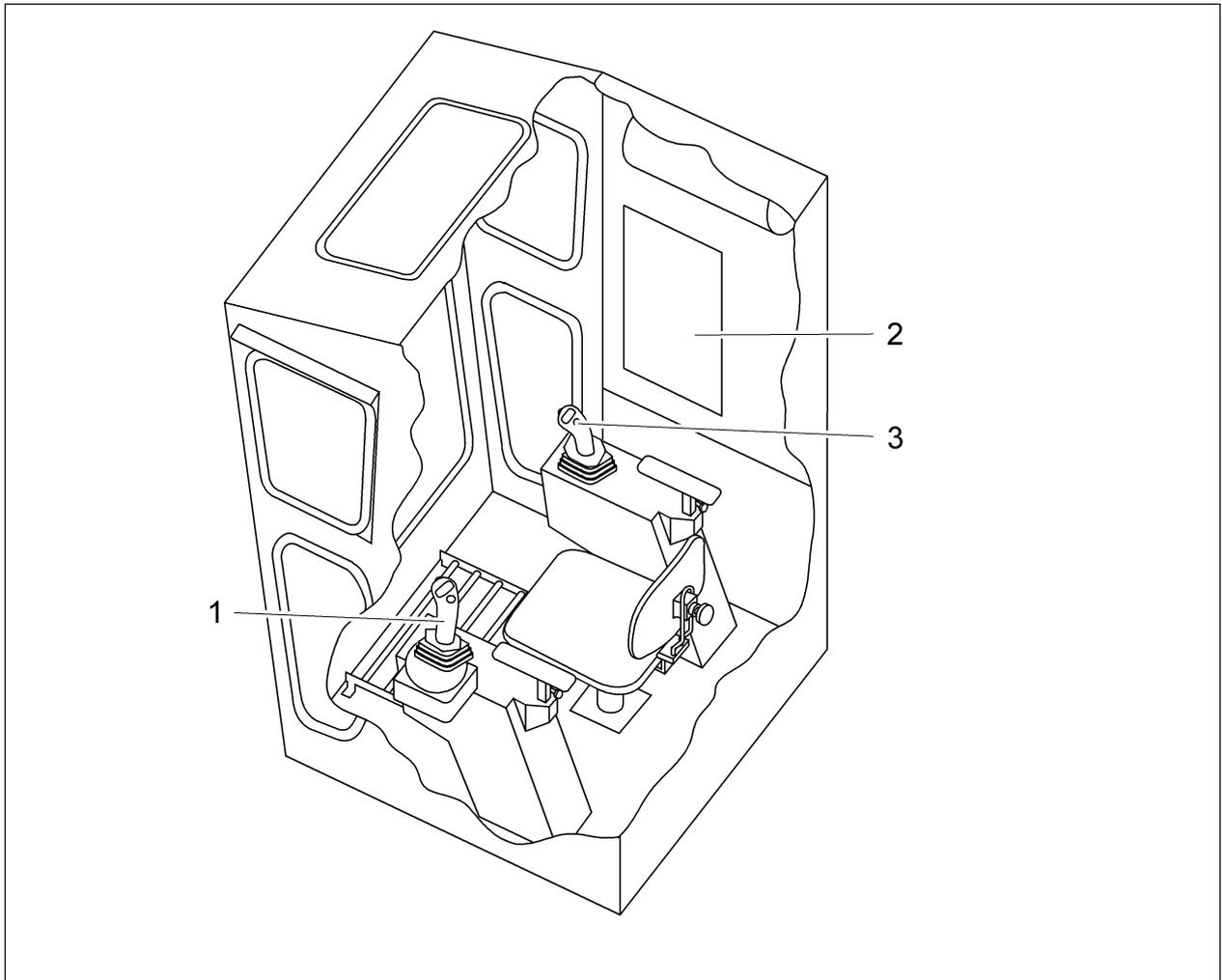
4. CONTROL AND OPERATING ELEMENTS

4.1. GENERAL

In this chapter the control and operating elements are described. According the function of the elements, they are mounted in the cabin or around the crane.

All other authoritative devices for safe crane operation, are listed in chapter 3 "SAFETY GUIDELINES" section safety and supervisory apparatus.

4.2. LAYOUT OF THE OPERATOR'S CONTROLSTAND



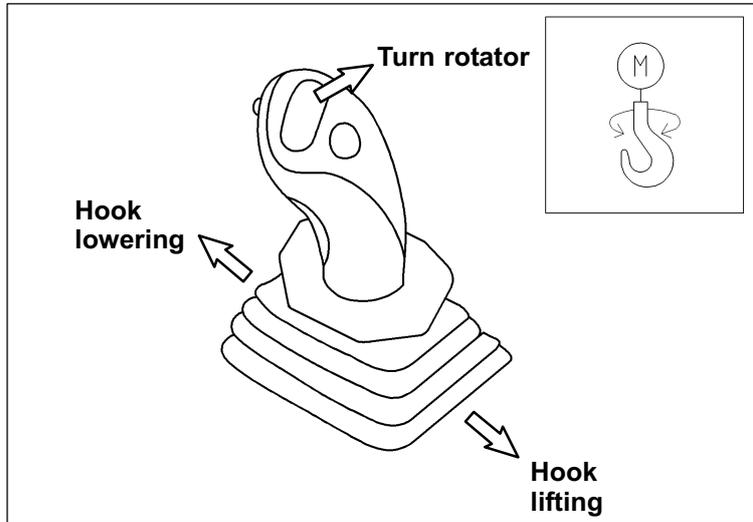
- 1 Left handed control lever
- 2 Switch unit X20
- 3 Righthanded control lever

4.3. CONTROL LEVER

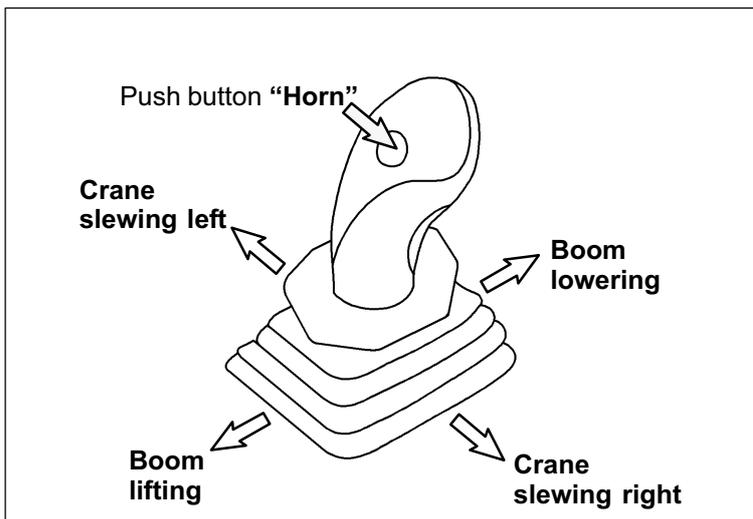
Combined control levers for stepless control of the hoisting, luffing and slewing system.
Luffing and slewing motion can be carried out at the same time.
Hoist motion can be carried out at the same time with luff or slew motion.

The control levers are spring centered and will automatically return to neutral when it is released.

Right-handed control lever



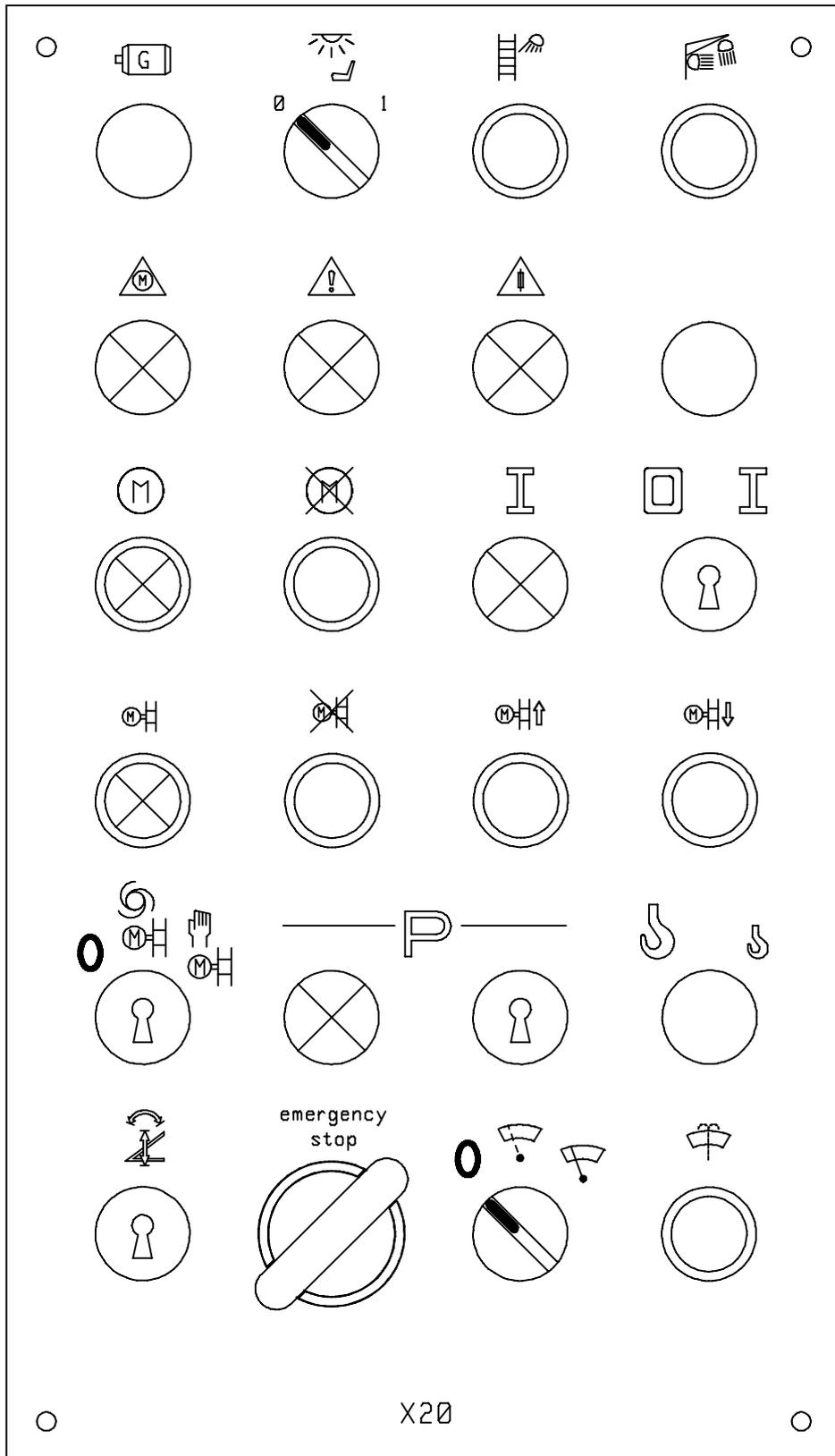
Left-handed control lever



4.4. CONTROL PANELS

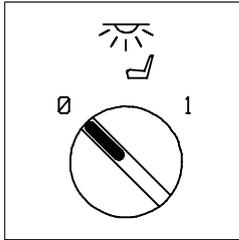
4.4.1. CONTROL PANEL X20

The control panel X20 is located inside the operator's cabin at the right-handed sidewall

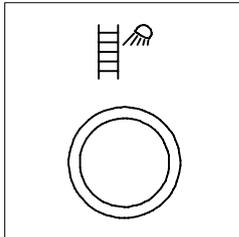


CONTROL AND OPERATING ELEMENTS

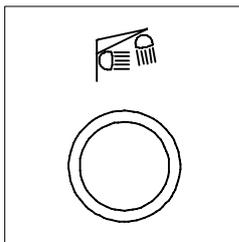
CONTROL ELEMENTS FOR LIGHTING



Switch “cabin lighting”
For operating the light inside the operator’s cabin.

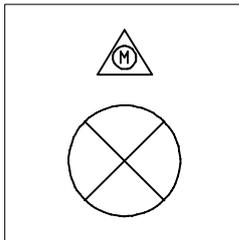


Push button “crane lighting”
For operating the lights inside the slewing column.
An additional switch is located at the ascent ladder.

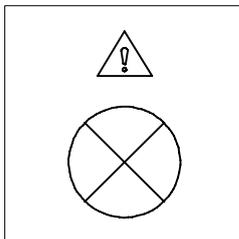


Push button “floodlight”
For operating the flood lights at the crane

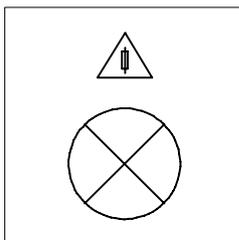
CONTROL ELEMENTS FOR TROUBLE INDICATION



Pilot light “main motor fault”
The pilot light illuminates, if one of the listed faults occurs:
- overtemperature protection (PTC) main motor tripped
- overcurrent relay main motor

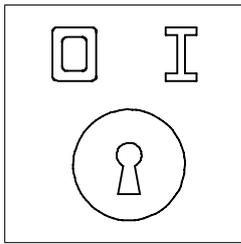


Pilot light “niveau / temperature fault”
The pilot light illuminates, if one of the listed faults occurs:
- low level switch in hydraulic tank tripped
- temperature switch “hydraulic oil temperature” tripped
- temperature switch “gear oil temperature hoisting winch” tripped



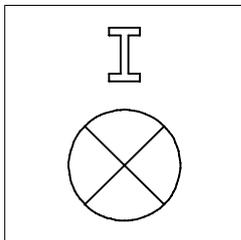
Pilot light “circuit breaker tripped”
illuminates, if the circuit breaker of the hydraulic oil cooler motor has tripped

CONTROL ELEMENTS FOR CRANE START UP



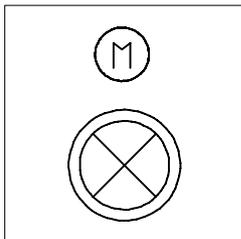
Key switch “crane on/off”

for switching on/off the main breaker of the electric power supply



Pilot light “crane on”

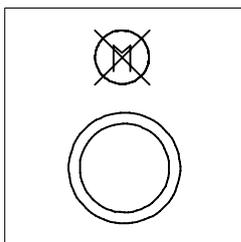
illuminates, if the electric power supply is available to start the main motor



Push button and pilot light “motor on”

Press push button to start the main motor

The inserted pilot light illuminates, if main motor is running



Push button “motor off”

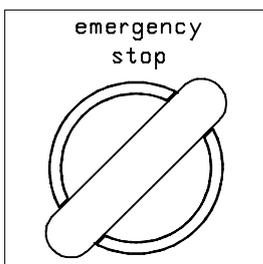
Press push button to stop the electric main motor



ATTENTION !

Before leaving the operator’s cabin the main motor must always be shut down !

CONTROL ELEMENT FOR EMERGENCY STOP



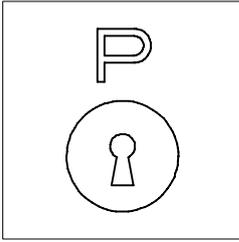
Red push button “emergency stop”

The button should be used in emergency case only!

If one of the emergency stop buttons is pressed the main motor stops and all gear brakes closing immediately

CONTROL AND OPERATING ELEMENTS

CONTROL ELEMENTS FOR CRANE PARKING

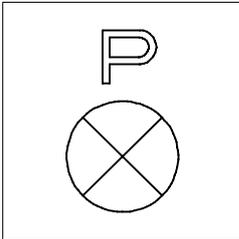


Key switch "park position"

Turn key switch to bypass the limit switches of boom motion.
Keep turned during parking procedure of the boom.

ATTENTION !

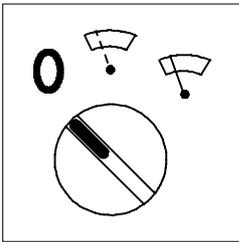
The movement of boom is not stopped automatically via limit switches !



Pilot light "boom below working range"

illuminates, if the boom is below working range of the crane for parking procedure

CONTROL ELEMENTS FOR SCREEN WIPER OPERATION



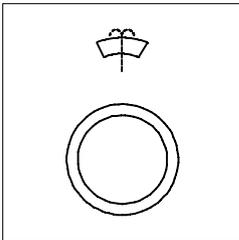
Switch "screen wiper"

for operating the screen wiper of the front window

Pos. "0": off

Pos. "I": screen wiper interval operation

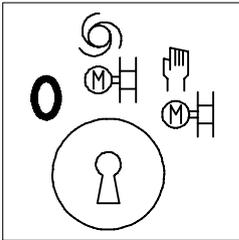
Pos. "II": screen wiper continuous operation



Switch "screen wiper pump"

for operating the pump for screen wiper operation of the front window

CONTROL ELEMENTS FOR CABLE REEL OPERATION



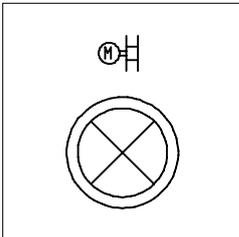
Key switch “cable reel operation mode”

illuminates, if the electric power supply is available to start the main motor



ATTENTION !

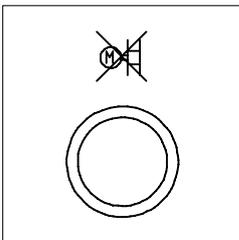
As long as the electric cable is connected to the hook block, this key switch must remain in pos. “2” cable reel automatic !



Push button and pilot light “motor on”

Press push button to start the main motor

The inserted pilot light illuminates, if main motor is running



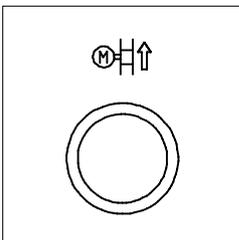
Push button “motor off”

Press push button to stop the electric main motor



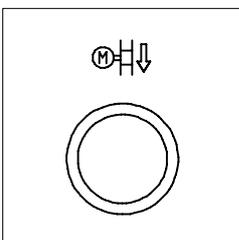
ATTENTION !

Before leaving the operator’s cabin the main motor must always be shut down !



Push button “winding up cable reel”

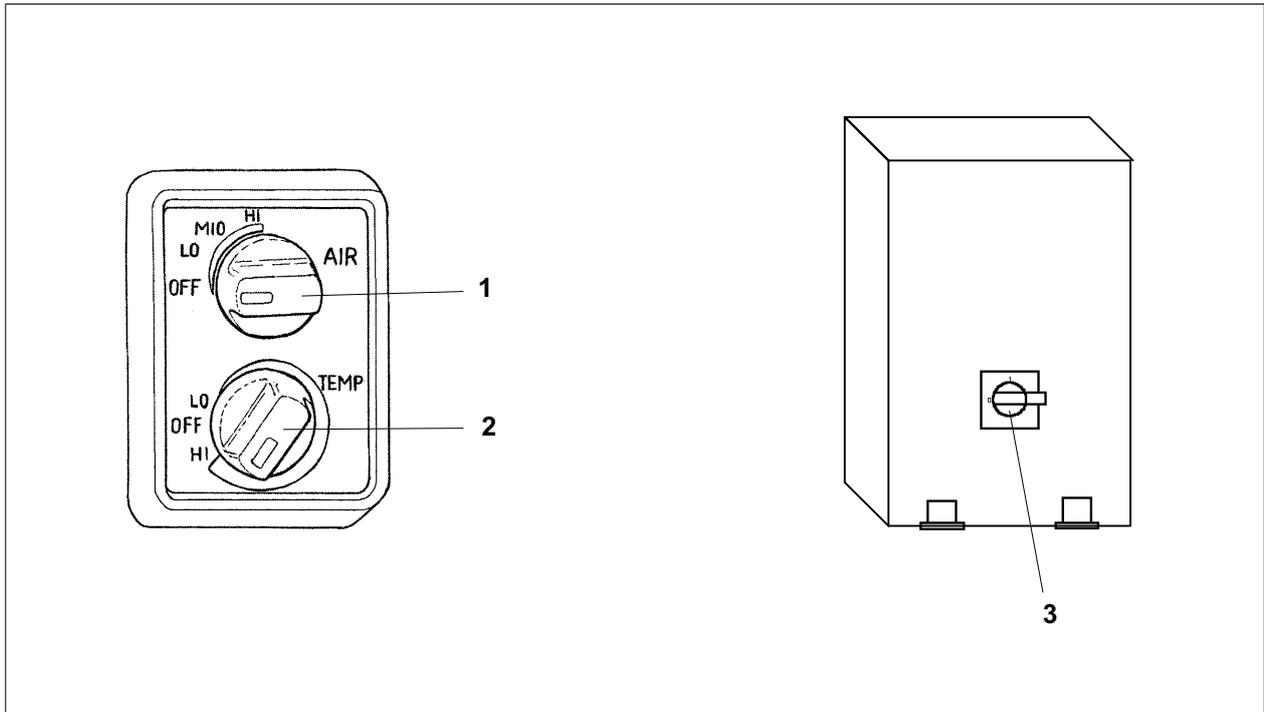
If this button is pressed, the cable on the cable drum will be spooled on to the cable drum as long as the push button is pressed. This function is only possible if key switch **“cable reel operation mode”** is in pos. “2” (cable reel manual mode).



Push button “winding down cable reel”

If this button is pressed, the cable on the cable drum will be spooled off from the cable drum as long as the push button is pressed. This function is only possible if key switch **“cable reel operation mode”** is in pos. “2” (cable reel manual mode).

4.5. CONTROL PANEL FOR AIR CONDITION

**1 Switch "AIR"**

Position: Off
Position: Lo
Position: Mio
Position: Hi

2 Switch "TEMP"

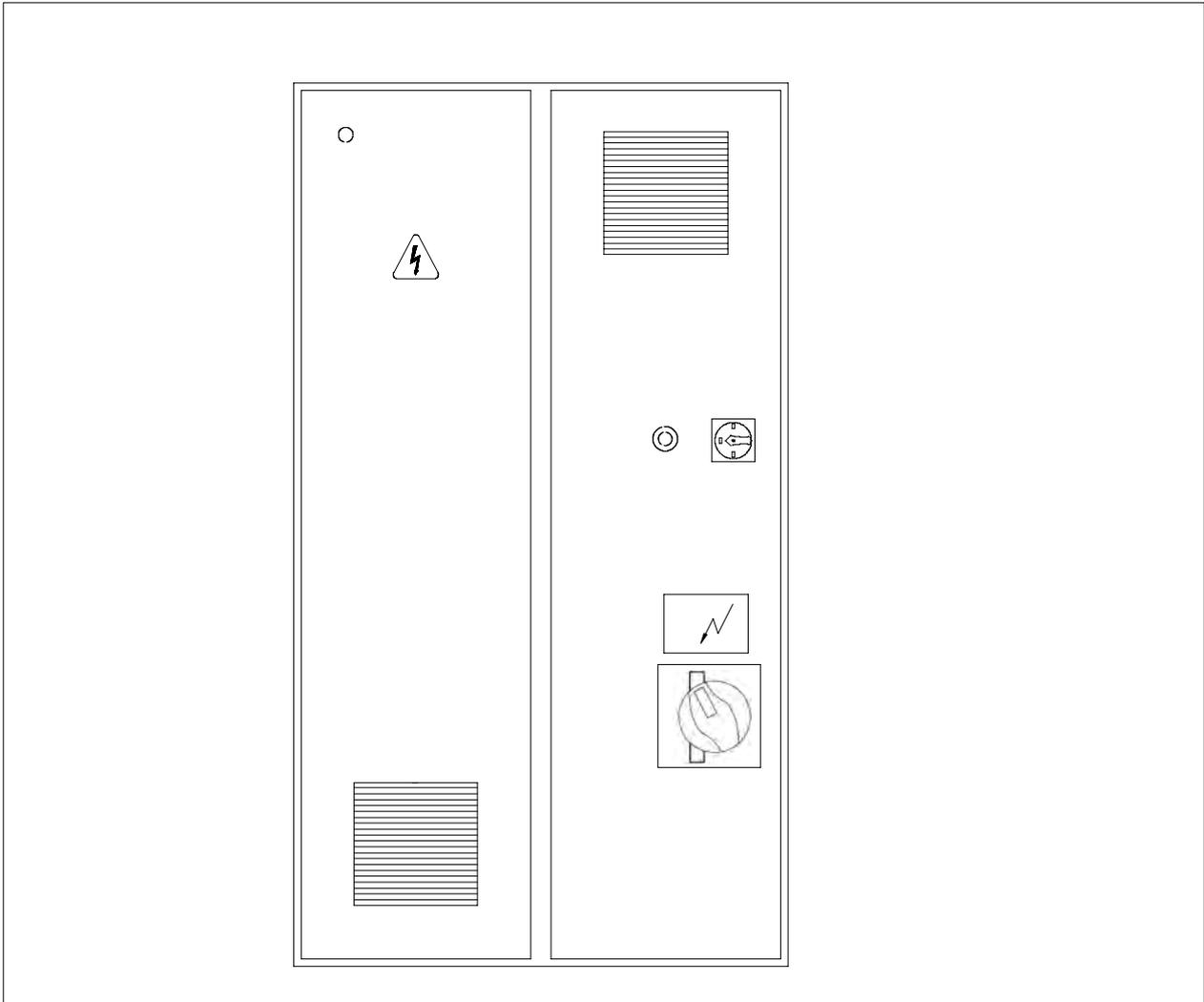
Position: Off
Position: Lo
Position: Hi

Temperature variable adjustable

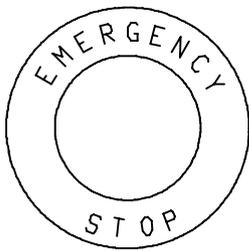
3 Main switch

Turn to position "I" for switch on air condition

4.6. SWITCH CABINET

**Red push button "Emergency stop"**

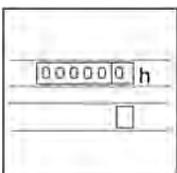
The main motor stops and all brakes apply immediately, if this button is pressed.

**NOTE !****USE ONLY IN EMERGENCIES**

To reset, turn button to the right and release !

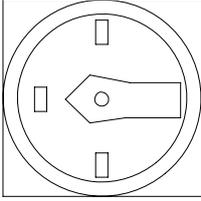
**IMPORTANT !**

If using this button during operation with full load, the multiple disc brakes of the hoist winch(es) must be inspected and checked for proper function !

Operation hours counter

The operation hours are used to determinate the maintenance intervalls

Main switch "Auxiliary power supply"



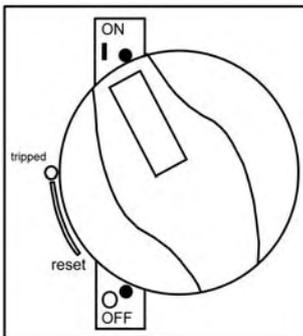
Operates the auxiliary power supply for the entire lighting and heating system on the crane.



IMPORTANT !

Must be switched on all the time in order to prevent condensation inside the crane and its main components (electric main motor, fan motors, hydraulic oil tank, etc.).
Switch off only for maintenance in the electrical system !

Main switch "Main power supply"



Operates the main power supply for the crane main drive system. Switch cabinet door can't be opened, when the switch is in the "ON" position.



IMPORTANT !

If main switch tripped, first reset the switch and switch it on again!



WARNING !

BEFORE OPENING ANY ELECTRICAL EQUIPMENT, IT IS ESSENTIAL TO SWITCH OFF THE POWER SUPPLY !

INDEX

5.	CRANE OPERATION	5.3
5.1.	GENERAL	5.3
5.1.1.	SAFE OPERATIONS WITH THE CRANE	5.3
5.2.	CHECKS BEFORE DAILY START UP	5.5
5.2.1.	INSPECTION TOUR	5.5
5.2.2.	CHECKS	5.5
5.3.	DAILY START-UP	5.6
5.3.1.	STARTING MAIN MOTOR	5.6
5.3.2.	MOVE CRANE TO WORKING POSITION	5.7
5.4.	START/STOP FOR A WORK BREAK	5.8
5.4.1.	SHUT DOWN THE CRANE FOR A WORK BREAK	5.8
5.4.2.	STARTING UP THE CRANE AFTER A WORK BREAK	5.8
5.5.	SHUT DOWN THE CRANE	5.9
5.5.1.	MOVE CRANE TO PARKING POSITION	5.9
5.5.2.	SHUT DOWN MAIN MOTOR	5.9
5.5.3.	LONGER STANDSTILL PERIOD OF THE CRANE	5.10
5.6.	CRANE OPERATION	5.11
5.6.1.	HOOK OPERATION	5.11
5.6.2.	ROTATOR OPERATION	5.12

5. CRANE OPERATION

5.1. GENERAL

This chapter familiarizes you with operation of the crane.

It guides you through the work flow and describes the operational steps

- for daily use,
- to operate the main components such as the boom or hook,
- for crane operation with detailed information,
- to safely shut down the crane.

5.1.1. SAFE OPERATIONS WITH THE CRANE

The crane operator is responsible for the safe operation of the crane.

Pay special attention to the following:

- the safety instructions in chapter 3.
- familiarize yourself with the layout of the controls before starting up the crane (see chapter 4).
- to the information in this chapter and remember the instructions provided by the crane manufacturer.



DANGER !

OPERATING ERRORS CAN ENDANGER HUMAN LIVES AND SEVERELY DAMAGE OR DESTROY THE CRANE!

The crane is equipped with various safety devices to prevent dangerous operational conditions. These safety devices cannot however prevent damage occurred due to negligence or erroneous operational input.

PRECAUTIONS:

- Simultaneous lifting and swinging of load with maximum speed is prohibited!
- Do not carry out any jerky movements with the crane; avoid every sudden acceleration or braking.
- Start each movement from a stand still position slowly and gently.
- Do not permit any dynamic effects, such as oscillation or jerkily lifting and lowering of load.
- Always work with foresight: allow plenty of time and space for braking a movement.



ATTENTION !

Never ascent a crane during crane operation !

5.2. CHECKS BEFORE DAILY START UP

CAUTION !
NEVER USE A DAMAGED CRANE OR EQUIPMENT !

All defects and errors found are to be reported at once to the person responsible.
 They are also to be professionally corrected before start up.
 When there is a change in crane operator, defects found are to be passed on to the next operator.

5.2.1. INSPECTION TOUR

The following visual inspection tour has to be performed daily before start up of the crane:

Check slewing column and boom if there are

- leaks (hydraulic oil),
- (willful) damages,
- all safety device are in place and correctly function,
- all bolts are in firmly,
- ropes do not show any sign of wear.

Check, if safety labels are attached and readable !

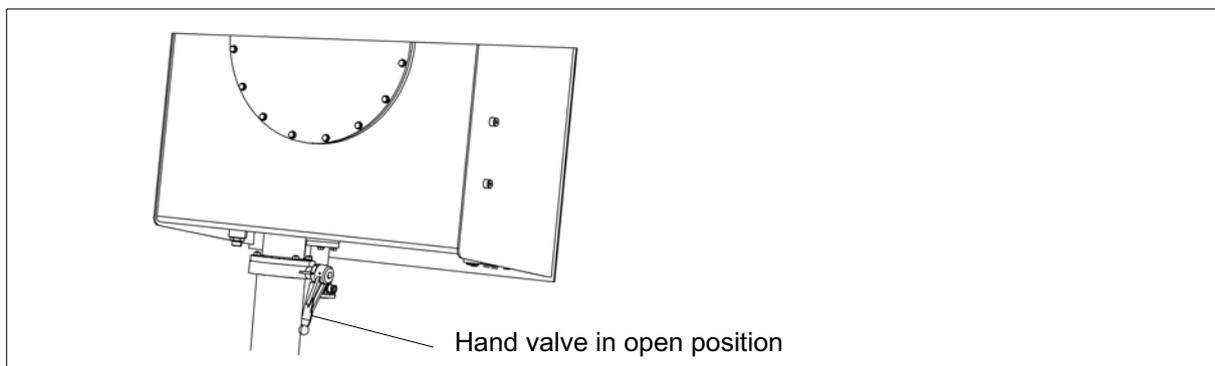
5.2.2. CHECKS



NOTE !

Pay attention to the following during the checks:
 Refilling fuels and lubricants is described in chapter 7. "Maintenance"
 Required safety precautions are described in chapter 3. "Safety guidelines"

- Assure a clear view from the operator's cab:
 - clean wind shield and side window glasses
 - refill wiper-washer fluid
- Perform daily lubrication according to maintenance plan.
 See chapter 7.
- Check hydraulic oil levels.
 See chapter 7.
- Availability of the auxiliary power supply
- Unlock all EMERGENCY-OFF switches by rotating them counter clock-wise.
- Check if hand valve (below the hydraulic tank) for hydraulic oil supply, is in open position



CAUTION !

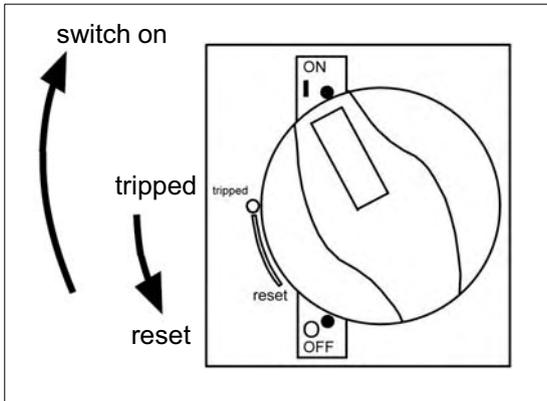
The hydraulic system can be destroyed, if the main motor is started with closed shut-off valve!

CRANE OPERATION

5.3. DAILY START-UP

5.3.1. STARTING MAIN MOTOR

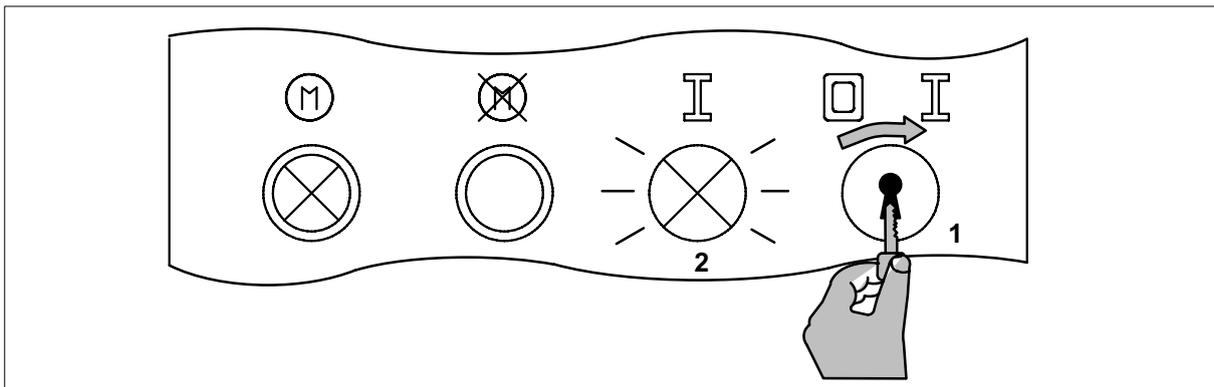
- Switch on the main switch manually at switch cabinet X1.



IMPORTANT !

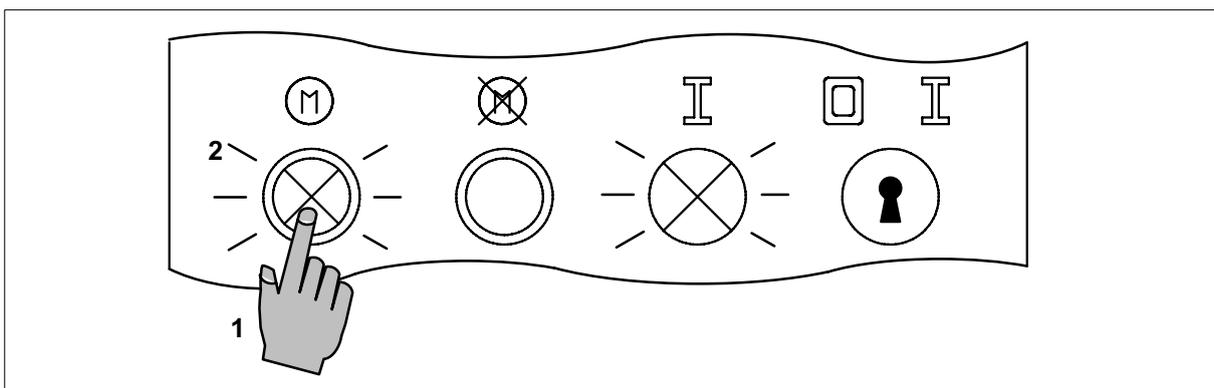
If main switch in tripped position, reset the switch first and switch it on again !

- Turn key switch "crane control on/off" to position "I"



- Pilot light "crane on" illuminates

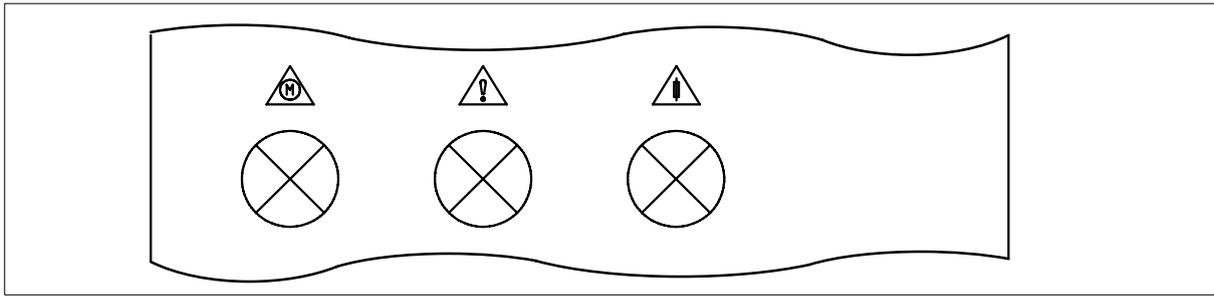
- Press the "motor on" button at switch unit X20 (all control levers must be in neutral position).
Wait until the pilot light "motor on" lights up



! ATTENTION !

While starting the hydraulic assembly it is not allowed to operate the control levers until the pilot light "motor on" illuminates !

- Check if no trouble is indicated at the control switch unit X20



IMPORTANT !

If one or more of the pilot lights are illuminated, check reason and eliminate troubles !

5.3.2. MOVE CRANE TO WORKING POSITION

- Move crane to working position, therefore the boom slowly using, the left-handed control lever, to working position.
If the boom reached the working position, pilot light “boom below working range” extinguishes.

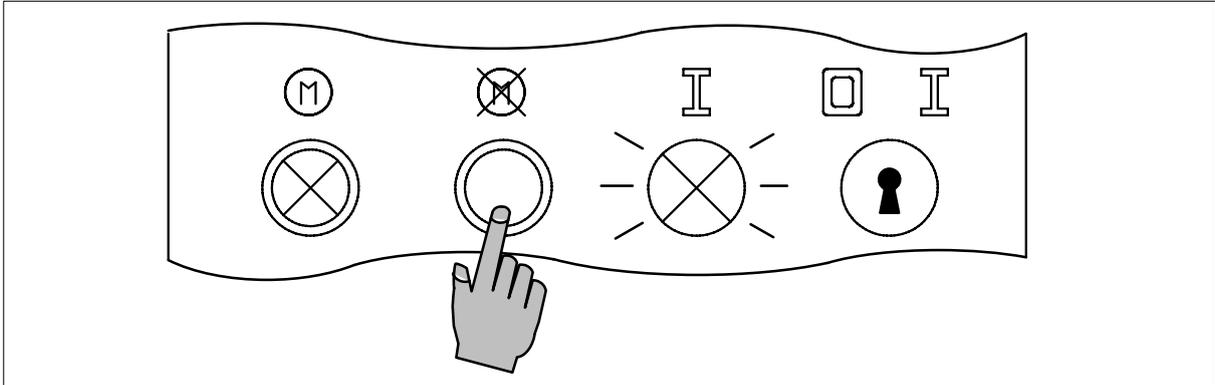
THE CRANE IS READY FOR OPERATION

CRANE OPERATION

5.4. START/STOP FOR A WORK BREAK

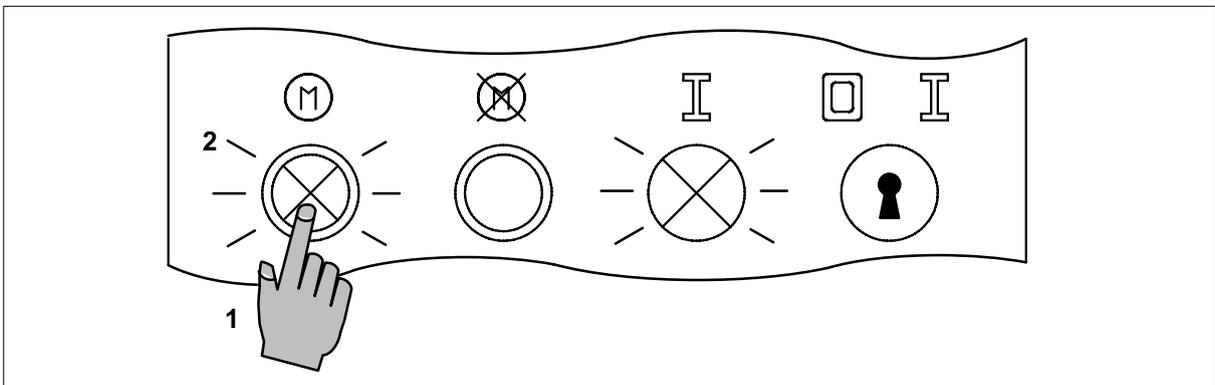
5.4.1. SHUT DOWN THE CRANE FOR A WORK BREAK

- Lower load to ground
- Move the boom and the hook to a position, which will not endanger anyone on board.
- Press the "motor off" push button and pilot light "motor on" extinguishes



5.4.2. STARTING UP THE CRANE AFTER A WORK BREAK

- Press push button "motor on"



- Wait until pilot light "motor on" lights up

THE CRANE IS NOW READY TO CONTINUE WORK

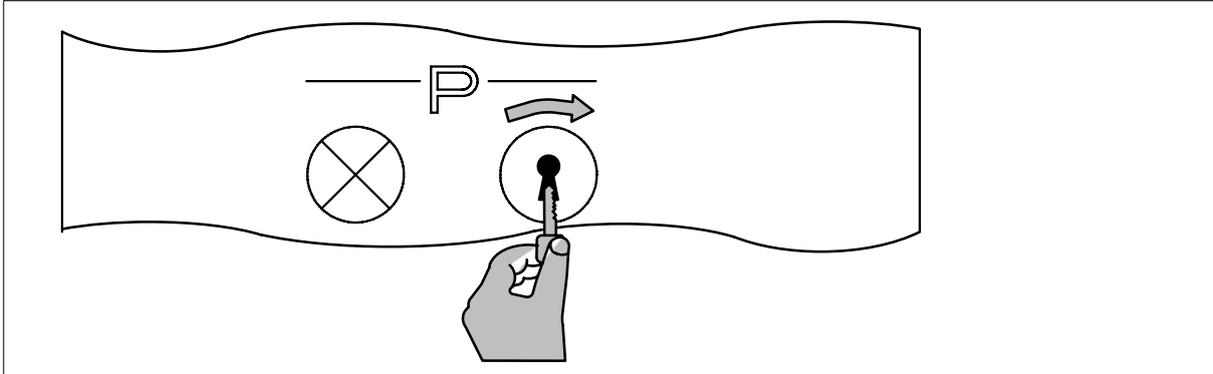
5.5. SHUT DOWN THE CRANE

5.5.1. MOVE CRANE TO PARKING POSITION

⚠ ATTENTION !

BEFORE PARKING THE HOOK THE PARK KEY MUST BE TURNED TO POS. I IN ORDER TO ACHIEVE CORRECT PRETENSIONING !

- Turn crane over parking position
- Lower the boom slowly to minimum working radius
- Keep turned key switch "bypass park position" in position "I"



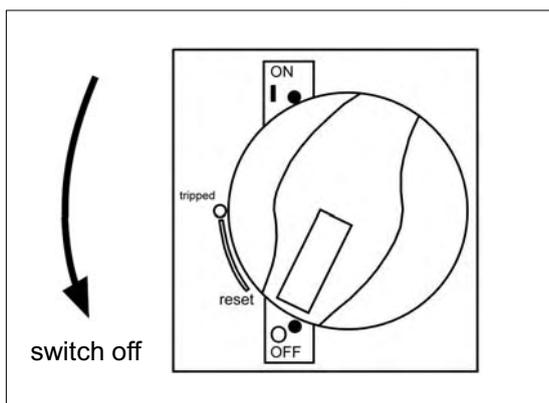
⚠ ATTENTION !

The luffing function is not stopped by a limit switch !

- Keep turned key switch "bypass park position" and lower the boom very slowly using the left-handed control lever to parking position (boom rest).
- Secure und lash hook as required

5.5.2. SHUT DOWN MAIN MOTOR

- Press push button "motor off"
- Turn key switch "crane control on/off" to position "0"
- Switch off the main switch manually on the switch cabinet



- Close firmly all windows and doors

⚠ ATTENTION !

The auxiliary supply must remain switched on for crane standstill heating !

5.5.3. LONGER STANDSTILL PERIOD OF THE CRANE



ATTENTION !

Should the crane be shut down for a period more than four (4) weeks - the crane has to be operated once a month for at least approx. one (1) hour. In addition to that all the greasing, oil inspections and oil level checks have to be done as well.

The standstill heating must be switched on all the time in order to prevent moisture in the electric and hydraulic systems. Switch off only for service work !

The crane has to be preserved, if not in operation for more than three (3) months. Detailed preservation instructions are obtainable at your local LIEBHERR service department.

5.6. CRANE OPERATION

Safety instructions

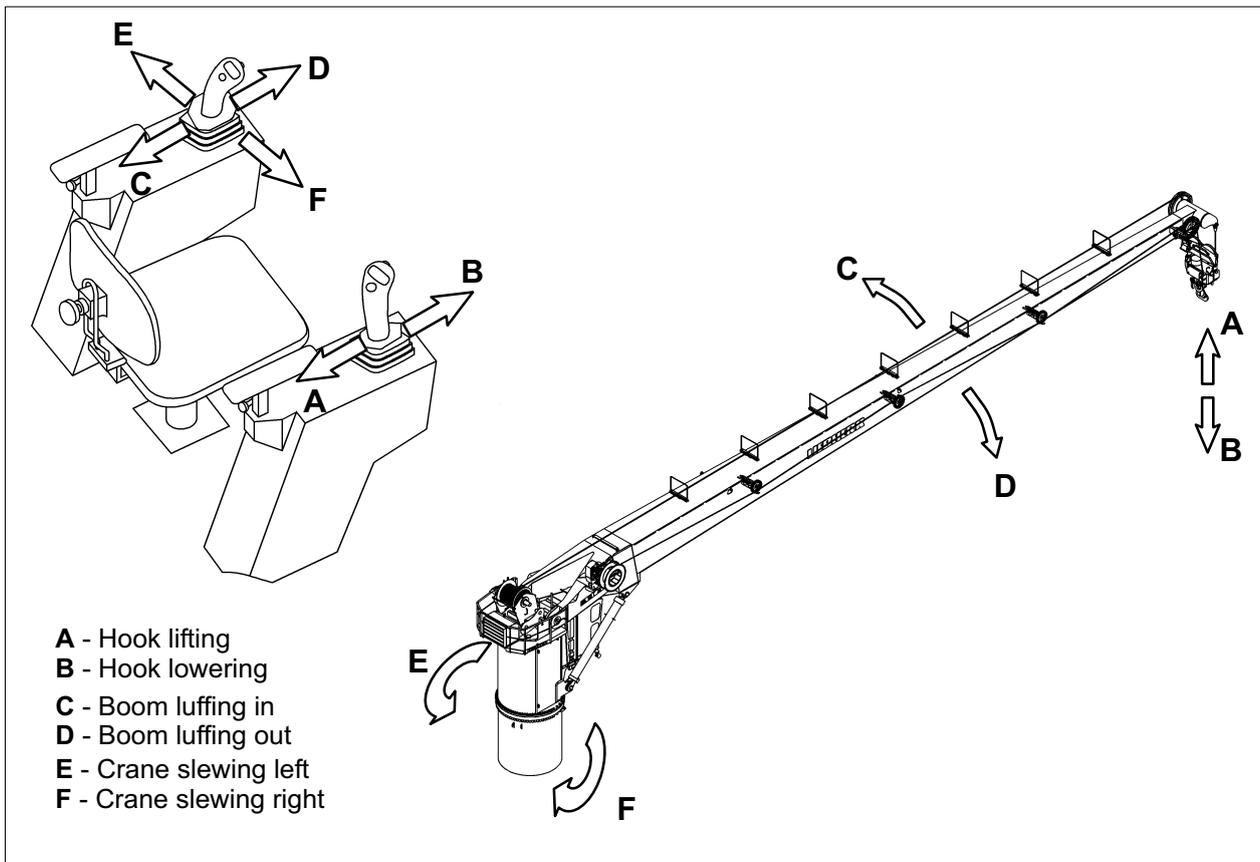
! DANGER !

- Before starting any operation, the crane must be in operational condition, meaning no trouble is indicated on switch unit X20 !
- It is strictly forbidden to lift heavier loads with the luffing gear than it is possible with the hoisting gear !

5.6.1. HOOK OPERATION

Operation:

- Start up crane as described under item "Start up of crane".



5.6.2. ROTATOR OPERATION



DANGER !

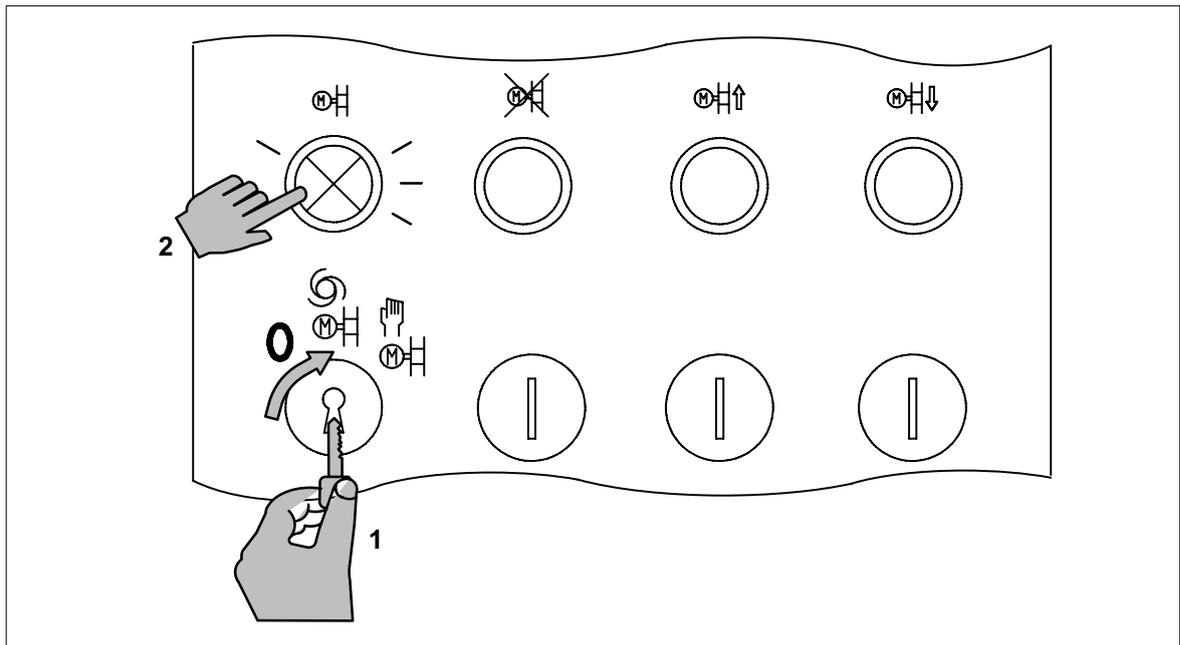
- Extreme care must be taken when rotating specially long and bulky loads.
- Ensure that no persons and objects are in the danger area !

Operation:

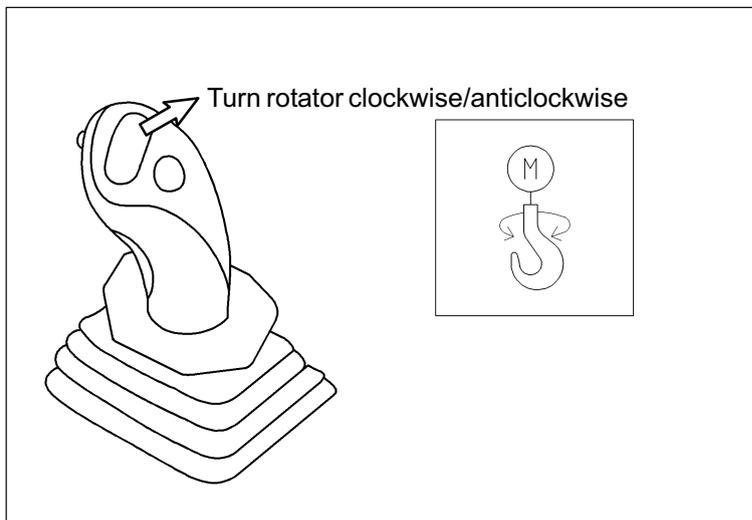
- Start up crane as described under item "Start up of crane"
- STARTING CABLE REEL FOR ROTATOR OPERATION

The different operation modes are:

- cable reel manual mode -> only for maintenance of electrical cable
- cable reel automatic mode -> for rotator operation
- Check if the electric cable is located properly in the guide pulley
- Connect electric cable to rotator by using an adapter cable
- Select "cable reel automatic mode" via key switch to operate the cable reel in automatic mode.
- Press push button "Start cable reel" and inserted pilot light must be illuminated



- The rotator can be controlled by right-handed control lever inside cabin



INDEX

6. EMERGENCY OPERATION 6.3

6.1. GENERAL 6.3

6.2. ARRANGEMENT OF EMERGENCY DEVICES 6.3

6.3. EMERGENCY HAND PUMP 6.4

6.4. PROCEDURE TO LOWER THE LOAD 6.5

6.5. PROCEDURE TO RELEASE THE SLEWING BRAKES 6.6

6.6. PROCEDURE TO LOWER THE BOOM 6.7

6. EMERGENCY OPERATION

6.1. GENERAL

With the hand pump it is possible to carry out the following emergency movements or operations **at a total standstill of the crane.**

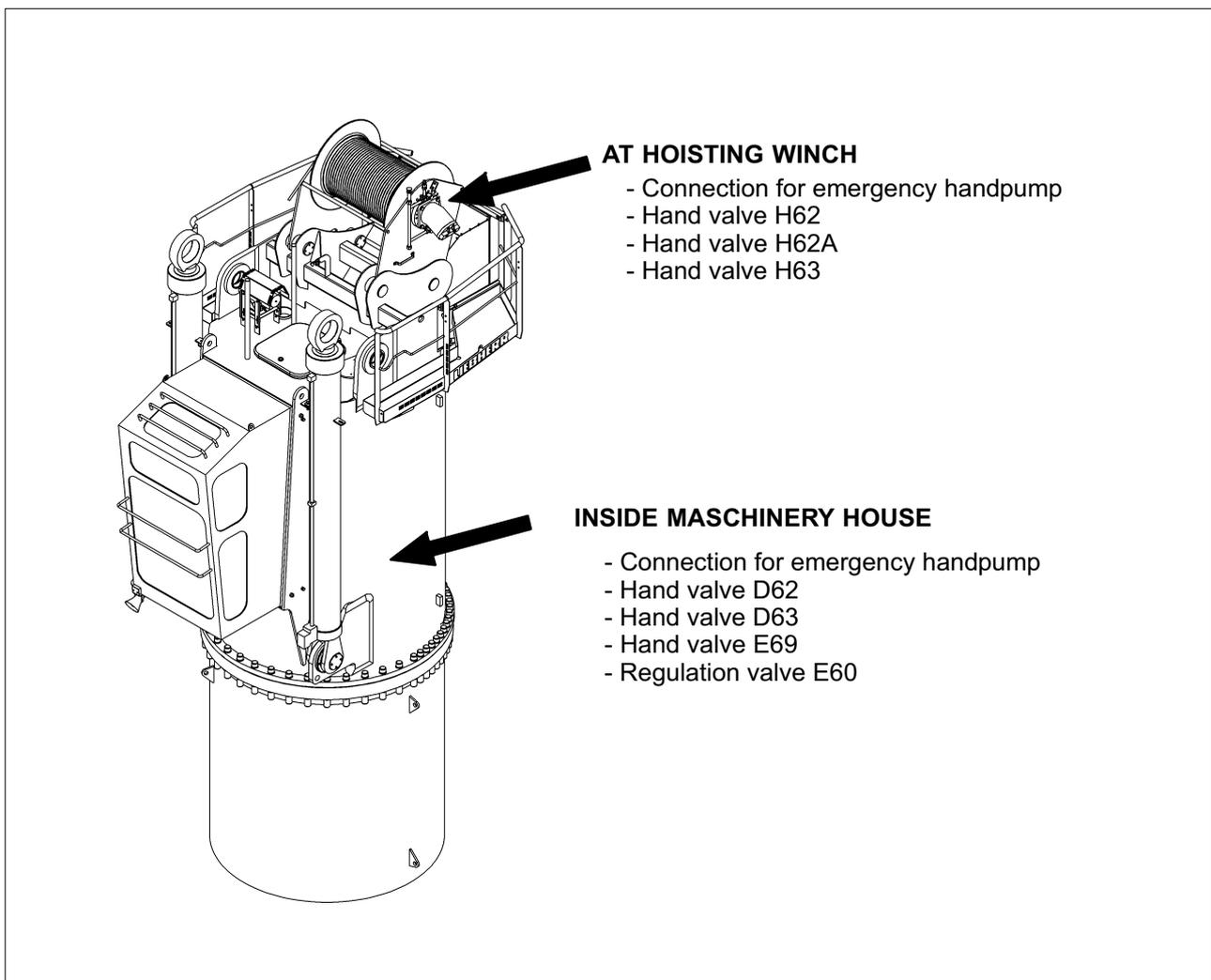
- lower the hook
- lower the boom
- open the slewing brakes

WARNING

In case an emergency operation is carried out, the crane movements are not stopped by limit switches or other safety devices.

Therefore the movements have to be supervised by additional personnel !

6.2. ARRANGEMENT OF EMERGENCY DEVICES



EMERGENCY OPERATION

6.3. EMERGENCY HAND PUMP

The hand pump shall be used in case of a total standstill of the crane since the hydraulically controlled multi disc brakes are closed without pressure.

With this hand pump it is possible to make an emergency lowering operation on the hoist system by releasing the spring loaded multiple disc brake.



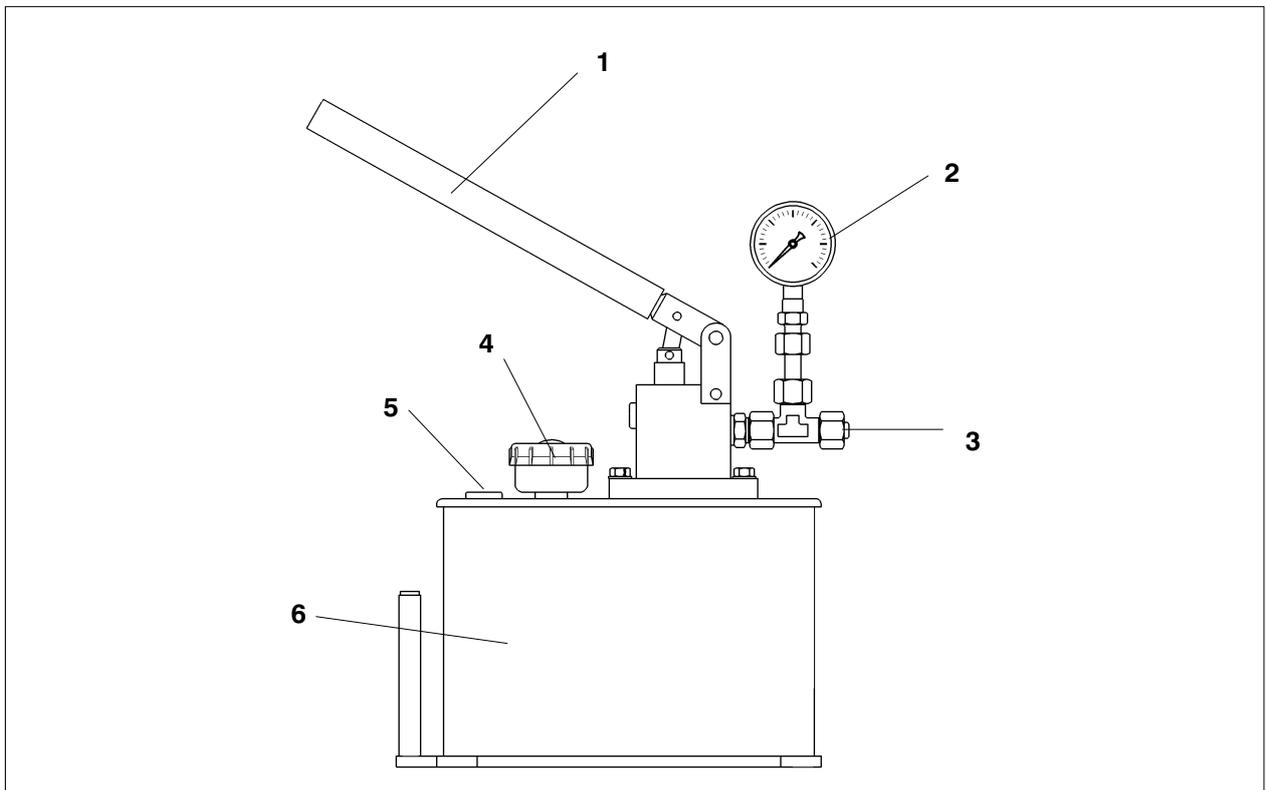
WARNING !

The operation of the emergency hand pump must be done at a place from where the emergency movement can be seen!

In case of emergency operation there is no stopping of crane movements by limit switches or other safety devices.

Therefore the movements have to be supervised by additional personnel !

LAYOUT OF EMERGENCY HAND PUMP

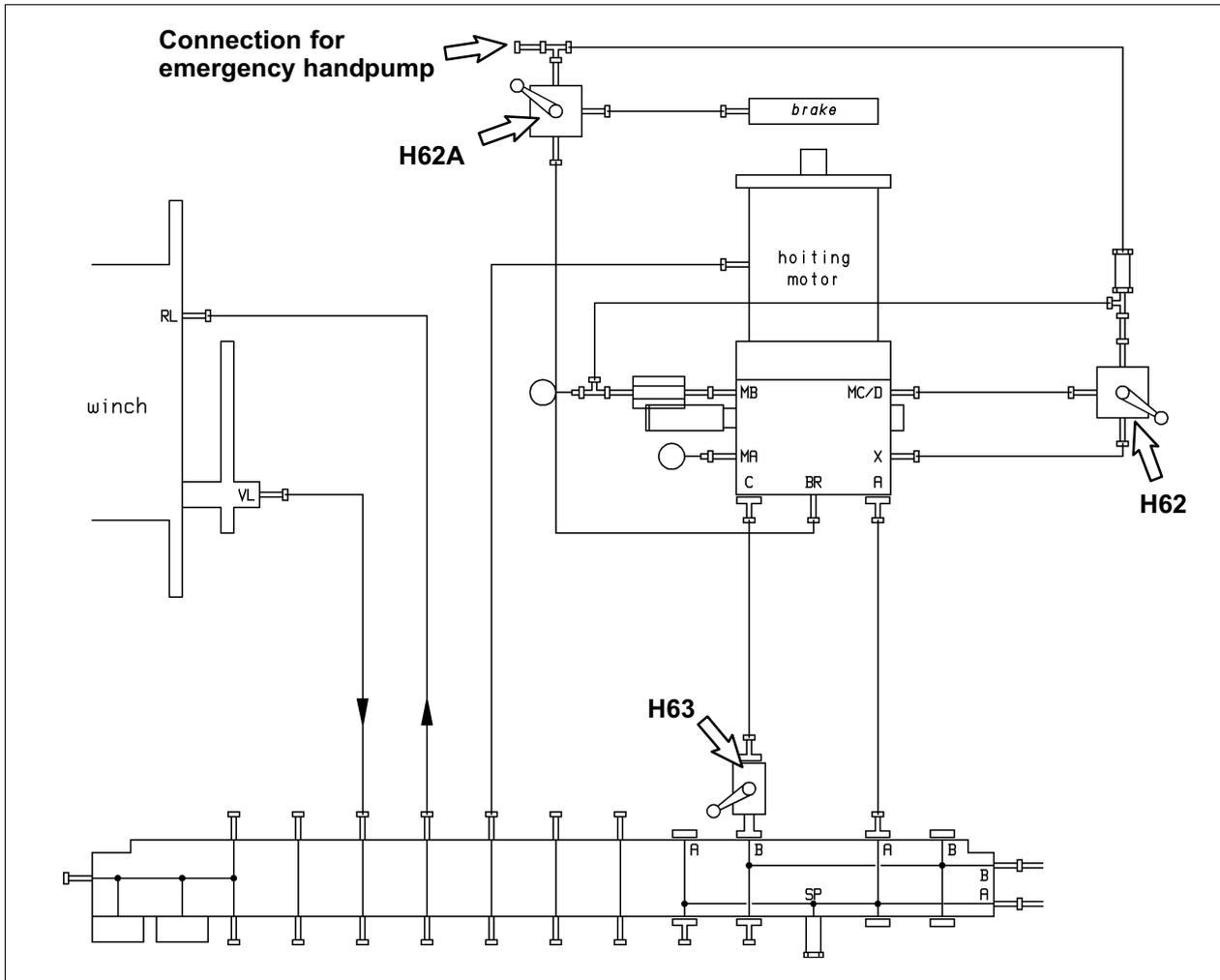


- 1 Pump lever
- 2 Pressure gauge (minimum 15 bar to release the brakes)
- 3 Connection to hydraulic system (pressure line of pump)
- 4 Breather filter
- 5 Oil filling and dipstick
- 6 Tank

NOTE ! At longer usage of hand pump during emergency operation (for example at large lifting heights) check oil level of hand pump with dipstick and if necessary refill tank with hydraulic oil.

6.4. PROCEDURE TO LOWER THE LOAD

Location of used valves:



H63 - located at the bulkhead plate near the hoisting winch

H62 / H62A - located near the hoisting motor

Procedure:

- Turn hand valve **H63** to emergency position
- Turn hand valve **H62A** to emergency position
- Turn three way hand valve **H62** to emergency position
- Connect one hose from hand pump to the tank and the second hose from the hand pump to the provided connection point
- Increase the pressure to the disc brake by use of the hand pump.
- Now the multiple disc brake **H61U** opens and the load will lower as long as the hand pump is operated.

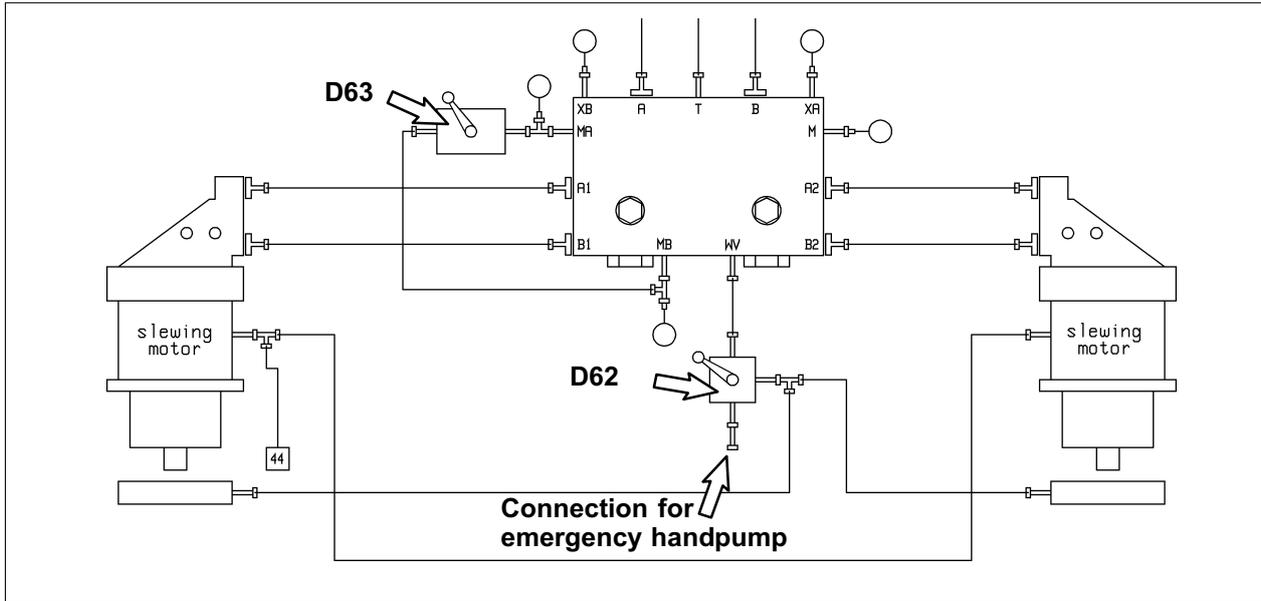
⚠ ATTENTION !

After emergency operation is finished:

- Change back three way valve **H62** and hand valves **H62A**, **H63** to normal position.

6.5. PROCEDURE TO RELEASE THE SLEWING BRAKES

Location of used valves:



D62 / D63 - located at the slewing gears

Procedure:

- Connect one hose from hand pump to the tank and the second hose from the hand pump to the provided connection point
- Turn hand valve **D63** to emergency position
- Turn three way hand valve **D62** to emergency position
- Increase the pressure to the disc brakes by use of the hand pump
- Turn the crane slowly by additional gear (e. g. second crane, chain block)

⚠ ATTENTION !

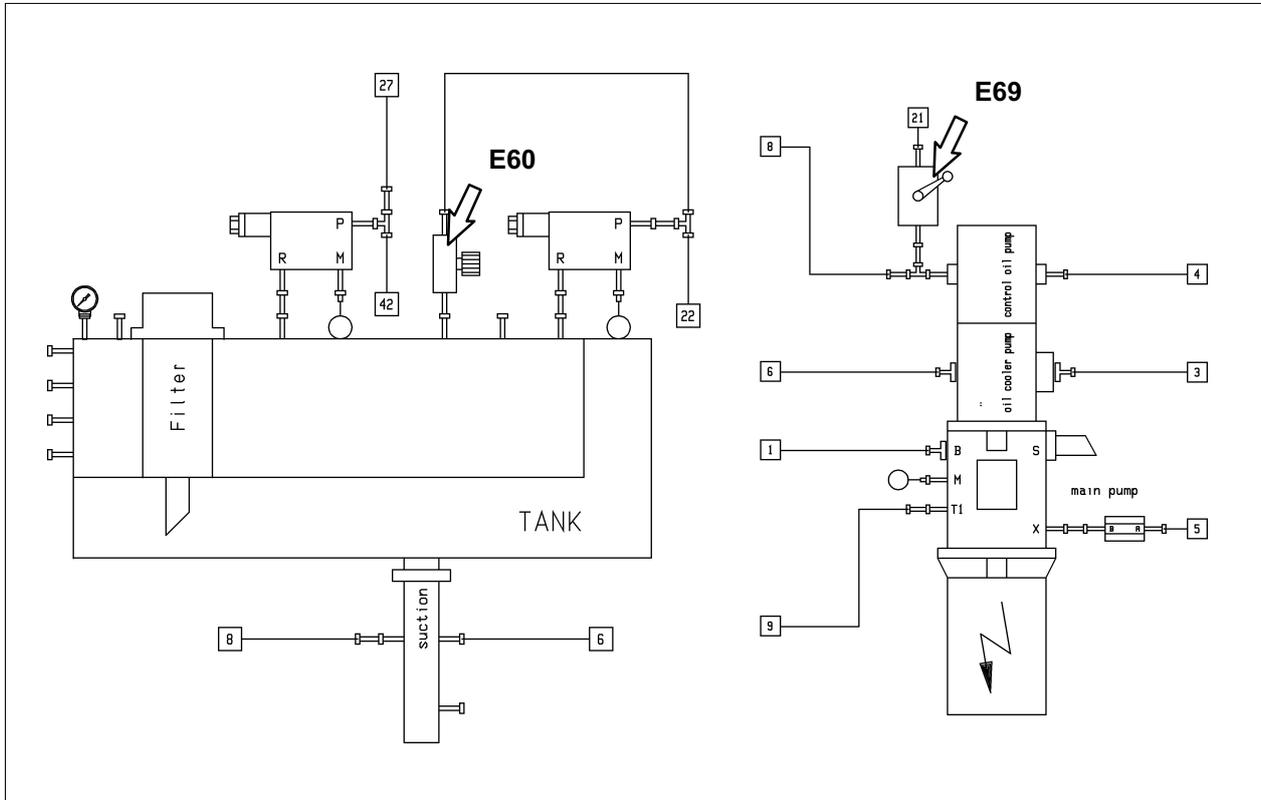
After emergency operation is finished:

- Change back three way hand valve **D62** and hand valve **D63** back to normal position!

6.6. PROCEDURE TO LOWER THE BOOM

**ATTENTION !****Before emergency lowering of boom rest load on ground !**

Location of used valves:

**E69** - located at the bottom of the hydraulic tank by the suction line**E60** - located at the top of the hydraulic tank

Procedure:

- Turn hand valve **E69** to emergency position
- Open slowly adjustable throttle valve **E60** and the boom starts to lower
- With adjustable throttle valve **E60** it is possible to adjust the lowering speed of the boom.

**ATTENTION !****After emergency operation is finished:**

- Close throttle valve **E60** completely
- Change back hand valve **E69** to normal position.

INDEX

7. MAINTENANCE	7.3
7.1. QUALIFIED PERSONS	7.3
7.1.1. GENERAL	7.3
7.2. SERVICE SPARE-PARTS AND STANDARD TOOLS	7.4
7.3. MAINTENANCE INTERVALS	7.5
7.3.1. GREASING SCHEMATIC	7.9
7.3.2. OIL FILLING SCHEMATIC	7.10
7.3.3. UTILITY REQUIREMENTS	7.11
7.3.4. LUBRICANT REQUIREMENTS	7.12
7.3.5. TABLE OF LUBRICANTS	7.13
7.4. ELECTRIC MOTOR	7.15
7.4.1. GENERAL SAFETY CONSIDERATIONS	7.15
7.4.2. MAINTENANCE AND LUBRICATION	7.15
7.5. GEARBOXES	7.17
7.5.1. SLEWING GEARBOXES	7.17
7.5.2. HOISTING WINCH GEARBOX	7.18
7.6. MULTIPLE DISC BRAKES	7.19
7.7. CABLE REEL	7.20
7.7.1. ASSEMBLY OF CABLE REEL	7.20
7.7.2. MAINTENANCE OF THE CABLE REELING DRUM	7.20
7.8. CRANE ROPES	7.23
7.8.1. SELECTION OF WIRE ROPES	7.23
7.8.2. ROPE INSTALLATION	7.23
7.8.3. MAINTENANCE	7.24
7.8.4. INSPECTION	7.24
7.8.5. INSTRUCTIONS FOR UNTWISTING OF HOIST ROPES	7.25
7.8.6. DISCARD CRITERIA	7.26
7.9. ROPE PULLEYS	7.27
7.9.1. GENERAL LAYOUT	7.27
7.9.2. STORAGE	7.27
7.9.3. TRANSPORT	7.27
7.9.4. DURING OPERATION	7.28
7.9.5. INSPECTION AND MAINTENANCE	7.28
7.9.6. RESISTANCE TO CHEMICAL PRODUCTS OF LAMIGAMIDR ROPE PULLEYS	7.29
7.10. HYDRAULIC LINES AND HOSES	7.31
7.10.1. GENERAL	7.31

MAINTENANCE

7.11. HYDRAULIC OIL TANK	7.32
7.11.1. RETURN FLOW FILTER HYDRAULIC OIL TANK	7.33
7.11.2. VALVE AND FILTER PLATE AGGREGATE ROOM	7.34
7.12. LIEBHERR CONDITION MONITORING	7.36
7.12.1. GENERAL	7.36
7.12.2. TECHNIQUES EMPLOYED IN CONDITION MONITORING	7.36
7.12.3. OIL SAMPLE / OIL EXCHANGE	7.38
7.12.4. TAKING AN OIL SAMPLE	7.39
7.12.5. CONDITION MONITORING REPORT	7.40
7.13. PRESSURE ACCUMULATORS	7.41
7.13.1. GENERAL	7.41
7.13.2. SAFETY INSTRUCTIONS	7.41
7.14. MAINTENANCE OF OIL COOLERS	7.41
7.15. ELECTRICAL SYSTEM	7.43
7.15.1. MAINTENANCE TO THE ELECTRICAL SYSTEM	7.43
7.15.2. WET CLEANING	7.43
7.16. SLIP RING UNIT	7.44
7.17. AIR CONDITIONING SYSTEM	7.45

7. MAINTENANCE

In tables, this chapter lists all maintenance works that have to be carried out on the crane. However, only the works the crane operator may perform by himself (after 10 and after 50 operating hours) are explained. They are indicated with "Chapter 7" in the "Remarks" column.

Maintenance work after 500 operating hours may only be carried out by qualified personnel or by LIEBHERR-CUSTOMER SERVICE respectively by authorized LIEBHERR partners contracted do to so. These maintenance works are marked "By LWN-Service only" in the "Remarks" column.

7.1. QUALIFIED PERSONS

PERSONS RESPONSIBLE FOR THE SAFETY OF THE CRANE MUST ENSURE THAT:

- qualified persons are only delegated to work on the machinery or apparatus,
- these persons must keep the Operating manual provided, and other documents, available when carrying out the operations to which they refer and to follow that documentation without fail,
- unauthorized persons are prohibited from working on, or approaching, the machinery or apparatus.

Qualified persons are persons who, as a result of their training, experience and the instruction they have received, and of their knowledge of the relevant Standards, directives, accident prevention regulations and operating conditions, have been authorized by those responsible for the safety of the machine to carry out the particular task required and who are able to recognize and avoid the potential hazards. A knowledge of first-aid and local rescue equipment is essential. According to regulations, unqualified personnel are forbidden to work for example on power installations and apparatus.

7.1.1. GENERAL



NOTE!

The specified maintenance and inspection intervals must not be exceeded.
When required, shorten the intervals.
The safety guidelines in chapter 3 must be observed and strictly adhered to.

Maintenance must be carried out conscientiously within the specified intervals. These maintenance intervals are indicated in operating hours and calendar days. Apply the maintenance interval that comes first.

The intervals supplement each other. This means that when maintenance of higher intervals is carried out, maintenance of lower intervals are to be carried out also.

Whenever the crane will not be in use for at least 3 months, all exposed parts must be covered and protected against the environment. The protective covers have to be removed before restarting the crane.

7.2. SERVICE SPARE-PARTS AND STANDARD TOOLS

A comprehensive **spare part list** is provided for reference when ordering spare parts or replacements. The drawings reproduced in the spare part manual are for the purpose to assist in identifying spare parts, they need not necessarily agree exactly with the actual constructional details of the parts involved. In order to avoid mistakes, it is advisable to use only the terms and expressions used in these instructions.

It is particularly important that spare part orders should include the following information:

- CRANE TYPE and CRANE SERIAL NUMBER
- LIEBHERR IDENT-NUMBER of each single spare part
- QUANTITY of parts required
- BRIEF DESCRIPTION of parts required

Careful attention to correct ordering is always important as omission of essential information will inevitably cause delay and may even lead to incorrect parts being supplied.

In order to avoid any delay we kindly ask to provide additionally following details:

- YOUR PURCHASE ORDER- OR REFERENCE NUMBER
- DELIVERY ADDRESS
- DELIVERY MODE
- YOUR CONTACTS (Address, Telephone No., Fax No.)



NOTE !

ALL SPARE PARTS SEE SPARE PART CATALOGUE

A complete list up of standard supplied tools, additional safety devices, etc. is provided in the spare part catalogue.

7.3. MAINTENANCE INTERVALS

INFORMATION FOR MAINTENANCE SCHEDULE

The maintenance intervals mentioned in this section are guiding times and should be observed. If due to extreme environmental conditions (i.e. dust, tropical conditions) or extreme operational conditions (i.e. multiple shift operation) a deviation to the given maintenance interval(s) should become necessary, ask your local LIEBHERR CUSTOMER SERVICE for advice and confirmation to do so.



NOTE !

IT SHOULD BE NOTED THAT IN PARTICULAR THE MAINTENANCE TIME INTERVALS INDICATED ARE APPROXIMATE. IN REALITY THESE INTERVALS SHOULD DEPEND ON CRANE USAGE AND THEREFORE - MAY NEED TO BE UPDATED ACCORDINGLY.



IMPORTANT !

The maintenance intervals indicated in the maintenance list are based on the **ACTUAL OPERATING HOURS OF THE CRANE**. Should the crane be standing for a period of more than four (4) weeks - the crane has to be operated **ONCE A MONTH FOR AT LEAST TWO (2) HOURS**. In addition to that all the greasing, oil inspections and oil level checks have to be done as well.

GENERAL MAINTENANCE								
10 h / daily	50 h / weekly	100 h / 2 weeks	250 h	500 h / 3 months	1000 h / 6 months	2000 h / every year		
							O = First time maintenance X = Repeated maintenance LS = LIEBHERR Service personell	
X						O	Check function and correct indication of all control devices	
X							Check correct function of emergency stops	
	X						Check cables and plug connection of main sensors	
				X			Check correct function of lighting	
				X			Check screw connections, brushes of slipring unit	LS
				X			Check-up of steel structure, welds, brackets, ladders, platforms	LS
				X			Drive all functions, check safety devices and limit switches	
						O	Check all terminals and ventilation of switch cabinet	LS
						O	Check junction boxes	
						X	Check correct fit of cables and sensors	
						X	Replace air filter of switch cabinet	

MAINTENANCE

GREASING SYSTEM							
10 h / daily	50 h / weekly	100 h / 2 weeks	250 h	500 h / 3 months	1000 h / 6 months	2000 h / every year	
	X						Check all greasing lines.
	X						Check greasing points.
			X				Regrease all greasing points
			X				Visual Check of all greasing points, check tightness of greasing lines
				O			Regrease all greasing points
			X				Regrease all greasing points, greasing lines and blocks

HYDRAULIC SYSTEM								
10 h / daily	50 h / weekly	100 h / 2 weeks	250 h	500 h / 3 months	1000 h / 6 months	2000 h / every year		
	X						Checking leaktightness and condition (hoses, pipes, fittings), check oil level.	
		O		X			Replace filter element of feed pressure filter , oil cooler filter and return flow filter	LS
				O			Drive system to working temperature. Take a oil sample, if required change oil; drain oil, clean complete inside tank.	
				X			Drive system to working temperature. Check oil level. Take oil sample.	
						X	Drive system to working temperature. Take oil sample, if required change oil; check leaktightness.	
						X	Check wear of tooth profile of hydraulic motors	LS
						X	Check pressures, adjustments if required	LS
						X	Replace air breather filter of hydraulic oil tank	
						X	Replace (check) pressure accumulators	LS

SLEWING GEARBOXES AND SLEWING BEARING							
10 h / daily	50 h / weekly	100 h / 2 weeks	250 h	500 h / 3 months	1000 h / 6 months	2000 h / every year	
			X				Check condition of gear rim and slewing bearing, regrease
X							Check gear oil level of slewing gearboxes
		X					Grease slewing gear rim
				X			Check correct oil level of slewing gear boxes
				X			Check air breather of slewing gear boxes
					O		Take oil sample on slewing gearboxes, check oil level
				O		X	Drive to temperature, take oil samples, if required renew oil to correct level.
					O	X	Check correct torque of bolts of slewing ring
							LS

ROPES AND ROPE PULLEYS							
10 h / daily	50 h / weekly	100 h / 2 weeks	250 h	500 h / 3 months	1000 h / 6 months	2000 h / every year	
X							Check condition, lubricants, function of ropes
				X			Check condition and rope fix points
				X			Check for damages / wear of rope pulleys

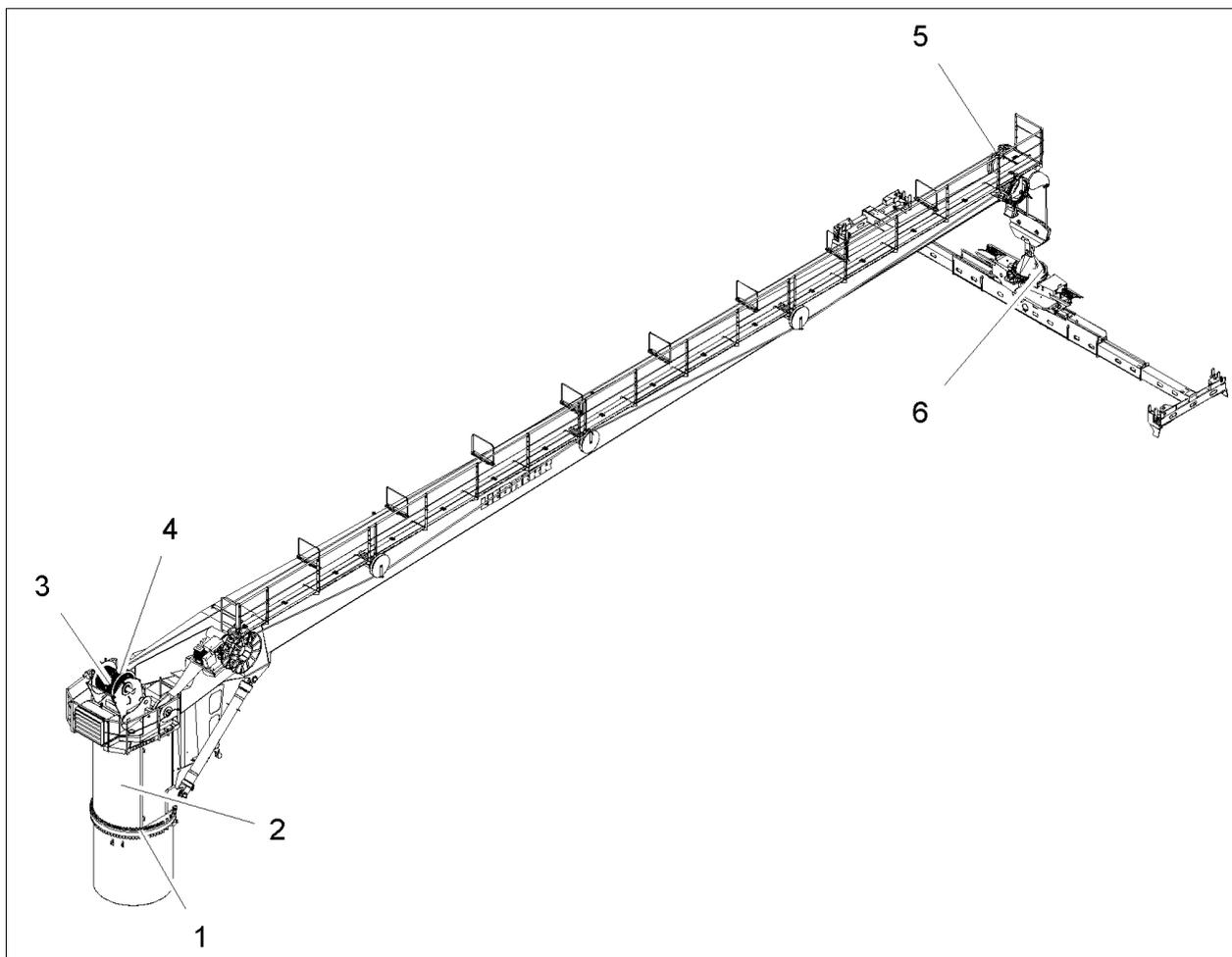
MAINTENANCE

HOISTING WINCH							
10 h / daily	50 h / weekly	100 h / 2 weeks	250 h	500 h / 3 months	1000 h / 6 months	2000 h / every year	
							<p>O = First time maintenance X = Repeated maintenance LS = LIEBHERR Service personell</p>
X							Check correct function of limit switches
X							Check gear oil level, grease counter bearing
		O					Take oil samples, if required renew oil to correct level. Before fitting new oil flush the gear boxes with little preheated oil in order to wash off any contamination. Check level after a short while again.
				X			Check for correct oil level, check air breathers
						X	Drive to temperature, take oil samples, if required renew oil to correct level. Before fitting new oil flush the gear boxes with little preheated oil in order to wash off any contamination. Check level after a short while again

AIR CONDITION							
10 h / daily	50 h / weekly	100 h / 2 weeks	250 h	500 h / 3 months	1000 h / 6 months	2000 h / every year	
							<p>O = First time maintenance X = Repeated maintenance LS = LIEBHERR Service personell</p>
X							Check, if dirty-water outlet is open
				X			Check the blowers as well as condenser- and evaporator lamellas for contaminations - clean if necessary
				O		X	Check if enough freon is inside and replenish if necessary
				O		X	Check if the screwings - especially at the expansion valve - are tighten and tight if necessary
							If the humidity indicator at the sight glass indicates discolouration, the filter drier and the freon should be renewed

7.3.1. GREASING SCHEMATIC

LUBRICANTS AND SERVICE FLUIDS should be selected from the SPECIFICATIONS OF SERVICE PRODUCTS of LIEBHERR

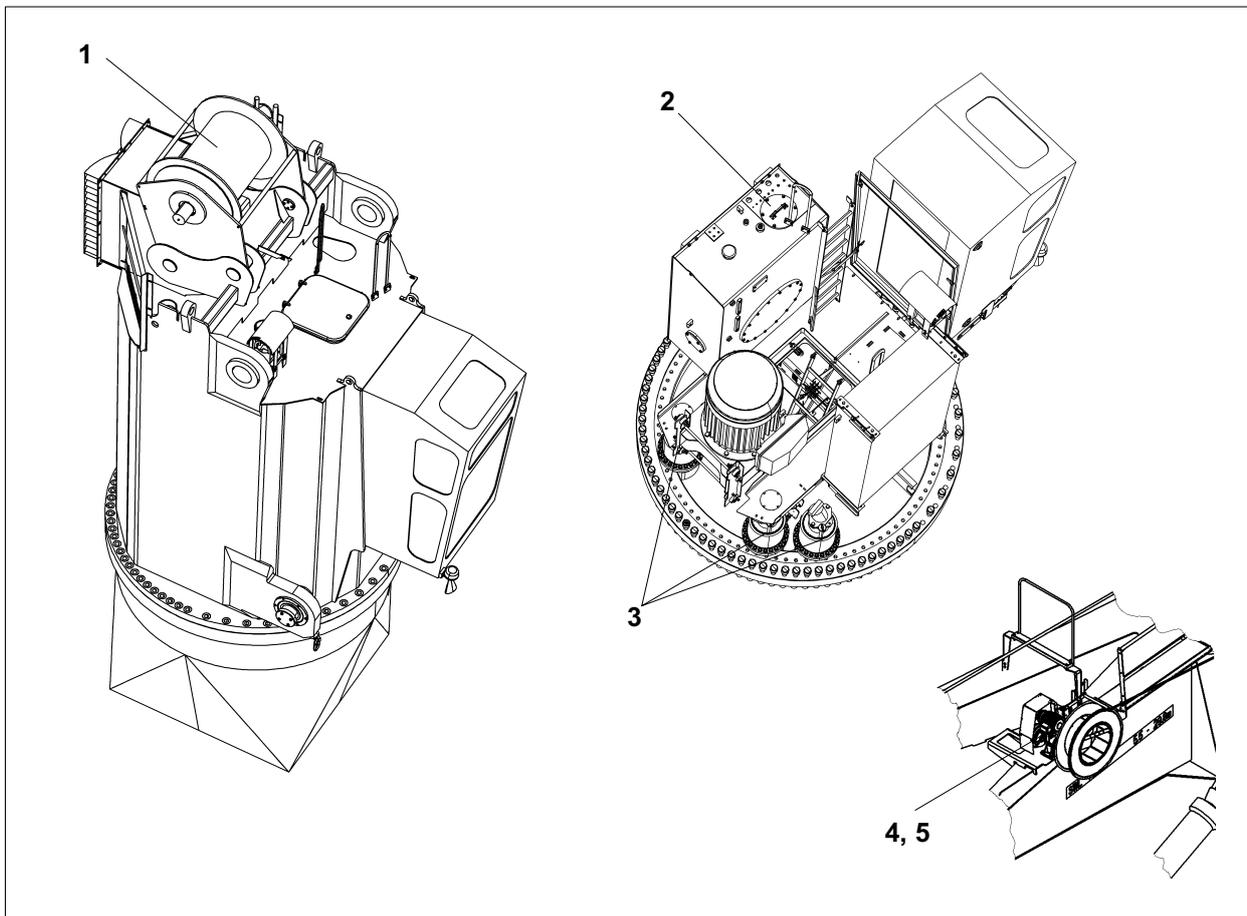


- 1 Slewing bearing - slewing gear rim
- 2 Inside slewing column: slewing gears
- 3 Hoisting winch counter bearing
- 4 Ropes
- 5 Rope pulleys
- 6 Hook block with rotator spreader

Regarded grease qualities

System	Grease
Rope pulleys	AVIALITH 2EP
Ropes	Calcium-grease EP
Slewing bearing	AVIALITH 2EP
Slewing ring gear rim	AVIA ALUPLEX 2
Slewing gear	AVIALITH 2EP
Winches	AVIALITH 2EP

7.3.2. OIL FILLING SCHEMATIC



- 1 Hoisting winch gearbox
- 2 Hydraulic oil tank
- 3 Slewing gear boxes
- 4 Cable reel gear
- 5 Turbo coupling

Regarded oil qualities and quantities

System	Type of oil	Filling quantities
Hoisting winch	API GL-5 (SAE 90 / SAE 80 W90)	5,8 l
Hydraulic oil tank	ATF or similar	750 l
Slewing gearboxes	API GL-5 (SAE 90 / SAE 80 W90)	3 x 11,2 l
Cable reel gear	ISO VG 220	5 l
Turbo coupling of cable reel	Shell Morlina 22	1,9 l



NOTE !

The oil filling quantities in the following chart are approximate values.
Determine the effective filling quantities always with the oil dipstick or oil sight glass.

7.3.3. UTILITY REQUIREMENTS

LIEBHERR - Utility Requirements

Item code **984002614**
Edition **00**

Crane: FCC-CBW 12/32 ST
Order: 162731

Unit	Req. / Unit	No. of Unit	Total	Type
1. Winches: - Luffing Winch - Main Hoist Winch	N / A 5,8 l	1 1	N / A 5,8 l	Gear Oil Gear Oil
2. Slewing Gear:	11,2 l	3	33,6 l	Gear Oil
3. Grease: - All sheaves, bearings - All other grease lines	1,4 kg 1,8 kg	1 1	1,4 kg 1,8 kg	Grease Grease
4. Cabin: - Windscreen washer	N/A	1	N/A	Anti Freeze Mixture
5. Gearbox:	N/A	0	N/A	Gear Oil
6. Hydraulic System: - hydraulic tank - hydraulic line system	750 l 100 l	1 1	750 l 100 l	Hydr. Oil Hydr. Oil
7. Electric Power Consumption: according to valid Electric - Power Supply Survey	N/A	1	N/A	-
8. E-Motor: according to valid Electric - Power Supply Survey	-	-	-	-

NOTE: For oil type refer to the attached list "RECOMMENDED OIL TYPES FOR LIEBHERR SHIP- AND OFFSHORE CRANES"

13.06.2006	LWN	LEDERLE / TB	according LIKV workflow	
Date	Work	Prepared	Checked	Approved

No copying or duplication of this document without the permission of Liebherr.
This document has been issued electronically and is valid without signature.

Utility quantity data sheet.xls

7.3.4. LUBRICANT REQUIREMENTS

Number	Lubrication Points	Ambient-temperature	Type ISO VG / SAE	Specification
1.	Engine ¹⁾ 500 Bh	all the year up to - 20 °C	SAE 10W-40	ACEA E4 API CF
2.	Engine ¹⁾ 250 Bh	all the year up to - 20 °C	SAE 10W-40	ACEA E2 / E3 API CE / CF-4 / CG-4
3.	Oilbath air cleaner	up to - 15 °C	SAE 15W-40 See lubricant requirement motor	MIL-L-2104 C/D (SHPD)
4.	Mechan. gearboxes and winches	up to - 20 °C	SAE 90 SAE 85W-140	API GL-5 MIL-L-2105B/C/D
5.	Axles	up to - 25 °C	SAE 80W-90 SAE 80W-140	
6.	Hydrostatic transmission	up to - 25 °C	ATF	1. DEXRON II D/E 2. DEXRON III
7.	Power steering	all the year up to - 15 °C ²⁾	ISO VG 46	DIN 51 524 / 2 Typ HLP / HLPD
8.		all the year up to - 20 °C ²⁾	ISO VG 46	DIN 51 524 / 3 Typ HVLP / HVLPD
9.		up to - 25 °C ²⁾	ISO VG 46	VDMA 24 568 / Typ HEES ³⁾
10.		up to -15 °C ²⁾	SAE 15W-40	ACEA E2 / E3 API CE / CF-4 / CG-4 MIL-L-2104 C/D
11.		up to - 20 °C ²⁾	SAE 10W-40	ACEA E2 / E3 / E4 API CE / CF-4 / CG-4 MIL-L-2104 C/D
12.	Ball resp. Roller slewing rings, cardan shafts, other greasing points	up to -30°C	Multipurposegrease Lithium based First fill "Liebherr Spezialfett 9610 Plus"	DIN 51 825, NLGI 2 KP 2 K-30 KPE 2 K-30
13.	Open gears and geared rims Ropes ⁴⁾	all sections	Lubricant and preservative	DIN 51 502 OGPF 0 / 1 / 2

- 1) The instructions of the manufacturer are obligatory (pay attention to the manual)!
- 2) With heating of crane in operation outside temperatures could be appr. 15 °C lower.
- 3) quickly biodegradable
- 4) See also the operating manual!

7.3.5. TABLE OF LUBRICANTS

Number						
1.	Agip SIGMA Ultra TFE 10W-40	Mega Turboral SAE 10W-40	AVILUB Motorenöl WDB 10W-40	Vanellus E7 Plus	Chevron Delo® XLD SAE 10W/40	Performance Expertly 10W-40
2.	Agip Sigma Super TFE 10W-40 Agip SIGMA TFE 10W-40	Extra Turboral SAE 10W-40	AVIA TURBOSYNTH CFE LUS 10W-40	Vanellus C6 Global Plus	10W-40AVIA MULTI CFE PChevron Delo® XLD SAE 10W/40	Performance Trophy DX 10W-40
3.	Agip Blitum T 15W-40 Agip Universal Multi-fleet 15W-40	Plus Turboral SAE 15W-40 Multi Turboral SAE 15W-40	AVIA MULTI HDC PLUS 15W-40 AVIA MULTI HDC EXTRA 15W-40	Vanellus E6	Chevron Delo® 400 SAE 15W/40	Performance Trophy DX 15W-40
4.	Agip ROTRA MP DB 85W-90 Agip ROTRA MP 85W-140	Getriebeöl Hyp 85W-140 Getriebeöl Hyp 85W-140	AVIA HYPOID 90 EP 85W-90 AVIA HYPOID 85W-140 EP AVIA SYNTOGEAR PE 220 (PAO)	Energear Hypo 85W-90 Energear Hypo 85W-140	Chevron RPM Universal SAE 85W/140	Tranself Typ B 90 Tranself Typ B 85W-140
5.	Agip ROTRA MP 90W-90 Agip ROTRA TRUCK GEAR 80W-90 Agip ROTRA TRUCK S (LSX) GEAR 75W-90	Getriebeöl EP Plus 80W-90	AVIA SYNTOGEAR FE 80W-90 AVIA HYPOID FE 80W-140 AVIA SYNTOGEAR FE 75W-90 EP (PAO)	Energear FE 80W-90 Energear FE 80W-140 Energear Hypo 80W-140	Chevron RPM Universal 80W/90	Tranself Typ B 80W-90 Tranself Universal FE 80W-90 Tranself Universal FE 80W-140
6.	Agip ATF D 309 Agip ATF II D Agip DEXRON III	1. ATF E-S 2. ATF 55	1. AVIA FLUID ATF 86 AVIA FLUID ATF 92 S 2. AVIA FLUID ATF 98	1. Autran LTF (Dexron II E) Autran MBX (Dexron II D) 2. Autran DX III	Chevron ATF Chevron ATF-2	Elfmatic G 2 SYN Elfmatic G 3 SYN
7.	Agip OSO 46 Agip OSO-D 46 Agip ARNICA D 46	Vitam GF 46/ Vitam DE 46	AVIA FLUID RSL 46 AVIA FLUID HLPD 46	Energol HLP-HM 46 Energol HLP-D 46	Hydraulic Oil AW Iso 46	Azolla ZS 46 Azolla D 46
8.	Agip ARNICA 46 Agip PRECIS System Multi Fluid	Vitam HF 46/ Vitam VF 46	AVIA FLUID HVI 46	Bartran HV 46	Chevron Clarity® Iso 46	Equivis ZS 46 Equivis D 46
9.	Only on request by Liebherr					
10.	Agip Blitum T 15W-40 Agip Universal Multi-fleet 15W-40	Multi Turboral 15W-40	As Item 3	Vanellus E6	As Item 3	Performance Trophy DX 15W-40
11.	Agip SIGMA Ultra TFE 10W-40 Agip Sigma Super TFE 10W-40 Agip SIGMA TFE 10W-40	Extra Turboral 10W-40 Mega Turboral 10W-40	As Item 1 & 2	Vanellus E7 Plus	As Item 1 & 2	Performance Trophy DX 10W-40
12.	Agip GR MU EP 2 Agip Longtime Grease 2 Agip/Autol TOP 2000 Agip/Autol TOP 2000 BIO 3)	Aralub HLP 2 Langzeitfett H/ Aralub BAB EP2	AVIALITH 2 EP AVIA SYNTOGREASE 2 3)	Energear LS-EP 2 Biogrease EP 2 3)	Ulti-Plex Grease EP #2	Multis EP 2
13.	Agip SAGUS 60 Agip GREASE SM 2	Aralub MKA Z 0 Aralub MKA Z 1 Aralub MKA PL	AVIA ALUPLEX 0 RHS AVIA ALUPLEX 2 RHY AVIA ALUPLEX RHS FLUID	Energear OG	Open Gear Grease	Ceran AD Ceran MM

- 1) The instructions of the manufacturer are obligatory (pay attention to the manual) !
- 2) With heating of crane in operation outside temperatures could be appr. 15 °C lower.
- 3) quickly biodegradable
- 4) See also the operating manual!

MAINTENANCE

Number							
1.	ESSOLUBE XTS 5	Kappa Ultra 10W-40	TITAN CARGO MC SAE 10W40	Rimula Ultra 10W-40	Mobil Delvac XHP Extra Mobil Delvac 1 Mobil Delvac 1 SHC	Rubia TIR 8600 10W-40	UNIMOT TRUCK LD 10W-40
2.	ESSOLUBE XT 5	Kappa Ultra 10W-40	TITAN UNIC MC SAE 10W40	Rimula Super FE 10W- 40	Mobil Delvac MX Mobilgard HSD	Rubia TIR 8600 10W-40	UNIMOT TRUCK LD 10W-40
3.	ESSOLUBE XT 5	Kappa Extra Plus 15W-40	TITAN UNIVERSAL HD SAE 15W40	Rimula Super 15W- 40	Mobil Delvac MX Mobilgard HSD	Rubia TIR 6400 15W-40	MARMAX TD 15W-40
4.	ESSO Gear Oil GX-D 85W-90 ----- ESSO Getriebeoel GX 85W-140	Pontonic MP 80W-90 Pontonic MP 85W-140	TITAN GEAR HYP SAE 90 TITAN SUPERGEAR SAE 85W-140	Spirax A 90 Spirax A 85W- 140	Mobilube HD 85W-90 A Mobil SHC 630 ----- Mobilube HD 85W-140 Mobil SHC 632	Total EP B 80W-90 Transmission TM 85W-140	HYPOID GEAR OIL TS 80W-140
5.	ESSO Gear Oil TDL 75W-90 ----- ESSO Gear Oil TDL 80W-140	Pontonic MP 80W-90 Pontonic A 80W-140	TITAN SUPERGEAR SAE 80W90 TITAN SUPERGEAR SAE 85W-140	Spirax A 80W-90 Spirax ST 80W-140	Mobilube 1 SHC 75W-90 Mobil SHC 630 ----- Mobilube HD-N 80W-140 Mobil SHC 632	Total EP B 80W-90 Transmission TM 80W-90 Transmission TM FE 85W-140	AS 4 + MPGO 85W-140
6.	ESSO ATF Dexron II ESSO ATF D 3	Finamatic S 6726 Finamatic HP	TITAN ATF 3000 TITAN ATF 4000 TITAN ATF 5000	3. Donax TA 4. Donax TX	Mobil ATF 220 (IID) Mobil ATF	Fluide SYN FE Fluide matic SYN	ATF II
7.	Nuto H 46 (HLP) Esso HLPD 46	Azolla ZS 46 Azolla D 46	RENOLIN B 15 RENOLIN MR 15	Tellus 46/ Tellus S 46 Tellus DO 46	Mobil DTE 25 (HLP)	Azolla ZS 46 Azolla D 46	HYDRAULIC OIL 46
8.	Univis N 46 (HVLP)	Equivis ZS 46 Equivis D 46	RENOLIN B 46 HVI RENOLIN MR 46 MC	Tellus T 46 Tellus TX 46 Tellus TD 46	Mobil DTE 15M (HVLP) Mobil SHC 525	Equivis ZS 46 Equivis D 46	PREMIUM HY-DRAULIC OIL HVI 46
9.	Only on request by Liebherr						
10.	ESSOLUBE XT 5	Kappa Ultra 10W-40	TITAN UNIVERSAL HD SAE 15W40	Rimula Super 15W- 40	Mobil Delvac MX Mobilgard HSD	Rubia TIR 6400 15W-40	MARMAX TD 15W-40
11.	ESSOLUBE XT 5	Kappa Extra Plus 15W-40	TITAN UNIC MC SAE 10W40	Rimula Super FE 10W- 40	Mobil Delvac MX Mobilgard HSD	Rubia TIR 8600 10W-40	UNIMOT TRUCK LD 10W-40
12.	Beacon EP 2	Multis EP 2	RENOLIT MP RENOLIT LZR 2 H PLANTOGEL 2 S2 3)	Alvania EP(LF)2 Alvania EPB2	Mobilgrease XHP 222 Mobilith SHC 460	Multis EP 2	SPECIALUBE MB 2
13.		Ceran AD Ceran MM	RENOLIT CX-HAT 0 RENOLIT CX-HAT 2	Malleus OGH Malleus GL 95	Mobilnac 375 NC OGPF 1-2 K-20 Mobilith SHC 460 Mobilgrease XHO 222 KP 2 G-30	Ceran AD Ceran MM	Unigrease 1732

- 1) The instructions of the manufacturer are obligatory (pay attention to the manual) !
- 2) With heating of crane in operation outside temperatures could be appr. 15 °C lower.
- 3) quickly biodegradable
- 4) See also the operating manual!

7.4. ELECTRIC MOTOR

7.4.1. GENERAL SAFETY CONSIDERATIONS

The electric motor is intended to be installed and used by qualified personnel who are familiar with relevant safety requirements. Safety equipment necessary for the prevention of accidents at the mounting and operating site shall be provided in accordance with the regulations prevailing in the local country.

POINTS TO OBSERVE

- The machine shall not be used to step on.
- The temperature of the outer casing of the machinery may be too hot to touch during normal operation.
- Some special machine applications require special instructions (eg using frequency converter supplies).
- Lifting lugs shall be used for lifting the motor alone.

INFORMATIONS ON NAME PLATE

Rating plate										Lubrication plate																	
ABB Oy, Electrical Machines LV Motors, Vaasa, Finland										ABB																	
CE										Regreasing intervals in duty hours																	
3~ Motor M3BP 315 SMB 4 B3										Bearings 6319 6316																	
IEC 315 S/M 80										Amount of grease 90g 70g																	
S1					No. 3291111 7711 SM					Mounting		Ambient temp.		1800 r/min		1500 r/min		1000 r/min		500-900 r/min							
					Ins.cl. F IP 55					Hor		25°C		6500		8500		12500		16000							
V		Hz		kW		r/min		A		cosφ		Duty		Hor		40°C		3250		4250		6250		8000			
690 Y		50		160		1487		166		0.85				Vert		25°C		3250		4250		6250		8000			
400 D		50		160		1487		287		0.85				Vert		40°C		1630		2130		3130		4000			
660 Y		50		160		1485		171		0.86				Do not exceed the motor max. speed													
380 D		50		160		1485		296		0.86		The following or similar high performance grease can be used:															
415 D		50		160		1488		279		0.84		Esso		Unirex N2, N3 or S2		Mobil		Mobilith SHC 100		Shell		Albida EMS2		Klüber		Klüberplex BEM 41-132	
440 D		60		185		1785		295		0.86		SKF		LGHQ 3		FAG		Arconol TEMP110									
Prod.code 3GBP312230-ADG																											
										Nmax		2300 r/min															
6319/C3		6316/C3		1000 kg								See the "Low Voltage Motors Manual"															
ABB IEC 60034-1																											

7.4.2. MAINTENANCE AND LUBRICATION

GENERAL INSPECTION

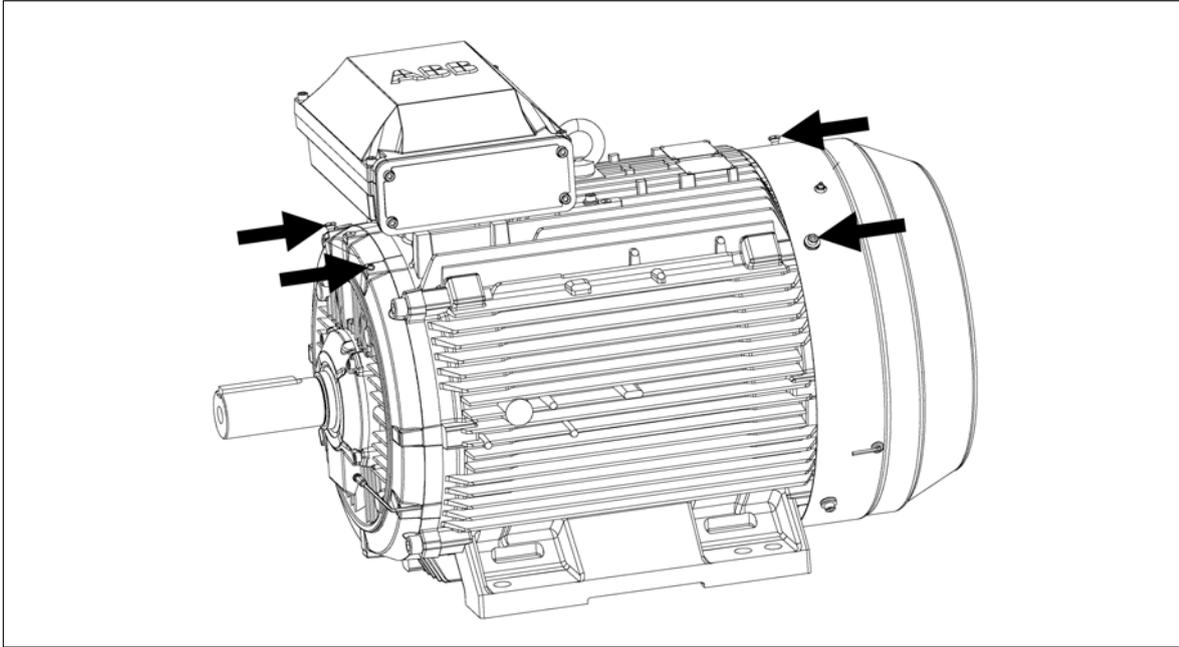
- Inspect the machine at regular intervals.
- Keep the machine clean and ensure free ventilation air-flow.
- Check the condition of connections and mounting and assembly bolts.
- Check the bearing condition by listening for unusual noise, vibration measurement, bearing temperature, inspection of spent grease



NOTE !

When changes of condition occur, dismantle the machine, check the parts and replace if necessary.

LUBRICATION



Machines fitted with grease nipples (see picture above)

Lubricate the machine while running.

If grease outlet plug fitted, remove temporarily when lubricating.



IMPORTANT !

The machine is fitted with a lubrication information plate. Follow the given values.

The grease amount is used if small quantities of fresh grease are replaced at regular intervals as above. As an alternative, when the machine is fitted with grease escape valves, fresh grease may be pressed into the bearings until the old grease is totally replaced.

LUBRICANTS

When regreasing, use only special ball bearing grease with the following properties:

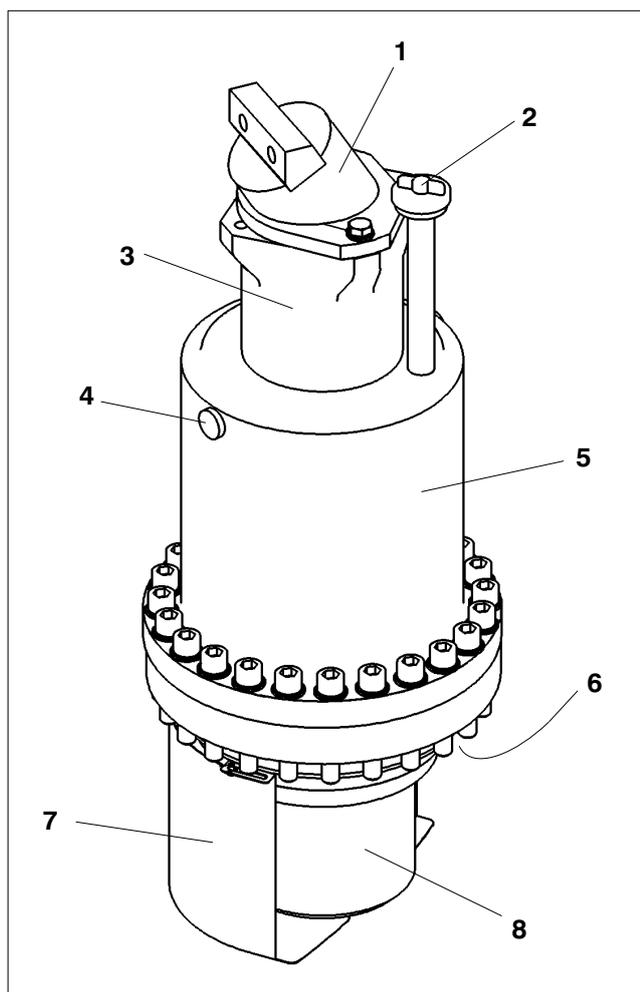
- good quality lithium base or lithium complex grease
- base oil viscosity 100-140 cST at 40 °C
- consistency NLGI grade 2 or 3
- temperature range -30 °C - +120 °C, continuously

Greases with the correct properties are available from all the major lubricant manufacturers. If the make of grease is changed and compatibility is uncertain, lubricate several times at short intervals in order to displace the old grease.

Highly loaded and / or slowly rotating bearings require EP-grease. If lubrication intervals are short due to bearing temperatures above 80 °C or above, use high temperature greases which normally permit approximately 15° C higher bearing temperatures.

7.5. GEARBOXES

7.5.1. SLEWING GEARBOXES



- 1 Hydraulic motor
- 2 Gear oil filling and air release of gear
- 3 Multi disc brake
- 4 Oil sight glass
- 5 Slewing gear box
- 6 Drainage plug
- 7 Protection cover
- 8 Slewing pinion (engaged to gear rim of slewing bearing)

OIL LEVEL INSPECTION

can be carried out by the provided oil sight glass (Pos. 4):
If required, refill gearoil



IMPORTANT !

Shut down the crane before making an oil change or oil level inspection !

OIL CHANGE

Remove the drainage plug (Pos. 6) when exchanging the oil, but don't forget to put it on again after the oil exchange.

Let the oil flow out at the oil drain (Pos. 6). Refill the gearbox at the oil filler inlet (Pos. 2).

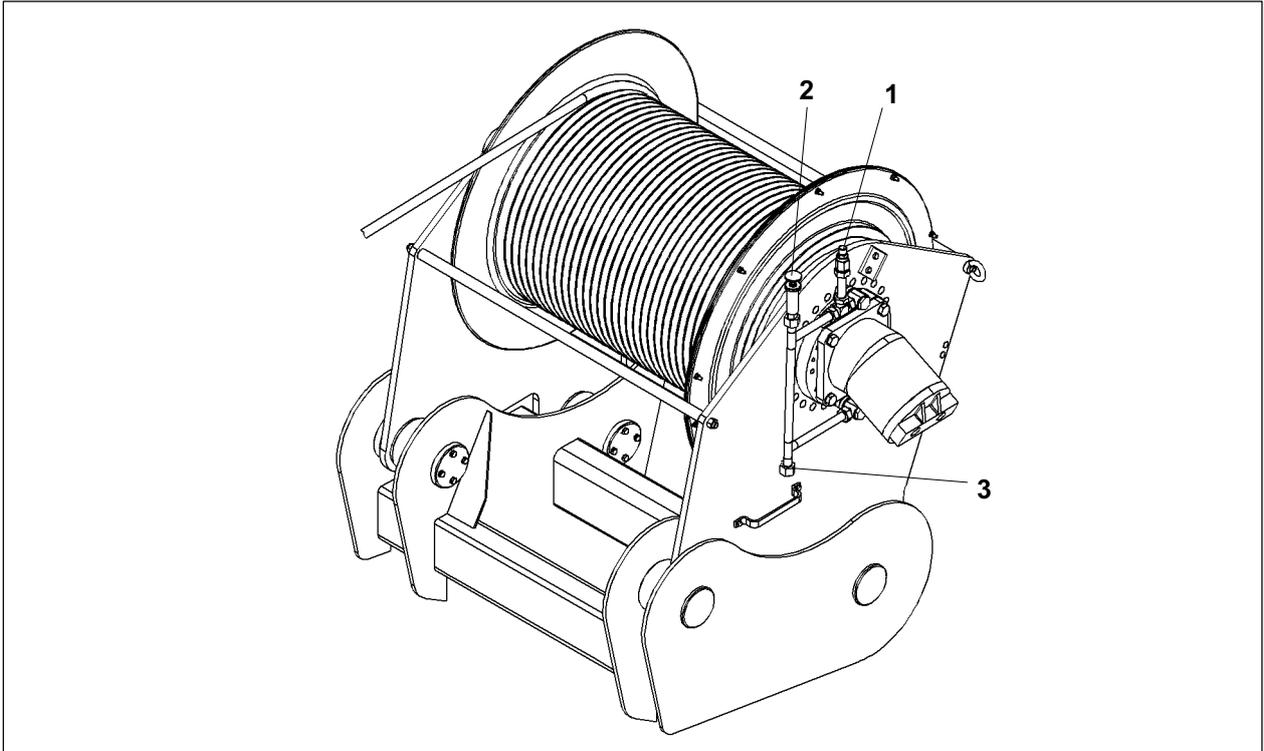
Oil change should be carried out at the working temperature of the gearbox. It is recommended to flush the gear with a little preheated new oil. In this way any abrasives and contamination can be washed off.



NOTE !

Further information about filling qualities and filling quantities are described in the chapters "FILLING QUANTITIES and TABLE OF LUBRICANTS".

7.5.2. HOISTING WINCH GEARBOX



- 1 Breather
- 2 Oil filler inlet with dipstick
- 3 Oil drain



IMPORTANT !

Shut down the crane before making an oil change or oil level inspection !

OIL LEVEL INSPECTION

can be carried out by the provided oil dipstick (Pos. 2):
If required, refill gearoil

OIL CHANGE

Remove the drainage plug (Pos. 3) and breather plug (Pos. 1) when exchanging the oil, but don't forget to put it on again after the oil exchange.

Let the oil flow out at the oil drain (Pos. 3). Refill the gearbox at the oil filler inlet (Pos. 2).

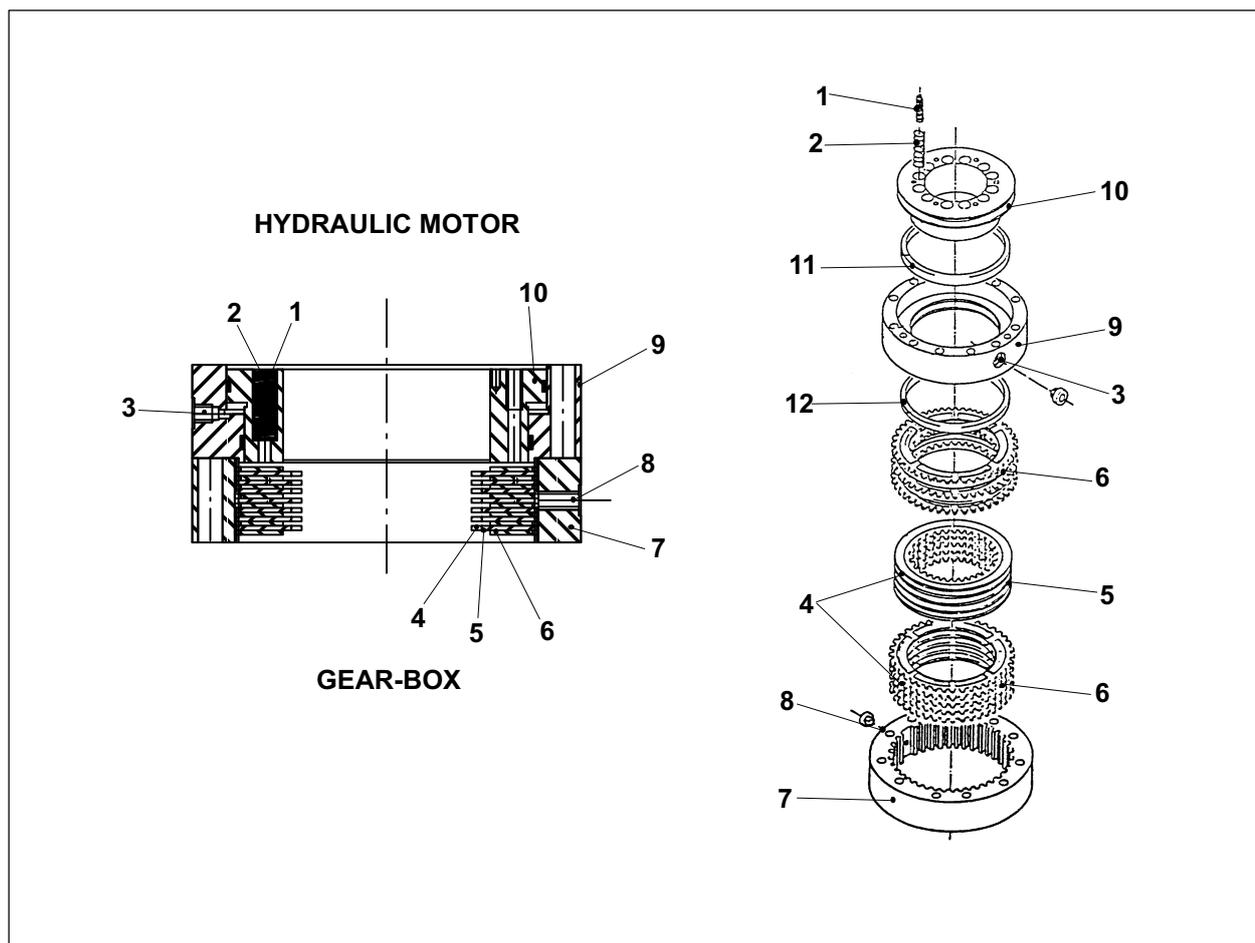
Oil change should be carried out at the working temperature of the gearbox. It is recommended to flush the gear with a little preheated new oil. In this way any abrasives and contamination can be washed off.



NOTE !

Further information about filling qualities and filling quantities are described in the chapters "FILLING QUANTITIES and TABLE OF LUBRICANTS".

7.6. MULTIPLE DISC BRAKES



- | | | | |
|---|-------------------------------------|----|---------------------|
| 1 | Outer spring for brake force (AF) | 7 | Discs bracket |
| 2 | Inner spring for brake force (IF) | 8 | Leak oil connection |
| 3 | Hydraulic pressure connection | 9 | Housing |
| 4 | Friction faces (RFL) | 10 | Piston |
| 5 | Brake disc with inner gear rim (IL) | 11 | Inner seal |
| 6 | Brake disc with outer gear rim (AL) | 12 | Outer seal |

GENERAL:

The spring loaded multiple disc brakes on our machines are used as **HOLDING BRAKES ONLY**, as the slow down of any movement is done by the hydraulic system. Therefore they are subject to very little wear. The brakes are only on **high wear**, in the case of an **EMERGENCY STOP SITUATION with full load. In this case the multiple disc brake of the winch(es) must be inspected and checked for proper function.**

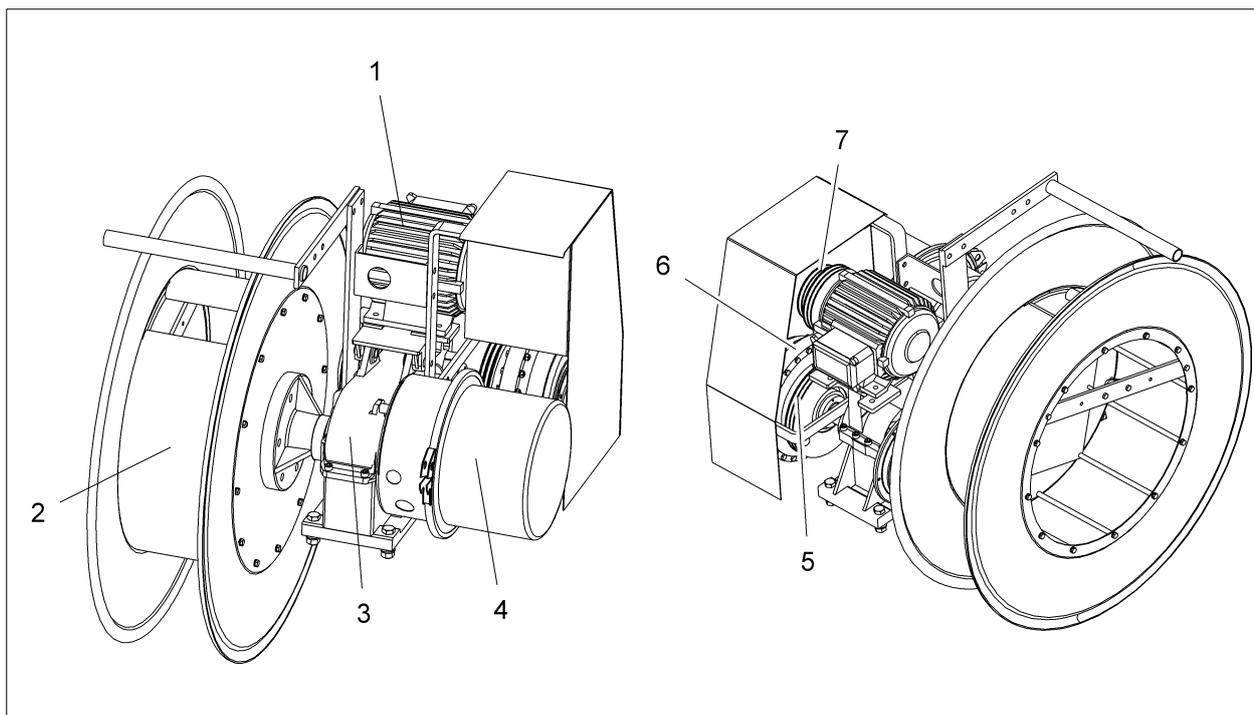
The maximum holding moment of a respective machine or drive is determined by the various arrangements of the disks and springs in these brakes.

⚠ WARNING !

For this reason, the arrangement and layout of the multi-disc-brake must always be exact and special caution must always be exercised, when repairs are carried out or when brakes are replaced. Only an exact arrangement protects the drives from overloading as well as guaranteeing the maximum holding moment !

7.7. CABLE REEL

7.7.1. ASSEMBLY OF CABLE REEL



- 1 Drive-motor
- 2 Cable drum body
- 3 Gear box
- 4 Slipring housing
- 5 Narrow V-Belt disc
- 6 Turbo coupling
- 7 Narrow V-Belt disc

7.7.2. MAINTENANCE OF THE CABLE REELING DRUM

a.) The brush holder and sliprings are subject to normal wear and are to be replaced on demand. The running surface has to be cleaned and the moveability of the brush holders has to be checked and to be cleaned or if required (when 2/3 of the brushes are abraded) replaced. After cleaning the sliprings please spray them the necessary special spray, which is available through our spare parts department. Make sure that the sliprings are always free of carbon dust of the brushes (flash in might occur). After the running in period of the brush holders the carbon dust inside the slipring housing has to be removed in regular intervals (every 3-4 month or after 120 000 rotations). The installed deep groove ball bearings are abundantly provided with grease and a re-lubrication only is necessary at rather long intervals.

b.) Narrow V-belt:

The narrow V-belt is to be readjusted, if necessary. The correct tension is checked by pressing a finger on the belt. If well adjusted, the V-belt should bend by the thickness of a finger.

c.) Solenoid-operated spring pressure brake:

The brake should be checked for its proper function in regular intervals. When the brake lining has to be changed please make certain that it is absolutely grease and oil free. There should be no grooves in the brake area.

d.) Three-phase current motor:

Only after about 5 000 working hours the motor bearings will have to be refilled with suitable high temperature grease (drop point between 170 and 190 degree C approximately). Before closing the terminal box cover it should be slightly spread with grease. Please observe the instruction plate inside the cover. (All maintenance should be carried out with a switched off motor).

e.) Turbo coupling: The hydraulic oil of the turbo coupling is to be renewed after 5 000 working hours. It is very important for the transmission of the turning moment to fill in high quality oil into the hydraulic coupling.

In the factory the turbo coupling has been filled with hydraulic oil:
SHELL MORLINA 22 ISO-VG 22; 22 cST/40° C; 4,3 cST/100 °C

Oil quantity: 1,9 l

f.) Spur gear:

The oil of the spur gear is to be renewed, according to the working hours, every 12-18 months. It is recommended, that the oil is drained after having stopped the gear. If possible, refill the gear with the same type of oil.

Type of oil: syntetic oil brand Mobil Glygoyle 30
quantity: 5 liter

It is important to carry out the changing of the oil under clean conditions.

7.8. CRANE ROPES

7.8.1. SELECTION OF WIRE ROPES

Rope constructions listed in this crane manual have been chosen after extensive testing. They provide the best possible match between crane and rope characteristics. Based on many years of experience these ropes guarantee an optimal crane performance. Characteristics of ropes, although of equal standard, may vary considerably if rope construction, number of strands or tensile strength is modified - even if offering equal rotation resistant properties.

⚠ WARNING !

If ropes are exchanged only use ropes of the same construction and tensile strength as the original rope. Should it be necessary to use a different rope crane manufacturer must be contacted for consent.

Max. actual rope diameter must be 4 %, in the case of hoist ropes for truck mounted cranes exceeding 25 mm dia. it should be max. 3 %, above the nominal diameter. A right-hand rope is to be mounted on a left-hand drum and vice versa.

7.8.2. ROPE INSTALLATION

Wire ropes are easily affected by external damage, i.e. they must be handled with utmost care during transport and unloading. All wire ropes should be stored clean, dry and cool, soil contact must be excluded.

Only an installation of an untwisted rope free of any outer damage will guarantee a trouble-free operation. Ropes always must be uncoiled from the reel or the ring in the direction of winding (picture 1). Lateral uncoiling causes the rope to be twisted until its total destruction by kink formation.

It is recommended to use a frame-mounted reel for coiling the rope on the drum (picture 2). Coiling in the direction of bend prevents additional tension build-up in the rope and results in an excellent fit of the rope on the drum. Never drag ropes through soil or dirt.

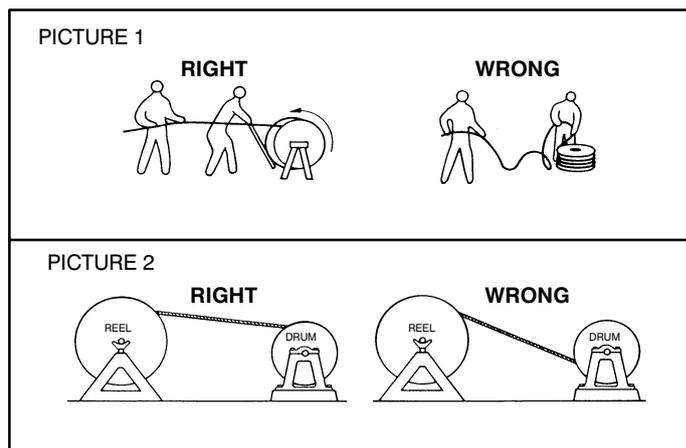
For the installation the new rope is fixed to the old rope still mounted or it is to be fixed to a auxiliary rope. Connection between the two ropes can be achieved either by a basket or two welded eyes. Any transmission of torsion from either the old or the auxiliary rope to the new rope must be definitively excluded. Rotation-resistant ropes must be protected from torsion by inserted swivels.

Multi-layer reeving requires that even the lower layers must be tightly coiled with a pretension of 1 - 2 % of minimum breaking load of the rope. This pretension is achieved by braking the reel.

For multi strand reeving hoisting rope and drum should have the same direction. If it is required to spread out a limited rope length on the floor for mounting the rope into the crane block it is important to avoid any twist or torsion in the rope.

Non-rotation free ropes may be used with fixed points at both ends only.

A test-run of several lifts under partial load and later with alternately loaded and unloaded crane block is required. Thus a flexible adaptation of the rope to bending direction and bending radii of pulleys and drum will be achieved.



7.8.3. MAINTENANCE

Maintenance at regular intervals guarantees safe crane operation and considerably increases rope life. Wire ropes must be regreased at regular intervals according to crane operation, this especially applies to the bending zones at the drums and pulleys. When exposed to the same test condition a well-greased rope has shown four times as many working cycles than an ungreased rope. Relubricants must be compatible with the original lubricant used.

The following lubricants are recommended:

All standard lubricants recommended by the crane manufacturer for open gears
Special lubricants like e.g.: Texaco Novatex Grease EP2, Rocol RD 105, Aral Aralub LFZ1

For ropes being reeved in multiple layers and therefore being exposed to extreme wear use of graphite containing lubricants is recommended like e.g.: Reiner Ceplattyn KG 10, Texaco Novatex FK 10

Heavily soiled wire ropes have to be cleaned regularly with a brush. If the lower layers on the drum are seldom used or not used at all, ropes have to be unreeved from time to time and then have to be reinstalled under prestress. A rope operates most economical when used in its whole length. Therefore it is recommended to always use the appropriate rope length according to crane operation; this is mainly true if crane is operated continuously for a long period of time.

If a rope is unequally loaded it may be reversed. The formerly free end is fixed in the drum by positioning unworn zones at zones mostly exposed to wear thus rope life can be extended considerably.

If wear mainly occurs if rope is multi-layer reeved on the Lebus drum, rope life may be increased by cutting-off one length according to 1/3 of drum circumference. This procedure can be repeated up to three times per rope.

7.8.4. INSPECTION

Wire ropes have been dimensioned to provide sufficient safety margins after the occurrence of first signs of a wire breakage before a replacement of the rope is required. The ropes have to be inspected in regular intervals; especially in the time period following directly after its installation. In addition special attention is required if a rope has been exposed to excessive wear, if non-visible damage is suspected or if there are other indications for rope damage.

The following criteria for a safe operation of the ropes can be applied:

- type and number of wire breakages (see table)
- position and time sequence of the wire breakages
- decrease of rope diameter
- corrosion, abrasion, deformation
- heat-effects
- length of period of running

First signs of a change in rope behavior must be carefully monitored.

 **ATTENTION !**

A twisting and waving of strands above the crane block can be an indication for a severely damaged rope. This twisting/waving is caused always by an additional torsion in the rotation-resistant hoisting rope originating from a number of adverse effects but may also be due to an overstretching of the hoist rope during heavy duty operation or due to shock loads resp. tearing on sticky container in hold. The torsion has to be untwisted at the rope fixpoint and requires extreme care and respective know-how. Therefore inspection is necessary at regular intervals especially shortly after the new rope has been installed.

Untwisting of crane pulley block with rotation-stable rope fixed point:

- Set down of pulley block
- Determine direction of twist.
- Detach rope from fixpoint and turn rope at the end approx. 180 - 360° into the direction which compensates the twisting resp. waving of the rope.
- Connect rope at fixpoint and carefully lift pulley block, operate crane unloaded with pulley block and also with crane trolley if present
- Repeat if necessary



IMPORTANT !

Make sure that twist is distributed to a long free rope end. By operating the crane in unloaded condition twist is to be distributed to the entire rope length. By no means forcefully twist a short length of rope; this may permanently damage rope structure.

If the hoisting rope was operated with open swivel an untwisting can be achieved by operating the trolley several times under no load conditions and with unloaded hook. If not successful, follow same procedure given for ropes with fixed point, e.g. if crane does not provide of a swivel, if rope is predamaged or if causes of twist can not be remedied otherwise. At the same time a regular check of all rope end terminations and suspensions for proper function is required. Individual components of rope drive unit, drums and pulleys must turn freely in their bearings. Grooves should not show any rope marks. Minimum groove radius on drums and pulleys should be 0,53 x nominal rope diameter.

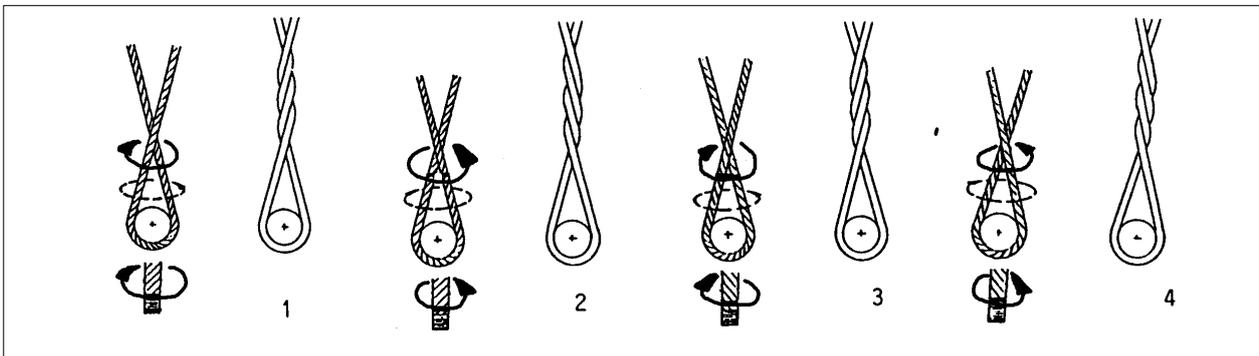
7.8.5. INSTRUCTIONS FOR UNTWISTING OF HOIST ROPES

- 1) Twisting of a multi-reeved crane block may be due to a number of causes. Any faults in the rope drive must be eliminated, the load/stretch torsion will "seat in" after some time of rope operation.
- 2) If a hoist rope is operated with open swivel an untwisting by several runs with unloaded hook will be sufficient in most cases. If this procedure proves to be ineffective refer to the instructions given for compensation of twist for ropes with rotation- stable fixed point, e.g.
 - if no swivel is provided
 - if the rope is predamaged or
 - if the causes of the twist can't be eliminated.

3) Determination of direction of twist

At first the direction of the twist of the crane pulley block must be determined. Pictures 1 and 2 show a possible twist of a right hand lay rope, on picture 3 + 4 of a left hand lay rope. In the right hand corner of each picture a sketch shows the occurrence of multiple twist. The respective direction of twist is indicated by a continuously drawn arrow printed in boldface. If it is difficult to identify the direction of twist for large hoisting heights turn rope in direction of arrow with dashed line once thus eliminating "braid". For compensation turn rope end shown separately in the direction of the continues arrow. It is important that the correct reference point is selected i.e. the crane operator must hold the rope in front of himself.

The direction of untwist can be determined also by simulating this situation by simply using a string.



4) Untwisting of crane pulley block with rotation-stable rope fixed point:

- Set down of pulley block
- Determine direction of twist
- Detach rope at fixed point
- Carefully turn rope at free end of at least 15 m length up to max. 180 - 360 degrees to compensate pulley block twist
- Reattach rope at the fixed point
- Carefully lift pulley block and operate unloaded crane with pulley block and jib
- Repeat if necessary



IMPORTANT !

Make sure that twist is distributed to a long free rope end. By operating the crane in unloaded condition twist is to be distributed to the entire rope length. By no means forcefully twist a short length of rope; this may permanently damage rope structure.

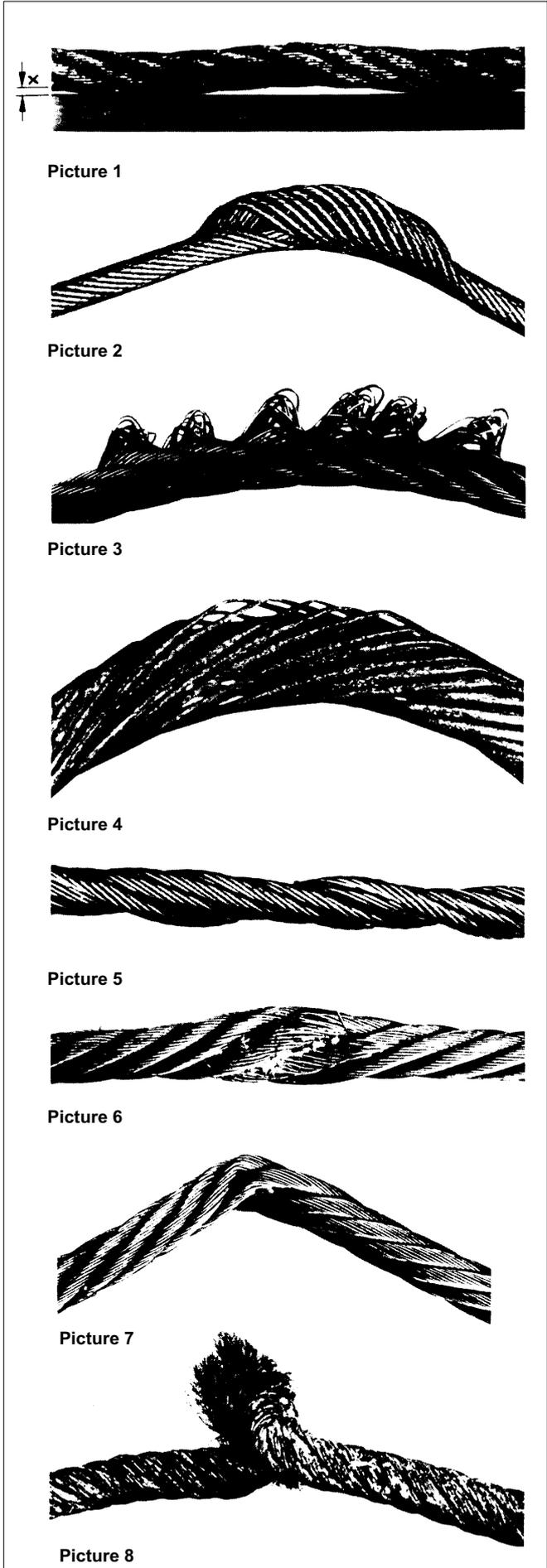
7.8.6. DISCARD CRITERIA

Warning for safety reasons crane ropes have to be discarded if showing one of the following criteria:

- Break of one strand
- Accumulation of wire breaks
- Number of wire breaks as defined in table
- Corkscrew-type deformations of more than 1/3 rope diameter (pic. 1)
- Basketlike distortions (pic. 2)
- Hair-pin type extrusion of wire or groups of wire (pic. 3)
- Decrease of rope diameter by 15 % against nominal diameter of rope or by 10 % if there are signs of corrosion and / or abrasion (pic. 4)
- Loosening of rope structure (pic. 4)
- Local decrease of rope diameter (pic. 5)
- Bends and local crushing (pic. 6 + 7)
- Kinks or resulting permanent deformations (pic. 8)

If special rope damage is found, the cause has to be determined and eliminated before a new rope will be installed. Damage or stress markings at crane components provide valuable information for possible causes of rope damage.

If in doubt discard rope or consult expert for further assistance.



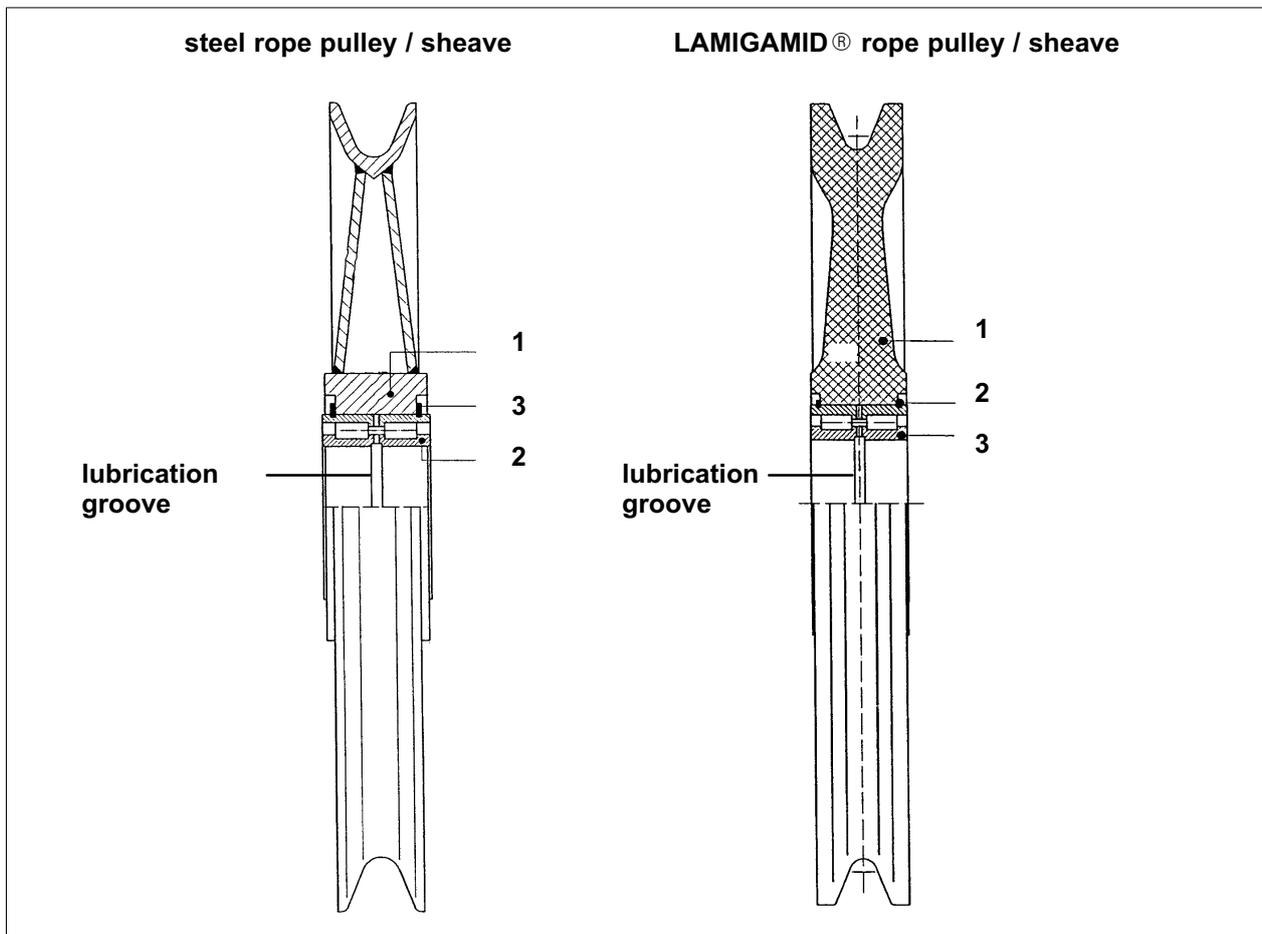
7.9. ROPE PULLEYS

7.9.1. GENERAL LAYOUT

Rope pulleys are constructed and manufactured as a result of many years of experience and knowledge of expectations and requirements of heavy machinery.

Smooth and reliable running of the equipment can however, only to be obtained if regular maintenance and care is given. Adhering to regular service intervals and use of correct lubricants as per the lubricants chart are also part of this. Special tools are not required for servicing.

All rope pulleys are designed with large diameters and with anti-friction bearings.



- 1 Rope pulley / sheave
- 2 Anti-friction bearing
- 3 Circlip

7.9.2. STORAGE

Rope pulleys in storage should be kept away from steam or hot water pipes, heated air ducts or any other source of heat, which can thin out lubricant and cause it to drain out of the rope pulley.

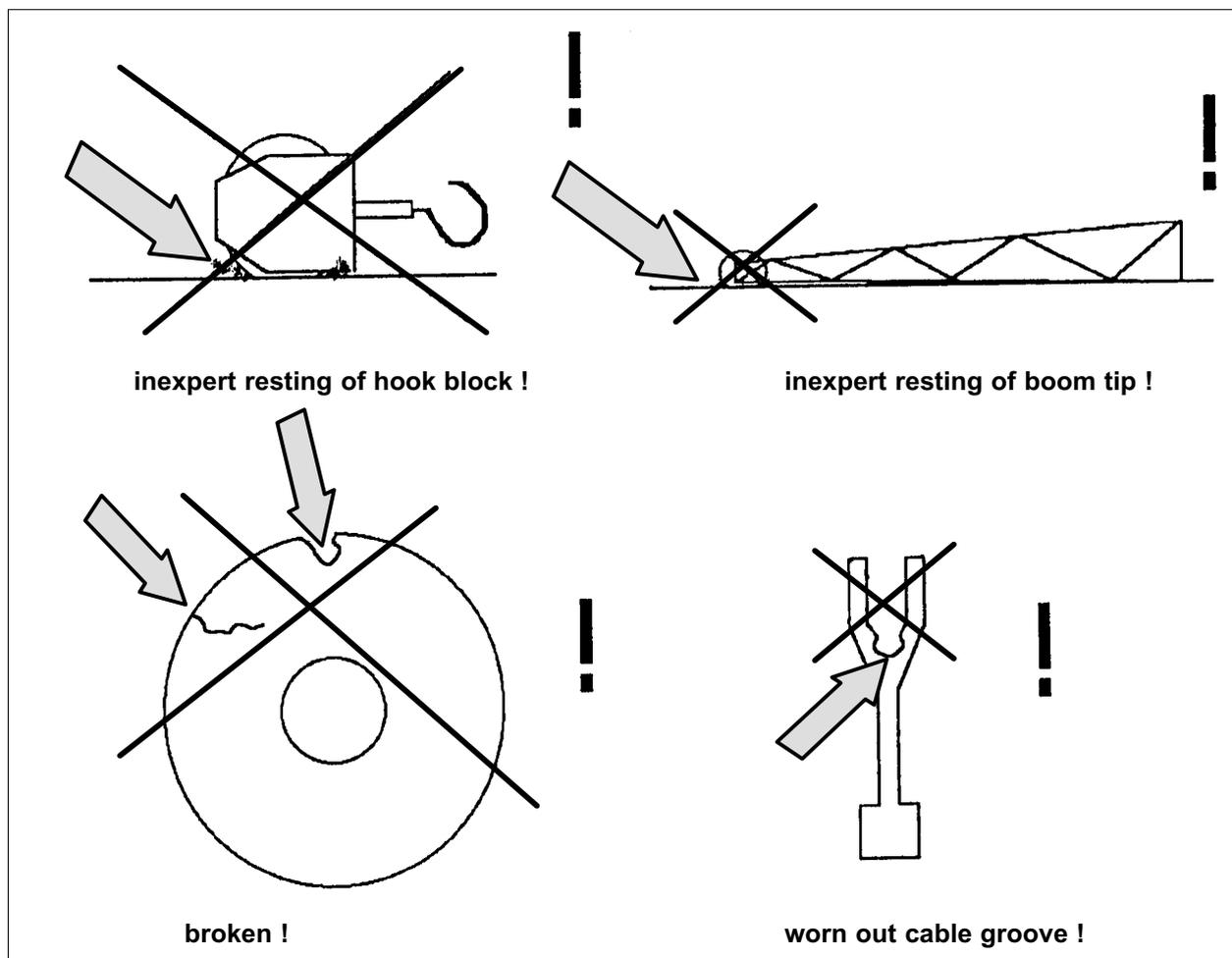
When storing rope pulleys - the following rule should be applied: FIRST IN - FIRST OUT. That means the rope pulleys should be used in the order of delivery. In this way it can be avoided that certain rope pulleys are only put into service after being stored for many years.

7.9.3. TRANSPORT

Rope pulleys are easily affected by external damage, i.e. they must be handled with utmost care during transport and unloading.

7.9.4. DURING OPERATION

Rope pulleys are easily affected by external damage, i.e. they never should rub against the provided rope guard device, never to lay down to ground without proper protection device. Thus could cause excessive wear to the components or even damaging the pulleys. Damaged pulleys must be replaced immediately.



7.9.5. INSPECTION AND MAINTENANCE

The rope pulleys have to be inspected in regular intervals; especially in the time period following directly after its installation. In addition special attention is required, if a rope has been exposed to excessive wear, if non-visible damage is suspected or if there are other indications for damage.



NOTE !

HEAVILY DIRTY OR SOILED WIRE ROPES HAVE TO BE CLEANED REGULARLY !

The frequency of rope pulley inspection is influenced by:

- Statutory requirements
- Type of appliance
- Operational environmental conditions
- Method and frequency of operation
- Manufacturer's recommendations
- Results of previous inspections
- Experience with previous rope pulleys on the appliance or system

Service intervals:

Smooth and reliable running of the equipment can however, only to be obtained if regular maintenance and care is given. Adhering to regular service intervals and use of correct lubricants as per the lubricants chart are also part of this. Special tools are not required for servicing.

ANTI -FRICTION BEARINGS OF the rope pulleys must be regreased at regular intervals according to crane operation. Individual components of rope pulleys must turn freely in their bearings.

GROOVES should not show any rope marks.

At the same time a REGULAR CHECK OF THE ROPES for proper function, cleanliness and sufficient lubrication is required.



NOTE !

AFTER FIRST **100 HRS** ALL PULLEYS HAVE TO BE CHECKED FOR SMOOTH AND RELIABLE RUNNING, CORRECT FIT OF ROPE PROTECTION AND OTHER SECURING DEVICES.

THE MINIMUM REQUIREMENT FOR MAINTENANCE / CHECK UP IS EVERY **500 HRS**, IF THE CRANE IS NOT OPERATED **AT LEAST TWICE PER YEAR** FOR ANY MECHANICAL DAMAGES, LUBRICATION CONNECTIONS AND CONDITION.



NOTE !

ENSURE THAT THE GREASE DOES ESCAPE FROM / BETWEEN THE ROPE PULLEYS AT LEAST EVERY **500 WORKING HOURS**.



NOTE !

CHECK THE WEAR OF THE ROPE GROOVE, FIRST SIGNS OF A CHANGE IN THE ROPE'S BEHAVIOR OR THE PULLEY ITSELF MUST BE CAREFULLY MONITORED ! THE ROPE PULLEY MUST BE EXCHANGED IF THE ROPE GROOVE IS SHRINK UP TO THE HALF ROPE DIAMETER. CHECK THE PULLEYS GROOVE PROFILE AT LEAST EVERY **500 WORKING HOURS**.

At this point we also do recommend to study carefully the "INSTRUCTIONS FOR USE OF CRANE ROPES".

7.9.6. RESISTANCE TO CHEMICAL PRODUCTS OF LAMIGAMID® ROPE PULLEYS

For cleaning of **LAMIGAMID® rope pulleys** various benzine may be used. However, the PULLEYS **SHOULD NOT BE CLEANED OR GET IN TOUCH WITH THE FOLLOWING CHEMICALS OR CHEMICAL COMPOUNDS:**

RESISTANT FOR

- Petroleum, benzine, kerosine, diesel fuel

LIMITED RESISTANT

- alcohol **except** ethyl-, methyl- and propyl alcohol
- anorganic chlorides, such as calcium, lithium-, magnesium- and zincchloride

NOT RESISTANT AGAINST

- concentrated mineral acids (i.e. sulphuric acid, hydrochlorid acid, nitric acid)
- concentrated organic acids (i.e. formic acid)
- concentrated alkalines (i.e. sodium, potash lye or caustic potash)
- phenolic resin, phenolic plastic

7.10. HYDRAULIC LINES AND HOSES

7.10.1. GENERAL



IMPORTANT !

HYDRAULIC LINES, HOSES AND FITTINGS MAY NEVER BE REPAIRED !

Any damaged sections must be replaced immediately.



ATTENTION !

Pressurized oil can cause body injuries or fires !

7.10.1.1. STORAGE

Even when hoses and lines are installed, stored and used according to specification - they undergo a natural aging process. For that reason, their service life is limited.

Improper storage, mechanical damage and improper use are the most frequent causes of hose fractures.



NOTE !

USE ONLY **ORIGINAL SPARE PARTS** according to manufacturers specification.

For replacement to the units we recommend that you acquire the necessary knowledge first or you ask for assistance / advise from your local **LIEBHERR CUSTOMER SERVICE**.

7.10.1.2. SERVICE LIFE



NOTE !

THE SERVICE LIFE OF A HYDRAULIC HOSE **MAY NOT EXCEED 6 YEARS**, FROM THE DATE OF THE LIEBHERR LABEL DATE ON THE HOSE CONNECTION. ADDITIONALLY CHECK THE MANUFACTURES DATE ON THE HOSE. THE DATE BETWEEN THE MANUFACTURES DATE AND THE DATE OF THE LIEBHERR LABEL SHOULD NOT EXCEED 2 YEARS.

7.10.1.3. INDICATION OF HOSES

Using hoses and lines close to the permitted working limit can shorten the service life (for example at high temperatures, frequent working cycles, extreme high impulse frequencies, multi shift operation or round the clock operations).

7.10.1.4. REPLACEMENT AND INSPECTION OF HOSES

Hoses and lines must be replaced if any of the following points are found during an inspection:

- Damage on the external layer into the inner layer (such as chaffing, cuts and rips)
- Brittleness of the outer layer (crack formation of the hose material)
- Changes in shape, which differ from the natural shape of the hose or line, when under pressure or when not pressurized, or in bends and curves - such as separation of layers, blister or bubble formation.
- Leakages
- Non observance of installation requirements
- Damage or deformation of hose fittings, which might reduce the strengths of the fitting or the connection between hose and fitting
- Any movement of the hose away from the fitting
- Corrosion on fittings, which might reduce the function or the strength of the fitting
- Storage or service life has been exceeded



NOTE !

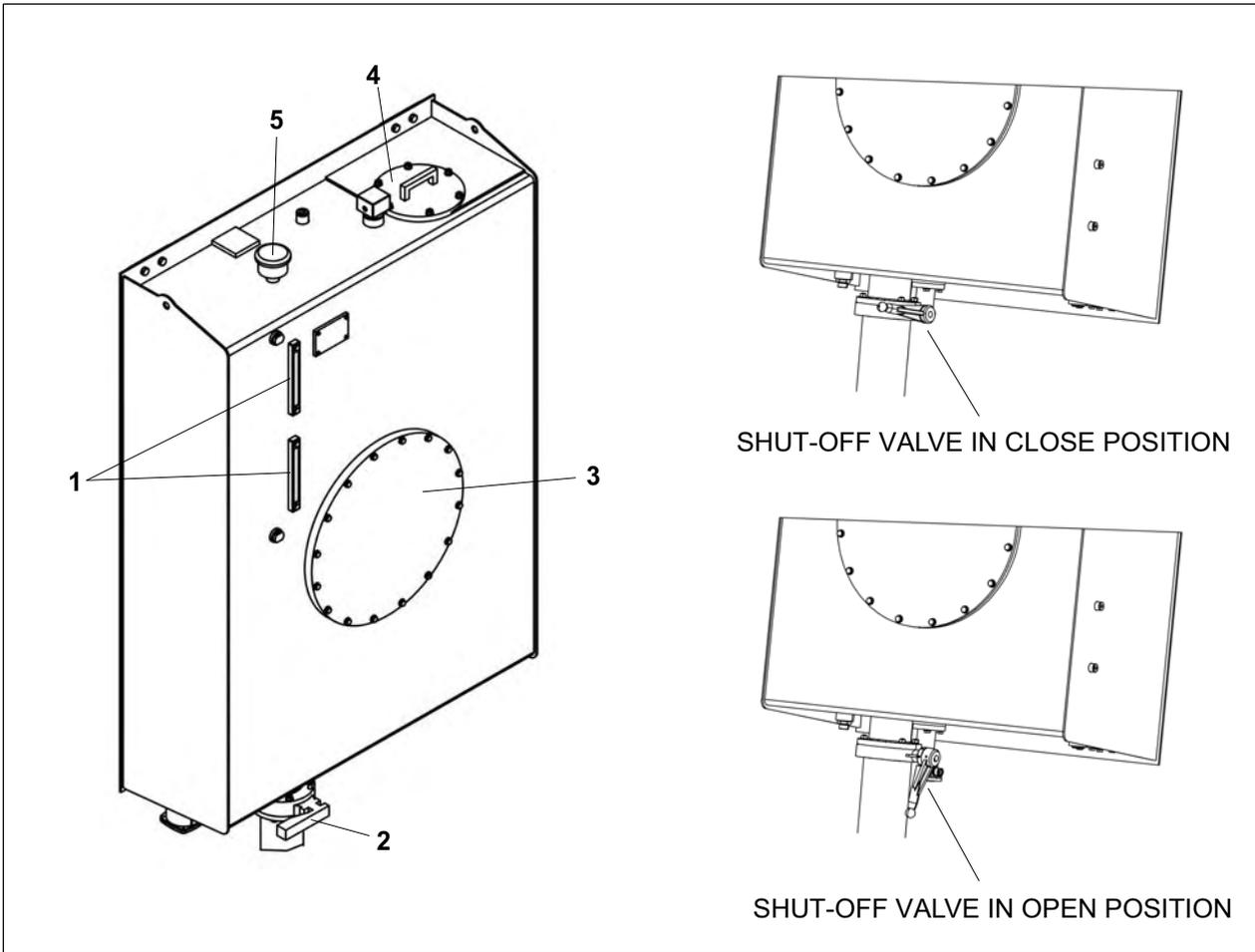
To avoid excessive leaks a **VACUUM-PUMP** could be connected to the hydraulic oil tank. Route or install the hoses and lines properly. **DO NOT MIX UP CONNECTIONS !**



DISPOSAL !

USED MATERIALS MUST BE PROPERLY DISPOSED OF IN ACCORDANCE WITH THE RELEVANT STATE REGULATIONS !

7.11. HYDRAULIC OIL TANK



- 1 Oil level sight glass
- 2 Suction line with suction shut-off valve
- 3 Inspection cover
- 4 Return flow filter
- 5 Breather filter



IMPORTANT !

Shut down the crane before making an oil change or oil level inspection !

OIL LEVEL INSPECTION can be carried out by the provided oil level sight glass (Pos. 1)
The oil level should always be between the MINIMUM and MAXIMUM mark.

OIL CHANGE is made by letting the oil flow out at the oil drain.
Refill the tank through the return flow filter (Pos. 4). Remove the breather filter (Pos. 5 when exchanging the oil, but don't forget to put it on again after the oil exchange.

TANK CLEANING

Let the oil flow out as described above and close the shut-off valve (Pos. 2) before cleaning the tank.
The empty oil tank should be cleaned carefully and must be dry and clean. Take care that no impurity is in the tank. Impurity can damage the hydraulic system !

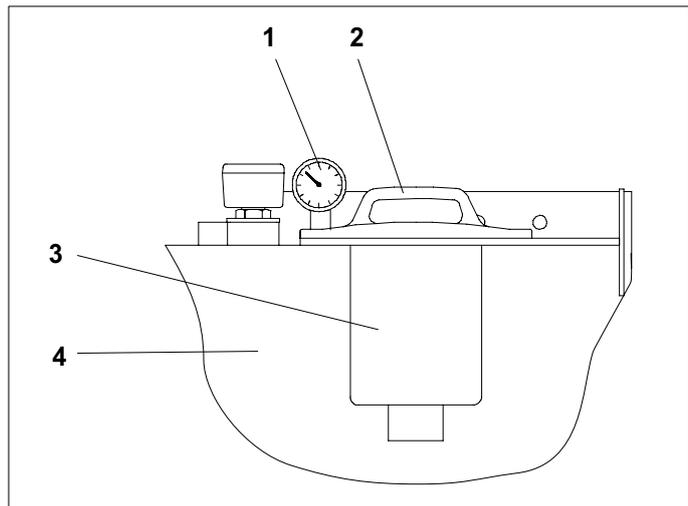
! ATTENTION !

Keep SUCTION SHUT OFF VALVE open all the time ! Close ONLY for inspection or service purpose. Before start-up of main motor check open position of shut off valve!

7.11.1. RETURN FLOW FILTER HYDRAULIC OIL TANK

ARRANGEMENT

- 1 Filter indication device:
green = satisfactory,
red = filter element blocked
- 2 Filter cover
- 3 Filter housing of Return flow filter **A7**
- 4 Hydraulic oil tank



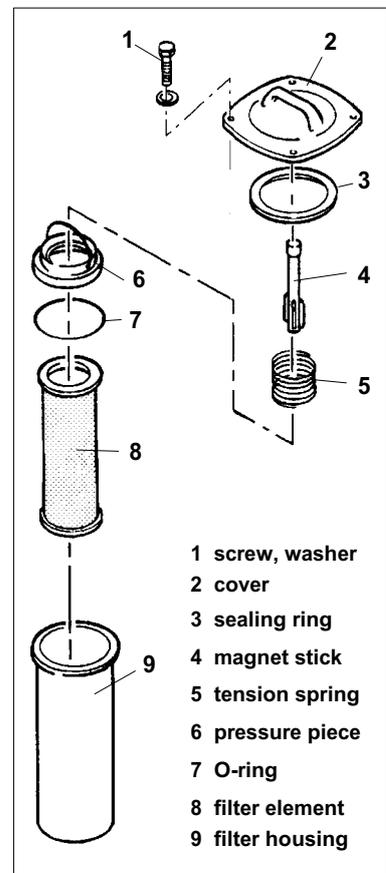
7.11.1.1. MAINTENANCE OF RETURN FLOW FILTERS

- Check **leaktightness, tight fit** at appropriate intervals.
- Should the **indication** device reads **red** “= filter element **clogged**”
 Filter element (insert) has to be checked and to be replaced immediately (latest at next working brake).

7.11.1.2. REPLACEMENT OF FILTER ELEMENTS

- Lower the load / auxiliary equipment safe to ground and shut off the main motor. Wait a few minutes till the pressure is reduced to 0 bar.

! WARNING !
 Prior replacing the filter element (insert), wait until the pressure reads 0 bar , all parts and the hydraulic oil are down to low temperature.



- Remove the cover (2) gently by using a spanner for the screws (1) of adequate size.
- Pull out gently magnet piece (4) and tension spring (5), pressure piece (6), O-ring (7) and used filter element (8) of the filter housing, Check the magnetic rod (there must be only metal dust = normal abbrasion)



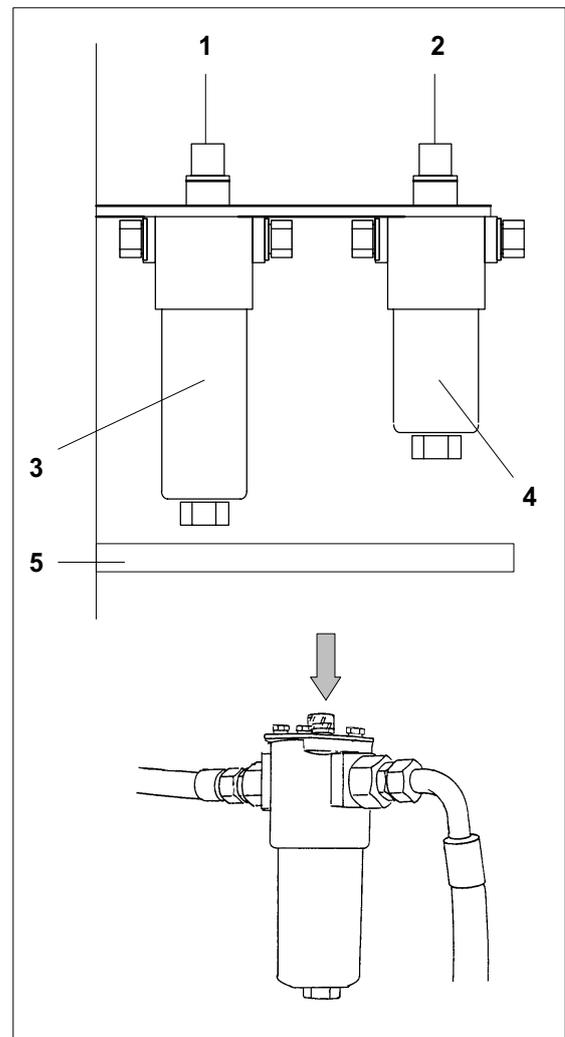
DISPOSAL !

USED MATERIALS MUST BE PROPERLY DISPOSED OF IN ACCORDANCE WITH THE RELEVANT STATE REGULATIONS !

- Clean all parts carefully (1 - 7, 9), check Sealing ring (3) and O-ring (7) for good condition and replace damaged parts if required
- Insert new filter element (8) into center of the filter housing, parts 7 - 4, check correct seat of sealing ring and O-ring, screw the cover (2) onto the housing.
- Tighten all screws (1) on the cover plate with a spanner.
- Start the main motor - watch indication on the indication device - check for tightness of cover after 5 minutes again.

7.11.2. VALVE AND FILTER PLATE AGGREGATE ROOM

- 1 Filter dirty indication
- 2 Filter dirty indication
- 3 Filter (A22) for oil cooling circuit
- 4 Filter (A2) for feed pressure circuit
- 5 Oil tray



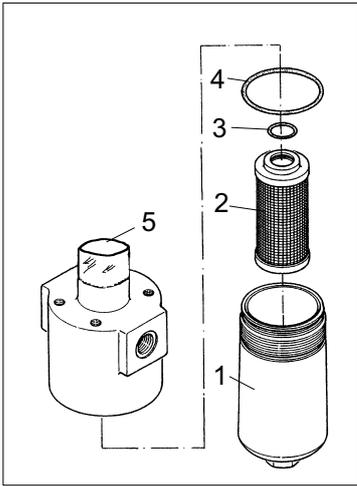
7.11.2.1. CHECK TO FILTERS

- During operation of the crane the filters are **monitored** by the **filter sensors** installed on top of the filters.
- Check **leaktightness, tight fit** of sensor (1, 2) and clean the oil tray (5) if required at appropriate intervals.
- Should one of the filter sensors indicate (red colour) "**pressure filter clogged**", the Filter element (insert) has to be checked and to be replaced immediately.

7.11.2.2. REPLACEMENT OF FILTER ELEMENTS

- Lower the load / auxiliary equipment safe to ground and shut off the main motor. Wait a few minutes till the pressure is reduced to 0 bar.

! WARNING !
 Prior replacing the filter element (insert), wait until the pressure reads 0 bar and all parts and the hydraulic oil are down to low temperature.



- Unscrew the lower housing (1) gently by using a spanner
- Pull out gently used filter element (2) of the lower housing
- Drain the remaining hydr. oil of the lower housing

DISPOSAL !
 USED MATERIALS MUST BE PROPERLY DISPOSED OF IN ACCORDANCE WITH THE RELEVANT STATE REGULATIONS !

- Clean all parts carefully, check O-ring (4) for good condition (replace if required)
- Insert new filter element, check correct seat of O-ring (3, 4) - and screw lower housing clockwise (by hand only) to the upper part again.
- Tighten lower housing (1) gently with combination spanner clockwise (max. turn 30 - 45°), check tight fit of filter sensor (5) .
- Start main motor - watch the filter sensors - check for tightness of housing after appr. 5 minutes again.

7.12. LIEBHERR CONDITION MONITORING

7.12.1. GENERAL

The LIEBHERR CONDITION MONITORING system for major components in a crane (e.g. diesel engine, distribution gear, winch gear etc.) relies on oil analysis.

Objectives:

- Prevent major failure
- Reduce downtime
- Minimise repair cost.

The idea of condition monitoring by spectrometric analysis of used oils is not new, it was first used in preventative maintenance programmes to solve the problem of short engine life.

Economically it is therefore essential for crane owners/operators to be aware of abnormal conditions before they become critical problems.

Condition monitoring through oil analysis is an excellent way to achieve this in units such as engines, transmissions and other oil filled systems.

7.12.2. TECHNIQUES EMPLOYED IN CONDITION MONITORING

Condition monitoring involves monitoring wear metals and physical parameters. Comprehensive and reliable programmes are made up of three parts:

- a) spectroscopic metal analysis
- b) physical and chemical oil tests
- c) Interpretation and diagnosis of data

Specific oil tests and spectrometric metal analysis are necessary to evaluate the true machine and oil condition.

The ideal combination of tests are given below, with the information to be gained from each. It will be evident that the purposes of the tests tend to overlap other tests. This is deliberate action, to ensure results of one test is confirmed by data from another. The work is repeated if this is not the case.

Used tests:

- Wear and additive metal analysis
- Viscosity
- Fuel dilution
- Oil condition index OCI
- Dispersancy
- Water/Glycol/Antifreeze
- Environmental dirt
- Total base number
- Particle count

7.12.2.1. SPECTROSCOPIC METAL ANALYSIS AND SIGNIFICANCE

Metals determined	Significance
Barium	Additive metals
Calcium	Oil type
Magnesium	contamination by other oil
Zinc	Additive metals
Sodium	Additive metals
Silicon	Coolant contamination
Aluminium	Upper cylinder and bearing, wear accessory drives, thrust washers
Chromium	Ring and seal wear, hydraulic rod wear
Molybdenum	Additive metal, ring and seal wear
Copper	bearing and bushing wear, thrust washers and clutch discs, cooler and turbo wear
Lead	Bearing and cooler wear, corrosion, petrol contamination
Tin	Bearing and liner wear
Manganese	Wear to steel components
Titanium	Environmental contamination in special cases
Nickel	compressor tube wear, special steel component wear, fuel contamination
Silver	Bearing and liner wear in special cases
Vanadium	Valve stem wear, special steel component wear, fuel contamination

The level of wear metals used to assess abnormal conditions differ for each engine or unit type, indeed they differ slightly for particular units of one type.

The information required must, therefore, be built-up for each unit by regular monitoring. Nevertheless, regular condition monitoring on a particular machine ultimately relies, not on the actual metallic values, but on sudden increases from the average.

7.12.2.2. VISCOSITY

The viscosity of the oil is important for its performance. It depends very much on the working conditions (e.g. temperature) and the time the oil has been in use. A viscosity change of 10 % is considered abnormal.

7.12.2.3. FUEL DILUTION

This is measured by either distillation or flash point. This test is essential to detect over rich mixtures, faulty injector systems and leaking pipework etc. An excess of fuel can lead to poor lubrication and excessive wear or failure. 5 % is considered abnormal.

7.12.2.4. OIL CONDITION INDEX OCI

The OCI is a measure of the conductivity of the oil. It indicates the concentration of soot and other conducting materials present in the sample, e.g. water and metal particles. An arbitrary scale of 0-40 is used. A value of 10-12 is typical of new oils and values up to 28 are typical of used oils in good condition. Higher values indicate a problem may exist. Again to establish the cause of an increase in the OCI value, other tests must be carried out.

MAINTENANCE

7.12.2.5. DISPERSANCY

This is relevant to engine oils only, and is simply assessed by the blotter spot method.

Engine oils contain detergents and dispersants to disperse soot and other insoluble carbon residues throughout the oil. If insufficient is present the solids will coagulate to form sludges. These will tend to block passage ways etc. and prevent lubrication of vital components.

Generally, an even distribution of soot is a good sign and a non-even distribution is a poor sign. This information is used with the other data to assess the condition of the oil.

7.12.2.6. GLYCOL - ANTIFREEZE - WATER

Where water is detected it is measured by distillation or other means to establish its concentration. More than 0.2% is considered significant. Having established water is present, it is necessary to identify its origin. The options include:

1. Coolant contamination
2. Condensation
3. supply tank contamination

7.12.2.7. ENVIRONMENTAL DIRT

The third major cause of engine or machine failure is dirt contamination. It acts as an abrasive on pistons rings, liners and bearings, etc. to cause severe problems.

7.12.2.8. TOTAL BASE NUMBER

To protect the crankcase from acid attack by corrosive acids produced in the combustion chamber, the lubricant contains a degree of reserve alkalinity. This reserve alkalinity is expressed as mg of KOH/gm of oil and is described as the Total Base Number (TBN). It is measured by one of two methods adopted by the Institute of Petroleum under the numbers IP177 and IP276 . The TBN is a measure of the neutralizing properties of the oil.

7.12.3. OIL SAMPLE / OIL EXCHANGE

7.12.3.1. GENERAL

The FIRST OIL EXCHANGE has to be performed as stated in the MAINTENANCE LIST of the crane. This oil exchange can not be delayed as at the "start up" period of any engine or transmission higher contamination of the oil can occur. NO OIL SAMPLE IS TAKEN !

7.12.3.2. SAMPLING PERIODS

AFTER the FIRST OIL EXCHANGE the sampling periods are the same as the in the MAINTENANCE LIST required oil exchange periods for that specific engine or transmission.

7.12.3.3. OIL EXCHANGE

NO SAMPLE HAS BEEN TAKEN:

The oil has to be exchanged as stated in the crane's MAINTENANCE LIST

SAMPLE HAS BEEN TAKEN:

The CONDITION MONITORING REPORT will tell, if:

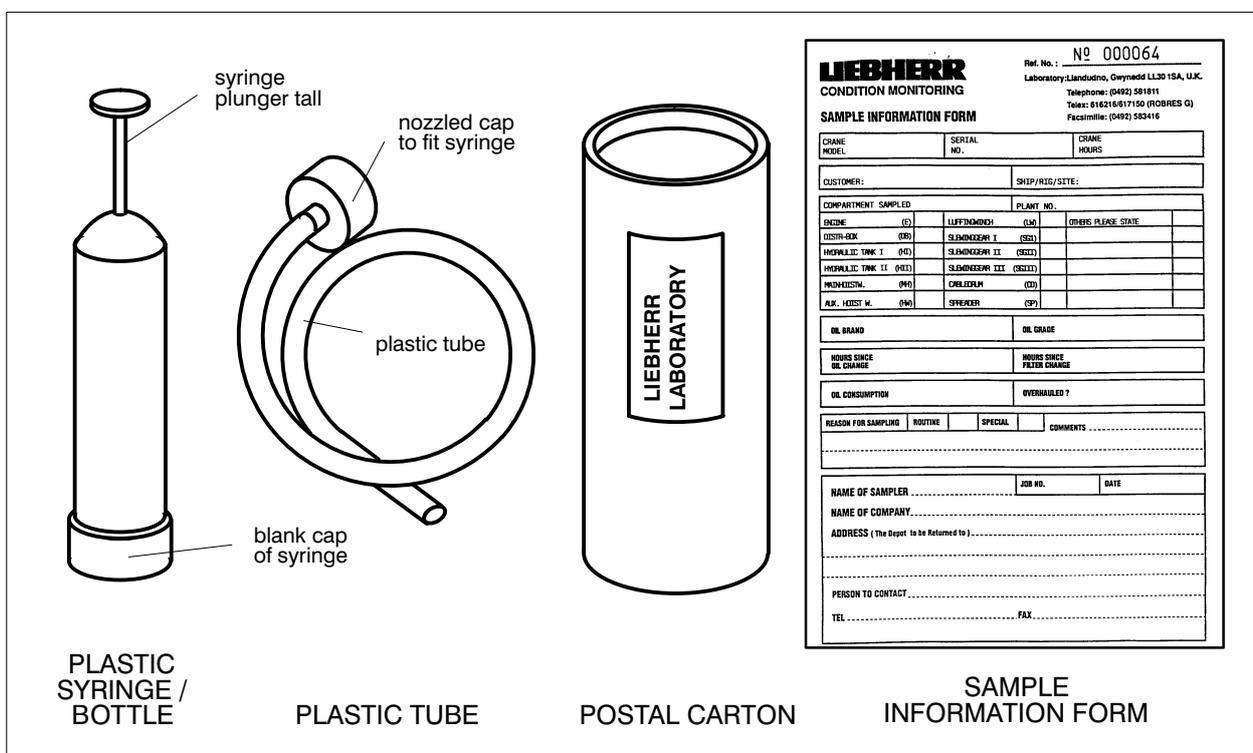
- the oil is still in good condition and no exchange is needed
- another sample is required
- the oil has to be exchanged
- further actions are required

7.12.4. TAKING AN OIL SAMPLE

7.12.4.1. GENERAL

For taking an oil sample a special PLASTIC SYRINGE-CUM-BOTTLE-KIT is available:

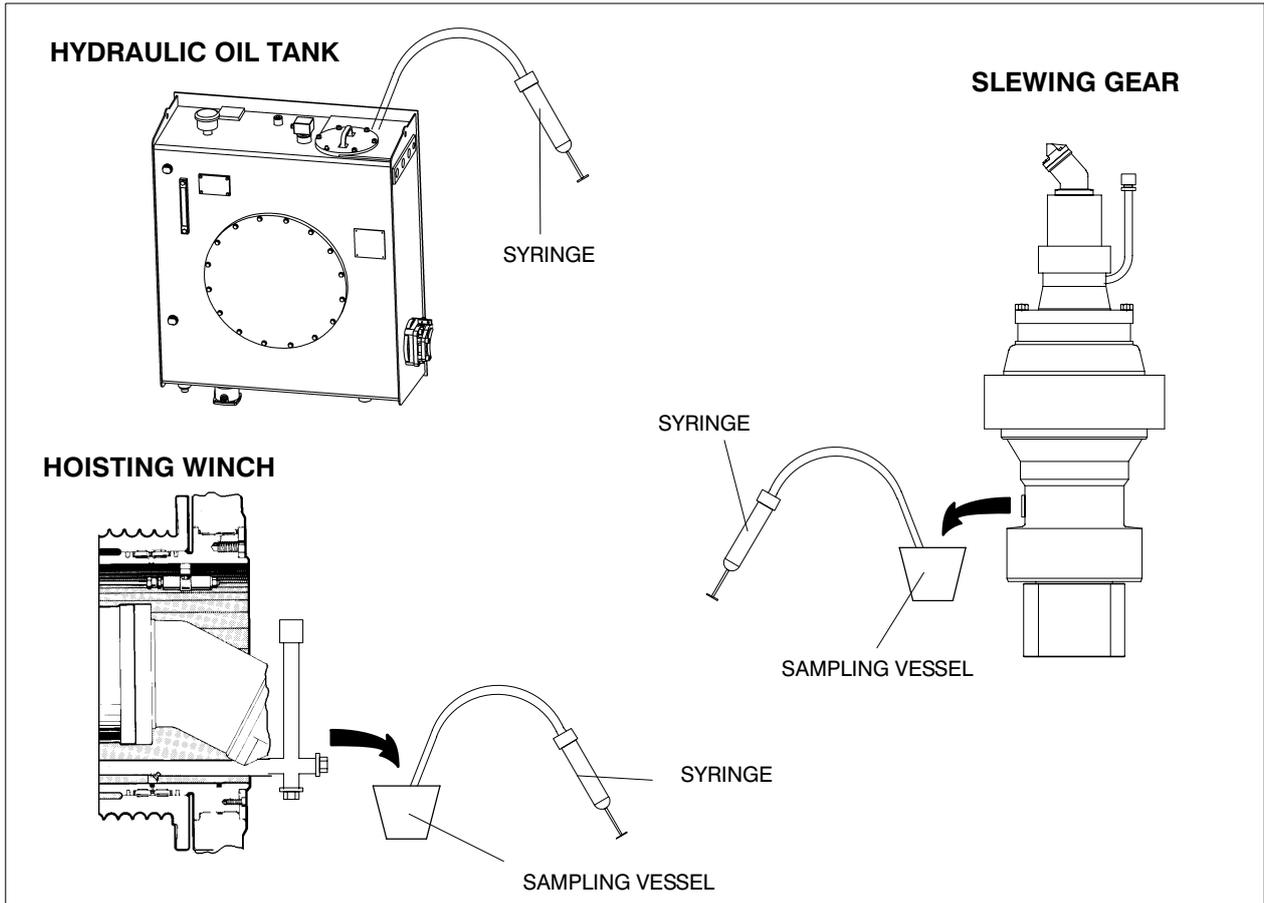
- The kit consists of:
- Plastic syringe / bottle to take and contain the sample
 - 1,5 m of plastic tubing for easier access of the oil
 - Postal carton
 - Sample information form to state all important data about the oil and the unit it was used in.



7.12.4.2. HOW TO TAKE A REPRESENTATIVE OIL SAMPLE

- Ensure the main motor or other units has been working for at least 15 minutes just prior to taking the sample.
- To obtain from the DRAIN PLUG allow about a quarter litre oil to empty away before holding the sampling vessel under the free flowing oil stream.
- Drain approx. 200 ml of oil into the sampling vessel
- Close the drainage hole again and check the oil level of that system - refill if necessary
- Connect the nozzle cap with the tube to the syringe
- Shorten the plastic tube to the minimum needed length
- Hold the free end of the plastic tube into the sampling vessel and fill the syringe with the sampling oil by pulling its plunger, while holding the syringe vertically with the nozzle pointing upwards.
- If the oil stops flowing before the syringe is full, loosen the cap and gently push the oil level to the top. Retighten the cap and continue drawing the oil.
- When the syringe is full, discard the nozzle cap, tubing and plunger tall (twist-off). fit the blank cap tightly.
- Fill in the provided SAMPLE INFORMATION FORM (completely !)
- Put the SAMPLE INFORMATION FORM together with the SYRINGE / BOTTLE into the POSTAL CARTON
- Send it to the the in section ADDRESS stated address

7.12.4.3. SAMPLING POINTS (EXAMPLES)



7.12.4.4. POST ADDRESS

LABORATORY: LLANDUDNO
GWYNEDD LL30 1SA
UNITED KINGDOM

7.12.5. CONDITION MONITORING REPORT

The results of the oil sample examination are all stated in the **CONDITION MONITORING REPORT** which is sent to the in the **SAMPLE INFORMATION FORM** stated address. In this report a diagnosis of the oil sample is given as well as a advice for further action.

Four different symbols are indicated to signalize the main action:



INDICATES Normal



INDICATES High result reading obtained, submit second sample for recheck



INDICATES Change oil as indicated



INDICATES Action required as indicated

7.13. PRESSURE ACCUMULATORS

7.13.1. GENERAL

For hydraulic accumulators, the relevant regulations at the place of installation must be adhered to prior to commissioning and during operation.

7.13.2. SAFETY INSTRUCTIONS

- On no account should welding, soldering or any mechanical work be carried out on the accumulator shell.
- Work on systems with accumulators (repairs, connection of pressure gauges etc.) should only be carried out once the pressure fluid has been drained out. Once the hydraulics have been connected, all air should be completely vented.
- New or repaired accumulators must be charged with nitrogen prior to commissioning.
- Never use oxygen or air! Danger of explosion!
- If the accumulator is supplied already pre-charged with the requested gas charging pressure, the pressure is marked.
- Note the limits of gas charging pressure and operating temperature!



IMPORTANT !

TO ENSURE THE SAFETY OF THE LIFTING APPLIANCE THE PRESSURE ACCUMULATORS HAVE TO BE CHECKED OR REPLACED EVERY TWO YEARS !

7.14. MAINTENANCE OF OIL COOLERS

The cooling lamella of the hydraulic oil cooler unit and winch gear oil cooler unit have to be free of dirt to achieve the maximum cooling capacity.

Therefore the lamella have to be inspected visually at least every week and cleaned if necessary.

CLEANING OF OIL COOLER UNIT

Depending on the kind of the dirt on the oil cooler unit the following methods may be used:

- DRY DUST = > Clean with air pressure (max. pressure 10 bar)
- WET DUST = > Clean with steam cleaner (max. pressure 150 bar)
- OILY DUST = > Clean with steam cleaner (max. pressure 150 bar) and add solvent cleaner



NOTE !

If in doubt of the correct cleaning method for a certain type of dirt, contact any LIEBHERR representative for advice !

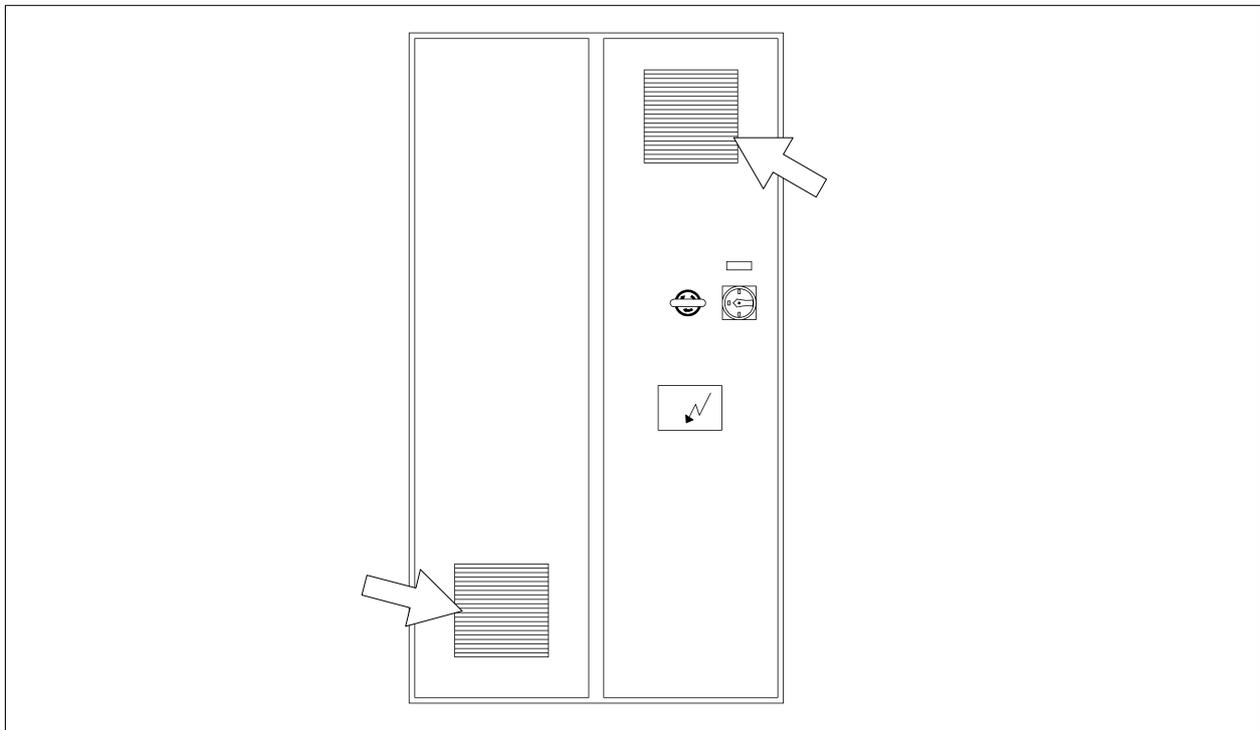
7.15. ELECTRICAL SYSTEM



7.15.1. MAINTENANCE TO THE ELECTRICAL SYSTEM

Maintenance of the electrical system is largely restricted to changing fuses and bulbs, if blown and cleaning the filters on the switch cabinet.

The filter on the switch cabinet fan should be renewed or cleaned every 3000 working hours.



All screws and bolts used for or with electrical equipment should be retightened in regular intervals. (see MAINTENANCE LIST)

⚠ ATTENTION !
 ALL ELECTRIC SAFETY EQUIPMENT (E.G. LIMIT SWITCHES, EMERGENCY STOP BUTTONS ETC.) SHOULD BE CHECKED IN REGULAR INTERVALS AS WELL TO ENSURE A SAFE OPERATION OF THE CRANE. (SEE MAINTENANCE LIST)

⚠ WARNING !
BEFORE OPENING ANY ELECTRIC EQUIPMENT, it is essential to SWITCH OFF THE POWER SUPPLY.

7.15.2. WET CLEANING

Wet cleaning of the switch box or switch gear is not allowed !

When washing or steam cleaning the crane or components - close all terminal- and switch boxes in order to prevent water from entering !

7.16. SLIP RING UNIT

The slip ring is installed inside the crane.
Access to slipring unit, ascent ladder inside base column.



DANGER !

**SWITCH OFF POWER SUPPLY, BEFORE OPENING ANY ELECTRIC EQUIPMENT!
ONLY QUALIFIED AND AUTHORIZED SERVICE PERSONS ARE ALLOWED TO
PERFORM MAINTENANCE OR SERVICE TO THE SYSTEM !**

TERMINAL BOX

Every 500 hours a tightness test of a random sample of the terminal clamp screws should be carried out.

POWER SECTION

Due to the low turning speed and the hardness of carbon brushes, the brushes have a relatively long life. They must be checked **every 1500 hours or latest every 6 months**, and must be changed in good time so that it never happens that a metal part of the brush holder touches the slip ring.

During this check it is also necessary to clean any carbon dust from the insulating barriers between the slipring ways so as to avoid creeping current. **Every 500 hours** a random sample of the **screw connections of the copper bus bars** should be checked for tightness.

SIGNAL SECTION

The 16 Amp. circuits are fitted with nickel plated and gold plated copper-beryllium wire brushes and with nickel plated and gold plated sliprings. About **every 1000 hours or latest every 6 months** the insulating barriers between the slip-ring ways should be cleaned of metal particles.

To reduce wear the slip-ring ways should be lightly sprayed with a contact oil such as "Cramolin B". A random sample of the terminal screws for the terminals of the cables from the copper-beryllium wire brushes should be checked for tightness.

The carbon brush blocks must be checked according to point 2 mentioned above.

CABLE INSULATION

The cables have to be checked for any damages in insulation when carrying out an inspection.

When cables connected to the slipring or have to be replaced always assure that the **insulation to be kept as short as possible**.



NOTE !

SHOULD YOU HAVE ANY QUESTIONS RELATING TO OPERATION, SERVICE, REPAIRS OR PARTS FOR THE SLIP RING INSTALLED ON THE CRANE, PLEASE CONTACT THE **LIEBHERR CUSTOMER SERVICE**.

7.17. AIR CONDITIONING SYSTEM

SAFETY PRECAUTIONS

Proper function of the air conditioning system is only assured, if all maintenance work is performed completely, properly and by qualified personnel.

Any work or repairs on the air conditioning system should only be done by specially trained personnel.

ATTENTION !

Do not operate with wet hand - it may cause electrical shock.

Repair or relocation should not be done by the customer - if this is done incorrectly, it may cause a fire, electric shock, injury by dropping of the unit, water leakage, etc.

When the air filter is to be removed, do not touch the metalparts of the unit - it may cause an injury.

Do not clean the air conditioner with water - water may enter the unit and degrade the insulation. It may cause an electrical shock.

When the unit is to be cleaned, switch off and turn off the breaker - since the fan rotates at high speed during operation, it may cause an injury.

Do not apply an insecticide or flammable spray - it may cause a fire or deformation of the cabinet.

MAINTENANCE

The air condition equipment requires low maintenance.



NOTE !

After 500 operation hours the two blowers are to be checked for contaminations and cleaned if necessary. Check, if dirty-water outlet is open.

