

LIEBHERR

CARGO DECK CRANE

VOLUME 1

INSTRUCTION / MAINTENANCE

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Subject to alteration!

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FOREWORD

This **DOCUMENTATION** has been prepared to allow the safe operation of the LIEBHERR crane while utilizing the crane's full range of operating possibilities. In addition, the manual emphasizes the daily routine maintenance and informs the operator of the operating principles of important assemblies and systems.

VOLUME 1 – INSTRUCTION / MAINTENANCE MANUAL

VOLUME 2 – TECHNICAL INFORMATION

VOLUME 3 – SPARE PARTS LIST

The **DOCUMENTATION** is prepared for extended service—, repair— and maintenance work as well as ordering spare parts. This manual shall be used by trained Service—personnel only.

This LIEBHERR crane shall be operated and serviced by from LIEBHERR—WERK NENZING trained or authorized personnel only.

The procedures described in the **DOCUMENTATION** and general safety precautions shall be observed at all times.

NON—OBSERVANCE OF THESE RULES CAN RESULT IN PERSONAL INJURY AND STRUCTURAL DAMAGE.

Special attention shall be given to the safety devices built—in to the crane. They shall be tested at regular intervals for good condition and proper operation. Crane operation is prohibited if the safety devices are not working properly.

”SAFETY ALWAYS COMES FIRST”

must be the way of thinking and behaviour before, during and after crane operation.

If you receive any further information for the crane, such as technical modifications or changes concerning operation, maintenance, or spare parts — please attach them to provided volumes.

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1. PREFACE

1.1. TO THE OWNER

Any questions concerning to the care and upkeep of this crane which have not been covered in this book should be directed to your nearest LIEBHERR SERVICE STATION.

LIEBHERR reserves the right to make alterations or modifications to this equipment at any time, which in their opinion may improve the performance or efficiency of the crane.

“**DANGER**”, “**WARNING**”, “**ATTENTION**”, “**IMPORTANT**” and “**NOTES**” are used throughout this manual to emphasize critical instructions. In this manual these special instructions are used as follows:

 **DANGER !**

Denotes an extreme intrinsic hazard, which could result in a high probability of death or serious injury, if proper precautions are not taken.

 **WARNING !**

Denotes a hazard, which could result in injury or death, if proper precautions are not taken.

 **ATTENTION !**

Denotes a reminder of safety practices or directs attention to unsafe practices, if proper precautions are not taken.

**IMPORTANT !**

Denotes **IMPORTANT** operation and maintenance procedures, which could result in damage or destruction of the machine or in any of its components, if not observed.

**NOTE !**

NOTE describes operation and maintenance procedures, which should be followed to keep your CRANE operational and insure long machine life and to facilitate certain procedures.

The **safety rules** included in this manual represents a minimum set of standards for safe crane operation. Every operator should be familiar with and follow these rules at all times. Written rules, however, cannot cover all situations which might occur on the job.

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1.2. GENERAL INFORMATION

1.2.1. CRANE SERIAL NUMBER

For easy identification each crane is marked with a serial number. This serial number is punched into a plate fixed to the base frame of the slewing column.

All correspondence with Liebherr or one of our branch offices should include the respective serial number of the crane.

1.2.2. SPARE PARTS / REPAIRS

In case crane components or service products have to be replaced, resp. added, only original equipment from the manufacturer and service products which are identical (design and function) to the original exchanged parts resp. products must be used.

If spare parts or service products other than those **authorized** by the original equipment manufacturer, LIEBHERR cannot be hold responsible for any malfunction or damage to persons or property.

Repairs or modifications on the crane software package are only allowed to be made by service engineers from LIEBHERR or LIEBHERR authorized personnel.

1.2.3. PRESERVATION

The crane has to be preserved if not in operation for more than 3 months.

Preservation instructions are obtainable through our service department.

1.2.4. WELDING OPERATIONS

Welding operations on the crane to be executed by qualified welders only with approved welding material and welding procedures, fully in accordance with the requirements of the relevant classification society.

1.3. CRANE APPLICATION AND OPERATION

1.3.1. GENERAL

This is probably the most important area relative to safety since it involves the greatest frequency of exposure to danger. The operator should be of sound mind and body and be able to understand and apply established operating rules. He should be able to exercise good judgment in dealing with the many situations which cannot be anticipated and covered herein.

Since the manufacturer has no direct control over the crane application and operation, the user is fully responsible for good safety practice.

1.3.2. APPLICATION

In general, established operating safety rules should be observed when performing operating functions. Operating safety rules are found in codes of the following organization:

–DOE (Department of Energy)

–ILO (International Labour Organization)

and in the Occupational Safety and Health Act, as well as in Local or National Codes.

It is obvious that written rules cannot cover all situations that might be encountered on the job. To meet such unexpected situations the operator must be able to supplement the rules mentioned above with his own ones based on good judgment.

1.3.3. USE OF THE CARGO DECK CRANE

Intended Operation

The LIEBHERR CARGO DECK CRANE is designed only for crane operation and only lifting appliances which have been approved by the crane manufacturer are to be used. The crane may only be used for loads which lie within the limits of the appropriate load curve.

It is to be assumed that the exterior conditions for the working range of the crane do meet the working requirements, so that the technical details stated in the section 'Technical Data' regarding angles, inclines, etc. can be maintained without risk.

When working, the crane is designed for hook operation. This also applies when the corresponding hoist accessories used by the customer meet the regulations of the crane type. In case of any doubts, this should be explicitly clarified.



DANGER !

Observe without fail the capacities for the individual operating situations. You will find these in the Technical Data as well as in the capacity charts in the Operation Manual.

Use of professional personnel

Operation, service, maintenance and repairs may only be carried out by specially trained personnel. It must be ensured that the trained personnel who are engaged do not only dispose of the corresponding specialized knowledge, but in addition also know and use all questions relating to safety and prevention of accident regulations.

Environmental Conditions

For the safe operation of the crane it is absolutely necessary to ensure that the environmental conditions, under which the machine will be operating, are according to regulations.

Other Foreseeable Misuses like

- offlead/Sidelead or dragging loads
 - transporting of people or personnel
 - operating loads outwith the prescribed limits
- are strictly forbidden !

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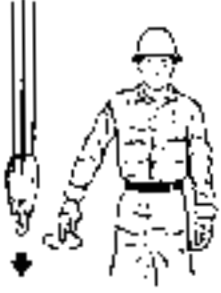
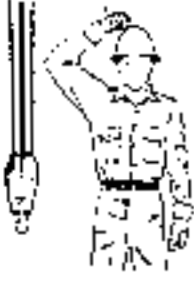

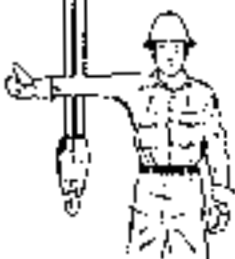
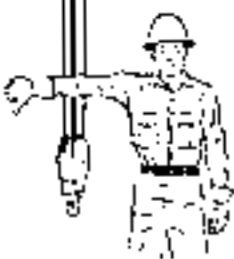

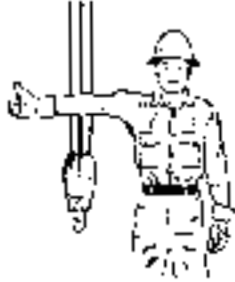
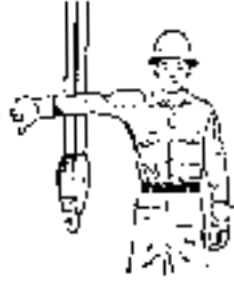
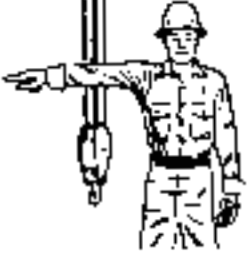
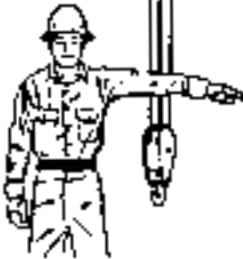

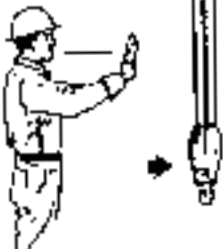

1.4. CONVERSION TABLE

Conversion factors for SI units : The current edition of the rules are in dual units presented with the MKS units first followed by the U.S. Customary units in parentheses. A third system of units now being used internationally is the system International d'Unites (SI). For the convenience of the purchasers of this book who use SI units, the following conversion table has been included. This table only provides conversion factors for those U.S. Customary units and MKS units that differ from SI units, that are used in the rules and guides of the American Bureau of Shipping. Proper use of significant figures and rounding—off techniques should be given due consideration when using the conversion table.

Quantity	U.S. Customary or MKS Unit	Multiply by	To obtain SI units
Area	ft ²	9.290 304 (10 ⁻²)*	m ²
	in ²	6.451 600 (10 ²)*	mm ²
Bending, Torque	lb-in	1.129 848 (10 ⁻¹)	Nm
	kg-m	9.806 650*	Nm
Density	lb/in ³	2.767 990 (10 ⁴)	kg/m ³
Electrical	ft-lb	1.355 818	J
	in-lb	1.129 848 (10 ⁻¹)	J
	kcal	4.186 800 (10 ³)*	J
	kg-m	9.806 650*	J
Force	lb	4.448 222	N
	ton (long)	9.964 017 (10 ³)	N
	kg	9.806 650*	N
	ton (metric)	9.806 650 (10 ³)*	N
Length	fathom	1.828 800	m
	ft	3.048 (10 ⁻¹)*	m
	in	2.540 (10 ¹)*	mm
Mass	lb	4.535 924 (10 ⁻¹)	kg
	ton (long)	1.016 047 (10 ³)	kg
	ton (metric)	1.000 (10 ³)	kg
Plan angle	degree	π/180	rad
Power	hp	7.456 999 (10 ²)	W
	hp (metric)	7.354 99 (10 ²)	W
Pressure, Stress	psi	6.894 757 (10 ³)	N/m ² (or Pa)
		6.894 757 (10 ⁻³)	N/mm ²
		6894 757 (10 ⁻²)	bar (or 10 ⁵ N/m ²)
	ton (long) in ²	1.544 426 (10 ⁷)	N/m ² (or Pa)
		1.544 426 (10 ¹)	N/mm ²
	kg/cm ²	9.806 650 (10 ⁴)*	N/m ² (or Pa)
	kg/mm ²	9.806 650 (10 ⁻¹)	bar (or 10 ³ N/m ²)
9.806 650 (10 ⁶)*		N/m ² (or Pa)	
Temperature	°F	(°F - 32) / 1.8*	°C
Velocity	knot (kn)	0.514 444	m/sec.
Volume	ft ³	2.831 685(10 ⁻²)	m ³
	gallon (liquid)	3.785 412 (10 ⁻³)	m ³
	in ³	3.785 412 1.638 706 (10 ⁴)	l mm ³

* Exact value

1.5. STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

 <p>HOIST</p>	 <p>LOWER</p>	 <p>USE MAIN HOIST</p>
 <p>USE WHIP LINE</p>	 <p>RAISE JIB</p>	 <p>LOWER JIB</p>
 <p>MOVE SLOWLY</p>	 <p>RAISE JIB AND LOWER THE LOAD</p>	 <p>LOWER JIB AND RAISE THE LOAD</p>
 <p>SWING</p>	 <p>STOP</p>	 <p>EMERGENCY STOP</p>
 <p>TRAVEL</p>	 <p>STOP ALL MOVEMENTS</p>	

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1.6. GENERAL HINTS AND ADVISE FOR CRANE OPERATION

This machine is used primarily for hoisting, lowering and positioning of loads. To operate with maximum safety certain procedures must be followed.

One capacity chart label (load diagram) is supplied with this crane. It is placed in the driver's cabin. The load diagram shows the max. permissible load which is allowed to be lifted in correspondence to the actual radius. The actual load and radius for main— or whip hoist are indicated on two displays in the cabin.

The following is a suggested procedure for making a typical lift:

- a) Determine the weight to be lifted. Be sure to add the weight of hookblock, slings, spreader bars, chains and any other gear used. The weight should be marked on the load – if not, consult someone who knows it. Do not attempt lifting any load of unknown weight.
- b) Consult the machine capacity chart for the maximum radius (min. jib angle) to safely handle the load. The following facts about the capacity chart should be noted at all times:
 - 1) The capacities listed in the chart are based on strength of materials. Exceeding these capacities will overload the machine and could result in attachment or rope failure, or damage to machine.
 - 2) All capacities are for 360° rotation.
- c) Raise the jib from jib rest and position hook over load.
- d) Lower the hook block directly over the load. If the jib angle is lower than the capacity chart listing for the weight involved the load must be positioned closer to machine or broken down into smaller packages.



IMPORTANT !

Do not attempt to drag the load closer to machine with the attachment.

- e) Secure the load to hookblock. The following points should be noted when picking a load:
 - 1) The jib head must be positioned directly above the load and within the maximum chart radius. The attachment is designed to lift and should never be used to drag a load sideways, inward or outward.
 - 2) Never exceed the capacities listed on either capacity chart.
 - 3) When lifting loads near max. machine— or rope capacity, care must be taken to avoid sudden loading and unloading of the hoist line. Ease into the load.
- f) Hoist the load to the desired height. Raise or lower the attachment to position the load for lowering. Be careful when jib down or swinging with the load, outswing caused by centrifugal force will increase the load radius resulting in a decreased load capacity. When lowering the jib, with load, do not exceed the maximum radius listed in the capacity chart for the weight being handled.



NOTE ! THINK SAFETY :

You, the operator are in charge of an important piece of equipment. It is very important that you know what it can do. It is also very important that you know what it should not do. No set of instructions can anticipate all of the situations you will come across. The rules given here cover general usage and some of more specific cases. If conditions arise not covered by these rules, consult the manufacturer. The cost of a phone call may save someone's life.



IMPORTANT !

Only operators trained by the manufacturer authorized personnel are allowed to operate the crane.

1.6.1. GENERAL SAFETY RULES

- 1) Read this operators manual and heed it. The manual contains valuable information.
- 2) Whenever an operator leaves the crane for any reason, the following must be done:
 - a) Lower the load to firm supporting surface.
 - b) Shut down engine.
 - c) Never depend upon the winch brake to suspend a load, unless the operator is at the controls and ready to handle the load. Brake slippage, vandals, mechanical malfunctions could cause the load to drop if left in the air unattended.
- 3) The operator must not eat, read, or otherwise given his attention while operating the crane. Remember, operating is a full time job.
- 4) Don't allow crane loads to pass over people, or endanger their safety. Remove all loose objects. All non—operating personnel should leave the immediate area when the crane is operating.
- 5) Be sure your work area is clear. Make sure you have proper clearance for crane, jib and load. Don't swing, hoist or lower the load, raise or lower jib without first making sure no one is in the way. If your vision is obscured, locate a signal man so you can see him and he can see all areas you can't. Follow his signals. Be sure you and the signal man understand each others signals.
- 6) Inspect the crane daily. Don't operate a damaged or poorly maintained crane. Pay particular attention to the attachment and wire ropes. If a component is worn or damaged, replace it before operating. Remember, parts are cheaper than people. OSHA (Occupational Safety and Health Act) regulations state "a through inspection of all ropes shall be made once a month and a full, written, dated and signed report of rope condition kept on file where readily available". Replace any worn or damaged rope. Pay particular attention to jib hoist ropes and pendants. Check end connections (pins, sockets, wedges, etc.) for wear and damage.
- 7) Don't let the load hit the jib. Don't let the jib rest or hit against other objects. A damaged or dented jib may result, which will weaken the jib. If the damage is severe the jib may collapse. If a lattice or diagonal bracing member is broken or cracked, replace it. If bent, straighten it. Important detailed information on jib repair is available from you distributor. Some of the steel used in jib is a special type which can be ruined by improper repair procedures. If a chord is bent or damaged, even a small amount, don't use it. don't try to repair it. Chords are so vital to the strength of the jib that it is not practical to attempt repairs.

If the jib is struck or damaged by anything — stop. The loading on a jib increases as the jib is lowered; a damaged jib or jib suspension system may collapse during lowering. Use a helper crane to assist in lowering a damaged jib.

- 8) Be sure the jib hoist pawl is always engaged except when lowering the jib. Don't relay on the jib hoist winch brake alone to hold the jib. Wear and other factors may affect the ability of the brake to hold the jib.
- 9) Never get on or off the crane in motion. Use both hands when climbing onto the crane. A ladder is provided — use it.
- 10) Keep your crane clean, in good repair and in proper adjustment, oil or grease on the decks may cause falls. Improper adjustments can lead to crane damage, load dropping or other malfunctions.
- 11) Keep a dry chemical or carbon dioxide fire extinguisher in the cab or immediate vicinity of the crane at all times. Instruct all operating and maintenance personnel in the use of the extinguisher. Check periodically to make sure it is charged properly and is in work order.
- 12) Never tamper with safety devices. Keep them in good repair and proper adjusted. They were put on the machine for your protection.
- 13) Don't smoke when fueling or fuel—up the crane near an open flame. Keep the nozzle in contact with the filler neck to prevent static electric sparks. Shut down the engine when fueling.
- 14) Before performing repairs or adjustments, bring jib into parking position and place load hook on deck. Post a warning sign in cab so no one will try to start the engine.

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- 15) Always replace protective guards and panels before operating machine. Never wear loose clothing which may be caught in machinery. Always wear hard hats, safety glasses, steel toe shoes and any other safety equipment required by local or job regulations.
- 16) Always shut the crane engine down before "servicing" any part of the hydraulic system.
- 17) Keep fingers, feet and clothing away from sheaves, drums and ropes unless the crane is shut down and everyone knows what you are doing. Never place a hand on lines when climbing to top of the crane. A sudden movement may pull them into the drum or sheaves.
- 18) Use extreme caution when removing radiator caps, drain plugs, grease fittings, hydraulic pressure caps, etc. They may blow off and hit you or you may be burned by hot oil, water or steam.
- 19) Always wear safety glasses when drilling, grinding or hammering on metal. You may get chips in your eye.
- 20) The operator, supervisor or person in charge must see to the following:
 - a) Loads must be well secured before lifting. Be sure that the rigging can't slip off or pull away from the load or get out of position on the load. Be sure load is rigged so it won't fall over.
 - b) Chains and slings must be of adequate size, in good condition and not twisted around each other. A test certificate must exist for each item of lifting equipment.
 - c) The load must not catch on an obstruction when lifting or swinging. Be sure load, fall lines or any other part of machine doesn't snag or strike any obstruction.
 - d) Avoid sudden starts and stops. Lift carefully, swing gently, lower and set loads carefully. Jerking the load, swinging the crane roughly and lowering the load rapidly will put shock loadings and possible side loadings on the jib. rough treatment can also break a machine. Unnecessary abuse labels the operator as a beginner. Be a professional.
 - e) Never wrap the hoist line around the load. Never use discharged, worn or damaged rope for slings. It may break and drop the load.
- 21) The hoist line must be vertical when starting to lift, if not the load will swing in, out or sideways when lifted from the ground.

When picking a heavy load, the crane will lean toward the jib. This is caused by elasticity of the crane and the jib. The lean will increase operating radius so the load will swing outward when it clears the ground. This outswing is dangerous to anything in the path of the load and because of the increase in the load radius may overload the crane. To overcome this outswing, jib up as the load is lifted so fall lines remain vertical. When setting the load on the ground, lower the jib after load touches down to avoid hook block swing when it is unhooked from load or the jib contacting the jib backstops.

- 22) One workman should be designated a signal man, and the operator should obey signals from him only. A signal to stop should be obeyed no matter who gives it. See hand signals chart earlier in this section.
- 23) Know your load. Don't try to guess or estimate the load. Use a scale weight or certified weight, a hook scale or load indicating system. Remember – the weight you are lifting includes the weight of any lifting slings or gear, the hook block and any overhaul weights. The total weight must never exceed the rated capacity of the machine, as listed on the capacity chart, for the position, jib length, load radius, no. of lines and conditions of operation being used. Remember – capacity chart ratings are based on ideal conditions:
 - a) Calm wind
 - b) No side loads or outswing of load
 - c) Good visibility
 - d) Machinery in perfect condition and equipped as when leaving the factory.

When such conditions cannot be attained, loads being handled must be reduced to compensate. The amount loads are reduced depends upon how good or how poor the actual operating conditions are. It is a matter of judgement and experience. Some factors which may require reduction of

loads below listed ratings are:

- a) wind
- b) Hazardous surroundings
- c) Inexperienced personnel
- d) Poor visibility
- e) Fragile loads
- f) Machine in poor condition

When in doubt, don't take a chance. Reduce ratings more than you think you need to.

Avoid working the crane in high winds. If you must work in a wind, reduce capacities considerably below those shown on the capacity chart. Wind blowing against the load and the jib produces a side load on the jib and reduces its capacity.

When lifting large loads such as building panels in a wind, the movement of the load may pose a danger to workmen or building structures. Out swing of load will increase load radius and may overload the machine. This could lead to jib failure or machine damage.

- 24) Don't operate at radii and jib lengths where the capacity chart lists no capacity. Don't use longer jib or tip extensions than listed on the chart. Either of the above can cause jib and/or extension failure.
- 25) Keep the load lines as short as possible to prevent excessive swinging.
- 26) Watch out for centrifugal force when swinging a load. Swing gently. Centrifugal force tends to increase load radius. This increase in radius could overload the crane and cause crane damage. When stopping the swing overswing of the load can side load the attachment.
- 27) Know the load radius. Don't guess it. Determine radius by using the gauge in the driver's cabin or mechanical jib angle indicator, the jib length and the capacity chart or measure it with a steel tape. Remember, radius is the horizontal distance from the centerline of rotation of the crane to the center of gravity of the load is hanging free.
- 28) Know the jib length. Don't guess it. Use of an incorrect jib length can cause an accident.
- 29) Use at least the number of parts of hoist line specified in the reeving plan to handle the load. Local codes may require more parts of line than shown. Check code requirements and use them where applicable.

Use special when handling loads on single part line with jib at a short radius. This is especially important when hoist line is off aux. winch. The jib may be whipped back over crane.

- 30) Test the winch brake by raising the load a few inches and holding. It should hold easily.
- 31) Don't pull sideways on the jib, not even a little bit. Lift straight up on every load. Moving anything by pulling sideways with the hoist line is liable to buckle the jib. It may also damage the swing mechanism.
- 32) Don't alter any part of the machine. Additions to or changes in any part of the equipment can create loadings which the crane was not designed for. Such changes may seriously affect the useable capacities and make the entire capacity chart invalid. Such changes can dangerously overload or weaken critical parts and may cause disastrous failure.
- 33) Don't pick loads with main winch and aux. winch at the same time, even if total load weight is within crane capacity
- 34) Don't lift more than one separately rigged load at a time even if both loads combined don't exceed the cranes capacity. Your full attention cannot be given to both loads, creating a dangerous situation.
- 35) Use caution when jib up to minimum radius. Be prepared to stop jib travel. If the jib limit device malfunctions, the jib and backstops may be damaged or someone may be hurt.
- 36) When operating near minimum radius, be ready to jib down as you set the load down, to compensate for the tendency of the jib to move back against the backstops when the load released. This

PREFACE

action occurs because of elasticity in the jib hoist system. Severe bending in the jib can occur if it is allowed to bear against the backstops too heavily.

- 37) Watch out for "two-blocking" (forcing the hook block into head machinery). This can result in rope or sheave damage and possibly pull the attachment over the rear causing crane damage. If this machine is equipped with an "anti-two block" device, make sure it is functioning properly before operating the crane. Never fully depend on "so called" safety devices. Nothing replaces the good judgement and safety consciousness of the crane operator.
- 38) Block under the jib top section (front and rear) before disconnecting from extensions. Since the top section is tapered, it will fall to the ground when unpinned. this could result in an accident.
- 39) When operating the crane equipped with any form of load indicating mechanism, overload warning system or any automatic safety device, remember that such devices cannot replace the skill and judgement of a good operator. Such devices cannot, for instance, tell when too few parts of line are being used to hoist a load, or correct for the effects of wind, or warn that the device may be improperly adjusted, or correct for side pulls on the jib, or for many conditions which may occur and which may create hazards. It requires all the skill, experience, judgement and safety consciousness that a good operator can develop to attain a safe operation. Many safety devices can assist the operator in performing his duties, but he should not depend on them to keep him out of trouble.
- 40) After a slack rope operation, make sure the rope is properly seated in sheaves and on drums before continuing to operate. Use a stick or mallet to set the rope, not your hands.
- 41) Make sure machine is equipped with an adequate length of wire rope. Check wire rope length by lowering hook block to water level and observing rope left on drum. Never allow less than 3 full wraps of rope on any drum. If all the rope is run off a drum, the load will jerk, possibly causing damage to rope, attachment or machine.
- 42) Make sure there is a latch on the hook, and that, it works properly. Without a latch, it is possible for slings or chains to come off the hook and allow the load to fall.
- 43) When lifting submerged loads. Don't pull sideways – or jib may collapse. If possible, rig the load so it is lifted from one end. Don't yank or jerk on the load. When a submerged load reaches the surface, don't attempt to lift it out of the water all at once. It may be saturated with water and will weigh many times what you expect. Allow it to drain as you raise the load slowly. Be patient, as draining may take a long time. A load, when removed from the water, even when fully drained, will have a greater effective weight than it will when submerged because of buoyancy.

1.7. EXPLANATION OF SAFETY SIGNS

1.7.1. PROHIBITION SIGNS:



Fire, exposed flame and smoking prohibited



Do not operate switch



No entrance for unauthorized personnel



Prohibited for persons with pacemaker

1.7.2. WARNING SIGNS



Warning of hanging load



Warning of electro-magnetic field



Warning of high voltage



Danger of falling



Warning of danger through batteries



Warning of danger through slipping



Danger through hot surface

1.7.3. MANDATORY SIGNS



Wear eye protection



Wear safety gloves



Wear safety protection



Wear safety helmet



Wear safety boots



Wear ear protection



Follow information on the component, in the instructions for use and instructions for operating the vehicle



Switch off power supply



Use safety device

1.7.4. RESCUE SIGNS



First Aid



Fire extinguisher



Doctor

1.8. LIEBHERR WORLD–WIDE SERVICE ORGANIZATION

Edition: 15.03.2000

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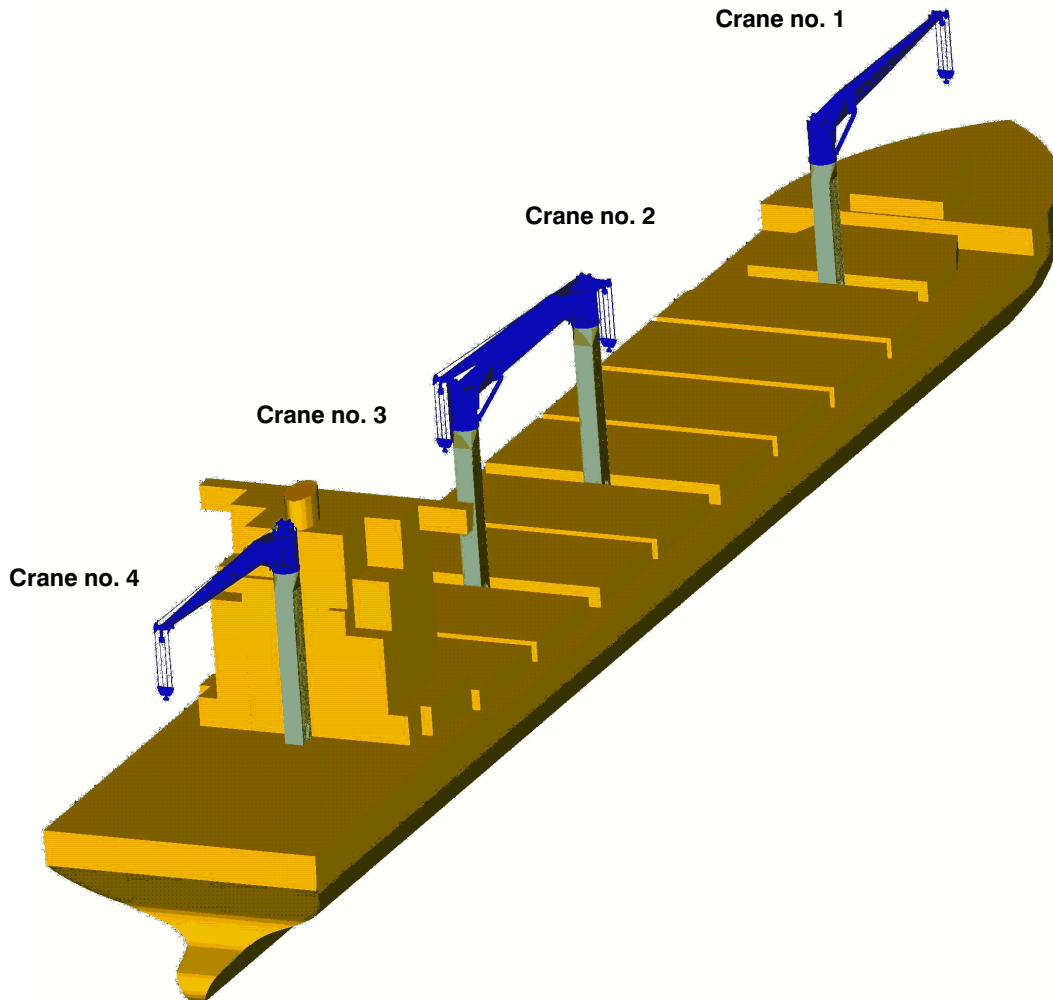
Contact: Mr. K. Wittenberg

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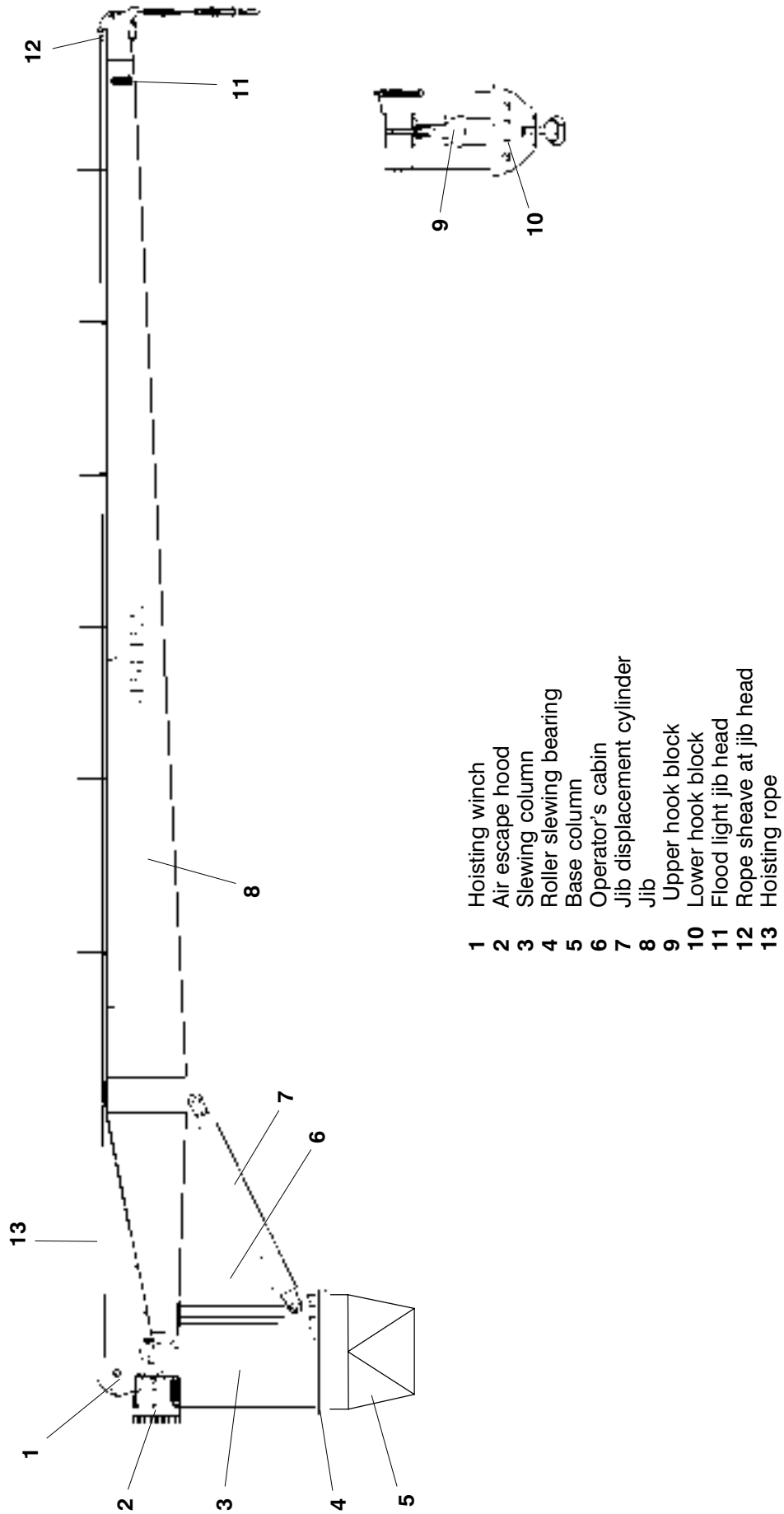
2. GENERAL DESCRIPTION

2.1. ARRANGEMENT OF CRANES ON SHIP



GENERAL DESCRIPTION

2.2. ARRANGEMENT OF THE MAIN PARTS OF THE CRANE



2.2.1. SLEWING COLUMN

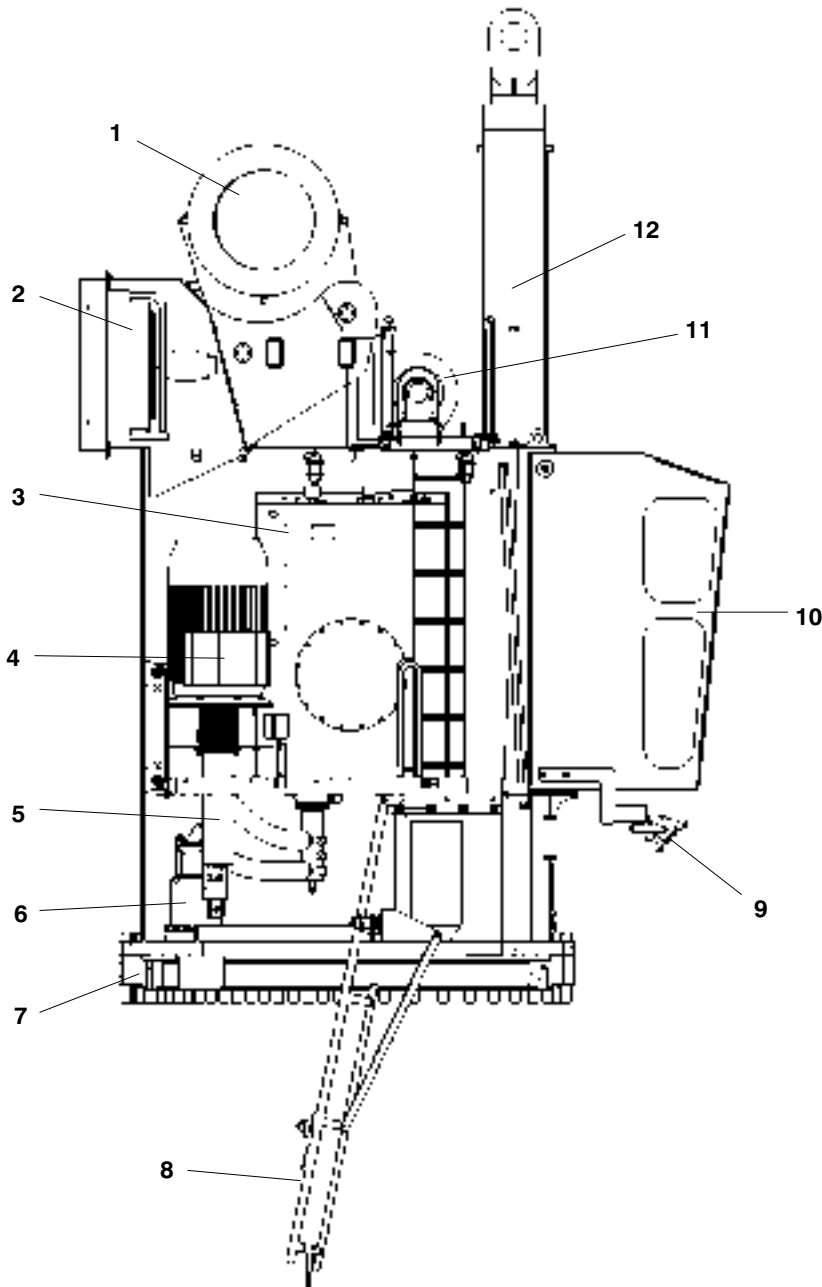
The slewing column comprises a robust metal housing divided into **three different levels**:

In **level 1**, the central pump assembly as well as the slewing gears are located.

In **level 2**, the hydraulic oil tank as well as the switch cabinet **X1** for motor control are located. This level provides access to the operator's cabin.

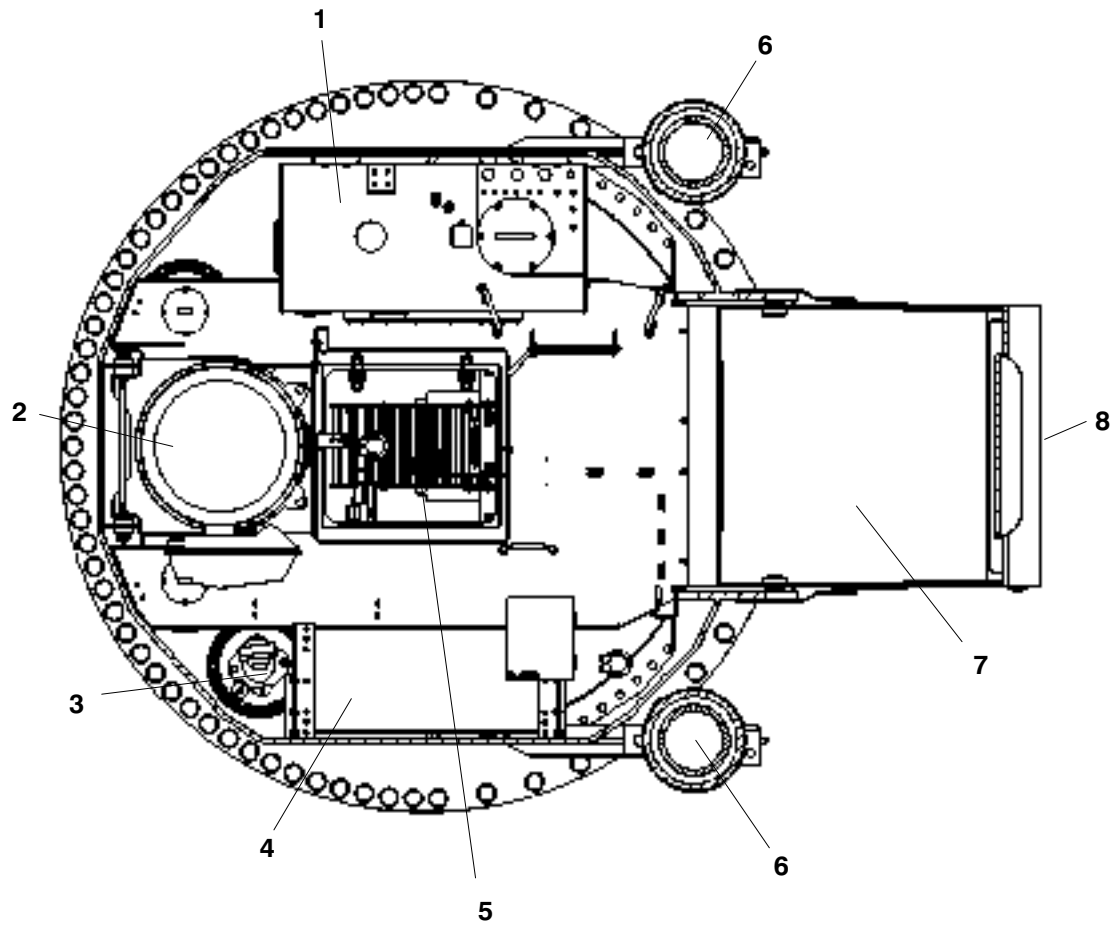
On top of the slewing column the hoist winch, the hydraulic oil cooler as well as the jib pivot point is located.

ARRANGEMENT OF THE MAIN COMPONENTS ON THE SLEWING COLUMN:



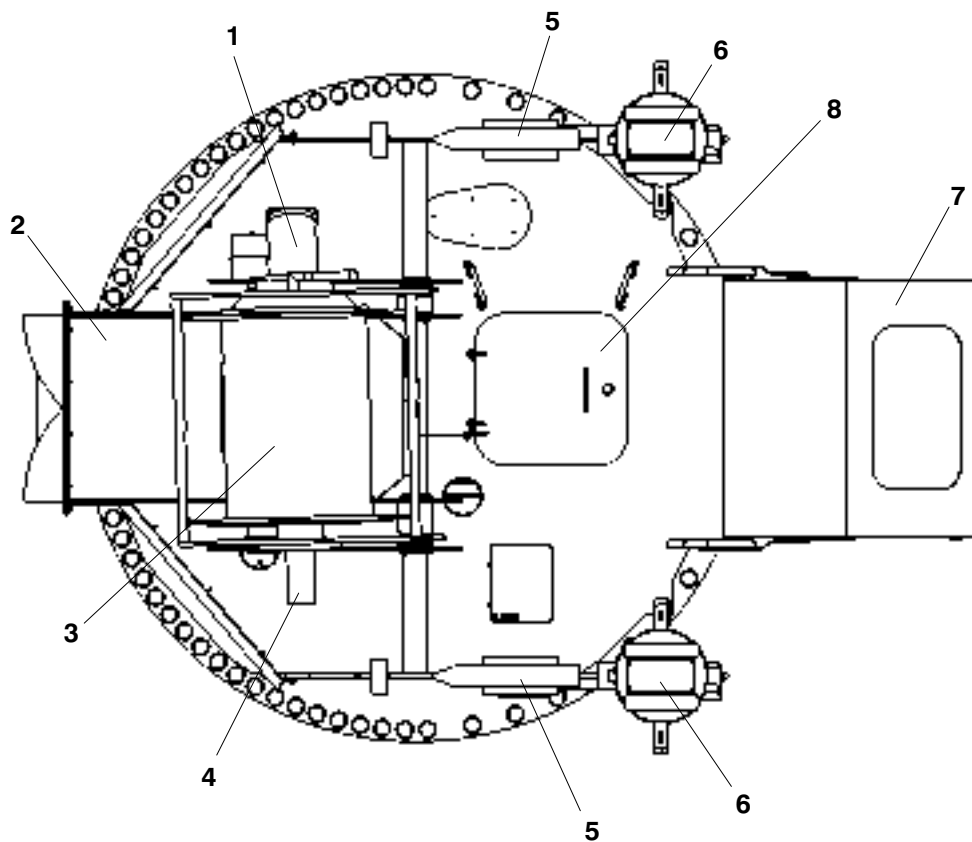
- | | | | |
|---|--------------------------------|----|---------------------|
| 1 | Hoisting winch | 7 | Roller slewing ring |
| 2 | Air escape hood with fan motor | 8 | Ascent ladder |
| 3 | Hydraulic oil tank | 9 | Float light |
| 4 | Electric main motor | 10 | Operator's cabin |
| 5 | Hydraulic pump assembly | 11 | Jib pivot points |
| 6 | Slewing gearboxes | 12 | Luffing cylinders |

CABIN LEVEL (LEVEL 2)



- 1 Hydraulic oil tank (see section "MAINTENANCE")
- 2 Electric main motor with hydraulic pump assembly
- 3 Slewing gearbox with hydraulic motor and multiple disc brake
- 4 Switch cabinet X1
- 5 Access to next lower level
- 6 Luffing cylinders **EU, EV**
- 7 Operator's cabin
- 8 Emergency descent

Top level



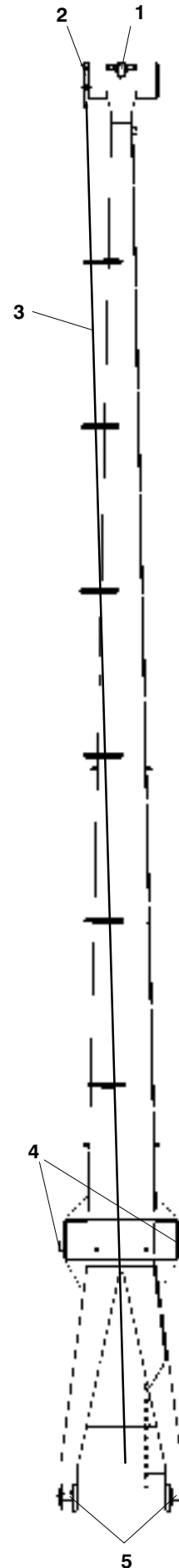
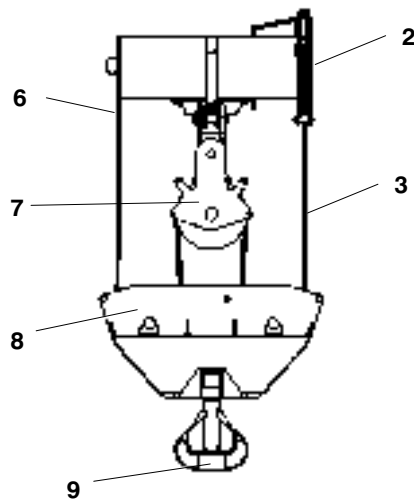
- 1 Hydraulic motor **HU** and multiple disc brake **H61U** for hoisting winch
- 2 Air escape hood with fan motor **4A-M05**
- 3 Hoisting winch drum
- 4 Gear cam limit switches
- 5 Jib pivot
- 6 Luffing cylinders **EU, EV**
- 7 Operator's cabin
- 8 Access to next lower level. **KEEP HATCH CLOSED DURING SEA VOYAGE !**

GENERAL DESCRIPTION

2.2.2. JIB

The jib consists of a completely enclosed welded box-section construction through which a high degree of stability is obtained. The hinges at both sides are fitted to the slewing column top and are provided with self-aligning spherical roller bearings. The jib head comprises the hoisting rope pulley, which guide the hoist rope.

- 1 Hook block (see detail below)
- 2 Hoist rope pulley on jib head
- 3 Hoisting rope
- 4 Luffing cylinder connection points
- 5 Connection to the jib hinge sections on the slewing column
- 6 Rope fix point on jib head
- 7 Upper hook block
- 8 Lower hook block
- 9 Load hook



2.3. TECHNICAL DESCRIPTION OF THE LIEBHERR DECK CRANE

2.3.1. GENERAL

The crane mainly consists of the base column, slewing ring, the slewing column, the jib and the hoisting and slewing gears.

All electric, hydraulic and mechanic units as well as the control stand required for operating the crane are housed inside the slewing column.

The crane is electric– hydraulically driven, i.e. all three movements of the hoist–, slew and jib motion operate hydraulically. One main electric motor is installed to drive the hydraulic assembly.

2.3.2. HOISTING SYSTEM

The hoisting gear consists of one axial piston pump with variable delivery, one variable hydraulic motor and the necessary control units. The hydraulic motor is flange–mounted to the planetary gear of the hoist winch. The rope drum is situated on top of the slewing column. The multi disc brake is between the hydraulic motor and the winch gear. The bearing of the hoist drum is sealed against sea water.

2.3.3. LUFFING SYSTEM

The luffing system consists of one axial piston pump (variable delivery), two luffing cylinders and the necessary control elements. The jib is guided by the hydraulic cylinders, which work in both directions, and therefore the jib is under constant control.

2.3.4. SLEWING SYSTEM

The slewing system consists of one axial piston pump, three hydraulic motors, three multi disc brakes and the necessary control units. The hydraulic function is similar to the hoisting gear circuit. The slewing gears are situated in the lower slewing column and are completely **sea water tight**.

2.3.5. POWER REGULATION

The hoist speed will be automatically proportional reduced at increasing load by the built–in power regulator in the variable pump A11VO.

2.3.6. CRANE CONTROL

The hoisting, luffing and slewing movements can be stepless controlled by full hydraulic joysticks. All movements can be carried out simultaneously from the control stand.

2.3.7. HEATING

If the temperature is below appr. + 20°C, the crane heating, which is in level 2 of the slewing column, is switched on by a room thermostat in switch cabinet X1.

The operator's cabin can be heated by a separate fan / heating system.

The switch cabinet, the slip ring, the hydraulic oil tank and the main motor have stand still heaters to avoid condensation.

THE AUXILLIARY POWER SUPPLY FOR LIGHTING AND HEATING HAS TO BE SWITCHED ON ALL THE TIME TO AVOID CONDENSATION IN THE ELECTRIC OR HYDRAULIC SYSTEM !

2.3.8. COOLING

In order to eliminate heat occurring during operation, one **combined winch gear and hydraulic oil cooler** with one ventilator is installed. The temperature is automatically regulated by thermostates.

2.3.9. OPERATOR'S CABIN

All control elements for crane control as the control stand with hydr. joystick, emergency push button, switch unit for crane control, lighting and heating, fan forced heating as well as emergency rescue device for emergency descent are placed in the cabin.

GENERAL DESCRIPTION

2.3.10. SAFETY DEVICES

2.3.10.1. HYDRAULICS

–BRAKES

The winch for the hoist system as well as the drive gears for the slewing system are equipped with spring loaded multiple disc brakes, which are in the applied position without control. The brakes open only if the corresponding control lever is operated. The brakes close automatically when the control lever is returned to neutral position, in addition the multiple disc brakes are applied automatically in the event of a power failure on the electric motor or pressure drop in the hydraulic system. The multi disc brakes are automatically self adjusting, that means the brakes need not to be re-adjusted.

–ADDITIONAL PROTECTION OF THE JIB MOTION

If the hose connection for movement “jib up” at the luffing cylinders get damaged, the jib movement “down” stops immediately because of the hose fracture safety valves placed at the bottom of both cylinders. Falling back of the jib is prevented by the extreme positions of the piston rods of the double acting hydraulic cylinders.

–OVERPRESSURE PROTECTION

The entire hydraulic system is protected against overpressure by means of pressure limiting valves.

2.3.10.2. ELECTRICS

–EMERGENCY STOP BUTTONS

Emergency stop buttons are installed to ensure an emergency shutdown of the crane if a dangerous situation occurs.

They are located:

- at the switch unit X20 (cabin)
- at switch cabinet X1
- at the acsenr ladder

–LIMIT SWITCHES

The winch for the hoist system as well as the luffing system are equipped with with gear cam limit switches which stop the movement at the corresponding limit position.

2.3.10.3. OTHER SAFETY DEVICES

–EMERGENCY HAND PUMP

The emergency hand pump (seperate delivered) can be used to rest the load at a total black out on the crane.

For operation of the hand pump refer to section “EMERGENCY OPERATIONS”

–EMERGENCY DESCENT/ENTRANCE

The emergency descent from the crane must be done through the front window of the cabin and by use of the rescue device (it is stored in the upper right corner of the cabin)

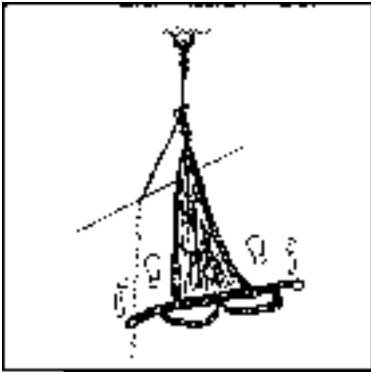
The use of this rescue device is explained on the following page. The front window can be opened by the provided handle.

2.3.11. EMERGENCY DESCENT

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



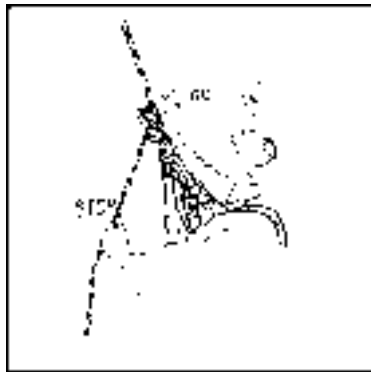
5. Take the harness at the D-rings, lift the harness up to the shoulders and latch the D-rings in the carabiner.



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 roping down shall be trained before an emergency case!
There is a **detailed operating and maintenance manual** of the manufacturer supplied with the crane !

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 !

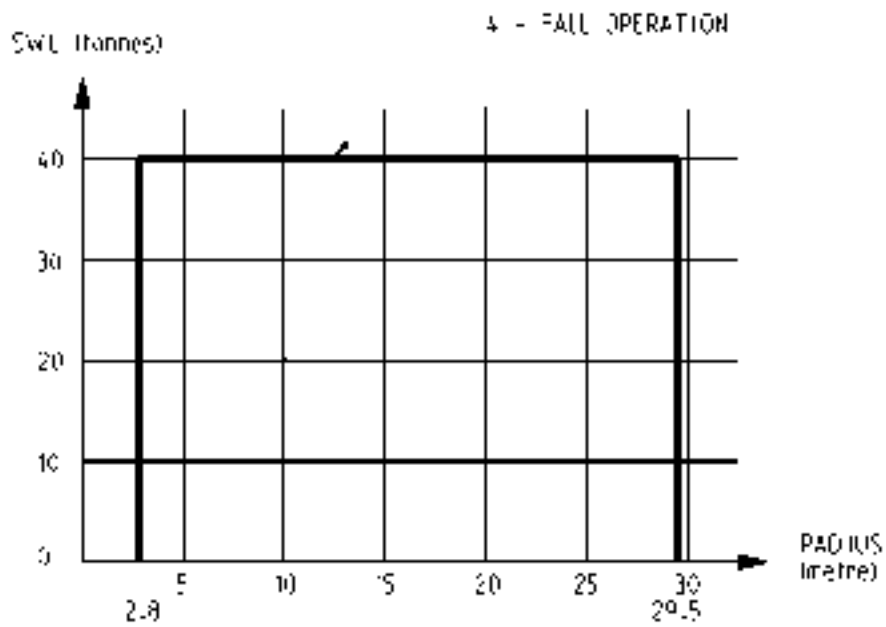
! ATTENTION !

The rescue equipment must be inspected by a competent person once a year according to the check-list supplied with the rescue-device !

2.3.12. LOAD DIAGRAM

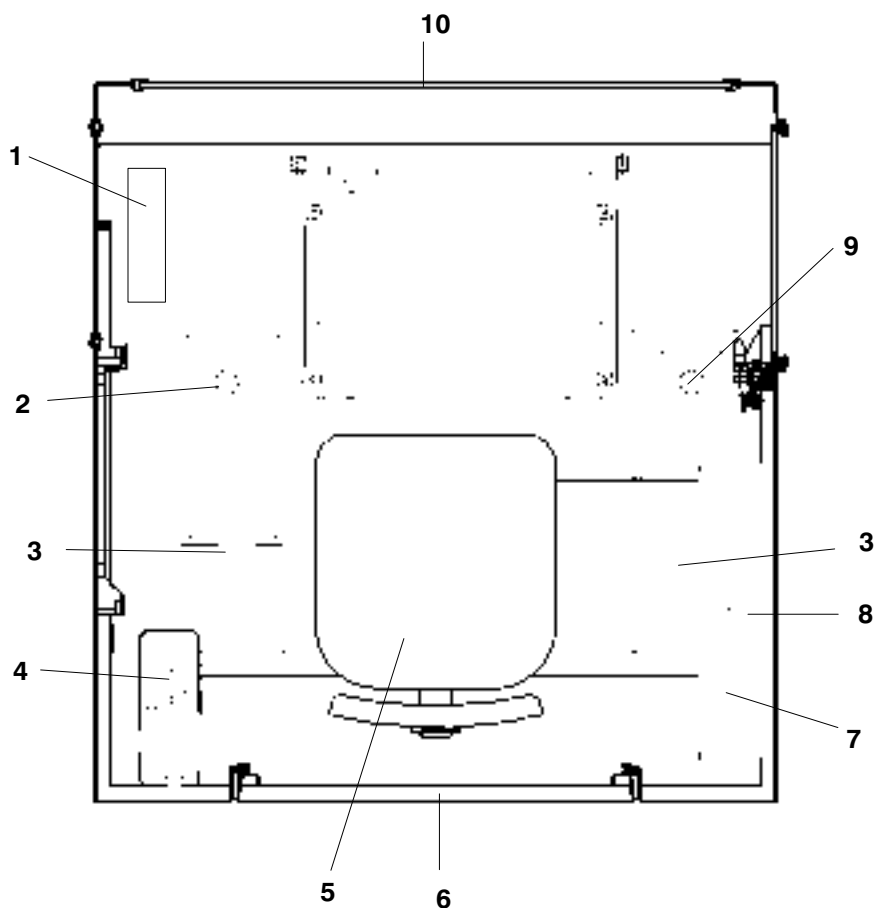
LIEBHERR

DECK CRANE
LBW 40/29.5 S1
LOAD DIAGRAM



IG NO. 9-9438074 DRAW. NO. 2786 100 00 00 C10 0XX

2.4. LAYOUT OF THE OPERATOR'S CABIN

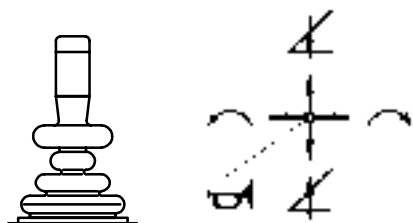


- 1 Cabin heater
- 2 Joy stick "jib / slew motion" (see description "EXPLANATION OF CONTROL ELEMENTS")
- 3 Arm rests
- 4 Watertank for windscreen washer
- 5 Driver's seat
- 6 Entrance door
- 7 Rescue device for emergency descent from the crane
- 8 Switch unit X20
- 9 Joy stick "hoist motion" (see description "EXPLANATION OF CONTROL ELEMENTS")
- 10 Emergency window for **emergency descent** (see section "EMERGENCY DESCENT")

GENERAL DESCRIPTION

2.4.1. EXPLANATION OF CONTROL ELEMENTS ON THE CONTROL STAND

2.4.1.1. JOY STICK "JIB / SLEW MOTION"

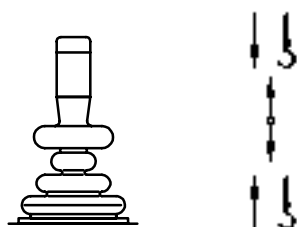


Combined joy stick for stepless hydraulic control of the luffing and slewing system. Both movements can be carried out at the same time.

The joy stick is spring centered and will automatically return to neutral when it is released.

A button on top of the joy stick can be used for operating the horn outside the cabin.

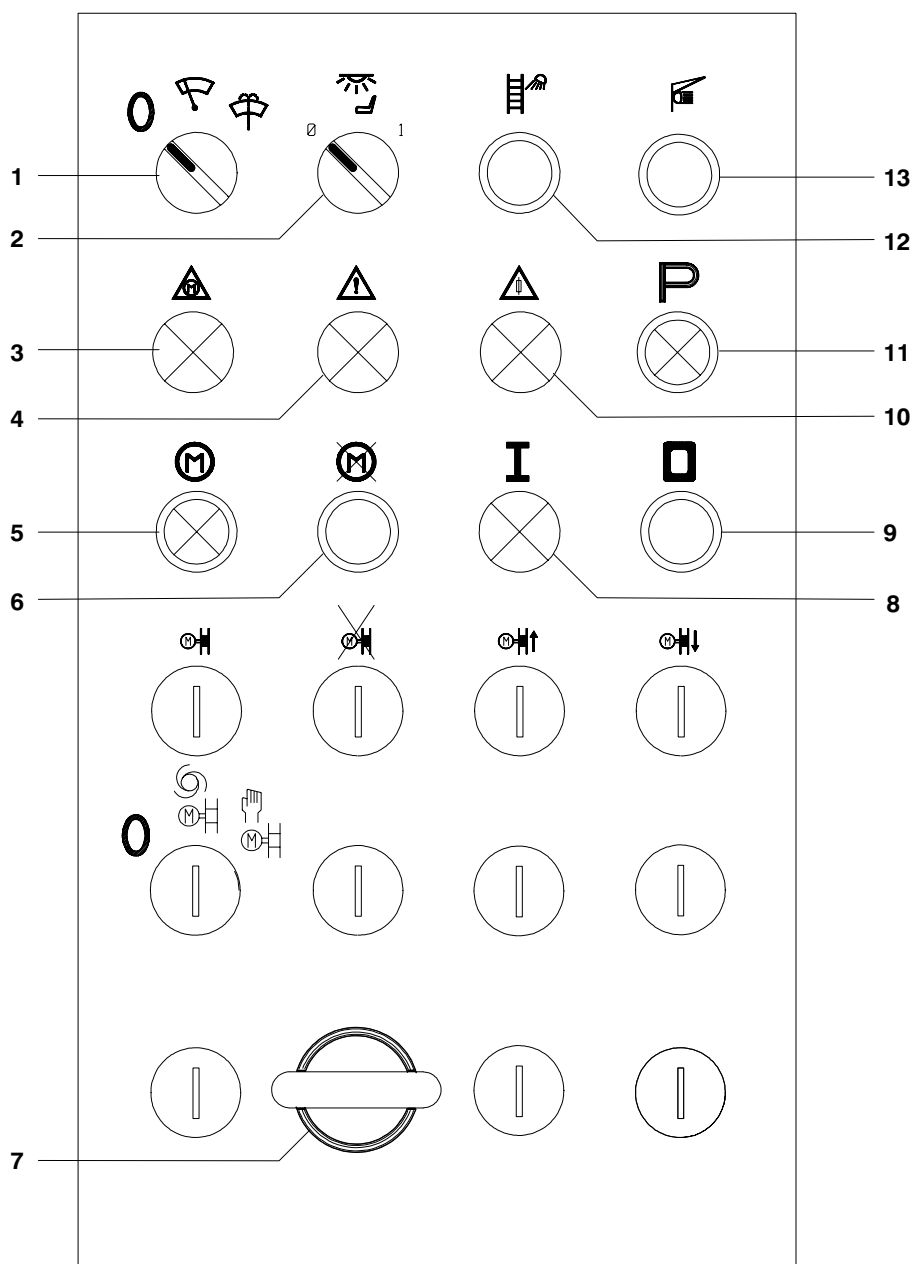
2.4.1.2. JOY STICK "HOIST MOTION"



Joy stick for stepless hydraulic control of the hoist motion operation can be carried out at the same time with luff or slew motion.

The joy stick is spring centered and will automatically return to neutral when it is released.

2.4.2. SWITCH UNIT X20 FOR CRANE CONTROL, LIGHTING AND HEATING



1 Switch “screen wiper front”

Pos. “0”: off

Pos. “I”: screen wiper operation

Pos. “II”: pump for screen wiper operation

2 Switch “lighting cabin”

For operating the light in the cabin.

3 Pilot light “main motor fault”

The pilot light illuminates if one of the listed faults occurs:

- overtemperature protection (PTC) main motor tripped
- overcurrent relay (PTC) main motor

GENERAL DESCRIPTION

4 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

5 Pilot light and push button “motor on”

Press push button to start the main motor in following sequence:

- Unlock all “EMERGENCY STOP” buttons
- Switch on the manual operated main breaker at switch cabinet **X1**
- Check if pilot light “CRANE ON” illuminates
- All joy sticks must be in neutral position
- Press push button “MOTOR ON”
- Check if pilot light “MOTOR ON” comes on after a few seconds (run up time main motor)

The main drive fails to start, if:

- the overcurrent relay
- the PTC—protection for the main motor has tripped or
- the hydraulic oil level is too low in the hydraulic tank

6 Push button “motor off”

Stops the electric main motor, if pressed.



ATTENTION !

Before leaving the crane the main drive must always be shut down !

7 Red push button “emergency stop”

If one of the emergency stop buttons is pressed the main motor stops. All brakes close immediately, because of the pressure loss in the brake lines.

These buttons should be used in emergency case only!



IMPORTANT !

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

Other emergency push buttons are located:

- at the switch cabinet door X1
- at the ascent ladder

8 Pilot light “crane on”

illuminates, if the manual operated key switch is on, that means power is available to start the hydraulic assembly.

9 Push button “crane off”

for switching off the main breaker when crane operation is finished.

10 Pilot light “circuit breaker tripped”

illuminates, if the circuit breaker of the oil cooler motor has tripped.

11 Push button and pilot light “park position”

If this button is pressed, the jib can be brought into “park position” (the limit switch “working position” will be bypassed).

If “parking” of the jib is wanted, lower the jib till this light comes on, now press bypass button and lower the jib into “park position”.

 **ATTENTION !**
If park position is reached, the movement of the jib is not stopped automatically via limit switches !

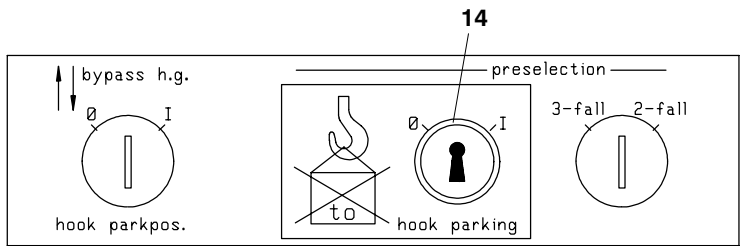
12 Switch “lighting crane”

For operating the lights inside the slewing column.
 An additional switch is located at the ascent ladder.

13 Switch “floodlights”


For operating the flood light at the jib head.

2.4.2.1. ADDITIONAL SWITCH UNIT “HOOK PARKING”



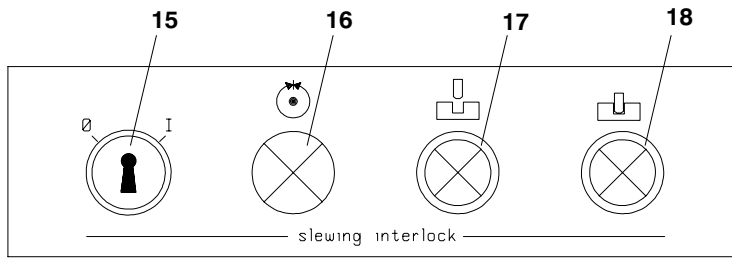
14 Key switch “parking”

Operate key switch to preselect “parking” of the jib.

 **ATTENTION !**
DO NOT OPERATE KEY SWITCH “PARKING” AS LONG AS LOAD IS ATTACHED ON THE HOOK !
Remove key after process is finished !

GENERAL DESCRIPTION

2.4.2.2. ADDITIONAL SWITCH UNIT “SLEWING GEAR INTERLOCK” (for crane no. 4 only!)



15 Key switch “preselection slewing interlock ”

Turn key switch to preselect interlock of slewing gear.
Precondition: Jib must be in lower limit switch position.

⚠ ATTENTION !
The key switch “slewing interlock” may be operated by trained personnel only and the key must be removed after process is finished !

16 Pilot light “ slewing interlock position”

The pilot light illuminates if the slewing column is in “slewing interlock” position

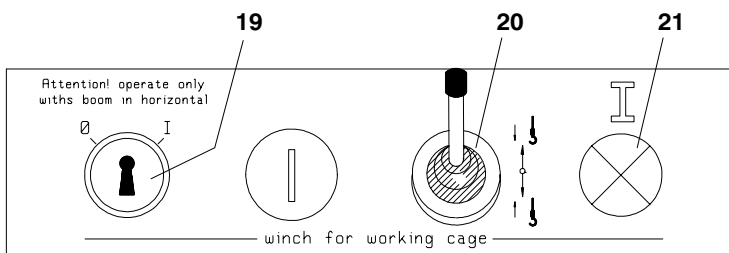
17 Push button and pilot light “park position unlocked”

If this button is pressed, the locking cylinder is activated and the slewing gear will be unlocked. The pilot light illuminates if the slewing gear is in unlocked position.

18 Push button and pilot light “park position locked”

If this button is pressed, the locking cylinder is activated and the slewing gear will be locked. The pilot light illuminates if the slewing gear is in locked position.

2.4.2.3. ADDITIONAL SWITCH UNIT “WORKING CAGE OPERATION” (for crane no. 4 only!)



19 Key switch “working cage operation”

Operate switch to preselect aux. winch (operation of winch refer to part “Operation”)

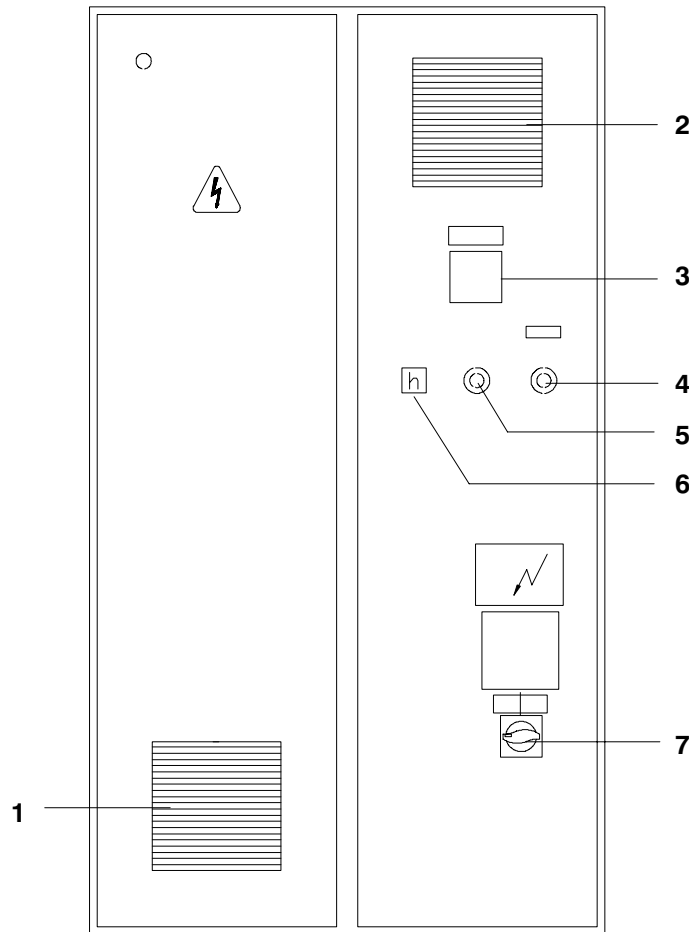
20 Joy stick “cage operation”

For operation of auxiliary winch in direction lifting or lowering

21 Pilot light “ready”

The pilot light illuminates if aux. winch is ready for operation

2.5. CONTROLS ON THE SWITCH CABINET X1



- 1 Air inlet with filter (clean or exchange the filter approx. every 3000 working hours) and fan **X1-M01**
- 2 Air outlet with filter (clean or exchange the filter approx. every 3000 working hours)
- 3 Ampere meter, measures the actual current of the main motor
- 4 Main switch "AUXILIARY SUPPLY" **X1-S02**. Operates the power supply for the entire lighting and heating system on the crane. **SWITCH OFF ONLY FOR SERVICE WORK IN THIS SYSTEM!**
- 5 Red push button "EMERGENCY STOP". **X1-S01**. Function see "EMERGENCY STOP" on SWITCH UNIT X20.
- 6 MOTOR OPERATION HOURS COUNTER. **X1-P01**. This value is used to determine the crane's maintenance intervalls.
- 7 Main switch "CRANE POWER SUPPLY". **X1-Q01**. Turn to switch on. Switch cabinet door can't be opened, when the switch is in the "ON" position.

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

GENERAL DESCRIPTION

2.6. PREPARATIONS FOR CRANE OPERATION

2.6.1. START UP OF CRANE (FROM PARKING POSITION)

- Switch on the main breaker manually at the door of switch cabinet X1. If switching on is not possible, check if all emergency stop buttons are in unlocked position.
- Check if the hand valve (below the hydraulic tank) for pump supply is in open position !
- Pilot light “crane on” (item 8) illuminates
- Press the “motor on” button (item 5) at the switch unit X20 (all joy sticks 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 joy sticks until the pilot light “Motor on” illuminates !

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

**NOTE !**

Following marked item (with *) are for crane no. 4 only!

- *– Operate key switch “slewing interlock” (item 15)
- *– Press push button “park position unlocked” (item 17) until inserted pilot light illuminates
- *– Turn back key switch “slewing interlock” to normal position
- Switch over key switch “parking” (item 14) to position “I”
- Hoist jib until pilot light “park position” (item 11) illuminates by pressing push button “park position” (item 11) and keep it pressed during operation
- Lower lower hook–block carefully from its hook storage
- Lower jib and hook block into working range
- Turn back key switch “parking” (item 14) to position “0”

**ATTENTION !**

The key switches “parking” (item 14) and “slewing interlock” (item 15) may be operated by trained personnel only and the keys must be removed after process is finished !

The crane is ready for operation.

2.6.2. SHUT DOWN THE CRANE (FOR WORK BREAK)

- Move the jib and load the hook to a position, which will not endanger anyone on board.
- Press the “motor off” push button

2.6.3. STARTING UP (AFTER A WORK BREAK)

- Press the “motor on” push button
- Press push button “motor on”
- Wait until pilot light “motor on” lights up

The crane is now ready to continue work.

2.6.4. SHUT DOWN OF CRANE (FOR PARKING POSITION)

- Change key switch “parking” (item 14) to position “I”
- Hoist jib until pilot light “park position” (item 11) illuminates
- Hoist lower hook–block carefully in its hook storage
- Lower jib to the rest position by pressing of push button “park position” (item 11) until the movement “jib down” stops.



NOTE !

Following marked item (with *) are for crane no. 4 only!

- *– Operate key switch “slewing interlock” (item 15) to position “I”
- *– Turn the crane until it is in its interlock position (pilot light “slewing interlock position” (item 16) illuminates)
- *– Press push button “park position locked” (item 18) until inserted pilot light illuminates
- Press push button “motor off” (item 6)
- Switch off the main breaker by push button “crane off” (item 9)
- Close firmly all windows and doors



ATTENTION !

The auxiliary supply (3 x 220V, 60 Hz) must remain switched on for crane heating and standstill heating !



ATTENTION !

The key switches “parking” (item 14) and “slewing interlock” (item 15) may be operated by trained personnel only and the keys must be removed after process is finished !

The crane is now ready for seagoing.

GENERAL DESCRIPTION

2.7. ADDITIONAL CRANE OPERATION

2.7.1. WORKING CAGE OPERATION

The working cage is used for hoisting rope exchange, greasing rope pulleys and maintenance purpose of floodlight on jib head.

PREPARATION:

- Hoist hook–block in upper limit
- Turn key switch “parking” (item 14) to position “I”
- Lower the jib to the rest position “0°” by pressing push button “park position” (item 11) until the movement “jib down” stops.

FOLLOWING CONTROL ELEMENTS ARE USED FOR OPERATION:

- Key switch “working cage operation” (item 19) for preselection of auxiliary winch
- Pilot light “ready” (item 21) which indicates “ready for operation”
- Joy stick “cage operation” (item 20) for aux. winch operation “lifting” or “lowering”

All control elements are situated on switch unit X20 refer to part 2.4.2.

OPERATION OF WORKING CAGE:



WARNING !

During working cage operation jib must be in park position “0°” and the hook block in the upper limit !

- Turn switch “working cage operation” to position “I”
- Wait until pilot light “Ready” illuminates
- Lower hoisting rope of auxiliary winch on deck with joy stick “cage operation”
- Connect working cage on the hook
- Move working cage to required position for maintenance works at jib head
- After work is done lower working cage on deck
- Disconnect working cage
- Spool up hoisting rope of auxiliary winch with empty hook in its rest position (upper limit)
- Turn key switch “working cage operation” to position “0” to switch off aux. winch
- Hoist jib into working range by pressing push button “park position” (item 11)
- Turn key switch “parking” (item 14) to position “0”



ATTENTION !

The key switches “parking” (item 14) and “working cage operation” (item 19) may be operated by trained personnel only and the keys must be removed after process is finished !

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TABLE OF LUBRICANTS

3. MAINTENANCE

3.1. GENERAL

Routine and preventive maintenance measures are essential for a safe and efficient operation of the crane. Failure of adequate maintenance may result in costly, unscheduled breakdown and dangerous situations.

Cleanliness is required for the operation of the hydraulic system. Filters of any type as well as the hydraulic oil have to be checked at appropriate intervals.

Periodical exchange of the oil used in the different gearboxes must be done.

All movable parts like winch bearings, hinge sections, rope pulleys, slewing bearing, ropes, doors, ventilation flaps etc. must always be greased.

For regular service intervals refer to attached maintenance list in section "MAINTENANCE LIST".



IMPORTANT !


Special care must be taken when the crane is out of operation. The standstill heatings must be on. Important pressures should be checked at extreme outside temperatures (e.g. feed pressure, control pressure etc. It is necessary to check the hose armatures, which are mounted on the outside of the crane and are exposed to the seawater, at regular intervals.

While greasing the bearings of the winches and the main slewing bearing ring, the winches as well as the slewing ring has to be turned slowly to ensure an adequate grease distribution.

The maintenance intervals indicated in the maintenance list depend on the actual operating hours of the crane. Should the crane be standing for more than a month, then the crane has to be operated every month for at least two hours. In that time all the greasing, oil inspections and oil level checks have to be done.

The crane has to be preserved, if not in operation for more than three months. Preservation instructions are obtainable through the LIEBHERR service department.

The bolts of the main slewing bearing have to be kept greased after erection and regreased after every inspection.

 **ATTENTION !**
Switch off the heater inside the hydraulic oil tank before exchanging or draining the oil !

3.1.1. MAINTENANCE INTERVALS

The maintenance intervals mentioned in the section MAINTENANCE LIST are guiding times and should be observed.

3.1.2. HIGH ADHESION LUBRICANT OR UNDERWATER GREASE

Gear rim of main slewing bearing **must always be greased**

Ropes **must always be greased**

3.1.3. DISPOSAL OF USED MATERIALS



DISPOSAL !

WHEN CHANGING OIL AND GREASE, BATTERIES, ETC.—USED MATERIALS MUST BE PROPERLY DISPOSED OF IN ACCORDANCE WITH THE RELEVANT STATE REGULATIONS !
 CONTAMINATION OF SOIL, SEWAGE AND WATER SYSTEMS MUST BE AVOIDED !

MAINTENANCE

3.2. SPECIAL SAFETY REGULATIONS

3.2.1. GENERAL MAINTENANCE SAFETY

- STUDY THE INSTRUCTION– AND MAINTENANCE MANUAL** before operating or servicing the crane. Make certain that you have additional information for special attachments of your crane, read it and understand it. IF IN DOUBT OR ANY INFORMATION REQUIRED, PLEASE CONTACT YOUR NEAREST LIEBHERR SERVICE STATION (Contacts to LIEBHERR Service stations see SECTION 1 OF THIS MANUAL).

- ALLOW ONLY **TRAINED AND AUTHORIZED PERSONNEL** TO OPERATE, MAINTAIN, SERVICE OR REPAIR THE **LIEBHERR DECK CRANE**.

- WHEN MAKING REPLACEMENTS – **USE ONLY ORIGINAL LIEBHERR SPARE PARTS ! THIS IS ABSOLUTELY NECESSARY FOR OPERATING YOUR CRANE SAFELY.**

- MAINTENANCE WORK SHOULD BE PERFORMED AS OUTLINED IN THE **MAINTENANCE GUIDLINES AND INTERVALS** OF THIS MANUAL.

- PERFORM ONLY WORK YOU UNDERSTAND**, USING THE MAINTENANCE MANUAL AND SPARE PART MANUAL AS GUIDLINE.

- WEAR PROPER WORKING– AND SAFETY CLOTHING** (coverall, safety boots, hard hat, safety glasses and gloves, ear protection, etc.) WHEN PERFORMING SERVICE OR REPAIR WORK. **KNOW YOUR LOCAL SAFETY RULES AND REGULATIONS.**

- KEEP UNAUTHORIZED PERSONNEL FROM THE CRANE** WHEN PERFORMING MAINTENANCE– or REPAIR WORK.

- BEFORE SERVICING THE CRANE**, ATTACH A "DO NOT OPERATE" TAG ON THE ACCESS LADDER AND THE CONTROL PANEL.

- DO NOT USE FLAMMABLE FLUIDS TO CLEAN THE CRANE.**

- NEVER CHECK FOR LEAKS WITH YOUR BARE HANDS AND / OR WITHOUT SAFETY GLASSES.** Fluids escaping from a small hole can have enough force to penetrate skin.

- DO NOT DISCONNECT LINES or HOSES, FITTINGS, CAPS or COVERS WHILE THE HYDRAULIC SYSTEM, ENGINE FUEL or COOLING SYSTEM is PRESSURIZED. ALWAYS LOWER A LOAD OR ATTACHMENT TO GROUND FIRST – LOWER THE JIB AND TOWER INTO MAINTENANCE POSITION.** SHUT OFF THE MAIN MOTOR, AND RELEASE THE RESSURE FIRST. After servicing, ensure that all lines, hoses and fittings are properly connected and all caps and covers are closed.

- DO NOT LIFT HEAVY COMPONENTS – USE PROPER LIFTING DEVICES SUCH AS CHAIN BLOCKS, CRANES**, etc.

- NEVER USE DAMAGED OR INSUFFICIENT WIRE ROPES, CHAINS AND SLINGS.** Always wear SAFETY GLOVES when handling wire ropes.

- NEVER USE METAL ON METAL SUPPORTS.**

continued /

3.2.2. FIRE AND EXPLOSION PREVENTION

- WHEN PERFORMING HOT WORK (welding, etc.) ALWAYS HAVE A FIRE EXTINGUISHER ON STAND-BY.**

- NEVER STORE FLAMMABLE FLUIDS ON THE CRANE EXCEPT IN THE STORAGE TANKS INSTALLED FOR THE CRANE OPERATION.**

- FREQUENTLY CHECK THE ELECTRICAL SYSTEM AND CORRECT ALL WIRING DEFECTS.**

- DO NOT USE FLAMMABLE MATERIALS / FLUIDS TO CLEAN THE CRANE.**

- INSPECT PERIODICALLY ALL COMPONENTS, LINES, TUBES AND HOSES FOR EVENTUAL LEAKAGES OR MECHANICAL DAMAGE. REPLACE OR REPAIR ANY DAMAGED COMPONENTS. BE AWARE, OILLEAKS CAN CAUSE FIRES !**

- KNOW THE LOCATION OF THE FIRE EXTINGUISHERS AND BE FAMILIAR WITH ITS OPERATION.**

MAINTENANCE

3.2.3. HANDLING AND DISPOSAL INSTRUCTIONS

GENERAL

THE ENVIRONMENT IS OF GREAT IMPORTANCE TO LIEBHERR BOTH IN THE FACTORY DURING PRODUCTION OF OUR GOODS AND IN THE DESIGN OF OUR PRODUCTS.

- energy saving crane powering concept
- less pollutants, lower gasoline consumption, lower noise levels

HANDLING AND DISPOSAL INSTRUCTIONS

When chemical cleaning, testing compounds and lubricants are used, the pertinent danger and also handling information on the packing units is to be adhered to and appropriate protective devices to be used.



IMPORTANT !

DO NOT USE FLAMMABLE FLUIDS TO CLEAN THE CRANE ! NEVER STORE FLAMMABLE OR OTHER DANGEROUS FLUIDS / GOODS ON THE CRANE !

DANGERS



EXPLOSIVE



POISONOUS



HIGHLY INFLAMMABLE



NOXIOUS



FIRE SUPPORTIVE MATERIALS



CORROSIVE, CAUSTIC



IMPORTANT !

LUBRICANTS, PAINTS, THINNERS AND CLEANING COMPONENTS ARE TO BE STORED OR PRESERVED ALWAYS IN CLOSED VESSELS.

NEVER STORE FLAMMABLE FLUIDS ON THE CRANE EXCEPT IN THE STORAGE TANKS (HYDRAULIC OIL, etc.) INSTALLED FOR THE CRANE OPERATION.



ATTENTION !

FILLED UP AND LABELLED PACKING UNITS OF USED LUBRICANTS, OLD PARTS, PAINTS, THINNERS AND CLEANING COMPONENTS TO BE RETURNED UNDER MAXIMUM SAFETY AND IN COMPLIANCE TO SPECIAL LOCAL RULES AND REGULATIONS TO YOUR NEXT DISPOSAL DEPOSITION.

3.2.4. LUBRICANTS AND OILS

Should only be chosen from the TABLE OF LUBRICANTS, which is attached to the end of this section.

NOTE:

Since we know that the ordinary commercialized multi purpose greases do not always comply with the requirements of our cranes, we have developed a grease paste in close collaboration with our suppliers.

This new grease paste has, after extensive tests, proved to be very suitable for the best greasing of our cranes and thus has been used for some time now in our factory for the greasing of cranes.

The working temperature of this grease paste range is from – 50°C to + 90°C. The grease paste is extremely resistant to pressure, water, can easily be conveyed through grease pipes and has a very high dripping point.

We are pleased to offer this grease paste as follows:

1) for greasing with automatic grease gun:

AVIALITH 2EP special paste in buckets to 25 kg

2) for greasing with manual press:

AVIALITH 2EP special paste in cartridges to 400 g

3.2.5. MAINTENANCE OF OIL COOLERS

The cooling lamellas 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 lamellas have to be inspected visually at least every week and cleaned if necessary.

3.2.5.1. 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 !

MAINTENANCE

3.2.6. HYDRAULIC OIL FILLING

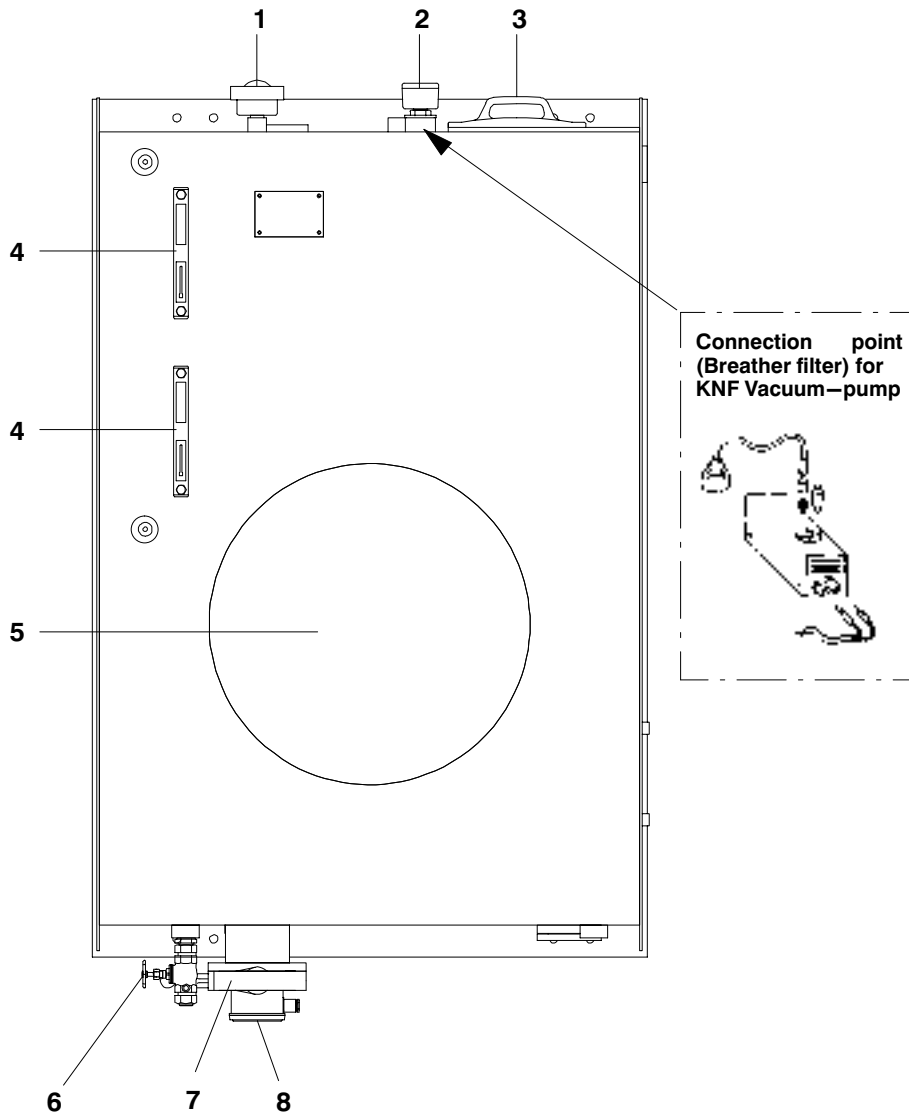
Check the oil level at the inspection glass on the front wall of the hydraulic oil tank. The oil level should always be between the MAXIMUM and MINIMUM mark.



NOTE !

Jib must be in the jib rest, when checking hydraulic oil level !

Components at hydraulic tank:



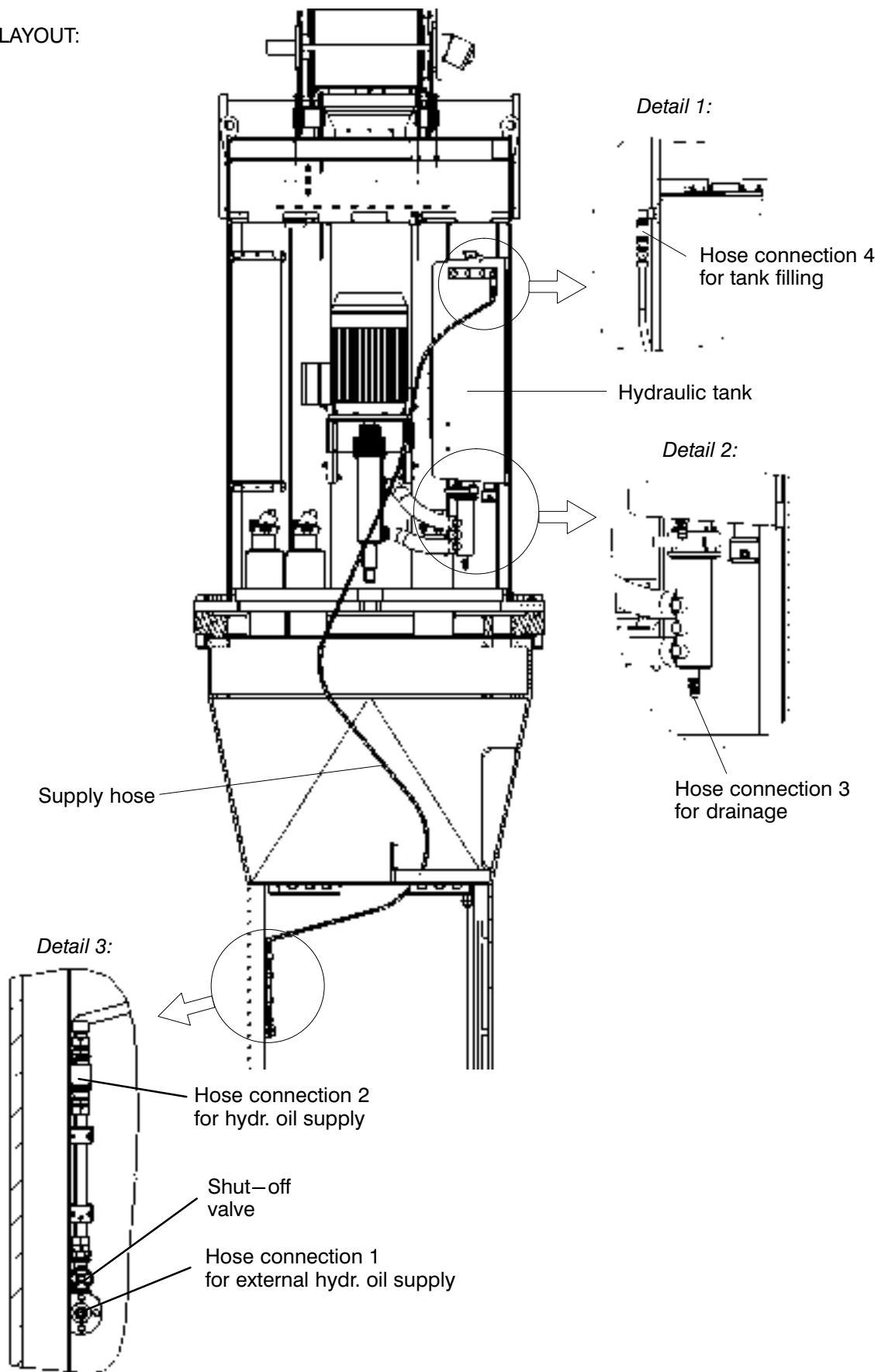
- | | | | |
|---|--|---|---------------------------|
| 1 | Air breather | 5 | Inspection cover |
| 2 | Oil level and temperature sensor | 6 | Drainage cock |
| 3 | Flow back filter | 7 | Oil supply shut-off valve |
| 4 | Inspection glasses (oil level and temperature) | 8 | Tank heater |

! 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 !

HYDRAULIC OIL FILLING SYSTEM

LAYOUT:



MAINTENANCE

HYDRAULIC OIL FILLING PROCEDURE



ATTENTION !

Filling of tanks must be performed by **two persons**, one person checks oil level, the other one must switch off oil supply when max. level at hydraulic tank is reached !

- Connect supply hose to the provided hose connections 2 and 4 (see details)
- Connect external hydraulic oil supply to hose connection 1
- Open shut–off valve
- Fill hydraulic tank with hydraulic oil to upper level limit of oil sight glass (jib must be in rest position)
- Close shut–off valve when filling of tank is complete
- Remove external supply hose from hose connection 1
- Remove supply hose from hose connections 2 and 4
- Store supply hose to provided place (detail below) in base column



NOTE !

COMBINE CONNECTIONS TO AVOID POLLUTION !

3.3. MAINTENANCE OF HYDRAULIC SYSTEM

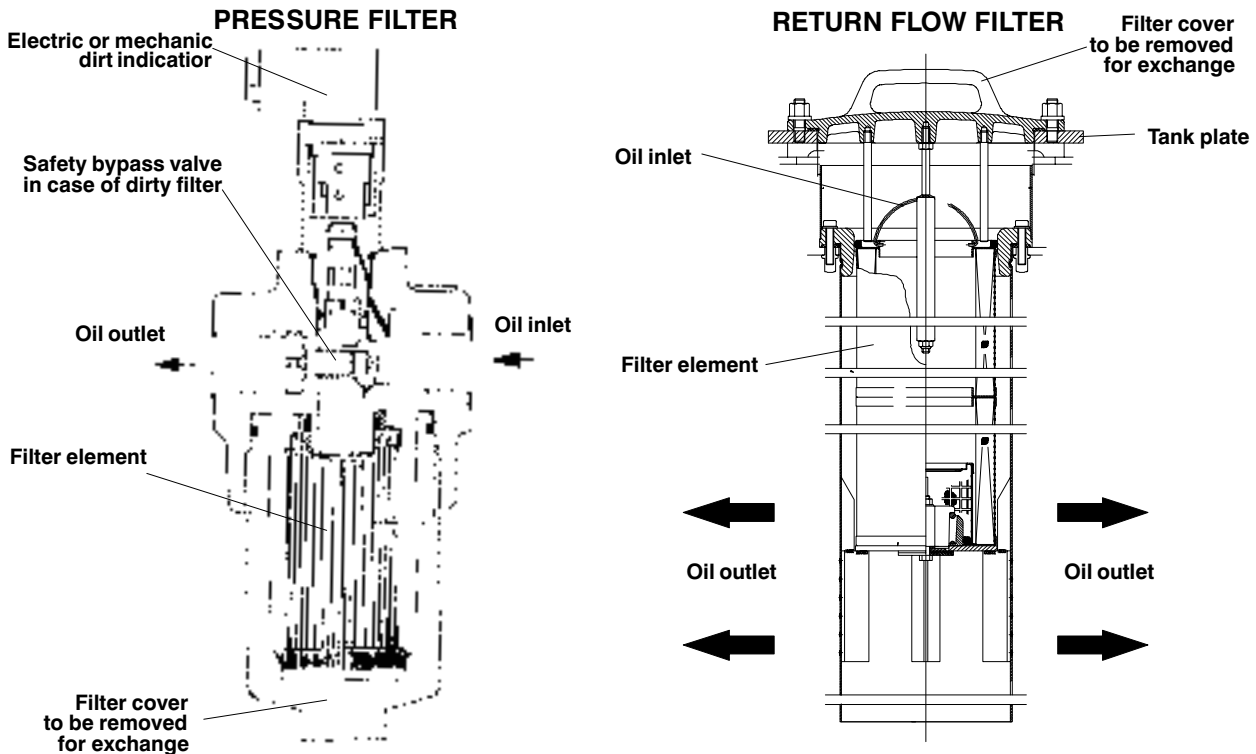
3.3.1. GENERAL

The correct function of the hydraulic system depends on maintenance. The biggest problem is impurity of the hydraulic oil. The checking of filters is very important and the renewing as well as the cleaning of filters and oil should be carried out according to the maintenance list.

Check the hydraulic system daily for leakages.

3.3.2. FILTER ELEMENTS

Initially the filter cartridge must be exchanged **after 100 working hours** and then **every 500 working hours**.



3.3.3. HYDRAULIC FLUID

Change the oil **initially** after approximately **500 working hours** and then **every 1500 working hours**.

We recommend that a oil sample of the used hydraulic fluid (approx. 0,25 l), which has to be drawn from the system (out of a filter), is submitted to the oil supplier for analysis. The oil supplier will inform you about the condition of the oil and recommend a new time for an oil exchange.

Hydraulic oil cleanliness requirement code: 18/15 ISO 4406
9 NAS 1638

At first operation used hydraulic oil: FLUID ATF 66 M of AVIA (temp. range: -25°C to +45°C)

3.3.4. FLUSHING OF HYDRAULIC CIRCUIT AND PREFILLING THE PUMPS

It is necessary to flush the hydraulic circuits, if any dirt or solid particles have penetrated. This can occur when a pump or motor is damaged or a valve or cylinder (ram) fails. Depending on the nature and extent of the damage, flush thoroughly all affected pipes, filters and the hydraulic oil tank.



IMPORTANT !

Before operating the crane after an oil exchange or an pump repair, all pumps and respective suction lines must be prefilled with hydraulic oil !

MAINTENANCE

3.3.5. HYDRAULIC LINES AND HOSES

3.3.5.1. 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 !

3.3.5.2. 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**.

3.3.5.3. 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.

3.3.5.4. 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).

3.3.5.5. 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 **KNF VACUUM–PUMP** could be connected to the hydraulic oil tank. Route or install the hoses and lines properly. **DO NOT MIX UP CONNECTIONS !**

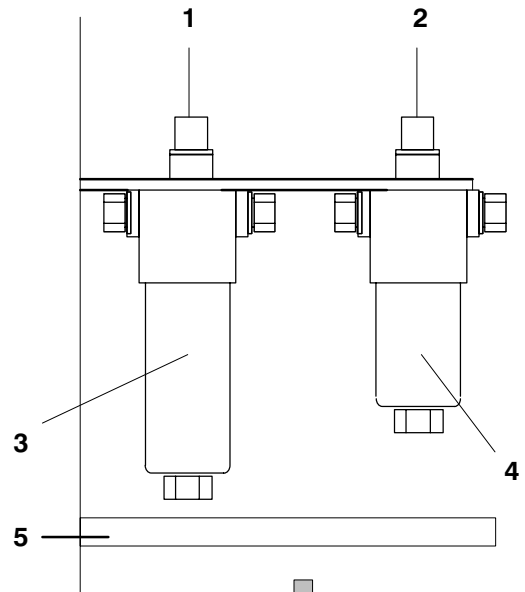


DISPOSAL !

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

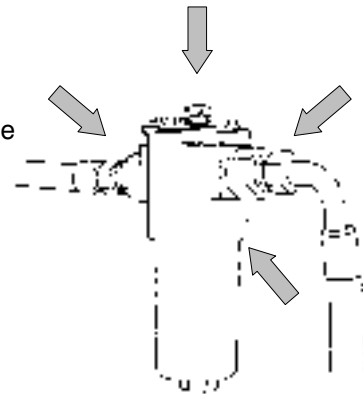
3.3.6. VALVE AND FILTER PLATE AGGREGATE ROOM

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



3.3.6.1. MAINTENANCE 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.



3.3.6.2. REPLACEMENT OF FILTER ELEMENTS

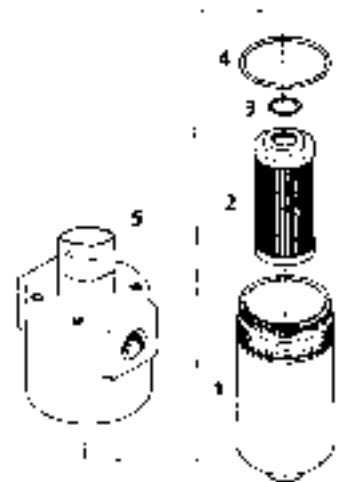
- Lower the load / auxiliary equipment safe to ground and shut off the main motor. Wait a few minutes till the pressure is reduced to 0 bar.

⚠ 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 !



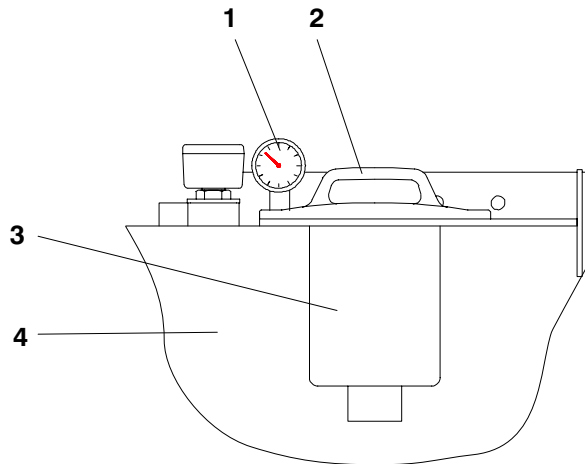
- Clean all parts carefully, check O–ring (4) for good condition (replace if required)
- Insert new filter element, check correct seat of O–ring (3, 4)– and screw lower housing clockwise (by hand only) to the upper part again.
- Tighten lower housing (1) gently with combination spanner clockwise (max. 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.

MAINTENANCE

3.3.7. 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



3.3.7.1. MAINTENANCE TO 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).

3.3.7.2. 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.

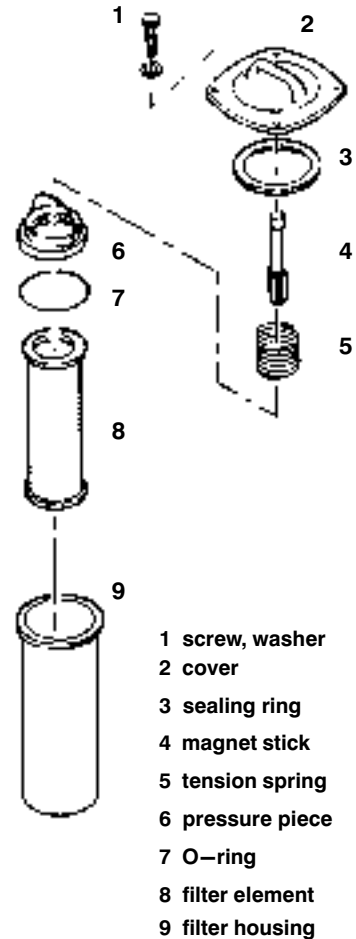
⚠ WARNING !

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 (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.



- 1 screw, washer
- 2 cover
- 3 sealing ring
- 4 magnet stick
- 5 tension spring
- 6 pressure piece
- 7 O–ring
- 8 filter element
- 9 filter housing

3.4. PRESSURE ACCUMULATORS

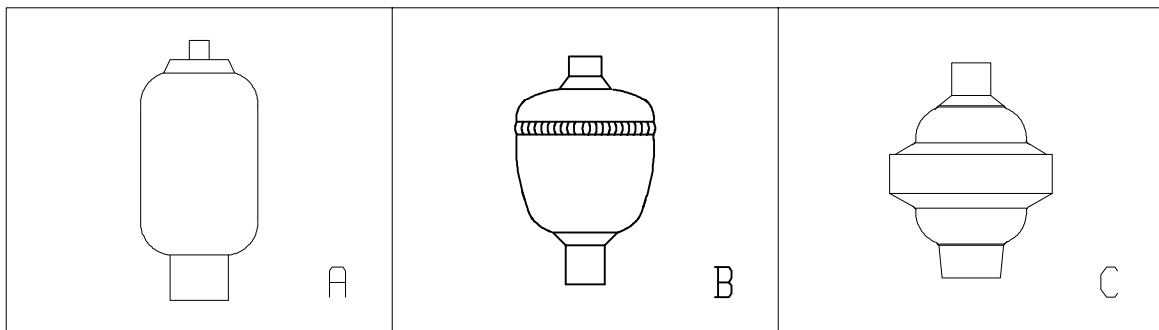
3.4.1. GENERAL

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

3.4.2. 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!

3.4.3. ACCUMULATOR TYPES IN THE CRANE



NR.	IDENT. NR.	BEZEICHNUNG		TYP	STUECK
		description		type	pieces
1	5117 027 14	SB0 210-0,32	18 bar	B	1
2	5117 028 14	SB0 210-0,32	8 bar	B	1



IMPORTANT !

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

MAINTENANCE

3.5. LIEBHERR CONDITION MONITORING

3.5.1. 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.

3.5.2. 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

3.5.2.1. 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.

3.5.2.2. 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.

3.5.2.3. 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.

3.5.2.4. 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

3.5.2.5. 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.

3.5.2.6. 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

3.5.2.7. 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.

3.5.2.8. 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.

3.5.3. OIL SAMPLE / OIL EXCHANGE

3.5.3.1. 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 !

3.5.3.2. 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.

3.5.3.3. 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

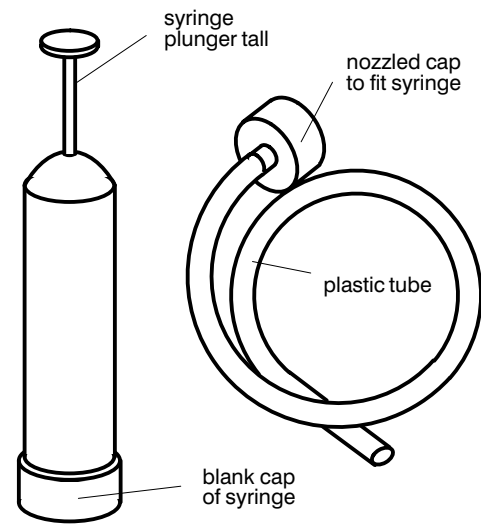
3.5.4. TAKING AN OIL SAMPLE

3.5.4.1. GENERAL

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

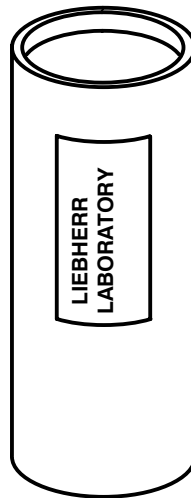
LIEBHERR Id. No.: **885601814**

- 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 is was used in.



PLASTIC SYRINGE / BOTTLE

PLASTIC TUBE



POSTAL CARTON

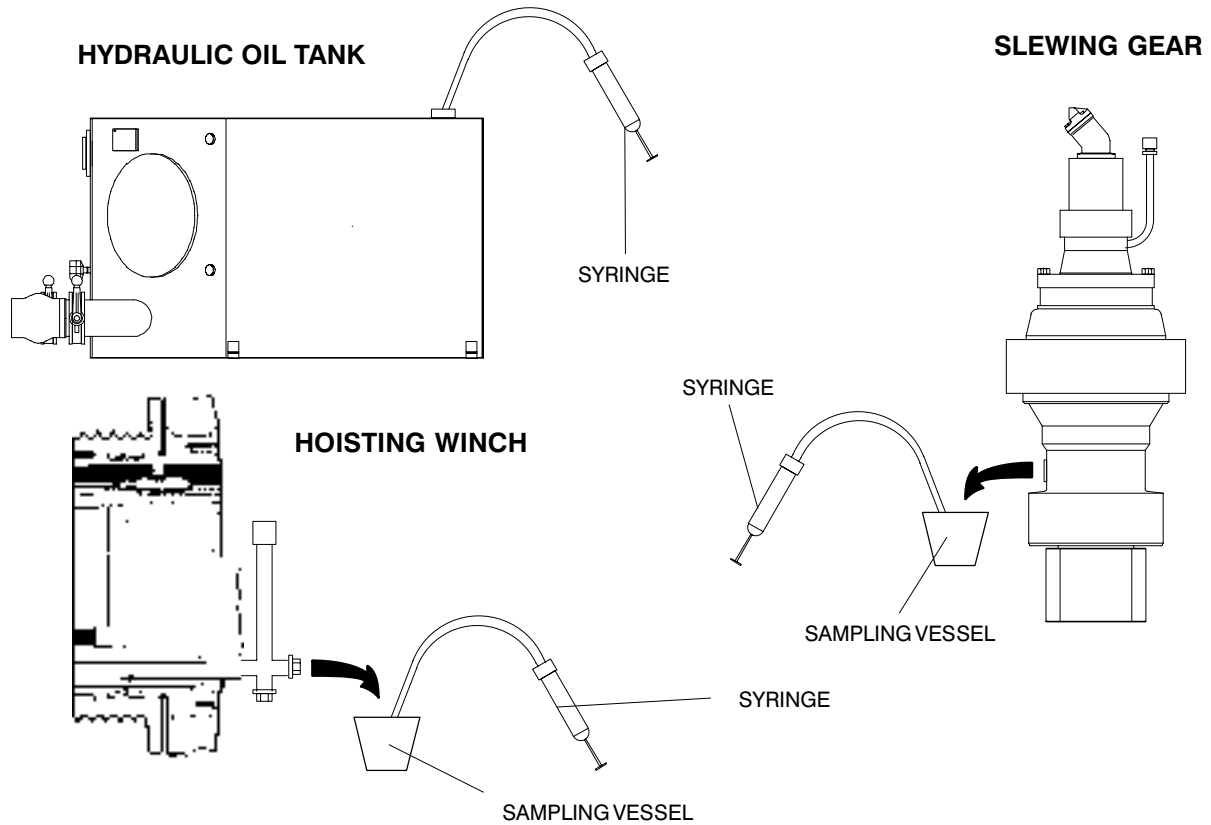
SAMPLE INFORMATION FORM

3.5.4.2. HOW TO TAKE A REPRESENTATIVE OIL SAMPLE

- Ensure the engine 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 nozzled 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. Re-tighten the cap and continue drawing the oil.
- When the syringe is full, discard the nozzled 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 ADRESS stated adress

MAINTENANCE

3.5.4.3. SAMPLING POINTS (EXAMPLES)



3.5.4.4. POST ADDRESS

LABORATORY: LLANDUDNO
GWYNEDD LL30 1SA
UNITED KINGDOM

3.5.5. 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

3.6. GEARBOXES

3.6.1. SLEWING GEARBOXES

Each **slewing gearbox** has a **splash lubrication system**.

Before setting into operation fill in gear oil (oil types see "TABLE OF LUBRICANTS", which is attached to the end of this section.)

The oil change is made by using the marked points of the figure below (oil quantities and intervals see MAINTENANCE LIST).

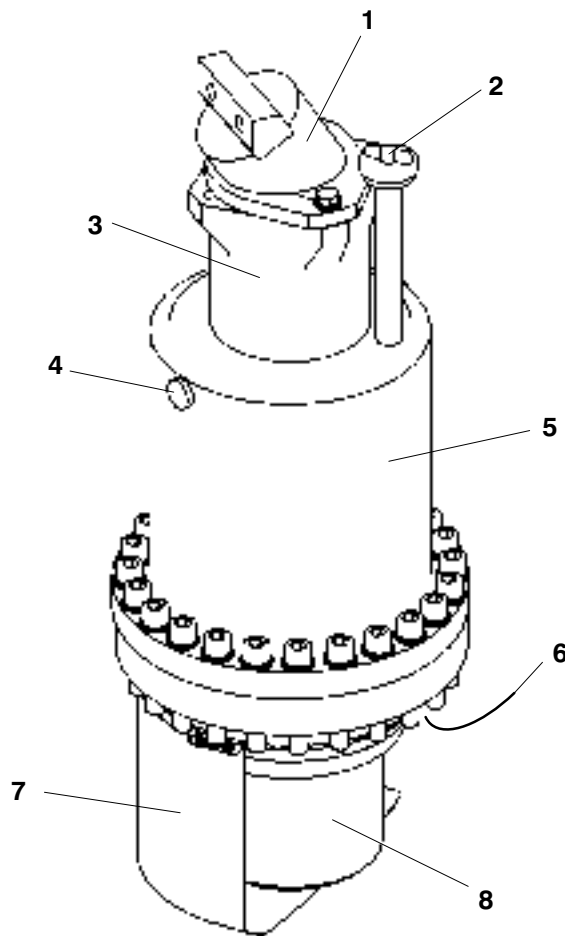
The oil level inspection can be carried out by the provided oilsight glass.
The correct oil level is in the middle of the oil sight glass.



IMPORTANT !

Check oil level only, if the crane is shut down.

- 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)



ATTENTION:
Before assembling motor, fill brake with 0,2 l hydraulic oil ATF

Recommendation for service

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.

MAINTENANCE

3.6.2. HOIST WINCH GEARBOX

There is one main winch gearbox used in the crane.

It has a **splash lubrication system**.

Before setting into operation fill in gear oil (oil types see "TABLE OF LUBRICANTS", which is attached to the end of this section.)

The oil change is made by using the marked points of the figure below.(oil quantities and intervals see MAINTENANCE LIST)

Remove the breather plug when exchanging the oil, but don't forget to put it on again after the oil exchange.

The oil level inspection can be carried out by the provided dip stick on the side of the winch drum. For the inspection **do** screw-in dipstick.

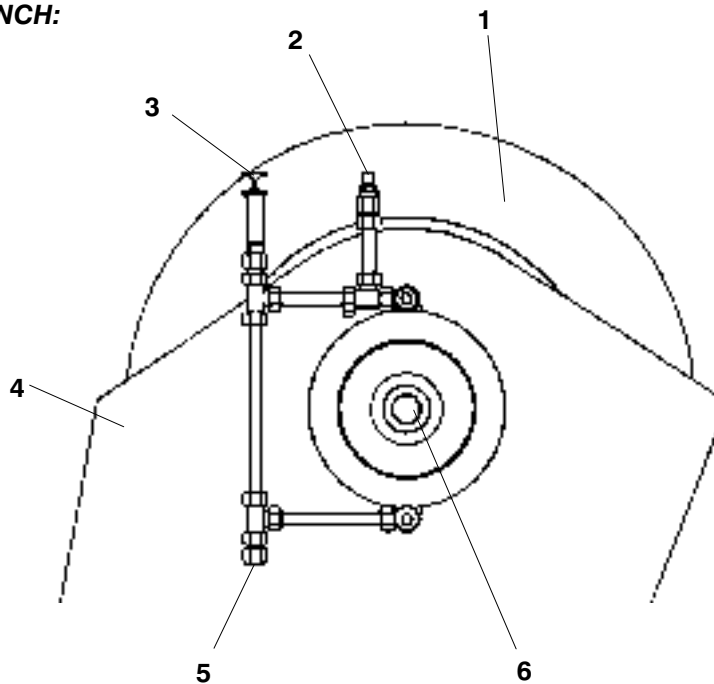


NOTE !

The **MAXIMUM OIL LEVEL** in a winch gearbox should be up to center line only, however check for correct level with provided **DIPSTICK**.

Check oil level only, if the crane is shut down.

LAYOUT OF WINCH:



- 1 Rope drum
- 2 Air breather
- 3 Dipstick and gear oil filling
- 4 Winch frame
- 5 Gearoil drainage
- 6 Flange for hydr. motores

Recommendation for service

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.

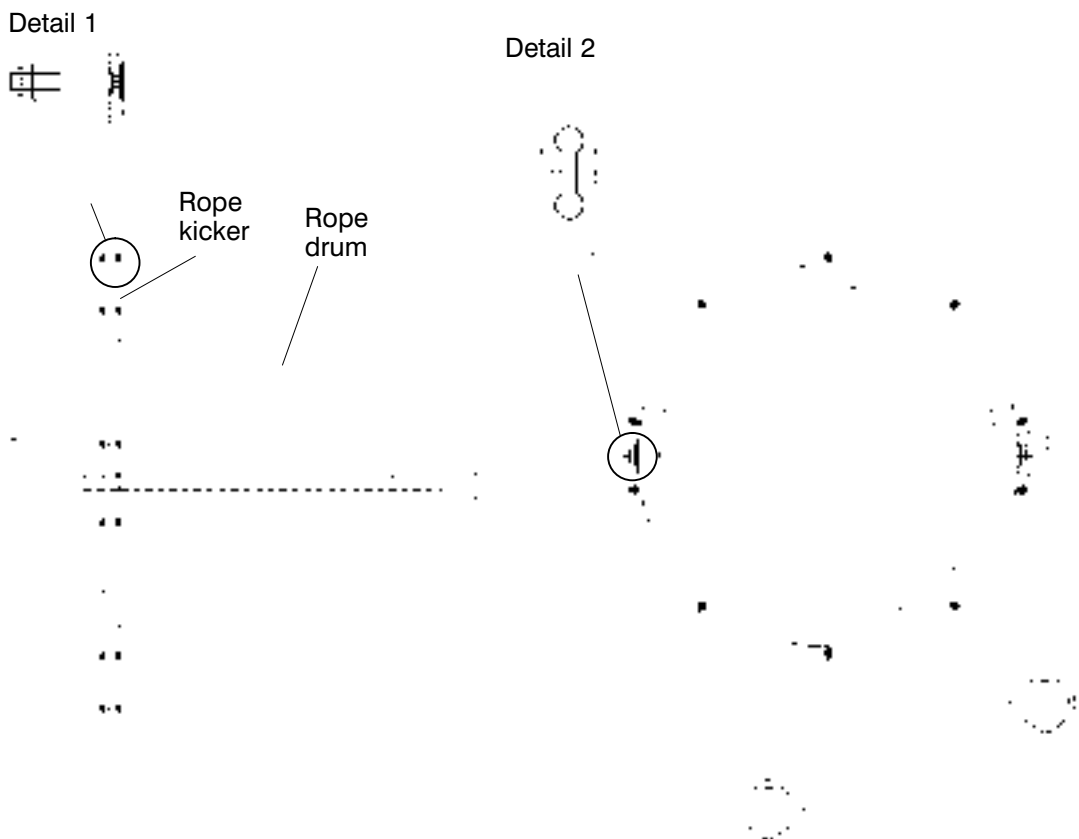
ROPE KICKER (DEFLECTOR):



NOTE !

Following maintenance works must be performed every 500 operations hours or every three months.

- Check wear and if necessary remove chaffing from rope kicker
- Check if screws are in counter sunk position (Detail 1)



In case of excessive wear exchange rope kicker to avoid damages of the hoisting rope



NOTE !

When mounting new rope kicker check, if in correct alignment (Detail 2)

MAINTENANCE

3.6.3. AUXILLIARY HOIST WINCH GEARBOX

There is one aux. winch gearbox used in the crane.

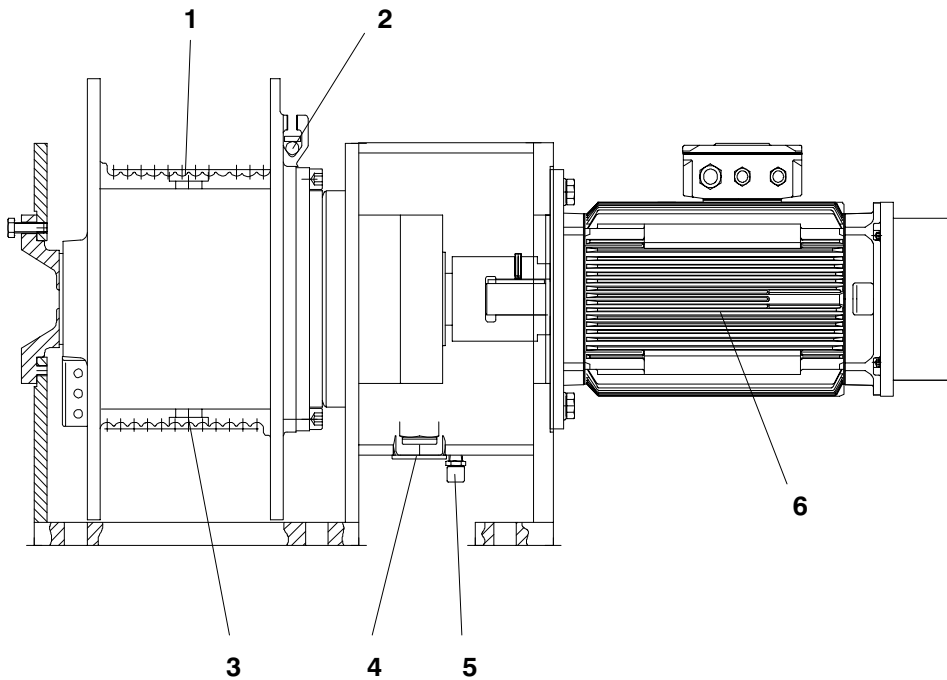
It has a **splash lubrication system**.

Before setting into operation fill in gear oil (oil types see "TABLE OF LUBRICANTS", which is attached to the end of this section.)

The oil change is made by using the marked points of the figure below.(oil quantities and intervals see MAINTENANCE LIST)

Remove the breather plug when exchanging the oil, but don't forget to put it on again after the oil exchange.

LAYOUT OF WINCH:



- 1 Gear oil filling
- 2 Rope fix point
- 3 Gearoil drainage plug at the rope drum
- 4 Gearoil drainage plug at at the drive
- 5 Breather
- 6 E—motor

Recommendation for service

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.

3.7. INSTRUCTIONS FOR USE OF CRANE ROPES

3.7.1. 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. If reeved in multi layers a Lang’s lay rope provides better wear resistant properties than a regular lay rope.

3.7.2. 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.

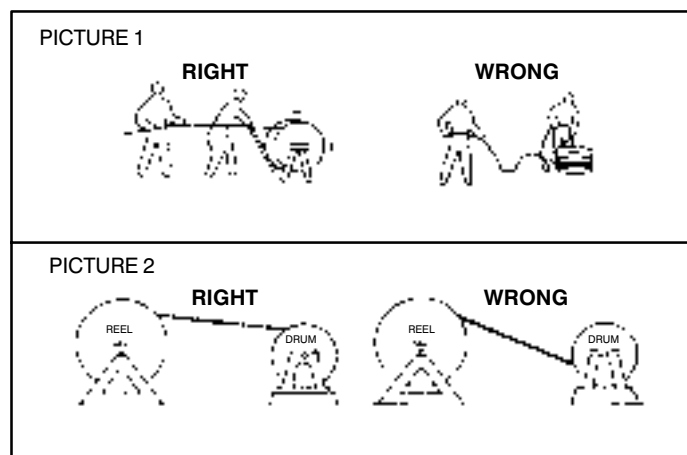
For the installation the new rope is fixed to the old rope still mounted or it is to be fixed to a auxiliary rope. Connection between the two ropes can be achieved either by a basket or two welded eyes. Any transmission of torsion from either the old or the auxiliary rope to the new rope must be definitively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



MAINTENANCE

3.7.3. 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 seldomly used or not used at all, ropes have to be unreeled 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.

3.7.4. 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 behaviour 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 shockloads 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.

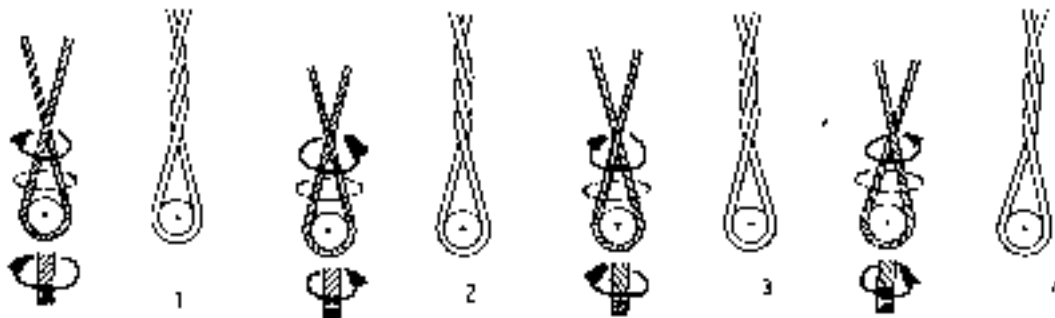
3.7.5. INSTRUCTIONS FOR UNTWISTING OF HOIST ROPES

- 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 continuous 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.

MAINTENANCE

3.7.6. 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 (pict. 1)
- Basketlike distortions
- Hair–pin type extrusion of wire or groups of wire (pict. 3)
- Decrease of rope diameter by 15 % against nominal diameter of rope or by 10 % if there are signs of corrosion and / or abrasion (pict. 4)
- Loosening of rope structure (pict. 4)
- Local decrease of rope diameter (pict. 5)
- Bends and local crushing (pict. 6 + 8)
- Kinks or resulting permanent deformations (pict. 7)

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.



Picture 1



Picture 2



Picture 3



Picture 4



Picture 5



Picture 6



Picture 8

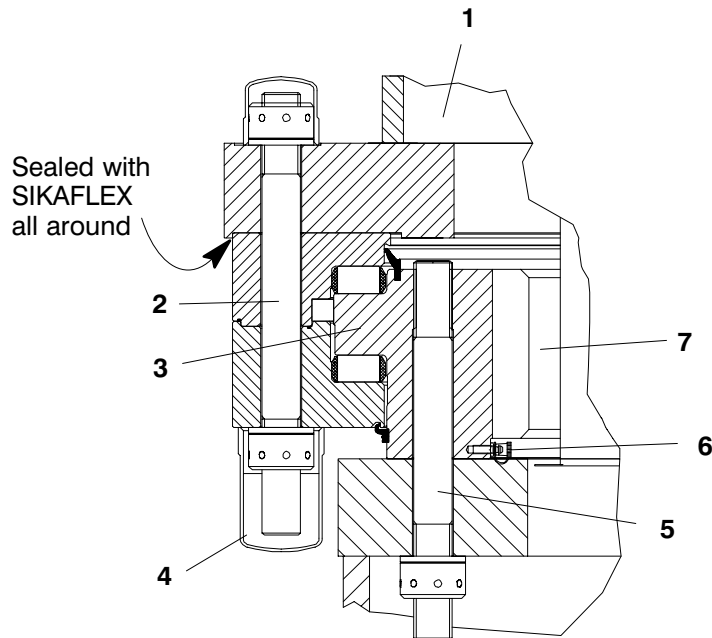


Picture 7

3.8. ROLLER SLEWING RING

The roller slewing ring connects the base column with the crane. It is equipped with hardened roller tracks and absorbs all vertical and horizontal forces as well as the tilt moment occurring during operation. The ring is attached by means of high tensile bolts. The pretension load for these bolts is shown on the sketch below.

The gear ring and the slewing pinion, which engages with the slewing ring are housed within the crane superstructure and protected against seawater.



Pretensioning load: **665 KN**

Pretensioning acc. to working-instruction: **QSA 09.601.00-xx**

Pretension jacking tool: **LWN 2-17-028 Idt.-No. 519618714**

- 1 Steel structure of slewing column
- 2 Outer bolt
- 3 Roller slewing bearing. Grease every 100 working hours
- 4 Protection cap (filled with grease)
- 5 Inner bolt
- 6 Grease nipple of roller slewing ring
- 7 Gear rim of roller slewing ring. Keep greased all the time !



IMPORTANT !

Gear rim (Pos 7): to be greased, we recommend to use **GREASE SP-F AVIA ALUPLEX 2 RHY**



IMPORTANT !

Bolts (Pos 2+5): thread greased, use no MOLYCOTES or GRAPHITIZED GREASES !

MAINTENANCE

3.9. MULTIPLE DISC BRAKES

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.

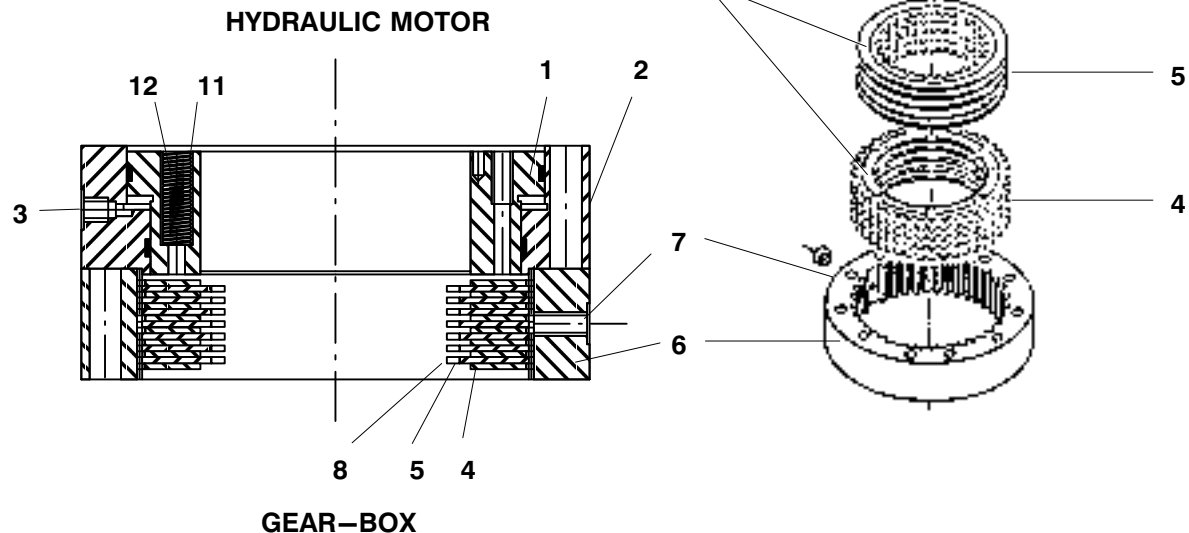
⚠ WARNING !

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 !

THE PROPER ARRANGEMENT OF THE DISCS AND SPRINGS IN THE BRAKES FOR THE WINCHES AS WELL AS FOR THE SLEWING GEAR ARE SHOWN IN THE CROSS SECTION DRAWINGS IN THE SPARE – PARTS – LIST OF THIS CRANE !

PRINCIPLE BRAKE LAYOUT:

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



3.10. REPLACEMENT OF ROPES

3.10.1. HOISTING WINCH

See also drawing ROPE REEVING PLAN in section DRAWINGS.



NOTE ! ONLY QUALIFIED AND AUTHORIZED SERVICE PERSONS ARE ALLOWED TO PERFORM MAINTENANCE OR SERVICE TO THE CRANE !



IMPORTANT !

PRIOR STARTING TO REPLACE THE ROPES READ CAREFULLY SECTION “**INSTRUCTIONS FOR USE OF CRANE ROPES**” (INSTALLATION, MAINTENANCE, INSPECTION, ETC.).
ALWAYS LOWER THE JIB INTO ITS REST POSITION FOR SAFETY REASONS !

- Always use adequate safety equipment (safety boots, safety gloves, hard hat)
- Disconnect auxiliary devices and lower the jib into its rest position (refer to part 2)
- It is advisable to discard the old rope first and install the new one afterwards
- Put hook block on deck and secure hoisting rope at rope fix point 1.
- Sufficient slack rope is required to allow disconnecting the rope from **rope fix point 1**.
- Use an auxiliary rope to lower hoisting rope to deck
- Drive hoisting winch in direction lowering until lower limit switch tripped to pull off the old rope to the front (sufficient space is required). Watch the rope on the drum.
- Bypass now the lower limit switch “lowering”.



IMPORTANT !

BYPASSING OF SAFETY DEVICES (LIMIT SWITCHES, ETC.) FOR SERVICE PURPOSES ONLY—TO BE PERFORMED BY QUALIFIED AND TRAINED PERSONAL !

- Continue spooling off the old rope until rope fix point 2
- Secure the rope at rope fix point 2
- Release hoisting rope from rope fix point 2 and connect a cable pulling strap (chinese fingers) on the rope
- Connect an auxiliary standard 'nylon rope' of adequate strength and length to the cable pulling strap
- Pull off the old hoisting rope to the front
- Disconnect the old rope from the cable pulling strap and connect new rope instead
- Use the auxiliary rope (nylon rope) and the pulling strap again to pull the new wire rope correctly into the system.



NOTE !

Any transmission of torsion from the auxiliary rope to the new rope must be definitively excluded.
Rotation-resistant ropes must be protected from torsion by inserted swivels.

- Secure the rope next to the drum
- connect the new rope to the rope fix points 1 and 2, pull the rope onto the drum till three (3) safety windings are on the drum, adjust (check) limit switch “lowering”.
- First a test-run of several lifts under unloaded load and partial load is required. Thus a flexible adaptation of the rope to bending direction and bending radii of pulleys and drum will be achieved. Check correct adjustments and function of all limit switches and all rope protection devices !

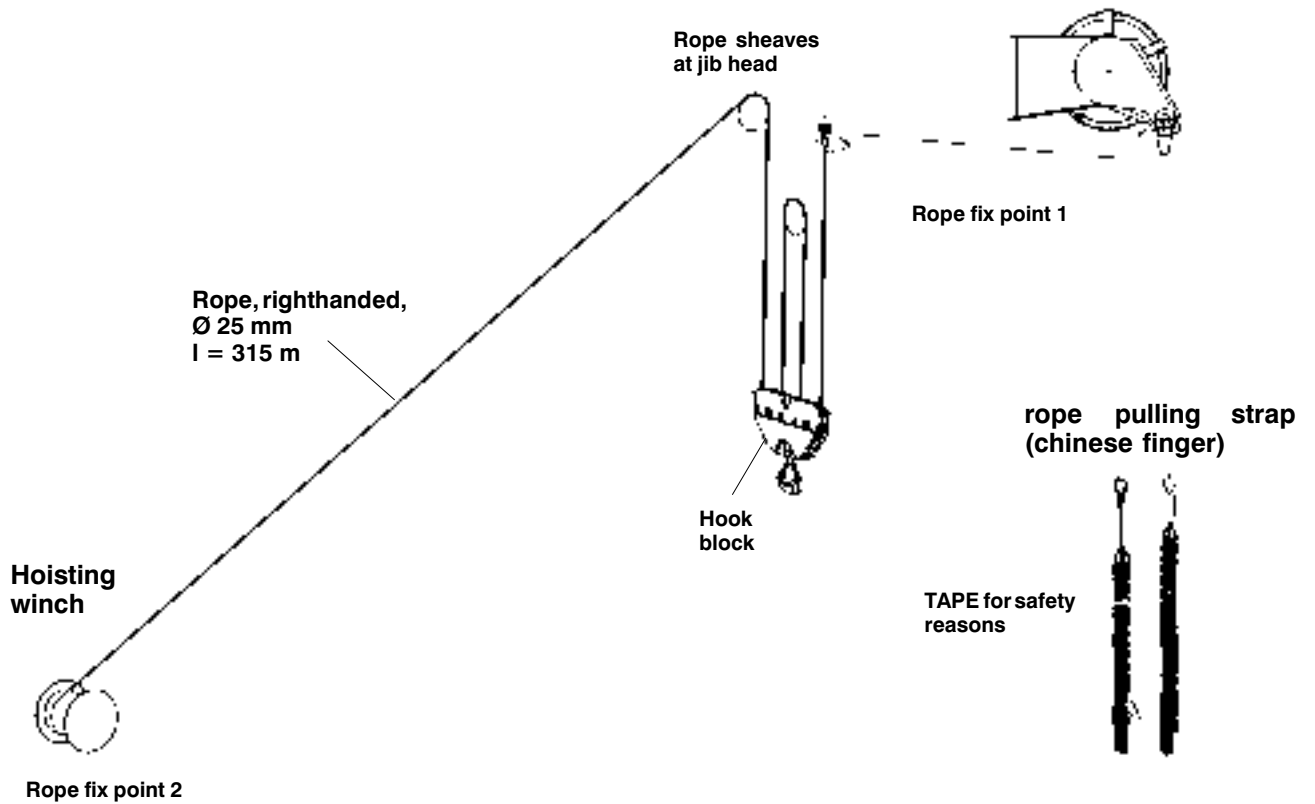


IMPORTANT !

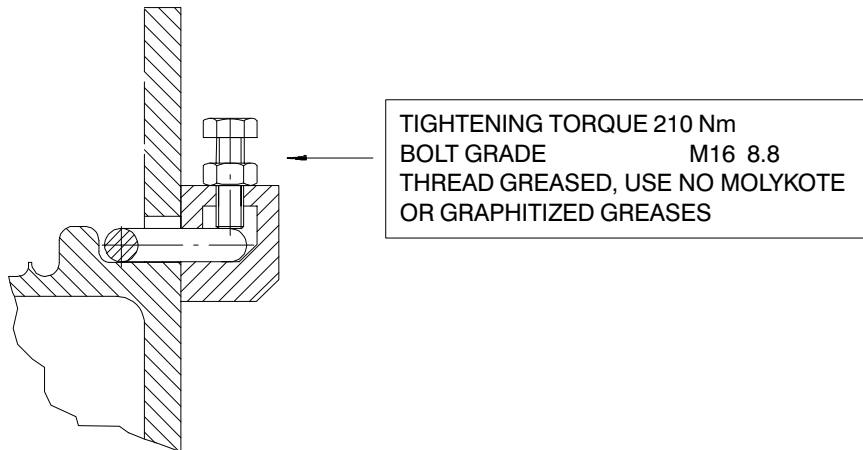
CHECK ALL SAFTY DEVICES AND LIMIT SWITCHES AFTER EACH REPLACEMENT OF ROPES!

MAINTENANCE

3.10.1.1. REEVING 4–FALL OPERATION



3.10.1.2. ROPE FIX POINT 2 (HOISTING WINCH)



IMPORTANT !

AFTER THE FIRST TEST–RUN OF SEVERAL LIFTS CHECK ROPE FIX POINTS, ROPE PULLEYS AND ROPE PROTECTION DEVICES AGAIN !



NOTE !

SHOULD YOU HAVE ANY QUESTIONS RELATING TO OPERATION, SERVICE, REPAIRS OR PARTS OF THE WINCH SYSTEM INSTALLED ON YOUR CRANE, PLEASE CONTACT THE **LIEBHERR CUSTOMER SERVICE**.

3.10.2. REEVING AUXILLIARY HOIST

See also drawing REEVING PLAN AUX. HOIST in section DRAWINGS.



IMPORTANT !

ONLY QUALIFIED AND AUTHORIZED SERVICE PERSONS ARE ALLOWED TO PERFORM MAINTENANCE OR SERVICE TO THE CRANE !



IMPORTANT !

PRIOR STARTING TO REPLACE THE ROPES READ CAREFULLY SECTION “**INSTRUCTIONS FOR USE OF CRANE ROPES**” (INSTALLATION, MAINTENANCE, INSPECTION, ETC.). **ALWAYS LOWER THE JIB INTO ITS REST POSITION FOR SAFETY REASONS !**

- Always use adequate safety equipment (safety boots, safety gloves, hard hat)
- Disconnect auxiliary devices (working cage) and lower the jib into its rest position
- It is advisable to discard the old rope first and install the new one afterwards
- Put hook on deck
- Drive aux. hoisting winch in direction lowering until lower limit switch tripped to pull off the old rope to the front (sufficient space is required). Watch the rope on the drum.
- Bypass now the lower limit switch “lowering”.



IMPORTANT !

BYPASSING OF SAFETY DEVICES (LIMIT SWITCHES, ETC.) FOR SERVICE PURPOSES ONLY – TO BE PERFORMED BY QUALIFIED AND TRAINED PERSONAL !

- Continue spooling off the old rope until rope fix point
- Secure the rope at rope fix point next to the drum
- Release hoisting rope from rope fix point and connect a cable pulling strap (chinese fingers) on the rope
- Connect an auxiliary standard ‘nylon rope’ of adequate strength and length to the cable pulling strap
- Pull off the old hoisting rope to the front
- Disconnect the old rope from the cable pulling strap and connect new rope instead
- Use the auxiliary rope (nylon rope) and the pulling strap again to pull the new wire rope correctly into the system.



NOTE !

Any transmission of torsion from the auxiliary rope to the new rope must be definitively excluded. Rotation-resistant ropes must be protected from torsion by inserted swivels.

- Secure the rope next to the drum
- Connect the new rope to the rope fix point, pull the rope onto the drum till three (3) safety windings are on the drum, adjust (check) limit switch “lowering”.
- First a test-run of several lifts under unloaded load and partial load is required. Thus a flexible adaptation of the rope to bending direction and bending radii of pulleys and drum will be achieved. Check correct adjustments and function of all limit switches and all rope protection devices !

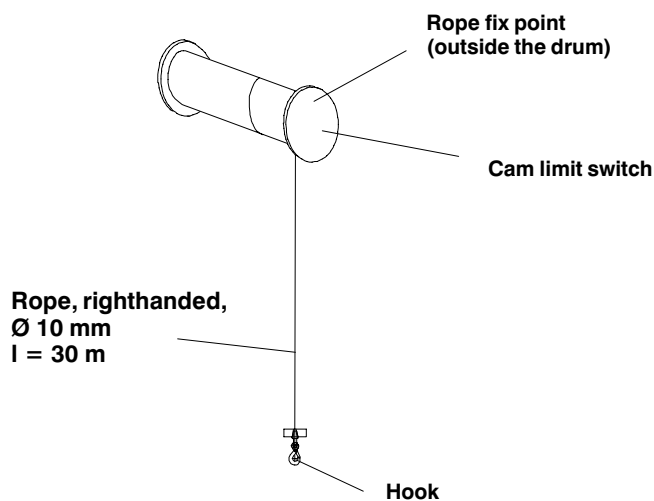


IMPORTANT !

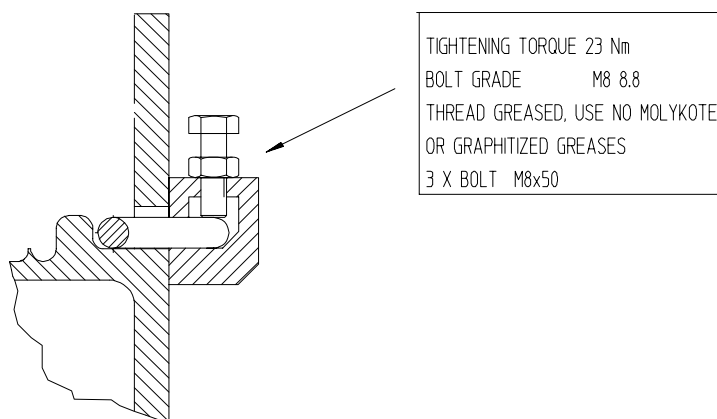
CHECK ALL SAFTY DEVICES AND LIMIT SWITCHES AFTER EACH REPLACEMENT OF ROPES!

MAINTENANCE

3.10.2.1. LAYOUT OF REEVING



3.10.2.2. ROPE FIX POINT



IMPORTANT !

AFTER THE FIRST TEST-RUN OF SEVERAL LIFTS CHECK ROPE FIX POINT AND ROPE PROTECTION DEVICES AGAIN !



NOTE !

SHOULD YOU HAVE ANY QUESTIONS RELATING TO OPERATION, SERVICE, REPAIRS OR PARTS OF THE WINCH SYSTEM INSTALLED ON YOUR CRANE, PLEASE CONTACT THE **LIEBHERR CUSTOMER SERVICE**.

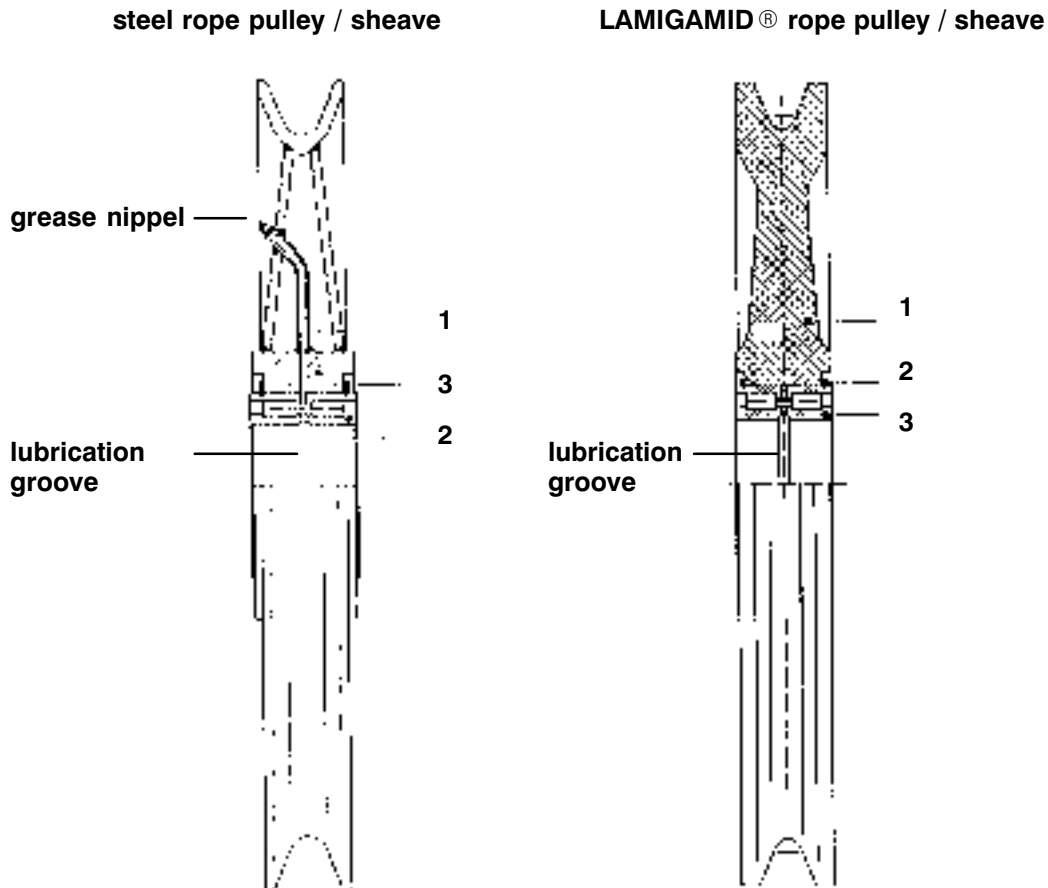
3.11. ROPE PULLEYS

3.11.1. 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

3.11.2. 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.

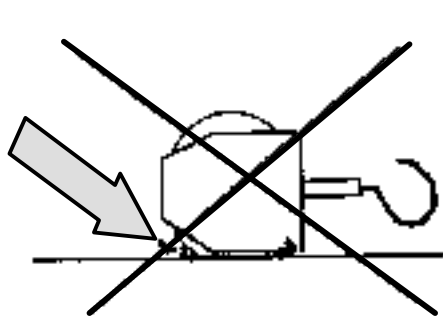
3.11.3. TRANSPORT

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

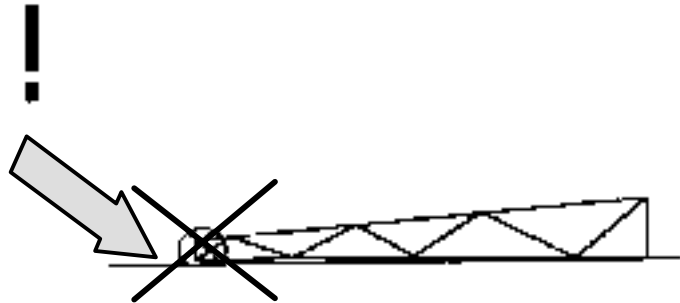
MAINTENANCE

3.11.4. DURING OPERATION

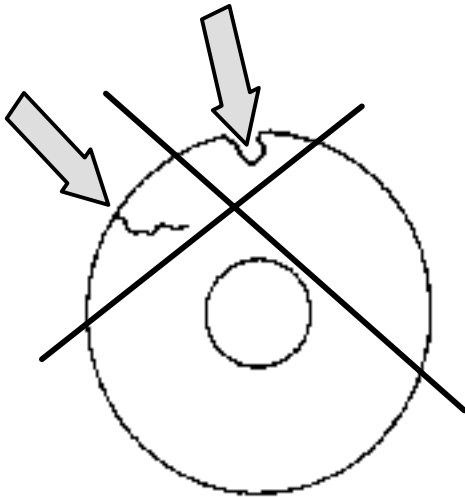
Rope pulleys are easily affected by external damage, i.e. they never should rub against the provided rope guard device, never to be layed down to ground without proper protection device. Thus could cause excessive wear to the components or even damaging the pulleys. Damaged pulleys must be replaced immediately.



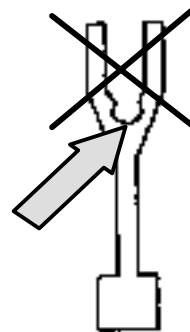
inexpert resting of hook block !



inexpert resting of jib tip !



broken !



worn out cable groove !

3.11.5. 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 !

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".

3.11.6. 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, kerosene, 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, hydrochloric acid, nitric acid)
- concentrated organic acids (i.e. formic acid)
- concentrated alkalines (i.e. sodium, potash lye or caustic potash)
- phenolic resin, phenolic plastic

MAINTENANCE

3.12. ELECTRICAL SYSTEM



3.12.1. 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 approximately every 3000 working hours.



NOTE !

CLEAN DUST FILTERS ON THE SWITCH CABINETS EVERY 3000 OPERATING HOURS. REPLACE DAMAGED OR CONTAMINATED FILTERS IMMEDIATELY.



NOTE !

BLOWN FUSES OR INDICATION LAMPS HAVE TO BE REPLACED IMMEDIATELY.

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.

3.12.2. 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 !

3.13. MAINTENANCE INSTRUCTIONS FOR SLIP RING UNIT



The slip ring is installed between SLEWING COLUMN and the PEDESTAL ADAPTOR.



NOTE ! ONLY QUALIFIED AND AUTHORIZED SERVICE PERSONS ARE ALLOWED TO PERFORM MAINTENANCE OR SERVICE TO THE SYSTEM !

3.13.1. TERMINAL BOX

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

3.13.2. 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 slip-ring 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.

3.13.3. 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.

3.13.4. CABLE INSULATION

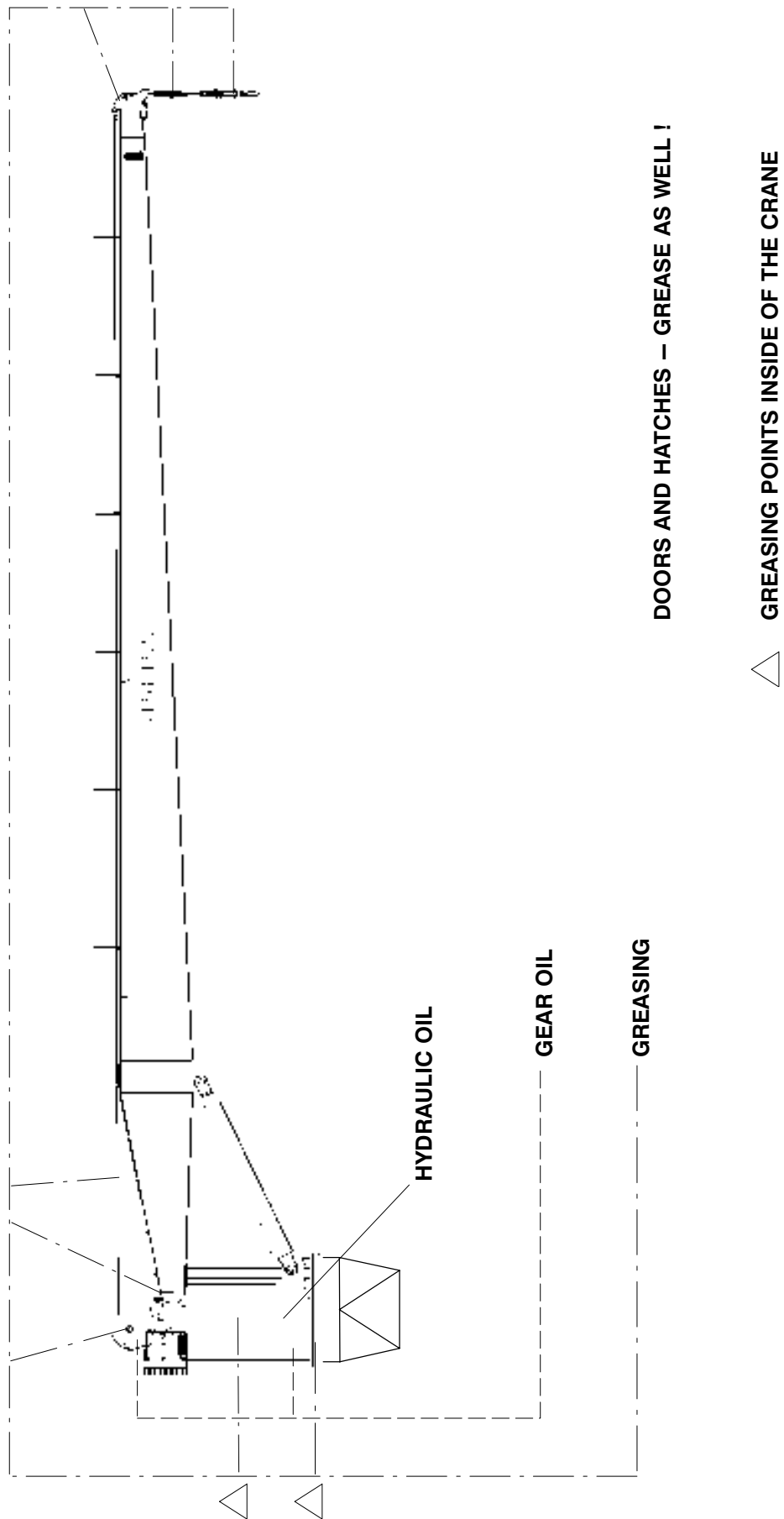
The cables have to be checked for any damages in insulation when carrying out an inspection.

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.

3.14. LUBRICATION AND GREASING DIAGRAM



3.15. MAINTENANCE LISTS

3.15.1. GENERAL INFORMATION

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.

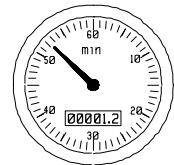


IMPORTANT !

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 then 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.

3.15.2. OVERVIEW MAINTENANCE INTERVALS

FIRST	100 HRS	resp. AFTER 2 WEEKS	<input type="checkbox"/>
FIRST	500 HRS	resp. AFTER 10 WEEKS	<input type="checkbox"/>
FIRST	1000 HRS	resp. AFTER 6 MONTHS	<input checked="" type="checkbox"/>
<hr/>			
EVERY	10 HRS	resp. DAILY	
EVERY	50 HRS	resp. WEEKLY	
EVERY	500 HRS	resp. EVERY 3 MONTHS	
EVERY	2000 HRS	resp. EVERY YEAR	<input checked="" type="checkbox"/>



operating hours counter
(switch box X1)

- Maintenance / Service shall be supervised by LIEBHERR SERVICE TECHNICIAN
- Maintenance / Service shall be carried out by LIEBHERR SERVICE TECHNICIAN

3.15.2.1. DISPOSAL OF USED MATERIALS



DISPOSAL !

When changing oil, grease, filter elements, batteries, etc. – used materials must be properly disposed of in accordance with the relevant state regulations. Contamination of soil, sewage and water systems must be avoided !

MAINTENANCE

3.15.2.2. 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– and Maintenance Instructions provided, and other documents, available when carrying out the operations to which they refer and to follow that documentation without fail,
- unauthorised 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 authorised by those responsible for the safety of the machine to carry out the particular task required and who are able to recognise 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.

3.15.3. FILLING QUANTITIES

FILLING QUANTITIES, appr. (liter)	1050 l					6 l	3 x 11,2 l	0,6 l		l	l	l					
SYSTEM	HYDR. OIL TANK					HOISTING WINCH	SLEWING GEAR BOX	WINCH FOR WORKING CAGE		GEAR RIM SLEWING RING	GREASING POINTS	ROPES					
Type of OIL																	
ATF or similar	■																
SAE, HDC or sim.					■	■	■										
GREASE																	
AVIALITH 2EP											□						
SP–F AVIA ALUPLEX 2											□		□				
Ca.–grease EP												□					

■ ... OIL


□ ...GREASE




NOTE !

See also details provided in section MAINTENANCE for each individual function group and TABLE OF LUBRICANTS !


3.15.8. FIRST 500 HRS / AFTER 3 MONTHS

FIRST 500 HRS / AFTER 3 MONTHS		CBW
Function Group	Work to be performed	see Section
CRANE COMPLETE	Checking for tight fit of all nuts, bolts <input type="checkbox"/> brackets, ladders, platforms	3.1, 3.2
GREASING SYSTEM	Regrease all grease points !	3.14
HYDRAULIC SYSTEM	Drive system to working temperature Take oil sample, if required change oil ; drain oil, clean complete tank inside	3.2.6, 3.5
FEED PRESSURE FILTER	Replace filter element	3.3, 3.3.2
OIL COOLER FILTER	Replace filter element	3.3, 3.3.2
RETURN FLOW FILTER	Replace filter element	3.3, 3.3.2
PRESSURE ADJUSTMENTS	Check pressures, adjustments if required <input checked="" type="checkbox"/>	
HOISTING WINCH SLEWING GEAR BOXES	Drive to temperature, take oil samples, if required renew oil to correct level. Before fitting new oil flush the gear boxes with a little pre- heated new oil in order to wash off any abrasives / contamination Check level after a short while again.	3.6, 3.6.2 3.6, 3.6.1
ROPES	Check condition and rope fix-points	3.8
ROPE PULLEYS	Check for any damages / wear	3.10
HOOK BLOCK	Regrease greasing points	3.11
ELECTRIC SYSTEM	Check correct fit of cables, sensors.	
LIGHTING SYSTEM	Check for completeness, correct function	
SLIP RING UNIT	Check screw connections, brushes	3.13
CONTROL PANELS	Check all functions and correct indication	2.4
FUNCTION TEST	Drive all functions, check safety devices	
<input type="checkbox"/> Shall be supervised by LIEBHERR SERVICE TECHNICIAN <input checked="" type="checkbox"/> Shall be carried out by LIEBHERR SERVICE TECHNICIAN		Operating hours:
 NOTE ! – FOR QUANTITIES OF OILS see section “Filling Quantities (3.15.3) “ – LUBRICANTS AND OILS should only be chosen from TABLE OF LUBRICANTS		
Date:	Name:	Signature:

3.15.9. EVERY 500 HRS / EVERY 3 MONTHS

EVERY 500 HRS / EVERY 3 MONTHS		CBW
Function Group	Work to be performed	see Section
CRANE COMPLETE	Visual check—up of steel structure, welds, brackets, ladders, platforms	3.1, 3.2
ELECTRIC SYSTEM	Check cable connections, sensors	
HOISTING WINCH	Check for correct oil level,	3.6.2
SLEWING GEAR BOXES	Check air breathers	3.6.1
GREASING SYSTEM	Regrease all greasing points, Check tightness of greasing lines / blocks	3.14
ROPES	Check condition and rope fix—points	3.8, 3.9
ROPE PULLEYS	Check for any damages / wear	3.10
LIGHTING SYSTEM	Check for completeness, correct function	
SLIP RING UNIT	Check screw connections, brushes, grease bearings	3.13
CONTROL PANELS	Check all functions and correct indication	2.4
HYDRAULIC SYSTEM	Drive system to working temperature Check oil level, Take oil sample Check leaktightness, clean radiator	3.2.6, 3.5
RETURN FLOW FILTER	Replace filter element	3.3, 3.3.2
FEED PRESSURE FILTER	Replace filter element	3.3, 3.3.2
OIL COOLER FILTER	Replace filter element	3.3, 3.3.2
FUNCTION TEST	Drive all functions, check safety devices	
		Operating hours:
 NOTE ! FOR QUANTITIES OF OILS see section “FILLING QUANTITIES” (3.15.3)		
Date:	Name:	Signature:

3.15.11. EVERY 2000 HRS / EVERY YEAR

EVERY 2000 HRS / EVERY YEAR		CBW
Function Group	Work to be performed	see Section
ROLLER SLEWING RING	Check correct torque of bolts <input type="checkbox"/>	3.11
HOISTING WINCH SLEWING GEAR BOXES	Drive to temperature, take oil samples, if required renew oil to correct level. Before fitting new oil flush the gear boxes with a little pre- heated new oil in order to wash off any abrasives / contamination Check level after a short while again.	3.6, 3.6.2 3.6, 3.6.1
HYDRAULIC MOTORS	Check wear of tooth profile <input checked="" type="checkbox"/>	
HYDRAULIC SYSTEM	Drive system to working temperature <input type="checkbox"/> Take oil sample, if required change oil ; Check leaktightness	3.2.6, 3.5
PRESSURE ADJUSTMENTS	Check pressures, adjustments if required <input checked="" type="checkbox"/>	
HYDRAULIC OIL TANK	Replace air breather filter	3.3.7, 3.16.2
ELECTRIC SYSTEM	Check cable connections, sensors Replace air filter element switch cabinet	
PRESSURE ACCUMULATOR	Replace (check) every 2 years <input checked="" type="checkbox"/>	3.4
ROPES	Check ropes for fatigue <input checked="" type="checkbox"/>	3.8
<input type="checkbox"/> Shall be supervised by LIEBHERR SERVICE TECHNICIAN <input checked="" type="checkbox"/> Shall be carried out by LIEBHERR SERVICE TECHNICIAN		Operating hours:
<p> NOTE ! – FOR QUANTITIES OF OILS see section “FILLING QUANTITIES” (3.15.3) – LUBRICANTS AND OILS should only be chosen from TABLE OF LUBRICANTS</p>		
Date:	Name:	Signature:

3.16. 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 the 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.)

3.16.1. HYDRAULIC CIRCUIT

QTY.	IDENT–No.	DESCRIPTION	NOTE
1	510658514	Filter element (A2 – feed pressure circuit)	500 hrs
1	510658514	Filter element (A22 – oil cooler circuit)	500 hrs

3.16.2. HYDRAULIC OIL TANK

QTY..	IDENT–No.	DESCRIPTION	NOTE
1	736877003	Filter element (A27 – return flow filter)	500 hrs
1	510713814	Filter element for air breather	2000 hrs

3.16.3. WIRE ROPE HOISTING AND LUFFING WINCH

QTY..	IDENT–No.	DESCRIPTION	NOTE
1	790223014	Hoist rope, right handed, galvan., diam. 25 mm, l = 315 m	*
1	790218114	Aux. winch rope, right handed, galvan., diam. 10 mm, l = 30 m	*

* for maintenance and discard criteria see section "ROPES"

MAINTENANCE

3.16.4. LUBRICANTS

QTY.	IDENT–No.	DESCRIPTION	
1	861301214	AVIALITH 2EP special paste in tins to 400 g (manual gr. gun)	
1	861301508	AVIA ALUPLEX 2RHY grease paste in tins 10 kg (for greasing of gear rims)	
1	774324203	Grease nipple DIN 71412 AM 10x1	
1	774324403	Grease nipple DIN 71412 CM 10x1	

For other products, type and specification see enclosed "LIEBHERR TABLE OF LUBRICANTS".

3.16.5. TESTING DEVICE

QTY.	IDENT–No.	DESCRIPTION	
1	750001114	Glycerine pressure gauge 0 – 60 bar	
1	750003414	Glycerine pressure gauge 0 – 400 bar	
1	510694314	Connection fitting for pressure gauge 1620	
20	885601814	Plastic syringe–cum–bottle–kit (Condition monitoring)	*

* one sample each for winch gear boxes, slewing gear boxes, distribution gearbox and hydraulic oil tank

3.16.6. SEALING COMPOUNDS AND SECURING COMPOUNDS

QTY.	IDENT–No.	DESCRIPTION	
1	870002014	Hylomar (for protection of screws, fittings, etc. installed outside)	
1	870001814	Dirko (high temperature resistant sealing compound)	
1	726425414	Sealing compound 'SIKAFLEX' in tins to 310 ml	
1	811202114	Loctite 242, 50 ccm	
1	862819203	Loctite 243, 250 ccm	
1	870001914	Loctite 572, 50 ccm	
1	870002114	Loctite 574, 250 ccm	
1	870002314	Loctite 586, 250 ccm	
1	870002414	Loctite 405, 50 ccm	

3.16.7. STANDARD TOOLS

QTY.	IDENT–No.	DESCRIPTION	
1	926365114	COMPLETE TOOL SET (STANDARD) INCL. TOOL BOX	
1	790042514	TOOL BOX 530 x 20, blue	
1	740814815	KNF–Vacuum pump complete with connection devices	



NOTE !

ALL STANDARD TOOLS SUPPLIED WITH THE CRANE ARE QUALITY TOOLS ACCORDING TO DIN–STANDARDS.

A COMPLETE LIST UP OF STANDARD SUPPLIED TOOLS, ADDITIONAL SAFETY DEVICES, etc. IS PROVIDED IN THE SPARE PART MANUAL.



NOTE !

ALL SPARE PARTS SEE SPARE PART BOOK

Schmierstofftabelle für

LIEBHERR

Schiffs- und Containerkrane

Offshorekrane

Seilbagger

Hafen-Mobilkrane

Table of lubricants for

LIEBHERR

Ship- and Container-Cranes

Offshore-Cranes

Cable Excavators

Harbour Mobile Cranes

LIEBHERR

LIEBHERR - Werk Nenzing GmbH

A-6710 Nenzing / Austria
Telefon 0043 - (0) 5525 - 606-0
Telefax 0043 - (0) 5525 - 606-20








LIEBHERR Sunderland Works

Ayres Quay, Deptford Terrace
Sunderland
Tyne and Wear, SR4 6DD
England / UK
Telefon 0044 - (0)191 - 514-3001
Telefax 0044 - (0)191 - 514-4191

Schmierstoffanforderungen / requirements of lubricants

Nummer Number	Schmierstellen Lubrication Points	Außentemperatur Outside-temperature	Typ / Type ISO VG / SAE	Spezifikation Specification
1.	Motor / Engine ¹⁾	ganzjährig / all the year bis / to - 10 °C	SAE 15W-40	ACEA E2 / E3 API CD / CE / CF-4
2.	Ölbadluftfilter Oilbath air cleaner	bis / to - 20 °C	SAE 10W-40	MIL-L-2104 C/D (SHPD)
3.	Mechan. Getriebe und Winden Mechan. gearboxes and winches	bis / to - 20 °C	SAE 90	API GL-5 MIL-L-2105 B
4.	Antriebsachsen Axles	bis / to - 25 °C	SAE 80W-90 SAE 80W-140	
5.	Hydrostatischer Antrieb Hydrostatic transmission	bis / to - 25 °C	ATF ³⁾	1. Typ A, Suffix A 2. DEXRON II D/E 3. DEXRON III
6.	Hydrolenkung Power steering	ganzjährig / all the year bis / to -20 °C ²⁾	SAE 10W-40	ACEA E2 / E3 API CD / CE / CF-4 MIL-L-2104 C/D
7.		bis / to -10 °C ²⁾	SAE 15W-40	
8.		bis / to - 15 °C ²⁾	ISO VG 46	DIN 51 524/2 Typ HLP / HLPD
9.		bis / to -25 °C ²⁾	ISO VG 46	VDMA 24 568 / Typ HEES schnell biologisch abbaubar quickly biodegradable
9.	Wälzlager - Anti-friction bearings, Gleitlager - Plain bearings Kugel- bzw. Rollendrehkränze Ball resp. Roller shewing rings, Kardangelenke - cardan shafts, sonstige Fettschmierung other greasing points	alle Bereiche all sections	Mehrzweckfett Lithium verseift Multipurposegrease Lithium based	DIN 51 825, NLGI 2 KP 2 K-30 KPE 2 K-30
10.	Offene Zahnräder und Zahnkränze Open gears and geared rims	alle Bereiche all sections	Schmier- und Konservierungsmittel Lubricant and preservative	DIN 51 502 OGPF 0, -1, -2
11.	Seile ⁵⁾ Ropes ⁵⁾	alle Bereiche all sections	Schmierfett + EP (Calcium) Lubricating grease + EP (Calcium)	DIN 51825, NLGI 2 KP 2 G-30
12.	Schmierstellen ü. Schmierleitungen Points greased through pipes	alle Bereiche all sections	Spezialfett (Lithium) Special grease (Lithium)	DIN 51 502, NLGI 00 MPE 00 E-40

- 1) Die Vorschriften des Motorenherstellers (siehe Betriebsanleitung) sind verbindlich! / The instructions of the manufacturer are obligatory (pay attention to the manual)!
- 2) Bei laufender Stillstandsheizung können die Außentemperaturen um ca. 15 °C tiefer liegen. / With heating of crane in operation outside temperatures could be appr. 15 °C lower.
- 3) Für Seilbaggerhydraulik zwingend vorgeschrieben / For cable excavator hydraulics strictly applied
- 4) Schnell biologisch abbaubar / quickly biodegradable
- 5) Siehe auch Betriebsanleitung ! / See also the operating manual!

LIEBHERR Für die Schmierung unserer Schiffs- und Containerkrane, Offshorekrane, Seilbagger und Hafen-Mobilkrane empfehlen wir die nachstehend aufgeführten oder nachweislich gleichwertigen Betriebsstoffe. We recommend the following products or those of proven equivalent quality for use when lubricating our Ship- and Container-Cranes, Offshore-Cranes, Cable Excavators and Harbour Mobile Cranes.							
Nummer Number							
1.	Agip BLITUM T Agip SIGMA TURBO Agip MULTIFLEET Agip PROF I	Aral Multi Turboral SAE 15W-40 Aral Plus Turboral SAE 15W-40	AVIA MULTI HDC PLUS AVIA MULTI HDC EXTRA AVIA MULTI HDC 15W-40	Vanellus C 3 Extra Vanellus Multigrad	Castrol Turbomax Castrol RX Super Plus 15W/40	Chevron RPM Heavy Duty Motor Oil SAE 15W-40 *) Chevron Delo 400 Multigrade SAE 15W-40	ELF PERFORMANCE TROPHY 15W-40 PERFORMANCE 3 D 15W-40 PERFORMANCE XR 15W-40
2.	Agip SIGMA TFE Agip SIGMA SUPER TFE Agip SIGMA ULTRA TFE	Aral Extra Turboral SAE 10W-40 Aral High Turboral SAE 10W-40 Aral Mega Turboral SAE 10W-40	AVIA TURBOSYNTH HT-E 10W-40 AVIA TURBOSYNTH 10W-40 AVIA MULTI CFE PLUS 10W-40 AVIA MULTI CFE 10W-40	Vanellus HT Extra Vanellus HT Vanellus FE Extra Vanellus FE	Castrol RX Super 15W/40	Chevron RPM Heavy Duty Motor Oil SAE 15W-40 *) Chevron Delo 400 Multigrade SAE 15W-40	ELF ECOMAX FE PLUS 10W-40 ELF ECOMAX FE 10W-40 ELF PERFORMANCE EXPERTY 7,5W-40
3.	Agip ROTRA MP DB	Aral Getriebeöl HYP SAE 85W-90	AVIA HYPOID 90 EP	Energear Hypo 90	Castrol EPX 90 Castrol Hypoy B EP 90		TRANSELF TYP B SAE 90
4.	Agip ROTRA MP 80W-90 Agip ROTRA MP 85W-140	Aral Getriebeöl HYP SAE 85W-90 Aral Getriebeöl HYP SAE 85W-140	AVIA SYNTOGEAR FE 80W-90 AVIA HYPOID FE 80W-140	Energear HT Energear FE	Castrol EPX 80W/90 Castrol Hypoy B EP 80W/90 Castrol Hypoy B EP 80W/140	*) Chevron Delo Gear Lubricant SAE 80W-90 *) Chevron Delo Gear Lubricant SAE 85W-140	TRANSELF TYP B SAE 80W-90 TRANSELF TYP B SAE 85W-140
5.	1. Agip ROTRA ATF 2. Agip ATF D Agip ATF D 309 Agip ATF II E 3. Agip ATF III D	1. Aral Getriebeöl ATF 22 2. Aral Getriebeöl ATF E-S 3. Aral Getriebeöl ATF 55	1. AVIA FLUID ATF 66 M 2. AVIA FLUID ATF 92 S AVIA FLUID ATF 86 3. -	1. Autran ATF 2. Autran DX II 3. Autran DX III	1. - 2. Castrol TQ Dexron II 3. -	1. - 2. - 3. Chevron Automatic Transmission Fluid	1. ELF TRANS-O-MATIC 2. ELFMATIC G 2 3. ELFMATIC G 3
6.	Agip SIGMA TFE Agip SIGMA SUPER TFE Agip BLITUM T Agip SIGMA TURBO Agip MULTIFLEET	Aral Extra Turboral SAE 10W-40 Aral Multi Turboral SAE 15W-40	AVIA MULTI CFE 10W-40 AVIA MULTI HDC 15W-40	Vanellus FE Vanellus C 3 Extra	Castrol RX Super 10W/40 Castrol Turbomax Castrol RX Super Plus 15W/40	Chevron RPM Heavy Duty Motor Oil SAE 15W-40 *) Chevron Delo 400 Multigrade SAE 15W-40	ELF ECOMAX FE PLUS 10W-40
7.	Agip OSO 46 Agip ARNICA 46 Agip OSO D 46	Aral Vitam GF 46 Aral Vitam DE 46	AVIA FLUID RSL 46 AVIA FLUID HLPD 46	Energol HLP 46 Energol HLP-D 46	Castrol Hyspin AWS 46 Castrol Hyspin AWH-M 46 Castrol Hyspin SP 46 Castrol Hydrauliköl HLPD 46 SF	Chevron Mechanism LPS 46 Chevron Hydraulic Oil AW MV 46	ELFOLNA 46 ELFOLNA DS 46 ELFOLNA HLPD 46
8.	Auf Anfrage bei Liebherr Only on request at Liebherr						
9.	Agip GR MU EP 2 Agip Longtime - Grease 2 Agip GREASE 30 AUTOL TOP 2000	Aral Langzeitfett H Aralub HLP 2 Aralub BAB EP 2	AVIALITH 2 AVIALITH 2 EP AVIA SYNTOGREASE 2 4)	Energear LS-EP 2 Biogrease EP 2	Castrol Spherol AP 2 Castrol LZV-EP Castrol Spherol EPL 2 Grease	Chevron Dura-Lith Grease EP 2 Chevron Ulti-Plex Synthetic Grease EP	EPEXELF 2
10.	Agip FIN 332 F AUTOL Hochleistungs-Zahnradsspray	Aralub MK-Z 1	AVIA SYNTOTAC AVIA ALUPLEX 0 RHS AVIA ALUPLEX 2 RHY AVIA ALUPLEX RHS FLUID	Open Gear Grease No. 2	Castrol Spherol LMM Grease	Chevron Open Gear Lubricant 250 NC	ELF CARDREXA GR 1 - AL
11.	Agip GR PV 2 AUTOL TOP 2000	Aralub MKC 2	AVIACAL 2 LD		Castrol Spherol SX2 Grease	*) Chevron RPM Automotive Grease EP 2	ELF PALISSA 2
12.	AUTOL ZSA synth. AUTOL ZSA	Aral Fließfett N Aral Fließfett BAB 000	AVIALITH 000 Bio	Biogrease EP 00	Castrol CLS-Grease	*) Chevron Dura-Lith Grease EP 00	ELF MULTI BT 000








Die Schmierstoff- bzw. Betriebsstoffmengen sowie die Wartungsfristen sind aus der Betriebsanleitung ersichtlich!

For lubricant and fuel quantities and maintenance intervals, see operating manual!

*) Unter dieser Bezeichnung in den USA erhältlich / Under this brandname obtainable in the USA

Für die Schmierung unserer Schiffs- und Containerkrane, Offshorekrane, Seilbagger und Hafen-Mobilkrane empfehlen wir die nachstehend aufgeführten oder nachweislich gleichwertigen Betriebsstoffe.

We recommend the following products or those of proven equivalent quality for use when lubricating our Ship- and Container-Cranes, Offshore-Cranes, Cable Excavators and Harbour Mobile Cranes.

Nummer Number							
1.	ESSOLUBE TDS ESSOLUBE MHX ESSOLUBE XD-3+ Multigrade	FINA KAPPA EXTRA FINA KAPPA SUPRA	TITAN SUPER 1540 TITAN UNIVERSAL HD 1540 TITAN TRUCK 1540	Mobil Delvac 1 SHC (5W-40) Mobil Delvac XHP (10W-40)	Shell Myrina X Shell Rimula TX	URSA SUPER LA 15W-40 *) URSA PREMIUM TDX 15W-40	VERKOPLUS 15W40 SHPD VERKOL TURBO SHPD 15W40
2.	ESSO HD 156 ESSOLUBE TDX ESSOLUBE LDX	FINA KAPPA ULTRA FINA KAPPA FE	TITAN UNIVERSAL 1040 MC TITAN CARGO MC SAE 10W-40 TITAN CFE 1040 MC	Mobil Delvac 1400 Super	Shell Myrina TX 10W-40	URSA SUPER TDX 10W-40	
3.	ESSO GEAR OIL GX-D 85W-90	FINA PONTONIC MP 80W-90, 85W-90 FINA PONTONIC FDL 75W-90, 80W-90	TITAN SUPER GEAR 8090 MC TITAN GEAR HYP SAE 85W-90	Mobilube HD 85W-90-A	Shell Spirax MB 90	GEARTEX EP-B 90	MYSTIK JT-7 SAE 90 EP
4.	ESSO GEAR OIL TDL 80W-90 ESSO GETRIEBEOEL GX 85W-140	FINA PONTONIC MP 80W-90 FINA PONTONIC FDL 75W-90, 80W-90	TITAN SUPER GEAR SAE 80W-90 TITAN SUPER GEAR SAE 85W-140	Mobilube HD 85W-90-A Mobilube SHC 75W-90 LS Mobilube HD 85W-140	Shell Spirax AX 80W-90 Shell Spirax HD 85W-140	GEARTEX EP-C 80W-90 / 80W-140 *) MULTIGEAR EP 80W-90 / 85W-140	MYSTIK JT-7 80W90 MYSTIK JT-7 85W140
5.	1. ESSO ATF TYPE SUFFIX A 2. ESSO ATF D (21611) ESSO ATF LDS 3. ESSO ATF F-30320	1. FINA PURFIMATIC FLUID 2. FINAMATIC II D-22233 FINAMATIC II D-22307 FINAMATIC S 6726 3. FINAMATIC HP	1. RENOLFLUID TF 20 2. RENOLFLUID 3000 3. TITAN ATF 4000	1. Mobil ATF 200 2. Mobil ATF 220 3. Mobil ATF	1. Shell Donax TM 2. Shell Donax TA 3. Shell Donax TX (F - 30366)	1. TEXAMATIC 1585 2. TEXAMATIC 4261 TEXAMATIC 4011 3. TEXAMATIC 7045 *) HAVOLINE ATF DEXRON III	1. VESTA AS-A 2. VESTA TD-2 3. -
6.	ESSO HD 156 ESSOLUBE TDX ESSOLUBE LDX ESSOLUBE TDS ESSOLUBE MHX	FINA KAPPA FE 10W-40 FINA KAPPA SUPRA 15W-40	TITAN UNIVERSAL 1040 MC TITAN UNIVERSAL HD 1540	Mobil Delvac XHP Mobil Delvac 1400 Super	Shell Myrina TX Shell Myrina X Shell Rimula TX	URSA SUPER TDX 10W-40 URSA SUPER LA 15W-40 *) URSA PREMIUM TDX 15W-40	VERKOPLUS 15W40 SHPD VERKOL TURBO SHPD 15W40
7.	NUTO H 46 HLPD-OEL 46	FINA HYDRAN TS 46 FINA HYDRAN HLP-D 46	RENOLIN B 15 RENOLIN MR 15	Mobil DTE 25 Hydraulikoel HLPD 46	Shell Tellus Oil 46 Shell Tellus Oil DO 46 Shell Tellus Oil TD 46	*) RANDO HD 46 ALCOR DD 46 *) RANDO HDZ 46	VESTA HLP-46 VESTA HLPD-46
8.	Auf Anfrage bei Liebherr Only on request at Liebherr						
9.	BEACON EP 2 RONEX MP-D RONEX MP *)	FINA MARSON EPL 2 FINA LICAL EP 2 FINA BIOLICAL EPS 2 4)	LAGERMEISTER EP 2 STABYL ECO EP 2	Mobilgrease HP 222 Mobilux EP 2	Shell Retinax EP2 Shell Alvania EP(LF)2	*) MULTIFAK EP 2 MULTIFAK 20 MULTIFAK T EP 2 *) MULTIFAK ALL PURPOSE 2	VERKOL RS-2 VERKOL EPX-2 ATLANTA
10.	CAZAR K 1	FINA CERAN AD FINA CERAN WR 2	CEPLATTYN 300 CEPLATTYN KG 10 HMF	Mobiltec 81 Mobiltemp 78	Shell Fett S.8327	*) CRATER PREMIUM 0 und 2	COBERTONE-00 COBERTONE-0 COBERTONE-1
11.	NEBULA EP 2	FINA CERAN WR 2 FINA CERAN AD (NLGI-0)	CEDRACON 95/100 N CEPLATTYN ECO 300	Mobilplex 47	Shell Rhodina EP(LF)2	*) CRATER PREMIUM 2	MYSTIK JT-6 MYSTIK JT-6-E
12.		FINA MARSON ZS	STABYL ECO 00		Shell Retinax CSB00	MULTIFAK 6833 EP 00 STARFAK EP 00	VERKOL EPX-00 CENTRALUB GR-00

Die Schmierstoff- bzw. Betriebsstoffmengen sowie die Wartungsfristen sind aus der Betriebsanleitung ersichtlich!

For lubricant and fuel quantities and maintenance intervals, see operating manual!

*) Unter dieser Bezeichnung in den USA erhältlich / Under this brandname obtainable in the USA

Diese Gesellschaften unterhalten einen Schmier-technischen Dienst, dessen Ingenieure auf Anforderungen in allen Schmierungsfragen zur Verfügung stehen.

These companies maintain a Technical Service whose engineers shall be glad to render assistance on all problems connected with proper lubrication of all machine parts.



Agip Schmier-technik GmbH, Würzburg
 und Agip - Vertriebspartner
 Im Ausland: Die Agip - Gesellschaften in der ganzen Welt
 Agip Companies all over the world



Aral Lubricants GmbH, Bochum
 Im Ausland Aral - Vertriebsgesellschaften in der ganzen Welt
 Agencies of Aral all over the world



AVIA Mineralöl-AG, München
 AVIA - Gesellschaften in Europa
 AVIA Companies in European countries



BP OIL Deutschland GmbH, Hamburg
 und ihre Niederlassungen
 Im Ausland: Die BP - Gesellschaften in der ganzen Welt
 BP Companies all over the world



THE BURMAH OIL (DEUTSCHLAND) GmbH
 Castrol Marine Division
 Im Ausland: Die BURMAH - CASTROL Gesellschaften in der ganzen Welt
 Overseas: THE BURMAH - CASTROL Companies all over the world



CHEVRON GERMANY INC., Hamburg, MARINE ABTEILUNG
 Die Chevron - Gesellschaften in der ganzen Welt
 Chevron Companies all over the world



ELF Mineralölwerk Osnabrück GmbH, Osnabrück
 Im Ausland: Die ELF - Gesellschaften in der ganzen Welt
 ELF Companies all over the world



ESSO A.G., Hamburg
 und ihre Vertretungen
 Im Ausland: Die ESSO / EXXON Gesellschaften in der ganzen Welt
 ESSO / EXXON Companies all over the world



FINA Deutschland GmbH, Frankfurt am Main
 Im Ausland: PETROFINA - und FINA - Gesellschaften in der ganzen Welt
 PETROFINA - und FINA - Companies all over the world



FUCHS LUBRITECH GMBH, Weilerbach
FUCHS AUSTRIA SCHMIERMITTEL Ges. m. b. H., A - Bergheim bei Salzburg
 Vertretungen und Lizenzfertigungen in Europa und Übersee auf Anfrage
 Addresses of representatives and licencees in Europe and overseas upon request



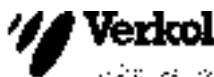
Mobil Oil AG, Hamburg
 Im Ausland: Die Mobil Oil Gesellschaften in der ganzen Welt
 Mobil Oil Companies all over the world



Deutsche Shell Aktiengesellschaft, Hamburg
 Im Ausland: Die Shell Gesellschaften in der ganzen Welt
 Shell Companies all over the world



TEXACO Deutschland GmbH, Düsseldorf
 Im Ausland: TEXACO - und CALTEX - Gesellschaften in der ganzen Welt
 TEXACO and CALTEX Companies all over the world



VERKOL Spain, Vera de Bidasoa (Navarra)
 VERKOL - Gesellschaften in Europa
 VERKOL Companies in European countries