Address of supplier

LIEBHERR CONTAINER CRANES LTD
Fossa
Killarney
Co. Kerry
Ireland

Product identification

Rubber Tyre Gantry Crane
Type: RTG 6/5/4/WS(E)
Drawing No.: 1096

Document identification

Manual number: RT8081
Author:
Document version: 01/06
MANUAL SECTIONS

A. TECHNICAL CHARACTERISTICS
   PRODUCT DESCRIPTION

B. SAFETY REGULATIONS

C. OPERATING INSTRUCTIONS
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THE MANUAL

The present RTG operating instructions and driver's manual enable the user/operator to familiarise himself with the safety, function and operation of the RTG. RTG drivers must not operate this crane without a knowledge and understanding of all these instructions, which must be carefully adhered to. Only then can satisfactory and safe operation of the crane be achieved and the best possible duty and service be obtained from the RTG. It is strongly recommended that one copy of the operating manual is stored in the driver's cabin or made available to the driver so that at any time, the driver can consult the manual. The crane must not be operated with any defective or damaged part. Should the RTG driver note a malfunction of any part, device or system, he must immediately report it to the appropriate department or person for investigation.

Any person working on the RTG must follow these operating instructions and in particular, the safety instructions. Operating staff must have access to these operating instructions and the mechanical and electrical manuals at any time, whilst keeping them in easy reach at the site of operation. It is recommended that both owner and operator should keep a copy at hand and avail themselves of the information contained therein, in order to obtain the best possible service from the RTG.

The drivers should be familiar with the contents of the Manual and be given adequate time to become fully conversant with all aspects of the RTG before beginning operation for the first time. Particular attention should also be paid to the section - "Operating Instructions", as this will provide valuable information on understanding the RTG. A comprehensive knowledge of the components will help the driver to get the maximum usage from the crane operation and enable him to give valuable information to the maintenance personnel.

Always consult the manual before carrying out any work on the RTG.

The sections dealing with maintenance and lubrication should be understood and complied with by those responsible for these matters.

The repair of minor faults is usually simple and can be done by any trained personnel. With the more complicated parts of this machine however, an inexperienced repairman can cause a considerable amount of damage. It is suggested therefore, that the repairs be done by a Liebherr Service Engineer.

Apart from the safety instructions pertaining to this equipment, the rules and regulations applicable at the operation site, as well as the rules for the prevention of accidents have to be observed. Such regulations may also provide for the handling of hazardous substances or for wearing protective clothing. Comprehensive Parts Lists are included in the manual for reference when ordering Spare Parts or replacements. The drawings, photographs reproduced in the manual are for the purpose of illustrating various points in the text or to assist in identifying spare parts. They need not
necessarily agree exactly with the actual constructional details of the parts involved. In order to avoid mistakes, it is advisable to use only the terms and expressions used in these instructions.

When ordering spare parts, the following information is required:

1. RTG Model
2. RTG Work No.
3. Year of Manufacture
4. Group Heading
5. Description of Part(s)
6. Order No. of Part(s) *
7. Quantity of parts required.

The information in this manual is provided for the benefit of the user and while every care has been taken to ensure that the information contained herein is correct, no liability can be accepted for any loss or damage which may occur due to omission or error, or to misinterpretation of the contents.

The manufacturer reserves the right to make any such alterations to this manual, as experience or technical advances may indicate without prior notice.

* In the case of the computer printed Parts List included in this Manual, please quote the eight or nine digit figure.

TOOL LIST

RT 80 is provided with a standard set of tools (see tool list TL037).

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A.

TECHNICAL CHARACTERISTICS

PRODUCT DESCRIPTION

RTG TYPE 6/5/4/WS(E)
CRANE WORK NOS. RT 80/81
DRAWING NO.: RT 1096

RTG GENERAL INFORMATION

LIEBHERR RUBBER TYRED GANTRY CRANE MODEL
RTG 6/5/4/WS(E)

is destined for the stacking and handling of ISO containers size 20' and
40' in container terminals and designed to stack one over five containers
(max. height 9' 6") and to span six rows of container plus one truck lane.

A telescopic spreader is provided, this is attached directly to the ropes.
The spreader is capable of handling 20 ft. and 40 ft. containers in single
lift mode. Four fixed side guides are provided, these also allow the
handling of 'pallet wide' containers.

The crane is designed for independent operation with diesel generator
power source mounted on the RTG.

The Liebherr RTG can perform the following operations:

- Transfer a 40.6 tonne container from a stack or ground position to
  a truck chassis, railroad flat car or a ground position and vice
  versa. Simultaneous hoisting, trolley-travelling and " inching" in
gantry travel direction is possible with a container load.

- Gantry travel, at reduced speed and trolley travel while carrying
  loads up to 40.6 tonnes.

- Gantry travel, at full speed and trolley travel with empty spreader.

- Turn its wheels through 90º for the purpose of travelling to other
  stack lanes or to other designated areas, without load, at a reduced
  speed.

- Set its wheels to perform a 180º spin turn about its own vertical axis
  at a reduced speed.

- The RTG is accessible via ladders, stairs and platforms for easy
  access to driver's cabin, main beam, trolley and maintenance
  points.

The crane structure and its mechanical and electrical equipment is
designed to allow safe crane operation up to a wind speed of 72 km/h.
LEGEND for following technical summary
**TECHNICAL SUMMARY SPECIFICATION**

<table>
<thead>
<tr>
<th>TECHNICAL SPECIFICATION FOR</th>
<th>RUBBER TYRED GANTRY CRANE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODEL</strong></td>
<td>RTG 6/5/4/WS(E)</td>
</tr>
<tr>
<td><strong>WORK NO.</strong></td>
<td>RT 80/81</td>
</tr>
<tr>
<td><strong>DESIGN</strong></td>
<td>acc. to FEM</td>
</tr>
<tr>
<td><strong>Classification</strong></td>
<td>U 7 – Q 2 – A 7</td>
</tr>
<tr>
<td><strong>S.W.L.</strong></td>
<td>40.6 tonnes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>DIMENSIONS</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gantry span d</td>
<td>23.56 m.</td>
</tr>
<tr>
<td>Wheel gauge e</td>
<td>9.20 m.</td>
</tr>
<tr>
<td>Lifting height above surface of paved track h</td>
<td>0.0 – 18.10 m.</td>
</tr>
<tr>
<td>Total trolley travel path c</td>
<td>18.46 m.</td>
</tr>
<tr>
<td>Trolley rail span f</td>
<td>6.40 m.</td>
</tr>
<tr>
<td>Overall width of RTG i</td>
<td>25.25 m.</td>
</tr>
</tbody>
</table>

| **Overall length over personnel guards k** | 13.30 m.                   |
| **Travel bogie width from track centreline** |                             |
| Inside                                   | 0.80 m / 0.80 m.            |
| Outside                                  | 0.95 m / 0.80 m.            |
| **No. of travel wheels**                 | 16                          |
| **Max. yard slope**                      | 2:100                       |
| **Trolley end approach a/b**              | 2.550 / 2.550 m.            |

**DRIVE SYSTEMS AND SPEEDS**

- **Hoist drive system**
  - 1 x 190 kW A.C. motor with A.C. speed control.
  - Load / speed range: 28 m./min. - 47.60 tonnes, 56 m./min. - 7.00 tonnes

- **Trolley drive system**
  - 1 x 28 kW A.C. motor with A.C. speed control.
  - 2 trolley wheels are driven.
  - Speed: 70 m./min. (with / without load)

- **Gantry travel drive system**
  - 4 x 35 kW A.C. motors with A.C. speed control.
  - Speed: 120 m./min. without load, 60 m./min with load up to 40.6 tonnes, 60 m./min. cross travel without load, 30 m/min spin turn without load.

**HYDRAULIC SYSTEMS**

- Operating pressure: 140 bar

**POWER SUPPLY**

- **Main Diesel Generator Set**
  - Generator Set Rating: 400 KVA
  - Operating Voltage / Frequency: 480 V / 60 Hz.
  - Engine Output: 320 kW
  - Diesel Fuel Tank Capacity (usable): 1000 Litres
  - Governor Type: Electronic
  - Control Panel: 110 V. A.C. / 24 V. D.C.
  - Starting: Remote / Local

- **Auxiliary Diesel Generator Set**
  - N/A
B SAFETY

This chapter contains

B 1. Basic Safety Information
B 2. Particular Safety Rules for Operating the Liebherr Container Crane
B 3. Safety Instructions
B 4. Environmental Protection
B 5. Safety for Service, Repair & Maintenance
B 6. Emergency Features
B 1.

BASIC SAFETY INFORMATION

WARNING

It is important to read and understand all safety instructions provided in our LCC container crane manuals. Improper operation or maintenance could result in a serious accident, or damage to the equipment, causing injury or death.

The Liebherr RTG 6/5/4/WS(E) has been built in accordance with relevant standards, safety rules and regulations. Nevertheless, failure to observe safe operating procedures may constitute a risk to life and limb of port personnel or third parties, or could cause damage to the RTG or other material.

The Liebherr RTG must only be used in perfect condition in accordance with its designated use and the instructions set out in the operation manual and only by safety conscious persons who are fully trained and aware of the risks involved in operating the RTG. Any functional disorders, especially those affecting the safety of the RTG should therefore be rectified immediately.

The RTG is designed exclusively for stacking and loading 20/40ft. ISO containers and always for straight vertical lifts. Using the RTG for purposes other than those mentioned above (such as for pulling and moving of lorries and other loads) is considered contrary to its designated use. The manufacturer cannot be held liable for any damage resulting from such use and the risk of misuse lies entirely with the user.

The operating instructions must always be at hand at the place of use of the RTG.

Personnel entrusted with work on the RTG must have read the operating instructions and in particular the chapter on safety before starting to work. Reading the instructions after work has begun is too late. This applies especially to persons working only occasionally on the machine e.g. during setting up or maintenance.

Liebherr Container Cranes provides copies of the RTG manual for each station involved in the operation, service, maintenance and spare parts organisation (if desired) according to the customer’s job organisation, working sequences or personnel entrusted with the work or maintenance.

The copy is simple to read and for ease of use, reference symbols are applied to lead the reader to the relevant section of the manual, or to lead to a more detailed section with further information.
In addition to the operating instructions, the user should observe all other generally applicable legal and other mandatory regulations relevant to accident prevention and environmental protection.

These compulsory regulations may also deal with the handling of hazardous substances issuing and/or wearing of personal protective equipment or traffic regulations.

Weather forecast should be monitored by the port operators to protect the crane from storm conditions. Note the operating wind speed mentioned in manual.

Every lifting operation should be properly carried out by a trained and competent person and in a safe manner and appropriately supervised.

Safe access and means of emergency escape should be maintained in good condition for the driving position(s) of the crane and for inspection, maintenance and repair of the crane.

Records should be maintained for each crane that are sufficient to enable the condition of the crane to be determined and its fitness for further operation to be properly assessed.
PARTICULAR SAFETY RULES FOR OPERATING THE LIEBHERR RTG

The following general safety rules for operating the RTG are drawn up in the event of no local regulations being in force. If local regulations are in force concerning RTG operation, then these should be followed carefully and adhered to.

The importance of these points cannot be over-emphasised as the accident-free, efficient operation and satisfactory functioning of the RTG and all its components is entirely dependent on their observance. A false sense of security on the part of the RTG operator can lead to serious trouble and sometimes serious accidents.

It is vital that the RTG is handled and operated gently and without aggression. In this way, it will be seen that the loading and unloading operation can be completed faster and without fuss and can reduce the wear on the RTG and its parts and will be far less tiring on the driver, other RTG operators and maintenance personnel.

2.1.1 QUALIFICATIONS OF RTG OPERATOR

Only reliable personnel of recognised ability, familiar with the mechanical and electrical characteristics of the RTG, instructed in safety codes and standards applicable in crane operation, may drive and operate the RTG. The operator must be over eighteen years of age, be mature in attitudes and responses, be in good health and his background should include both training and experience in the operation of this type of equipment. He must possess a general knowledge of the RTGs construction, be familiar with details of power supply and electricity, hydraulics, safety devices, emergency cutouts, emergency exits, fire extinguishers, etc.

2.1.2 RESPONSIBILITIES OF RTG OPERATOR

A knowledge of technical terms, parts’ identification and maintenance is required for this work. The RTG operator is responsible for seeing that the RTG is in a safe and serviceable condition and has its maintenance completed at the recommended intervals (lubrication, etc.). He must have the operating instructions at his disposal at all times. He must check all parts, which are subject to, wear and he must report all cases of excessive wear without delay to the site foreman or supervisor. He must immediately report any damage to ropes, or any mechanical, electrical or structural faults. The RTG operator must be satisfied with the functioning of all brakes, limit switches, safety devices, etc. He must be satisfied that the RTG is properly serviced at the recommended intervals.
2.1.3  HANDLING OF DEFECTS/FAULTS

The RTG operator must keep a record of any defects noticed in a logbook. He must also report any defects to the supervisor or foreman without delay, as well as advise the relief operator when changing shifts. The supervisor or foreman must be informed immediately should the relieving operator fail to report on site on time.

2.1.4  "NO STORAGE" OF WASTE

The storing of rags, waste, oil or any combustible material in any part of the RTG must be prohibited.

2.1.5  NATIONAL DIRECTIVES

National directives, local by-laws and safety procedures concerning the operation of RTGs, if available and in force, must be posted in the operator’s cabin or elsewhere - as necessity indicates.

2.1.6  "TRANSPORT" OF PERSONNEL

Personnel may not be transported on containers, spreaders or any lifting equipment.

2.1.7  "NO LOAD" OVER PERSONNEL

Hoisting loads over personnel on the ground is strictly forbidden. All ground personnel should wear high visibility jackets.

2.1.8  ACCESS TO OPERATING RTG

During operation, the RTG may only be entered or exited after the RTG operator has been informed and the RTG brought to a standstill. The cabin platform may be entered and exited through the safety gates after the RTG operator has been informed and the trolley has been brought to a stand still with both entry gates in the lined up position.

2.1.9  WORKING UNDER OPERATING RTG

Working under the operating RTG or within the travelling area of the RTG is strictly forbidden. If it is imperative that work in this area has to be done during the RTG operation, then the driver has to be consulted directly by people carrying out this work.

2.1.10  REMOVAL OF TOOLS FROM RTG

Tools or other objects must not be left lying on the trolley tracks or any part of the RTG structure. They can severely damage the RTG and cause serious or fatal injury to personnel involved in the RTG operation.
2.1.11 OBSERVE THE OPERATION OF OTHER RTG’S

The utmost care must be taken when travelling towards adjacent RTGs.

2.1.12 RTG TRAVELLING

Great care must be taken during normal RTG travel motion, cross travel and spin turn that the run ways are free of all obstacles, machinery, vehicles, personnel etc. A minimum clearance between the RTG and the container stacks must be maintained during normal RTG travel. Lateral Anti-Collision sensors are provided at all corners to ensure that the RTG does not collide with the stack or other objects.

LACK OF CONSTANT CARE DURING THIS OPERATION CAN LEAD TO SERIOUS CONSEQUENCES FOR MACHINERY AND PERSONNEL

2.1.13 RTG AND TRUCK TO BE STATIONARY

When loading or unloading trucks, it is imperative that both the truck and the RTG are stationary.

2.1.14 LOAD LIFTING, LOAD MOVEMENT

The load must be raised clearly above any surrounding obstacle before any attempt to travel is made. The operator must watch the load and spreader at all times during operation.

2.1.15 CONTAINERS TO BE UNLOCKED

If loads are taken directly from trucks, the RTG driver must ensure that the truck is completely at rest and that any devices securing the container to the truck body are disengaged. Containers to be lifted must be completely unlocked and not in a “jammed” condition.

2.1.16 NO “DRAGGING” OF LOAD

The loads must always be lifted vertically. No attempt must be made to “drag” the load by the use of the trolley or long travel.

2.1.17 LIFTING CAPACITY OF RTG

The overload device should not be treated as an operational control device.

THE RTG MAY NOT BE LOADED ABOVE ITS RATED MAXIMUM CAPACITY.
Safe Working Load under the BROMMA Telescopic Spreader:
40.60 Tonnes. = 40,600 kg in single lift mode.

The data provided on the Safe Working Load (S.W.L.) signs fitted to the RTG and the lifting equipment must be clearly legible and clearly understood at all times.

2.1.18 LIFTING EQUIPMENT

Whereas the lifting equipment provided with this RTG is designed for heavy-duty operation, it is imperative that excessive impact loadings are not applied.

It is therefore essential that proper deceleration is applied to the hoist system before the lifting equipment -loaded or unloaded- comes into contact with any other item.

2.1.19 COMMUNICATION WITH GROUND PERSONNEL

Hand signals should be agreed between RTG operators and ground personnel. If required, these signals can be used to direct the RTG operator. If local regulations regarding signals are in force, then these should be used. Only responsible and competent personnel who are thoroughly familiar with the signalling system in use should be allowed to give these signals.

The agreed signals should be posted at strategic locations in the cabin, at ground level and other desirable locations, e.g. rest rooms, workshops, etc.

See last page of manual detailing signalling recommended.

2.1.20 SAFETY DEVICES

The RTG driver should ensure that all safety devices are operating properly. These should be tested frequently. He should also ensure that all protection systems to the mechanical and electrical equipment are properly fitted, e.g. covers over rotating parts, guards, etc.

2.1.21 MOTION LIMIT SWITCHES

Pre and Final stop limit switch systems are provided to protect RTG and driver in the event of an error in driver’s judgement. These switch systems should not be considered as normal operational switches and drivers must operate with due caution when approaching limit switch zones.

NOTE: (i) All motion limit switch systems must be tested for correct operation prior to commencement of each driver’s shift, without load on lifting equipment.
(ii) The RTG must not be operated should any of the limit switch systems be defective without prior approval of the terminal’s safety engineers.

2.1.22 BUFFERS

All trolley buffers, including their support structures, should be kept in good condition. Note that these buffers are considered as emergency stops only in case pre-limit and final-limit switch system fails.

2.1.23 EMERGENCY

If any trouble occurs during the RTG operation, then one of the emergency buttons should be pressed. See Section 4.2 for the location of the emergency stops.

2.1.24 SAFE PARKING OF RTG

The driver must not leave the RTG without ensuring that the RTG is properly parked. (See Section “TAKING THE RTG OUT-OF-SERVICE”).

The normal out-of-service trolley parking position is with the trolley at the extreme end approach on the main entry side. As a minimum (if wind speeds are below 72 km/h), the travel wheels must be turned 45° at all RTG corners to their parking positions.

2.1.25 OPERATING WIND SPEED

It should be noted once again that THIS RTG SHOULD NOT BE OPERATED IN WIND SPEEDS EXCEEDING 72 km/h (= 45 m.p.h.). The RTG must be taken out of service at such a speed and the parking systems properly applied.

(See Section “TAKING THE RTG OUT-OF-SERVICE”).

2.1.26 WARNING SIGNS AND NOTICES

At various locations on the RTG and its lifting equipment, LIEBHERR has provided Warning Signs in accordance with the RTG specification and which are considered by LIEBHERR to meet the requirements in this respect. However, if any local safety regulations and requirements applicable for this RTG require additional Warning Signs, Notices, Regulations, Recommendations, or otherwise, then such requests must be made known to LIEBHERR at the latest at RTG commissioning date. Arrangements will then be made by LIEBHERR to meet these requests.

It is the purchaser’s responsibility to permit access to the RTG to authorised personnel only, and/or the working areas of the RTG. The purchaser/user must also ensure that this is strictly adhered to at all times. If any of the signs provided become dislocated or damaged, it is important that they are replaced or repaired immediately.
2.1.27 ADVERSE WEATHER CONDITIONS

Very high temperatures, storms, very low temperatures, snow, ice, prolonged and heavy rainfall, thunder storms, extreme sudden changes in temperature and other natural phenomena may effect the condition of the structural components, the electrical and mechanical equipment and the safety systems. Due consideration should be given to this. Depending on the severity and abnormality of such adverse weather conditions, appropriate action should be arranged for before putting the RTG into operation again.

2.1.28 NO DRAW STRINGS

It is recommended that personnel entering the RTG do not wear jackets or other garments with draw strings, as they can get entangled in parts of the machinery. This may lead to situations causing serious or fatal injury.
B 3.

SAFETY INSTRUCTIONS

TO PREVENT SERIOUS RISK OF INJURY TO YOURSELF AND OTHERS, OBSERVE ALL SAFETY INSTRUCTIONS IN THIS MANUAL, ALL SAFETY SIGNS ON THE CRANE, AND ALL RELEVANT SAFETY RULES APPLICABLE IN THE PORT.

3.1 All drivers of the crane must be trained, authorised and competent to do so. Competence includes a clear understanding of the operating manual.

3.2 No unauthorised person should be allowed onto the crane.

   No person(s) should be permitted to board or leave the crane without first obtaining the driver's permission or the permission of the responsible supervisor. The driver should be aware of the precautions that are necessary while the person(s) is boarding or leaving and should take them.

3.3 All relevant legislation and regulations, standards and codes of practice with regard to safe operation of cranes as applicable in the port must be adhered to.

   These compulsory regulations may also deal with the handling of hazardous substances, issuing and/or wearing of personal protective equipment or traffic regulations.

3.4 A safe system of work should be established and should include the following:

   a) planning of the operation
   b) selection, provision and use of suitable equipment
   c) maintenance, examination and where necessary testing of the crane and equipment.
   d) the provision of properly trained and competent personnel who have been made aware of their relevant responsibilities.
   e) It is essential for the safety of the operation to ensure that all personnel can communicate clearly in the same language.
   f) adequate supervision by properly trained and
competent personnel having the necessary authority

g) Test and examination certificates. All current certificates of test and examination for cranes and hoisting gear should be kept readily available. The crane should not be used unless it has the appropriate current test certificates. Tests will be required following substantial repairs or alteration, and/or periodically as prescribed by legislation.

h) preventing unauthorised operation, movement or use at all times

i) the safety of persons not involved in the hoisting operation.

The hoisting operation should be taken to include any necessary preparation of a site.
The safe system of work should be effectively communicated to all parties concerned.

3.5 Always adhere to correct operating procedures. THE CRANE DRIVER IS RESPONSIBLE FOR THE OPERATION OF THE CRANE.

3.6 Before beginning work, familiarise yourself with the surroundings and circumstances of the site, such as obstacles in the working and travelling area.

Consideration should be given to the presence of proximity hazards such as overhead electrical lines or cables, nearby structures, other cranes, vehicles or ships being loaded or unloaded, stacked goods and public access areas.

3.7 During start-up and end of operation always observe the indicators in accordance with the operating instructions.

Before starting work or setting the container crane in motion -

- make sure that nobody is at risk
- that steering, signalling and lighting systems are fully functional
- that accessories have been safely stowed away

3.8 Check the container crane at least once per working shift for obvious damage, defects and malfunction. Report any observations to the competent person immediately. If necessary, stop the crane at once and put the crane out of service.
3.9 Check and observe safety instructions and warning signs attached to container crane and their legibility.

3.10 Only use the Container Crane in a safe and reliable condition. Damaged hoisting equipment, ropes, spreaders, etc. must not be used but repaired or discarded as appropriate. An inspection and preventive maintenance programme must be put in place.

3.11 Never exceed the Safe Working Load (SWL) of the crane or lifting equipment. ALL lifting equipment must be clearly marked with its SWL and used for its intended purpose only. The SWL of each piece of lifting equipment must ALWAYS be MORE THAN the weight of the load to be lifted.

3.12 Avoid any operation that might be a risk for the stability of the container crane.

3.13 ENSURE that all lifting or hoisting equipment is SECURED to the crane.

3.14 NEVER WALK UNDER A SUSPENDED LOAD. NEVER LIFT A LOAD OVER ANY PERSON.

3.15 Appropriate site access / prohibition rules should be put into place in the port to ensure that no person is or may be struck by the crane or load.

3.16 NEVER leave a load suspended when the crane is unattended.

3.17 Ensure that there is an unimpeded view of the operation or otherwise have a signaller with a suitable system of communication.
3.18 In conditions of poor visibility and after dark always switch on the lighting systems.

3.19 Before leaving the drivers seat always secure the machine against inadvertent operation, movement and unauthorised use.

3.19 Personnel working on the crane should be familiar with the location and use of fire extinguishers, and evacuation procedure. See Section Emergency Features B 6.

(Refer to section Emergency Features Section B 6 of this manual.)

3.20 ELECTRICITY - DANGER! Electricity can kill! Lethal voltages may be present in some of the equipment referred to in our manuals.

a) In the unlikely event that the container crane comes into contact with a live wire
   • do not leave the cabin
   • drive the machine out of hazard zone
   • warn others against approaching or touching the container crane
   • have the live wire de-energised
   • do not leave the machine until damage line has been de-energised.

(b) Access to electric terminal boxes, circuits, etc., is prohibited to all except personnel who are trained, competent and authorised to do so.

(Refer to maintenance section below)

3.21 In the event of safety-relevant modifications or changes in the behaviour of the crane stop the container crane immediately and report the malfunction to the competent authority/person.

3.21 Never make any modification, additions or conversions, which might affect safety without the supplier’s approval. This also applies to the installation and adjustment of safety devices and valves as well as to welding work on load-bearing elements. Modifications may require the crane to be re-tested and certified.
Your container crane has been manufactured with the objective of environmental protection, pollution prevention and continual improvement. The manufacturing process has been in accordance with the philosophy of Best Available Technology Not Entailing Excessive Cost (BATNEEC) with strict controls over environmental impact. The user of this crane is encouraged to continue this philosophy.

4.1 When filling or draining oil reservoirs, diesel tanks and radiators, care should be taken to contain all spillages.

4.2 Regular preventive maintenance, e.g. cleaning/changing oil filters, will prolong the life of the equipment and fluid and minimise the energy required to operate crane efficiently.

4.3 All waste arising from the maintenance and upkeep of the crane should be disposed of in accordance with local waste regulations. Recycling is recommended:
- Waste Electrical & Electronic Equipment
- Oils and grease
- Touch-up paints & solvents
- Lighting
- Etc.
B 5. SAFETY FOR SERVICE, REPAIR & MAINTENANCE

Before attempting maintenance work on any part of the crane or its components, the LCC operation and maintenance instructions, and in particular the safety warnings, must be read and clearly understood.

5.1 SERVICE AND REPAIR.

Spare parts must comply with the technical requirements specified by the manufacturer. Spare parts from original parts manufacturers and/or suppliers can be relied on.

Replace hydraulic hoses within stipulated and appropriate intervals even if no safety-relevant defects have been detected.

Preventive Maintenance

Adhere to prescribed intervals or those specified in the operating instructions for routine checks and inspections.

5.2 SERVICE/MAINTENANCE

- All maintenance work (mechanical, hydraulic or electrical) must only be carried by personnel who are qualified and competent to do so, the maintenance personnel should be fully conversant with the machinery they are required to maintain and its hazards and be familiar with the procedures and precautions recommended. The maintenance personnel should be responsible for maintaining the crane and ensuring its safe and satisfactory operation. They should carry out all necessary maintenance in accordance with the manufacturer's maintenance manual and within the safe system of work.
The operation of a “PERMIT-TO-WORK” system is strongly recommended by LCC. An effective permit to work system will ensure that the crane is physically incapable of movement and circuits are isolated before written authority is given to the person who is to undertake the work.

- Adhere to prescribed adjusting, maintenance and inspection procedures and intervals and those specified in the operating instructions for routine checks and inspections.
- Ensure that maintenance areas are adequately secured.
- The container crane must be secured against inadvertent starting by:
  
  Return control levers to “0” and turn the start key to “0” position, respectively consult the driver's or operation manual.

- Carry out maintenance and repair only if crane is out of service. Before returning the crane to service ensure that all guards, safety devices, etc., are in good condition and correctly installed.

- Never use machine parts as climbing aid. If not standing firmly on a platform/walkway wear a safety harness anchored securely when carrying out maintenance at a height greater than 2 metres.

- Keep all handles, steps, handrails, platforms, landings and ladders clean and free from snow and ice (where applicable)

- Clean the container crane of any traces of oil, fuel or preservatives before maintenance/repair and examine all fuel, lubricant and hydraulic fluid lines for leaks, loose connections, chafe marks and damage in order to rectify them without delay.

- Tighten bolted connections that might have been loosened during maintenance/repair.

- Ensure that all consumables and replaced parts are disposed of safely and with minimum environmental impact.
• When working with chemicals (paint, oils, grease, etc.) adequate precaution should be taken as detailed on Material Safety Data Sheets.

• ELECTRICAL - Work on electrical system or equipment should be carried out by a competent electrician only according to maintenance/service and repair handbook.

• The electrical equipment of the crane is to be inspected and checked at regular intervals.

• Fire extinguishers should be scheduled for periodic inspection and be renewed as necessary.

• Suitable Personal Protective Equipment should be used as required.

• Documented inspection and maintenance records should be kept.

5.3 HYDRAULIC EQUIPMENT

BASIC SAFETY WHEN USING HYDRAULICS

Check all lines, hoses and connections for leaks and obvious damage. Splashed oil may cause injury and fire.

• Depressurise all system sections before loosening/removal of pressure pipes and/or connections in accordance with the specific instructions for carrying out any repair work.

• Ensure that all relevant machinery is switched off and that personnel not involved in repair/maintenance are excluded from working area.

• Only service machinery, which you understand, and for which you are qualified to do so.

• Ensure that all cylinders and loads are mechanically supported or safety locked.

• If accumulators are fitted, ensure that the oil is discharged from them before commencing any other work. If work is to be carried out on the gas side of an accumulator – discharge the gas – slowly.
• Do not attempt to stop a leak or tighten a joint while it is under pressure.

• Do not use hands or fingers to search for a leak.

• Remember that pressure control valves are fitted for safety reasons. Do not adjust without authorisation.

• Some valves pumps contain strong springs under tension, make sure you understand each component that you dismantle.

5.4. SERVICE CRANE on TROLLEY

Note that the gates provided in this location must remain closed at all times. The gates may only be opened while moving a service crane load through the opening. When not in use, the service crane jib must be secured with the locking pin provided. The ‘parking’ position for the jib is over the hydraulic tank, with the hook raised to maximum height.

REMEMBER! THIS LIST IS NOT COMPLETE – SAFETY IS UP TO YOU!
B 6. EMERGENCY FEATURES

6.1 EMERGENCY STOPS

6.1.1 GENERAL EMERGENCY STOPS

The RTG operation can be immediately halted in an emergency at the following locations:

(a) Driver’s Control Console (Driver’s Cabin)
(b) One push-buttons on Switchgear Panel (Electrical House)
(c) Two push-buttons at Ground Level (one per side)
(d) One push-button on Main Beam platform near the trolley parking position.
(e) Two Push-button on Trolley

6.1.2 GENERATOR SET EMERGENCY STOPS

(a) One push-button on Diesel Control Panel (E-House Entry).
(b) One push-button on generator set control panel.

IMPORTANT

IT IS IMPERATIVE THAT ALL PERSONNEL Concerned with the RTG and its operation, I.E. RTG OPERATORS, MAINTENANCE PERSONNEL, ETC. IMMEDIATELY BECOME FAMILIAR WITH THE LOCATION AND OPERATION OF ALL EMERGENCY STOP STATIONS BEFORE INITIAL OPERATION OF THE RTG.

6.2 EXIT IN EMERGENCY

The RTG is provided with adequate means of descending to ground level in the event of an emergency. The drivers (and other personnel) should acquaint themselves fully with what can be done in an emergency and then when the emergency occurs, immediate positive action should be taken without hesitation.

The following facilities are provided:

6.2.1 The Main Beam (energy chain side) can be left through the permanently installed main entry system.

6.2.2 The Driver’s Cabin in the ‘trolley parked’ position can be left through the entry gates; descent to ground level is in the usual manner using the main entry system.

6.2.3 There is one trolley entry/exit point to the main beam platform near trolley corner No. 4.
6.2.4 If the trolley with the driver’s cabin is stopped in any position other than the ‘trolley parked’ position, the following route must be taken:

- Up the ladder directly outside the cabin door, onto the trolley, turn left and enter main beam platform (energy chain side), descent to ground using the main entry system.

6.3 FIRE

If for some reason, a fire should occur in any part of the RTG, the operator/driver should ensure that the severity or potential severity of it is quickly assessed. He should then follow the following procedure:

1. Stop the RTG and all its motions.
2. Inform other personnel that a fire has occurred.
3. If it is felt that the fire can be overcome using fire extinguishers, then these should be used.
4. If however, the fire is a major fire, then all personnel should leave the RTG at once and the fire department should be informed. Immediately a brief description of the fire should also be given if possible.
5. The section “TAKING THE RTG OUT-OF-SERVICE” should be complied with.

It is recommended that all operating personnel be informed about the types of fire and their proper treatment. This information will readily be given by the local fire authority.
Carbon Dioxide fire extinguishers

- Remove the pin and aim the gas discharge at the base of the fire.
- Do not hold the discharge funnel with your hand to avoid freeze burn – use handle only.
- Gas discharge is **VERY LOUD** from CO\(_2\) extinguishers. Do not be alarmed, as this is normal.

Fire extinguishers are located in the following areas:

In Driver's Cabin : 2.0 Kg. Type CO2 Gas
Outside Electrical House : 5.0 Kg. Type CO2 Gas
Outside Generator Set : 5.0 Kg. Type CO2 Gas
At Ground Level main entry ladder: 2.0 kg. Type CO2 Gas
OPERATING INSTRUCTIONS AND DRIVER’S MANUAL

CRANE TYPE: RTG 6/5/4/WS(E)

WORK No: RT 80/81

DRAWING No: RT 1096
1. CABIN
   a) Drawing
**LIEBHERR- Container Cranes LTD**  
Brieda Cabin  
(24107.1D) Liebherr RTG Cabin RT80/81

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>1</td>
<td>Cabine</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Trolley</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Drive Control</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Control House</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Cabine</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Control House</td>
<td>1</td>
</tr>
</tbody>
</table>

Version 01.06 CSD
2. SUMMARY SPECIFICATION

CRANE TYPE P146L-
SUPER
CRANE WORK NOS. IR
1557/IR-1558
DRAWING NO.: IR-7233-
000.000

1. DESIGN

The crane structurally complies with F.E.M. 1.001 -1987 10.01, 3rd Edition. It is classified as follows:

<table>
<thead>
<tr>
<th>State of Loading</th>
<th>Group Class</th>
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</table>
The crane is designed for handling:

- I.S.O. containers of 20ft., 30ft., 35ft., 40ft., 45ft. and 48ft. lengths weighing up to 40 Tonnes - all with appropriate lifting equipment. It is also designed to handle 2 x 20ft. empty containers in twin lift mode using the appropriate lifting equipment.

- Cargo weighing up to 50 Tonnes excluding the self-weight of a cargo beam (hookbeam). The cargo beam is attached to the underside of the headblock in a similar manner to the spreader.

The crane mechanically complies with F.E.M. 1.001 - 1987, 10.01 3rd Edition. Each main motion is classified as follows:

- **Group Classification**
  - **Hoist Unit**: T7-L2-M7
  - **Cross Travel Unit**: T7-L2-M7
  - **Long Travel Unit**: T4-L2-M4
  - **Derrick Unit**: T3-L2-M3

2. **SAFE WORKING LOAD**

The S.W.L. of the crane is 40 Tonnes under Liebherr and Bromma telescopic spreaders over the full trolley travel path and 50 Tonnes under the hook beam over the full trolley travel path.

The spreader beam and head block (Pulley Frame) collectively known as the lifting equipment have a total weight of 13.00 Tonnes. The head block is connected to the spreader or cargo beam using four manually operated pins.
3. **MAX. PERMISSIBLE CONTAINER ECCENTRICITY**

   The max. permissible eccentricity for containers weighting up to 35.50 tonnes is:
   - 1.22 m. in longitudinal direction and 0.20 m. in lateral direction.

4. **SPAN**

   : 20.00 m.

5. **OUTREACH ON WATERSIDE**

   : 44.50 m. (From Waterside Rail)

6. **OUTREACH ON LANDSIDE**

   : 16.00 m. (From Landside Rail)

7. **SPREADER HEIGHT ABOVE RAIL**

   : 32.00 m. (Seaside)

   : Total Spreader Hoisting below Rail : 47.00 m.

   : Lowest point of Spreader below Rail : 15.00 m.

8. **MAXIMUM OVERALL TROLLEY WIDTH**

   : 6.990 m.

9. **PORTAL STRUCTURE**

   9.1 **Wheel Gauge**

   (a) Landside Rail : 18.53 m.

   (b) Seaside Rail : 18.53 m.

   9.2 **Clearance Between Portal Legs**

   : 17.00 m.

   9.3 **Overall length Buffer to Buffer**

   : 29.10 m. (buffers compressed)
9.4 Clearance under Portal Structure: 14.00 m.

10. Distance Waterside Rail to Quay Edge:

- 3.80 m. (including fender)

11. Rail Level Difference: 0.010 mm. (Landside rail is at a higher level)

12. Hoist Unit:

2 x 300 kW DC Motors with field weakening and Liebherr Digivert Speed Control.

Load/speed range:

- 50 m./min. - 55.00 Tonnes **
- 60 m./min. - 53.00 Tonnes *
- 125 m./min. - Empty Spreader

The Hoist speeds are continuously variable and load-dependent up to the max. speeds quoted above.
12. HOIST UNIT (contd.)

* These loads include the lifting equipment ** Heavy Lift Application

NOTE (a): An Emergency Hoist Drive System consisting of an A.C. motor and gear reduction unit is provided for emergency hoist operation

NOTE (b): Emergency braking is provided on each hoist drum in addition to the normal braking system.

13. TROLLEY UNIT

4 x 35 kW D.C. Motors with Digivert Thyristor Speed Control. (Self Powered Trolley).

Speed: 180 m./min.

NOTE: A hand driven trolley travel system is provided for emergency purposes.

14. LONG TRAVEL UNIT

8 x 25 kW D.C. motors with Digivert Thyristor Speed Control.

Speed: 45 m./min.

15. DERRICK UNIT

1 x 95 kW DC Motor with Digivert Thyristor Speed Control.

Derricking Time: 5 minutes

NOTE: Derricking Emergency Drive: 15 kW A.C. Motor, time approx. 30 Mins.

16. POWER SUPPLY
11.0 kV, 50 Hz, 3 Phase +
Earth, 3 wire plus earthed neutral system with 450 m. cable for
approx. 750 m. crane travel.

Power Rating:

17. TRIM SYSTEM (±5º)

15 kW AC squirrel cage
motor (also used for List and Skew).

Time to trim spreader by
5º: 16.0 seconds approx.

18. LIST SYSTEM (±3º)

15 kW AC squirrel cage
motor (also used for Trim and Skew).

Time to List spreader by
3º: 8.0 seconds approx. (average)
19. **SKEW SYSTEM (±3°)**

- ___________ 15 kW AC motor (also used for Trim and List)
- ___________ Time to skew by 3°: 8.0 seconds approx. (average)

20. **NUMBER OF CRANE WHEELS AND LOADINGS**

- **Seaside Rail**
  - 8 wheels/corner
  - 38.34 tonnes / Wheel (In-Service)
  - Wheel Distance: 7 x 1300 mm.

- **Landside Rail**
  - 8 wheels/corner
  - 35.17 Tonnes / Wheel (In-Service)
  - Wheel Distance: 7 x 1300 mm.

**NOTE:** Seaside Rail is 10 mm. lower than landside rail. Both rails are A100 Din 536.

21. **DESIGN FEATURES**

21.1 The crane is provided with a lattice structure for boom and beam and uses clamped down A65 trolley rails on resilient pads. Special quality replaceable sections are used at the boom / beam hinge.

21.2 All main motions are controlled using Thyristor Control Technology.

21.3 A computer based Fault Condition Monitoring / Memory and Crane Management System is incorporated.

21.4 The crane is provided with a High Tension 11.0 kV, 3 phase + earth, 3 wire + earthed neutral system, high Voltage supply with cable drum for 450 m. cable.

21.5 Load and spreader Height Indicators are provided.

21.6 An Anemometer is fitted and has its readout in the driver’s cabin and electrical house.
21.7 **Hour meters** for recording the operation time of the various drive units are installed in the main electrical switchgear.

21.8 A two-level **Cable Inspection Platform** for the festoon cable system is provided. The system incorporates a cabin cleaning platform.

21.9 A **head block** with four-pin connection to the spreaders and heavy lift hook beam is provided. The pulley frame incorporates a **geared anti-sway system**. Supply to the spreader is via a cable basket on the head block.

21.10 **A multi-point Telephone System** is installed.

21.11 **Long Travel Control** from **Derrick Control Cabin** and from a ground station.

21.12 **A 4.0 Tonne Service Crane** is provided in the machinery house.

21.13 All travel motions of the crane are protected by pre-limit and final limit switches.

21.14 The crane is provided with **automatic storm pins and automatic ramp-type rail clamps**.
21. DESIGN FEATURES

(contd.)

21.15 The derrick system (two ropes) for operating the boom incorporates a double brake arrangement with an Alni Overspeed device. Secondary brake acts directly on the drum. An emergency derrick drive system is also provided.

21.16 The crane is provided with a LIEBHERR, 400 Kg, 4 person, 42 m./min 2 stop rope operated personnel lift enclosed within a lift shaft.

21.17 The hoist gear is provided with two primary brakes, an emergency hoist system and emergency braking on each hoist drum.

21.18 The crane is designed for operation with empty spreader when the boom is in the raised position.

21.19 A spacious driver's cabin with double glazed tinted safety glazing is provided. An air conditioning unit and mirrors are provided.

21.20 The crane is provided with a compartmented machinery house for mechanical equipment and switchgear with a separate entrance to each section. Both sections have insulated cladding. The switchgear section is air-conditioned. The house includes a 4.0 Tonne service crane and a re-reeving winch. An air compressor, welding machine and bench drill are also provided.

21.21 A trim system ±5º, a list system ±3º and a skew system ±3º is provided and also incorporates anti-snag and hoist rope adjustment features.

21.22 In addition to the lift above (21.16), a stairs system is provided from lower landing level of lift to main beam. A stairs system is provided to machinery / electrical house and to derrick control cabin.

21.23 A hoist rope re-reeving device is provided.

21.24 Long Travel buffers are provided with long travel limit switches.

21.25 An emergency stand-by power connection point is provided.

21.26 An extensive tool list is provided.

21.27 One hoist rope support trolley is provided on the landside of the main trolley.
21.28 Power factor correction equipment is provided.

21.29 The crane is provided with a checkers cabin under the landside end carriage.

21.30 Emergency drives are provided for hoist and derrick systems and a hand operated emergency system is provided on the trolley.

22. LIFTING EQUIPMENT

The crane is provided with a head block (pulley frame) which is designed for attaching the new lifting equipment. It has a 4-pin connection to the lifting equipment.

The total Lifting Equipment provided for the two cranes is as follows:

(a) Head Block (Pulley frame) with each crane.
(b) 3 x Off Liebherr Telescopic Spreaders
(c) 1 x Off Bromma Twin-Lift Telescopic Spreader
(d) 1 x Adaptor Frame to be used when any of the spreaders under (b) and (c) above are connected to the previous Liebherr and other container cranes owned by the port.
NOTE: One Liebherr spreader and the Bromma spreader are considered as ‘spare parts’.

23. OPERATIONAL LIMITATIONS

- **Boom Down**
  - Full operation with full load over full length of boom and beam.

- **Boom Up**
  - Full operation with empty spreader over full length of boom and beam.

- **Simultaneous motions**
  - The hoist / lowering, trolley travel and long travel can be carried out simultaneously.

NOTE: Boom shall always be in fully raised position in “out-of-service” conditions.

NOTE: The In-Service wind speed is 72 km/hr. (45 m.p.h.)

24. COLOUR

<table>
<thead>
<tr>
<th>Spreader Type</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>Ultra Marine Blue</td>
</tr>
<tr>
<td>Tip</td>
<td>Traffic Red</td>
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</table>

25. COMMISSIONING

Dates are:

- **The Crane Commissioning**
- **Work No. IR 1557**
- **2000**
### 2. LAYOUT OF CONTROLS

<table>
<thead>
<tr>
<th>Class of Utilisation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State of Loading</td>
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The crane is designed for handling:

- I.S.O. containers of 20ft., 30ft., 35ft., 40ft., 45ft. and 48ft. lengths weighing up to 40 Tonnes - all with appropriate lifting equipment. It is also designed to handle 2 x 20ft. empty containers in twin lift mode using the appropriate lifting equipment.

- Cargo weighing up to 50 Tonnes excluding the self-weight of a cargo beam (hookbeam). The cargo beam is attached to the underside of the headblock in a similar manner to the spreader.
The crane mechanically complies with F.E.M. 1.001 1987, 10.01 3rd Edition. Each main motion is classified as follows:

**Group Classification**

- **Hoist Unit**: T7-L2-M7
- **Cross Travel Unit**: T7-L2-M7
- **Long Travel Unit**: T4-L2-M4
- **Derrick Unit**: T3-L2-M3

**2. SAFE WORKING LOAD**

The S.W.L. of the crane is 40 Tonnes under Liebherr and Bromma telescopic spreaders over the full trolley travel path and 50 Tonnes under the hook beam over the full trolley travel path.

The spreader beam and head block (Pulley Frame) collectively known as the lifting equipment have a total weight of **13.00 Tonnes**. The head block is connected to the spreader or cargo beam using four manually operated pins.
3. MAX. PERMISSIBLE CONTAINER ECCENTRICITY

The max. permissible eccentricity for containers weighting up to 35.50 tonnes is:

- 1.22 m. in longitudinal direction and 0.20 m. in lateral direction.

4. SPAN : 20.00 m.

5. OUTREACH ON WATERSIDE : 44.50 m. (From Waterside Rail)

6. OUTREACH ON LANDSIDE : 16.00 m. (From Landside Rail)

7. SPREADER HEIGHT ABOVE RAIL : 32.00 m. (Seaside)

Total Spreader Hoisting: 47.00 m.

Lowest point of Spreader below Rail: 15.00 m.

8. MAXIMUM OVERALL TROLLEY WIDTH : 6.990 m.

9. PORTAL

9.1 Wheel Gauge (a)
- Landside Rail: 18.53 m.
- Seaside Rail: 18.53 m.

9.2 Clearance Between Portal Legs: 17.00 m.

9.3 Overall length Buffer to Buffer: 29.10 m. (buffers compressed)
9.4 Clearance under Portal Structure: 14.00 m.

10. Distance Waterside Rail to Quay Edge:

   : 3.80 m. (including fender)

11. Rail Level Difference: 0.010 mm.

   (Landside rail is at a higher level)

12. Hoist Unit

   : 2 x 300 kW DC Motors with field weakening and Liebherr Digivert Speed Control.

   Load/speed range:

   50 m/min. - 55.00 Tonnes **
   60 m/min. - 53.00 Tonnes *
   125 m/min. - Empty Spreader

   The Hoist speeds are continuously variable and load-dependent up to the max. speeds quoted above.
12. **HOIST UNIT** (contd.)

* These loads include the lifting equipment **Heavy Lift Application**

**NOTE(a):** An Emergency Hoist Drive System consisting of an A.C. motor and gear reduction unit is provided for emergency hoist operation.

**NOTE (b):** Emergency braking is provided on each hoist drum in addition to the normal braking system.

13. **TROLLEY UNIT**

4 x 35 kW D.C. Motors with Digivert Thyristor Speed Control. (Self-Powered Trolley).

**Speed**: 180 m./min.

**NOTE:** A hand driven trolley travel system is provided for emergency purposes.

14. **LONG TRAVEL UNIT**

8 x 25 kW D.C. motors with Digivert Thyristor Speed Control.

**Speed**: 45 m./min.

15. **DERRICK UNIT**

1 x 95 kW DC Motor with Digivert Thyristor Speed Control.

**Derricking Time**: 5 minutes

**NOTE:** Derricking Emergency Drive: 15 kW A.C. Motor, time approx. 30 Mins.

16. **POWER SUPPLY**

_______
11.0 kV, 50 Hz, 3 Phase + Earth, 3 wire plus earthed neutral system with 450 m. cable for approx. 750 m. crane travel.

Power Rating: 1000 KVA

17. TRIM SYSTEM (±5º)

15 kW AC squirrel cage motor (also used for List and Skew).

Time to trim spreader by 5º: 16.0 seconds approx.

18. LIST SYSTEM (±3º)

15 kW AC squirrel cage motor (also used for Trim and Skew).

Time to List spreader by 3º: 8.0 seconds approx. (average)
19. SKEW SYSTEM (±3°)

- 15 kW AC motor (also used for Trim and List)
- Time to skew by 3°: 8.0 seconds approx. (average)

20. NUMBER OF CRANE WHEELS AND LOADINGS

- Seaside Rail:
  - 8 wheels/corner
  - 38.34 tonnes / Wheel (In-Service)
  - Wheel Distance: 7 x 1300 mm.

- Landside Rail:
  - 8 wheels/corner
  - 35.17 Tonnes / Wheel (In-Service)
  - Wheel Distance: 7 x 1300 mm.

NOTE: Seaside Rail is 10 mm lower than landside rail. Both rails are A100 Din 536.

21. DESIGN FEATURES

21.1 The crane is provided with a lattice structure for boom and beam and uses clamped-down A65 trolley rails on resilient pads. Special quality replaceable sections are used at the boom / beam hinge.

21.2 All main motions are controlled using Thyristor Control Technology.

21.3 A computer based Fault Condition Monitoring / Memory and Crane Management System is incorporated.

21.4 The crane is provided with a High Tension 11.0 kV, 3 phase + earth, 3 wire + earthed neutral system, high Voltage supply with cable drum for 450 m. cable.

21.5 Load and spreader Height Indicators are provided.

21.6 An Anemometer is fitted and has its readout in the driver's cabin and electrical house.
21.7 **Hour meters** for recording the operation time of the various drive units are installed in the main electrical switchgear.

21.8 A **two-level Cable Inspection Platform** for the festoon cable system is provided. The system incorporates a cabin cleaning platform.

21.9 A **head block** with four pin connection to the spreaders and heavy lift hook beam is provided. The pulley frame incorporates a **geared anti-sway system**. Supply to the spreader is via a cable basket on the head block.

21.10 A **multi-point Telephone System** is installed.

21.11 Long Travel Control from Derrick Control Cabin and from a ground station.

21.12 A **4.0 Tonne Service Crane** is provided in the machinery house.

21.13 All travel motions of the crane are protected by pre-limit and final limit switches.

21.14 The crane is provided with **automatic storm pins** and **automatic ramp-type rail clamps**.
21. DESIGN FEATURES

(Contd.)

21.15 The derrick system (two ropes) for operating the boom incorporates a double brake arrangement with an Alni Overspeed device. Secondary brake acts directly on the drum. An emergency derrick drive system is also provided.

21.16 The crane is provided with a LIEBHERR 400 Kg, 4 person, 42 m/min 2 stop rope operated personnel lift enclosed within a lift shaft.

21.17 The hoist gear is provided with two primary brakes, an emergency hoist system and emergency braking on each hoist drum.

21.18 The crane is designed for operation with empty spreader when the boom is in the raised position.

21.19 A spacious driver's cabin with double glazed tinted safety glazing is provided. An air conditioning unit and mirrors are provided.

21.20 The crane is provided with a compartmented machinery house for mechanical equipment and switchgear with a separate entrance to each section. Both sections have insulated cladding. The switchgear section is air conditioned. The house includes a 4.0 Tonne service crane and a re-reeving winch. An air compressor, welding machine and bench drill are also provided.

21.21 A trim system ±5º, a list system ±3º and a skew system ±3º is provided and also incorporates anti-snag and hoist rope adjustment features.

21.22 In addition to the lift above (21.16), a stairs system is provided from lower landing level of lift to main beam. A stairs system is provided to machinery / electrical house and to derrick control cabin.

21.23 A hoist rope re-reeving device is provided.

21.24 Long Travel buffers are provided with long travel limit switches.

21.25 An emergency stand-by power connection point is provided.

21.26 An extensive tool list is provided.

21.27 One hoist rope support trolley is provided on the landside of the main trolley.
21.28 Power factor correction equipment is provided.

21.29 The crane is provided with a checkers cabin under the landside end carriage.

21.30 Emergency drives are provided for hoist and derrick systems and a hand operated emergency system is provided on the trolley.

22. LIFTING EQUIPMENT

The crane is provided with a head block (pulley frame) which is designed for attaching the new lifting equipment. It has a 4-pin connection to the lifting equipment.

The total Lifting Equipment provided for the two cranes is as follows:

(a) Head Block (Pulley frame) with each crane.
(b) 3 x Off Liebherr Telescopic Spreaders
(c) 1 x Off Bromma Twin-Lift Telescopic Spreader
(d) 1 x Adaptor Frame to be used when any of the spreaders under (b) and (c) above are connected to the previous Liebherr and other container cranes owned by the port.
NOTE: One Liebherr spreader and the Bromma spreader are considered as ‘spare parts’.

23. OPERATIONAL LIMITATIONS

- Boom Down: Full operation with full load over full length of boom and beam.
- Boom Up: Full operation with empty spreader over full length of boom and beam.
- Simultaneous motions: The hoist / lowering, trolley travel and long travel can be carried out simultaneously.

NOTE: Boom shall always be in fully raised position in “out-of-service” conditions.
The In-Service wind speed is 72 km/hr. (45 m.p.h.)

24. COLOUR

<table>
<thead>
<tr>
<th>Spreader</th>
<th>Itra Marine Blue - RAL 5002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trolley</td>
<td>Traffic Red - RAL 3020</td>
</tr>
</tbody>
</table>

25. COMMISSIONING

The Crane Commissioning Dates are:

- Work No. IR 1557
- 2000
2.1 DRIVER’S CABIN EQUIPMENT

The following equipment is incorporated in the driver’s cabin:

2.1.1 Driver’s Control Console; incorporates the control joysticks, push-buttons, selector switches and status lights for crane and spreader operation.

Audible and visual warning devices, electrical fault and overload warning zone also included.

2.1.2 EMS Display Panel: incorporating digital readout display of load, height, trim, skew angle position, and status indication for spreader, i.e. twistlocks open, twistlocks closed, and deposit points.

2.1.3 Air conditioning unit

2.1.4 Cabin Light.

2.1.5 Crane Lighting control: incorporating push-buttons for:

- Crane Floodlighting - Trolley Access Lighting

2.1.6 Emergency Light.

2.1.7 Socket Outlet – 230 V.

2.1.8 Windscreen Wiper / Washer.

2.1.9 Telephone Handset

2.1.10 Signal Horn

2.1.11 Fire Extinguisher

2.1.12 Public Address System

2.1.13 Heater
NOTE: All joystick controls, push-buttons, selector switches, indication lamps, audio devices, and visual displays are highlighted by legend plates identifying their corresponding functions.
PLEASE FIND ON FOLLOWING PAGES ILLUSTRATIONS, DESCRIPTIONS AND DISPLAYS COVERING CONTROL LAYOUT
The EMS has 14 buttons, arranged in two rows of 7 buttons underneath the LCD display.

The upper seven buttons are denoted B1 to B7, from left to right, and are used to select crane driver’s displays 1 to 6 and machine data display 1 (diagnosis display).

- B2 button Selects crane driver’s display 2 (See “DISPLAY 2”)
- B3 button Selects crane driver’s display 3 (See “DISPLAY 3”)
- B4 button Selects crane driver’s display 4 (See “DISPLAY 4”)
- B5 button Selects crane driver’s display 5 (See “DISPLAY 5”)
- B6 button Selects crane driver’s display 6 (See “DISPLAY 6”)
- B7 button Selects machine data display 1

The lower seven buttons are used to operate the EMS menu structures.

- ◄ button Moves the cursor to the left, or changes the display in the highlighted display section.
- ➤ button Moves the cursor to the right, or changes the display in the highlighted display section.
- ▲ button Moves the cursor upwards, or increases a value.
- ▼ button Moves the cursor downwards, or reduces a value.
- Clear button Changes a setting to an initial or standard value.
- Enter button Activates selected menu items, or confirms value inputs.
- Key button Selects the main menu display.
### EMS-2 DISPLAY SYMBOL MEANINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trolley position</td>
<td></td>
<td>Spreader length</td>
</tr>
<tr>
<td><img src="image" alt="Trolley" /></td>
<td></td>
<td><img src="image" alt="Spread" /></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Load" /></td>
<td>Load</td>
<td><img src="image" alt="Relative" /></td>
<td>Relative value (distance to the reference value)</td>
</tr>
<tr>
<td><img src="image" alt="Hoist Height" /></td>
<td>Hoist height</td>
<td><img src="image" alt="Reference" /></td>
<td>Reference value</td>
</tr>
<tr>
<td><img src="image" alt="Container Trim" /></td>
<td>Container inclination in the longitudinal direction (TRIM)</td>
<td><img src="image" alt="Absolute" /></td>
<td>Absolute value</td>
</tr>
<tr>
<td><img src="image" alt="List" /></td>
<td>Container inclination in the lateral direction (LIST)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Slew Angle" /></td>
<td>Skew angle (SKEW)</td>
<td><img src="image" alt="Crane Display 1" /></td>
<td>Crane driver's display 1</td>
</tr>
<tr>
<td><img src="image" alt="Slew Angle" /></td>
<td>Slew angle (SLEW)</td>
<td><img src="image" alt="Crane Display 2" /></td>
<td>Crane driver's display 2</td>
</tr>
<tr>
<td><img src="image" alt="Boom Angle" /></td>
<td>Boom angle or boom control on display (BOOM)</td>
<td><img src="image" alt="Crane Display 3" /></td>
<td>Crane driver's display 3</td>
</tr>
<tr>
<td><img src="image" alt="Gantry" /></td>
<td>Gantry (TRAVEL)</td>
<td><img src="image" alt="Crane Display 4" /></td>
<td>Crane driver's display 4</td>
</tr>
<tr>
<td><img src="image" alt="X Coordinate" /></td>
<td>Container co-ordinate in the X-direction (Trolley)</td>
<td><img src="image" alt="Crane Display 5" /></td>
<td>Crane driver's display 5</td>
</tr>
<tr>
<td><img src="image" alt="Y Coordinate" /></td>
<td>Container co-ordinate in the Y-direction (Travel)</td>
<td><img src="image" alt="Crane Display 6" /></td>
<td>Crane driver's display 6</td>
</tr>
<tr>
<td><img src="image" alt="Fault" /></td>
<td></td>
<td><img src="image" alt="Fault" /></td>
<td>Fault Information</td>
</tr>
</tbody>
</table>
## EMS-2 Display Symbol Meanings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Symbol" /></td>
<td>Twistlocks open</td>
</tr>
<tr>
<td><img src="image2" alt="Symbol" /></td>
<td>Spreader landed (probe pins or deposit pins operated)</td>
</tr>
<tr>
<td><img src="image3" alt="Symbol" /></td>
<td>Main menu display or key button</td>
</tr>
<tr>
<td><img src="image4" alt="Symbol" /></td>
<td>Page back to the previous display</td>
</tr>
<tr>
<td><img src="image5" alt="Symbol" /></td>
<td>COM2 diagnosis display</td>
</tr>
<tr>
<td><img src="image6" alt="Symbol" /></td>
<td>Time or date</td>
</tr>
<tr>
<td><img src="image7" alt="Symbol" /></td>
<td>Password entry required. Parameter cannot be changed, or key-operated switch in normal operation</td>
</tr>
<tr>
<td><img src="image8" alt="Symbol" /></td>
<td>Machine data display 3</td>
</tr>
<tr>
<td><img src="image9" alt="Symbol" /></td>
<td>Long-term machine data display 1</td>
</tr>
<tr>
<td><img src="image10" alt="Symbol" /></td>
<td>Long-term machine data display 2</td>
</tr>
<tr>
<td><img src="image11" alt="Symbol" /></td>
<td>Long-term machine data display 3</td>
</tr>
<tr>
<td><img src="image12" alt="Symbol" /></td>
<td>Sensor or scaling display</td>
</tr>
<tr>
<td><img src="image13" alt="Symbol" /></td>
<td>Interbus-S diagnosis display</td>
</tr>
<tr>
<td><img src="image14" alt="Symbol" /></td>
<td>Password entered correctly, or parameter can be changed, or key-operated switch in the configuration mode</td>
</tr>
</tbody>
</table>

### Spreader Display, with indication of the flippers and twistlocks:

- **Probe Pin not operated and twistlock open**
- **Probe Pin not operated and twistlock closed**
- **Additional twistlocks visible only for twin lift**
- **Flipper down**
- **Flipper Up**
- **Probe pin operated and twistlock open**
- **Probe pin operated and twistlock closed**
- **Spreader length in feet**
## LAYOUT OF CONTROLS

**EMS-2 DISPLAY 1**

<table>
<thead>
<tr>
<th>TROLLEY POSITION</th>
<th>24.1 [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>NETT LOAD</td>
<td>68.5 [t]</td>
</tr>
<tr>
<td>HEIGHT</td>
<td>12.4 [m]</td>
</tr>
<tr>
<td>DEPOSIT POINTS</td>
<td></td>
</tr>
<tr>
<td>TWISTLOCKS CLOSED</td>
<td></td>
</tr>
<tr>
<td>TWISTLOCKS OPEN</td>
<td></td>
</tr>
<tr>
<td>NETT LOAD HEIGHT</td>
<td>92.4</td>
</tr>
<tr>
<td>TROLLEY POSITION</td>
<td>14.2</td>
</tr>
</tbody>
</table>
LAYOUT OF CONTROLS

EMS-2 DISPLAY 3

X = 134 +

Y = E -

Z = 3 *

+ = Difference for the next container
- = Difference from the previous container
* = Container in position

LOAD

DEPOSIT POINTS

TWISTLOCKS CLOSED

TWISTLOCKS OPEN
LAYOUT OF CONTROLS

EMS-2 DISPLAY 4

LOAD

SPREADER SYMBOL WITH INDICATION OF THE FLIPPERS, TWISTLOCKS AND PROBE PINS OR DEPOSIT POINTS

LIST ANGLE

TRIM ANGLE

SKEW ANGLE

0.0

-3.9

-16.3

8.2

[°]

[°]

[°]
LAYOUT OF CONTROLS

EMS-2 DISPLAY 5

LOAD 68.5 [t] 82.4 [t]
HEIGHT 12.4 [m] 14.2 [m]
TROLLEY -24.1 [m] 30.1 [m]
GANTRY -69.4 [m] 34.4 [m]

Spreader symbol with indication of the flippers, twistlocks and probe pins or deposit points

List angle 5.9 [m] 4.9 [m]
Trim angle 10.1 [°] 13.2 [°]
Slew angle 0.0 [°] 0.0 [°]
Slew angle -58.1 [°] 29.3 [°]
LAYOUT OF CONTROLS

EMS-2 DISPLAY 6

LOAD HEIGHT

SPREADER SYMBOL WITH INDICATION OF THE FLIPPERS, TWISTLOCKS AND PROBE PINS OR DEPOSIT POINTS

LIST ANGLE
TRIM ANGLE
SKEW ANGLE

HOIST POSITION
TROLLEY POSITION
GANTRY POSITION

HOIST POSITION
TROLLEY POSITION
GANTRY POSITION
3. **STARTING THE CRANE**

To put the RTG into service for any period of time, two steps must be taken which are:

- Start Main Diesel.
- Start RTG Drives.

Before starting the RTG, please ensure that the following items have been checked:

(a) Ensure that all fuel levels are okay.
(b) Ensure that chock blocks are away from wheels and properly stowed.
(c) Ensure all diesel e-stops are in the RESET / ON position.
(d) Ensure that main diesel is in auto-run mode.

**NOTE:** Main Diesel to be in this mode all times except when maintenance work is being carried out on Diesel / Generator Set

3.1 To Start Main Diesel

Proceed to RTG Main Entry E-House Entry. Diesel Control Panel located on ladder. Press green pushbutton (DIESEL ON) If Diesel refuses to start, suspend all operations until fault is rectified OR

OR

Proceed to Driver’s Cabin.
Press illuminated Push Button Diesel ON on Left Hand Control Console. The push-buttons light will flash for a few seconds until the main diesel is up and running and then it will illuminate constant. If this light remains flashing, this means there is a problem with starting the main diesel, therefore further operations should be suspended, the fault determined and rectified.

Prior to switching RTG drives ON, ensure:

(a) All joysticks are in Neutral.
(b) Electrical fault lamp / buzzer are OFF.
(c) Anchor pin is released - status light should be OFF (Status light illuminated indicates anchor pin is anchored in place).
(d) All emergency stops are in the RESET/ON position.
(e) All gates on portal / cab entry are closed.

(f) Ensure that the status light respective to the wheel position is illuminated.

At the driver’s control console, switch on as follows:

3.2 Starting RTG drives ON

3.2.1 Press Crane ON Push-button on left hand control console. The built-in-Status Lamp will flash for a few seconds then will illuminate constant.

NOTE: Flashing light indicates that not all drives have been energised. If this happens, further operation should be suspended, the cause determined and rectified. No light indicates that all drives have not been energised.

A self-test of approx. 2 seconds duration is initiated, where upon all status lights on driver’s control console panel are switched ON to verify that same are operative.

Check that the following are operative:

- CRANE ON Status Light - Switched ON.
- SPREADER ON, Status Light, - Switched ON.
  spreader beam switched ON indicating twistlocks OPEN.

3.3. Check that the following are inoperative:

- OVERLOAD Warning Status Lamp - Switched OFF.
- OVERLOAD Status Lamp - Switched OFF.
- ELECTRICAL FAULT Status Lamp - Switched OFF.
- ELECTRICAL FAULT Audio Alarm - Switched OFF.
- DIESEL FAULT Status Lamp - Switched OFF.
- LOW FUEL LEVEL Status Lamp - Switched OFF.
- ANTI-COLLISION Status Lamp - Switched OFF.

Should any of the above be operative, crane operation should immediately be ceased, the reason determined and the necessary action taken.

3.4. A push-button for ANTI-COLLISION OVERRIDE is provided to allow bypass of travel Anti-Collision Limit Switches to allow movement of crane away from object.
3.5 Spreader is switched ON automatically when CRANE ON button is pressed. Green twistlocks Open Lamp on Spreader Beam will indicate this.

3.5.1 Spreader can be switched OFF at any time by pressing the spreader OFF button. Right Hand Console.

3.5.2 Spreader can be started by pushing CRANE ON button again.

3.5.3 A two-position selector switch is provided for spreader length selection as follows:

1 - 20ft. Spreader.
2 - 40ft. Spreader

3.6 Trim / Skew / Steering operate automatic ON with joysticks and automatic time delayed OFF after usage.

3.7 Access way lighting and main floodlighting are controlled by two switches on Left Hand Console.

3.8 Windscreen washer and wiper controlled by two switches on Right hand Console.

3.9 A three-position selector switch is provided for FAN and HEATER selection as follows:

1 - Fan and Heater OFF.
2 - Fan ON and Heater OFF.
3 - Fan and Heater ON.

3.10 Cabin Air Condition Unit is automatic start. Remote control for individual comfort settings on right-hand sidewall of cabin.

3.11 Ashtray located to front of Right Hand console.

3.12 Public Address System with floor mounted footswitch and left-hand console mounted microphone fitted in cabin. Amplifier for P.A. System mounted on outside of Right Hand Console.

3.13 Telephone System

To communicate with ground level, electrical house and numerous other points throughout crane located on side of actual left console.
4. TAKING THE RTG OUT-OF-SERVICE

NOTE

CRANE MUST TO BE TAKEN “OUT OF SERVICE” IF THE WIND SPEED EXCEEDS 72 KM/H.

WHEN PUTTING THE CRANE OUT OF SERVICE FOR ANY PERIOD, HOWEVER SHORT, THE FOLLOWING PROCEDURE MUST BE STRICTLY ADHERED TO. ONLY THEN CAN IT BE PROPERLY ENSURED THAT THE CRANE IS SAFELY PARKED AND IS CAPABLE OF WITHSTANDING THE FORCES IMPOSED BY STRONG WINDS.

4.1 Remove load from lifting equipment.
4.2 Park crane in parking area.
4.3 Park trolley in parking area at entry platform.
4.4 Hoist spreader to max. height.
4.5 Wheels should not be turned in out-of-service position. Wheel chocks used.
4.6 Switch off as follows at the driver’s control console:

(a) Ensure joysticks for all drives are in NEUTRAL POSITION.
(b) Press CRANE OFF pushbutton. The various status lights for the crane operation are switched off.

4.7 Turn off main diesel by pushing main DIESEL OFF button on the Left-hand console.

NOTE: Main Diesel on lamp will now flash repeatedly. This indicates the main diesel is in the SWITCH OFF mode. There is a time delay of approx. 1 minute before main diesel actually shuts down.

4.8 Manually lower Storm Anchor pin on Trolley.
4.9 Go to ground level.
4.10 Install chock blocks under wheels.
4.11 Plug in auxiliary power supply. This is required for lighting, heating / cooling and anti-condensation heating throughout the crane.
4.11 The following equipment on the crane is fitted with Anti-Condensation Heating:

(a) Electrical Switchgear Panels
(b) Electronic Regulator Panels
(c) Main A.C. Drive Motors
(d) Hydraulic unit motors
(e) Diesel Terminal / Electronic Panel

WARNING

THE ANTI-CONDENSATION HEATING EQUIPMENT MUST REMAIN ON AT ALL TIMES WHEN THE CRANE IS OUT OF SERVICE.

IT IS ABSOLUTELY ESSENTIAL THAT THE POWER SUPPLY TO THE ANTI-CONDENSATION HEATING IS NOT INTERRUPTED TO PREVENT CONDENSATION BUILD-UP WHICH MAY DAMAGE ELECTRICAL / ELECTRONIC EQUIPMENT AND COMPONENTS.

The Anti-Condensation heating system should be monitored regularly for correct operation.

THE MANUFACTURER WILL NOT ACCEPT ANY DAMAGE CLAIM RESULTING FROM FAILURE TO COMPLY WITH THE ABOVE INSTRUCTIONS.

WARNING

IF THE CRANE IS TO REMAIN “OUT OF SERVICE” FOR A PERIOD LONGER THAN THREE WEEKS, SPECIAL STORAGE PRECAUTIONS SHOULD BE TAKEN TO AVOID DAMAGE TO CRANE COMPONENTS. IF SUCH CIRCUMSTANCES ARISE, CONSULT THE MANUFACTURER FOR ADVICE. FAILURE TO COMPLY WITH THESE PRECAUTIONS WILL FORFEIT GUARANTEE CONDITIONS.
5. OPERATING THE RTG

5.1 HOIST UNIT OPERATION

5.1.1 OPERATION

NOTE: The master joystick for Hoist / Travel/ Twistlocks and Trolley are spring return to Zero position types.

The hoist system is controlled by means of the joystick on the right-hand control console. Forward movement of the joystick is for lowering, backward movement for hoisting. Continuously variable speeds from creep speed to full speed may be achieved in both directions.

To commence hoisting, push the joystick in the desired direction. The further the joystick is moved the faster the hoist motion will run.

“Positioning Mode” on right hand joy stick (left hand side) is for creep speed lowering of the hoist drive unit.

5.1.2 OVERLOAD PROTECTION SYSTEM (For further details, see Part 2)

The Overload Protection System provides for the safe operation of the crane/hoisting equipment.

Overload gives a visual and audible warning when the lifted load exceeds the safe working load of the crane/hoisting equipment. Further hoisting of the load is prevented and the load may only be lowered.

5.1.3 LIMIT SWITCHES

Limit Switches are incorporated in the hoist control system, which provide for the proper functioning of the hoist “up” and “down” functions.

The following limit switches are provided:

**Hoist Up / Down**

Rotary limit switch coupled to hoist rope drums, incorporating the following functions:

**Hoist Prelimitation Up**

Slows the hoist up motion to creep speed close to the maximum hoist up position.

**Hoist Up**

Stops the hoist up motion at the maximum hoist up position.
Hoist Prelimitation Down

Slows the hoist down motion to creep speed close to the ground when lowering.

Hoist Down

This stops the hoist down motion at the maximum hoist down position.

Hoist Overspeed

This stops the hoist motion, when the hoist drum exceeds 10% faster than rated speed.

Hoist Up Emergency Stop

A proximity limit switch is mounted on the trolley, which provides for an emergency stop hoist ‘up’ position. In the event of this limit switch being activated, maintenance personnel should be notified to reset the electrical control, which prevents further hoist equipment motion, the hoist should then be carefully lowered, and the cause of the failure established.

5.1.4 HOIST HEIGHT POSITION

A potentiometer coupled to the rotary limit switch at the hoist rope drum provides for visual indication of hoisting height on the EMS display panel in the driver’s cabin.

NOTE: IN THE EVENT OF EQUIPMENT MALFUNCTION, CRANE OPERATION SHOULD IMMEDIATELY BE STOPPED, THE EXACT SEQUENCE OF FAILURE NOTED AND MAINTENANCE PERSONNEL NOTIFIED. THE REASON FOR MALFUNCTION OR FAILURE SHOULD BE DETERMINED AND CORRECTED IMMEDIATELY.

5.2 TROLLEY DRIVE SYSTEM OPERATION

5.2.1 OPERATION

NOTE: The master joysticks for Hoist / Travel / Twistlock and Trolley are spring return to zero position types.

The trolley system is controlled by means of the joystick on the left-hand control console. Forward movement of the joystick is for trolley forward motion, and reverse movement for trolley reverse motion. Continuously variable speed from creep speeds to full speed may be achieved in both directions.

To commence trolleying, push the joystick in the desired direction. The further the joystick is moved, the faster the trolley motion will run.
Limit switches are incorporated in the trolley control system which provide for the proper functioning of the trolley "forward" and "reverse" motions.

5.2.2 LIMIT SWITCHES

The following limit switches are provided:

**Forward Main Beam Stop**
Stops the trolley forward motion at the end of the Main Beam.
(Controlled by Proximity Switch)

**Reverse Mainbeam Stop**
Stops the trolley reverse motion at the end of the main beam.
(Controlled by Proximity Switch)

**Forward/ Reverse main Beam Prelimitation 25%**
Slows the trolley reverse motion to 25 % of full speed close to the end of the Main Beam.
(Controlled by Encoder)

**Reverse / Forward Main Beam Prelimitation 10%**
Slows the trolley forward and reverse motion to 10% of full speed close to the end of the Main Beam.
(Controlled by Encoder)

5.2.3. Flipper Movement

N/A

5.3 CRANE TRAVEL DRIVE SYSTEM OPERATION

5.3.1 OPERATION

**NOTE:** The master joysticks for Hoist / Travel / Twistlocks and Trolley are spring return to zero position types.

The travel system is controlled by means of a joystick on the right-hand control console. Right movement of the joystick is for travel right motion; left movement is for travel left motion. Continuously variable speeds from creep speed to full speed may be achieved in both directions.

To commence travelling, push joystick in the desired direction. The further the joystick is moved, the faster the travel motion will run.
5.3.2 ANTI-COLLISION

Lateral Anti-Collision limit switches are fitted on endcarriage 1+2. In the event of activating one of these (crane E-stop situation), press the Anti-Collision override pushbutton on the right-hand console, which allows "back-out" of crane travel operation by reverse movement of joystick.

5.3.3 ALIGNMENT AND STEERING

An RTG differs from rail mounted cranes. To maintain straight and true travel along the marked out tracks, it is necessary to do the following:

Travel right or left using joystick on right-hand console. If and when crane goes out of alignment, i.e. pulling away from track, it is possible to align it simultaneously as crane travels, the main joystick on Left Hand console can be moved to right or left to correct the alignment. This is done by increasing the speed of the far side of crane and at same time decreasing the speed of near side or vice-versa.

5.3.4 CRANE TURNING / TRAVERSING

The necessary command devices to enable crane turning and/or traversing are provided on the right-hand control console.

The following devices are provided:

1. Wheels "0" pos. – pushbutton / lamp
2. Wheels spin pos. – pushbutton / lamp
3. Wheels 90 degrees pos. – pushbutton / lamp.

To enable traversing, press pushbutton WHEELS 90 DEG. POS., when status light has switched ON and wheels are in 90 degrees pos., it is possible to move crane from current row to desired row by moving the joystick on the right-hand control console.

But pressing pushbutton WHEELS "0" pos. normal travel operation can again be resumed.

To enable circle turning, press pushbutton Wheel Spin Pos. Status Light for same switched ON. Wheels at four corners are aligned to enable crane to turn about its centre point.
5.4 SPREADER BEAM OPERATION

5.4.1 OPERATION

The spreader control is switched on via push-button CRANE ON on the driver’s control console.

A push-button for SPREADER OFF is provided for switching OFF if required.

The twistlocks are controlled via pushbuttons fitted to the topside of the right-hand joystick controller. The following buttons are provided:
- Blue button twistlocks lock.
- Yellow button Twistlocks Unlock.

Status lights fitted to spreader beam give indication of twistlocks OPEN and/ or closed status, the following lamps are provided:
- Green lamps Twistlocks OPEN
- Red lamp Twistlocks CLOSED

The telescope expand / retract functions are controlled via selector switch fitted to left side of console.

The following positions are provided:
- 20 ft position
- 40 ft position

5.5. TRIM / SKEW OPERATION

5.5.1 FUNCTION

The Trim System provides for the lowering/ raising of the ends of the spreader beam / container with respect to the horizontal by ±2.5°.

The Skew System provides for rotation of the spreader beam / container around its vertical axis by an angle of ±5% from its normal, parallel to the long travel rail position.

5.5.2 OPERATION

The Trim / Skew system is switched on via the push-button CRANE ON on the left-hand control console. For a time only, thereafter by moving either joystick or by reset to zero.

Trim and Skew are controlled via pushbuttons fitted to topside of left-hand joystick controller. To select trim or skew, just press the appropriate button until selected operation is performed.

Press Green button : “Trim Left”
Press Yellow button : “Trim Right”
Press Red button : “Skew Left”
Press Blue button : “Skew Right”

Trim and Skew motions are achieved by controlled shortening / lengthening of the hoist ropes.

Visual indication of Trim / Skew angles are provided on the EMS-Display Panel.

The left pushbutton on the front side of the left-hand joystick controller provides for Auto-Zeroing of the Trim / List system.

NOTE: Auto Reset to “Zero” of trim/skew takes place when spreader with load is raised to the one container over three height. Auto reset to “Zero” of skew takes place when trolley reverses into parking area and when the trolley enters the forward pre-10% limit zone. It is possible again to adjust skew when trolley is stopped in this area.

NOTE: IN THE EVENT OF EQUIPMENT MALFUNCTION, CRANE OPERATION SHOULD IMMEDIATELY BE STOPPED, THE EXACT SEQUENCE OF FAILURE NOTED AND MAINTENANCE PERSONNEL NOTIFIED. THE REASON FOR MALFUNCTION OR FAILURE SHOULD BE DETERMINED AND CORRECTED IMMEDIATELY.
6. CHANGING THE SPREADER

The Bromma type YSX40E spreader is specially designed for the direct rope attachment to the RTG without the use of a headblock.

To change the spreader the following steps must be taken:

1. Lower spreader to ground level. Place a timber board under each of the twist locks. Pay out the ropes (by lowering hoist) until the spreader link pieces are in a horizontal position.

2. Switch off spreader and disconnect spreader cable socket from plug on spreader. Disconnect the cable basket mountings and move the cable basket out of the way.

3. Disconnect all eight hoist ropes by removing the pins of the rope spelter sockets.

4. Attach another spreader by following above points in reverse sequence.

SEE DRAWING NEXT PAGE
CHANGING THE SPREADER

Disconnect plug before disconnecting ropes

When changing the spreader, disconnect ropes here
7.

MAINTENANCE AND INSPECTION

GENERAL

The LIEBHERR RTG must be kept in good and safe structural, mechanical, hydraulic and electrical condition at all times. The maintenance, part replacement and lubrication instructions in the different sections of this manual must be strictly adhered to.

All safety systems and devices must be operational at all times and kept in good condition.

If crane insurance, local safety standards and regulations do not insist on regular inspection, Liebherr recommends the following minimum check and test procedures for the RTG:

Six months after handover, a thorough examination of the complete RTG should be carried out by a competent person. Thereafter the thorough examination should be repeated at least every twelve months. The examination should be carried out with the RTG in operation and at rest.

It is understood that when any fault, faulty part or damage is discovered within the check intervals, a repair or replacement is arranged for immediately and not delayed until the next examination is due.

After any substantial modification or repair, an RTG overload test is required, as carried out for initial RTG commissioning. The RTG structure, mechanical, hydraulic and electrical equipment must be in safe and good condition.

After the overload test, a thorough examination should take place as described above. At the completion of the test and examination, all safety devices should be restored and checked to ensure that they function correctly.

It is imperative that complete records are kept of all above examinations and tests. Any abnormalities found and recorded must be passed on to Liebherr Container Cranes Ltd. for comment.

NOTE: Liebherr should be informed before any substantial modifications or major repair work is carried out. Carrying out modifications to the RTG without approval from Liebherr may result in the loss of the Liebherr guarantee.
7.1 SUMMARY OF MAINTENANCE AND LUBRICATION

Introduction

The importance of regular routine preventative maintenance cannot be over stressed. The benefits arising from a properly organised and scheduled maintenance programme are:

a. Maintenance in itself ensures that the RTG and its components are maintained in good operating condition, thus ensuring minimum crane operation downtime.

b. Machine and component inspection which form a large and crucial part of a good maintenance programme, in many instances highlight potential problems which though not of immediate consequence, could prove to be problematic in the long term.

c. Equipment functionality checks and tests are extremely important particular with respect to safety features and devices.

The maintenance programme detailed in the following pages is provided as a general purpose guideline only. It neither claims to be totally comprehensive nor fully accurate in all details, with respect to any given RTG. It does however, provide a solid foundation on which a comprehensive maintenance schedule for a particular RTG may be built and / or customised.

It should also be noted that in particular the maintenance time intervals indicated are approximate. In reality, these intervals should depend on RTG usage and therefore may need to be adjusted accordingly.

See also various sections in the Manual for more specific details. See also page detailing oil/grease type and quantities.

If Lubricant Laboratory Tests are required they can be provided by LIEBHERR at a fee per item prior to lubricant changes if required.
<table>
<thead>
<tr>
<th>Maintenance Interval</th>
<th>RTG Area</th>
<th>RTG Component</th>
<th>Maintenance Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Weekly</td>
<td>Crane Travel System</td>
<td>Motors, Couplings, Brakes, Axles, Axle Support, Wheels, Personnel Guards, Bindings</td>
<td>Visual inspection of all components. Check for undue noise, vibration. Check for oil leaks on axles. Check tyre pressure and pump if below 10.0 Bar. Check wheel alignment indicator brackets.</td>
</tr>
<tr>
<td>1.2 Weekly</td>
<td>Trolley Travel System</td>
<td>Motors, Hubs, Brakes, Gearboxes, U J S Wheels, Buffers (on main beam)</td>
<td>Visual inspection of all components. Check for undue noise, vibration. Check for oil leaks in Gearboxes.</td>
</tr>
<tr>
<td>1.3 Weekly</td>
<td>Hoist System</td>
<td>Motor, Coupling, Brake, Gearbox, Rope clamps to drum, Pulleys</td>
<td>Visual inspection of all components. Check for undue noise, vibration. Check Rope Clamps for tightness.</td>
</tr>
<tr>
<td>1.4 Weekly</td>
<td>Hoist O/L System, Hoist Rope to Spreader attachment</td>
<td>Torque Reaction Arm, Load Cell Arrangement, Hoist Rope Attachment to spreader</td>
<td>Visual inspection of Overload system including load cell mounting, rope anchorage to spreader.</td>
</tr>
<tr>
<td>1.5 Weekly</td>
<td>Hydraulic Wheel Turning / Locking System</td>
<td>Hydraulic Tank Unit, Hoses, Valve Blocks, Rams, Axle Supports, Tie Rods</td>
<td>Visual inspection of all components, Hydraulic tank, motor, coupling, pump, oil level, valves, hoses, rams, all bindings. Check for oil leaks.</td>
</tr>
<tr>
<td>1.6 Weekly</td>
<td>Hydraulic Skew / Trim System</td>
<td>Hydraulic Tank Unit, Hoses, Valve Blocks, Rams, Skew / Trim Levers and Pulleys</td>
<td>Visual inspection of all items in this area including hydraulic tank, motor, coupling, pump, oil level, valves, hoses, rams, pulley levers including transducer. All bindings. Check for oil leaks.</td>
</tr>
<tr>
<td>1.7 Weekly</td>
<td>Main Diesel Generator Set</td>
<td>Main Diesel Generator Set</td>
<td>Separate Manual</td>
</tr>
</tbody>
</table>
## Maintenance Interval

<table>
<thead>
<tr>
<th>Maintenance Interval</th>
<th>RTG Area</th>
<th>RTG Component</th>
<th>Maintenance Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>Weekly</td>
<td>Auxiliary Diesel Generator Set</td>
<td>N/A</td>
</tr>
<tr>
<td>1.9</td>
<td>Weekly</td>
<td>Spreader</td>
<td>Separate Manual</td>
</tr>
<tr>
<td>Maintenance Interval</td>
<td>RTG Area</td>
<td>RTG Component</td>
<td>Maintenance Instructions</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------</td>
<td>---------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>2.1 Monthly</strong></td>
<td>Crane Travel System</td>
<td>Motor, Brakes, Couplings</td>
<td>Check general condition in particular for excessive play of flexible inserts in the couplings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brakes</td>
<td>Visual check for proper operation (see more detailed 3 monthly check).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Axles</td>
<td>Check general condition. Check for oil leaks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slewing Bearings</td>
<td><strong>Lubricate</strong> slewing bearing while axle assembly is rotating.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wheels, Personnel Guards, Bindings</td>
<td>Visual inspection. Check wheel nuts for tightness.</td>
</tr>
<tr>
<td><strong>2.2 Monthly</strong></td>
<td>Trolley Travel System</td>
<td>Motors, Gearboxes, U J S.</td>
<td>Visual inspection of all components. Check for undue noise, vibration, gearbox, oil leaks, and brake. Check for excessive play of U J S.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wheels, Trolley Rails</td>
<td>Check visually for undue wheel flange wear. Check visually for trolley rail wear.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Buffers, Cabin Supports</td>
<td>Visual check.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rope Guards</td>
<td>Check for alignment over pulleys.</td>
</tr>
<tr>
<td><strong>2.3 Monthly</strong></td>
<td>Hoist System</td>
<td>Motor, Gearbox, Coupling</td>
<td>Visually check general condition. Look for play, undue noise, and vibration during motor rotation in both directions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coupling, Motor Lantern</td>
<td>Check coupling for play, wear of flexible elements and bindings. Check motor lantern bindings to gearbox and motor. Ensure motor lantern drain hole is open.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brake</td>
<td>Visually check for proper operation. Check for oil leaks. Check pad alignment and wear. Check disc surfaces, inspect bolt bindings including brake disc to gearbox shaft.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gearbox</td>
<td>Check visually for undue operating noise.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rope Drum, Plummer Blocks, Rope Clamps</td>
<td>Check visually all areas for undue noise, vibration. Check for lubricant leaks from plummer blocks at outer end of drum and gearbox end. Check bindings of rope clamps, plummer blocks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rope Drum</td>
<td>Check binding bolts rope drum to driven flange for tightness.</td>
</tr>
</tbody>
</table>
## Maintenance Interval

<table>
<thead>
<tr>
<th>Maintenance Interval</th>
<th>RTG Area</th>
<th>RTG Component</th>
<th>Maintenance Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4 Monthly</td>
<td>Hoist Overload System, Hoist Rope to spreader attachment</td>
<td>Hoist Overload System, Hoist Rope to spreader attachment</td>
<td>Visual inspection of all items on Overload System including Load Cell Mounting. <strong>Grease</strong> pins / spherical bearings of load cell arrangement. Check bindings, including torque reaction arm to gearbox. Check all bindings of ropes to spreader for tightness.</td>
</tr>
<tr>
<td>2.5 Monthly</td>
<td>Hydraulic Wheel Turning / Locking System</td>
<td>Hydraulic Tank Unit Hoses, Valve Blocks, Rams, Axle Supports, Tie Rods</td>
<td>Check for oil leaks. <strong>Check Oil Level.</strong> Check hoses, valve blocks and hydraulic rams for leaks. Check for undue noise during operation. Visual inspection of all components, Hydraulic tank, motor, coupling, pump, oil level, valves, hoses, rams, all bindings.</td>
</tr>
<tr>
<td>2.6 Monthly</td>
<td>Hydraulic Skew / Trim System</td>
<td>Hydraulic Tank Unit Hoses, Valve Blocks, Rams, Skew/Trim Levers and Pulleys</td>
<td>Check for oil leaks. <strong>Check Oil Level.</strong> Check hoses, valve blocks and hydraulic rams for leaks. Check for undue noise during operation. Visual inspection of all components, Hydraulic tank, motor, coupling, pump, oil level, valves, hoses, rams, all bindings.</td>
</tr>
<tr>
<td>2.7 Monthly</td>
<td>Trolley Platforms</td>
<td>Pulleys Platforms</td>
<td>Check pulley grooves. <strong>Grease pulley bearings.</strong> Check pulley bindings for tightness. Check security of platforms.</td>
</tr>
<tr>
<td>2.8 Monthly</td>
<td>Spreader</td>
<td>Spreader</td>
<td>Visually inspect cable basket. Check security of cable basket to spreader and hoist-up emergency stop striker to cable basket. Grease spreader cable.</td>
</tr>
<tr>
<td>2.9 Monthly</td>
<td>Hoist Ropes</td>
<td>Hoist Ropes</td>
<td>Visual check of ropes. Depending on usage and environment, grease at intervals from 2 months up to 6 months.</td>
</tr>
<tr>
<td>2.10 Monthly</td>
<td>Energy Chain Trough Cables</td>
<td>Energy Chain Trough Cables</td>
<td>See Igus Instructions</td>
</tr>
</tbody>
</table>
## RTG MAINTENANCE SCHEDULE - 3 MONTHLY INTERVAL

<table>
<thead>
<tr>
<th>Maintenance Interval</th>
<th>RTG Area</th>
<th>RTG Component</th>
<th>Maintenance Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>3-Monthly</td>
<td>Crane Travel System</td>
<td>Motors: See Electrical Maintenance Instructions. Check bindings, check play of inserts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Couplings:                                                                          Check bindings, check play of inserts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brakes: Check brake setting and pad wear.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Check thruster movement, add oil if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Axles: Check oil level. Check for leaks. Check binding to axle support.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slewing Bearing: Check slewing bearing bindings for tightness.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Personnel Guards: Check any loose bindings, damage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rocking Beams: Lubricate pins (may require more frequent greasing in severe climatic conditions).</td>
</tr>
<tr>
<td>3.2</td>
<td>3-Monthly</td>
<td>Trolley Travel System</td>
<td>Motors: See Electrical Maintenance Instructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Gearboxes: Check for leaks, check oil levels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Universal Joint Shafts: Grease telescoping spline joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wheels: Lubricate wheel support bearings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trolley Anchor: Check for correct functioning. Check all bindings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cabin Gates: Check gates on cabin and on leg platform for tight bindings and proper operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Buffers (on Main Beam): Check condition and binding bolts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bindings: Check throughout trolley, cabin and general area. Trolley gearbox mounting.</td>
</tr>
<tr>
<td>Maintenance Interval</td>
<td>RTG Area</td>
<td>RTG Component</td>
<td>Maintenance Instructions</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------</td>
<td>---------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>3.2</td>
<td>Trolley Travel</td>
<td>Trolley travel limit switch and encoder arrangement.</td>
<td>Check for correct operation. Check all bindings on trolley and on main beam (strikers)</td>
</tr>
<tr>
<td>3.4</td>
<td>Hydraulic Wheel Turning / Locking System</td>
<td>Hydraulic Tank Unit Hoses, Valve Blocks, Rams, Axle Supports, Tie Rods</td>
<td>Visual check of all items. Check oil level of tank according to hydraulic maintenance instructions. Check oil pressure during operation. Check for oil leaks. Grease hydraulic ram to RTG connections and tie rod bearings.</td>
</tr>
<tr>
<td>3.5</td>
<td>Hydraulic Skew / Trim System</td>
<td>Hydraulic Tank Unit, Hoses, Valve Blocks, Rams, Skew / Trim Levers and Pulleys</td>
<td>Visual check of all items. Check oil level of tank according to hydraulic maintenance instructions. Check oil pressure during operation. Check for oil leaks. Grease hydraulic ram to RTG connections, transducer bearings and skew/trim lever bottom bearings.</td>
</tr>
<tr>
<td>3.6</td>
<td>Hoist Ropes</td>
<td>Hoist Ropes</td>
<td>Check ropes throughout their length. Grease hoist ropes.</td>
</tr>
<tr>
<td>3.7</td>
<td>Access System</td>
<td>All stairs, ladders, platforms including generator set platform.</td>
<td>Walk over entire crane. Check complete security of access system. Ensure all bolts, nuts are secure. Check for loose panels, ladders, stair steps.</td>
</tr>
</tbody>
</table>
### Maintenance Interval and RTG Area

<table>
<thead>
<tr>
<th>Maintenance Interval</th>
<th>RTG Area</th>
<th>RTG Component</th>
<th>Cover Maintenance Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>6-Monthly</td>
<td>Wheel turning / locking and skew / trim hydraulic systems</td>
<td>First check only (afterwards every 12 months). Change return filter and breather elements on all hydraulic tank units. Check quality and cleanliness level of oil. If cleanliness is below 18/15 to ISO 4406, change oil of complete hydraulic system. Clean hydraulic valve blocks, hose end fittings, hydraulic fittings and spray with protection coating &quot;Tecyl 506&quot;.</td>
</tr>
<tr>
<td>4.2</td>
<td>6-Monthly</td>
<td>Energy Chain Trough Cables Cover</td>
<td>See Igus Instructions. Check bindings and check clearance of moving parts.</td>
</tr>
<tr>
<td>Maintenance Interval</td>
<td>RTG Area</td>
<td>RTG Component</td>
<td>Maintenance Instructions</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------</td>
<td>--------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>5.1 12-Monthly</td>
<td>Crane Travel System</td>
<td>Axles</td>
<td>First oil change after 100 working hours or 1000 km. (whichever value is reached first) and then every 1000 hrs. or 10000 km or 12 months maximum. Change oil in brake Thrustors</td>
</tr>
<tr>
<td>5.2 12-Monthly</td>
<td>Trolley Travel System</td>
<td>Gearboxes</td>
<td>First oil change after 400 working hours and then every 1500 - 5000 hrs. or 12 months maximum.</td>
</tr>
<tr>
<td>5.3 12-Monthly</td>
<td>Hoist System</td>
<td>Gearbox, Brake Gearbox output, shaft to drum tail pin connection, Rope Drum</td>
<td>First oil change after 400 working hours and then every 1500 - 5000 hrs. or 12 months maximum. Change oil in brake Thrustor, Check bolts for tightness, Check bindings drum barrel to drive flange for tightness,</td>
</tr>
<tr>
<td>5.4 12-Monthly</td>
<td>Wheel Turning / Locking and Skew / Trim Hydraulic Systems</td>
<td>Wheel turning/ locking and skew/trim hydraulic systems</td>
<td>Change return filter, and breather elements on all hydraulic tank units. Check quality and cleanliness level of oil. If cleanliness is below 18/15 to ISO 4406, change oil of complete hydraulic system. Check all bindings including associated locking plates for tightness.</td>
</tr>
<tr>
<td>5.5 12-Monthly</td>
<td>Access System</td>
<td>All Stairs, Ladders, Platforms</td>
<td>Clean and touch up with paint if applicable.</td>
</tr>
<tr>
<td>5.6 12-Monthly</td>
<td>Structure</td>
<td>Crane Steel Structure and auxiliary components</td>
<td>Visually check crane structure throughout thoroughly. It is recommended that a thorough examination by a competent person is carried out at 12 month intervals, in respect of major components and the recommendations in relation to the HSFG bolt bindings of the main structural components. Check bindings E-house to sill beam &amp; legs, Genset to sill beam, exhaust system.</td>
</tr>
</tbody>
</table>
7.3 MAINTENANCE AND INSPECTION

7.3.1. LUBRICATION CHART

The lubricant quantities shown are per unit for first filling. The exact amount of lubricant should be as indicated on the unit nameplate or as indicated by the dipstick or oil glass level.

IMPORTANT: LUBRICANT LEVELS MUST BE CHECKED AT REGULAR INTERVALS.

For additional lubrication information on other drive areas, e.g. generator sets, refer to relevant Section in Operating Manual

<table>
<thead>
<tr>
<th></th>
<th>LUBRICANT TYPE</th>
<th>APPROX. LUBRICANT AMOUNT LITRES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hoist Gearbox</td>
<td>Shell OMALA HD 320</td>
</tr>
<tr>
<td>2.</td>
<td>Hoist Brake</td>
<td>Shell TELLUS C10</td>
</tr>
<tr>
<td>3.</td>
<td>Trolley Gearbox</td>
<td>Synth. Oil CLP PAO VG 68</td>
</tr>
<tr>
<td>4.</td>
<td>Trolley Travel Wheel Bearings (8 off)</td>
<td>Shell ALVANIA R3</td>
</tr>
<tr>
<td>5.</td>
<td>Long Travel Axle, Driven</td>
<td>Shell Spirax ASX 75W90</td>
</tr>
<tr>
<td>6.</td>
<td>Long Travel Axle, Non-Driven</td>
<td>Shell Spirax ASX 75W90</td>
</tr>
<tr>
<td>7.</td>
<td>Wheel Turn Slewing Bearings</td>
<td>SHELL ALVANIA EP2</td>
</tr>
<tr>
<td>8.</td>
<td>Rope Pulley</td>
<td>Shell ALVANIA EP2</td>
</tr>
<tr>
<td>9.</td>
<td>Hoist Drum Bearings</td>
<td>Shell ALVANIA EP2</td>
</tr>
<tr>
<td>10.</td>
<td>Wheel Turning Hydraulic Unit</td>
<td>SHELL TELLUS Arctic 32</td>
</tr>
<tr>
<td>11.</td>
<td>Skew / Trim Hydraulic Unit</td>
<td>SHELL TELLUS Arctic 32</td>
</tr>
</tbody>
</table>

** 210 Litres incl. cylinders and lines.
8. CRANE SIGNS

A) PIECE LISTS

B) DRAWING SIGN LOCATION

C) RTG DATA PLATE
9. HAND SIGNALS

As Recommended in BS 5744

TRAVEL IN DIRECTION INDICATED
TRAVEL TO ME SIGNAL WITH BOTH HANDS

ROTATE WRIST OF LEFT HAND
TWIST LOCKS ON/OFF

OPERATIONS CEASE
OPERATIONS CEASE

The signaler should stand in a secure position where HE CAN SEE THE LOAD AND CAN BE SEEN CLEARLY by the driver.
Face the driver if possible.
Each signal should be distinct and clear.

Mobile Crane Signals

CLEANC AND FINGERED TO SIGNAL "TAKE STRAIN" OF THE LOAD
CLEANC AND FINGERS TO SIGNAL"TAKE STRAIN" OR "INCH" THE LOAD

IN DIRECTION INDICATED
IN DIRECTION INDICATED

SLEW
SLEW

EXTEND JIB RETRACT JIB
TELESCOPIC JIB

JIB DOWN JIB UP
DEHINCHING JIB

STOP
EMERGENCY STOP
LOWER

STOP
EMERGENCY STOP
LOWER