1. Tower crane terms

Generally, about cranes

For operating a crane, a crane operator certificate is always required.

A crane can be characterized as a equipment for transport and movement of loads both vertically and horizontally. The load is freely hanging in a steel wire.

Around the world there are different national rules for steel constructions. For calculations of steel structures in Europe, most crane constructions follow the German DIN standard or Swedish SIS standard. To day the EN standard are used.

Besides the calculation rules there are specifics standards in each country such as rules for wires, wire wheels (Pulleys), crane hooks and electric installations and other safety precautions to be taken into account.



- 18 Overload security
- 19 Bottom cross
- 20 Boogies
- 21 Ballast blocks
- 22 Hoist wire



















3. Safety rules and equipment

Safety Equipment

All cranes must be provided with devices to ensure against overloading and improper operation.

These devices must be designed in such a way that they can stop the crane's movements, so breakdown or other disaster not occurs.

A security mechanism that works automatically will be preferred, instead of a security device requiring action from the crane operator.

In the manual you can see which security mechanisms the crane is equipped with and how they should be checked.

Security items for tower cranes



- 01 Height stop for hoisting
- 02 Over load security
- 03 Momentum security
- 04 End stop on rails
- 05 Security on boogie
- 06 End stop for trolley
- 07 Security for turn over
- 08 Wind sail for balance

Height Stop for hoisting

Height-and depth-stop can be found in various designs, depending on the type of crane. All models works on the same principle.

On the wire drum there is mounted a mechanical device and two switches connected to the winch. One circuit breaker is functioning so that the winch will stop when there is minimum two turns left on the wire drum.

The second circuit breaker is set to stop when the hoist wire is coiled up on the drum and when there are two meter to the trolley.

By chancing the mast height it will be necessary with a new setting of the height stops.

Safety equipment.

Security devices on cranes:

- .. Height Stop for hoisting
- .. Overload device for hoisting
- .. End stop for trolley, electrically and mechanically
- .. Load Torque cell
- .. Final Stop on rails
- .. Limit on trolley
- .. Signal Appliances
- .. Emergency stop
- .. Light projectors
- .. Overturn Security

Besides the already mentioned security devices are a part ancillary equipment of importance to the safety.

Anemometer

(measuring the wind speed) shall be provided on the crane. Fig 9.

Signs

Tower cranes jib must have signs indicating how much the crane may be loaded at that point, or the position of the trolley.

Spirit level

Spirit level placed on under carriage to indicate if the crane is in level. fig. 10





Height Stop for hoisting

Height-and depth-stop is available in different designs depending on the type of crane. This applies further that all models works on the same principle.

In connection with hoist drum is mounted a mechanical device and two switches. One switch is set to load the game stopped riding when there are mine. 2 turns back on the drum. The second switch is set to stop hoisting when the hoist wire is coiled up on drum and the hen located to approx. 2 m from the trolley.

If amending the mast height a new setting will be necessary.



- 01 Driving wheel
- 02 Drum for hoist wire
- 03 Nut
- 04 Adjustable switches

Overloading Protection

Overload device is configured to disconnect at e.g. 5% overload. This ensures an automatic interruption of power when trying to hoist burdens greater than max. allowable load.



Overload

Overload device is located in such way that a pull in the wire can cause interruption of current.



01 Adjusting screw 02 Stop 03 Counter nut

Load Torque Fuse

Load Moment device is fitted on the jib wire. The purpose is to prevent the crane hoisting heavier loads than indicated at the curve shown on the load diagram for the specific crane.



01 Adjusting screw 02 Wire



- 01 Sprocket
- 02 Hoist wire drum
- 03 Rod
- 04 Adjustable switch

Overload switch

Overload switch is configured to disconnect at e.g. 5% overload. This ensures an automatic interruption of power when trying to lift loads greater than allowable load.

Overload switch is positioned so pulling of the wire, will cause cut off of the hoisting function.

Moment switch

Load moment switch is mounted on the jib stay bar. The purpose of the moment switch is to prevent the crane can to lift heavier loads than given by the load diagram, see fig. 54.

On diagram for the specific crane are values for load given at a specific reach.

Krøll crane K-200D reach 40 m, Krøll crane K-200D reach 52 m, Krøll crane K-800 reach 72m

Overload and moment can be displayed electronic by means of "Strain gage"



Max load indicator 01 Hoist winch 02 Switch 03 Inner Jib 04 Hoist wire

End stop for trolley

Cranes must be equipped with automatic end stop for trolley.

By mechanical contact the power for the trolley will be cut off before the trolley reaches end of the jib.

Signalling Equipment

Signal Apparatus such as warning light or bell, starts automatically when the crane is travelling.

Emergency stop

The emergency stop shall be located so it can be operated by operators on the ground.

The purpose of this stop is obvious. Other than the crane operator must in emergency be able to stop the crane, see fig. 58.

Projectors

Projectors, must be appropriately designed, including anti-glare.

OPERATION & SAFETY RULES

- * Every day before commencing work, all operations, braking functions, stop switches and other safety devices should be tested with care.
- The crane must be operated correctly to avoid damage or accident. Do not move the control handle immediately from neutral to max. speed or vice versa.
 Leave a time gap at each step for smooth acceleration/deceleration.
- If the crane for some unknown reason does not obey the controllers, operate the emergency stop button, which will cut all power and activate the brakes.
- * NEVER alter the setting of safety equipment.
- * Faults in the electro power or control systems must be corrected by professional personnel.
- * The crane itself, wire slings and other lifting gear should be inspected frequently by the crane operator.
- * Never allow anyone to climb up the mast when the crane is in service. Be sure that all personnel are clear of the crane and mast before starting work.
- * Always know the weight of any load lifted. Do not use the load devices as
 "scales" or limit switches as stops. These devices are safety devices only
 and not working parts of the crane mechanism. THEY ONLY FUNCTION FOR POOR
 OPERATION.
- * Before lifting a load, be sure it is slung correctly and is not "stuck" to concrete, clay, ice, etc. Remove any obstacles before hoisting a load.
- * The hook must not be lowered onto the ground, allowing the hoist rope to become slack. If this occurs, care must be taken that it is recoiled evenly and tautly on the drum.
- * Always position the trolley directly over the load to be lifted in order to avoid unequal stresses in the crane structure. Never pull loads up on the skew. Before lifting a load, tighten the hoist rope on min. speed.
- If the power supply is cut or the crane does not obey the controllers, a
 suspended load can be lowered (with care) by operating the brake manually.
- * The operator shall always stop the trolley before it fouls the trolley buffers fitted at either end of the jib. Load swings are "caught" by operating the trolley in the same direction as the swing. When the overload or load moment devices are operated, the trolley cannot travel out on the jib. If a heavy load is lifted on a short jib radius, the trolley will automatically stop in accordance with the load diagram on the specification sheet when it is being moved out on the jib.

TRADEHOUSE Crane Operator Course

OPERATION & SAFETY RULES

- TRADEHOUSE
- If a collector ring is not fitted, the electro cables between the stationary and moving structure can be twisted and damaged if the crane is slewed more than 3 or 4 turns in anyone direction without reversing to "unwind" the twist in the cables.
- * The crane must not be operated when wind velocity repeatedly exceeds 15 m/s (33 MPH), but irrespective of this max. limit, operation must be discontinued
- * if the load because of its shape or size cannot be landed safely, and
- * if it is difficult to slew the jib up against the prevailing wind (risk of overloading the slewing motor).
- * When the crane is left unattended, lock the master switch and remove the key.
 - When the crane is out of service, the brake on the slewing machinery must be released to allow the jib to swing freely. The trolley must be moved close to the mast and the hook hoisted to its top position to prevent it from fouling other objects.
 - When a rail-mounted crane is left unattended, it must be secured to the track by rail clamps to prevent drifting.

Slewing Brakes



Slewing brakes

The slewing brakes are holding brakes. When the crane is out of operation, the slewing brakes must be released by screwing out the brake nut (A) to allow the jib to weather-vane in the prevailing wing.

Before recommencing operation, the slewing brakes must be put back in the operational position by screwing the brake nut (A) in to the nuts (B).



Load moment cut-out position.

The load moment cut-out is positioned approx. 1/3 of the total stay length eye from the jib stay connection.

On cranes fitted with steel stays which taper in from the jib to a central position on the tower, the cut-out is placed below and adjacent to a stay point.

On cranes fitted with steel stays which run parallel from the jib to the tower, the cut-out is placed adjacent to the stay point.

On cranes fitted with wire stays, the cut-out is placed a minimum of 1 m (40 inches) from any intermediate stay point.

The cut-out is fitted between the two stay lines.

The screw shackle is adjusted until the total defection of the stays is approx. 40 mm (1 5/8 inch).

Position the platform (and access ladder) in relation to the cut-out for service and inspection.











TRADEHOUSE Crane Operator Course

Personal Safety Equipment

Foot protection (Safety Shooes)

Head protection (Hardhat)

Hand protection (Gloves)

Eye protection (Safety Goggles)

Hearing protection (Ear Muffs)









OPERATION

NOTES:

From this sheet onwards, instruction is given on operating the crane. Open out the double-fold sheets showing the

cabin control box layout and the ground control box.

As the instructions are studied, the position of the controls and instruments can be seen. In the interest of safety a malfunction of any safety device, indicator, lamp, push-button or controller should be reported to the person in charge of crane operation and to service.

IT SHOULD ALSO BE NOTED IN THE CRANE LOG BOOK.

ELECTRICAL PANEL

The electrical control panels and electronic equipment are built into the driver's cabin.

They are fitted with an anti-condensation heater and the cabin is cooled with an air-con.

The driver's cabin is not storage for spare parts, bolts, oil, grease etc. Please keep the area in front of the panel doors clear so there is easy access to the electrical components.

Only the crane driver and electrical maintenance staff should have possession of the key that opens the electrical panel.

There is no necessity for any other personnel to have access to the panel.

Operating Tower Cranes

Start, operate and stop

It is vital for the safety of crane work, that the crane driver not overload his crane.

Start

Daily check list before the crane is started:

- Ask for the wind direction and wind speed
- If the crane is on rails, then check that the rails are clear
- · Check that claws on rail going cranes are loosed
- Is power turned on
- Are slew brake loosed
- Are remote control unlocked
- Height Stop, limit switches, signalling devices and brakes to be tested.
- Test all crane functions
- Check that the wires will run properly on drums and pulley wheels

When the above check list is completed, then the crane is ready for operation.

Some crane suppliers have a more extensive initial procedure. Check the above mentioned with the procedure described in the manual, which is applicable to the crane. If it is more comprehensive, it naturally must be followed.

Operating

It is important for safety, that the goods are transported as careful as possible.

If the load comes in swing it must be immediately stopped.

Every object has a centre of gravity. The effect of gravity on an object can be counted as a single force that attack in the centre of gravity and is directed vertical down to ground.

Any item is reluctant to have its motion changed. If the load is stationary, it will provide resistance against being put in motion.

It is vice versa if the load is in motion. The load will continue to move and provide resistance to being stopped.

The load slings outwards by slewing because of the centrifugal force. The fact occur when objects are placed in rotations. It is known from carousels, where seats are thrown away from the axis of rotation. Gravity and centrifugal forces are measured in Newtons (N).





Trolley movement

Remember that the trolley has a brake, but the load has no brake. When you stop the trolley, the load will continue its movement

Cranes which only have one speed in trolley movement, must therefore stay in driving mode just after take-off and continue again when the load hangs vertically.

Stopping trolley movement going in the opposite sequence see fig. 93

Slewing

For slewing with cranes with one or more speeds, the same principles as in trolley movement are used.

However, most cranes are equipped with mechanics that makes a stop after starting unnecessary (Oil Coupling and BSS system, etc.)

The principle of stopping the slew movement is depending on the slew machinery the crane is equipped with. It is therefore important that the crane operator has knowledge about this. See manual.

Slew drive can be divided into two main groups:

- · Cranes, which are operated counter-current
- Cranes which are **not** operated counter-current

On cranes, which must be stopped by counter-current, the slew movement is stopped by reverse direction.

On cranes not counter-current operated, the slew movement will stop by moving stepwise down to 0.



Undercarriage

Always check whether there are special rules for operating cranes with undercarriage, see manual.



Overload

Many cranes have been exposed to turn-over, due to overload or attempted to.

Therefore remember:

- Are you as a crane operator in doubt then ask for weight of the load
- Never pull fixed objects
- Never use 'run-up' for all movements
- Never use the crane's emergency stop as ordinary stop.



Inclined Pull

Inclined Pull gives danger of overturning.



Inclined Pull	1m	2m	3m
Overload	11%	22%	33%

Never oblique pull, either by downloading a load outside the crane outreach or beside jib's vertical position.



Shock effects

If the hoisting wire breaks and the crane looses its load, the internal tension in the crane structure by will suddenly be released.

The jib will thereby tilt upwards and the whole crane go backwards. The bigger load the greater reaction.

If you land a big load with heigh speed or if you lift from ground with heigh hoisting speed, the same thing will happen.

If the crane has been subjected to shock impacts it must be carefully examined by qualified personnel, even if apparently no harm is seen at the crane.



Stopping

If the load can not be landed safely or the crane only with difficulty can slew due to wind, the crane must be stopped immediately.

If you find any error while operating or hear strange noises in the crane, you must stop operating immediately.



Stop at end at the working day

At the end of the working day rail going cranes must be locked to the rails or on a parking position

The Tower crane must be able to turn 360 degrees without colliding with other cranes, buildings, electrical wires etc.

The trolley must be placed a few meters from the tower.

Position the crane jib so it stands in the wind, (Weathervane) the slew brake must be loosened as crane can slew freely in the wind.

Radio remote box must be locked and the power turned off.

If the crane runs on shift, then remember to report any problems regarding crane to the colleague who will replace you.

BRAKES, PHASE FALL-OUT RELAYS AND INDICATORS

Brakes, hoist, slew, trolley, travel motions.

All brakes are applied by springs and opened by hydraulic pressure or electro-magnets.

In the event of any power loss, the brakes will be applied.

Phase fall-out relays

Phase fall-out relays are fitted and in the event of a fall-out of 1, 2 or 3 phases, the control system reacts in the same way as when the emergency stop button is pressed.

The system is fail safe, motor drive to all motions will stop and the brakes be immediately applied.

After the phase failure has been corrected, the green button 2 must be activated before the crane can be operated. Indicators may suffer damage through shocks.

Refrain from banging of any of the instruments or indicators. INFORM SERVICE – IF ANY INDICATOR SHOWS A "SUSPECT" READING.

GENERAL BEFORE STARTING WORK

- Adjust seat to comfortable operating position.
- Adjust controllers to comfortable position.
- Adjust heating/ventilation.
- Check window wipers, lights, etc.
- Windows should be clean.
- Check communication to ground.
- Report any defects which may impair good operation.

SHUTDOWN

In the operation-shutdown position:

- The load trolley is at the inner position.
- The hook is at max. height position.
- The slewing brakes are released.
- The machinery is switched off and the key removed.

All operating instructions begin from

OPERATION SHUTDOWN

The crane should always be left as described at the end of a work shift, if there is no immediate shift change-over.

NOTE

RAIL-MOUNTED CRANES

Rail-mounted cranes should always be left at determined parking positions with ground anchors (shoot bolts or shackles, etc.).

Before starting work the ground anchors should be released. **Shutdown** - When the crane is left the ground anchors should be re-engaged.

CONTROL SYSTEM

PRINCIPLE OF OPERATION JOYSTICK CONTROLLERS

Move the joystick controllers smoothly. On release they will return to the neutral position. The control system for hoist/ slewing/ trolley/ undercarriage motions is stepless. The electronic circuits will adjust the speed range in accordance with the position of the joysticks.

The trolley/slewing/ and the hoist/undercarriage joysticks may be moved into an angular position, enabling both motions to be carried out at the same time.

RED EMERGENCY BUTTON (7)

On depressing, all motions will stop and the brakes will be applied.

THIS IS NOT A PANIC BUTTON - THINK FIRST AND FAST!

If the joystick is in neutral position and the load is lowering at creeping speed or in steps and the icon for the hoist brake is lit green **DO NOT PRESS THE EMERGENCY STOP BUTTON!** (The load is automatically being lowered by the DC converter because the brake

is sliping. UNLOAD HOOK

IMMEDIATELY USING THE JOYSTICK! See the section "Prevention of free fall due to hoist brake failure" on page 6). If the emergency stop button is pressed when the load is being lowered the hook with load will free fall to the ground.

CONTROL RESTRICTIONS

When the joystick controllers are moved, the following restrictions under normal operation will be noted:

JOYSTICK CONTROLLER (1-2 & 3-4)

Hoist motion (1-2): Automatic reduction of speed, height and depth stop.

* Load cannot be lifted with overload.

* Load cannot be lifted with 100% moment.

Travel motion (3-4): Automatic reduction of speed, stop at each end of the track.

JOYSTICK CONTROLLER (A-B & C-D)

Trolley motion (A-B): Automatic reduction of speed and stop each end.

* Trolley motion out is stopped with 100% moment.

* Max. trolley speed out is reduced to 10% with 90% moment.

Slewing motion (C-D): There are no restrictions on the slewing motion.

NOTE: A number of other restrictions are also applicable, see the Event Indication List. There can also be fitted anti-collision equipment such as SMIE, which will restrict motions on the crane.



OPERATION & SAFETY RULES

OPERATOR CABIN

BEFORE COMMENCING OPERATION

- Adjust seat to comfortable operating position.
- Adjust controllers to comfortable height and angle.
- Adjust controllers to comfortable height and angle.
- Adjust heating/ventilation.
- Adjust sun visor (if fitted).
- Check window wipers, lights, etc.
- Windows should be clean.
- Report any defects which may impair good operation.

SAFETY

- It is the duty of the operator to ensure that the cabin is kept clean and that all fittings (lights, fire extinguishers, etc.) are in working order.
- A crane log book should be kept recording work hours, maintenance, stoppages, lubrication, checks carried out, and DEFECTS REPORTED and the person or department they were reported to.

SHUTDOWN

In the OPERATION SHUTDOWN position

- the load trolley is at its inner position
- the hook assembly is at max. height position
- the slewing brakes are manually released
- the machinery is switched off and the key No.1 removed
- the red emergency stop button No.3 is in the depressed position.

All operating instructions begin from OPERATION SHUTDOWN.

The crane should always be left as above at the end of a work shift, unless there is no immediate shift change-over.
RIGHT-HAND CONTROLLER

JOYSTICK CONTROLLER (1-2 & 3-4) : - Control of hoist winch and crane travel motion.

Movement forwards : - Hook block will lower (1)

Movement backwards : - Hook block will rise (2)

Movement to direction 1 : - Crane will travel to direction 1 (3))*

Movement to direction 2 : - Crane will travel to direction 2 (4))*

* Only applicable to rail mounted cranes.

PUSH BUTTON (5) : - Press: warning horn is activated.

KEY SWITCH (6) : - ON/OFF-switch for the crane electr. circuits. Turn to energize the motion circuits for hoist, slewing, trolley and bogies.

EMERGENCY BUTTON (7) : - Emergency stop switch. All motions will stop and the brakes will automatically be applied.

ENGAGE BUTTON (8) : - Push button for engagement of main relays and the green start lamp in the operator display. If all winches work properly the lamp is on constantly.

If one of the winches is not in operation the lamp is flashing.

LEFT-HAND CONTROLLER

JOYSTICK CONTROLLER (A-B & C-D) : - Control of trolley winch and slewing motion.

Movement forwards : - Trolley travels out (B)

Movement backwards : - Trolley travels in (A)

Movement to the left : - Slewing counter-clockwise (C)

Movement to the right : - Slewing clockwise (D)

PUSH BUTTON (E) : - Press: slewing brakes will be applied if speed is close to zero.

MOTION-FITTED LIMIT SWITCHES

HOISTING & TROLLEY MOTIONS Illustration

HOISTING TROLLEYING

- stop

- stop - max 10%

- max 10% speed - max 10% speed

- max 10% speed - stop

- stop

CRANE TRAVEL (if applicable)

Illustration

- stop with deceleration time

- max 10% speed
- max 10% speed
- stop with deceleration time

DESCRIPTION OF CONTROL SYSTEM

HOIST WINCH - Hoist: Lower:	R.H. controller (1-2) - Movement is centre backwards (1) - Movement is centre forwards (2)
TRAVEL MACHINERY Travel to direction 1: Travel to direction 2:	 R.H. controller (only rail mounted cranes) Movement is centre to position "Direction 1" (3) Movement is centre to position "Direction 2" (4)
TROLLEY WINCH Out: In:	 L.H. controller (A-B) Movement is centre forwards (B) Movement is centre backwards (A)
SLEWING MACHINERY Slewing clockwise: Slewing counter-clockwise:	 L.H. controller (C-D) Movement is centre to right (D) Movement is centre to left (C)

THE JOYSTICK CONTROLLERS ARE SPRING LOADED AND WILL RETURN TO THE NEUTRAL POSITION ON RELEASE.

THE RED EMERGENCY STOP BUTTON IS POSITIONED ON THE R.H. CONTROLLER.

- * Depressing this button will immediately apply the brakes to all operations USE ONLY IN AN ABSOLUTE EMERGENCY!
- After use the hoist brake and all the control operations of the crane must be checked before resuming normal work.

IF ANY FORM OF SHOCK-LOADING HAS TAKEN PLACE, THE CRANE MUST BE CHECKE AND TEST LOADED.

TO START

- * Lift the red emergency stop button (if depressed).
- Insert the key (R.H. control pos. 6) and turn it clockwise)
- Press the engage button (R.H. control pos. 8). The green start lamp in the monitor display will beON constantly if all drives are started up. If one or more drive does not start up the lamp will flash.

THE CRANE IS NOW READY FOR USE. ALL MOVEMENTS OF THE JOYSTICKS SHOULD BE MADE AS STEADY AND PRECISE OPERATIONS.

HOIST WINCH OPERATION

The speed range of the winch is stepless in that the electronic circuits will adjust the speed according to the position of the joystick and the load on the hook.

 When the joystick is moved out from the neutral position, the brake is opened and the hoist winch is in operation. The green lamp for "Hoist brake free" on the monitor

display panel will be on.

• Return the joystick to the neutral position and the winch will ramp down, stop and apply the brake.

The brake lamp will switch off.

COUPLED SAFETY DEVICES TO HOIST WINCH

Emergency Stop Button - as described.

Depth Stop

The depth stop is fitted with 1 contact.

• One contact is set so - when activated - the winch will stop close the brake with a min. of 3 turns hoist rope remaining on the drum.

Height Stop

The height stop is fitted with 2 contacts:

- One contact is set so when activated at a determined height the hoisting speed is reduced to max. 10% for the remaining distance until 2nd height stop is activated.
- One contact is set so when activated at a determined distance between trolley and hook block the winch will stop and the brake is applied.

By pressing the hoist override push button (14) in the operator display the hook block may be moved past the height limit for changing over wire parts, see page 1.7.

Overspeed surveillance

The overspeed supervision is totally independent of the DC-thyristor converter. The overspeed supervision consists of a perforated disc and a counter on the hoist drum. The counter is connected to a counter relay in the electrical panel. If the drum speed exceeds 110% of maximum speed, the counter relay will cut out the main contactor of the winch and thereby immediately apply the brakes.



Prevention of free fall due to hoist brake failure.

The hoist speed is continuously monitored via an encoder or tacho generator. If the hoist brake should slip (i.e. bad maintenance of brake and brake lining) and the crane is started up the DC converter will pulse automatically and "catch" the hook from falling to the ground. The converter will either lower the load in steps or slowly lower the load, which gives the crane driver time to take control of the hoist via the joystick

and put the load on the ground. This function will prevent a load from free falling to the ground and most importantly prevent a person on the ground from being injured or even killed.

There is no alarm for this in the display so if the crane driver is not operating the hoist joystick, the load is automatically lowering at creeping speed or in steps then the brake cannot hold the load on the hook.

IMPORTANT: DO NOT PRESS THE EMERGENCY STOP BUTTON OR THE HOOK WILL FALL TO THE GROUND!!

Instead the crane driver must take over the control of the winch via the joystick and lower the load to the ground and inspect the hoist brake immediately.

NOTE: This function is only functional when the crane is started up via the key switch and engage button so the main contactor and circuits for the hoist are engaged and operational. Moment Device

* A yellow warning lamp in the monitor display indicates that the winch is lifting 90% of the allowed load.

* A red warning lamp in the monitor display indicates that the winch is lifting 100% of the allowed load.

* The winch will stop and the brake be applied on 100% allowed load. The hoisting and trolley-out motions are stopped.

Overload Device

* A yellow warning lamp in the monitor display indicates that the winch is lifting 90% of the max. load.

* A red warning lamp in the monitor display indicates that the winch is lifting 100% of the max. load.

• The hoist winch will stop and the brake be applied on 100% max. load. The hoisting motion is stopped.

•

TRAVEL OPERATION

The speed range of the drive is stepless. The electronic circuit will adjust the speed according to the position of the joystick.

* When the joystick is moved out from the neutral position, the brakes are opened and the crane will travel.

* Return the joystick to neutral position the crane will ramp down and stop the travel machinery and apply the brakes.

COUPLED SAFETY DEVICES TO TRAVEL MACHINERY

Travel Limit Switches

One of the bogies are fitted with a switch which operates as follows:

* At a determined distance from the rail buffers the travel movement is automatically decelerated to reduced speed of 10% until 2nd travelling stop is activated.

* At a determined distance from the rail buffers the travel movement is automatically decelerated to stand still and the travel machinery is stopped.

• A bell or siren will sound constantly when the crane is travelling.

TROLLEY OPERATION

The speed range of the trolley winch is stepless, i.e. the speed will be adjusted according to the position of the joystick controller and the load on the hook.

- When the joystick is moved out from the neutral position, the brake is opened and the trolley operational. The green lamp for "trolley brake free" on the monitor display panel will be on.
- Return the joystick to the neutral position and the trolley winch will ramp down, stop and the brake applied. The lamp for "trolley brake free" will switch off.

COUPLED SAFETY DEVICES TO TROLLEY WINCH

Trolley limit switches

The trolley winch is fitted with a switch which operates as follows:

- One switch is set at a determined distance from the 2nd final limit switch in either end of the trolley rail to reduce the trolley speed to 10%.
- One switch is set at a determined distance from the mechanical end stop to stop
- the trolley winch and close the brake.

NOTE: - The trolley-out movement will also be stopped by the moment device!

SLEWING OPERATION

The speed range of the slewing is stepless, i.e. the speed will be adjusted according to the position of the joystick controller.

- When the joystick is moved out from the neutral position, the brake is opened and the slewing operational. The green lamp for "slew brake free" on the monitor display panel will be on.
- Return to the joystick to neutral position and the slew will ramp down, stop and close the brakes. When the slewing speed is close to zero the slewing brakes can be applied by pressing the joystick push-button

(E) or the brakes will be automatically close approx. 15 sec. after reaching minimum speed. The slewing brake lamp will switch off when the brakes are applied.

CONTROLLER LAYOUT





L.H. CONTROLLER

- A-B Joystick TROLLEY IN/OUT
- C-D Joystick SLEWING RIGHT/LEFT
- E Push button SLEWING BRAKE

R.H. CONTROLLER

- 1-2 Joystick HOISTING/LOWERING
- 3-4 Joystick *) TRAVEL DIRECTION I & II
- 5 Push button HORN
- 6 Key switch ON/OFF
- 7 EMERGENCY STOP BUTTON
- 8 Push button MAIN RELAYS ENGAGE



OPERATOP DISPLAY

(1) Indication of hook load (tons)

- (2) Indication of crane moment (%)
- (3) Indication of wind speed (m/s)
- (4) Indication of hook height (m)
- The distance shown is from the jib and downwards
- (5) Indication of trolley radius (m)
- (6) Load alarm lamp
 - 90% load: Yellow lamp
 - 100% load: Red lamp
- (7) Moment alarm lamp
 - 90% load: Yellow lamp
 - 100% load: Red lamp
- (8) Wind speed alarm lamp
 - 15 m/s: Red lamp
- (9) Trolley brake engaged, Green lamp
- (10) Slewing brake engaged, Green lamp
- (11) Hoist brake engaged, Green lamp
- (12) Drives engaged, Green lamp
 - When all drives engaged the lamp is ON constantly. If one of the drives is not engaged the lamp is flashing.
- (13) RESET push button
 - Reset of alarms
- (14) Override height stop push button For wire part change over
- (15) 2 part line push button
 - Must be ON when hook is operating in 2 part line for correct load and hook height indication
- (16) 6 part line push button
 - Must be ON when hook is operating in 6 part line for correct load and hook height indication
- (17) (18) Display brightness push buttons
- (19) Change screen push button
 - For service personnel only, password protected
- (20) Events message text box
- (21) (22) Time and date

WIND SPEED INDICATOR

The wind speed indicator is positioned on the left-hand side of the cabin above the window.

THE MAX. OPERATING WIND SPEED FOR THE CRANES IS 20 m/sec. (= 45 mph - 39 knots).

The indicator reads in metres per sec. (m/sec.). A damping device is fitted for gusting wind.

An event message will appear in the display at 15 m/sec. At 22 m/sec. an acoustic alarm will sound at a low pitch. When 18 m/sec. is reached the crane supervisor should be informed.

The crane will operate up to 20 m/sec., but for loads with a large surface area the speed should be reduced.

SEMI-AUTOMATIC 2/4 LINE PART CHANGE-OVER SYSTEM PRINCIPLE OF OPERATION

The trolley is fitted with 2 spring-loaded pawls (A). The intermediate block is fitted with a centre suspension hook (B). The hook assembly has a pawl-operating plate (C).

Before the hook assembly reaches the trolley, the hoist limit switch will be operated and the hoist winch will stop. By pressing button no. 1 on the touch screen, the hook assembly may then be hoisted to change-over position on min. speed.

CHANGE-OVER WILL TAKE PLACE ACCORDING TO THE POSITION OF PLATE (C).

With the intermediate blocks in the hook assembly (2-part reeve) and the plate (C) down in pos. (1), the intermediate block will be held in the pawls (A) giving 4-part reeving on lowering the hook assembly.

With the intermediate block in the trolley (4-part reeve) and plate (C) up in pos. (2), the intermediate block will be released from the pawls (A) - the hoist rope will retain the intermediate block in the hook assembly giving 2-part reeving on lowering the hook assembly.

SAFETY PRECAUTIONS

* NO LOAD ON THE HOOK ON CHANGE-OVER.

* NO HOOK BLOCK MUST BE AT REST UNDER THE TROLLEY BEFORE STARTING THE OPERATION.

* NO ROTATIONAL WING OF THE HOOK ASSEMBLY PRIOR TO ENGAGEMENT OF THE PAWLS.

* THE CRANE OPERATOR SHOULD CHECK THAT THE INTERMEDIATE BLOCK IS PROPERLY IN MESH WHEN CHANGE-OVER HAS TAKEN PLACE.

THE CRANE

When left un-attended.

Must always be

- free to weathervane
- all rail clamp in locked position

SLINGS

The hoist rope and its fittings are an important part of the crane equipment.

HE SLINGS BETWEEN HOOK AND LOAD ARE JUST AS IMPORTANT!

The crane operator can have from his position a better overall view of the load than ground staff have.

Inform the ground staff if slinging does not seem satisfactory before lifting a load. All slings used should be subjected to test and inspection at set intervals.

TEST LOADING - GENERAL

The test loads used when the crane is erected and put into service should be kept in a convenient position. They can be lifted periodically to check the function of the load moment and overload safety devices. They may also be used to check the emergency store and hook load indicators.

• If the crane has been subjected to any form of shock loading, i.e. a load has been dropped because of a faulty sling, it must always be test loaded.

ALWAYS RECORD A SHOCK LOADING IN THE CRANE LOG BOOK AND INFORM THE CRANE SUPERVISOR IMMEDIATELY!

• Test loading should always be carried out under the direction of the crane supervisor.

• RECORD IN THE CRANE LOG BOOK ALL DETAILS OF THE TEST CARRIED OUT!



Lifting persons with tower cranes

As a main rule it is not allowed to lift persons by using a tower crane.

In special cases permission can be given, and there are special demands to the crane.

The working platform to be used must be constructed in a special way.

See Fig. 15



WIND DEFLECTORS

If a tower crane is fitted with wind deflectors in the form of name plates and sign boards fixed to the counter jib, the total resisting moment of the counter jib may increase to the extent whereby the crane - when out of service - cannot slew the jib with the wind under high wind conditions.

THIS MAY HAVE SERIOUS CONSEQUENCES!

When wind conditions are approx. 3-5 m/sec., all cranes **MUST** be checked in the following manner:

- Slew the jib, side on to the wind.
- The slewing brake(s) should be in the disengaged position.

If the area of wind deflectors is correct, the jib should now slew with the wind. If the jib remains in position:

• Reduce the area of deflectors on the counter jib.

For cranes of short jib lengths - under 25 m (82 ft) approx. - it may be necessary to remove not only the deflectors from the counter jib, but also to fix deflectors to the tip section of the jib.

The test should be repeated several times, as a sudden gust of wind can slew even an exactly balanced jib. A single test could thus give an incorrect result.

ILLUSTRATION



OPERATIONAL CRANE

When the crane is constantly in use within its normal operational area the restricted areas of operation should be used to check stop operations and conductors at least once a month.

STANDING CRANE

If the crane is not to be used for a period of time, the hoist, trolley, slewing and travel motions should be run over their operation distance at least once every 2 weeks.

Inspection and Lubrication.

At smaller sites it is often the crane operator who will perform the necessary lubrication, checking oil levels and other check routines.

During execution of this work, he shall inspect the crane and observe irregularities and report them to the proper authorities.

At bigger companies it is often such that the crane operator should only operate the crane. There are service crew that are specialized in lubrication service and repair.

A crane operator must never intervene in the adjustment of overload and momentum safety device. Interference with the electrical system is **absolute not allowed**.

In the manual for the crane, you can see how the crane should be lubricated.

Crane Suppliers often suggest a wide range of lubricants and different brands to choose from. In the crane manual tables indicating lubrication points and intervals are given. The intervals may be days, weeks, months, years or operating hours.

The manufacturers instruction must always be followed.



LUBRICATION GENERAL HINTS

Constant readiness for operation and high life deserve the slight effort of regular and conscientious lubrication. Prior to crane assembly effect the necessary oil change. We request that the following are complied with in detail:

Danger!

For lubrication and maintenance operation also conform to protective and accident prevention regulations and comply with the valid special regulations at the resp. jobsite. Take the crane out of operation. Secure danger areas at and in the slewing crane (an unintentional taking into operation of the crane mustn't be possible).

Used oil mustn't be poured out in the environment, nor mixed to household rubbish or being burnt in not licensed facilities.

Preventive environment protection secures our future and our living standard and is more economic.

Lubrication points and lubrication periods:

Under particularly heavy loading, severe development of dust or very wet conditions, it may be necessary to maintain the crane more frequently than stated in the lubrication instructions. The enclosed lubrication instructions provide an overview of all lubrication points, filling quantities and the associated lubricants and lubrication periods. The following is of interest for the lubrication points.

Roller bearings:

All roller bearings except for the bearings in the gearboxes are provided with grease filling in the factory. Under normal operation, it is sufficient to check the bearings around halfyearly. The roller bearings of rope pulleys and rollers without possibility of lubrication have permanent life lubrication for maintenance-free operation.

Attention!

The lubrication of the ball race bearing requires special care. Here we urgently request that the lubrication and maintenance instructions for the ball race bearing are complied with. Separate lubrication and maintenance instructions are also binding for the electric motors. **Gears:**

All gears are filled with oil in the factory. You have to change the oil after 2000 hours of operation, at least every two years unless other lube intervals are stated. You only may use one of the prescribed quality oils. Oils with different basic oils mustn't be mixed with one another (e.g. mineral oil with synthetic oil). If large grain abrasion (more than 25 μ m) or flashes of material of the gear flanks are ascertained, the gear must be generally checked by visual inspection. The gear must be generally overhauled in the case of features such as scores, seizing, formation of pits, flaking, cracks and plastic deformations of gear wheels. **Ropes:**

Regular maintenance and good lubrication increase life. At least as soon as bare places show, lubricate with oils specified for this the total length of the ropes. The lubrication instructions resp. lubrication instructions of the rope manufacturer must be complied with for the ropes.

For all other lubrication points we request you to comply with the lubrication and maintenance instructions.

Danger!

You only may take a ready for work slewing crane into operation (covers and protection devices must be installed).

LUBRICATION



								_	
	A	в	С	D	E	F	G	н	J
See table	4/3	4/3	4	4/3	2/1	7	7	5	12
Including in a 10-day program	✓	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	~	\checkmark	\sim
Max number of weeks between oil change/lubrication	4	12	52	۱	52	1	4	52	52
Max number of operating hours between oil change/ lubrication	100	250	2 5 00	20	2500	50	100	2500	2500

Temperaturområde +10° til -30°C "+45° " -20°C

Lubrication – Trolley Winch



Grease quantity in Gearbox: approx. : 4.5 litre (Pos 1) and 0.6 litre (Pos 2)

Lubrication chart: INFO No. 2300 Lubricants: INFO No. 2102





NOTE: Trolley and Hoist ropes must NOT be greased

Lubrication chart:	INFO No. 2300
Lubricants:	INFO No. 2102

Lubrication – Trolley and Hook block





Lubrication chart: Lubricants: INFO No. 2300 INFO No. 2102

Lubrication – Slewing bearing ring



The bearing to be greased with Krøll lubricant No. 3 after every 20 hours operation or, alternatively, a minimum of once a week, unless the is fitted with an automatic greaser unit.

Under no circumstances may molybdenum disulphide lubricants be used for the bearing. The teeth should be greased with Krøll lubricant No. 7 after 10 hours operation or alternatively a minimum of twice a week.

If dry lubrication is preferred, use Krøll lubricant No. 9 or No. 10.

Pressed-out grease should be removed in order that ladders and platforms do not be come slippery.

Lubricants:

INFO No. 2102

Lubrication – Slewing machinery



Grease quantity in Gearbox: approx. : 11 litre

Lubrication chart:	INFO No. 2300
Lubricants:	INFO No. 2102

Lubrication – Hoist Winch



Grease quantity in Gearbox: approx. : 15 kg

Lubrication chart:	INFO No. 2300
Lubricants:	INFO No. 2102

SMØRING / LUBRICATION

SMØRESKEMA LUBRICATION CHART

	1						r			1			1		
SMØREMIDDEL	+ 10 ÷ 30° C		4	2	12	7/9			5	7/9 3		3	4		
LUBRICANT	15 . 309 C			2										3	
	[+ 45 ÷ 20° ℃			,		1							<u> </u>	-	5
POSITION	227 AND 100 AND	A	В	с	D	E	F	G	н	J	к	L	м	N	0
METODE METHOD															
MAX. PERIODE I UGER	KONTROL CHECK					1	4	1	4	1			12	52	4
	SMØREINTERVAL LUBE INTERVAL	4	12	25	1						12				*
MAX. PERIOD IN WEEKS	SKIFT CHANGE	×				5	2			52					
MAX. ANTAL DRIFTSTIMER	KONTROL CHECK					100	100	50	100	20		8	250	2500	100
MAX. NUMBER OF OPERATION	SMØREINTERVAL LUBE INTERVAL	100	250	1250	20						250				*
HOURS	SKIFT CHANGE			10	1000										
1	EVT. SMØRING LUBE IF REQUIRED							•	•			•	•		
	EFTERFYLDES, NÅR FYLDMÆNGDEN ER NEDE PÅ CA. 1/9 AF MAXIMUM. * REFILL WHEN APPROX. 1/5 OF THE MAX. FILLING IS LEFT IN THE TANK.														

DANSK - BEMÆRKNINGER

De fleste rulningslejer er livstidssmurte og kræver ingen smøring.

Pos. E: Første skift af olie i gearkasser foretages efter 12 uger eller 250 driftstimer. Gearkasser skal udskylles med skylleolie, før ny olie påfyldes.

ENGLISH - NOTES:

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Most ball/roller bearings are lifetime sealed and require no greasing.

Pos. E: First change of oil in gearboxes after 12 weeks or 250 operating hours. Clean out the gearboxes with flushing oil before filling in new oil.

SMØREMIDLER : LUBRICANTS : INFO NO.: 2102

LUBRICANTS EUROPEAN TYPE DESIGNATIONS

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		0.0000												
		- ATNO		Slewing Ring & King Pin assemb.			Winter		Summer					
SPECIAL			Lubral MP 2				Molykote W Ferro Gard Sp. Medium 12%		Molykote X Molypan K	Ferro Gard Molymax				Silicon Grease
MOLUB- Alloy	Gear Oil 90	Gear Oil 80	BRB 572	BRB 572-1			OG Grease 882 EP Medium	MWO-30	OG Grease 882 EP Heavy		Gear Oil 140	Grease 0 *)		- (41)
CASTROL	Alpha SP 220 Hopoy LS 90	Hopoy Light 80 Hopoy C 80W/90	APS 2 Grease LM Grease	APS 2 Grease LM Grease	Hyspin AWS/AWH 32	Hyspin VG 5	Grippa 60S Grippa 33S	Magna BD 68 Non Creep 26	MS 3 Grease Impervia MO		Hypoy C 85W/140 Hypoy C 80W/140	DK Grease *) Alpha Gel	MS 3 Grease Impervia MO	
TEXACO	Multigear Lube EP 80W/140	Multigear Lube LP 80W/90	Multifak EP 2	Regal AFB 2 Multifak EP 2	Rando Oil HDAZ-32		Texclad Spray	Way Lube 68	Molytex EP 2		Multigear Lube EP 80W/140	Marfak 00 *)	Molytex EP 2	
MOBIL	Mobilgear 629 Mobillub HD 90	Mobilgear 626 Mobillub HD 80	Mobilplex 48 Mobilgrease 77	Mobilplex 48	Mobilfluid 125		Mobiltac 81	Vectra No. 2				Mobilplex 44 *)		
ESSO	Spartan EP 150 GO GX 80 / 90	Nuto HP 68 Motor Oil 20 W	Beacon EP 2 MP-Grease	Beacon EP 2 MP Grease	Nuto HP 32		Surret Fl. 30	Millcot K 55				Fibrax 370 *)		
GULF	EP Lube S 88 MP GO 90	Mechanism LP55 Harmony AW 54	Gulfcrown Grease No. 2		Mechanism LP 47 Harmony AW 48		Lubcote Spec.	Gulfway	Gulflex Moly			Gear *) Grease 0		
SHELL	Spirax HO Multigrade 85W/140	Spirax HO Multigrade 80W/90	Alvania EP 2 Retinax A	Aero Shell Grease 14	Tellus T37	Tellus R5	Kuggspray Kuggrease	Tonna T68	HD Grease 221		Spirax HO Multigrade 85W/140	Grease S 3655	HD Grease 221	
REF.	I	7	3	. 4	5	9	7	8	6	10	Ξ	12	13	14

On delivery the cranes are lubricated with SHELL.

*) Must not be mixed with SHELL GREASE S 3655

LUBRICANTS EUROPEAN TYPE DESIGNATIONS

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												- 1		
		<i></i>												
			2											
								ŝ.						
ELF	Tranself B 85W/140	Tranself B 80W/90	Epexa 2		Hydrelf 32			Resto 68			Tranself B 85W/140			
BP	Hypogear 85W/140EP	Hypogear 80W/90EP	Energrease LS-EP 2	Energrease LS-EP 1	Energol SHF 32	Energol HP S	Energrease OG	Maccurat 68	Energrease L 21 M	1	Hypogear 85W/140EP	Energrease FG 00-EP	Energrease L 21 M	
CHEVRON	Universal Gear lube 85W/140	Universal Gear lube 80W	Polyurea EP Grease 2	Polyurea EP Grease 1	EP Hydraulic Oil 32 HV			Way Oil 68	Pinion Grease MS		Universal Gear lube 85W/140	GP Grease 0 *)		
SHELL Before 820101	Spirax HD 90	Spirax HD 80			Tellus T27	Tellus C5		-			Spirax HD 140			
REF.	1	2	. 3	4	s	9	7	8	6	10	=	12	13	14

On delivery the cranes are lubricated with SHELL.

*) Must not be mixed with SHELL GREASE S 3655

Repair and maintenance of cranes

Safety instructions

In the notices from the Labour Inspectorate there is a clause, which aims to improve safety. The requirement on crane certificate, is done to achieve crane work in a more safety way. SAFETY FIRST!

During the repair and maintenance of a crane, the crane must be stopped and secured from being started. It is recommended that the crane, regardless of the extent of a repair, must always be stopped.

If more cranes are working on the same crane track, the crane with the break down must be secured, e.g. by flashing light, lock and preferably also with signs on the other cranes.

Following text can be used: **Beware, repair at neighbouring crane.**

An efficient security against start-up can be done as shown at fig. 7

Preventive maintenance

An example of a preventive maintenance can e.g. be control of wires, pulleys and wire drums.

The crane operator may, in the review of the crane ensure that the wire winds correct on the drum. If not, the wire can break or pressure between wire parts can occur which reduce the designed lifetime. In the worst case, the wire burst upon such action.

Another example of preventive maintenance can be r e-tightening of the mast bolts in tower sections and in other places where bolts are used for assemblies or fastening.

Control of all wear parts of the crane. Brake linings can come in question, and inspection of rails and wheels.

Preventive maintenance also includes cleanliness of the crane.

Signs, posters and other markings should be kept visible and clear.

Foundation, track laying and placement Base for the crane

Tower cranes have a high centre of gravity location and a very small supporting area. It is therefore of importance for the stability that it is placed horizontal on stable surface.

Regardless that the crane is fixed or on rails, it is therefore important that the soil on which it is erected is prepared. Should the crane be operating in long time it may be necessary to take in consideration changing in weather conditions. Even a good solid ground surface can become mud unless the area is adequately drained.

Position of the cranes.

Tower cranes should not come so near each other that their jib stay can collide. In a clash between counter jibs there is the potential risk for that the counter-weights can be damage and an accident can have the tower crane to collapse. Cranes must not be able to collide.

One should also be aware of that the crane off duty can slew freely in the wind. See Fig. 23.

If a tower crane is not able to slew because of space and therefore must be tethered for the night, the supplier's guarantee of the soundness of tethering must be obtained. If the crane is placed in the immediate vicinity of overhead electric cables there are specific security considerations to be taken.





Erection of a stationary crane

As previously mentioned, the crane erected as stationary, either as cast in or on a bottom cross, see Fig. 27 and 28

The way of presenting the chosen solution dependent on how long time the crane must operate, which work to be performed and the type of crane.

There are crane types, mounted on pyramids. Pyramids provide support towards the ground. In this way the crane supporting surface increases significantly. As rule of thumb the soil load capacity is approx. 20 ton/m2 (2kg/cm2). Get always all information of the soil bearing capacity before you erect the crane. Ask the civil engineer at site.













TRADEHOUSE



- 01 Boogie 02 Ballast blocks 03 Supporting legs 04 Tower sections 05 Slewing ring 06 Stay bar 07 jib
- 08 Trolley 09 Hook block
- 10 Counter jib
- 11 Hoist winch
- 12 Counter weight
- 13 Drivers cabin
- 14 Overload security
- 15 Hoist wire

Masts designs.

Tower and jib are designed as lattice structures. A very characteristic trait for tower cranes. The lattice structure is used to minimize the surface for wind force.

Looking at the various Crane suppliers, all types of steel profiles are used.

There are used flat-iron, angles, I-profile, U-profile, box profiles and pipes, Fig. 38



and can be composed to square rectangular and triangular profiles for tower- and jib sections.

Most crane types are developed with this in mind, that they are suitable for certain tasks under certain working conditions.

It is of utmost importance that the assembly of the sections may be very accurate. Erection of the crane must be done in such a way that the crane tower is completely vertical.

To meet this requirement the manufacturers are very careful about the joints between sections.

Assembly of bolted sections have a great significance for the crane's stability.

Slewing and hoisting equipment

That the crane is slewing means that the tower rotates around its longitudinal axis. Lifting movement needs no explanation.

In order to perform those functions the crane must be equipped with the necessary power.

TRADEHOUSE



As early as in the year 1500 Leonardo da Vinci invented the worm. The picture is a copy of the original drawing, fig. 40.

The idea of this is used in many forms of gear and gear boxes. Today's engineers uses still this principle.

As previously mentioned, there are a wide range of crane brands, all types can not be shown, but the principle of operation is virtually identical for all types.

It is not the idea that you are trained as a repairman on this course, but in everyday life you can benefit from knowing how things work.

You will as a crane operator be responsible for an expensive machinery, and at least you also are responsible for other peoples security.
Slewing drives



- 01 Brake
- 02 Motor with gear box
- 03 Slew ring
- 04 Pinion

Hoist winch



- 01 Motor
- 02 Gear box
- 03 Brake
- 04 Hoist drum

TRADEHOUSE

Trolley winch



- 01 Motor
- 02 Gear box
- 03 Adjustment for trolley wire04 Trolley wire



Fig. 45.

Hoisting Ropes (hoist wires)

When replacing a hoist wire, a new test load is compelling.

There must be a certificate for the hoisting wire in the crane journal. See crane records for information about the procedure.

There are laws with requirements given for the design of crane wires and pulleys.

By hoisting equipment designed to lift persons a specific requirement is necessary.

Pulley wheels, wire drums and hook blocks.

Although all the requirements for steel wire should be satisfied there are also other factors that must be considered.

It is important that a wires are running correct over pulley wheels and wire drums and that the groove profiles have the correct profile. Small groove profiles means excessive wear and rapid deterioration of the wire.

A wire must fit correctly into the groove profiles it should have the dimension as shown in fig. 45.

To prevent the rope from wear at the drum's flanges, the distance L must be at least 20 times the drum width. For drums without grooves L must be at least 15 times the drum width.

See the following figure. 46th

There are laws for requirements for design of crane wires and pulleys. Hoisting equipment and winches designed for transport of persons shall be calculated to twice the intended maximum load.

When designing the gear the ratio principle is used and in connection with wires it is also used. With relatively little power, it is possible to hoist heavier loads when reeving the wire as shown below.

Sketch below (Fig. 47) shows reeving of wires to respectively 2, 4 and 6 parts.

With a pull at 500 kg, respectively. 1000, 2000 and 3000 kg can be lifted.



Tower crane with trolley

This section of the Compendium was initiated with descriptions of track laying, undercarriage, mast design, slew and hoisting winch.

In the section General cranes were safety equipment and data equipment described:

- .. Height stop for hoisting
- .. Overload device for hoist
- .. Momentum safety device
- .. End stop on rails
- .. Signal light and horn
- .. Emergency stop
- .. Projectors



- 01 Height stop
- 02 Overload device
- 03 Momentum safety device
- 04 End stop
- 05 Permanent brake for trolley
- 06 End stop for trolley
- 07 Overturn security



Proposals for good radio communications

Make sure there is a good connection before you begin. Test the link between the radios.

Think – press key - speak. It is important you know what you will say before you press key

Speak clearly. Keep the microphone into the chin.

Give always the message in good time.

Crane driver must be given time to react.

Always enter accurate distances (meter - feet – inches). Do not use words like "little" "a bit".

Set always the direction based on the crane position "Right" is the right of the crane, wherever the rigger is located

If the crane operator is in doubt about a message, stop the crane. It is important for safety reasons, that all messages are clearly understood.

Only use the radio to necessary communications.

Always use a sober language.





2.2 Spare parts



N°	Code	Description
2.3	F0BATT00E07A0	MH0707L battery to Nichel Metal Idrato
2.4	F0CABA01E02N0	CH260R battery charger for MH0707L (230 Vac) *
2.4	F0CABA01E03N0	CH261R battery charger for MH0707L (24 Vdc)
2.4	F0CABA01E04N0	CH262R battery charger for MH0707L (12 Vdc)
2.4	F0CABA01E05N0	CH263R battery charger for MH0707L (115 Vac)
С	F0CAVI00E20A0	24 Vdc and 12Vdc extendable cable for battery chargers

 \ast together with the code, indicate also the type of battery charger (given on the technical data plate)

The "N°" is the paragraph number that deals with the spare parts (except for the extension cable).

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Final theory test

1.	You may only leave the crane with a hanging load when: The power is cut off When the load is in top position Never For a short period	
2.	When may you perform oblique pull (out of vertical) ? Never At test load At slewing At hoisting in speed one	
3.	Which safety equipment is not required ? Height Stop Overload Stop End Stop trolley End Stop undercarriage Slewing stop	
4.	When the crane's maximum wind is exceeded, crane must stop. Where is wind speed measured? At the loading point	
5.	What is the safety factor for the hoisting wire? Half of the breaking load Third of the breaking load Fourth of the breaking load Fifth of the breaking load	
6.	If the over load device is cut off you will not be able to? Lower the load Lift the load and move it Move undercarriage Slew.	
7.	Whom is responsible for the daily inspection of the crane? The President The safety Representative The crane Operator The Service Engineer The Rigger	

8.	Firm objects may be pulled loose when: The crane's lifting capacity is not exceeded With the President's authorization Never By carefully hoist in the speed one
9.	A crane must be tested when erected and after major repairs, but how big is the test load? 105% 125% 150% 200%
10.	What is Max wind speed that a tower crane must be operated in? At a wind speed 20 m/sec As long as the crane operator likes At a wind speed 15 m/sec
11.	By changing from 2-part wire to 4- part wire you will achieve Increased lifting capacity - lower speed Heigher hoisting capacity - higher speed Less lifting capacity - lower speed Less lifting capability - higher speed
12.	Which safety equipment is blocking all manoeuvre options? Momentum Device Overload Protection Height Stop Emergency stop End stop.

TRADEHOUSE

Theory test

Which requirements must a rigger have? Which personal safety equipment must a rigger wear? Whom shall instruct a rigger? What are the rules when lifting in more than one strap? What to do if slings are damaged? How big is the safety factor for chains? How big is the safety factor for straps? Breaking load for a wire strap is 80 tons, what is the SWL? Must hooks be equipped with safety plate? How to maintain chains? When must a chain be scraped? What does SWL and WLL means? Are you allowed to splice wire ropes your self? What does safety factor means? How big is the safety factor for hooks? How much can a rope strength be reduced, if not protected against sharp edges? How to store wire rope when not in use?