# 11 MAINTENANCE

Regular maintenance is fundamental to ensure a long operative life of the machine.

The following information is intended to assist the operator or the personnel responsible for the maintenance, the use and the safety application of the maintenance procedures contained in this manual.

*Before performing any maintenance procedure, you should have great knowledge of the machine functioning and of the instructions to work in safety conditions.*

*Do not perform any maintenance or repair work on the machine that you are not able to finish.*

*Always use appropriate tools and equipment for the intervention, replace or repair worn or damaged equipment.*

*When you disassemble or install a component or a plant, complete each step in sequence.*

*Make all adjustments as required. Check again the adjustments that have been carried out*

## 11.1 General information of danger

- Carry out regularly and correctly all checks, maintenance, lubrication and greasing operations according to the procedures described in the operating and maintenance manual.
  In carrying out these operations, carefully follow the instructions regarding the possible need to remove some protection or to intervene on exposed points.
- Prior to maintenance or leaving the machine at the end of work, unless advised otherwise, rest the load, lower the boom and bring it back in, dismantle the equipment, position the crane on a flat area and use the parking brake, block the wheels or lower the stabilisers.
- Before performing maintenance or any repairs, attach a warning sign inside the cabin.
- During maintenance operations, do not allow the presence of unauthorised personnel on the crane.
- Avoid wearing loose clothing, rings, bracelets and necklaces that can get caught in machine parts.
- Wear a helmet, gloves and any other necessary suitable personal protective equipment.
- Keep the cabin, the platforms, the mudguards, the bonnet and the access steps to the machine clean from oil, diesel or grease to prevent slipping.
- Keep the machine free of foreign materials. Remove all personal items, tools and rags, which could be soaked in grease and oil, used for the maintenance.
- Wear suitable protective clothing, boots and goggles when you clean the machine with compressed air or pressurised water. Particles and debris projected by air or pressurised water can cause injury.
  The compressed air used for cleaning must not exceed pressure of 2 bar. The maximum water pressure must be less than 4 bar.
- Use all detergent solutions with care.
- Ensure that liquids do not come out during maintenance operations.
  Be prepared to collect liquids in suitable containers before getting rid of any component that contains them.

- Recuperate and recycle all used fluids. Never store liquids that have been collected in glass containers, which can break and spill the contents. Drain all liquids into closed and properly labelled containers. Never pour flammable liquids into open, wide and low containers.
- Dispose of used liquids observing the regulations in force.
- Do not run the engine indoors, except if there is an effective exhaust fume extraction system.
- Keep away from all revolving and moving parts. Leave the protections installed until maintenance has been completed.
- Check the level of the coolant fluid with the engine turned off and with the radiator cold. Make sure that the radiator cap is cool before removing it. Slowly unscrew the cap to relieve pressure. Any contact with steam or coolant fluid at high temperatures can cause severe burns.
- Do not smoke when refuelling.
- Keep an extinguisher at hand when carrying out works which could cause flames.
- Clean the brake gaskets with specific non inflammable products.
- Do not touch the steel wire ropes with bare hands.
- Inflate the tyres in a cage, protect yourself and those nearby from a possible slipping of the ring of the rim or from a tyre blowout.

### 11.1.1 Hydraulics

The hydraulic system of the crane operates at high pressure. Special care should be taken when dealing with a hydraulic system under pressure.

*Do not work on a hydraulic system while it is running or until the system pressure has been fully discharged.*

*Do not check for leakages in the system with bare hands, but always use a cardboard sheet or a panel. Leakage of oil under pressure, even from a tiny hole, may penetrate the skin causing serious injury. If this happens, you must immediately consult a doctor who is specialised in this type of injury.*

*Make sure that all the oils and liquids that are used are recovered and properly recycled, do not leave these products or containers without appropriate labels in unfit places.*
*Do not leave stains of any kind of liquid on the ground or floor.*

- Before disconnecting hoses or hydraulic components, make sure that the circuit is depressurised.
  Pressure can remain trapped in the hydraulic system for a long time after the engine has stopped. If the pressure has not been correctly discharged, the hydraulic oil or the hose pipe fittings can be violently projected causing serious accidents.
- Hot oil and hot lubricated components can cause burns. Pay particular attention that these do not come into contact with skin.
- Hydraulic oil is flammable, so avoid welding pipes, tanks or other components which contain hydraulic oil.

- Do not change the setting values of the pressure control valves of the hydraulic system. Higher calibration values may cause failure of the hydraulic components; lower values may be insufficient to operate the manoeuvres of the crane.

### 11.1.2 Electric plant

- Before performing any work on the electrical system, disconnect the batteries by turning the knob placed on the battery switch.
- Do not carry out connections or changes to the electrical system without knowing the wiring diagram of the machine.
  An incorrect connection may cause serious personal injury and damage the machine.
- Batteries contain sulphuric acid which can cause severe burns and ruin clothing.
  Always wear protective clothing, gloves and goggles when checking batteries or performing maintenance on them.
  In case of accidental contact with skin or eyes with battery fluid, wash the affected area with water and immediately consult a doctor.
- Do not smoke when you perform maintenance on a battery. Batteries release flammable vapours which can cause explosions.
- Check the fluid level of the battery by using an electric torch. Keep the electrolyte at the maximum level indicated on the battery. If necessary, top up with distilled water.
- Do not short-circuit the battery terminals to check the charge. The sparks that are emitted may cause vapours to explode with consequent injuries to the people who are nearby.
  To check the battery charge use a voltmeter or ammeter.
- If the electrolyte of a battery is frozen, the battery can explode if recharged or if the machine is started by using an auxiliary battery. In order to prevent the freezing of the electrolyte, always keep the batteries fully charged.
- When using an external battery to start the engine, connect the grounding cable last and disconnect it first, thus avoiding the formation of sparks that could cause the explosion of the battery with consequent injuries to people who are nearby.
- Before charging a battery, remove all the caps to allow the release of vapours.

### 11.1.3 Welding instructions

The engine installed on the crane is of the electronic control type. To prevent damage to the Electronic Control Module (ECM) of the engine, disconnect the sensor and its components whether you need to weld in an appropriate way.

When possible, remove the component from the machine and then weld it. If it is not possible to remove the component, to perform the welding take a look at the following procedures in order to minimize the risk of damage of electronic components.

*Do not earth the welding machine by connecting it to electronic components such as the ECM or the sensors. An inadequate grounding can damage the transmission bearings, the hydraulic components, the electrical ones and other parts.*

1. Stop the engine. Turn the ignition key to the OFF position.
2. Disconnect the batteries.
3. Unplug the connectors from the ECM.
4. Fix the grounding cable of the welding machine on the part that has to be welded, as close as possible to the welding area, in order to minimise the possibility that the current damages bearings and components of the hydraulic and electrical plants.
5. Protect the wiring from welding residues and splashes.
6. Follow the procedures for standard welding.

## 11.2 Maintenance operations list

The maintenance intervals are based on a normal use of the machine. If the crane operates in working conditions or more severe environmental conditions (marine or sandy environments, with temperatures approaching -20 or + 50°C), the operator must change the service intervals in half the time scheduled for the greasing of components and oil changes.

For some components the maintenance intervals of the machine depend on the operating hours recorded by the engine hour counter. However, there are other maintenances that are required to ensure the perfect functionality of the crane at the time that they must be performed at different intervals: monthly, half-yearly or annually, independently of the hours logged by the engine.

### 11.2.1 Symbols

This manual highlights, through the symbols below, that for certain maintenance procedures the requirement to use appropriate personal protective equipment.


Compulsory use of helmets.


Compulsory use of gloves.


Compulsory use of protective glasses.


Compulsory use of work shoes.


Compulsory use of protective clothing.

In the following summary tables of maintenance processes, in the first column the following explanatory icons are provided which define which maintenance processes are the responsibility, with the specific tasks, of the various maintenance technicians.


Process that should be supervised by a mechanical maintenance technician.


Process that should be supervised by a maintenance plumber.


Process that should be supervised by a maintenance electrician.

| C1 | **Inspections to be carried out daily** | |
|---|---|---|
| | **Process** | **P.P.E.** |
| | Check the cooling liquid of the radiator | |
| | Check the oil level of the engine | |
| | Check the clogging of the engine air filter | |
| | Check the oil level of the transmission | |
| | Check the fuel level | |
| | Check the hydraulic oil reservoir level | |
| | Check inflation pressure and the conditions of the tyres | |
| | Check the condition of the hoist rope | |
| | Check all the manoeuvres of the crane | |
| | Check the shank hook safety latch | |
| | Check the brake circuit | |
| | Check that the headlights and the cabin instruments work correctly | |
| | Check the correct functioning of the Anti-2-Block device | |
| | Check the hosting down limit switch | |
| | Check the functionality of the LMI | |
| | Check the functionality of the motion cut-off device | |

| C2 | **Inspections to be carried out every 50 hours**<br>(to be performed in succession to table C1) | |
|---|---|---|
| | **Process** | **P.P.E.** |
|  | Check oil level of the differential |  |
|  | Check oil level of the wheel hubs |  |
|  | Check the tightening of the wheel hubs |  |
|  | Check the tightening of the engine hose clamps |  |
|  | Check for eventual leaks of the hydraulic plant |  |
|  | Check greasing of all the pivot axis pins |  |
|  | Check the tightening of the hookblock shoulder nuts |  |
|  | Check the tightening of the grub screw of the shank hook ferrule |  |
|  | Check the status of the tyres and the inflation pressure |  |

| C3 | **Inspections to be carried out every 200 hours**<br>(to be performed in succession to table C1 and C2) | |
|---|---|---|
| | **Process** | **P.P.E.** |
|  | Check the tightening of the slewing ring bolts (first time) |  |
|  | Check the tightening of the slewing gearbox bolts (first time) |  |
|  | Check the oil level of the slewing gearbox |  |
|  | Check the tightening of the hoist gearbox bolts |  |
|  | Check the oil level of the hoist gearbox |  |
|  | Check the backlash of the hookblock sheaves on their axis |  |
|  | Check for eventual wear of the shank hook seat and its opening |  |

| C4 | **Inspections to be carried out every 500 hours or every six months**<br>(to be performed in succession to table C1, C2 and C3) | |
|---|---|---|
| | **Process** | **P.P.E.** |
|  | Check that the boom extends proportionally |  |
|  | Check the leaks on the hydraulic plant |  |
|  | Check the leaks on the pneumatic plant |  |
|  | Check the electrolyte battery level |  |
|  | Check the status of the electric plant (wear, deterioration and/or oxidation) |  |
|  | Check the boom ropes, lifting ropes and the lifting points (corrosion, wear, deterioration) |  |
|  | Check the tightening of the slewing ring bolts (turret side) |  |
|  | Check the tightening of the hoist and counter-weight bolts |  |
|  | Check the tightening of the engine bolts |  |
|  | Check the tightening of the transmission bolts |  |
|  | Check the tightening of the axle bolts |  |

| **C5** | **Inspections to be carried out every 1000 hours or annually**<br>(to be performed in succession to table C1, C2, C3 and C4) | |
|---|---|---|
| | **Process** | **P.P.E.** |
| | Check that the machine does not present critical conditions( corrosion, wear, deformation, cracks) |  |
| | Check the engine transmission belt |  |
| | Check the lubrication on the sliding parts |  |
| | Check the status of cylinders, gear reducers and of the moving organs (oil leaks) |  |
| | Check for the presence of damaged gaskets or seals |  |
| | Measure the slewing bearing /pinion backlash |  |
| | Measure the slewing bearing tilting backlash |  |
| | Check the deterioration of the vibration dampers |  |
| | Check screws tightening of the counterweight, gear reducers, slewing bearing, axles, wheels, engine and transmission |  |
| | Check that the electric connections are not damaged |  |
| | Check the status of the hook according to UNI 9473-1 (visible deformations, wear and superficial cracks) |  |
| | Check the lubrication and protection to corrosion of the ropes |  |
| | Check the status of the rope clamps and wedges |  |
| | Check the conservation status of the rope anti-derailment devices and the safety elements (pins, cotter pins, etc.) |  |

## M1 — Maintenance to be carried out every 10 hours or daily

| Process | P.P.E. |
|---|---|
| Drain the water from the separator filter |  |
| Drain condense from the air tanks |  |

## M2 — Maintenance to be carried out every 50 hours or weekly

(to be performed in succession to table M1)

| Process | P.P.E. |
|---|---|
| Grease the drive shaft joints |  |
| Grease the suspension cylinders |  |
| Grease the sliding surfaces of the outrigger beams |  |
| Grease the slewing ring rows |  |
| Grease the pinion and the rack of the slewing ring |  |
| Grease the hinge pin of the boom |  |
| Grease the pins of the lifting cylinder |  |
| Grease the pin of the drum on the boom telescopic cylinder |  |
| Grease the hookblock |  |
| Grease all the sliding surfaces of the boom sections |  |
| Drain the water and the sediments from the fuel tank |  |

## M3 — Maintenance to be carried out every 200 hours

(to be performed in succession to table M1 and M2)

| Process | P.P.E. |
|---|---|
| Clean the engine radiator |  |
| Clean the engine air filter |  |

| **M4** | **Maintenance to be carried out at 500 hours or after six months** | |
|---|---|---|
| | **Process** | **P.P.E.** |
| | Change the oil of the engine |  |
| | Replace the oil filter of the engine |  |
| | Replace the fuel filter |  |
| | Replace the separator fuel filter |  |
| | Replace the air filter cartridge |  |
| | Replace the air filter safety cartridge |  |
| | Replace the oil filter of the transmission |  |
| | Replace the oil filter of the hoist gearbox |  |
| | Replace the hydraulic oil filter cartridge |  |
| | Replace the air compressor filter |  |
| | Replace the air-dryer filter |  |

| **M5** | **Maintenance to be carried out at 1000 hours or annually** | |
|---|---|---|
| | **Process** | **P.P.E.** |
|  | Change the oil of the engine |  |
|  | Replace the oil filter of the engine |  |
|  | Replace the fuel filter |  |
|  | Replace the separator fuel filter |  |
|  | Replace the air filter cartridge |  |
|  | Replace the air filter safety cartridge |  |
|  | Replace the oil filter of the transmission |  |
|  | Change the oil of the transmission |  |
|  | Replace the oil filter of the hoist gearbox |  |
|  | Replace the air compressor filter |  |
|  | Replace the air-dryer filter |  |

| **M6** | **Maintenance to be carried out at 1500 hours** | |
|---|---|---|
| | **Process** | **P.P.E.** |
| | Change the oil of the engine |  |
| | Replace the oil filter of the engine |  |
| | Replace the fuel filter |  |
| | Replace the separator fuel filter |  |
| | Replace the air filter cartridge |  |
| | Replace the air filter safety cartridge |  |
| | Replace the oil filter of the transmission |  |
| | Change the oil of the hoist gearbox |  |
| | Replace the hydraulic oil filter cartridge |  |
| | Change the hydraulic oil |  |
| | Replace the air compressor filter |  |
| | Replace the air-dryer filter |  |
| | Replace the engine transmission belt |  |

| **M7** | **Maintenance to be carried out at 2000 hours or after two years** | |
|---|---|---|
| | **Process** | **P.P.E.** |
| | Adjust the backlash between the pinion and the slewing ring |  |
| | Change the cooling liquid of the engine radiator |  |
| | Change the oil of the engine |  |
| | Replace the oil filter of the engine |  |
| | Replace the fuel filter |  |
| | Replace the separator fuel filter |  |
| | Replace the air filter cartridge |  |
| | Replace the air filter safety cartridge |  |
| | Replace the oil filter of the transmission |  |
| | Change the oil of the transmission |  |
| | Replace the oil filter of the slewing gearbox |  |
| | Replace the air compressor filter |  |
| | Replace the air-dryer filter |  |
| | Change the oil of the hubs and the differential |  |

| **M8** | **Maintenance to be carried out at 2500 hours** | |
|---|---|---|
| | **Process** | **P.P.E.** |
| | Change the oil of the engine |  |
| | Replace the oil filter of the engine |  |
| | Replace the fuel filter |  |
| | Replace the separator fuel filter |  |
| | Replace the air filter cartridge |  |
| | Replace the air filter safety cartridge |  |
| | Replace the oil filter of the transmission |  |
| | Change the oil of the hoist gearbox |  |
| | Replace the hydraulic oil filter cartridge |  |
| | Replace the air compressor filter |  |
| | Replace the air-dryer filter |  |

| **M9** | **Maintenance to be carried out at 3000 hours** | |
|---|---|---|
| | **Process** | **P.P.E.** |
| | Replace the engine transmission belt |  |
| | Replace the hose pipes of the brake circuit |  |
| | Change the oil of the engine |  |
| | Replace the oil filter of the engine |  |
| | Replace the fuel filter |  |
| | Replace the separator fuel filter |  |
| | Replace the air filter cartridge |  |
| | Replace the air filter safety cartridge |  |
| | Replace the oil filter of the transmission |  |
| | Change the oil of the transmission |  |
| | Replace the air compressor filter |  |
| | Replace the air-dryer filter |  |

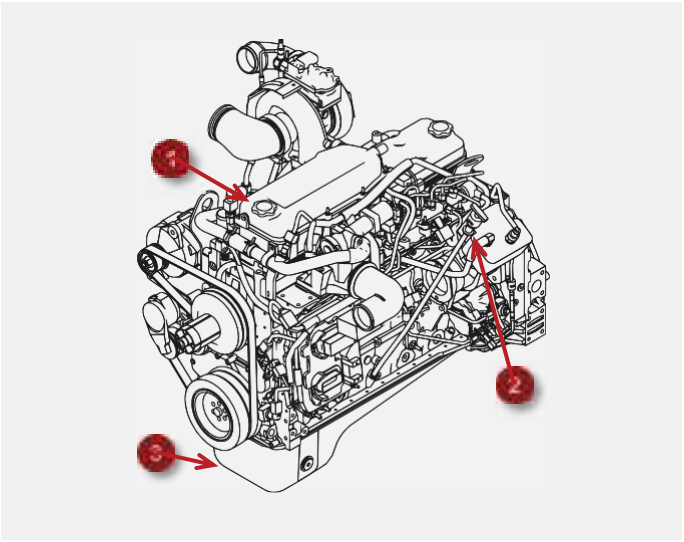
## 11.3 Programmed maintenance summary

| | 500 h<br>3500 h<br>6500 h | 1000 h<br>4000 h<br>7000 h | 1500 h<br>4500 h<br>7500 h | 2000 h<br>5000 h<br>8000 h | 2500 h<br>5500 h<br>8500 h | 3000 h<br>6000 h<br>9000 h |
|---|---|---|---|---|---|---|
| Engine belt | | | ● | | | |
| Engine oil filter | ● | ● | ● | ● | ● | ● |
| Fuel filter | ● | ● | ● | ● | ● | ● |
| Fuel separator filter | ● | ● | ● | ● | ● | ● |
| Air filter primary cartridge | ● | ● | ● | ● | ● | ● |
| Air filter safety cartridge | ● | ● | ● | ● | ● | ● |
| Air compressor filter | ● | ● | ● | ● | ● | ● |
| Hydraulic oil filter | ● | ● | ● | ● | ● | ● |
| Transmission oil filter | | ● | | ● | | ● |
| Air dryer filter | ● | ● | ● | ● | ● | ● |
| A/C external filter | ● | ● | ● | ● | ● | ● |
| A/C internal filter | ● | ● | ● | ● | ● | ● |
| Engine oil | ● | ● | ● | ● | ● | ● |
| Hydraulic oil | | | ● | | | |
| Transmission oil | | ● | | ● | | ● |
| Wheel hub oil | | | | ● | | |
| Differential oil | | | | ● | | |
| Slew gear oil | | | | ● | | |
| Hoist gear oil | ● | | ● | | ● | |
| Radiator fluid | | | | ● | | |

## 11.4 Maintenance of the main components

### 11.4.1 Engine

1. Bocca di riempimento
2. Astina olio
3. Scarico olio




#### 11.4.1.1 Engine diagnostic

The diesel engine of the crane is the electronic control type, equipped with diagnostic functions that ensure its proper operation.
The start-up of the instrument display, on the right top part of the multifunction display, in absence of errors shows the writing 'NO ERROR'. If, instead, there is an error, this is displayed continuously on the display by a code number similar to 'Ɛ XXX.XX' accompanied by an acoustic signal.

*During the functioning of the crane, when the system detects a problem it sends an error message to the operator accompanied by an acoustic signal and, in case of important anomalies, automatically limits the speed and the torque of the engine.*

The errors remain on the display until the CAN line stops sending them.
The diagnostic error code numbers are partially recorded in the error page of the multifunction display and are archived, completely, in the permanent memory of the ECM of the engine.

For example, in the following chart are reported some of the error code numbers of the engine and the correspondent failure.

| Code no. | Alarm/fault description |
|---|---|
| Ɛ 1721.01 | Clogged gasoil filter alarm |
| Ɛ 194.01 | Exhaust gas high temperature |
| Ɛ 360.01 | Oil low pressure – alarm |
| Ɛ 360.03 | Oil low pressure – halt |
| Ɛ 361.01 | Coolant liquid high temperature – alarm |
| Ɛ 361.02 | Coolant liquid high temperature – power reduction |
| Ɛ 361.03 | Coolant liquid high temperature – halt |

To enter the errors list of the display, keep the left button on the control frame pressed for 5 seconds. The last error messages will be visualised up to a maximum of ten 10 messages.
The last error that has been received is inserted at position 1, scrolling downwards all the other ten messages.
After 20 seconds the display returns to show the main page.

#### 11.4.1.2 Engine oil drainage

A seal valve with a control lever (pos.3) is placed on the bottom of the sump in order to allow the oil outflow. Connect a hose extension and fix it to the valve to allow the oil discharge without smudging the components of the crane.

*When you change the engine oil, the crane must be on tires and with the oscillating axle locked.*

*The engine oil must be drained when it is hot. With cold oil, particles of slag in suspension are deposited on the bottom of the sump and do not flow out with the oil during the discharge, with the result that the debris can enter again into circulation in the lubrication system of the engine.*

*The oil and the hot parts of the engine can cause serious injury. Avoid contact with the skin.*

To discharge oil:

1. Run the engine until the water temperature reaches 60 °C.
2. Stop the engine.
3. Prepare a container with a capacity of at least 30 litres underneath the frame structure, in correspondence with the sump (pos.3).
4. Open the valve at the bottom of the sump to drain the oil.
5. Make sure that all the oil and the contaminants are removed from the engine.
6. When the oil is discharged, close the valve.

#### 11.4.1.3 Engine oil refilling

**Lubricant**

**Change:** every 500 h or yearly;
**Check-up:** see tables (§11.2 e 11.3);
**Quantity:** 15 litres;
**Type:** EO (see '*Appendix A*')

For refilling, or for topping up, pour the oil through the filler neck (pos.1) placed on the upper part of the engine. Start the engine and run it for a minute. Switch the engine off and check that the oil level reaches the top notch on the dipstick (pos.2). In case the oil is still below the maximum oil level notch, top up until it reaches it.

### 11.4.2 Engine air filter

*To prevent dirt from entering the engine, always perform the maintenance of the air filter while the engine is stopped.*

#### 11.4.2.1 PSD Air Cleaner maintenance

1. Shut off the engine. Unlatch and remove the housing service cover.

2. Remove the primary filter. Pull the filter out of the housing. You must first loosen the filter gasket seal. Using the handle, push down on the filter to loosen the seal, which will tilt the filter to approximately a 5° angle.

*Remove any dirt excess and clean out the housing before removing the secondary filter.*


3. Remove the secondary filter. Using the plastic handle on the face of the safety filter, pull the filter towards the centre of the housing and remove it.

*A secondary filter only needs to be replaced at every third primary air filter change.*

4. Insert the new filter before installing. Visually check for cuts, tears, or indentation of the sealing surfaces before installation. If any damage is visible, do not install.


5. If replacing the secondary filter, use the plastic handle on the safety filter, slide the filter at an angle into the outlet side and push in place until the filter seats firmly and evenly within the housing.

*Insert the safety filter tab into the positioning slot before pushing the filter in place.*

6. Insert the primary filter.
   Slide the filter down at approximately a 5° angle until it hits the end of the housing. Rotate the filter towards the outlet section to complete the seal.

7. Replace the service cover.
   Place the service cover in position and fasten the latches.

*If the cover does not seat, remove and re-check the filter position. The cover will be difficult to install if the filter is not installed correctly.*

8. Visually inspect the inlet and outlet connections. Inspect the Vacuator™ valve. Replace if any signs of wear or damage are visible.

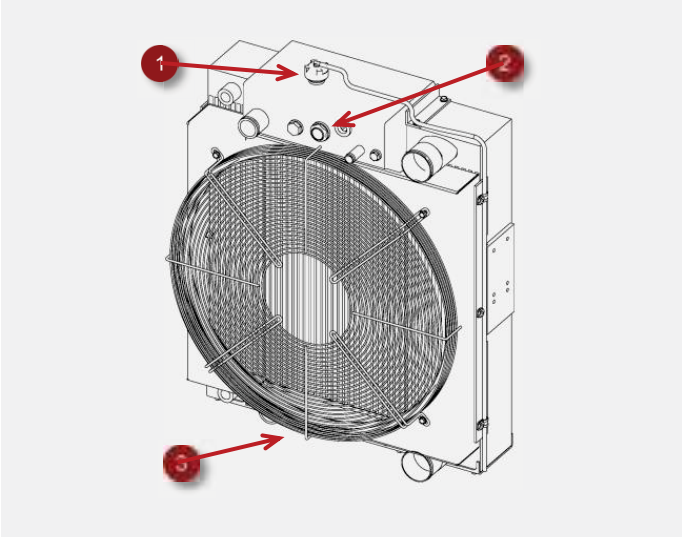
### 11.4.2.2 Engine air filter clogging indicator

The clogging indicator shows a red colour signal in the clogging window when the clogging limit has been reached.

Manually reset by pressing the push-button, located above the indicator, after having cleaned and/or replaced the air filter.

### 11.4.3 Radiator

1. Filler neck
2. Visual oil level
3. Oil drainage




#### 11.4.3.1 Radiator liquid drainage

Remove the filler neck (pos.1) placed on the top of the radiator, open the valve (pos.3) placed on the bottom to discharge the coolant liquid.

Once that the liquid has been drained, close the drainage valve.

*Make sure that the engine is not warm and that the coolant liquid is at room temperature.*

#### 11.4.3.2 Radiator liquid refilling

**Coolant liquid**

**Change:** first time 2000 h, then every 3000 h;
**Check-up:** see tables (§11.2 e 11.3);
**Quantity:** fill up to 2 cm from the filler neck edge;
**Type:** CAL (see '*Appendix A*')

Check that the drainage valve (pos.3) is closed.
Unscrew the filler neck cap (pos.1) and pour the coolant liquid through the filler neck. The anti-freeze liquid is made by a solution of comprising 50% coolant liquid and 50% water (see table reported in Appendix A).
Check the level of the coolant liquid and add, if necessary, water or anti-freeze liquid until the level is up to 2 cm from the edge of the filler neck.

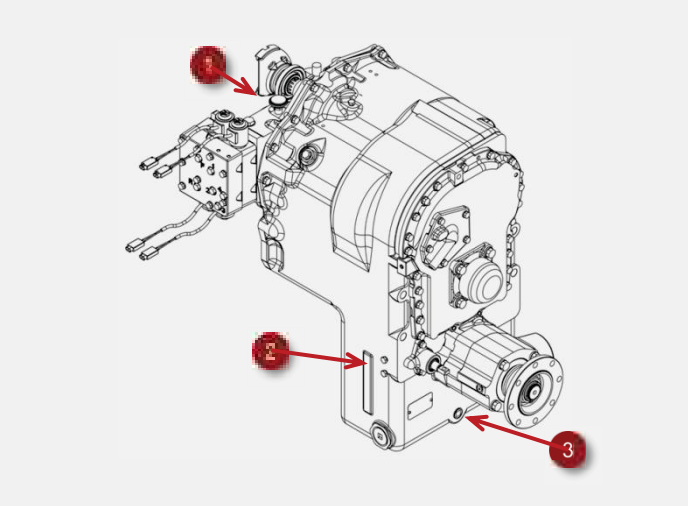
Screw back again the filler neck cap (pos.1).

Start the engine letting it run at idle for a few minutes checking the temperature indicator placed on the control board inside the cabin to prevent eventual overheating.
Stop the engine, wait for a few minutes to cool down the engine, unscrew the cap, verify the level of the liquid and eventually top up until the liquid reaches the previous liquid level.
Screw the filler neck cap back on again and repeat the last two operations until the level of the coolant liquid is stable.

*Carefully handle the coolant liquid, remember that overheated components and hot oil can cause skin burns.*
*Never add cold coolant liquid when the engine is overheated.*

### 11.4.4 Transmission

1. Filler neck/breather
2. Oil level
3. Oil drainage




#### 11.4.4.1 Transmission oil level check-up

The transmission oil level checking procedure must be carried out with an oil temperature comprised between 83 and 94 °C and the engine at 800 RPM.
Refill the oil if necessary.

To bring the transmission oil to temperature carry out the following manoeuvres:

1. Insert the parking brake.
2. Select the fast gears.
3. Put the gear into neutral position 'N'.
4. Run the engine at idle for at least two minutes.
5. Put it into third forward gear.
6. Run the engine at 1,000-1,500 RPM for 30 seconds.
7. Put it into reverse gear for 5 seconds.
8. Return the gear lever to the neutral position 'N'.
9. Let the engine run at idle to check the transmission oil level.

The oil level is indicated on the transmission dipstick. Top up, if necessary, to the 'FULL' level of the dipstick.

*The specifications of the transmission oil are given in 'Appendix A'.*

#### 11.4.4.2 Transmission oil change

**Lubricant**

**Change:** every 1000 h or yearly;
**Check-up:** see tables (§11.2 e 11.3);
**Quantity:** 41 litres;
**Type:** TO (see '*Appendix A*')

The normal drainage of the oil and the replacement of the filter are calculated for cranes that work in average environmental conditions and working cycles.

Proceed by discharging the oil when the oil has reached a temperature comprised between 65 and 93°C:

1. Disassemble and dispose the used filter. Install the new filter.
2. Refill the transmission with oil up to the maximum level sign.
3. Run the engine at 800 RPM to allow the oil to circulate in the converter and in the pipes.
4. Check again the level with the engine at 800 RPM and add oil until it reaches the minimum level sign.
5. When the oil temperature is comprised between 82.2 and 93.3 °C carry out a final check-up and refill if necessary until the oil level reaches the maximum level sign.

#### 11.4.4.3 Cardan shaft lubrication

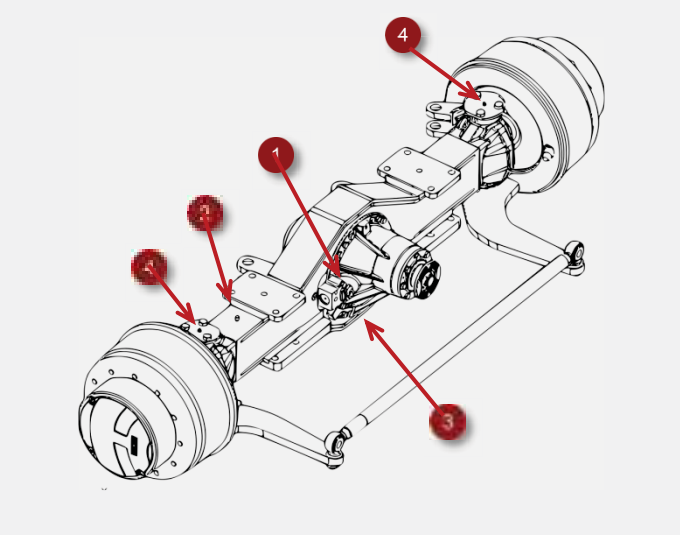
**Grease**

**Check-up and maintenance:** vedi tabelle (§11.2 e 11.3);
**Type:** TO (see '*Appendix A*')

Check the lubrication and if necessary lubricate again.
The cardan shafts are equipped with greasers to allow a good lubrication.
Mildly lubricate the universal joint placed near the parking brake disc.

### 11.4.5 Axles

1. Filler neck/oil level
2. Breather
3. Oil drainage
4. Greaser




#### 11.4.5.1 Differential oil drainage

Drain the oil through the cap placed on the lower side of the case and through the one placed on the lower side of the gearbox.
At each check-up verify the efficiency of the breather placed on the upper side of the case, by clearing it with gas oil and drying it with compressed air.

*It is advisable to drain the oil from the differential when it is still warm.*

*The oil and hot components of the differential can cause serious injuries. Avoid contact with the skin.*

#### 11.4.5.2 Differential refilling

**Lubricant**

**Change:** first time 2000 h, then every 3000 h;
**Check-up:** see tables (§11.2 e 11.3);
**Quantity:** 22 litres;
**Type:** EP-GBO (see '*Appendix A*')

Make sure that the drainage cap (pos.3) is screwed on tightly.
Unscrew the filler neck/breather cap (pos.1) and pour in it the lubricant.
Check the oil level through the oil level gauge (pos.1) until the oil reaches the maximum oil level.
Screw back again the filler neck/breather cap (pos.1).

#### 11.4.5.3 Wheel hubs oil drainage

Drain the oil through the inferior cap of the two hubs with the level notch in horizontal position.

#### 11.4.5.4 Wheel hubs refilling

**Lubricant**

**Change:** first time 2000 h, then every 3000 h;
**Check-up:** see tables (§11.2 e 11.3);
**Quantity:** 1.5 litres x4;
**Type:** EP-GBO (see '*Appendix A*')

With the level notch in horizontal position, proceed to refill until the oil reaches the lower part of the filler neck/oil level.

### 11.4.6 Tyres

#### 11.4.6.1 Tyre pressure check-up

The tyre pressure should be checked daily - while the tyres are cold and without any hanging load - and, if necessary, corrected for the different applications according to the following chart. Values, together with the tightening torques of the wheel nuts are reported over the four wheel mudguards of the mobile crane.

| Dimensions | Inflating pressure | | Tightening torque |
|---|---|---|---|
| | Static lifting | Driving on road | |
| 23.50x25 | 700 kPa (7 bar) | 500 kPa (5 bar) | 650 Nm (66kgm) |

In the case of long journeys, after 60 minutes of travel, take at least 30 minutes of rest to cool the tyres. At your destination, allow the tyre to cool to room temperature before working on tyres.

*Never deflate hot tyres.*

#### 11.4.6.2 Tyre inflating procedure

To allow inflation of the tyres, the crane is equipped with an air inflation plug incorporated into the air dyer unit, on the left side of the machine.

The inflation should always be carried out with cold tyres, or after a few hours of rest of the machine.

*Always use a protective inflation cage when the tyre to be inflated is not mounted on the crane.*

To inflate the tyres use a hose with, at one end, a fast-on and, at the other end, an inflation gun with pressure gauge, long enough to enable the operator to maintain a safety distance from the tyre.

*The bursting of a tyre or the eventual slipping of the wheel disc ring can cause serious injury.*

1. Remove the valve cap of the tyre.
2. Connect the fast-on of the inflating hose pipe to the upper air inflation plug of the air dryer unit and the extension of the inflation gun to the tyre valve.
3. Reduce the pressure by pressing and releasing, once or twice, the brake pedal.
4. Start the engine.
5. Inflate the tyre pressing the trigger of the gun. The pressure gauge indicates the pressure of the tyre. Check and adjust the pressure until you get the correct values.
6. Screw the valve cap. The cap is essential to ensure a perfect seal and protect the mechanism of the valve.

#### 11.4.6.3 Wheel replacement

Disassembly procedure:

1. Loosen the nuts of the wheel, but not enough to let them turn freely on the threading of the struts.
2. Lift the crane onto the outriggers, with the wheels lifted from the ground.
3. Remove the wheel from the struts and slide it off the wheel hub.

Reassembly procedure:

1. Prepare the wheel in the position for inserting it onto the wheel hub. Use two metal bars to lift it up to the hub, paying attention that it does not fall forwards.
2. Position the wheel on the struts.
3. Screw the nuts without tightening them completely.
4. Retract the outriggers to lower the crane on wheels.
5. Tighten the nuts a little bit at a time, at their torque value, acting crosswise.

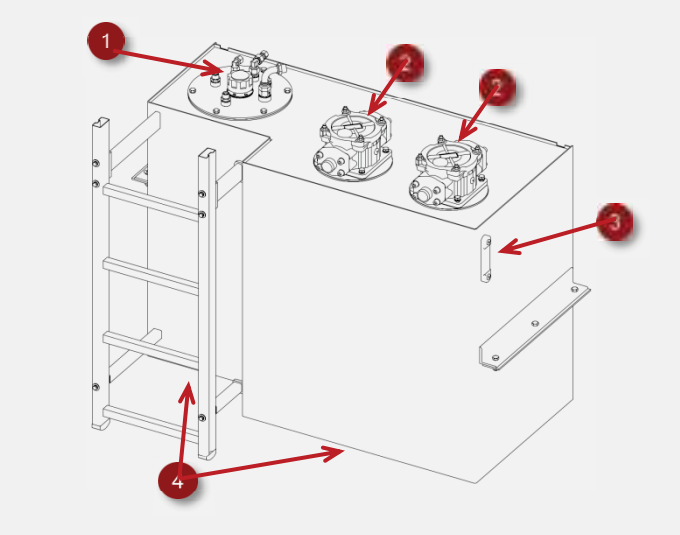
*When a wheel is removed or re-mounted, pay attention not to damage the threaded part of the wheel struts.*

### 11.4.7 Fuel tank

*Drain water and sediments from the separator filter daily, by turning by hand, anti-clockwise, the drain valve.*

### 11.4.8 Hydraulic oil reservoir

1. Breather
2. Oil filter
3. Oil level
4. Oil drainage




#### 11.4.8.1 Hydraulic oil tank checks

Check-up daily the level of the hydraulic oil contained inside the reservoir when the crane is in a horizontal position, the outriggers are fully retracted, the telescopic boom is retracted and lowered and the oil is cold.

#### 11.4.8.2 Hydraulic oil drainage

To drain the hydraulic oil from the reservoir, unscrew the two drainage caps placed on the bottom of the reservoir.

#### 11.4.8.3 Refilling the hydraulic oil reservoir

**Lubricant**

**Change:** first time 1500 h, then every 3000 h;
**Check-up:** see tables (§11.2 e 11.3);
**Quantity:** 560 litres;
**Type:** HYDO (see '*Appendix A*')

The hydraulic oil reservoir must be filled, until the oil reaches the maximum level shown on the level gauge, through the filter which is mounted on the upper side of the reservoir.
The filling of the reservoir must be carried out when the telescopic boom is retracted and lowered and the outriggers and the jacks are retracted.

#### 11.4.8.4 Hydraulic oil filter clogging indicator

The hydraulic oil filter is equipped with a clogging indicator which is divided in two areas – green (clean filter) and red (clogged filter) – that allows to directly read the clogging condition of the filtering element.

*The inspection of the filter should be done after the hydraulic circuit has reached its normal operating temperature, since it is possible that a higher viscosity oil in cold creates a pressure differential sufficient to move the pointer in the red zone.*

If the indicator is in the red area, while the hydraulic circuit is operating at normal temperature, it is necessary to replace the element with a new one, because the counter-pressure caused by the clogged filter element enables the bypass, placed inside the head of the filter, to open and let the oil to flow directly into the reservoir without passing through the filter element.

Procedure for the removal of the filter element and the breather:

1. Stop the hydraulic plant.
2. Clean the cover and the head of the filter.
3. Put a container near the oil reservoir to collect the oil that spills out of the element.
4. Loosen and remove the cover of the filter.
5. Remove the bridge and the filtering element from the container of the filter.
6. Remove the encasement of the breather from the cover of the filter by loosening the central M8 screw.
7. Remove the filter of the breather
8. Remove the filtering element and the air filter and put them in a container.
9. Clean the magnetic pre-filtering column.

Procedure for the installation of the filter element and of the breather filter:

1. Mount a new element in the container of the filter.
2. Mount the bridge taking care that it is centred on the element of the filter.
3. Mount on the cover a new filter of the breather and tighten the screw that holds the encasement of the breather.
4. Install a new gasket on the cover.
5. Screw the cap on the head of the filter.
6. Start the engine and operate the controls in order to discharge the air.
7. Check for the eventual presence of leakages and carry out the eventual reparations.

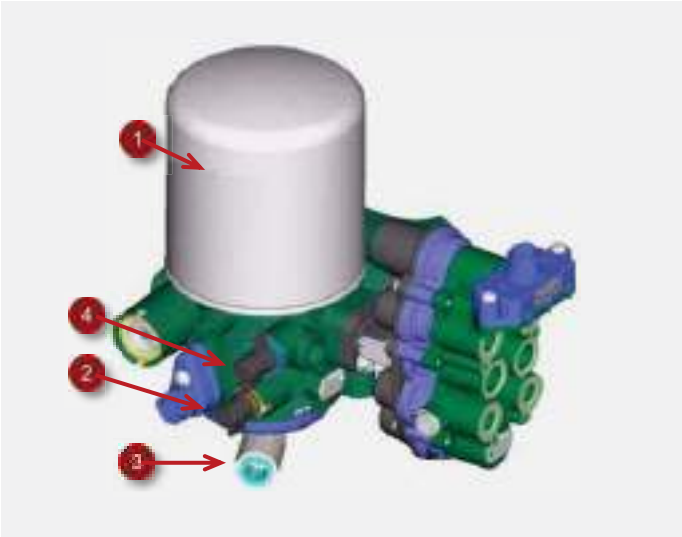
### 11.4.9 Air tanks

*Purge daily, at the end of every working day, the air reservoirs and discharge sediments and condensation.*

### 11.4.10 Air treatment unit

The air treatment unit integrates into a single group, combining all the functions of treatment, control and distribution of compressed air of the braking system of the mobile crane.

1. Cartridge
2. Pressurised air plug
3. External air plug
4. Inlet air plug




*The replacement of the cartridge is needed when, during the daily check up, in a period of normal operation of the machine, is found repetitively the presence of water in the air tanks.*

### 11.4.11 Slewing ring

#### 11.4.11.1 Slewing ring bolt tightening

To warrant the functioning safety, the machine's durability and efficiency, it is necessary to use the best care in the maintenance of the bearing and in the correct tightening of the fixing bolts.

1. Use dynamic torque wrenches, or hydraulic tensioners, with torque limiters that can be pre-set to the required values.
2. Use the screws shown in the torque table.
3. In case of partial or total replacement of the screws and / or the entire bearing, tighten the screws as shown in the table reported in 'Appendix A'. Check the rotation during the tightening. The operation should be carried out by experienced technicians.
4. Check the torques of the slewing bearing starting from a screw and proceed as shown in Figure 1 until the operation is complete.

## Torque

**Check-up:** every 500 hours, see tables (§11.2 e 11.3);
**Screws:** M30x150 - 10.9;
**Tightening:** see table (Appendix A)

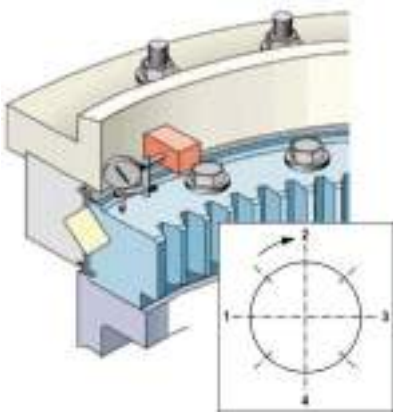
**Fig. 1**

*Repeated tightening can cause the stretching of the bolts, making it necessary to replace them.*

*When a high-strength bolt is removed, it must be replaced with a new bolt of the same degree and size.*

*Dynamometric wrenches are precision instruments that must be handled with care and periodically calibrated to ensure precise tightening torque values.*
*The dynamometric wrench is not comprised in the equipment of the crane.*

### 11.4.11.2 Giochi ralla



To check the clearances with external loads on the rolling track diameter, use an analogue comparator with a precision class of 0.1 mm keeping the slewing bearing still.

You will notice the oscillation between the condition with a negative moment and one with a positive moment by performing surveys in four equidistant points on the circumference of the slewing bearing.

To reduce the influence of the elastic deformations of the structures, it is necessary to perform the surveys, if possible, between the bearing rings, and in any case, as close as possible to the rolling diameter, and also the test must be carried out with static loads without causing any impact.

*The slewing bearing must be replaced when the clearance increment exceeds the maximum values given in the table (see 'Slewing bearing clearances chart' in Appendix A).*

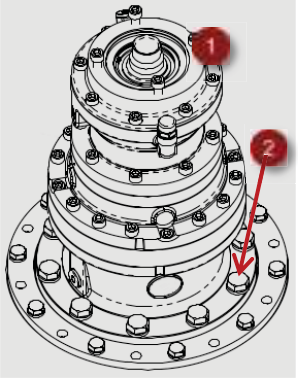
### 11.4.11.3 Slewing ring lubrication

## Grease

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** EP-GEG (see '*Appendix A*')

For a correct lubrication of the slewing ring, pump grease until it spills out of the slewing ring raceway, then turn of 90° and repeat the operation. Repeat the operation until the entire bearing is greased.

### 11.4.12 Slewing ring/pinion backlash




The backlash adjustment between the pinion tooth and the slewing ring teeth is obtained by turning the gear of the slewing gearbox.

To carry out the backlash adjustment:

1. Extend and position the outriggers. Make sure that the crane is perfectly levelled.
2. Insert the turret slew locking pin.

*The non-insertion of the locking pin can cause serious or fatal accidents when the slewing brake is disengaged.*

3. Disconnect the hose from the attachment on the slewing brake and connect a hand pump to the brake.
4. Pump pressurised oil to loosen the slewing brake.
5. Remove the outer bolts (pos.2) which fasten the slewing gearbox (pos.1) to the turret.
6. Turn the slewing gearbox CW until the pinion tooth comes in contact with the teeth of the slewing ring.

   The acceptable backlash [$J_t$] (see fig.2) between the side of the three green coloured slewing ring teeth (point of maximum ovalisation) and the pinion, in the narrowest point it must not exceed the maximum value given in the table reported in Appendix A.

   Reposition the flange outer bolts and tighten them to the specific torque (see 'Screw coupling torque chart' Appendix A).
7. Connect the hose to the slewing brake.

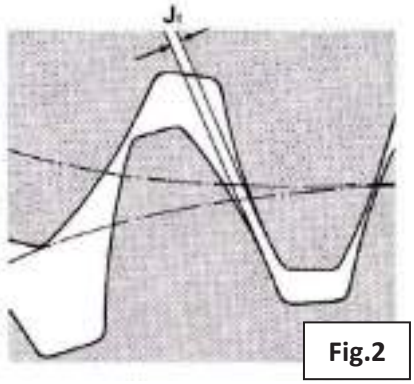



**Fig.2**

#### 11.4.12.1 Slewing gearbox refilling

**Lubricant**

**Change:** first time 2000 h, then every 3000 h;
**Check-up:** see tables (§11.2 e 11.3);
**Quantity:** 6.5 litres;
**Type:** EP-GBO (see '*Appendix A*')

In case the level of the lubricant should need to be topped up, proceed by topping up through the filler neck placed on the upper part of the gearbox.

### 11.4.12.2 Pinion and slewing ring teeth lubrication

**Grease**

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** RPL (see '*Appendix A*')

In order to minimise the friction between the slewing ring and the turret slewing gearbox pinion, proceed by abundantly greasing the pinion teeth and of the slewing ring by using a spatula to apply the lubricant.

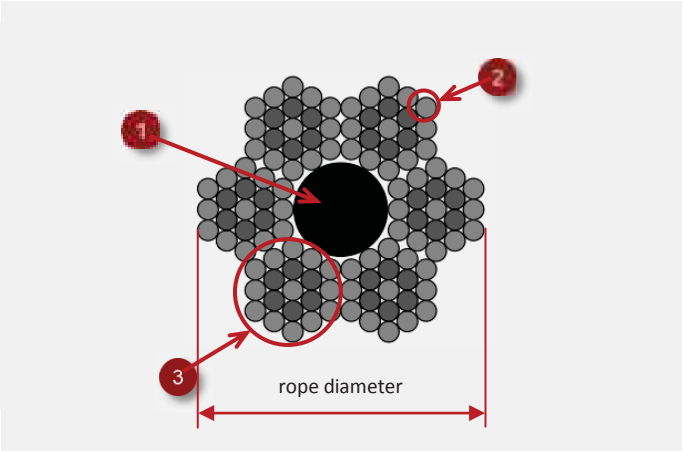
## 11.4.13 Metal ropes

### 11.4.13.1 Rope check-up

The metal ropes are one of the main mechanical components of the crane, on which are used to lift the load and to telescope out and telescope in the boom.

A rope is made of many spiral bound metal strands wrapped around a metal core; the strands are made by multiple metal wires arranged in helical shape around a central core made of metal wires.

1. Core
2. Wire
3. Strand




The rope used to lift the load is an 'anti-rotation' type, made of two or more layers of strands corded in alternate direction to block the unwinding rotation of the rope respect to its own axis due to the helix winding used in the manufacturing.

The boom extension and retractions ropes are 'right cross' lay type, made in polished steel with a high ultimate tensile strength.

Metal ropes always require special attention starting from their installation on the machine, to their operational and maintenance check-up.

### 11.4.13.2 Lifting rope

The lifting rope must be visually checked every day in order to detect and monitor wear and deformation signs, particularly in the areas that are subject to quick deterioration, such as those in correspondence with the end attachments or the sheaves where the movement of the rope is limited. Even the damaging of the boom sheaves and the hookblock, or the grooves of the hoist drums, can accelerate wear and deterioration of the metal ropes.

The checking of the rope to detect any damage that require its replacement must evaluate the following considerations:

a. number and position of broken wires that are visible on the outside of the rope;
b. flattening of the wires as a result of wear;
c. reduction of rope diameter due to external and internal corrosion;
d. other rope damage or deterioration of the rope.

*By law, rope conditions and any replacement must be reported in a control register of the machine during the periodical three monthly inspections.*

*All metal ropes are subject to a wear limit after which they must be replaced.*

An anti-rotation rope must be replaced when one of the following conditions occur:

a. The number of visible broken wires is more that 2 on a length equal to 6 times the diameter of the rope, or more than 4 on a length equal to 30 times its diameter.
b. Presence of a reduction in the nominal rope diameter, even in just one point, more than the 7% due to internal or external corrosion.
c. Presence of crushing, torsion, bending or other permanent deformation of the rope structure.
d. When the rope core comes out, even if only in one point.
e. Presence of one or more loosened and jutting strands even when the rope is in traction.

### 11.4.13.3 Typical examples of rope wear

The photographs shown here below illustrate a few examples of rope deterioration and the safety measures to be carried out.

Breaking and moving of wires on two adjacent strands.
The rope has to be replaced.

Severe wear and considerable number of broken wires.
The rope has to be replaced.

Breakage of wires on one strand and light wear.
Remove the broken wires to make the rope smooth.

Broken wires in a number of strands close to a return sheave.
The rope has to be replaced.

Broken wires in two strands due to bending stress associated to a serious localised wear.
The rope has to be replaced.

Nest deformation of a multi-strand rope (anti-revolving type) caused by forced rotation due to a too narrow groove or an excessive deflection angle.

Expulsion of the metal core generally associated to a nest deformation.

Only one strand is concerned by the expulsion of wires. The examination of one section of rope shows that the deformation is visible at regular intervals, normally equal to the winding pitch.

Aggravation of the previous defect with expulsion of the internal wires of the strands. Serious local defect caused by the application of pulsing loads.

Local increasing of the diameter of a parallel winding rope, caused by distortion of the metal core, due to a sudden load.

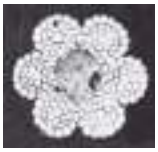
Metal rope which has been twisted during the installation phase, but used the same for lifting and know subjected localised wear and loosening of the strands.

Flattened area caused by the local squashing due to mechanical action that leads to disequilibrium in the strands. Simultaneous presence of broken wires.

Flattened area of a multi-strand rope due to mechanical action on a long section of the rope, caused by an incorrect winding from a drum.

Example of severe bending of the rope.

Typical example of rope that has come out the groove of a sheave and got stuck in the sheave itself. The result is a flat deformation with localised wear and many broken wires.



Rope section with a severe internal corrosion. The rope has to be replaced.

#### 11.4.13.4 Head and hookblock sheaves

The use of plastic sheaves compared to the use of metal ones significantly extends the duration of the rope, but makes more difficult to estimate its replacement because the wear of the rope takes place internally and cannot be seen from the outside, making replacement criteria inadequate based exclusively on visible ruptures of wires and strands.

#### 11.4.13.5 Lifting rope replacement

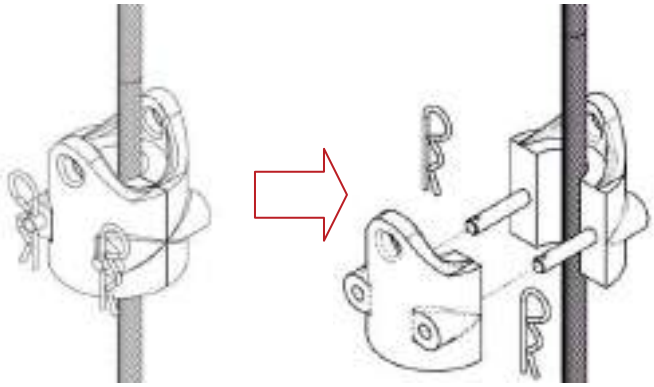
The rope is fixed to the hoist drum by an anchoring wedge and wound around the drum for a minimum of three complete spirals before passing along the boom and then between the head and hookblock sheaves.

For an even number of falls, the rope is fixed to the head of the boom, while when there is an uneven number of falls it is fastened to the hookblock. The mounting of the various falls is shown later.

The winding and unwinding limits of the hoist rope are controlled by two limit switches that stop the movement. The first switch is applied to the head of the boom, the second to the hoist drum.

To remove from the machine the rope that has to be replaced follow the procedure:

1. Completely lower the boom and position it with the head on the front side of the machine.
2. Rest the hook-block on the ground.
3. Separate the two semi-blocks of the hookblock limit switch weight to free the rope.



4. Remove the rope lug from the head of the boom or from the hookblock, depending on the number of set falls. Free the end of the rope by removing the wedge from the lug.
5. Slowly rotate the hoist to unwind the rope from the drum and, at the same time, wind it onto a suitable support.
6. When on the drum there are only a few remaining spirals, to completely unwind the rope, lift the hoist limit switch system roller in order to avoid that the drum stops.
7. Remove the protection carter from the left side of the hoist to access the rope fixing seat.

*Pay maximum attention when working without the protection carter. The drum, revolving, can cause serious injury.*

8. Free the end of the rope by removing the anchoring wedge from the seat on the outside of the drum flange.
9. Properly mark the replaced rope in order to identify it as the rope that has been removed from service and can no longer be used.

*Never touch the rope with bare hands. Always wear protective gloves. Broken wire on a rope can cause serious injuries.*

*When you need to fully unwind the rope from the hoist drum, during the subsequent rewinding operation, a minimum tension is recommended which is equal to 3% of the breaking load of the rope under direct pull.*

The rope that has been chosen for the replacement must have the same characteristics of the original one, whose data is reported in the certificates attached to the crane control register.
The rope must be clean and must not show any signs of deterioration or corrosion.
Before installing a new rope you need to make sure that the grooves and flanges of the head and the hook-block sheaves are not worn or deformed by the passing of the old rope, and that all sheaves rotate freely. Damaged sheaves cause quick deterioration of the rope.

To install a new rope on the hoist drum follow the procedure:

1. Completely retract the boom and position it on the front side of the crane.

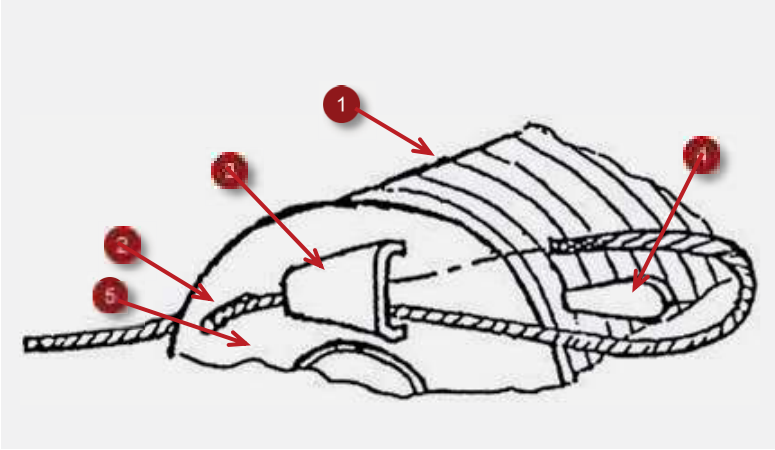
Position the hookblock on the ground, directly underneath the head of the boom. Unwind the rope following the instructions illustrated below to avoid the forming of loops form that may irreversibly damage the rope.

**INCORRECT UNWINDING**

**CORRECT UNWINDING**

2. Remove the rope restraint pin on the head of the boom and slide the rope on the upper head sheave and along the base section of the boom, up to the hoist drum.
3. Rotate the drum of the hoist so that the side pocket of anchorage of the rope on the drum flange is positioned at the top.

1. Drum
2. Slot
3. Pocket
4. Wedge
5. Flange




*Always wear protective gloves when handling a rope.*

4. Pass the end of the rope through the side slot on the drum flange and wind it around the anchoring wedge. The end of the rope must adapt perfectly with the bottom of the groove of the wedge.

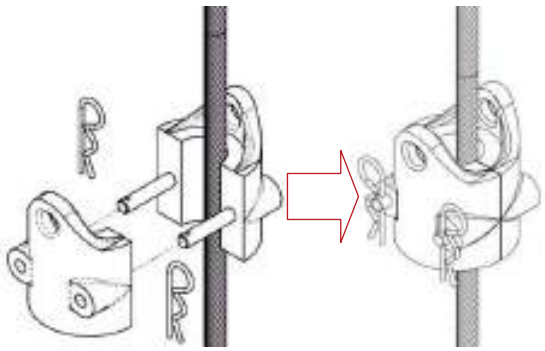
5. Insert the anchoring wedge inside the side pocket of the drum. Pull with force the free end of the rope to block the wedge inside the pocket. Hit with a rubber mallet the wedge to fix it even tighter.

*Fastening the rope improperly or using a wedge that does not couple with the pocket can damage the rope or cause the rope to slide out of its fixing pocket, causing the load to fall with serious consequences.*

6. Replace the hoist protective carter.
7. Slowly rotate the drum making sure that the first layer of rope is uniformly wrapped on the drum. Use a brass or rubber mallet to align the spirals with light taps.
8. Winding the second layer of rope, pay attention that the spirals are tight against one another to avoid overlapping or crossing of the rope in the next layer.
9. Install the remaining part of the rope according to your necessity.

*Wind or unwind the rope keeping it always pulled. Never wind on the drum more than the appropriate amount of rope.*
*During the winding or unwinding phase it is recommended to maintain a minimum tension of the rope equal to 3% of the breaking load of the rope under direct pull.*

10. Pass the rope over the upper sheave of the head of the boom and then between the lower sheaves and the hookblock, according to the number of falls desired.
11. Pass the last segment of rope between the two semi-blocks of the limit switch weight. Connect and lock the two semi-blocks.



12. Fasten the free end of the rope to the lug and then to the anchoring point.
13. Lift the boom to work position with a suspended test load to definitively settle the wedge and the rope inside the lug and check the correct mounting of the falls.

*Free end of the rope fastening:*

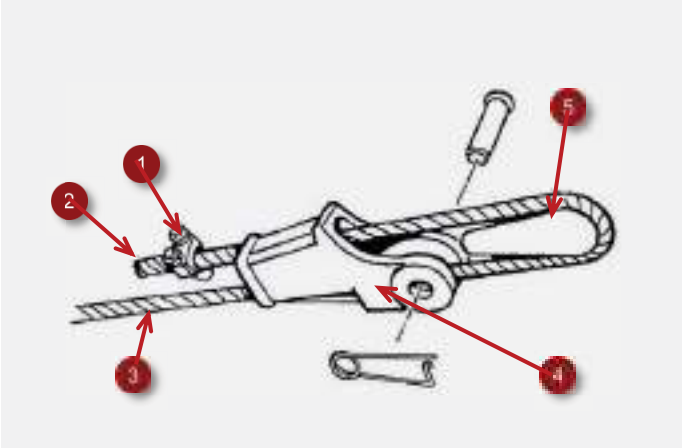
After having mounted the rope on the hoist, the free end must be fastened to the head of the boom or to the hookblock according to the number of falls.
The fastening system is based on the use of a self-blocking wedge swaging socket. The wedge socket can be quickly and easily mounted and taken apart, but it requires the correct mounting of the rope.

*Fastening the rope improperly or using a wedge that does not couple with the swaging socket can damage the rope or make the rope slide out from the socket, causing the falling of the load with serious consequences.*

To fasten the rope to the swaging socket:

1. Make sure that the wedge to insert and the socket are suitable for the diameter of the rope used.
2. Make sure that the end of the rope to be inserted is braze welded or well tied with carbon steel wire, in order to prevent it from coming undone and avoiding the opening of the steel wires of the rope and the core to come out.
3. Insert the end of the rope in the socket and make it get out once again, forming a loop, making sure that the part of the pulled rope is positioned along the axis of the socket fork, and that the length of the terminal part of the rope (dead end) that extends after the final blocking is at least 15 cm long.

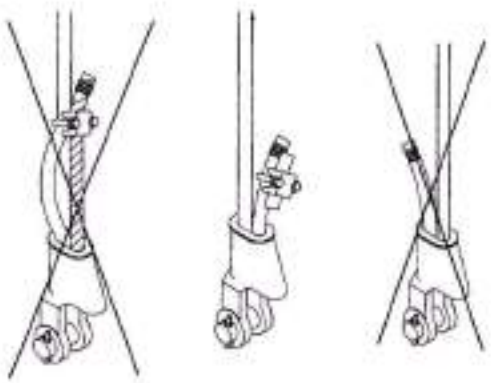
1. Wire rope clip
2. Dead end
3. Free end
4. Swaging socket
5. Wedge




4. Insert the wedge in the ring and pull the free end of the rope. The wedge and the rope must move freely until they adhere against the walls inside the socket, locking themselves.
5. Fasten a wire rope clip to the dead end of the rope as an additional safety measure avoiding the rope to slip out of the swaging socket.

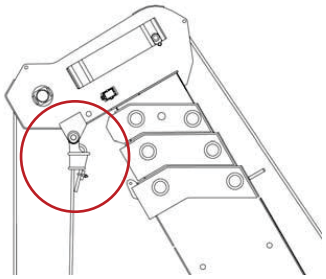
*An incorrectly fastening of the rope as shown in figures A and C may cause the sliding of the rope until its complete detaching, with serious consequences.*

**INCORRECT** **CORRECT** **INCORRECT**



**A** **B** **C**

6. Permanently settle the wedge and the rope in the swaging socket by lifting a load.



When the swaging socket is fastened to the boom, it must be mounted with the dead end of the rope towards the boom of the crane, as shown in the figure.

*The fixing of the free end of the rope must be made with great care and should be checked often because, being subject to stresses and accidental blows, is one of the most sensitive issues.*

### 11.4.13.6 Testing and adapting of the rope

Running of the rope is an important operation. In fact, a new rope settles during the first load cycles.
After having mounted the rope and checked its attachments, lift a few light loads with the boom completely extended and lifted.
It is possible that the hookblock has a tendency to rotate on itself and, once that the load is released, the supporting segment ropes get twisted. This is caused by the winding direction of the strands that, even in anti-revolving ropes, causes an internal rope settling with a tendency to twist. In order to obviate this inconvenient, after a certain number of load cycles with gradually increasing loads, rest the hookblock on the ground and disconnect the rope swaging socket from its attachment. Twist the rope two or three times in the opposite direction to the winding direction of the external strands in order to discharge the rope tension. Re-connect the swaging socket and complete a few hookblock raising cycles without load, with the extended and lifted boom. In this way the rope can settle and you can verify if it still has a tendency to twist. Repeat this sequence of rope loading and swaging socket rotation until the rope has not settled.

### 11.4.13.7 Supporting rope segments mounting procedure (falls)

The main hoist is equipped with a steel rope which features are reported in the audit register of the machine.

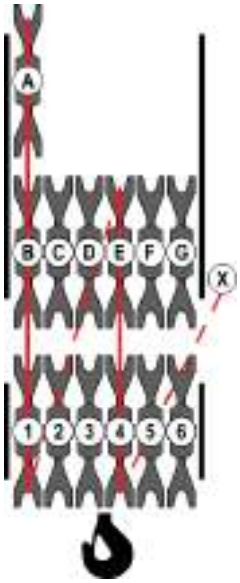
The rope can be mounted in various number of falls according to the required lifting capacity. The lifting capacity of a crane depends on the traction force of the hoist and the number of supporting rope segments, between the head of the boom and the hookblock.

*Always use a number rope segments suitable for the load that has to be lifted.*

***CE norms:***

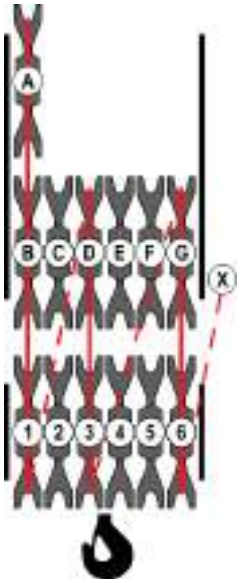
| **No. of falls** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Perm. load [t]** | 5,4 | 10,8 | 16,3 | 21,7 | 27,1 | 32,5 | 37,9 | 43,3 | 48,8 | 54,2 | 59,6 | 65,0 |

The following figures illustrate the procedures for installing the hookblock in fourth, eighth, tenth and twelfth fall. The sheaves indicated by the letters A, B, C, D, E, F and G are the ones that are mounted on the head of the boom; the sheaves indicated by the numbers 1, 2, 3, 4, 5 and 6 are the ones of the hookblock. Position X corresponds to the swaging socket placed on the boom head.



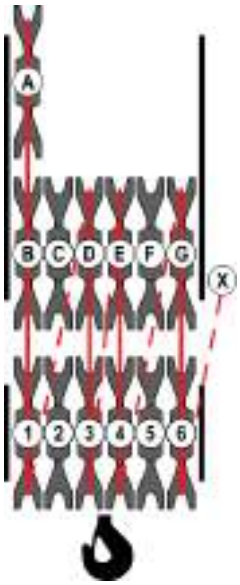

**Four falls**

From sheave A pass the rope over sheave B.
From sheave B pass the rope underneath sheave 1.
From sheave 1 cross and pass the rope over sheave E.
From sheave E pass the rope underneath sheave 4; anchor the end of the rope to the wedge and fix it to the anchor point X placed on the boom head.




**Six falls**

From sheave A pass the rope over sheave B.
From sheave B pass the rope underneath sheave 1.
From sheave 1 cross and pass the rope over sheave D.
From sheave D pass the rope underneath sheave 3.
From sheave 3 cross and pass the rope over sheave G.
From sheave G pass the rope underneath sheave 6; anchor the end of the rope to the wedge and fix it to the anchor point X placed on the boom head.

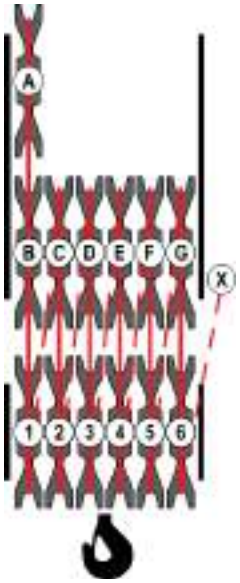



**Eight falls**

From sheave A pass the rope over sheave B.
From sheave B pass the rope underneath sheave 1.
From sheave 1 cross and pass the rope over sheave D.
From sheave D pass the rope underneath sheave 3.
From sheave 3 cross and pass the rope over sheave E.
From sheave E pass the rope underneath sheave 4.
From sheave 4 cross and pass the rope over sheave G.
From sheave G pass the rope underneath sheave 6; anchor the end of the rope to the wedge and fix it to the anchor point X placed on the boom head.


**Ten falls**

From sheave A pass the rope over sheave B.
From sheave B pass the rope underneath sheave 1.
From sheave 1 cross and pass the rope over sheave C.
From sheave C pass the rope underneath sheave 2.
From sheave 2 cross and pass the rope over sheave E.
From sheave E pass the rope underneath sheave 4.
From sheave 4 cross and pass the rope over sheave F.
From sheave F pass the rope underneath sheave 5.
From sheave 5 cross and pass the rope over sheave G.
From sheave G pass the rope underneath sheave 6; anchor the end of the rope to the wedge and fix it to the anchor point X placed on the boom head.




**Twelve falls**

From sheave A pass the rope over sheave B.
From sheave B pass the rope underneath sheave 1.
From sheave 1 cross and pass the rope over sheave C.
From sheave C pass the rope underneath sheave 2.
From sheave 2 cross and pass the rope over sheave D.
From sheave D pass the rope underneath sheave 3.
From sheave 3 cross and pass the rope over sheave E.
From sheave E pass the rope underneath sheave 4.
From sheave 4 cross and pass the rope over sheave F.
From sheave F pass the rope underneath sheave 5.
From sheave 5 cross and pass the rope over sheave G.
From sheave G pass the rope underneath sheave 6; anchor the end of the rope to the wedge and fix it to the anchor point X placed on the boom head.

- *When the installation is completed, before starting to work, raise the boom in working position with a test load suspended for securely tighten the rope and the anchoring wedge against the seat of the swaging socket.*
- *To maintain a stable positioning of the hookblock during the lifting, perform the rope winding procedures on the sheaves in order to have an equal distribution of rope tension.*

*To maximise the life span of the rope and to reduce the rotation of the hookblock use, if possible, an equal number of bearing segments of the rope.*

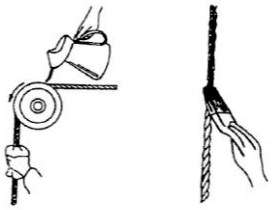
### 11.4.13.8 Lifting rope maintenance

*For a long life span of the rope, for the safety of load lifting and of personal safety, it is fundamentally important to keep the ropes in an optimal condition.*

**Grease**

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** WRL (see '*Appendix A*')

The rope is internally lubricated during manufacturing in order to ease reciprocal wire sliding during bending and inhibit oxidation.
This lubrication cannot last the entire operational lifespan of the metal rope; therefore it is necessary to periodically lubricate it
The lubricant can be applied with different methods: spreading it along the rope with a brush or a sprayer, or making it drip down the rope.



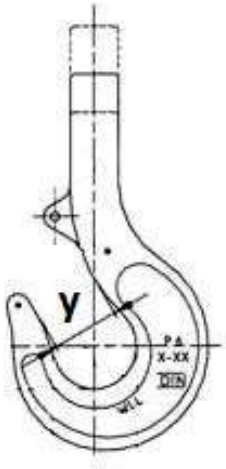
To promote penetration, the lubrication should be performed in an area where the rope is bent, such as the one in correspondence of a sheave. The lubricant must be applied on top of the curvature, because at this point the strands are opened by the bend and it is easier to make it penetrate inside.

*Avoid laying the rope on muddy or dusty floors.*

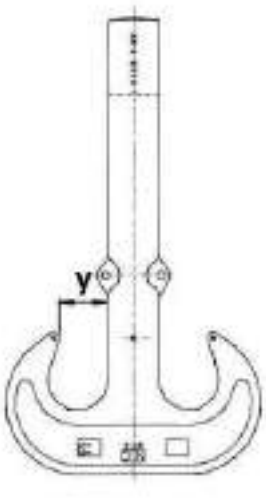
*Always wear protective gloves when handling a rope.*

### 11.4.14 Hookblocks

- *Before lifting a load, make sure that the return spring of the safety latch is not damaged, and that it pushes the latch against the hook closing its opening. Never use hooks where the safety latches are bent or damaged.*
- *Do not lift with jolts, but do it in the most continuous way as possible.*
- *Never lift loads that are heavier that those allowed by the maximum hookblock lifting capacity. Maximum lifting capacity is reported on the plate fixed to the hookblock and embossed on the hook. If a load that exceeds the maximum allowed lifting capacity is lifted accidentally, it is necessary to immediately verify the measurement of the "y" dimension of the shank hook opening, before going back to work. The measured value must be compared to the one indicated on the certificate issued by the manufacturer and reported shown in the audit register of the machine. If the value measured is different from the certified one, immediately suspend work and promptly warn the person in charge of maintenance. The hook must be replaced.*




**SHANK HOOK**




**RAMSHORN SHANK HOOK**

#### 11.4.14.1 Hookblock lubrication

**Grease**

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** EP-GEG (see '*Appendix A*')

Grease the axial bearing and lubricate the cross pin on each axial joint of the hookblock until the grease comes out.

### 11.4.15 Safety devices

#### 11.4.15.1 Anti-2-Block device

The limit switch is mounted of the head of the boom in order to prevent the latter to come in contact with the hookblock when the rope is lifted or the boom is extended. The device is made of a watertight switch connected to a chain and a weight block. When the hookblock, moving upwards, hits the weight block, the switch opens the electrical circuit and, through a solenoid valve discharges the joysticks hydraulic circuit, causing the movements to stop.

The same limit switch device is alternatively used for working with the main boom and for the heavy duty jib or the lattice extension.

In case you are using the auxiliary hoist, associated with an extension, contemporarily to the main hoist, a second Anti-2-Block device will have to be used. The two devices, connected in series, will ensure that, lifting the load, the device that will intervene first will also block the manoeuvre of the second one.

Before starting the crane make sure that:

1. The limit switch is fixed to the specific support attachment on the head of the boom and fastened with a restraint.
2. The Anti2Block device is connected to the electric socket placed on the head of the boom.
3. The weight block is linked through the chain to the metal cable of the switch and it is closed around the last rope segment of the swaging socket.

*The minimum length for the chain of the counterweight for the limit switch device must be at least 80 cm long.*
*Moderate the hoist lifting speed when working with the hookblock near the limit switch.*

The limit switch counterweight is made out of two detachable semi-blocks kept in position with two reference pins and two elastic split pins.

To insert the rope in the limit switch counterweight:

1. Remove the two R-clips from the block and separate it into two parts.
2. Close the two semi-blocks around the swaging socket rope segment and fasten it with the elastic split pins.

#### 11.4.15.2 Lifting intervention and exclusion of the limit switch mode

The limit switch stops the lifting movement of the hookblock and the extension of the telescopic boom.

When the limit switch starts to work, all the movements that increase the loading moment are blocked, and the Load Moment Indicator (LMI) lights a warning light and emits a continual acoustic signal. No error message appears on the LMI display. The blocking of the movements and the alarm signals continue until the related joystick is moved to invert the movement.

*The lifting limit switch is disengaged when the LMI is excluded: danger of accident.*

Check daily the functioning of the hookblock limit switch.

### 11.4.15.3 Hoist hook limit switch

The rope descent limit switch is mounted on the drum of the main and auxiliary hoist - if provided - to stop the descent movement by the hoist when only three spirals of rope remain on the drum.

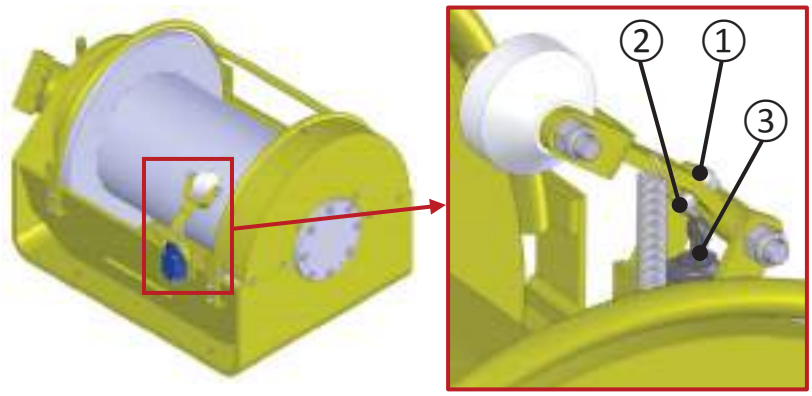
The device is made of a watertight switch mounted on a support, by a roller probe hinged on the support and by a spring which keeps the roller presses against the rope winded around the hoist drum.

When on the drum there are just three spirals of rope winded on the drum, the roller, pressed down by the spring, spins until it comes in contact with the drum, by engaging the switch that cuts off the electrical circuit blocking, through the discharge solenoid valve of the joysticks hydraulic circuit, the rope descent movement.

In case you are using the auxiliary hoist, associated with an extension, contemporarily to the main hoist, a second device will have to be used. The two devices, connected in series, will ensure that, lifting the load, the device that will intervene first will also block the manoeuvre of the second one.

To adjust the rope descent limit switch device:

1. Lift and extend the boom. Unwind the rope until only three spirals remain winded on the hoist drum. The descent movement should stop automatically.




If that does not occur:

2. Loosen the nut (pos.1) and adjust the screw (pos.2) so that, with the roller pressed against the drum, the cam (pos.3) gets pressed until it engages the switch.
3. Rewind the rope in various layers on the drum and check the safety of the rope descent limit switch device.
4. Periodically check the wear of the limit switch device by adjusting, or in case, replacing it.

### 11.4.15.4 Dead man's switch


Every day, before operating the crane and without hanging a load, make sure that the dead man's switches are working by slightly moving one of the two joysticks, without pressing the switches: manoeuvres shall not be activated.

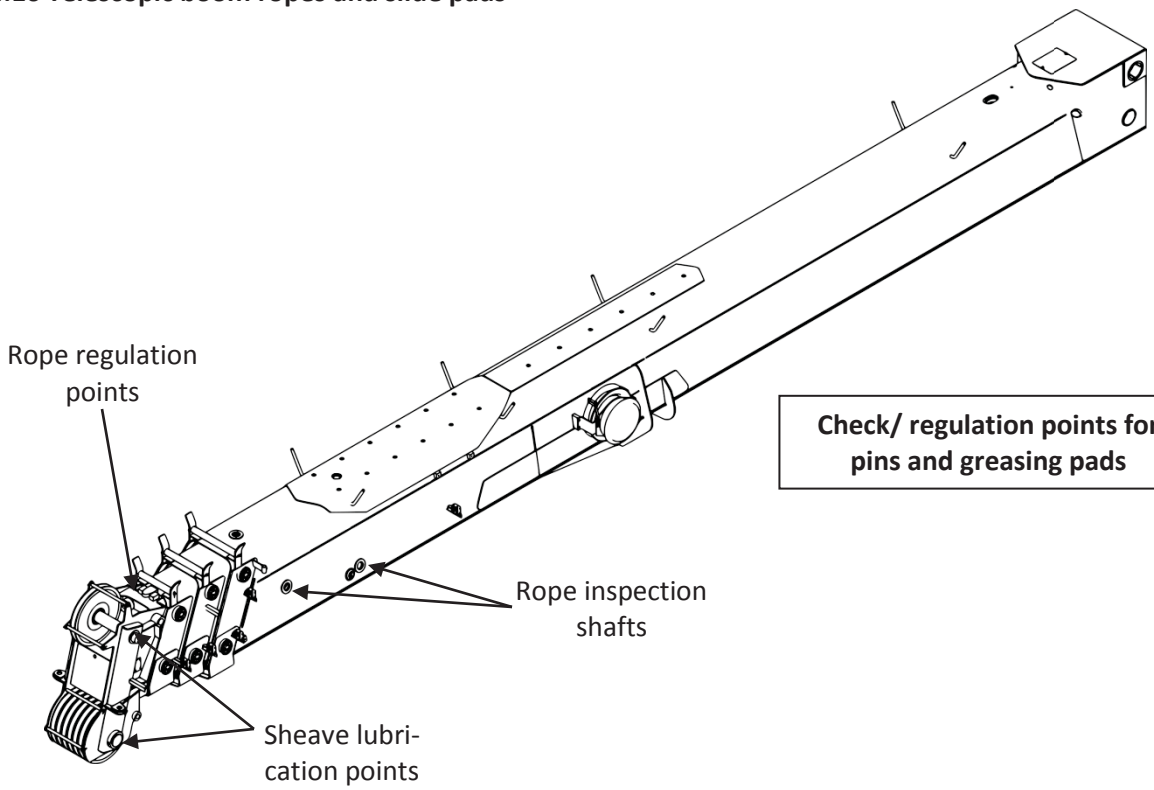
### 11.4.15.5 Main and auxiliary hoist refilling

**Lubricant**

**Change:** first time 500 h, then every 1000 h;
**Check-up:** see tables (§11.2 e 11.3);
**Main hoist quantity:** 4.5 litres;
**Auxiliary hoist quantity:** 2.6 litres;
**Type:** EP-GBO (see '*Appendix A*')

The refilling has to be carried out through the filler neck placed in the upper part of the hoist gearbox.

### 11.4.16 Telescopic boom ropes and slide pads




**Check/ regulation points for pins and greasing pads**

#### 11.4.16.1 Boom extension and retraction ropes

It is necessary to check periodically the correct tension of the rope and chains of the boom by checking if, in the extension and retraction phase, all three telescopic sections start moving simultaneously without any synchronisation delay.

*In case there should be a synchronisation delay of one or more telescopic sections, contact the manufacturer.*

*It is recommended to replace the extension and retraction multiple and single ropes of the boom at least every 7 years.*

#### 11.4.16.2 Lubrication of ropes and chains

**Grease**

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** WRL (see '*Appendix A*')

The boom internal ropes and chains must be checked through the inspection shafts of the boom to verify that they are lubricated.
The lubrication, that usually is carried out during the boom overhaul, will have to be done after an accurate clearing. The rope cleaning must be done by using a metal brush in order to remove dust, dry grease, deposits or any other impurities that could prevent an efficient lubrication of the ropes.

#### 11.4.16.3 Boom slide pads lubrication

**Grease**

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** EP-BEG (see '*Appendix A*')

The internal slide pads of the boom must be checked through the inspection shafts of the boom to verify that they are lubricated.

For a correct lubrication, first of all, pull out the slide pads from their seats, clean them with a metal brush to remove eventual impurities from the surface of the slide pads and afterwards grease them before putting them back in their seats again. In case there should be some profiled slide pads with greasers fixed on them, pump grease in the greasers until the grease spills out.

#### 11.4.17 Hinge pins

**Grease**

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** EP-GEG (see '*Appendix A*')

On the hinge pins which are equipped with greasers, pump grease inside the greasers until the grease spills out.

### 11.4.18 Battery

Keep the electrolyte level to the 'MAX' sign printed on the battery. If necessary, top up with distilled water. Check the fluid level more frequently during the summer months.

If the crane remains unused for a long time or, in winter, if you run the engine for short periods, the batteries may not be fully recharged. Make sure that the batteries are fully charged to prevent them from freezing.

Keep the batteries clean by wiping them with a solution of sodium bicarbonate and clean water. Dry up the terminals and protect the terminals and the clips by spreading on them a silicone based lubricant, petroleum jelly or grease.

*Do not dispose the exhausted batteries in the environment, but send them to an authorized collector waste plant.*

### 11.4.19 Heating system

During the summer season, empty the fuel tank of the heating system. The tank is placed on the cabin.

Keep clean the filter placed on the diesel feeding pipe attachment placed on the base of the tank.

### 11.4.20 Calibration of pressure relief valves

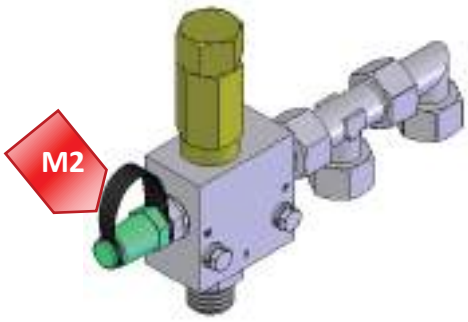
To check the settings of the pressure relief valves the circuit is equipped with pressure test plugs. Connecting a pressure gauge to the pressure test plugs you can check the value of the pressure relief valves of the different circuits.

*For the regulation values of the main relief valves and the reducing valve settings consult the hydraulic scheme.*

*Stop the engine before connecting the pressure gauge to one of the pressure test plugs.*

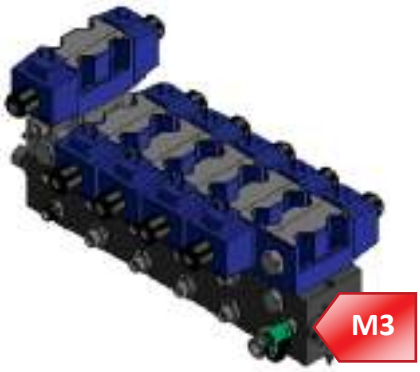

**M1 - Servo controls pressure plug**

The pressure plug for the servo controls is on the accumulator manifold placed on the turret.




### M2 - Steering pressure plug

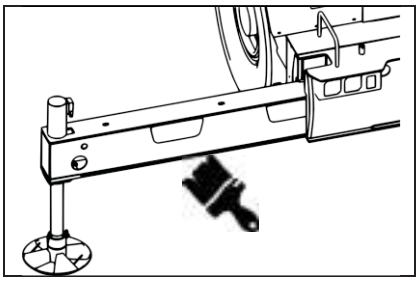
The pressure plug for the steering is on the relief valve placed underneath the carriage.




### M3 - Outrigger pressure plug

The pressure plug for the outriggers is on the manifold placed underneath the carriage.

#### 11.4.21 Outrigger beams



Grease the inferior surfaces of the outrigger beams by applying two layers of grease for each beam by using a spatula.

**Grease**

**Check-up and maintenance:** see tables (§11.2 e 11.3);
**Type:** EP-GEG (see '*Appendix A*')