

OCCUPATIONAL RISK PREVENTION MANUAL

ARTICULATED HYDRAULIC TRUCK CRANE



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HYDRAULIC TRUCK CRANES

The purpose of this manual is to expose the specific risks that are originate in the work carried out with truck mounted hydraulic cranes (GHA) as well as the protection and prevention measures to be adopted in their use.

For this purpose, these equipments, types and accessories are described, as well as the safety systems that must be incorporated for a safe use of them, rules of use, personal protection equipments, the requirements that must be met by the operator and the maintenance and marking rules.

2. DEFINITION AND PARTS. TYPES. APPLICATIONS

DEFINITION

A loader crane (Articulated Hydraulic Crane) (Standard UNE-EN 12999) is a crane composed of a column that rotates on a base, and a system of arms attached to the top of the column. This crane is usually mounted on a commercial vehicle (including trailer) with a significant residual load capacity. Loading cranes are designed for loading and unloading the vehicle as well as for other tasks specified in the "Manufacturer's Manual". A cargo crane, as defined above, installed on a static base is still considered a cargo crane.

PARTS

The main parts of a loader crane are:

- ➔ Base: Frame, including anchor points and bearings for the rotation of the column.
- ➔ Column: Structural member supporting the boom system.
- ➔ Boom system: Structural member in the loader crane boom system.
- ➔ Stabilizers: Aids the loader structure connected to the vehicle to provide the required stability.

They may have a raised operating position, i.e. a seat attached to the loader crane column or a platform located on the loader crane base.

TYPES

There are various types of truck loader crane assemblies such as those mounted behind the truck, in the back, in the center of the trailer, cantilevered in the back, etc.

There are other types of mounts such as those installed on fixed bases or on other vehicles.

APPLICATIONS

The possible applications of these equipments depending on their load diagram and the next by the manufacturer are

- ➔ Loading / unloading your own vehicle or another vehicle.
- ➔ Lifting, holding and moving loads in the permitted positions according to their load diagram.
- ➔ Lift, hold and move loads below ground level according to your load diagram.
- ➔ Lifting loads at a high height and then supporting this load for assembly work (rafters, metal beams, concrete elements, etc.).
- ➔ Use of manufacturer-approved accessories such as: jib (third articulated arm), bucket for lifting and moving bulk material (sand, pebbles, etc.), pallet rack, octopus, etc.
- ➔ Transporting concrete tanks to the different areas to be concreted and releasing the load at height.

- ➔ Loading and unloading vehicles.
- ➔ Lifting of loads from the ground to different heights (e.g. transporting gravel to a roof).
- ➔ Assembly work such as positioning beams and building structures.
- ➔ Lifting building material on pallets at different heights in a building, transporting it from the truck itself, from the ground or from another truck.
- ➔ Moving the concrete cupola to different heights for concreting.
- ➔ Positioning pipes at ground level or inside trenches and keeping them in position while they are being joined together.
- ➔ Handling of heavy loads, pre-cast concrete slabs, etc. mainly in the construction sector.
- ➔ Supporting and moving submerged pumps in wells for repair or replacement with the aid of a winch.

3. RISKS AND RISK FACTORS

The risks and risk factors that most frequently occur in the work carried out with this equipment are: vehicle overturning, falling loads, blows against objects or people, entrapment, indirect electrical contacts, among others that are listed below.

Overturning of the carrying vehicle due to:

- ➔ Positioning of stabilizers and/or defective leveling of the same.
- ➔ Failure of the land where it sits.
- ➔ Exceeding the maximum permissible load moment (e.g. when removing material).
- ➔ Effect of wind.

Drop in load during movement due to:

- ➔ Failure of the hydraulic circuit.
- ➔ Crash of loads or boom tip against an obstacle.
- ➔ Due to breakage of slings, cables or other auxiliary elements (hooks, pulleys, etc.).
- ➔ Due to improperly made hitching or spoiling.

Blows against objects or people due to:

- ➔ Handling of cargo in the proximity of people, goods, etc.
- ➔ Due to breakage of slings, cables or other auxiliary elements (hooks, pulleys, etc.).

Limb entrapment:

- ➔ Among auxiliary elements (hooks, slings, pulleys, etc.).
- ➔ By the load itself when deposited.
- ➔ By the moving parts of the equipment.

Indirect electrical contacts due to:

- ➔ Entering the structure or cables in contact with electrical lines.

Burns with hot liquids or conduits due to:

- ➔ Coming into contact with the distributor, valves, pipes and hoses, fittings, cylinders, etc. of the hydraulic circuit that are hot due to the flow of oil when circulating through them.
- ➔ Due to the breakage of any element in the circuit, causing the fluid to be ejected at high temperature.

Falls from heights due to:

- ➔ When the operator climbs on the equipment, to carry out repairs, to access auxiliary control posts, etc.

Sound trauma due to:

- ➔ To the power source, usually the vehicle engine. Exhaust gas inhalation due to:
- ➔ Exhaust gas components, such as carbon monoxide, nitrogen oxides or diesel soot, affecting the operator when at the control position.

Various transport risks due to

- ➔ Running with the extensions and support jacks not fully retracted.
- ➔ Driving with the crane deployed above the load to be transported exceeding the maximum height of the vehicle.
- ➔ Do not correctly secure loads and accessories so that they do not move during transport or are placed in such a way that they exceed the limits permitted by current legislation.

Risks of various kinds in the work area due to

- ➔ Movement of moving parts of the equipment when stabilising it.
- ➔ Fall of loads from height or movement of them.
- ➔ Overturning of the equipment due to loss of stability.

4. PREVENTION AND PROTECTION MEASURES

The prevention and protection measures are specified in the precautions to be taken into account in the assembly of the crane on the truck and the safety systems that must be installed in this work equipment. In addition, a series of safety regulations are given for the safe use of this equipment in relation to the risks indicated.

Mounting the crane on the carrier vehicle

The assembly of the crane must be carried out in accordance with the crane manufacturer's assembly instructions and the instructions issued by the vehicle manufacturer.

After correct assembly, the vehicle must be stable over the entire working area of the crane. The stability of a vehicle carrying a loader crane deduced by calculation should only be used as an indication. Stability verification should be done by a load test.

During the loading test, one or more outriggers or a wheel may be lifted off the ground. However, at least one of the wheels locked by the hand brake must remain in contact with the ground. The loading test must be carried out with the vehicle unloaded and without the driver. According to Standard UNE-EN12999, the test load must be at least 1.25 x the nominal load.

If the nominal capacity is lower in sectors of the turning field, the crane must be equipped with turning limiters (see "turning limiters" in the section "equipment safety systems"). Once all the checks have been carried out, the assembly shop must fix a plate on the crane or a support element.

This plate must contain the following information:

- Name and address of the installer.
- Year of installation.
- Serial number of the crane.
- Chassis or registration number.

The person responsible for handing over the equipment to the operator is responsible for instructing the operator in the handling of the crane and informing him of the dangers and possible risks of accidents.

When the crane is handed over to the operator, he must also receive the "Maintenance Manual", the "Operating Instructions" (including supplements resulting from assembly) and the joint "EC Declaration of Conformity" for the crane and the assembly for cranes sold within the European Union.

Subsequently, the owner of the crane is responsible for subjecting it to the periodic controls prescribed by the regulations in force, through adequate maintenance in order to maintain the same safety conditions as when it was first put into service (art.3 of RD. 1215/97).

Equipment safety systems (GHA and chassis)

These are devices incorporated into the assembly or accessories used that serve to control one or more of the risks described without conditioning the operating process. The most important are the rated capacity limiter, the rated capacity indicators, the rotation limiters, the level indicator, the emergency stop button, the pilot load holding valves, the protective nets for hoses and the transport indicator.

Rated capacity limiter

Cranes with a nominal capacity of 1 000 kg or more or with a net lifting moment of 40 000 Nm or more, must be fitted with a device which automatically prevents the crane from handling loads in excess of its nominal capacity, taking into account the dynamic effects during normal operation. In addition, the rated capacity limiter also reduces the risks of overloading the structure, tipping the vehicle and dangerous movements of the load.

The system works in such a way that when it reaches the overload zone (instability) all crane functions that would increase the lifting moment (see load diagrams) are disabled and the equipment only allows, once activated, movements towards the stability zones.

For cranes with a nominal capacity of less than 1 000 kg or a maximum net lifting moment of less than 40 000 Nm, pressure relief valves must provide protection against overloading where no nominal capacity limiter is provided.

For cranes equipped with a winch and/or a third articulated arm, these must be incorporated in the rated capacity limiter system.

The capacity limiters have different technical solutions among the different models of cranes, therefore to know which one is installed in the crane it is necessary to consult the "Manufacturer's Manual" of the equipment.

Rated capacity indicators

Cranes with a rated capacity of 1 000 kg or more or with a net lifting moment of 40 000 Nm or more must be fitted with a capacity indicator (continuous visual or acoustic signal) to warn the operator when the load exceeds 90% of the rated capacity. If the rated capacity is exceeded, a clearly different signal from the above and also a continuous signal must warn the operator and persons in the vicinity of the crane of the overload.

For cranes with a nominal capacity of less than 1 000 kg or a maximum net lifting moment of less than 40 000 Nm, and where no nominal capacity limiter is provided, the installation of a clearly marked pressure gauge, indicating the approach to the nominal capacity, visible from the crane control, would fulfil the function of a nominal capacity indicator for these cranes. For cranes with remote control, the installation of an additional visual or sound indicator will be necessary, indicating the approximation to the nominal capacity.

Rotation Limiters

If the rated capacity is lower in parts of the swivel range, the crane must be equipped with rotation limiters. These limiters must have priority over the crane controls when it tries to turn in that sector with a load higher than the rated capacity or lifts loads higher than the rated capacities within that sector.

Level indicator

Cranes fitted with outriggers must be equipped with a level indicator at each crane control position where the truck's inclination can be checked.

Emergency stop button

The emergency stop button is a safety device that when activated instantly blocks all crane movements and must be located at all control positions.

Pilot operated load holding valves

These valves are used to prevent uncontrolled movements in all load bearing circuits in the event of a break in the hydraulic line.

Protective nets for hoses

Hydraulic hoses containing fluid at a pressure exceeding 5 Mpa and/or having a temperature exceeding 50oC and located less than 1 m from the operator must be protected. Any element or component that can retain or deflect a possible fluid jet can be considered as a sufficient protection device.

Transport indicator

When the arm system of a vehicle-mounted crane is to be supported on the loading platform or on top of the load during transport, an indicator (e.g. angle sensor) should be provided. This indicator should inform the operator when the height of the crane exceeds a predetermined maximum value.

Safety rules for preparing the crane for operation

Compliance with safety regulations in use can prevent most of the risks outlined.

Location of the vehicle

The machine shall be positioned avoiding the irregularities of the ground and levelling its surface if necessary, in order to ensure that the crane is perfectly levelled; this levelling shall be verified before starting the work, which shall be stopped immediately if any support is observed to be collapsing during the work.

The verification of the inclination levels must be done in each crane control station. If the air bubble is in the centre of the level, the crane is in a horizontal position.

If the load is transmitted by means of stabilisers and the ground is clayey or does not offer any guarantees, it is preferable to extend the load distribution over the ground by increasing the support area by means of special bases, for example, high-strength support bases designed for such n; by one or more layers of railway sleepers or planks, etc.

The bearing surface can be approximately calculated as follows. The values for the maximum bearing force can be found in the technical data of the crane. The calculation of the required surface area can be made using the following expression.

$$\text{Stabilisation area } A [\text{cm}^2] = \text{Supporting force } F (\text{N}) / \text{Ground bearing capacity } [\text{N}/\text{cm}^2]$$

The maximum permissible pressure on the ground (ground resistance), defined according to DIN 1054.

Levelling Nivelación

Work with the crane is not permitted until the vehicle is supported on the stabilisers and leveled correctly (see "Level indicator" in section "Equipment security systems").

Check the "User's Manual" of the equipment manufacturer for the maximum permissible inclination depending on the configuration and working angles.

Operating positions

The command posts can be of the following types:

- ▶ Controls from the ground.
- ▶ Controls from a jib platform, turntable, elevated seat or cabin
- ▶ Remote controls from a remote control.
- ▶ Cabin.

The control stations must comply with the following specifications:

- ▶ Where more than one control position is provided, means must be provided to prevent simultaneous operation from both positions, unless the controls are mechanically linked to each other.
- ▶ The control position for the extension function of the stabilizer should be located so that the operator has a perfect visibility of the movement to be controlled.
- ▶ The operator's platform must be designed so that the operator cannot be crushed or have his clothes caught by the moving parts of the crane. If it is not possible to install guards, the safety distances defined by the standards must be applied (see "safety distances" in point 2 of NTP-869). According to UNE EN 12999:2009, if it is not possible to comply with the above points, warning indicators must be placed to define the risk.

- ▶ On the high control platforms:
 - According to Spanish legislation (RD.486/97 and RD.1215/97), from 2 m working height, precautions must be taken to prevent the operator from falling from the platform.
 - During operation the operator must be protected against possible entrapment by the moving parts of the crane. If necessary, provision must be made for the installation of guards and/or turning angle limitations.

- ▶ Raised seats:
 - The controls or configuration of the crane in positions the default settings should not prevent access to the seat.
 - The seat must be equipped with means to prevent the risk of falling when the operator is in the working position; these means must not prevent access to the seat. If side protection is provided, it must be at a minimum height of 100 mm from the seat base, as specified in the UNE-EN ISO 5353:1999 standard.
 - A platform must be installed for the operator's feet. The minimum dimension for each foot is 160x300 mm.
 - It is not permitted to operate the lift from any position other than the high seat.

- ▶ Access and exit from high command posts: The installation of elements for the access and exit of the high commands, they must comply:
 - A simultaneous three-point support must be provided (two hands and one foot or two feet and one hand).
 - A safe exit must be provided in all crane service configurations.
 - Handrails and handles should not have sharp edges and should preferably be circular in section.
 - The steps of the ladders should have a minimum width of 300 mm; a step width of 150 mm is only acceptable when space restrictions do not allow a width of 300 mm.
 - The angle of the ladders must be 75 to 90 degrees above the horizontal.
 - For dimensional data, see information appendix L of the Standard UNE-EN 12999:2009 and standard UNE-EN 13586:2005+A1:2008.
 - The platforms and steps of the access stairs to them must be non-slip.

Controls

The layout of the controls and the functions of the crane and stabilisers (symbols) in the operating position of each individual crane is different from one piece of equipment to another, so it is necessary to consult the "Manufacturer's Manual" to familiarise yourself with each piece of equipment.

Both two-way and multi-way controls (joystick) are available. All controls must return to the neutral position when they have been released. The symbols must be permanently and visibly marked for each of the working functions. The control levers must be protected against unintentional operation.

The arrangement of the bi-directional controls must follow the sequence of the working functions from the base of the crane to the load handling device. The control levers for the positioning functions must be separated by a space or clearly differentiated (otherwise than by symbols) from other control levers.

Support system

If the stability and safety calculation of the crane allows it, it could be possible to work with a wheeled crane by transmitting the forces to the ground through the tyres. It should be noted that under these conditions the manufacturers generally recommend higher inflation pressure than the pressure they should have when circulating, so before moving from one situation to another it is very important to correct the pressure so that it always complies with the standards set by the manufacturer.

If the stability calculation does not allow work to be carried out on the tyres alone, a jack and beam support system must be used. When extending the stabilizer beams and jack stands, the operating position must be selected so that their entire area of movement can be seen. The crane components that are moving at any given time must never be lost sight of. No persons or objects should be found in the movement area of the outrigger beams / jack stands, always observing the minimum safety distances (see "Safety distances" in point 2 of NTP-869).

In the case of an asphalt surface, it must be ensured that the vehicle is not supported on holes or cavities, such as a manhole.

The vehicle must not be raised when supporting the jacks, otherwise the jacks will be overloaded and the effectiveness of the braking effect will be reduced. The support cylinders are designed to compensate only the tilting moment, therefore the vehicle must never be lifted with them.

Also in the case of load transmission through tyres, the suspension of the supporting vehicle must be locked so that, by remaining rigid, the horizontality of the chassis is preserved in any position taken by the load and to avoid unexpected movements of the vehicle. In addition to being kept in service and locked to the hand brake, the wheels must be properly shod.

If a vehicle is equipped with additional jacks and these have not been removed, the vehicle may tip over. In vehicles equipped with additional extensions, all safety instructions concerning the support must be observed in the same way as for crane vehicles.

Stabilizer beam

For cranes with a capacity of 1 000 kg or more, or with a maximum net lifting torque of 40 000 Nm or more, vehicle stability should be included in the crane's overload system. "Rated capacity limiter" under "equipment safety systems").

Stabiliser extensions should be marked to show when they are correctly deployed (e.g. with yellow markings). Stability calculations are made for when the jacks are fully extended.

According to the standard UNE-EN 12999:2009, on truck-mounted cranes (except forest cranes) which must have a rated capacity limiter and need the use of stabilisers to comply with the stability of the equipment (see "Mounting of the crane on the supporting vehicle" in point 4), the position of the stabilisers should be supervised by the rated load limiter and the capacity of the crane should be dependent on the position of the stabilisers.

There are two types of extensions, manual and hydraulic. Manual extensions must be provided with handles, locking devices for working and transport positions and extension stops. The hydraulic extensions must be fitted with locking devices for the transport position and also in the working position if the hydraulic cylinders cannot withstand the forces when handling the loads.

Objects must not be pushed or pulled with the hydraulic stabilisers.

Jack on the stabiliser

The stabilizer cylinder must have means, e.g. saucers, to support it on the ground, and it must be designed to adjust to ground unevenness of up to 10°.

There are two types of stabilizer jacks depending on the way they are transported: fixed or rotary with manual or hydraulic tilting.

When the jack has a tilting device, locking devices that can withstand normal operating forces (e.g. pins) must be provided to secure the jack in both working and transport positions.

Neither the operator nor other persons must be in the swivel range of the swiveling jack.

Working position. Crane deployment

The crane will be ready for work after the following operations:

- ▶ The extensions are secured with bolts and pins.
- ▶ The vehicle is correctly supported on the stabilisers.
- ▶ There are no persons or objects in the crane's movement area.
- ▶ All crane movements must be within the operator's field of vision.
- ▶ Weather conditions: with wind speeds above 50 km/h, safety when working with the crane cannot be guaranteed. If this wind speed is reached, the crane must not be started or must be stopped. If a storm approaches, the crane must not be started or must be stopped.
- ▶ Operating the controls. Use the most suitable controls for each particular case.
 - From the ground.
 - Move the main boom to the working position from the operating position opposite the main boom support. If the crane is deployed from the wrong operating position, there is a serious risk of accident to the operator from the loading arm.

- Do not extend the jib system until the crane is deployed. If the extension arms are extended before the main boom is in the raised position, there is a risk of accident to the operator

 - Radio remote control system: Choose a location outside the danger zone. If the operator is in the crane's movement area, there is a serious risk of accident.
 - Control from the raised seat: Move the loading arm to the working position from the high seat.
 - Command from the elevated position: Bring the loading arm into the working position from the control position on the floor opposite the arm rest. There is a serious risk of accident due to lowering or turning the main boom.
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- ▶ Sequence for unfolding the crane: Respect the sequence defined in the "User's Manual" of the equipment manufacturer. Each piece of equipment can be folded and unfolded differently due to its transport position, built-in accessories, etc.
 - ▶ The correct operation of the emergency stop in each control station and the load limiter and indicator (according to the user manual) has been checked. (see section "Safety systems").

2

HYDRAULIC TRUCK CRANES

HYDRAULIC TRUCK CRANES

Prior to any loading manoeuvre.

The operator of a hydraulic crane must be familiar with and take account of such matters as the uses intended by the manufacturer, the characteristics of the load to be handled, the most appropriate working position and the characteristics of the additional accessories that may be used.

1. INTENDED USES

The crane can be used, in the load range according to its load capacity diagram and according to the nest by the crane manufacturer, to lift, transport, support and deposit loads.

Some examples of work permitted by the manufacturers are:

- ➔ Loading / unloading your own vehicle or another vehicle.
- ➔ Raise, holding and moving loads in the positions permitted by their load diagram.
- ➔ Lifting, holding and moving loads below ground level according to their load diagram.
- ➔ Lifting loads to a high height and then support this load for assembly work (rafters, metal beams, concrete elements, etc.).
- ➔ Use of accessories authorised by the manufacturers such as: jib, bucket for lifting and moving bulk material (sand, pebbles, etc.), pallet rack, octopus, etc.
- ➔ Use of Transporting concrete buckets to the different areas to be concreted and releasing the load at height. authorised by the manufacturers.

If the instruction manuals for auxiliary equipment or the user's own instructions allow use (digging, oblique traction, etc.) contrary to the lift manufacturer's instruction manual, the lift's instruction manual applies.

This is prohibited:

- Pressing against obstacles or loads.
- Pulling, starting and all oblique traction.
- Holding loads at points other than those intended.
- Excavation work with the grab.
- Transport of persons without taking the measures provided for in the legislation in force.

The crane must be aware of the load characteristics and adopt an optimum working position for all work. The accessories used must also be taken into account, as they can affect the manoeuvre.

Knowledge of load characteristics

The safe execution of a manoeuvre requires knowledge of the weight of the load so, if it is not known beforehand, an approximation by excess must be obtained, by cubing it and applying a specific weight, for example between 7.85 and 8 kg/dm³ for steel, 2.5 kg/l for concrete. The weight of the load is also added to the weight of the auxiliary elements (buckets, tanks, clamps). Example: Loading mass produced by a 500 litre concrete vat:

- Concrete density: 2.5 kg/l
- Mass of the load = density (kg/l) x volume (l) = 2.5 x 500 = 1 250 kg

Once the weight of the load is known, the crane operator should verify with the load diagram (which should be on a plate on the crane itself and in the "Manufacturer's Manual") that the equipment to be used is adequate.

In operations such as rescuing accident vehicles, dismantling structures, etc., the maneuver must be carried out with great care, because if the load is trapped and the traction is not exercised vertically, the angle of pull itself can cause the working edge to have a load moment that is greater than the maximum admissible.

On the other hand, pendulum oscillations must be avoided, which, when the mass of the load is large, can acquire amplitudes that would endanger the stability of the machine. Therefore, when carrying out any manoeuvre, the movement of the load must be harmonious, i.e. without sudden movements, since the smoothness of the movements or steps followed in carrying out the manoeuvre has a more direct effect on stability than the speed or slowness with which it is carried out.

Crane working positions

The instructions for use of the equipment and accessories (third articulated arm (JIB), winch, etc.) contain information on the most suitable working positions.

In general:

- ➔ The movements permitted in the load diagrams must be carried out (see section "Equipment safety systems" of NTP 868).
- ➔ Smooth and uniform crane movements must be made.
- ➔ As the tilt (more than 60°) and height of the lateral deflection of the loading arm is increased.
- ➔ With a loading arm position greater than 80° , if the lift arm is overextended, the loading arm may deflect sideways or backwards, therefore, it is necessary to know the load diagrams and the manufacturers' manuals to verify the dangerous positions on each piece of equipment. According to UNE-EN 12999:2009, if there are areas of possible instability in specific positions and the geometry of the machine allows these areas to be reached, then a displacement limiter must be installed to prevent passage to these areas, except if necessary for movements to the transport position.

Accessories

The crane can be equipped with a number of lifting devices and accessories, for example: pallet holder, clamps, grabs, suction cups, concrete buckets, etc. When using these devices, it must be taken into account:

- ➔ The size and capacity of the devices must be appropriate to the capacity of the crane.
- ➔ Subtract the weight of the device from the maximum load of the crane.
- ➔ The capacity of the crane is limited by the lower capacity of the device. Check its capacity before starting work.
- ➔ The manufacturer of the accessory will carry out the CE marking, define the weight of the accessory on the device itself and deliver the "EC Declaration of Conformity" and its "User Manual".
- ➔ En some cases it will be necessary to calculate some masses in an approximate way: earth, concrete, etc.
- ➔ The manual extensions must be marked with their maximum capacity (Max XXX kg).
- ➔ According to the UNE-EN 12999:2009 the hydraulic hoses that are used for the connection of the interchangeable equipment must be designed, identified or located to avoid an incorrect connection causing a danger (for example to reverse the direction of movement of a hydraulic cylinder), a solution for example is to identify the connections by colors.

2. WORKING ENVIRONMENT

Performing a loading manoeuvre in a given location requires taking into account the environment and circumstances of the place where work is to be done. In this respect, it is important to take into account the area where the work is to be done, to use the rules for signalling manoeuvres, to respect safety distances and to take into account the proximity to overhead power lines.

Area where the work is to be carried out

The working area is the entire space covered by the boom during its rotation or trajectory, from the point where the cargo is tied up to the point where it is placed. This area shall be:

- ▶ Free of obstacles and previously delimited to avoid the passage of personnel, as long as the manoeuvre lasts.
- ▶ Check that all crane functions can be operated without being obstructed by trees, poles, power lines or other objects.
- ▶ Ensure that no other work is being carried out in the crane's working area or that other persons are endangered by the crane.
- ▶ The operator and the crane should be as close to the work site as possible.

Roads and paths that cross the work area should be closed while the crane is in use. Driving or passing through the work area is strictly prohibited for anyone not directly involved in the work of the crane (the crane operator and the person in charge of the maneuvering if it is not the same person).

It is also forbidden to remain under a suspended load, including the crane operator and the person in charge of the manoeuvre (the crane has warning signs indicating this prohibition).

All crane movements for loading and unloading positions, assembly, disassembly and accessory uses (depending on the manufacturer's uses) must be within the operator's field of vision and the load must never be out of sight.

If it is not possible to visually control the entire working area, the operator must be guided by a qualified person by means of signs. Standardised signal codes known to the operator and signaller must always be used, as described in the section on signalling for manoeuvres.

At dawn and dusk, as well as at other times of darkness, the working area must be artificially lit to ensure safe working.

If the passage of suspended loads over people cannot be avoided, pre-established signals, generally sound, must be given so that they can be made safe from possible detachment.

When the manoeuvre is carried out in a place accessible to the public, such as a road, the crane vehicle shall be fitted with flashing or rotating yellow-coloured lights located in its upper plane, which shall remain lit only for the time necessary for the manoeuvre to be carried out and shall be visible at a distance, particularly at night.

Signalling of manoeuvres

If the crane forms a group of work teams, and a joint manoeuvre is to be carried out, there must be a person in charge, with the necessary training and capacity to be able to direct it, who will be responsible for its correct execution, and who may be assisted by one or more manoeuvre assistants, if its complexity so requires.

The crane operator shall only obey the orders of the person in charge of the manoeuvre and the assistants, who shall be easily identifiable by their badges or clothes that distinguish them from the other operators.

If the signals are necessary to carry out the different operations with the load because the crane operator cannot be near the position of the load (in cranes with remote control the crane operator can usually check perfectly the manoeuvre to be carried out), they will at least follow what is indicated in Annex VI of RD.485/1997 on Signalling. These signals can be extended, if necessary, by the gestures contemplated in the UNE 58000:2003 standard, which is more specific to lifting and load transport operations. With respect to the latter, it should be noted that not all of the gestural signals contemplated by RD. 485/1997 appear in the UNE 58000:2003 standard, and that some of them are different from those published by the same standard, so in case of contradiction, the signals of the legal provision will prevail.

Safety distances

Avoid situations where the operator or others could be crushed by the crane, jacks or the load.

The situations listed below are not considered dangerous if the minimum safety distances indicated are observed, and provided that the next largest part of the body cannot reach the working area either.

Work in the vicinity of power lines

Maintain minimum safety distances from power lines. If this is not possible, the lines must be disconnected.

The arrangement and height of the power lines cannot be used to determine their voltage. If the line voltage is not known, the minimum safe distance between the crane and the cables should not be less than 5 meters. This applies equally to all devices and accessories installed on the lift.

Keep in mind that the wind can move the cables and that the crane arms can swing (also upwards) when making sudden movements. This simple unintentional approach can cause a flashover.

Minimum safety distances to high voltage lines and power lines of railways, trams, etc. must be observed. The safety distances to high voltage overhead power lines are defined in the Technical Guide of the Royal Decree 614/2001 on minimum requirements for the protection of the health and safety of workers from electrical risks.

In the event of accidental contact of the cable or wires with a live electric line, as a safety rule the crane operator must:

- ▶ Remain calm, do not move.
- ▶ Warn those around you and urge them to keep the safety distance.
- ▶ The minimum distance to the vehicle, apparatus, load or downed lines must be at least 10 m. (zone of influence).
- ▶ Leave the zone of influence only by jumping. When doing so, keep your legs closed due to the strain of passage.
- ▶ Never leave the raised operator's platform, the raised seat, the driver's cab or the loading area. Stay where you are and do not touch any objects.
- ▶ Do not touch the appliance, the load or downed lines.
- ▶ Immediately order the lines to be disconnected while driving.
- ▶ Before rescuing people from the electrical circuit, the supply line must be disconnected.

3. SAFETY RULES FOR LOADING

We will distinguish between general rules, specific safety rules during and at the end of the work, and other recommendations.

General rules

In general, the strobe should be carried out in such a way that the load distribution is homogeneous so that the suspended piece is in stable equilibrium, avoiding the contact of strobe with sharp edges through the use of corner pieces. The angle formed by the straps between them shall in no case exceed 120° and must be less than 90°. In any case, it must be proved in the corresponding tables that the useful load for the angle formed is greater than the real one.

Each of the auxiliary elements used in the manoeuvres (slings, hooks, shackles, frogs, etc.) must have a sufficient load capacity to carry, without deformation, the loads to which they will be subjected. Cables whose broken wires, counted along a stretch of cable less than eight times their diameter, exceed 10% of the total must be discarded.

Specific safety regulations

We will distinguish between the rules relating to loading operations, those for hooking or unhooking the load and those for lowering the load.

Loading operations

- ▶ Please note the special instructions for handling the load and the gripping devices such as: attachment points, centre of gravity, position, etc.
- ▶ Secure the load
- ▶ The weight of the load must be known. If there are no data on the load, it must be calculated or estimated.
- ▶ Ensure that the load can move freely and is not anchored, frozen or otherwise secured.
- ▶ Clear the load of snow and ice before lifting. Wet or icy loads can drain.
- ▶ Always lift loads vertically from their center of gravity.
- ▶ Observe the instructions given in the section "Area of application of the work."
- ▶ Before moving the crane, make sure that no one is in the working area (danger zone) of the crane.
- ▶ Immediately stop all movement with the lift if someone enters the work area. Do not resume crane operations until all persons have left the work area.

- ▶ The operator must have established the complete sequence of work operations before commencing crane operations.
- ▶ The assistants, signaller and persons in the vicinity must be informed of the impending work.
- ▶ All crane movements, the resulting load path and the load itself must be in the operator's field of vision.
- ▶ If the operator cannot see the entire load path or the load itself, he must work with a signal person.
- ▶ During the entire crane operation, the operator must not carry out any activities other than the manoeuvre that could distract him. (e.g. telephoning, etc.).
- ▶ In remote control mode the operator must not let go of the remote control console from his hand.
- ▶ To prevent overloading of the stabilisers during the loading and unloading operation of the vehicle itself, it may be necessary to reset the stabiliser jacks. This is only permitted:
 - No load.
 - With the extension arms retracted.
 - With the loading arm placed on the loading surface or in transport position.
- ▶ If a hazard arises suddenly, all crane movements must be stopped immediately.

Load engaging / disengaging

- ▶ Put the loading arm in position and stop the movements of the crane.

For auxiliary personnel:

- ▶ The assistant must not enter the crane's danger zone until authorized by the operator.
- ▶ Only engage/disengage the load when the crane is completely idle and has been authorized by the operator.
- ▶ The helper must leave the danger zone after the load has been hooked in/out.
- ▶ Once the helper has left the danger zone, movements can be resumed with the crane.

By the operator

- ▶ To hook/unhook the load, the operator enters the crane's danger zone.
- ▶ Switch off the crane at the operator's desk on the remote control transmitter console.
- ▶ Hook or unhook the load.
- ▶ Leave the danger zone.
- ▶ Switch on the lift.

Lowering the load

When lowering the load, on cranes that do not have a rated capacity limiter (see section "Rated capacity limiter" of the NTP 868) the range must not be increased as this can lead to uncontrolled lowering of the load. Please note that if this movement is to be carried out, the rated capacity indicator must be observed.

Dispose of the load in accordance with the following guidelines:

- ▶ The place for depositing the load must be free of obstacles.
- ▶ Do not deposit the load on snow/ice.
- ▶ Do not deposit the load on edges of the ground, uneven areas, slopes, holes and pits, etc.
- ▶ Place the loads only on a flat, firm floor. Use a suitable base if necessary.
- ▶ Before releasing the gripping device, check whether the load is well supported and its position is stable. Interruption of loading/unloading activity
- ▶ When it is necessary to leave the lift unattended:
 - Deposit the load.
 - Stow the loading arm properly.
 - Switch off the lift.
 - Secure the crane against unauthorized start-up.

Resume loading/unloading

- ▶ Before resuming crane operations, check whether the crane has been tampered with in the meantime. It must be ensured that work can continue safely.

Safety regulations at the end of a job

Attention should be paid to three operations: folding the crane into the transport position, retracting the stabiliser system and starting to drive.

Folding the lift into the transport position

Cranes with a ground level control panel or overhead controls must be folded from the ground level control. Move the crane to the transport position from the control position opposite the loading arm support.

If the lift is operated by remote control, a safe distance must be maintained outside the reach of the lift arms.

Retraction of the stabilizing system

Do not retract the outrigger until the crane loading arm is in the transport position. If the vehicle is equipped with an additional stabilizer, the stabilizer must also be retracted.

When retracting the outrigger beams and jacks, choose the control position so that you can see the entire area of movement. Never lose sight of the crane components that are moving at any given time. No persons or objects should be in the area of movement of the outrigger beams / jack stands.

The outrigger beams and jack stands must be inserted/retracted individually on each side. When doing so, the operator's position must be changed.

No objects may be pushed or pulled with the hydraulic outriggers.

It must be clearly visible to the operator when the locking device is in the locked or unlocked position. It should also be possible, from the driving position, to check that the outriggers are in the transport position, (e.g. mirrors, light-sound warnings interlocked with the outrigger position). Although according to UNE-EN 12999:2009, this warning device must be only luminous, the acoustic signalling provides a safety bonus, to execute this operation with more protection guarantees.

Before you go

Every time you start to drive, you must test the corresponding securing of the crane and the stabilizing system. Each time, before starting to drive, it should be checked if:

- ▶ The crane has been tampered with without permission.
- ▶ Stabilizer jacks and stabilizer beams are fully retracted and properly secured.
- ▶ The crane (hydraulic pump) is switched off.
- ▶ The crane is in the transport position or, if it is placed on the loading platform, is sufficiently secured against sideways movement.
- ▶ If the loading arm has to rest on the loading surface, the overall height of the vehicle can be changed and it must be ensured that the transport indicator is switched off.
- ▶ If components such as the winch, gripping devices, auxiliary equipment, etc., protrude beyond the width of the vehicle in the transport position, they must be removed before driving and stowed safely.
- ▶ The load is properly secured. With regard to safety when lashing loads, with lashing straps made from chemical fibres, fastening chains and/or steel lashing cables, there is the series of standards UNE-EN 12195 that specify the conditions for load fastening devices in road vehicles.
- ▶ The truck driver must know and take into account the total height, axle weights and total weight (including the crane, auxiliary equipment and load) of the vehicle.

4. SAFETY RECOMMENDATIONS FOR OTHER DESCRIBED RISKS

The key aspects to consider are crane tipping, falls from height, burns, noise exposure and exhaust gas inhalation.

Crane tipping in adverse weather conditions

Do not operate with the crane in case of:

- ▶ Above the wind speed defined in the manufacturer's instruction manual.
- ▶ Threat of storm.
- ▶ Outside of the ambient nest temperature range in the manufacturer's Manufacturer's instructions.

Falls from height

You must not climb onto the equipment, except to access the **operating positions** (ja platform, turntable, elevated seat or cabin) and **emergency controls** (for cranes operated by radio control they are usually integrated into the crane column) but always by the nest access and exit aids for the elevated controls.

Burns

Some components can become very hot during crane operation (pipes, hoses, valves, control levers on valves, hose couplings, hydraulic cylinders, oil-hydraulic motors, pumps and the like).

In the event of oil leaks, the unit must be shut down immediately and the fault repaired.

The vehicle's exhaust system must be protected or heat insulated in the area of operation, or sufficient distance must be maintained from it.

Exposure to noise

The main source of noise is the vehicle engine. To prevent the risk of hearing loss among exposed workers, RD 286/2006 on the protection of the health and safety of workers from risks related to exposure to noise must be applied. It establishes reference values for the sound pressure level, which must be respected. If individual hearing protectors are used, their possible masking effect on the safety acoustic signals must be taken into account.

Removing the worker from the noise source, where possible, by using remote controls (radio frequency) reduces exposure to noise.

Exhaust gas inhalation

Exhaust gas components such as carbon monoxide, nitrogen oxides or diesel soot can endanger the operator when he is at the operator's platform. Care must therefore be taken to ensure that, as long as the stability of the vehicle is not compromised, the vehicle's exhaust gases do not flow into the area where the control positions are located. The use of radio control facilitates the elimination of this risk. In addition, personal respiratory protective equipment may be used. In this respect, RD 374/2001 on hazardous chemical agents and RD.773/97 on the use of personal protective equipment by workers must be taken into account.

5. PERSONAL PROTECTIVE EQUIPMENT

For accident protection when manoeuvring with truck mounted hydraulic cranes, in addition to the safety devices and preventive measures described, the following personal protective equipment must be used, depending on the risk assessment of each working circumstance:

- Work clothing.
- Safety helmet.
- Screens for face protection or, if necessary, eye protection glasses.
- Headphones or helmets for hearing protection.
- Safety shoes with metal reinforcements.
- Safety gloves.
- Reflective vest.

6. OPERATOR

Crane operation requires skill, knowledge and experience. Entrust the operation of the crane only to people who comply:

- ▶ Physically and psychologically fit (rested, not drunk or under the influence of drugs or medication).
- ▶ Able to operate the crane responsibly.
- ▶ Equipped with the necessary knowledge, training and sufficient information on the use of the crane and strobing (if applicable).
- ▶ Able to demonstrate that they have received the necessary information to operate the lift and that they know the contents of the instruction manual for both the lift and any accessories.

Crane operation involves a great deal of responsibility and should therefore only be entrusted to capable persons who are free from physical constraints (limited vision and hearing, tendency to vertigo, other physical disabilities, etc.), who are quick to decide and react and who have the necessary technical knowledge.

A careful medical and psycho-technical examination makes it possible to make a preliminary selection of suitable personnel, but their specialisation in crane manoeuvres also requires, with positive results, a period of theoretical instruction and practical training as a qualified assistant crane operator.

In any case, there should be written evidence of the specific training received and the written authorisation of the employer, if applicable, to operate the relevant work equipment.

Since the optimum position for the human body is in a sitting position or, failing that, in a standing position, a comfortable seat for the crane operator is essential for machines with high seats, which must be positioned in such a way as to allow maximum visibility for all lifting operations.

The machine controls must be within the crane operator's reach, so that they can be operated without undue effort.

7. MAINTENANCE

We will distinguish between general maintenance and trolley maintenance which must be carried out on a daily basis.

General maintenance

Maintenance shall be carried out in accordance with the manufacturer's instructions, and it is the responsibility of the owner of the equipment to ensure that the work equipment is kept in the same safe condition as when it was first put into service with proper maintenance.

To achieve this objective, it is necessary to follow the instructions in the crane manufacturer's Maintenance Manual.

Daily checks

A daily check of the crane and its assembly must be carried out to ensure that any defects, damage or other visible anomalies are detected in good time. The following aspects should be checked:

- ▶ Fittings, nuts, bolts and all elements of the hydraulic system for possible defects or oil leaks.
- ▶ Smooth running of the controls as well as their return to their initial position.
- ▶ Possible defects (cracks...) in the structure, accessories, hooks, locks and lifting devices (cable, etc.).
- ▶ Safety devices such as emergency stop, overload protection, etc., must be checked before the lift is operated.

8. REVIEWS

"The employer shall adopt the necessary measures so that work equipment subject to influences that may cause deterioration that may lead to dangerous situations is subject to periodic checks and, where appropriate, tests, in order to ensure compliance with health and safety provisions and to remedy such deterioration in time. Additional checks on such equipment must also be carried out each time exceptional events occur, such as changes, accidents, natural phenomena or prolonged lack of use, which could have detrimental consequences for safety".

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