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Cranes — Safe use —

Part 3: Tower cranes

Appareils de levage à charge suspendue — Sécurité d'emploi —

Partie 3: Grues à tour

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 96, *Cranes*, Subcommittee SC 7, *Tower cranes*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This third edition cancels and replaces the second edition (ISO 12480-3:2016), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Clause 4 has been revised;

— Clause 14 has been reviewed;

— editorial modifications have been included throughout the document.

It is intended to be used in conjunction with ISO 12480-1.

A list of all parts in the ISO 12480 series can be found on the ISO website.

Cranes — Safe use —

Part 3: Tower cranes

1 Scope

This document establishes required practices for the safe use of tower cranes.

Subjects covered include safe systems of work, management, planning, selection, erection and dismantling, special base, operation and maintenance of cranes and the selection of operators, slingers and signalers.

It does not cover manually (non-powered) operated cranes, or cranes in which at least one of its motions is manually operated.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4306-1, *Cranes — Vocabulary — Part 1: General*

ISO 4306-3, *Cranes — Vocabulary — Part 3: Tower cranes*

ISO 9927-3:2005, *Cranes — Inspections — Part 3: Tower cranes*

ISO 11660-3, *Cranes — Access, guards and restraints — Part 3: Tower cranes*

ISO 12480-1:1997, *Cranes — Safe use — Part 1: General*

ISO 12482, *Cranes — Monitoring for crane design working period*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10245-3, ISO 12480-1, ISO 4306-1 and ISO 4306-3.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Management of the lifting operation

4.1 Safety system work

ISO 12480-1 shall apply.

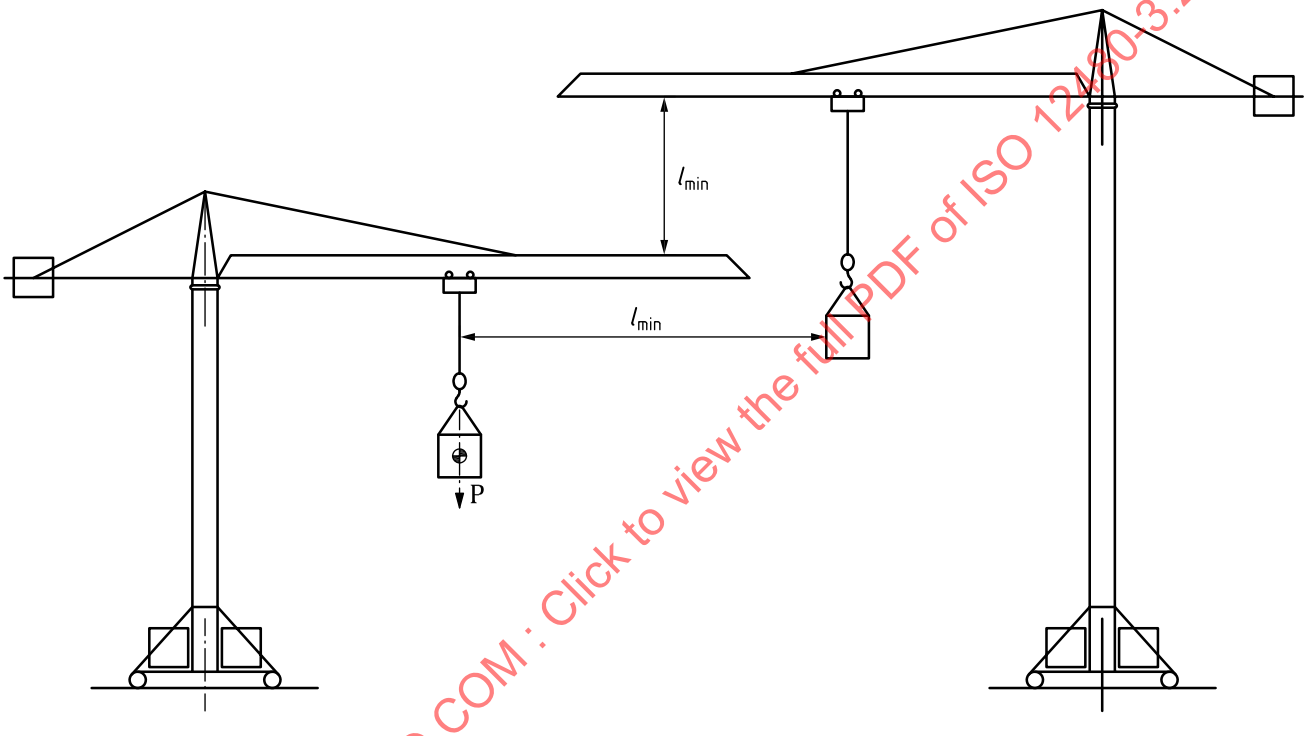
In addition, the following considerations shall be taken into account.

On sites with multiple tower cranes that are not equipped with anti-collision devices, and there is a possibility of collision between cranes, a person, designated as the crane coordinator (see 5.9) and the crane operator shall coordinate the sequence of crane movements to prevent collisions. Any corresponding instructions from the crane coordinator to the crane operators shall be via the respective signalers. In such circumstances, the signalers shall obtain the agreement of the crane coordinator before carrying out any operation.

During planning of operations, if any tower cranes are required to overlap where a collision between components can occur, a clearance shall be maintained to prevent collisions. This distance shall be either:

a) a minimum clearance of 3 m; or

b) a minimum clearance of 500 mm between components, when taking into account the manufacturer's deflections, only when full details are available from the manufacturer (see Figure 1).



Key

l_{min} minimal distance of 500 mm

Figure 1 — Example of minimum clearance between components

During out-of-service conditions as specified by the manufacturer, cranes and their components shall be positioned such that no collisions can occur [see 10.4 b)].

Cranes should, where possible, be erected such that collision hazards are eliminated or minimized.

4.2 Control of the crane operation

ISO 12480-1:1997, 4.2, shall apply.

5 Selection, responsibilities and minimum requirements of personnel

5.1 General

ISO 12480-1:1997, 5.1, shall apply.

5.2 Duties of the person appointed to control the crane operation (the appointed person)

ISO 12480-1:1997, 5.2, shall apply.

In the interests of safety, the appointed person shall arrange the lifting program such that no operator is required to be at the control station or operating the crane for an unreasonably long period, taking into account environmental conditions. The operator shall have breaks from the working activity in line with other personnel on the site.

5.3 Crane operator

ISO 12480-1:1997, 5.3.1 and 5.3.2, shall apply.

When selecting tower crane operators, the requirements to climb to considerable heights and to spend long periods of time in isolation shall be considered.

ISO 9926-1 and ISO 9926-3 specify the minimum training to be given to trainee tower crane operators in order to develop the basic operational skill in driving and to impart the required knowledge for the correct use of these skills.

5.4 Slinger (Rigger)

ISO 12480-1:1997, 5.4, shall apply.

5.5 Signaler

ISO 12480-1:1997, 5.5, shall apply.

5.6 Crane erector

ISO 12480-1:1997, 5.6, shall apply.

In addition, the crane erectors should be familiar with:

a) the appropriate sections of the manufacturer's instruction manual;

b) all aspects of their personal protective equipment and capable of using it correctly;

c) laws and safety regulations relating to tower cranes and understand them.

5.7 Maintenance personnel

ISO 12480-1:1997, 5.7, shall apply.

In addition, the maintenance personnel shall be familiar with:

a) the appropriate sections of the manufacturer's instruction manual;

b) the “permit to work” system where it is required by the safe system of work (see ISO 12480-1:1997, 10.2.2), and able to operate it correctly;

c) all aspects of their personal protective equipment and capable of using it correctly.

5.8 Inspection personnel/crane inspector (for “routine periodic inspection”)

5.8.1 Duties

The inspection personnel/crane inspector shall:

a) verify that:
   - the documentation is available;
   - the crane is erected according to the manufacturer's instructions;
   - there is no defect or deterioration of:
     - the steel structure;
     - mechanisms (brakes);
     - the control system;
   - all mechanisms (brakes) are functioning properly;
   - all limiting and indicating devices are functioning properly; and

b) give a report of the inspection to the appointed person.

5.8.2 Minimum requirements

The inspection personnel/crane inspector shall be;

a) competent for the type of inspection being performed;

b) able to work confidently and safely at heights;

c) familiar with regulations relative to the crane;

d) familiar with the use of the crane;

e) capable of verifying and recognizing the importance of defects.

For non-routine inspections (eg. first use inspection, inspection after major repair or modification, special assessment), an expert engineer is required (see ISO 9927-1 and ISO 12482).

5.9 Crane coordinator (Lift director)

5.9.1 Duties

The crane coordinator should coordinate the sequence of operations of tower cranes on sites having more than one crane, to prevent the collision of the cranes, components and/or loads.

5.9.2 Minimum provisions

The crane coordinator should be:

a) competent;

b) over 21 years of age unless under the direct supervision of a person competent for the purposes of training;

c) fit, with particular regard to eyesight, hearing, reflexes and agility;

d) experienced for at least five years in the use of tower cranes;

e) trained in the techniques of signalling and with a good understanding of hand signals for cranes;

f) capable of giving precise and clear instructions, (e.g. verbal, non-verbal, audio);

g) where audio equipment (e.g. radio) is employed, capable of operating such equipment;

h) capable of producing a crane coordinator's plan [see 5.10.1 b)].

5.10 Crane erection supervisor

5.10.1 Duties

The crane erection supervisor is the “erector in charge”, as detailed in ISO 12480-1:1997, 5.6.1.

The crane erection supervisor should have the responsibilities of a crane erector and, in addition:

a) be in control of all crane erectors and of any additional crane and lifting equipment which can be used in erection/dismantling operations;

b) provide a means for ensuring that the operation is carried out in accordance with the crane coordinator's plan;

c) ensure that additional crane and lifting equipment are in accordance with that specified and properly certified;

d) verify that all erectors are equipped with the necessary tools and personal protective equipment.

The appointed person (see 5.2) retains overall responsibility for erection/dismantling operations, including the planning.

If the crane erection supervisor must leave the site of the operation, even for a few minutes, he/she should appoint another suitably qualified member of his/her team to be in charge during the period of absence, in order to prevent any ambiguity as to the control of the operation. However, the crane erection supervisor shall be present during all critical parts of the operation.

The crane erection supervisor should remain on site throughout any erection/dismantling operations.

5.10.2 Minimum provisions

The crane erection supervisor should have the same attributes as the crane erector and, in addition:

a) have at least five years of experience in the erection and dismantling of tower cranes or similar equipment, and be trained in the supervision of such operations;

b) be in possession of and familiar with the manufacturer's instruction manual for the specific crane;

c) be trained in the control of personnel carrying out the duties of erecting and dismantling tower cranes, and in ensuring that all persons use their personal protective equipment correctly;

d) be able to confirm the suitability of the equipment used in the erection process.

5.11 Other particulars

If the slinger or signaller is required to carry out a lifting operation which is outside the crane coordinator's plan, the appointed person shall be alerted.

6 Safety

6.1 General

ISO 12480-1:1997, 6.1, shall apply.

6.2 Identification of signal person directing crane movements

ISO 12480-1:1997, 6.2, shall apply.

6.3 Personal safety equipment

ISO 12480-1:1997, 6.3 shall apply.

6.4 Use of personal protective equipment

ISO 12480-1:1997, 6.4, shall apply.

Helmets with chin straps should be used when working at heights.

A safety harness with dual lanyard shall be used where appropriate.

Personnel working on tower cranes should wear suitable footwear for climbing structures.

6.5 Access

6.5.1 General

ISO 12480-1:1997, 6.5.1, shall apply.

If personnel need to be present on the crane while the machine is in use, the crane operator shall be informed in advance.

It is recommended that access to tower cranes be prohibited to personnel whose presence is not essential.

6.5.2 Boarding and leaving the crane

ISO 12480-1:1997, 6.5.2, shall apply.

The appointed person should verify that ladders, rest platforms and other means of access are in accordance with manufacturer's instructions.

The erection supervisor shall verify that access equipment is installed correctly throughout the erection process. Particular attention should be paid to:

a) ladder joint bolts;

b) guard rails, particularly on rest platforms and inspection platforms;

c) access from ground to the foot of the lowest ladder or to the chassis of the crane;

d) access from levels of the construction to the crane.

Where the crane cab level is in excess of 30 m from the ground and there is no access from a supporting building, it is recommended to have a crane lift or an elevating control station.

6.5.3 Instruction of personnel

ISO 12480-1:1997, 6.5.3, shall apply.

6.5.4 Jib and counter jib access

Access to and along jibs and counter jibs for inspection and servicing shall be made safe. Catwalks shall be provided with handrails or safety line in accordance with ISO 11660-3. Where lifelines are provided, a suitable device shall be used in conjunction with the harness to permit full passage along the jib without detachment.

NOTE Personnel carrying cages attached to the trolley can provide suitable alternative safe access along the jib.

6.5.5 Cab safety

The appointed person should verify that:

a) vision panels in the floor of cabs or at the operator's feet are maintained to ensure that they are able to withstand all of the operator's weight, are, for example, guarded by a mesh of adequate strength to carry a person's weight over the area concerned;

b) window panels in walls of cabs are maintained to ensure that they protect against being knocked outwards to prevent persons falling through the aperture;

c) panoramic and similar cabs of which the top part can be opened meet specified requirements, as appropriate.

6.6 Fire extinguishers

ISO 12480-1:1997, 6.6, shall apply.

Tower cranes shall be equipped with appropriate types and quantities of fire extinguishers, which shall be easily accessible to the operator.

The operator and any other personnel likely to be in the cab should be adequately trained in the use of such fire extinguishers.

6.7 Documentation

For rated capacity charts, instruction manuals and inspection certificates or reports, ISO 12480-1 shall apply.

The plan or method details for the erection of tower cranes should be retained throughout the duration of a crane's service on any one contract, together with calculations and specifications for the tower crane base.

NOTE It can be necessary to refer to these in the event of a change of construction in the course of the contract requiring alterations to be made to the crane.

6.8 Crane operator's aids

Tower cranes shall be provided with the following as applicable:

a) rated capacity limiter;

b) load radius indicator;

c) motion limiting devices;

d) overload limiting devices;

e) level indicator (where applicable);

f) anemometer;

g) working space limiters (where applicable);

h) anti-collision systems (where applicable).

Working space limiters may be applied to a single tower crane where there is an area which it shall not travel during operation, or over which it shall not carry loads. Anti-collision systems are used where there are two or more cranes which can interfere with each other's freedom of movement. Such devices shall limit the slew, the trolley motion, or the travel motion of the crane to prevent collision, between the structure of one crane and the components of another crane, in accordance with Annex A.

NOTE It can be considered preferable to have these devices equipped to warn or give information to the operator, rather than interfere with the operation of the crane.

Where trailing cables are used for communication between one crane and another, consideration shall be given to the means required to protect them adequately against interference or accidental damage.

6.9 Other safety provisions

6.9.1 Crane earthing

Tower cranes should be effectively earthed in accordance with manufacturer requirements.

Earthing does not provide lightning protection. Lightning protection is a separate issue which is very technical in nature.

6.9.2 Ballast

When base or counterweight concrete ballast needs to be provided, it is important that the ballast shall either:

a) have been constructed in accordance with the crane manufacturer's design and specification; or

b) be of a design which has been approved by the crane manufacturer or competent engineer, and effectively secured to prevent accidental displacement or removal.

Only ballast blocks having markings showing their correct weight shall be used.

Since the counterweight ballast is at height and the blocks have a tendency to rub together during crane operation, precautions shall be taken to prevent concrete from falling.

6.9.3 Alarms

Rail mounted tower cranes should be fitted with an audible travel alarm, activated when the crane starts to travel.

6.9.4 Signboards

Signboards, decorations, outline lights, etc. can impose additional loading on the crane and shall not be fitted unless approved by the crane manufacturer.

Wiring shall be protected against damage and shall not create a hazard to personnel.

7 Selection of tower cranes

Selection of a tower crane should be considered by taking the following into account:

a) ISO 12480-1:1997, Clause 7;

b) wind speeds, which can restrict the use of tower cranes in certain locations, and require limiting tower height or jib length;

c) principal features of the common types of tower crane, as described in ISO 4306-3.

With a horizontal trolley jib, a suitable allowance needs to be made for deflection when calculating the clearance between adjacent cranes or their components (see 4.1).

With a luffing jib, due to the varying out-of-service conditions, particular care shall be taken to observe the manufacturer's instructions.

Consideration shall also be given to the dismantling of the crane once the structure is completed, especially for climbing cranes.

A mobile tower crane is particularly suitable when considerable mobility is required on site. Extra care shall be taken in ensuring that outriggers, jacks, etc., are adequately supported for their imposed loads.

Some very small capacity tower cranes are available on trailer mounts with pneumatic tires. These machines need to be towed into position and shall be properly mounted on their outriggers or jacks before erection or use. The manufacturer's erection instructions shall be observed and, if the operator is to erect and dismantle this type of crane, he/she shall be specifically trained and have the attributes of an erector (see 5.6).

Crawler mounted tower cranes without self-leveling shall be moved only in strict accordance with the manufacturer’s instructions (within the slope tolerances specified). Particular care shall be taken to avoid collisions and to satisfy wind limitations.

Where cranes are available with remote controls, care shall be taken in their selection paying special attention to site limitations, e.g. height, radius.

8 Erecting of tower cranes

8.1 General

ISO 12480-1:1997, 8.1, shall apply. Attention is drawn to 4.1.

8.2 Crane standing or support conditions

8.2.1 General

ISO 12480-1:1997, 8.2, shall apply.

Where tower cranes are to be erected close to the foundations of existing buildings or buildings to be constructed, the appointed person shall ensure that the ground is consolidated as required by the designer.

Where disturbance to the ground has occurred in the construction of adjacent foundations, the designer shall be consulted to ensure that the integrity or the crane foundations are maintained.

It is important that the base be installed within the manufacturer’s tolerance of accuracy to ensure that the erected crane is within operational limits when the crane is mounted on:

a) rails;

b) special foundation anchors;

c) an expendable tower section, cast into a concrete foundation block.

In certain circumstances, a crane shall be tied to the structure it is constructing, or held by guy ropes for any one of the following reasons:

a) to obtain a height in excess of the available free-standing height;

b) to restrict the movement of the tower when available space is limited;

c) to comply with the requirements of the occupiers of adjacent properties, e.g. railways.

In any of these cases, the tying/guying arrangements:

— should be in accordance with either the manufacturer's approval or calculations carried out by a competent engineer; and

— shall be attached to a structure capable of withstanding the imposed loads.

8.2.2 Tower crane foundations

8.2.2.1 Expendable base blocks

Minimum dimensions for any expendable base block together with the overturning moment and other loading during operation and out-of-service conditions shall be as specified by the crane manufacturer.

Having obtained from the crane manufacturer the loads imposed by the crane (noting that these may be net and exclusive of any impact of safety factors), the foundation shall be designed by a competent engineer so that the ground bearing capacity is not exceeded.

Where the base design limits the free-standing height of the crane, the maximum permitted free standing height shall be clearly stated.

8.2.2.2 Rail tracks for tower cranes

Rail track shall be made of suitable materials and strict control shall be exercised to ensure that it is not in any way abused.

Rail track requires expertise in its design, layout and installation, particularly if it is to be curved.

The area between the tracks shall never be used for the storage of materials or for access to, from or across the site. The total area of the rail tracks shall preferably be fenced off to prevent access by unauthorized persons.

If there needs to be a point at which vehicles cross the rail track, this shall be carefully controlled to prevent accidental collision, and precautions shall be taken to ensure that the track is not overloaded by the vehicles crossing it.

The gauge of rail tracks shall be maintained by suitable means, e.g. tie bars.

Rail tracks shall not be welded or subjected to heating unless authorized by a competent metallurgist.

End stops or buffers shall be fixed to the rail and precisely adjusted to ensure that the crane makes contact with both sides simultaneously. These end stops shall be shock absorbing, and shall be moved hard against the crane chassis if the machine is to be used in a static position for any period of time. Rail stops shall not be taken into account when calculating the stability of the machine.

Rail clamps which the crane manufacturer may provide to prevent the crane from rolling along the track in storm conditions shall be fitted whenever the machine is out-of-service. If clamps are not supplied, adequate means shall be adopted to achieve the same result.

Rail tracks of all types require periodic inspection (according to the manufacturer's recommendations, if available), and, should any defect or out-of-level become apparent, corrective action shall be immediately employed.

8.2.2.3 Special base

Where the particular application calls for a special base arrangement, e.g. structural steelwork, then the appointed person shall ensure that the base is designed by a competent engineer, allowing for the loads imposed by the crane, as advised by the manufacturer.

8.3 Proximity hazards

ISO 12480-1:1997, 8.3, shall apply.

9 Erecting, dismantling and alteration of height

9.1 Planning

ISO 12480-1:1997, 9.1, shall apply.

The plan for erection, alteration of height and particularly the dismantling of tower cranes requires careful consideration. Most organizations that erect tower cranes, either for themselves or for others, use some form of pro forma or check list to ensure that nothing has been overlooked at the planning stage.

A plan for erection or dismantling of tower cranes shall be drawn up by a person or persons having actual experience of these operations. It is desirable that this information is available prior to the operation so that personnel can become familiar with the content. It is advisable to conduct a pre-operational meeting with personnel in order to review planned procedures and to assign duties. The plan shall deal with the following:

a) the format in which the crane is to be transported to or from the site;

b) the selection of cranes that are required to assist in the erection/dismantling process, especially considering the removal of components from a height. For example, when removing a section such as a jib from an erected tower crane, the assisting crane will be carrying the entire load with no opportunity for safely replacing it once the attachment pins have been removed. In this case, it may be desirable for the crane to have some excess capacity to allow for any error resulting in the sudden release of a component. Under no circumstances shall the crane used in the dismantling operation be used to break a load free. When required, a method of jacking or other means shall be used to break the load free after the initial tension is taken by the crane;

c) the availability of access to the site for the vehicles involved in transportation as well as the crane(s) used for erection;

d) the ground conditions for the erecting crane;

e) the free-standing height to which the crane will be erected and the length of the jib;

f) proximity hazards (attention is drawn to ISO 12480-1:1997, 8.3);

g) any specialized lifting gear that is required in the course of erection;

h) liaison with occupiers of neighboring properties;

i) arrangements for any necessary notifications;

j) arrangements for any necessary road closures;

k) the provision of a radio license where required;

l) the availability on site of a comprehensive manufacturer's erection/dismantling/operation manual, in a language understood by the erection team.

The area in which a tower crane is to be erected, altered in height or dismantled shall be roped or fenced off and all personnel not immediately connected with this duty shall be excluded. It is advisable

to conduct a pre-operational meeting of the personnel concerned to review planned procedures and to assign duties.

9.2 Identification of components

ISO 12480-1:1997, 9.2, shall apply.

9.3 Electrical supply

ISO 12480-1:1997, 9.3, shall apply.

9.4 Personnel

The erection, dismantling and alteration of the height of tower cranes shall be carried out by specialist personnel under the continuous control of the crane erection supervisor and in accordance with the manufacturer's instructions. The supervisor shall have the authority to stop the operation if he/she considers such action is warranted by ground conditions, weather, obstruction or any other cause.

The crane erection supervisor shall be in close liaison with the site management and shall carefully consider any comments or warnings that management, any members of the site team, or any other appropriate person or body present.

9.5 Control

In the case of erection, dismantling or alteration of the height of tower cranes, the person appointed to control the lifting operation shall also take control of any additional crane which can be used in the course of such an operation, and be familiar with details of that crane, to facilitate the carrying out of the duties, as detailed in ISO 12480-1:1997, 4.2 and 4.3.

The appointed person shall also ensure that the operation is under the constant supervision of the crane erection supervisor.

9.6 Inspection before erection

All parts shall be inspected prior to erection to verify they belong to the crane being erected and are in good condition, free from defect.

Slinging points shall be identified for all components.

NOTE Under certain circumstances, it can be advantageous to carry out an inspection of the tower crane before it is delivered from the supplier to the user, but an on-site inspection is still required.

9.7 Weather

Tower cranes shall not be erected altered in height or dismantled in weather conditions that can affect the stability of the crane or its components, e.g. high winds (reference shall be made to the manufacturer's instructions for the maximum permissible wind speed for these particular operations), or under conditions of impaired visibility, e.g. fog.

More stringent restrictions on wind speed apply to heightened cranes.

This type of work shall be avoided if the conditions (e.g. ice on component parts, walkways) are likely to endanger the erectors.

9.8 Manufacturer's erection, alteration of height and dismantling instructions

The crane manufacturer's instructions shall be closely followed. Any departures from the specified sequential procedure shall be approved by the designer or another competent engineer, to ensure stability

of the crane and to ensure that structural and mechanical parts are not subjected to excessive loading. This is particularly important when a climbing frame is used to alter the working height of the crane.

NOTE Many tower crane manufacturers detail specific inspections and checks to be carried out in their erection and dismantling manual. For example, it is important to ensure that the lubrication requirements of tower joint bolts with the specified grease/oil are met before applying torque.

9.9 Tower crane climbing

9.9.1 General

Tower crane climbing is the activity of altering the height of a tower crane using purpose built jacking equipment.

For reasons of clarity, the two main methods of tower crane climbing are described in Annex B.

It shall be noted that, while most tower crane climbing systems use similar principles, as described in Annex B, details vary between makes, types and models of tower cranes, crane towers and climbing frames. The specific manufacturer's instructions shall be taken into account under all circumstances.

9.9.2 Planning the climbing operation

A safe system of work shall be established and be followed when undertaking a tower crane climbing operation.

A safe system of work shall be drawn up and agreed to by the persons involved in the climbing operation, e.g. those involved in planning, those undertaking the climbing operation, those affected by the operation and those appointed to re-commission the re-configured crane upon completion of the climbing operation.

Under all circumstances, the operation shall be properly planned and undertaken by competent persons, appropriately supervised. This operation shall be carried out in a safe manner.

9.9.3 Appointed person

The appointed person shall maintain overall control of the planning and delivery of the climbing operation. The appointed person shall be competent to undertake such responsibilities and be familiar with the relevant manufacturer's instructions.

The appointed person shall consider all the risks associated with the climbing operation, draw up an effective operational plan and ensure that:

a) the crane support foundations or structures are of adequate strength to support the new crane configuration and, in all circumstances, in accordance with the crane manufacturer's instructions;

b) the climbing operation will be phased effectively and not be affected by any other construction activity;

c) the requirements of adjacent occupiers, e.g. railways, airports, others in the vicinity, are accommodated, and that these occupiers are kept informed;

d) the crane coordinator is consulted when other cranes are being operated in the vicinity;

e) the crane to be reconfigured is maintained in an efficient state, in efficient working order and in good repair;

f) any equipment to be used during the operation is made readily available and maintained in an efficient state, in efficient working order and in good repair;

g) an erection supervisor is appointed who is competent to undertake the operation, is familiar with the safe system of work/operational plan and the manufacturer's instructions for the specific type and model of crane, crane tower and climbing frame involved in the operation;

h) special emergency or rescue services are made available when required;

i) the current manufacturer's manuals for the specific crane, crane tower and climbing frame involved in the operation are available to the erection team for the duration of the climbing operation.

9.9.4 Erection supervisor

The erection supervisor is the person appointed to be in control of the team of tower crane erectors undertaking the operation. The erection supervisor shall have sufficient experience and additional skills to enable him to supervise, and take responsibility for, the team.

The erection supervisor shall carry out the following:

a) ensure, prior to commencing the operation, that the erection team members are competent to undertake the operation in a safe manner, are familiar with the safe system of work/operational plan and with specific manufacturer's instructions for the specific type and model of crane and climbing frame involved in the operation;

b) ensure, prior to commencing the operation, that all equipment to be used in the operation is checked and is in good order;

c) confirm, prior to commencing the operation, that the crane to be reconfigured is in good order and free from any defect that can affect the operation. Specific attention should be paid to the condition of the climbing frame mounting arrangements and to ensuring that the tower is vertical and within manufacturer's accepted tolerances;

d) confirm, prior to commencing the operation, that the weather conditions will not affect the stability of the crane during the operation;

e) ensure that effective levels of communication between all those involved in the operation are checked prior to commencement and maintained at all times during the operation;

f) ensure that the crane is maintained in a state of balance as required by the manufacturer and the jib is correctly aligned at all times during the operation;

g) ensure that weather conditions are monitored during the operation. (In general terms, and regardless of manufacturer's recommendations, climbing should not be undertaken when wind speeds exceed 12 m/s).

9.9.5 Re-commissioning the crane upon completion of the climbing operation

When the climbing operation is complete, and prior to returning the crane to service, an inspection by a competent person shall be performed. The inspection should include verification of all indicating and limiting devices. The inspection should confirm, if the crane:

a) has been re-configured correctly;

b) is free from any defect which may affect its safe operation;

c) is safe to use.

The results of the inspection should be detailed in a formal written report.

9.10 Components and materials

9.10.1 Interchangeability of components

The interchange of structural components between one tower crane type and another shall only be permitted if the manufacturer has given approval.

Having carried out such an interchange, a tower crane type shall be re-tested in its new combination, and the interchanged parts shall be specified on the test certificate.

9.10.2 Materials

Most tower crane parts are made from special steels and no repair or replacements other than the manufacturer's specifications shall be permitted.

Welding or other heat treatments shall be carried out under the manufacturer's specified conditions.

The re-use of high tensile bolts shall be strictly in accordance with the manufacturer's specifications.

High strength friction grip bolts shall not be re-used, except in accordance with the manufacturer's specifications.

Bolts used to secure slew races shall be renewed whenever they are removed except in accordance with the manufacturer's specifications. They shall only be tightened in accordance with the manufacturer's specifications.

10 Procedures and precautions

10.1 Crane operation

ISO 12480-1:1997, 10.1, shall apply.

10.2 Working on cranes

10.2.1 General

ISO 12480-1:1997, 10.2.1, shall apply.

For tower cranes likely to sway or slew in the wind, appropriate precautions shall be taken to prevent people from being displaced from their place of work, injured or trapped by such movement.

10.2.2 Permit to work system

ISO 12480-1:1997, 10.2.2, shall apply.

10.2.3 Periodic inspections

Periodic inspections should be carried out in accordance with ISO 9927-1.

10.2.4 Regular inspections

ISO 12480-1:1997, 10.2.4, shall apply.

10.2.5 Condition monitoring

ISO 12482 shall apply.

10.3 Reporting of defects and incidents

ISO 12480-1:1997, 10.3, shall apply.

10.4 Leaving the crane

When a tower crane is to be left unattended for even a short period, it is essential that the following precautions are carried out.

a) No load shall be left on the hook, and all chains, slings, etc. shall be removed.

b) The crane shall be put out-of-service in accordance with the manufacturer's instructions.

NOTE 1 In nearly every case, this involves turning the jib downwind and taking some action to ensure that the slew brake is off, so that the crane is free to slew in the wind.

NOTE 2 In the case of saddle jib cranes, it is usual practice to bring the trolley or carriage to a minimum radius position.

c) In the case of luffing jib and similar cranes, the manufacturer's instructions concerning the angle of the jib for out-of-service purposes shall be observed.

d) Rail travelling cranes shall be well secured to the rails, to ensure that in the event of a high wind the crane cannot be blown accidentally along the rails. When left for long periods (e.g. overnight), the power supply to the crane shall be cut off and the door of the cab secured and locked;

e) When a power supply is required to be maintained overnight for cab or control cabinet heaters, lights etc., separate arrangements shall be made for the isolation of the power supply to the machinery.

10.5 Working at heights

A safe system of work shall be used, in accordance with ISO 12480-1:1997, 4.1, as relevant.

11 Operating conditions

11.1 Rated capacity

ISO 12480-1:1997, 11.1, shall apply.

11.2 Operation and control

ISO 12480-1:1997, 11.2, shall apply.

The most common variation in operation and control encountered between different makes and models of tower cranes is the procedure for stopping the slewing motion, therefore, it is essential that the crane operator is aware of the applicable method for the tower crane being operated.

NOTE Failure to use the correct method can result in excessive structural stress on the crane as well as failure in the electrical systems.

It is recommended that a notice decal be affixed in the cab (in addition to the manufacturer's instruction manual) detailing the method of stopping the slew.

11.3 Handling of loads near persons

ISO 12480-1:1997, 11.3, shall apply.

11.4 Multiple lifting

Tower cranes should not be used for multiple crane lifts, except as engineered lifts under special control procedures as set out by the manufacturer.

11.5 Special duties

11.5.1 General

ISO 12480-1:1997, 11.5.1, shall apply.

11.5.2 Grabbing and magnet crane service

Tower cranes should not be used for carrying out special duties such as grabbing or lifting by magnet, except as approved by the manufacturer.

NOTE The manufacturer can recommend de-rating of the crane for this type of operation.

11.5.3 Demolition and other special operations

Tower cranes should not be used for balling operations, pile driving, or extracting. When used for demolition of an existing structure, a lift plan shall be engineered and the lift director shall control each lift according to the lift plan.

11.6 Weather conditions

11.6.1 General

ISO 12480-1:1997, 11.6.1, shall apply.

See also 9.7.

More stringent restrictions on wind speed apply to heightened cranes. This type of work shall be avoided if the conditions (e.g. ice on component parts, walkways) are likely to endanger the erectors.

11.6.2 Wind

ISO 12480-1:1997, 11.6.2, shall apply.

11.6.3 Visibility

ISO 12480-1:1997, 11.6.3, shall apply.

11.6.4 Rain, snow or ice

ISO 12480-1:1997, 11.6.3, shall apply.

Heavy accumulations of ice can make access along the jib extremely hazardous, therefore, consideration shall be given to not starting work with the crane until the temperature is sufficient to cause melting of the ice. Personnel in the vicinity shall be warned that large lumps of ice can fall when melting.

NOTE Horizontal jib tower cranes are more prone to excessive loading from snow and ice than other types of crane.

When there has been an excessively heavy fall of snow this shall be carefully removed from the jib and counterweight jib before putting the crane into service.

11.6.5 Inspection following adverse weather conditions

After exposure to weather conditions in excess of the manufacturer's published limitations for the crane, the anchorage arrangements and ballasts shall be examined by a competent person as soon as practicable and before the crane is used, and any necessary steps shall be taken to ensure the stability of the crane.

While the above inspection is being performed, the whole structure shall be inspected, as appropriate, to ensure that it has not suffered any damage or condition likely to lead to failure in the course of bad weather.

ISO 9927-3:2005, Clause 7, shall apply.

12 Slinging and handling of loads

ISO 12480-1:1997, Clause 12, shall apply.

13 Raising and lowering of persons

ISO 12480-1:1997, Clause 13, shall apply.

Due to the extra height often involved, special care shall be taken to prevent the swing of the cradle (man basket) carrying personnel, which may, in turn, cause the cradle to spin. It is not generally practicable to attach a tag line or similar equipment to such a cradle (man basket), and it is suggested that a cradle (man basket) which is rectangular or square is easier to control when bringing it alongside a structure or building on which the occupants may be required to work.

Care shall be taken to ensure that the cradle (man basket) is kept clean and in good condition and is not used to carry any tools, loads or equipment which can make a foothold difficult for the occupants.

Tower cranes are not intended for the lifting of persons unless it has been determined to be the least hazardous method.

14 Tests, inspections and condition monitoring

14.1 General

ISO 12480-1:1997, Clause 14, shall apply.

Extreme service conditions: If a tower crane has been subjected to such usage, consideration shall be given to the use of non-destructive testing to detect possible fatigue cracking or excessive corrosion. The manufacturer or design authority shall assist to determine the vulnerable areas of the structure.

Usage or storage of the crane in a corrosive environment can also cause deterioration of the crane structure and this can require more extensive examination.

Fatigue damage and corrosion are also likely to be present on older tower cranes, which can require more detailed examination and testing as described above.

14.2 Personnel safety

Attention is drawn to the fact that a test can fail and all personnel not essential for the test shall be kept away from the area. Where a crane is equipped with a remote control, the test shall be carried out using the remote control, with the operator outside the danger zone.

15 Signalling systems

15.1 General

Copies of the hand signals to be used shall be issued to all crane operators, slingers and other personnel involved in the lifting operation to ensure that a universal signaling code is used.

In situations where special lifts are involved, or where hand signals alone are inadequate, other forms of communication shall be used, such as radio or telephone, in addition to the hand signals.

When radio is used for signaling, the channel selected shall be kept clear of all other communications. All personnel involved in the signaling shall be given a clear and unique call sign and all communications shall start with this call sign.

During the the lifting operation, only one person at a time shall give hand signals and any voice instruction to the crane operator.

Due to the distance between tower cranes and other personnel, it is important to use clear systems of identification and communication.

Attention is drawn to ISO 12480-1:1997, 6.2.

15.2 Radio communications

Radio communication and operation during tower crane activities may require observance of special communication requirements.

The appropriate body responsible for radio communication should be contacted to ensure compliance with and use of safe radio techniques.

Annex A
(normative)

Requirements for provision of working space limiters and anti-collision devices

A.1 General

This annex specifies requirements concerning the installation of working space limiters (e.g. forbidden overlying, fixed obstacles) as well as anti-collision devices (overlapping cranes) on tower cranes.

A.2 Power supply

A.2.1 Working -space limiter

As the working space limiter is not to be operated independently from the crane, when the crane's power supply is cut, the supply to the working space limiter shall automatically be cut at the same time.

A.2.2 Anti-collision device

As the anti-collision device shall function when the crane is not in use, its power supply shall allow the anti-collision device to operate when the power supply to the crane is cut.

A.3 Requirement

Tower cranes shall be designed and constructed such that they can be equipped with working space limiters and/or anti-collision devices. However, for tower cranes with automatic erection, of small capacity (lower than or equal to 30 m·t), this requirement is limited to the possibility of fitting slewing and trolleying limiters (these limiters allow prohibition of an access area to the hook).

Therefore, the tower cranes shall be:

a) equipped in order to receive a device available as an option;

b) equipped with sensors delivering the information necessary for the functioning of the device; or

c) provided with reference points or pick-up points for the sensors as in b).

The crane manufacturer shall determine the connection points necessary for the action of the device on the movements or function of the crane.

The choice of these points of connection shall be such that the actions of the device are compatible with the normal use of the crane mechanisms (decelerating before stopping the movement with high inertia, application of the mechanical brakes). In particular, it shall use the starting and stopping procedures provided by the crane manufacturer so as not to introduce excessive transient operation.

All the connection points necessary for the action of the device on the movement of the crane shall be assembled in a specific control box or on a special terminal strip. This control box or terminal strip is not required for tower cranes initially equipped with an anti-collision device.

A.4 Signaling

The space for the signal display shall be within the crane operator's field of vision. This signaling can be carried out by means of the signal lamps, displayed on dial or screen.

A.5 Instructions

A.5.1 Installation of the cranes (see Figure A.1)

These instructions shall:

a) remind the crane erector/operator to install the crane such that the following hazards are avoided:
   - risk of collision between the moving crane and any fixed obstacles;
   - risk of overflying critical or forbidden areas;
   - risk of collision between various cranes in motion due to contact between:
     - the hoist rope of a high crane and the counter-jib of the crane overflown;
     - the hoist rope of a high crane and the jib of the crane overflown;
     - the jib and/or the counter-jib of the lower crane and the tower of a high crane in the case of cranes traveling on the same track or on tracks which are very close to each other;

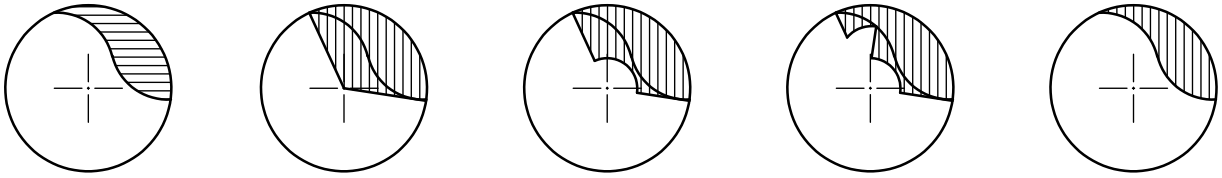
b) remind the crane erector/operator to mitigate hazards by installing working space limiters and/or anti-collision devices;

c) recommend that in cases where contact between the hoist rope of a high crane and the counter-jib of a crane over flown can occur, the area that can be over flown should be considered as a forbidden zone.

A.5.2 Information necessary for the correct installation of the device

Specify, in particular, the following:

- power supply of the device: if provided by the crane manufacturer, the characteristics of this supply (voltage, power, earthing, etc.);
- information required for the functioning of the device:
  1) if the information required by the device is available on the crane, indicate their characteristics and possibly the connecting points [see A.3 b)];
  2) if the information required by the device is *not* available on the crane, indicate the possibilities for fixing the sensors and the characteristics of reference or pick-up points (kind and characteristics of the signals emitted by the sensors and kind and characteristics of the pick-off of the movements and corresponding characteristics) [see A.3 c)];
- action of the device on the crane: indicate the connecting points, the characteristics of the connections which are necessary for the action of the device on the movements or functions of the crane.

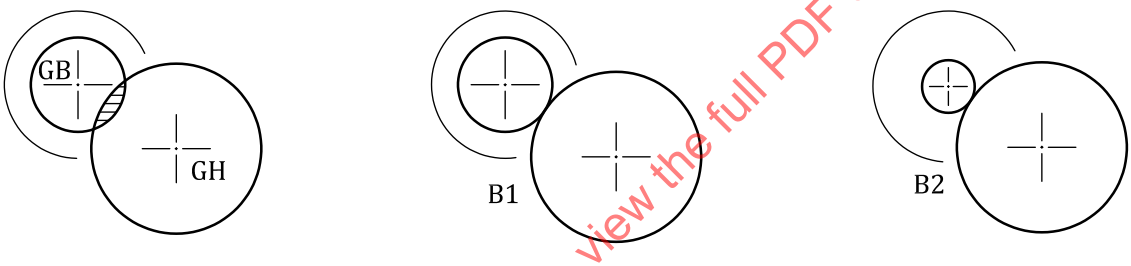


A1 A2 A3 A4

A: prohibited area

Prohibition of access to

- A1 a sector
- A2 an annular sector
- A3 several annular sectors
- A4 an equivalent profile area

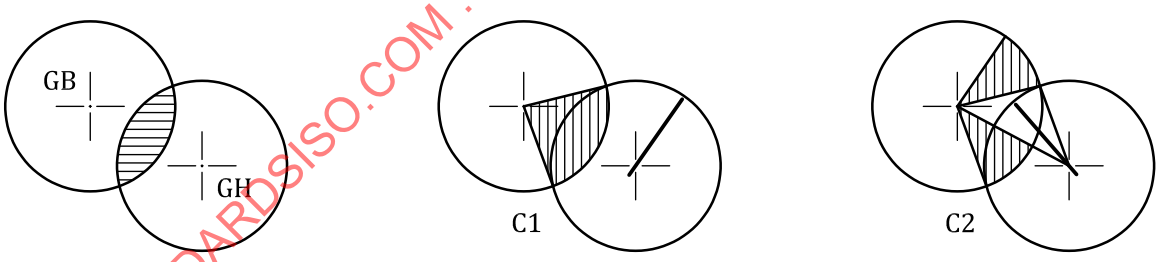


B: counter jib/rope

To be avoided by

B1 modification of layout

B2 selection of equipment



By prohibited access for the lower crane (as in A.1):

C1 whatever the position of the upper crane

C2 taking into account the position of the jib of the upper crane