

Code of practice for

Safe use of cranes

Part 5. Tower cranes

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- Associated British Ports
- Association of Lorry Loader Manufacturers and Importers
- British Iron and Steel Producers' Association
- Building Employers' Confederation
- Construction Plant-hire Federation
- Electricity Association
- Engineering Equipment and Materials Users' Association
- Federation of Manufacturers of Construction Equipment and Cranes
- Federation of Wire Rope Manufacturers of Great Britain
- Health and Safety Executive
- Institute of Logistics
- Institute of Mechanical Engineers
- Institute of Occupational Health and Safety
- Institute of Plant Engineers
- Institute of Structural Engineers
- Lifting Equipment Engineers Federation
- Lloyd's Register of Shipping
- Safety Assessment Federation Ltd.

The following bodies were also represented in the drafting of the standard, through a subcommittee:

- Amalgamated Engineering Union (Construction Health and Safety Group)
- Federation of Civil Engineering Contractors
- Institute of Civil Engineers
- Oil and Chemical Plant Contractors' Association Ltd.

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Foreword

This Part of BS 7121 has been prepared by Technical Committee MHE/3. It provides recommendations for the safe use of tower cranes. It should be used in conjunction with BS 7121 : Parts 1 and 2, to which specific references are made.

It is in the interest of all parties involved in lifting operations to ensure that these operations are carried out efficiently and safely. This Part of BS 7121 has been written to provide recommendations for the safe use of the tower crane at all stages of its utilization.

This Part of BS 7121 is commended to owners and users of tower cranes, who are encouraged to observe all the recommendations, and where possible, upgrade existing equipment and operating procedures accordingly.

Whilst it is recognized that the recommendations given do not relate to the design and manufacture of tower cranes, designers are strongly advised to take them into consideration.

This Part of BS 7121 is one of a series of standards entitled *Code of practice for safe use of cranes* as follows:

- Part 1. *General*
- Part 2. *Inspection, testing and examination*
- Part 3. *Mobile cranes*¹⁾
- Part 4. *Lorry loaders*
- Part 5. *Tower cranes*
- Part 6. *Derrick cranes*¹⁾
- Part 7. *Overhead/underhung travelling and goliath cranes*¹⁾
- Part 8. *High pedestal and portal jib cranes*¹⁾
- Part 9. *Container handling cranes*¹⁾
- Part 10. *Rail mounted cranes*¹⁾
- Part 11. *Offshore cranes*¹⁾

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

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Attention is drawn to relevant legislation and, in particular, to statutory requirements for the testing and examination of cranes.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

¹⁾ In preparation.

Code of practice

1 Scope

This Part of BS 7121 gives recommendations for the safe use of tower cranes. It should be read in conjunction with BS 7121 : Parts 1 and 2.

Subjects covered include planning the installation, erection, testing, maintenance, operation and application, dismantling, and transportation, as well as safety measures to be taken during the execution of all the above functions.

It also covers the appropriate selection of personnel for safe use of tower cranes.

NOTE. Reference is made to different types of tower crane and it should be noted that these types are often combined, for example, self-erecting, railmounted, luffing jib.

2 References

2.1 Normative references

This Part of BS 7121 incorporates by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 7121 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This Part of BS 7121 refers to other publications that provide information or guidance. Editions of these publications current of the time of issue of this standard are listed on the inside back cover but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 7121 the definitions given in BS 7121 : Part 1 : 1989 apply, together with the following:

zoning device

An electromechanical/electronic device to control the zone in which a tower crane works.

4 Management of the lifting operation

4.1 Safe system of work

Reference should be made to **3.1** of BS 7121 : Part 1 : 1989.

4.2 Control of the lifting operation

4.2.1 General

Reference should be made to **3.2** and **3.3** of BS 7121 : Part 1 : 1989.

4.2.2 Other particulars

On sites where there is more than one tower crane and there is a possibility of collision between cranes, a person, the crane coordinator (see **6.3.2**), should plan the sequence of crane movements to prevent collisions. Any corresponding instructions from the crane coordinator to the crane drivers should be via the respective signallers. In such circumstances the signallers should obtain the agreement of the crane coordinator before carrying out any operation.

Where tower cranes inter-arc, a vertical distance should be maintained to prevent collisions. This distance should be either:

- a) a minimum clearance of 3 m; or
- b) a minimum clearance of 600 mm plus the manufacturer's deflections where full details are available from the manufacturer.

The positioning of the crane and components in the out-of-service condition, as specified by the manufacturer's instructions, should be such that no collisions can take place (see **12.4b**).

4.3 Duties of the person appointed to control the lifting operation

Reference should be made to **3.3** of BS 7121 : Part 1 : 1989.

In the interests of safety the appointed person should arrange the lifting programme such that no one driver has to be in attendance at the control station or actually operating the crane for an unreasonably long period, taking into account environmental conditions. The driver should have breaks from the working activity in line with other personnel on the site.

4.4 Contractual considerations

4.4.1 Contract lifting operations

Reference should be made to **3.4.1** of BS 7121 : Part 1 : 1989.

4.4.2 User's duties when using hired cranes

Reference should be made to **3.4.2** of BS 7121 : Part 1 : 1989.

5 Planning the lifting operation

5.1 General

Reference should be made to clause **4** of BS 7121 : Part 1 : 1989.

5.2 Other particulars

If the slinger or signaller is required to carry out a lifting operation which is outside the existing plan, the appointed person should be alerted. The appointed person should delay that particular lifting operation until a plan can be prepared for it.

6 Selection and duties of personnel

6.1 Selection

Reference should be made to **5.1** of BS 7121 : Part 1 : 1989 and **6.1** of BS 7121 : Part 4 : 1997.

6.2 Duties

6.2.1 Crane driver

Reference should be made to **5.2.1** of BS 7121 : Part 1 : 1989.

6.2.2 Slinger

Reference should be made to **5.2.2** of BS 7121 : Part 1 : 1989.

6.2.3 Signaller

Reference should be made to **5.2.3** of BS 7121 : Part 1 : 1989.

6.2.4 Crane erector

Reference should be made to **5.2.4** of BS 7121 : Part 1 : 1989.

6.2.5 Maintenance personnel

Reference should be made to **5.2.5** of BS 7121 : Part 1 : 1989.

6.2.6 Crane coordinator

The crane coordinator should plan the sequence of operations of tower cranes on sites having more than one crane, to ensure that cranes, components and loads do not collide.

6.2.7 Crane erection supervisor

NOTE 1. The crane erection supervisor is the 'erecator in charge', as detailed in **5.2.4** of BS 7121 : Part 1 : 1989.

The crane erection supervisor should have the responsibilities of a crane erector plus the following.

- a) The crane erection supervisor should be in control of all crane erectors and of any additional cranes and lifting equipment which may be used in the erection/dismantling operation.
- b) The crane erection supervisor should provide a means for ensuring that the operation is carried out in accordance with the crane coordinator's plan.
- c) Additional cranes and equipment should be in accordance with that specified and properly certified.
- d) All erectors should be equipped with the necessary tools and personal protective equipment.

NOTE 2. The appointed person (see **3.2** of BS 7121 : Part 1 : 1989) retains overall responsibility for the erection/dismantling operation, including the planning.

If the crane erection supervisor has to leave the site of the operation, even for a few minutes, he or she should appoint another 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.

NOTE 3. The crane erection supervisor should attempt to remain on site throughout the whole of the erection/dismantling operation.

7 Attributes of personnel

7.1 Crane driver

Reference should be made to **6.1** of BS 7121 : Part 1 : 1989.

Tower crane drivers can be required to climb to considerable heights and to spend long periods of time in isolation. This should be borne in mind when selecting tower crane drivers.

7.2 Slinger

Reference should be made to **6.2** of BS 7121 : Part 1 : 1989.

7.3 Signaller

Reference should be made to **6.3** of BS 7121 : Part 1 : 1989.

7.4 Crane erector

Reference should be made to **6.4** of BS 7121 : Part 1 : 1989.

7.5 Maintenance personnel

Reference should be made to **6.5** of BS 7121 : Part 1 : 1989.

In addition, the maintenance personnel should be:

- a) fully conversant with the appropriate sections of the manufacturer's instruction manual;
- b) familiar with the 'permit to work' system where it is required by the safe system of work, and able to operate it correctly;
- c) familiar with all aspects of their personal protective equipment and capable of using it correctly.

7.6 Crane coordinator

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 the signal code in figure 2 of BS 7121 : Part 1 : 1989;
- f) capable of giving precise and clear verbal instructions where audio equipment (e.g. radio) is employed, and capable of operating such equipment in accordance with **19.2**.

7.7 Crane erection supervisor

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

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



- b) be fully conversant with the manufacturer's instruction manual for the particular crane (see note);
- 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) have knowledge of the certification requirements for all equipment used.

NOTE. The crane erection supervisor should be in possession of the manufacturer's instruction manual for the particular crane.

8 Selection of tower cranes

8.1 General

Selection of a tower crane for a particular lifting operation should be considered by taking the following into account:

- a) clause 7 of BS 7121 : Part 1 : 1989;
- b) prevailing wind-speeds, which can restrict the use of tower cranes in certain locations;
- c) principal features of the common types of tower crane, as described in this Part of BS 7121.

NOTE. Static and mobile tower cranes are available in a wide variety of types and configurations according to the particular combination of tower, jib and type of base which they employ. Individual cranes can comprise almost any combination of the features shown in figures 1, 2 and 3.

8.2 Types of tower (see figure 1)

Tower cranes have either a non-slewing or slewing tower. With a non-slewing tower, the slewing ring is situated at or near the top of the tower and the jib slews about the vertical axis of the tower, which itself remains stationary. With a slewing tower, the slewing ring is situated at the bottom of the tower and the whole of the tower and jib assembly slews relative to the base of the crane.

Where non-slewing towers have to be tied to a fixed structure, it is imperative that the manufacturer's instructions are followed. The ties should be designed by a competent person to withstand the loads specified by the manufacturer, and be attached to a structure capable of withstanding the imposed loads.

8.3 Types of jib (see figure 2)

8.3.1 Horizontal trolley jib

The jib is held by tie bars or ropes in a horizontal or slightly raised position, and the hook is suspended from a trolley which moves along the jib to alter the hook radius. A suitable allowance needs to be made for deflection when calculating the clearance between adjacent cranes (see 4.2.2).

8.3.2 Inclined trolley jib

The inclined trolley jib is similar to the horizontal trolley jib except that the jib may be set at a significant angle of inclination.

8.3.3 Luffing jib

The jib angle can be changed to reposition the load at various radii. The jib may be single- or multi-component, and if multi-component, may be articulated (goose necked) or telescopic. Due to the varying out-of-service conditions for these cranes particular care should be taken to observe the manufacturer's instructions (see 12.4b).

8.3.4 Fixed radius jib

The radius at which the load is carried cannot be varied. Fixed radius jibs are usually only available on small tower cranes (self-erectors and similar), and it is generally desirable to be able to travel the crane in order to move the load.

8.4 Types of base (see figure 3)

8.4.1 Expendable base

The crane is mounted on special foundation anchors or an expendable tower section, cast into a concrete foundation block. (see figure 3d).

NOTE. It is important that the foundation anchors or expendable tower section are installed within the maker's tolerance of accuracy to ensure that the erected crane is within operational limits.

8.4.2 Crane base structure

The crane stands on its own base structure with ballast (cill base) or with its base structure bolted down to a concrete foundation block (cruciform base). With this arrangement a larger area of ground floor space is taken up and, therefore this type of base is not always acceptable on small sites.

Where the base is secured by ballast blocks there should be a notice attached detailing the position and weight of the blocks, and that the blocks should be adequately secured to prevent accidental displacement. The ballast arrangement should not be altered after the crane has been tested, for constructional or any other reasons (see 9.4.10).

8.4.3 Non-crane structure

A base provided by a structure which is not a normal part of the crane (e.g. part of a bridge, a building or structure provided specifically for such a purpose).

8.5 Types of tower crane

8.5.1 Climbing crane

A climbing crane is a tower crane that may be altered in height after initial erection. Where the crane remains on its original base this may be achieved by the use of internal telescoping equipment or external climbing frames. Another type of climbing crane can ascend through a structure using a climbing frame, the supported crane being provided by the surrounding structure.

NOTE. This type of crane requires less initial outlay due to the reduced quantity of mast required, but it has disadvantages in that the structure needs to have adequate strength and rigidity to carry the imposed loads, and the mast through the middle of the structure may interfere with the completion of the structure. Consideration should also be given to the dismantling of the crane once the structure is completed.

8.5.2 Rail mounted tower crane

A rail mounted tower crane is mounted on a chassis frame which is supported on rail wheels which are usually double flanged. There can be four single wheels on smaller machines or more usually four double wheel bogeys. The wheels or bogeys can have special mountings to enable the crane to negotiate bends. Rail mounted tower cranes may be of any of the types described in 8.2 and 8.3. Stability is normally obtained by means of ballast weights which should be adequately secured to prevent accidental displacement or removal, and the detail of the ballast should be on the notice near the base of the crane giving the crane capacities.

NOTE. Rail tracks for tower cranes are in 10.3.2.

8.5.3 Lorry mounted tower crane (see figure 4)

A lorry mounted tower crane is mounted on a truck or lorry chassis. These are particularly suitable when considerable inter-site mobility is required. Extra care should be taken in ensuring that outriggers, jacks, etc., are adequately supported for their imposed loads.

8.5.4 Wheel mounted tower crane

Some very small capacity tower cranes are available on trailer mounts with pneumatic tyres. These machines need to be towed into position and should be properly mounted on their outriggers or jacks before erection or use. The manufacturer's erection instructions should be scrupulously observed and if the operator is to erect and dismantle this type of crane, he or she should be specifically trained and have the attributes of an erector (see 7.4).

8.5.5 Crawler mounted tower crane

Some tower cranes mounted on a crawler base have means of self-levelling. They are equipped with a sensing device to detect verticality. The self-levelling function has a limited range of correction and great care should be taken when travelling over uneven ground. Crawler mounted cranes without self-levelling should not be moved over uneven ground when erected.

8.5.6 Micro tower crane

Micro tower cranes are tower crane units complete for mounting on the top of either a special mast or a hoist mast. They usually have a radius of approximately 6 m, a safe working load always under 1000 kg and are remote controlled. Micro tower cranes are generally used for offloading materials and placing within a limited area of a building.

8.6 Remote controls

Where cranes are available with remote controls, care should be taken in their use for the following reasons.

- a) The crane driver has no 'feel' for the machine and could, under certain circumstances, be tempted to handle the machine more dangerously than if the crane were operated via a cabin control.
- b) Infra-red remote control may be unreliable on tower cranes if the receiving sensor rotates with the crane and thus loses alignment with the transmitter.

NOTE. Remote controls have one main advantage in that the crane driver can be at a point of safety when the crane is in use, especially during overload testing.