

BRITISH STANDARD

Code of practice for safe use of cranes –

Part 5: Tower cranes

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British Standards

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Foreword

Publishing information

This part of BS 7121 was published by BSI and came into effect on 28 April 2006. It was prepared by Subcommittee MHE/3/11, *Crane safety and testing*, under the authority of Technical Committee MHE/3, *Cranes and derricks*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 7121 supersedes BS 7121-5:1997, which is withdrawn.

Relationship with other publications

The Lifting Operations and Lifting Equipment Regulations (LOLER) [1] and the Provision and Use of Work Equipment Regulations (PUWER) [2] came into force on the 5 December 1998. Details of the Regulations, an Approved Code of Practice plus HSE guidance can be found in the HSE books *Safe use of lifting equipment* [3] and *Safe use of work equipment* [4].

BS 7121-1 provides general recommendations for crane types not covered in an additional part of BS 7121. BS 7121-2 covers in-service inspection, thorough examination and, where appropriate, testing for the safe use of all types of crane. Subsequent parts of BS 7121 deal with the specific crane types as follows:

- Part 3: Mobile cranes;
- Part 4: Lorry loaders;
- Part 5: Tower cranes;
- Part 6: Derrick cranes;
- Part 7: Overhead/under-hung travelling and goliath cranes;
- Part 8: High pedestal and portal jib dockside cranes;
- Part 9: Container handling cranes;
- Part 10: Rail mounted cranes;
- Part 11: Offshore cranes;
- Part 12: Recovery vehicles and equipment;
- Part 13: Hydraulic gantry lifting systems;
- Part 14: Side boom pipelayers.

When all parts of BS 7121 have been published, CP 3010 will be withdrawn and BS 5744 will be revised to cover manually operated and light cranes only.

Information on the background to the development and use of BS 7121 since the initial publication of BS 7121-1 in 1989 is given in Annex E.

The BS 7121 series has been accepted as representing the consensus of practical experience for safety on cranes.

Information about this document

This new edition represents a full revision of the standard. It is intended to be used in conjunction with other parts of BS 7121 to ensure, so far as is reasonably practicable, that lifting operations are carried out safely.

The Health and Safety Executive (HSE) commends the use of this British Standard to those who have duties under the Health and Safety at Work etc. Act 1974 [5]. This standard was drawn up with the participation of HSE representatives and will be referred to in relevant HSE publications.

Use of this document

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.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This part of BS 7121 gives recommendations for the safe installation and use of tower cranes, including self-erecting tower cranes.

Subjects covered include selection of tower cranes, planning the installation (including site specific design work, e.g. base and ties), erection, extension (including climbing), thorough examination (including testing), maintenance, operation, and dismantling, as well as safety measures to be taken during the execution of all the above functions. It also covers the appropriate selection and training of personnel involved in the safe installation and use of tower cranes.

NOTE Self-erecting tower cranes have been addressed briefly in this document. It is envisaged that a full treatment will be given in a future publication.

2 Normative references

The following referenced documents are indispensable for the application 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.

BS 7121 (all parts), *Code of practice for the safe use of cranes*

BS 7671:2001, *Requirements for electrical installations – IEE Wiring Regulations – Sixteenth edition*

BS EN 13586, *Cranes – Access*

[16] HSE Guidance Note GS 6, *Avoidance of danger from overhead power lines*. Sudbury: HSE Books, 1997

[22] HSE Guidance Note HS G 118, *Electrical safety in arc welding*. Sudbury: HSE Books, 1994

3 Terms and definitions

For the purposes of this part of BS 7121, the following terms and definitions apply.

3.1 appointed person

person with the training, practical and theoretical knowledge and experience required to comply with 4.3

3.2 carrier

device that supports persons during lifting and lowering

NOTE This may also be known as a “manrider”.

3.3 climbing

increasing or decreasing the tower height of a crane using a means other than another crane

3.4 competent engineer

person who has such theoretical knowledge and experience of the design of the lifting equipment as enables them to assess the design of tower crane bases, ties and supporting structure connections, together with the adequacy of supporting structures to take the loads imposed by the crane

3.5 competent person

person who has such practical and theoretical knowledge and experience of the crane and the equipment used in the lifting operation as is necessary to carry out the function to which the term relates in each particular context

3.6 crane coordinator

person who plans and directs the sequence of operations of cranes to ensure that they do not collide with other cranes, loads and other equipment (e.g. concrete placing booms, telehandlers, piling rigs)

3.7 crane operator

person who is operating the crane for the purpose of positioning loads or erection of the crane

NOTE Sometimes referred to as “crane driver”.

3.8 crane supervisor

person who controls the lifting operation, and ensures that it is carried out in accordance with the appointed person's safe system of work

3.9 employing organization

person or organization who requires a lifting operation to be carried out and is responsible for safe use of the crane

NOTE In the case of a hired crane the degree of the employing organization's responsibility for the safe use of the crane depends on whether the crane is being supplied under a crane hire contract or a part of a contract lift. See Clause 5.

3.10 erector

person trained and assessed in tower crane erection, working under the supervision of an erection supervisor

3.11 erection supervisor

person in control of a team of tower crane erectors on site, who is a senior erector with sufficient experience and additional skills to enable them to supervise, and take responsibility for, the team

3.12 indicator

device which provides warnings and/or data to facilitate the competent control of the crane within its design parameters

3.13 installation

group of activities associated with the erection, alteration and dismantling of a tower crane

3.14 lifting

any movement of loads or persons that includes a change of height

3.14.1 basic lift

lifting operation where the weight of the load(s) can be simply established, and there are no hazards or obstructions within the area of the operation

3.14.2 standard lift

lifting operation where there are hazards, either within the working area of the crane or on the access route to the working area

3.14.3 complex lift

lifting operation which includes cranes using load enhancement equipment, lifting of persons or when the lifting operation is at a location with exceptional hazards

NOTE An example of a location with exceptional hazards is a chemical plant.

3.15 lifting equipment

work equipment (crane) for lifting or lowering loads, including attachments used for anchoring, fixing or supporting the load

3.16 load

weight which is lifted by the crane

NOTE If cranes are used to lift loads from water, the load could also include forces due to water flow or suction.

3.17 lifting accessory

equipment from which the load can be suspended

NOTE Also known as accessories for lifting.

3.18 method statement

document produced by the appointed person to describe how the crane installation or lifting operation is to be carried out

3.19 radius

horizontal distance between the point at which the axis of rotation meets the ground and the vertical centreline passing through the hook

NOTE For non-slewing cranes, the horizontal distance from the centreline of the hook to the centreline of the nearest bogie or axle, bogie or track, measured at ground level, can be assumed to be the radius.

3.20 radius indicator

device that shows the radius at which the crane is operating

3.21 rated capacity

load that the crane is designed to lift for a given operating condition (e.g. configuration, position of the load)

NOTE The rated capacity was formerly known as “safe working load”.

3.22 rated capacity indicator/limiter

RCI/L

device that warns of the approach to overload and prevents the crane from being overloaded as described in BS EN 12077-2

NOTE This was previously known as an “automatic safe load indicator” (ASLI) and “overload protection”. For information on ASLIs see BS 7262.

3.23 senior erector

erector with sufficient experience and additional skills to enable them to work with and directly oversee a trainee erector

3.24 service conditions**3.24.1 in-service**

condition where the crane is handling loads not exceeding the rated capacities within permissible wind speeds and other conditions as specified by the manufacturer

3.24.2 out-of-service

condition where the crane is either not required for use or is out of use, without a load on the hook and in conditions as specified by the manufacturer

NOTE These conditions may include a higher wind speed than that permitted for the in-service conditions.

3.25 signaller

person responsible for directing the crane operator to ensure safe movement of the crane and load

3.26 slinger

person responsible for attaching and detaching the load to and from the crane, for correct selection and use of lifting accessories in accordance with the specifications of the appointed person and for initiating the movement of the load

3.27 thorough examination

examination by a competent person in such depth and detail as the competent person considers necessary to enable them to determine whether the equipment being examined is safe to continue in use

NOTE The thorough examination is not part of the maintenance regime for the equipment but provides owners with information which could be used to determine the effectiveness of the regime. The competent person may require supplementary tests as part of thorough examination. See BS 7121-2.

3.28 tower crane

3.28.1 conventional tower crane

slewing jib type crane with jib located at the top of a vertical tower which is assembled on site from components

**3.28.2 self-erecting tower crane
SETC**

jib type crane with jib located at the top of a vertical slewing tower which is a pre-assembled unit transported to site and deployed from its travelling configuration for use

3.29 trainee erector

person undergoing training in the erection of cranes and working at all times under the direct supervision of a senior erector

3.30 use

<of work equipment> activity of any kind involving work equipment

NOTE This includes starting, stopping, programming, setting, transporting, repairing, modifying, servicing and cleaning.

3.31 user

person or organization that has control of the lifting operation and the crane operator, and has a responsibility to ensure that cranes are properly maintained and thoroughly examined by a competent person

3.32 weight

vertical force exerted by a mass as a result of gravity

3.33 zoning device

electromechanical/electronic device to control the area in which a tower crane works

4 Management of installation and lifting operations

4.1 Safe system of work

A safe system of work should be established and followed for every crane installation operation or lifting operation whether it be an individual lift or a group of repetitive operations. The same principles should be applied when the operations are carried out at a temporary site, for example construction, or when the crane is a permanent fixture, for example in a factory or at a dock.

The safe system of work should include:

- a) planning of the operation;
- b) selection, provision and use of a suitable crane(s) and work equipment;

NOTE Crane specifiers have a duty to ensure that cranes are selected with adequate capacity for the intended use. Crane users have a duty to ensure that the crane is only used for its intended purpose.

- c) any necessary preparation of a site and erection and dismantling of the crane(s);
- d) maintenance, examination and where necessary testing of the crane(s) and equipment;
- e) the provision of properly trained and competent personnel who have been made aware of their relevant responsibilities under the Health and Safety at Work etc. Act 1974 [5] and supporting regulations;
- f) adequate supervision by properly trained and competent personnel having the necessary authority;
- g) ensuring that all necessary reports of thorough examination and other documents including the manufacturer's manuals are available;
- h) preventing unauthorized movement or use at all times;
- i) the safety of persons not involved in the installation or lifting operation.

The safe system of work should be communicated to all parties concerned.

It is essential for the safety of the operation to ensure that all personnel can communicate clearly in the same language.

Cranes are work equipment and it is essential that they are not used for the lifting of persons for entertainment purposes, including joyriding, bungee jumping and stunts.

4.2 Control of the installation or lifting operation

4.2.1 General

In order to implement the safe system of work effectively, one person should be appointed to have overall control of the installation/lifting operation to act on behalf of the management of the employing organization requiring the load to be moved. The appointment of the person does not remove any legal responsibility from the management but enables them to use the appointed person's expertise the better to fulfil their responsibilities. The person appointed may have other duties and need not be an employee of the employing organization. The appointed person should have adequate training and experience to enable these duties to be carried out competently.

On large construction sites where multiple lifting operations are carried out by various subcontractors, the principal contractor should appoint the appointed person for the site. Each of the sub-contractors on site may employ individuals who have undergone appointed person training but they should remain sub-servant to the principal contractor's appointed person. The principal contractor's appointed person should ensure that the crane coordinator is advised of all lifting operations in order that they may perform their duties.

4.2.2 Selection and assessment of appointed person

NOTE To assist in selection of an appointed person, some examples of lifting operations that require different levels of expertise, training and experience, and that impose different duties on the appointed person, are given in 4.3. Details of the requirements for installation operations are given in Clause 12 and Clause 13.

When selecting an appointed person the employing organization should take into account the variety and complexity of the operation, as well as all the problems that could arise from proximity hazards and environmental courses. The appointed person should be notified formally in writing of their appointment. The appointed person should be given authority to carry out the duties involved, including consulting others with specialist knowledge and experience, and should be able to delegate duties and tasks for any part of the safe system of work to suitably qualified individuals.

The employing organization should review and assess the performance of the appointed person periodically. Different installation/lifting operations might entail selection of a new appointed person, as appropriate, or provision of additional training to the existing appointed person.

4.2.3 Avoidance of collisions

On sites where there is a possibility of collision between cranes and other equipment the crane coordinator (see **7.2.3**) should plan the sequence of crane movements to prevent collisions. Any corresponding instructions from the crane coordinator to the crane operators should be given via the respective signallers. In such circumstances the signallers should obtain the agreement of the crane coordinator before carrying out any operation.

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 **14.6b**). This activity should be part of the initial planning process.

4.3 Duties of the person appointed to control the installation/lifting operation

4.3.1 General

The appointed person's duties should include the following.

- a) Being familiar with the relevant parts of the project Health and Safety Plan where the lifting operation is being carried out on a site where the Construction (Design and Management) Regulations [6] apply.
- b) Assessing the installation/lifting operation to provide such planning, selection of crane(s), lifting accessories and equipment, instruction and supervision as is necessary for the task to be undertaken safely. This may include consultation with other responsible bodies if necessary and ensuring that, where different organizations are involved, they collaborate as necessary.
- c) Ensuring that adequate inspection/examination and maintenance of the equipment has been carried out. For further information see BS 7121-2.
- d) Ensuring that there is an effective procedure for reporting defects and incidents and taking any necessary corrective action.
- e) Taking responsibility for the organization and control of the installation/lifting operation.
- f) Ensuring that the crane supervisor is fully briefed on the contents of the method statement (see **6.3**).

The appointed person should be given the necessary authority for the performance of all these duties and, in particular, authority to stop the operation whenever they consider that danger is likely to arise if the operation were to continue.

Duties, but not responsibilities, may be delegated to another person where considered appropriate.

NOTE As the crane operator is required to be at the controls of the crane when it is handling loads, it would not be appropriate to appoint the operator to be in control of the lifting operation. For a basic lifting operation, the management of the employing organization may consider it appropriate to appoint the slinger to be in control of the lifting operation.

The duties of appointed persons for crane operations can vary according to the complexity of the operation. The duties for a basic lift are considerably fewer and less demanding than for a lift at a hazardous location. An appointed person employed for a basic lift might not be suitably trained or experienced for a more complicated operation, and another appointment could be required for this. The information given in 4.3.2 to 4.3.4 can be used so that an appropriate appointment is made and a suitable method statement produced for each lifting operation. The requirement for an appointed person with appropriate training and experience also applies to installation operations.

4.3.2 Basic lift

If the weight of the load(s) can be simply established, and there are no hazards or obstructions within the area of the operation, then the duties of the appointed person should include the following.

- a) Establishing the weight of the load. This can be by a reliable source of information, weighing the load, or calculation (with allowance for possible inaccuracies).

NOTE If cranes are used to lift loads from water, the load could also include forces due to water flow or suction and the effect of loss of buoyancy.

- b) Selection of the crane, based on the weight of the load, including the crane hook block and any lifting tackle; the maximum height of lift and the maximum radius required. The rated capacity of the crane should be specified by the manufacturer in the information for use supplied with the crane, or else on the current report of thorough examination issued by the competent person. Manufacturer's sales leaflets should not be relied on for the rated capacity for a specific crane.
- c) For self-erecting tower cranes consideration of the location of the operation, taking into account the access and egress required for the crane, and the suitability of the ground to take the loads imposed on the crane during preparation for the lift and during the lift itself. Lifting operations involving self-erecting tower cranes should take into account the recommendations given in Annex A.
- d) Ensuring that the crane is not operated in wind speeds in excess of those given in the instruction manual for the crane. Consideration should also be given to the wind area of the load to ensure that its movement in the wind does not present a hazard.
- e) Ensuring that the crane has been thoroughly examined at least within the previous 6 months (for lifting of persons) or 12 months (including testing where appropriate), inspected and checked before use.
- f) Ensuring that a system for reporting defects is in place.
- g) Selecting appropriate lifting accessories, including their method of attachment to the load, and any protection used to prevent damage.
- h) Ensuring that lifting accessories are thoroughly examined, at least within the previous 6 months, inspected and checked before use.

- i) Designating a person to check the lifting accessories and any lifting points that are provided on the load to ensure they are free from any obvious defect before attaching the load to the crane.
- j) Briefing all persons involved in the lifting operation to ensure that the safe system of work described in the method statement is understood. All persons involved in the lifting operation should be instructed to seek advice from the appointed person if any change is required to the lifting operation, or if any doubts about safety arise. If handlines/taglines are required to give more control of the load, the appointed person should designate persons to handle the lines.
- k) Checking, if numerous loads are to be lifted over a long period, that no changes are required in the safe system of work.
- l) Ensuring that there is a crane supervisor (see **7.2.2**) designated to direct personnel and that the operation is carried out in accordance with the method statement.

The appointed person and crane supervisor should be aware of the limits of their knowledge and experience concerning lifting operations, and when conditions exceed these limits, further advice should be sought.

4.3.3 Standard lift

If there are hazards, either within the working area of the crane or on the access route to the working area, the duties of the appointed person should include the following, in addition to the duties listed in **4.3.2**.

- a) Investigating all hazards in the operating area, including any areas required for access or erection/dismantling of the crane.

NOTE Hazards can be from surrounding buildings, or overground or underground services.

- b) Taking account of increased risks if the load is lifted from a structure at a height above the standing position of the crane.

NOTE Additional risks can arise from the crane driver not being able to observe the load while taking the initial strain, and movements due to deflections as the load is lifted clear of the supporting structure, making it not possible to put the load back down.

- c) Liaison with any other person or authority, as required to overcome any hazard, by including any necessary corrective action or special measures in the safe system of work.
- d) Consideration of the effect of the lifting operation on surrounding property or persons, including the general public. This should lead to arranging for appropriate action to minimize any adverse effects, and to giving appropriate notice to all persons concerned.

4.3.4 Complex lift

If the lifting operation is at a location with exceptional hazards (for example, at a chemical plant), persons are being lifted, lifting a load from height, or the load being lifted is a complex shape or with a large wind area then the appointed person should ensure, in addition to the duties listed in 4.3.2 and 4.3.3, that:

- a) the weight of the load and the position of its centre of gravity are accurately known;
- b) the wind area of the load is known and a limiting wind speed for lifting is established;
- c) any lifting points provided on the load are adequate for the loads applied;
- d) the method statement includes access, ground conditions, erection etc., as well as the exact sequence of operations when lifting the load;
- e) where persons are being lifted ensure that the requirements of Annex B are met.

Tower cranes should not be used for multiple lifts.

4.4 Duties of the persons involved in construction projects

The Construction (Design and Management) (CDM) Regulations [6] require that designers, planning supervisors, principal contractors, sub-contractors and clients consider health and safety matters throughout all stages of a construction project from conception, design and planning through to carrying out the work, including maintenance, repair and/or demolition.

Lifting operations are commonly carried out using cranes and they should be included in the Health and Safety Plan required by the CDM [6] so that factors influencing crane safety can be assessed at a sufficiently early stage.

When constructing the Plan, the ways in which the cranes are intended to be used, i.e. by the manufacturer and hirer, and any limitations that would affect safety in the conditions expected on site should be taken into account.

The Plan should include information to allow all parties involved in the specification, installation or use of cranes to be made aware of the fundamental criteria and planning issues needed to ensure that lifting operations are initiated and proceed in a logical and safe manner.

Designers should obtain and make available to the CDM planning supervisor, information relating to the site and type(s) of crane to be used.

When designing a structure to be assembled by cranes designers should consult an appropriate appointed person at the design stage to ensure compatibility between structure components and the cranes that are likely to be lifting them into position. Further advice is given in CIRIA C654 [7] and the Construction Industry Council General Information Note I 002 [8].

NOTE Contractors have a duty to operate cranes safely, and this can be made extremely difficult by thoughtless design which puts pressure on them to use cranes at their operating limits and sometimes encourages improper use.

5 Contract lift or crane hire

5.1 General

Given the wide variety of contractual arrangements used in the construction industry, it is important to ensure that the planning, organization, control and management of lifting operations is not compromised. In general, any organization requiring a load to be moved by crane, which does not have its own craneage, has two basic options: hiring a crane (Hired Crane) or employing a contractor to carry out the lifting operation (Contract Lift). The difference between the two options is summarized in Figure 1.

If an individual or organization does not have expertise in lifting operations they should not hire cranes but should opt for a contract lift. Before entering into a contract, employing organizations should satisfy themselves that the contractor has the necessary competence to carry out the work.

NOTE Responsibilities for insurance in terms of the crane, personnel, the load and third parties might also need to be clarified.

5.2 Contract lifting operations

The employing organization may enter into a contract with a contractor who undertakes the work on their behalf.

The parties to the contract should ensure that:

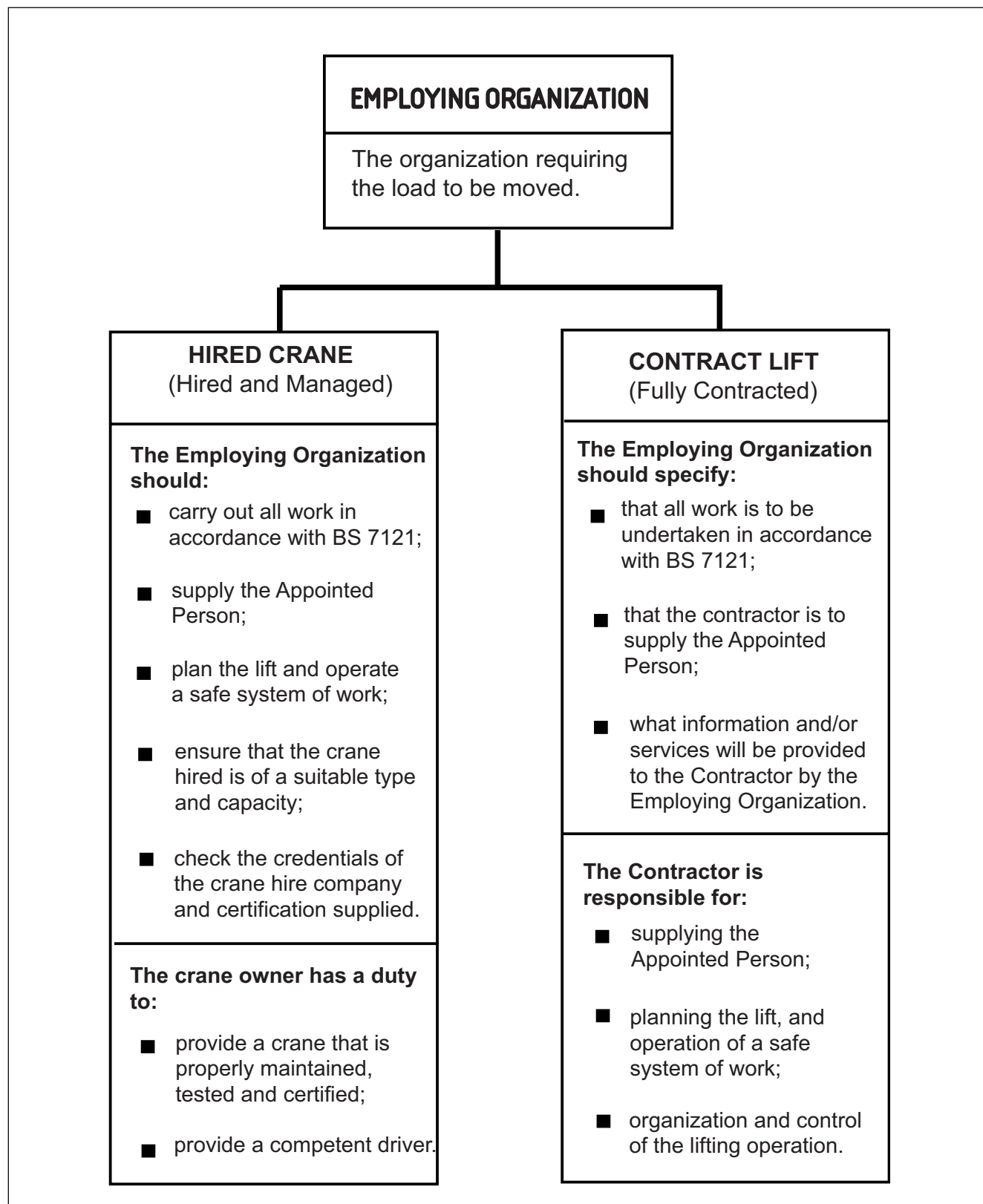
- a) all work is carried out in accordance with the BS 7121 series;
- b) the contractor appoints a person, in accordance with 4.3 to the satisfaction of the employing organization;
- c) all information or services provided by the employing organization to facilitate compliance with the BS 7121 series are notified to the contractor in writing.

The contractor should carry out lifting operations in accordance with the BS 7121 series. The contractor should be given full authority by the employing organization to work in accordance with the BS 7121 series including, where appropriate, authority to control and instruct the employing organization's personnel.

NOTE Although the BS 7121 series is intended to assist organizations to comply with their statutory and common law obligations, it does not relieve them from these obligations.

Before entering into a contract, the employing organization should ensure that the contractor has the necessary competence to carry out the work in accordance with the BS 7121 series.

Figure 1 **Contract options**



5.3 User's duties when using hired cranes

When a crane is hired out together with an operator to the user organization, the crane owner should provide a competent operator and a crane that is properly maintained, inspected and tested in accordance with BS 7121-2, and has a current report of thorough examination.

The user organization retains the responsibility for nominating the appointed person in accordance with **4.3** and for following the recommendations given in the BS 7121 series. Notwithstanding any advice the crane owner might have offered concerning the selection of a particular crane or any other relevant matter, for example clearances, ground conditions, the responsibility for ensuring that the crane is of a suitable type, size and capacity for the task being undertaken and for planning the operation remains with the user organization.

Therefore if an individual or organization does not have expertise in lifting operations, they should not hire cranes but should opt for a contract lift.

6 Planning of lifting operations when the crane is in use

6.1 General

All lifting operations should be planned to ensure that they are carried out safely and that all foreseeable risks have been taken into account. Planning should be carried out by an appointed person who has the appropriate knowledge for the lift being undertaken (see **4.3.2** and **4.3.3**).

In cases of repetitive or routine basic lifting operations, this planning might only be necessary in the first instance, with periodic reviews to ensure that no factors have changed.

For lifting operations carried out on construction projects, further information on the duties of personnel is given in **4.4**.

Planning of the lifting operation should take into account:

- a) the load, its characteristics and the method of lifting;

NOTE It may also be necessary to make allowance for any adhesion between the load and its support.

- b) the selection of a suitable crane(s) appropriate to the operation ensuring that adequate clearances are maintained between the load(s) and the crane structure (see Clause **9**);
- c) the selection of accessories for lifting/lifting attachments, the weight to be taken into account when assessing the load on the crane(s);
- d) the position of the crane(s) and of the load before, during and after the operation (see **14.6**);
- e) the site of the operation including proximity hazards, space availability and suitability of the ground or foundations;

- f) any necessary erection and dismantling of the crane(s);
- g) the environmental conditions that exist or could occur at the site of the operation, which could necessitate stopping the operation when conditions are unsuitable.

6.2 Risk assessment

6.2.1 The risk assessment carried out by the appointed person as part of the planning process should identify the hazards associated with the proposed lifting operation. The assessment should evaluate the risks involved and the nature and extent of any measures required to mitigate those risks. The appointed person should also take into consideration hazards identified by the overall site risk assessments.

NOTE Attention is drawn to the Management of Health and Safety at Work Regulations [9] which require that a risk assessment is carried out.

6.2.2 Generic risk assessments are unlikely to be sufficient since most sites have hazards that are unique to that situation and should be taken into account in the separate site specific assessment.

The results of the risk assessment should be recorded in writing and used in the preparation of the method statement (see **6.3**) for that site.

6.2.3 The risk assessment together with the manufacturer's instructions, should then be used to develop a detailed method statement for the safe transportation, assembly, erection, use and dismantling of the equipment at that site.

6.3 Method statements

6.3.1 Once the risk assessment has been carried out, the appointed person (see **4.3**) should ensure that a full method statement is prepared, detailing the safe system of work (see **4.1**) for the lifting operation and including the risk assessment.

6.3.2 The appointed person should, when necessary, consult with others with specialized knowledge and experience to assist in the planning process for which the appointed person retains responsibility.

6.3.3 The method statement should include:

- a) the tasks to be achieved and the sequence in which they are to be carried out;
- b) the configuration of the crane when not in use;
- c) details of the steps to be taken to eliminate danger to personnel not involved in the lifting operation, and where necessary, prevent their entry into danger zones, e.g. by organizing for road closures if necessary;

NOTE Exclusion zones generally require the agreement of the principal contractor.

- d) the requirement for pre-use checks to be completed;
- e) a clear statement of the allocation of tasks to all parties involved in the lifting operation.

6.3.4 The lifting operation will be under the control of a crane supervisor who has the authority to stop the work if local conditions are unsatisfactory.

6.3.5 The crane supervisor should ensure that all persons involved in the lifting operation (the lifting team) are inducted in the general site precautions and the specific features of the method statement at the start of the job.

6.3.6 A copy of the method statement and associated operating instructions should be given to all those involved in the planning of the lifting operation.

6.3.7 The method statement should be sufficient to provide the basis for a briefing or induction of each member of the team (see **12.1.7.6**).

The crane supervisor or principal contractor's representative should normally take the opportunity during the site induction to seek the views of the team about any arrangements for health and safety that might be relevant to them.

6.3.8 To be effective the method statement needs to specify clear roles for each member of the team. Arrangements for effective communication among the team (and if necessary with adjacent crane operators in case of danger) should be available.

NOTE The appointed person may delegate the task of preparing the method statement to another person; however they retain responsibility for the method statement. It is essential that the appointed person sign and date the document before it is issued for use to signify their approval of the method statement's content.

7 Selection and duties of personnel

NOTE See 4.3 for the selection and duties of the appointed person.

7.1 Selection of personnel

Safe lifting operations (including installation) depend upon the selection of suitable personnel who are competent to carry out the required duties. Records of training and experience of persons such as the crane operator assist in the selection of suitable personnel. Crane operators and slingers should be trained in accordance with the recommendations given in Annex C.

Those responsible for the selection of personnel should ensure that the personnel involved in the operation are efficiently organized in order to ensure good team-work in the working situation.

Work associated with lifting operations should not be carried out by personnel whose efficiency is impaired by alcohol, drugs or other influences. It is essential that all personnel in the team are made aware of both this fact and their other duties (see **7.2**).

Where personnel are under training, they should be supervised by appropriate personnel.

NOTE For basic lifts it may be appropriate for one person to undertake more than one of the duties identified in 7.2, depending on the hazards identified by the risk assessment.

7.2 Duties of personnel

7.2.1 Crane supervisor

NOTE The appointed person may decide to undertake the duties of the crane supervisor or to delegate these to another person with appropriate expertise for the lifting operation.

The crane supervisor should direct and supervise the lifting operation, ensuring that these are carried out in accordance with the method statement. The crane supervisor should be competent and suitably trained and should have sufficient experience to carry out all relevant duties. The crane supervisor should have sufficient authority to stop the lifting operation if they consider it dangerous to proceed.

7.2.2 Crane coordinator

The crane coordinator should plan and direct the sequence of operations of tower cranes to ensure that they do not collide with other cranes, loads and other equipment (e.g. concrete placing booms, telehandlers, piling rigs).

7.2.3 Crane operator

The crane operator should be responsible for the correct operation of the crane in accordance with the manufacturer's instructions and within the safe system of work (see **4.1**).

The crane operator should at any one time only respond to the signals from one slinger/signaller who should be clearly identified (see **10.2**).

In an emergency a commonly recognized stop signal may be given by any person observing a situation leading to danger and the crane operator should respond to that signal.

7.2.4 Slinger

The slinger should be responsible for attaching and detaching the load to and from the crane hook and for the use of the correct accessories for lifting and other equipment in accordance with the planning of the operation.

The slinger is responsible for initiating and directing the safe movement of the crane [see **8.5h**].

If there is more than one slinger, one should be designated as the "slinger in charge" by the crane supervisor.

Where continuity of signalling is required and this slinger is not visible to the crane operator, another slinger or signaller may be necessary to relay signals to the crane operator. Alternatively, other audio or visual methods may be used.

Where audio or visual methods are used, the equipment or its means of use should be such that the operator is immediately aware of failure of the equipment, to enable them to stop crane movements.

Typical examples of audio or visual methods used are as follows.

- a) A blank screen on a television monitor immediately indicates that the operator should stop all crane movements.
- b) A slinger using a radio should continuously instruct the operator to lower a load, e.g. by saying “Lower-lower-lower...”, and failure of this continuous instruction from the slinger indicates that the operator should halt all crane movements.

If, during the lifting operation, responsibility for directing the crane and load is to be transferred to another nominated person, the slinger should clearly indicate to the crane operator that this responsibility is being transferred and to whom, and the slinger should clearly indicate to the new nominated person that this transfer is taking place.

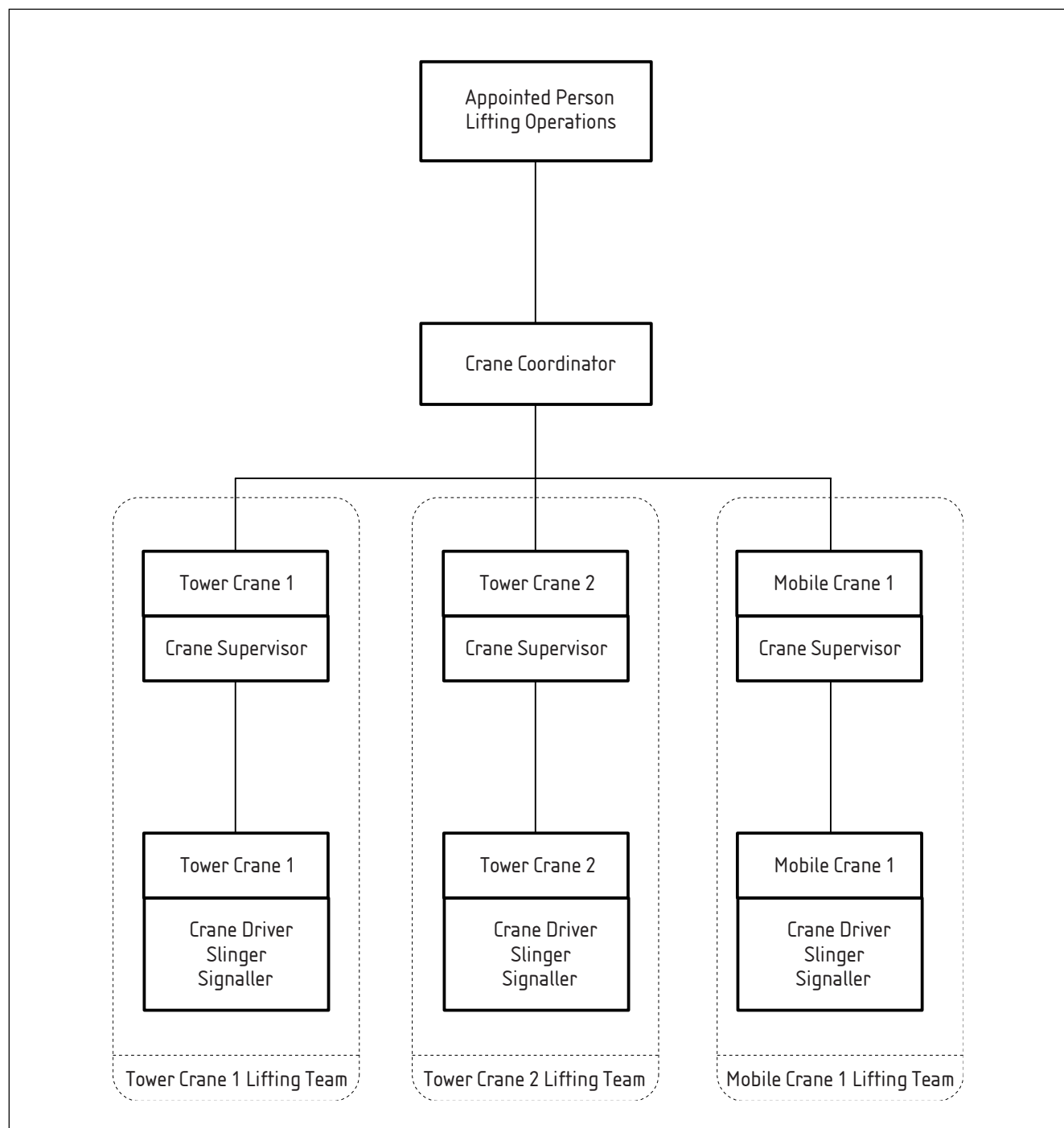
Furthermore, the operator and the new nominated person should clearly indicate that they accept the transfer of responsibility.

7.2.5 Signaller

NOTE Figure 2 shows the flow of information and control of lifting operations between personnel.

The signaller should be responsible for relaying the signal from the slinger to the crane operator. The signaller may be given the responsibility for directing movement of the crane and load instead of the slinger, provided that only one person has the responsibility.

Figure 2 **Flow of information between personnel involved in lifting operations**



7.2.6 Maintenance personnel

The maintenance personnel should be responsible for maintaining the crane and ensuring its safe and satisfactory operation. They should carry out all necessary maintenance in accordance with the manufacturer's maintenance manual and within the safe system of work (see 4.1).

7.2.7 Erector

The erector should be responsible for working on the installation of the crane in accordance with the manufacturer's instructions and a job specific method statement, working under the guidance of a senior erector or erection supervisor.

7.2.8 Senior erector

The senior erector should have the responsibilities of an erector in addition to the following.

- a) Supervision of erectors as directed by the erection supervisor.
- b) Responsibility for, and close monitoring of, any trainee erectors involved with the installation of the crane.

7.2.9 Crane erection supervisor

The crane erection supervisor should have the responsibilities of a crane erector in addition to the following.

- a) The crane erection supervisor should be in control of all senior erectors, erectors and trainee erectors and of any additional craneage and lifting equipment which could be used in the erection/dismantling operation, thereby fulfilling the role of the crane supervisor.
- b) The crane erection supervisor should provide a means for ensuring that the operation is carried out in accordance with the method statement.
- c) Additional craneage 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 The appointed person (see 4.3) 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.

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

7.2.10 Trainee erector

The trainee erector should be responsible for working on the installation of the crane under the direct supervision of a senior erector.

8 Minimum attributes of personnel

NOTE 1 This clause also includes information on training of personnel.

NOTE 2 See 4.3 for the duties of the appointed person in lifting operations.

8.1 General

All personnel should be:

- a) competent;
- b) adequately trained and assessed;
- c) able to present a record of training and assessment;
- d) physically able to carry out the work;
- e) assessed for their ability to work confidently and safely at height;
- f) assessed for health in accordance with the recommendations of HS(G)6 [10].

8.2 Crane supervisor

The crane supervisor should be:

- a) authorized to carry out the duties listed in 7.2.1;
- b) fully conversant with the duties of all persons involved in the lifting operation;
- c) able to give clear, unambiguous instructions to all other members of the team;
- d) able to assess danger to the lifting operation from changed circumstances on site, and to call a halt to the operation if the risk becomes unacceptable, so that the appointed person can be referred to for further instructions.

If the crane supervisor is also a crane operator, then the crane supervisor should not operate any crane involved in the lifting operation being supervised.

8.3 Crane coordinator

The crane coordinator should be:

- a) over 18 years of age;
- b) fit, with particular regard to eyesight, hearing, reflexes and agility;
- c) 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 16.2;
- d) familiar with the types of crane and lifting equipment to be used on site in terms of capacities, size, speed of operation, method of control, limitations, etc.

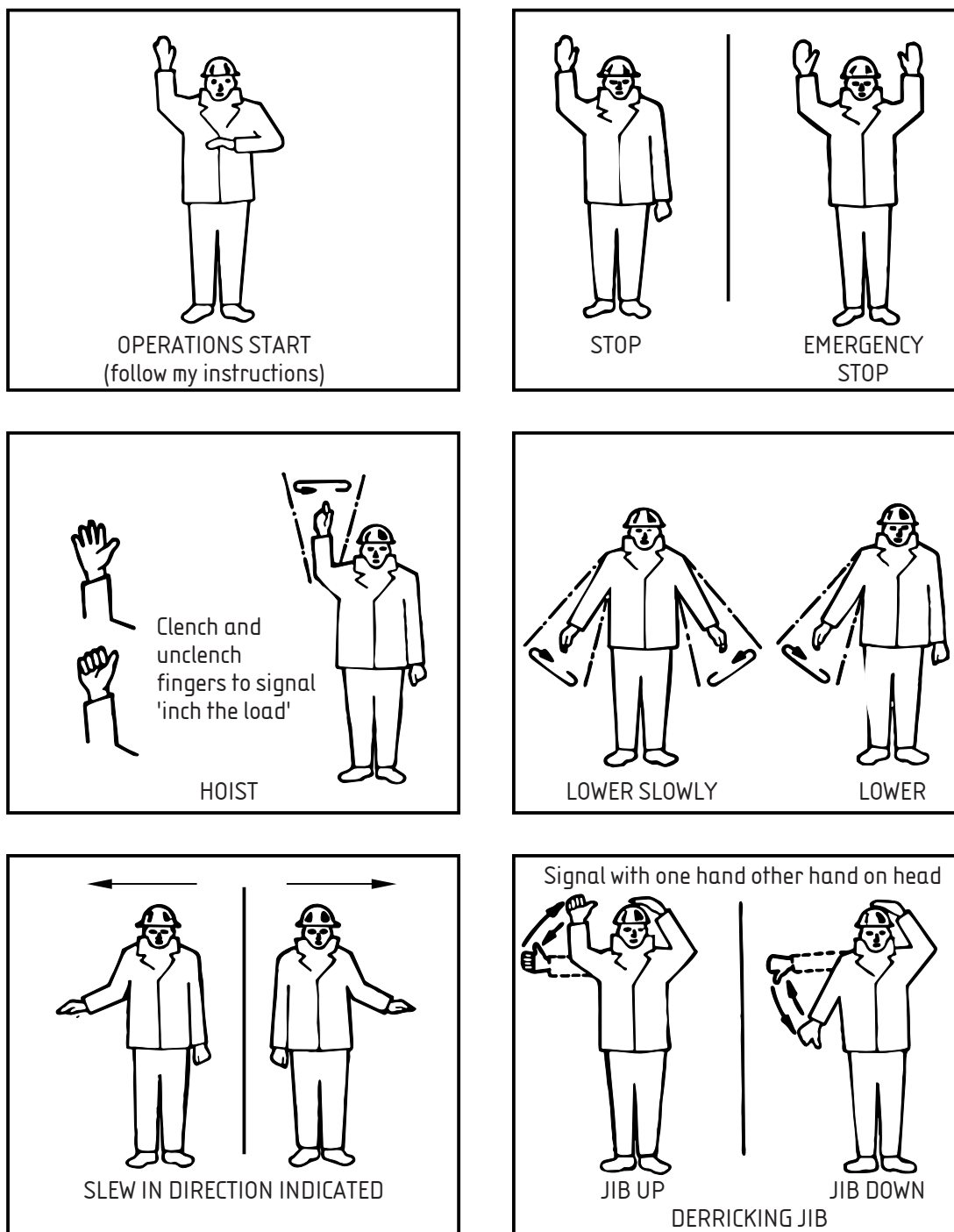
8.4 Crane operator

The crane operator should be:

- a) either over 18 years of age or under the direct supervision of a person competent for the purpose of training;
- b) fit, with particular regard to eyesight, hearing and reflexes;
- c) physically able to operate the crane safely;
- d) able to judge distances, heights and clearances;
- e) adequately trained for the type of crane being driven and have sufficient knowledge of the crane, its operating instructions and its safety devices (see Annex C);
- f) fully conversant with the duties of the slinger and signaller, and have been instructed in the signal code shown in Figure 3 and any alternative methods of relaying the signals that are to be used, in order to implement safely the instruction of the slinger or signaller;
- g) trained in the use of the fire extinguishing/fighting equipment on the crane (where provided);
- h) trained in the use of any means provided for escape in case of emergency;
- i) authorized to operate the crane.

Evidence that the operator is medically fit to drive a crane should be obtained at not more than 5 yearly intervals. The type of evidence obtained is dependent on the type of crane being operated and the risks to the operator and others involved in the operation.

Figure 3 Hand signals



8.5 Slinger

The slinger should be:

- a) either over 18 years of age or under the direct supervision of a person competent for the purpose of training;
- b) fit, with particular regard to eyesight, hearing, reflexes and agility;
- c) physically able to handle accessories for lifting and equipment;
- d) able to establish weights, balance loads and judge distances, heights and clearances;
- e) trained in the techniques of slinging;
- f) capable of selecting accessories for lifting and equipment in suitable condition for the load to be lifted (see BS 6166-3 and BS 6210);
- g) trained in the techniques of signalling and have been instructed in the signal code shown in Figure 3;
- h) capable of giving precise and clear verbal instructions where audio equipment (e.g. radio) is used and capable of operating the equipment in accordance with **16.2**;
- i) capable of initiating and directing the safe movement of the crane and load;
- j) authorized to carry out slinging duties.

8.6 Signaller

The signaller should be:

- a) either over 18 years of age or under the direct supervision of a person competent for the purpose of training;
- b) fit, with particular regard to eyesight, hearing, reflexes and mobility;
- c) able to judge distances, heights and clearances;
- d) trained in the techniques of signalling and have been instructed in the signal code shown in Figure 3;
- e) capable of giving precise and clear verbal instructions where audio equipment (e.g. radio) is employed and capable of operating the equipment in accordance with **16.2**;
- f) capable of directing the safe movement of the crane and load;
- g) authorized to carry out signalling duties;
- h) aware of the responsibilities allocated by the appointed person (see **7.2.3** and **7.2.4**) to the crane operator and slinger.

8.7 Maintenance personnel

Maintenance personnel should be:

- a) fully conversant with the machinery they are required to maintain and its hazards;
- b) properly instructed and trained. Where special machinery is involved this should include attending appropriate courses given by the supplier of the equipment;

- c) familiar with the procedures and precautions recommended in Clause 14;
- d) fully conversant with the appropriate sections of the manufacturer's instruction manual;
- e) familiar with the use of permit to work systems where they are required by the safe system of work, and able to operate them correctly;
- f) familiar with all aspects of their personal protective equipment and capable of using it correctly.

8.8 Crane erector

The crane erector should be:

- a) either over 18 years of age or under the direct supervision of a person competent for the purpose of training;
- b) fit, with particular regard to eyesight, hearing, reflexes and agility;
- c) physically able to handle safely the loads involved in crane erection;
- d) able to work confidently and safely at heights;
- e) able to establish weights, balance loads and judge distances, heights and clearances;
- f) trained in the techniques of slinging and signalling;
- g) capable of selecting lifting gear and equipment that is suitable for the load to be lifted;
- h) adequately trained in the erection, dismantling and working of the type of crane being erected, and in the safe use and setting up of any lifting appliance used in the course of these duties;
- i) capable of assessing that components and equipment are in a suitable condition for incorporation into the crane being assembled;
- j) adequately trained in the setting and testing of the safety devices fitted to the crane being erected.

8.9 Senior erector

The senior erector should have the same attributes as the crane erector and:

- a) have at least three years' experience in the erection and dismantling of tower cranes or similar equipment;
- b) be conversant with the manufacturer's instruction manual for the particular 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 trained in the direct supervision and monitoring of trainees gaining experience in the erection and dismantling of tower cranes.

8.10 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;
- 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 demonstrate knowledge of the certification requirements for all equipment used.

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

8.11 Trainee erector

The crane erector should be:

- a) over 18 years of age unless under the direct supervision of a person competent for the purpose of training;
- b) fit, with particular regard to eyesight, hearing, reflexes and agility;
- c) physically able to handle safely the loads involved in crane erection;
- d) able to work confidently and safely at heights;
- e) able to establish weights, balance loads and judge distances, heights and clearances;
- f) trained in the techniques of slinging;
- g) capable of selecting lifting gear and equipment that is suitable for the load to be lifted.

8.12 Training of erection personnel

8.12.1 Basic skills

All tower crane erection personnel should be trained in a set of basic skills to enable them to work safely on site and participate effectively in the climbing process. These basic skills should include the following.

- a) Understanding basic site safety.
- b) Slinging and signalling.
- c) Basic tool skills which includes the selection and use of tools.
- d) Identification, selection and fitting of fasteners.
- e) Use and maintenance of fall protection equipment (working at height).

NOTE Further information on selection, use and maintenance of personal fall protection systems and equipment is given in BS 8437.

- f) Interpretation of technical information, use of manuals.

- g) Basic assessment of ground conditions.
- h) Basic assessment of weather conditions.
- i) Basic principles of tower crane erection and stability, including verticality checks.
- j) Basic practice of erection and dismantle.
- k) Product familiarity which is limited to cranes on which initial training is being carried out.
- l) Preparing equipment for use.
- m) Effective communication including the use and care of radio equipment.
- n) Assisting with examinations and testing.
- o) Identifying proximity hazards.

NOTE A suitable programme for the training of tower crane installation personnel is the Tower Crane Installation Training Programme, TWR 01 [11] developed jointly by the Construction Plant-hire Association, the Construction Industry Training Board and the HSE.

8.12.2 Additional skills

As tower crane erectors gain experience, their basic set of skills should be augmented with additional skills, including the following.

- a) Product familiarity (to be added as part of erectors' ongoing training).
- b) First aid.
- c) Wire rope inspection and termination.
- d) Use of specialist tools and equipment.
- e) Foundation checking.
- f) Tying to structures.
- g) Climbing (internal and external).
- h) Setting limits, including RCI/L.
- i) Functional testing.
- j) Carrying out thorough examinations and testing.
- k) Carrying out maintenance.
- l) Carrying out adjustments (complex and not).
- m) Identifying and rectifying faults in equipment.
- n) Operating the crane during erection/dismantle.
- o) Operating the crane whilst the crane is working.
- p) Commissioning and handover to operator.
- q) Training to become a Lift Supervisor.
- r) Training to become an Appointed Person.
- s) Loading components onto transport.
- t) Supervision skills.

8.12.3 Familiarization with new systems or equipment

All tower crane erection personnel need additional training from time to time before they work on new systems or equipment with which they are not familiar. The nature and extent of this training depends on the complexity of the new equipment and the degree of difference from the equipment with which they are familiar.

8.12.4 Assessment

It is important that all personnel in the erection team are regularly assessed to ensure that they can carry out their duties safely and effectively. Assessment should form part of any training.

NOTE Training assessment tools are given in the Tower Crane Installation Training Programme, TWR 01 [11].

8.12.5 Traceability of training to manufacturers

The training of erection personnel does not necessarily need to be carried out by the equipment manufacturer. However the training should be directly traceable to the manufacturer with the person delivering the training having been appropriately trained by the manufacturer.

8.12.6 Health and fitness

Tower crane installation operations involve a substantial degree of physical work and those engaged in it should possess a level of physical strength and fitness that enables them to carry out their duties effectively and without endangering the other members of the erection team. Personnel should be advised that they may not be a member of the team if their efficiency is impaired by alcohol, drugs or other influences.

Evidence that members of the erection team are medically fit to carry out their duties should be obtained at not more than five yearly intervals. Advice on health assessment is given in HS(G)6 [10].

9 Selection of tower cranes

9.1 General

Tower cranes are available in a number of forms and the characteristics of the various machines should be considered in relation to the job requirements. Having decided upon the type of crane and knowing the overall requirements involved, a crane that can carry out the planned lift safely should be selected.

Points to be taken into account in making the selection of the tower crane include the following:

- a) weights, dimensions and characteristics of loads;
- b) operational speeds, radii, heights of lifts and areas of movement;
- c) number, frequency and types of lifting operations;
- d) length of time for which the crane is required or anticipated life expectancy for a permanently installed crane;
- e) remaining life expectancy;