BRITISH STANDARD

BS 7121-3:2000

Code of practice for safe use of cranes —

Part 3: Mobile cranes

ICS 53.020.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee MHE/3, Cranes and derricks, to Subcommittee MHE/3/11, Crane safety and testing. This British Standard is based on text initially provided by the late Mr A J McDermot whose contributon is greatly appreciated. The following bodies were represented on the committee:

Association of Lorry Loaders, Manufacturers and Importers
Construction Confederation
Construction Health and Safety Group
Construction Plant-Hire Association
Electricity Association
Federation of Manufacturers of Construction Equipment and Cranes
Health and Safety Executive
Institution of Mechanical Engineers
Institution of Occupational Safety and Health
Institution of Plant Engineers
Institution of Structural Engineers
Lloyd's Register of Shipping
Low Power Radio Association
Offshore Contractors' Association
Safety Assessment Federation Ltd.

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Contents

Foreword

This part of BS 7121 has been prepared under the direction of the Mechanical Handling Standards Policy Committee. It should be used in conjunction with other parts of BS 7121 to ensure, as far as reasonably practicable, that lifting operations are carried out safely.

It is in the interest of all parties involved in lifting operations to ensure that they are carried out efficiently and safely. CP 3010 and BS 5744 have for many years provided advice to assist crane users to achieve these objectives.

During the review of CP 3010 it was decided that it is essential to broaden the scope to recognize the need for planning the lifting operation, and for adoption of safety systems of work, as these are essential to a successful operation, regardless of the type of crane. It was decided that CP 3010 and BS 5744 should be combined into a single standard. BS 7121-1 covers common features and BS 7121-2 covers in-service inspection, testing and examination. This part of BS 7121 covers safe use of mobile cranes.

Subsequent parts of BS 7121 will cover each crane type as follows:

— *Part 4: Lorry loaders;*

— *Part 5: Tower cranes;*

— *Part 6: Derrick cranes;*

— *Part 7: Overhead/underslung 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: Pontoon cranes.*

BS 7121-1, -2 and -3 supersede the corresponding sections of CP 3010 and BS 5744.

Amendments to CP 3010 and BS 5744 will be published to remove the relevant sections from each publication and to amend the references to BS 7121. When all parts of BS 7121 have been published, CP 3010 will be withdrawn. BS 7544 will be revised to cover manually operated and light cranes only.

The Health and Safety Executive (HSE) commend the use of this British Standard code of practice to those who have duties under the Health and Safety at Work etc. Act 1974 and other relevant health and safety legislation. This code of practice was prepared with the participation of HSE representatives and will be included in the list of "standards significant to health and safety at work" available from HMSO.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with this code of practice 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 34, an inside back cover and a back cover.

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1 Scope

This part of BS 7121 provides recommendations for the safe use of mobile cranes and should be used in conjunction with BS 7121-2, which gives general guidance on inspection, testing and examination of all types of cranes.

Mobile cranes are manufactured in many different forms. Mobility is either by means of road wheels or crawler tracks. Rail-mounted cranes are not covered by this part of BS 7121. Cranes may be fully mobile and able to travel with rated capacity loads suspended (pick and carry), or may be semi-mobile and not permitted to travel with suspended loads. Semi-mobile cranes include wheeled and crawler-mounted cranes, fitted with stabilizers or outriggers; and cranes that, due to size and weight, are taken to the work site in parts and assembled at the site. Cranes that are assembled on site to work from a fixed base with outriggers are also covered by this part of BS 7121.

Because of their mobility, the cranes covered by this part of BS 7121 can be used for a wide variety of lifting operations in numerous locations.
BS 7121-1 provides general advice on planning, management, selection of equipment and personnel, etc., for safe lifting with all types of cranes. This part of BS 7121 provides specific guidance on safety when dealing with the hazards caused by mobility and the diversity of locations for mobile crane lifting operations.

2 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 4-1:1993, *Structural steel sections — Specification for hot-rolled sections*.

BS 5306-3:1985, *Fire extinguishing installations and equipment on premises — Code of practice for selection, installation and maintenance of portable fire extinguishers*.

BS 6187:1982, *Code of practice for demolition*.

BS 7121-2:1991, *Code of practice for safe use of cranes — Inspection, testing and examination*.

BS 7262:1990, *Specification for automatic safe load indicators*.

CP 3:Chapter V-2:1972, *Code of basic data for the design of buildings — Wind loads*.

ISO 12482-1:1999, *Cranes — Condition monitoring — Part 1: General*.

HSE Guidance Note GS 6, *Avoidance of Danger from Overhead Electric Lines*, 1990. HMSO.

HSE Guidance Note GS 39, *Training of Crane Drivers and Slingers*, 1986. HMSO.

HS[G] 118, *Electrical Safety in Arc Welding*, 1994. HMSO.

Code of Practice for the Safe Use of Lifting Equipment, 1994. Lifting Equipment Engineers' Association.

Crane Stability on Site, 1996. CIRIA Special Publication 131. Construction Industry Research and Information Association.

Lifting Operations and Lifting Equipment Regulations (LOLER) 1998. Statutory Instrument 1998, No. 2307. HMSO.

The Management of Health, Safety and Welfare Regulations 1999. Statutory Instrument 1999, No. 3242. HMSO.

Provision and Use of Work Equipment Regulations (PUWER '98) 1998. Statutory Instrument 1998, No. 2306. HMSO.

The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995. Statutory Instrument 1995, No. 3163. HMSO.

The Supply of Machinery (Safety) Regulations (SMR) 1992. Statutory Instrument 1992, No. 3073. HMSO.

3 Definitions

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

3.1

rated capacity

maximum load that can be safely handled by a crane at a specified position and under specified conditions

NOTE The rated capacity is the "safe working load".

3.2

rated capacity indicator

device that automatically provides, within a specified tolerance, warning that the load is approaching rated capacity, and another warning when rated capacity is exceeded

NOTE Rated capacity indicators are also known as automatic safe load indicators.

3.3

rated capacity limiter

device that automatically prevents, within a specified tolerance, motions that could increase risks, if the rated capacity is exceeded

3.4

radius

horizontal distance between the point at which the centre of rotation meets the ground and the vertical centreline passing through the load lifting attachment

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

3.5

radius indicator

device that shows the radius at which the crane is operating and the corresponding rated capacity

3.6

lifting accessory

component or equipment, that is not part of the crane, placed between the crane and the load, or on the load, to attach the load to the crane

NOTE Lifting accessories are also known as lifting tackle or lifting gear.

3.7

appointed person

person with training, practical and theoretical knowledge and experience required to comply with **4.7**

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

crane driver

person who operates the crane to position loads or to assemble the crane

NOTE The crane driver is also known as the crane operator.

3.10

slinger

person responsible for attaching and detaching the load to and from the crane and for correct selection and use of lifting accessories

3.11

signaller

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

3.12

competent person

person with appropriate practical and theoretical knowledge and experience to examine lifting equipment and to detect defects or weaknesses in the equipment, and to assess these in relation to safety and to continued use of the equipment

3.13

in-service

handling loads up to rated capacity in permissible wind speeds and other conditions specified by the manufacturer

3.14

out-of-service

out of use, without load on the lifting attachment and in conditions specified by the manufacturer

NOTE The manufacturer may specify a higher wind speed and other conditions different to conditions permitted in-service.

3.15

rough terrain crane

telescopic jib, wheeled crane, primarily designed for working on sites and able to travel on site between lifting operations over dry, firm, uncompacted ground

NOTE The manufacturer's manual should specify the conditions that apply to free-on-wheels and pick and carry operations.

3.16

all-terrain crane

telescopic jib, wheeled crane with a specially designed chassis that allows travel on the highway at normal road speeds, and incorporates features, such as additional steering and driven axles, to give it better manoeuvrability on site

NOTE The term "all-terrain" should not be taken to mean that the crane can travel over rough, uncompacted ground.

3.17

free-on-wheels

able to lift loads with a wheeled crane without the use of outriggers or stabilizers

3.18

load enhancing equipment

equipment fitted to a mobile crane to increase the margin of stability or to reduce the structural stress within the loaded members, allowing the rated capacities for the crane configuration to be increased.

NOTE Load enhancing equipment may be known by a proprietary name (e.g. "Superlift").

3.19

method statement

document produced for or by the appointed person to describe how the lifting operation should be carried out, including any contingency plan if the operation becomes interrupted (e.g. because of weather change, break down, etc.)

3.20

employing organization

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

4 Management of the lifting operation

4.1 Safe system of work

A safe system of work should be established and complied with for each lifting operation, whether it is an individual lift or a group of repetitive operations. A safe system of work should be applied if the lifting operations are carried out at a site or if the crane is a permanent fixture (e.g. in a factory or at a dock).

The safe system of work should include the following:

a) risk assessment;

b) planning of the operation;

c) preparation of a method statement;

d) selection, provision and use of a suitable crane(s) and equipment, including:

1) maintenance;

2) inspection;

3) examination, and testing if required;

e) preparation of the site, if required;

f) provision of properly trained and competent personnel aware of their statutory responsibilities;

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

g) supervision by properly trained and competent personnel with authority;

h) ensuring that all test certificates and other documents are available;

i) preventing unauthorized movement or use of the crane at all times;

j) consideration for the safety of persons in the danger zone but not involved in the lifting operation.

Erection and dismantling of the crane(s) should also be covered by a safe system of work (and may be a separate lifting operation).

Safe systems of work should be effectively communicated to all parties concerned.

4.2 Control of the lifting operation

The employing organization (**3.20**) should contract an appointed person (**3.7**) prior to each specific lifting operation. The appointed person should ensure that the safe system of work is implemented.

NOTE Provision of an appointed person does not lessen the legal responsibility of the employing organization for ensuring safety. The appointed person may have other duties and is not necessarily a direct employee of the employing organization.

The appointed person should have sufficient training and experience to carry out all duties competently (see **4.8**).

4.3 Planning of the lifting operation

All lifting operations should be planned to ensure that they are carried out safely and that all foreseeable risks are taken into account. Planning should be carried out by an appointed person.

NOTE 1 Guidance on carrying out risk assessments is given in HSE publication *Five Steps to Risk Assessment*.

NOTE 2 For repetitive or routine operations, planning may only be required in the first instance, with periodic reviews to ensure that no factors change.

Planning should include consideration of the following:

a) the load characteristics and the method of lifting;

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

b) selection of an appropriate crane(s) for the operation, ensuring that sufficient clearances are maintained between the load(s) and the crane structure (see clause **7**);

c) selection of lifting accessories, including taking into account the weight of accessories on the total load on the crane(s);

d) the position of the crane(s) and load before, during and after the operation;

e) the site of the operation, taking into account proximity hazards, space availability and suitability of the ground or foundations;

f) erection and dismantling of the crane(s);

g) present and foreseeable environmental conditions at the site, that could entail interruptions to the operation.

4.4 Method statement

A method statement should be prepared, by the appointed person, including a step-by-step description of the safe system of work for the entire lifting operation. The method statement should include at least the following:

a) the schedule of responsibilities (e.g. type of hire, road closures, base preparation, isolation of live services);

b) full details of the crane(s);

c) details of ancillary equipment;

d) details of the lifting accessories;

e) the name of the appointed person;

f) the name of the crane supervisor (who may be the appointed person);

g) a complete plan including the sequence of the operation [from site preparation, arrival of the equipment on site, any necessary erection, positioning of the crane(s), lifting and placing of the load(s), and dismantling the crane(s), to moving off site].

NOTE 1 This list is not exhaustive and in some circumstances further information may be required.

During preparation of the method statement the appointed person should consult with any persons with specialized knowledge and experience, as appropriate, to ensure that all hazards that may be caused by, or to, the crane(s), are taken into consideration.

The method statement should give details of the steps to be taken to eliminate danger to personnel not involved in the lifting operation, and if required, to prevent entry into the danger zone.

NOTE 2 Mobile cranes are used in a wide variety of locations. On large construction sites, a number of different lifting operations can be carried out each day (from straightforward and repetitive to complex and unique). On these sites there can be sufficient people with knowledge and experience to control all lifting operations. At other locations there can be a single lifting operation required, and no one with prior knowledge and experience of using a crane (e.g. if a factory takes delivery of a new machine, and, on arrival, the machine is lifted from the delivery transport). Other locations include petro-chemical plants, where cranes may be required for maintenance operations, and docks that can require loads to be lifted that are outside the capacity of their own cranes. At other sites, a mobile crane can be required where it can be moved into position, the lift carried out, and the crane moved out again to leave the site clear for other operations.

4.5 Insurance

The monetary value of cranes and ancillary equipment can be very high, and there is always some potential for serious personal injury and damage to property during lifting operations. It is essential that sufficient, appropriate insurance cover is obtained for all liabilities. Full details of insurance cover should be agreed and documented between all parties, before any lifting operations are carried out.

NOTE For operations in live plant, see **9.3.6**.

4.6 Contracts

The employing organization may enter into a contract with another party to carry out the lifting operation on behalf of the employing organization. If so, the employing organization should be satisfied that the other party is competent to carry out the lifting operation.

A contract should be made between the employing organization and the other party, including at least the following:

a) an agreement that an appointed person (**3.7**) is provided;

b) an agreement that the employing organization provides accurate information on the locations of all services (e.g. drains), as requested by the appointed person.

The appointed person should have sufficient authority to carry out the recommendations of this part of BS 7121.

The employing organization may hire a crane and crane driver from a crane owner without entering a contract for the crane owner to carry out the lifting operation. In this case, the employing organization should obtain the personnel and expertise to comply with this part of BS 7121 from another source.

4.7 Selection of appointed person

When selecting and assessing an appointed person the employing organization should consider the variety and complexity of the operation, as well as all the problems that could arise from proximity hazards and environmental causes. The appointed person should be notified formally in writing. 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.

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 **4.8**.

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

4.8 Duties of appointed persons for mobile crane operations

4.8.1 *General*

The duties of appointed persons for mobile crane operations can vary in accordance with 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" may not be suitably trained or experienced for a more complicated operation, and another appointment may be required for this. Subclauses **4.8.2** to **4.8.4** should assist in ensuring that an appropriate appointment is made and a suitable method statement produced for each lifting operation.

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

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 as required by statutory requirements. Manufacturer's sales leaflets should not be relied on for the rated capacity for a specific crane.

c) 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.

d) Ensuring that the crane has been thoroughly examined (including testing where appropriate), and inspected and checked, before use.

e) Ensuring that a system for reporting defects is in place.

f) Selecting appropriate lifting accessories, including their method of attachment to the load, and any protection used to prevent damage.

g) Ensuring that lifting accessories are thoroughly examined, inspected and checked, before use.

h) 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.

i) Briefing all persons involved in the lifting operation to ensure that the safe system of work described in the method statement is understood. (This should include a recommendation for all persons involved in the lifting operation to seek advice from the appointed person if any change is required to the lifting operation, or if any doubts about safety arise.)

NOTE If one or more handlines/taglines are required to give more control of the load, the appointed person should designate persons to handle the lines.

j) Checking, if numerous loads are to be lifted over a long period, to ensure that no changes are required in the safe system of work.

k) Ensuring that there is a crane supervisor (see **5.2.3**) designated to direct personnel and to ensure 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 should understand that when conditions exceed these limits, that further advice should be sought.

4.8.3 *Standard lift*

NOTE Normally lifting of persons is a standard lift.

If there are hazards, either within the working area of the crane or on the access route to the working area, but no multiple crane lifting is required, the duties of the appointed person should include, in addition to the duties listed in **4.8.2**:

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

4.8.4 *Complex lift*

If the lifting operation requires more than one crane to lift the load, or cranes using load enhancement attachments, or if the lift is at a location with exceptional hazards (e.g. at a chemical plant), then the appointed person should ensure, in addition to the duties listed in **4.8.2** and **4.8.3**, that:

a) The weight of the load is known.

b) Any lifting points provided on the load are adequate for the loads applied.

c) The proportion of the weight taken by each crane throughout the lifting operation is known accurately to within ±2 %.

d) The cranes are compatible in lifting characteristics, with sufficient margins within the rated capacity of each crane to allow for any additional dynamic loading that could be transferred from one crane to another during movement of the load. [Load transfer can be minimized by accurate monitoring of the load magnitude, position and verticality of the hoist rope. If the appointed person is satisfied that all factors that can induce loads into each crane are accurately known, and that they are monitored by instruments (including side loads on the jibs, etc.), the cranes may be used up to their rated capacity. If all factors cannot be accurately evaluated, an appropriate down rating of at least 20 % should be applied to each of the cranes involved (e.g. a rated capacity of 125 t to lift a load of 100 t).]

e) The lifting operation is planned so that there is no possibility of contact between the jibs of the cranes or jibs and load.

f) The method statement includes access, ground conditions, erection, etc., as well as the sequence of operations when lifting the load.

g) The suitability of the ground is investigated to withstand the forces applied during the lifting operation, and taking into account the effect of cranes standing in close proximity to each other.

h) During the load lifting phase of the operation, the hoist rope loads and inclinations are monitored, and that the information is displayed suitably and clearly to the crane supervisor directing the crane drivers. (It may also be appropriate to monitor the inclination of the load during the lifting operation.)

4.9 Supervision

Each lifting operation with a mobile crane should be properly supervised to ensure safety.

As it is not possible for a crane driver to observe, from position at the crane controls, all hazards that could be present during movement of the load, at least one other person should be present throughout a lifting operation, to supervise and direct the crane driver.

The appointed person should designate one person to act as crane supervisor (see **5.2.3**) for the lifting operation. The supervisor should be fully briefed on the safe system of work as described in the method statement. The supervisor should have the authority to stop the lifting operation and report back for further guidance if the supervisor considers that it could be unsafe to continue.

5 Selection and minimum attributes of personnel

5.1 Selection

Suitable personnel who are competent to carry out all duties required should be selected to carry out the lifting operation safely. Records of training and experience of persons should be consulted to assist in selection.

NOTE 1 Guidance on training of personnel can be found in HSE Guidance Note GS 39.

Persons responsible for selection of personnel should ensure that personnel are efficiently organized to ensure good team work. Personnel should not be under the influence of alcohol, drugs or other impairments to efficiency. All personnel should be aware of their duties (see clause **6**). Personnel undergoing training should be properly supervised. Young persons should be employed in accordance with The Management of Health, Safety and Welfare Regulations 1999.

5.2 Minimum attributes of personnel

5.2.1 *General*

All personnel should be:

a) competent;

b) trained and assessed;

c) able to present a record of training and assessment;

d) physically able to carry out the work.

5.2.2 *Appointed person*

The appointed person should be able to perform the duties described in **4.8**.

5.2.3 *Crane supervisor*

The crane supervisor should be:

a) authorized to carry out the duties listed in **6.2**;

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 should be referred to for further instructions.

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

5.2.4 *Crane driver*

The crane driver should be:

a) trained on the specific model of crane used;

b) able to assimilate and apply information contained in reports and duty charts relating to the range of duties and safe use of the crane;

c) familiar with the manufacturer's instructions for the rigging operation and for maintenance of the crane;

d) aware that the crane should be used on level ground or else set level on outriggers before any load is applied;

e) fully conversant with the correct use of outriggers and where outriggers should be fitted, and aware of how to properly support the outrigger feet (this requires regular monitoring to ensure that no movement occurs throughout the operation);

f) able to set and check the functioning of the rated capacity limiter and rated capacity indicator;

g) aware of the effects of wind and other climatic effects on the crane and load;

h) able to resist pressures from other persons to carry out unsafe operations;

i) able to take the action to avoid dangerous situations, including stopping operations;

j) able to operate fire suppressant equipment, if fitted.

5.2.5 *Slinger*

The slinger should be:

a) able to establish weights and the effect of the centre of gravity, and to balance loads and judge distances and clearances;

b) able to select the appropriate lifting accessories and check that they are in a suitable condition;

c) able to initiate safe movement of the crane and load using the designated signalling method.

5.2.6 *Signaller*

The signaller should be able to:

a) relay signals from the slinger to the crane driver;

b) direct safe movement of the crane and load;

c) give clear and precise verbal instructions where audio equipment (e.g. radio) is employed.

5.2.7 *Crane erector*

The crane erector should be able to:

a) prepare the specific model of crane for use and subsequently for removal from the site, in accordance with the manufacturer's instructions;

b) work safely and confidently at heights;

c) set and check the functioning of the rated capacity indicator/rated capacity limiter and other safety devices;

d) establish weights, balance loads and judge distances, heights and clearances;

e) perform the techniques of slinging.

5.2.8 *Maintenance personnel*

Maintenance personnel should be able to:

a) maintain the specific model of crane to be used, in accordance with the manufacturers instructions;

b) follow the safe system of work, including any permit to work systems.

6 Duties of personnel

NOTE In some circumstances it may be appropriate for one person, other than the crane driver, to undertake more than one of the duties described in clause **6**.

6.1 Appointed person

The appointed person should perform the duties described in **4.8**.

6.2 Crane supervisor

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 the supervisor considers it dangerous to proceed.

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.

6.3 Crane driver

The crane driver should be responsible for correct operation of the crane in accordance with the manufacturer's instructions and within the safe system of work. The crane driver should only respond to a signal from the slinger to carry out initial lifting of the load, and then only to signals from one slinger/signaller, who should be easily identified, during the remainder of the lifting operation.

WARNING It is essential that the crane driver does not tamper with any controls, mechanisms or other equipment, including the rated capacity indicator.

6.4 Slinger

The slinger should be responsible for attaching and detaching the load to and from the crane load lifting attachment, and for using the correct lifting accessories and equipment in accordance with the operation plan.

The slinger should direct initial movement of the crane. If there is more than one slinger, only one slinger should direct initial movement.

If continuous signalling is required and the slinger is not visible to the crane driver, another slinger or signaller should relay the signals to the crane driver.

NOTE Alternatively, other audio or visual methods may be used. If other audio or visual methods are used, the equipment or means of equipment use should be so that the crane driver can become immediately aware if the equipment fails, so that movement of the crane can be stopped.

The following indications of equipment failure should cause the crane driver to immediately stop movements of the crane:

a) a blank screen on a television monitor;

b) cessation of continuous instructions from a signaller using a radio, to e.g. "lower... lower... lower" etc.;

NOTE If radio is used as a means of signalling, the selected frequency should be kept clear of other communications. All personnel involved in signalling should be given a clear and unique call sign and all communications should be preceded by the call sign. The crane driver should not respond to signals not preceded by the call sign.

c) during the lifting operation, hand signals and voice instructions to the crane driver(s) should be given by only one person at any time.

If, during the lifting operation, responsibility for directing the crane and load is transferred to another signaller, the first signaller should clearly indicate to the crane driver that this responsibility is transferred and to whom. The first signaller should clearly indicate to the second signaller that the transfer is taking place. The crane driver and the second signaller should clearly indicate that they accept the transfer.

6.5 Signaller

The signaller should be responsible for relaying the signal from the slinger to the crane driver. The signaller may be responsible for directing movement of the crane and load instead of the slinger, provided that only one person is responsible at any time.

NOTE It is common practice to train personnel to enable them to carry out duties of both slinger and signaller.

6.6 Crane erector

The crane erector should be responsible for erection of the crane in accordance with the manufacturer's instructions. If there are two or more crane erectors, one should be designated "erector in charge" and should control this operation.

6.7 Maintenance personnel

Maintenance personnel should be responsible for maintaining the crane in a safe condition. Maintenance personnel should carry out all maintenance in accordance with the manufacturer's maintenance manual and within the safe system of work.

7 Selection of cranes

7.1 General

Cranes are available in many forms and the various characteristics of these should be considered in relation to the requirements of the lifting operation. After deciding the type of crane and other overall requirements, a crane that can safely perform the planned lifting operation should be selected. The following should be considered when selecting a crane:

— weights, dimensions and characteristics of the loads;

— operational speeds, radii, heights of lifts, and areas of movement;

— number, frequency and types of lifting operations;

— length of time the crane is required for;

— site, ground and environmental conditions, or restrictions arising from existing buildings, etc.;

— space available for crane access/egress, erection, travelling, operation, and dismantling;

— any special operational requirements or limitations imposed.

NOTE Subclauses **7.2** to **7.8** give information on features and suitability of the types of mobile crane currently available. The list is not exhaustive, and could be extended as new types become available.

Economic factors may influence the choice of crane, but it is essential that the crane conforms to the safe system of work.

7.2 Truck-mounted crane

NOTE 1 A truck-mounted crane is a crane unit mounted on a road truck chassis. Truck-mounted cranes are able to travel on public highways at normal road speeds. The chassis may be of an ordinary commercial truck that has been adapted, or it may have been specially manufactured to carry the superstructure unit. In either case the chassis is fitted with a set of outriggers or stabilizers to provide improved stability when lifting loads. Truck-mounted cranes are subject to requirements for braking, steering, lighting, etc., specified in road traffic regulations. The crane travels at normal road speed to the site and can usually be used in a lifting operation without adaptation or addition, although separately transported, additional jib sections and/or counterweight may be fitted to increase the lifting range after arrival at the site.

Good access to the site should be provided if truck-mounted cranes are used, and the load-bearing ability of approach roads to the site should be assessed prior to selecting a truck-mounted crane.

NOTE 2 The wheel loads even of cranes with low nominal lifting capacity can be high.

The width of the truck-mounted crane, any overhead obstructions that reduce the clearance height, and the gradient of, and any tight bends or sharp corners in, approach roads should be considered prior to selecting a truck-mounted crane. The length and manoeuvrability of the truck-mounted crane should be considered in relation to the layout of the site.

7.3 Fixed-base crane

NOTE Fixed-base cranes are cranes with a very high nominal lifting capacity, that are usually transported to the site in several parts and assembled there. After assembly, these cranes may be able to make some limited travel, but work on a fixed base when lifting loads.

Fixed-base cranes are similar to truck-mounted cranes and **7.2** should be complied with when using these.

7.4 Rough-terrain crane

NOTE 1 A rough-terrain crane is a wheel-mounted crane intended for use on a site where a number of loads are lifted at different locations. The loads can be moved between the lift locations quickly, without damage to the site surface. "Rough-terrain" does not mean that this type of crane can travel over, and lift loads on, uneven ground with poor load-bearing ability. Rough-terrain cranes require the same ground conditions as other wheeled vehicles (i.e. ground firm enough for good traction without excessive sinking).

If rough-terrain cranes pick and carry loads on the crane hook (not necessarily up to the full rated capacity) careful consideration should be given to planning and use to ensure a safe system of work.

When lifting "free-on-wheels" the ground should be level within the limits specified by the crane manufacturer.

NOTE 2 Rough-terrain cranes are fitted with outriggers, and may be able to travel across moderate slopes without load, and jacked level for lifting loads.

7.5 All-terrain crane

NOTE An all-terrain crane is a hybrid of a truck-mounted crane and a rough-terrain crane. It is as compact as a rough-terrain crane, and able to travel on public highways at the same speeds as a truck-mounted crane. On some models of all-terrain crane, all axles can drive and steer, so that the crane has good traction and manoeuvrability on unmade-up ground. All-terrain cranes can often move into places where it is not be possible for a truck-mounted crane to enter, and so an all-terrain crane of lower nominal lifting capacity may carry out a lifting operation with more safety than a larger capacity truck-mounted crane, if the truck-mounted crane is required to stand further from the load landing position. "All-terrain" does not mean that this type of crane can travel and lift loads on any surface.

The same ground conditions are required for all-terrain cranes as for truck-mounted cranes, with regard to load bearing and level. All-terrain cranes may have better ability to climb gradients, but the manufacturer's specification should be consulted to confirm this.

7.6 Yard crane

NOTE 1 A yard crane is a wheeled crane designed for working within a work site or factory where there is a known range of loads to be lifted. The crane chassis is short and usually fitted with two axles (one to steer and one driven). Power for travel is provided by the crane engine. Speed of travel is usually about walking pace. Outriggers may be fitted to yard cranes for increased lifting, and these cranes can travel with rated loads suspended from the crane hook in conditions specified by the manufacturer.

The area of operation of a yard crane should be level and laid out so that the crane can travel, with or without load suspended, on a surface able to take the wheel loading, and wide enough to allow the outriggers to be extended if required.

NOTE 2 The jib is usually of lattice construction, either strut or cantilever design, and of fixed length, although it may be extended, if required, with additional jib sections.

7.7 Low-headroom crane

NOTE Low-headroom cranes are designed to lift and carry loads in locations where there is an overhead clearance restriction, e.g. on a factory floor. These cranes have two axles (usually one to drive and one to steer, although in special applications both axles can drive). A single engine provides power for travel and crane motions. The jib is of cantilever, telescopic construction, but there can be the option of extensions (e.g. a fly jib). Travel speed is lower than for small all-terrain cranes. Use of public highways for travel between sites may be permitted if the low-headroom crane conforms to appropriate road traffic legislation. Low-headroom cranes may be prohibited from travelling on some roads (e.g. motorways).

As the road driving cabin is also the operating cabin for low-headroom cranes, and the crane driver does not rotate with the load, allowance should be made for this limitation when planning the safe system of work.

7.8 Crawler crane

NOTE 1 Crawler cranes are mobile cranes that were developed from the rope operated dragline excavator, mounted on crawler tracks. Crawler cranes comprise a fully rotating crane superstructure connected, through a slewing ring, or race, to a track-laying undercarriage. The crane hoist system may have one, two, or three rope drums. These can be operated by mechanical, friction clutch gear drives and friction foot brakes, although modern units are more likely to be driven and braked by hydraulic motors. Older, mechanical type cranes and some cranes with hydraulic power have a "free fall" feature that allows grabbing and dragline operations.

"Free fall" on the hoist can be dangerous when loads are being lifted, and should not be used. Electro-mechanical control systems can be fitted to the hoist control to lock out the "free fall" feature and ensure that the hoist drum remains connected to the power train whenever a load is raised or lowered. This control system is usually operated through a key switch and the key should be removed when the hoist drum is in the power load lowering position to ensure that "free fall" cannot be accidentally selected. The appointed person should take account of any such safety features when selecting a crane and should ensure that the safe system of work includes briefing all personnel involved on its correct use.

Crawler cranes should be considered for construction sites where a significant number of loads are handled, over an extended period, and if the following apply:

— there is a low ground bearing pressure;

— compactness is required once the crane is erected;

— the ground is poor to travel over;

— the ground is sloped.

NOTE 2 The operator's manual should be consulted for the manufacturer's permitted out of level operation.

The following should be taken into consideration when selecting a crawler crane:

— the crane is transported to the site in parts;

— erection and dismantling may require an auxiliary crane;

— sufficient space is required on site for erection of the crane, particularly if a long jib combination is required;

— a long jib should be laid down quickly, in the working position, if adverse weather conditions are expected.

7.9 Jib configurations

7.9.1 *General*

There are many different combinations of attachments that can be used with the main jib of the various types of mobile crane. Not all combinations are available on each type. The recommendations of **7.9.2** and **7.9.3** are intended to provide guidance for selection of the most appropriate equipment, and should be used when planning a safe lifting operation.

7.9.2 *Fly jib*

NOTE 1 A fly jib is a short lattice jib, consisting of top and bottom taper sections that are pinned or bolted together. A fly jib can be extended by insertion of intermediate lattice sections, but usually it is of shorter length than the main jib. The main purpose of the fly jib is to increase the overall length of the main jib and to thereby increase the effective height of the lift. The fly jib can be set in the same line as the axis of the main jib, or can be offset at a fixed angle. If the fly jib is offset at an angle, the crane can be used to reach in over a structure (effectively increasing the radius). The greater the angle of offset, the higher the structure that can be negotiated and/or the further the crane can reach in to lift the load; but because of the increased stresses induced at the fly jib attachment point, only a reduced load can be lifted.

Fly jibs are erected on site before use. The safe system of work should ensure the suitability of the location, particularly if erection requires another crane.

NOTE 2 Fly jibs may be of telescopic box construction, but, because of a relatively high self-weight that can reduce their lifting capacity considerably, these are of limited application only.

7.9.3 *Luffing fly jib*

NOTE 1 A luffing fly jib is a development of the fixed offset fly jib and is also of lattice construction. If required, the luffing fly jib can be of greater length than the main jib in use.

A luffing fly jib should be used with the main jib set at the maximum angle of elevation, to reach over existing structures and to handle loads at load radii that could otherwise require a main jib length outside the length permitted by the crane design. Some crane specifications permit use of an angle for the main jib other than the maximum (but this is unusual). The crane duty charts and test certificates should be consulted. Use of the main jib at an angle other than the maximum should be considered a complex lift (see **4.8.4**).

To ensure that the main jib of the luffing jib configuration is not used at an angle other than specified by the manufacturer, a limit switch should be fitted to warn the crane driver.

NOTE 2 The switch may be linked to the rated capacity limiter, to prevent the possibility of dangerous structural overloading.

Site requirements for erection and dismantling of a luffing fly jib should be considered as part of the selection process. If additional craneage is required as part of this process, sufficient area should be available. If ground loadings are increased significantly when a long luffing fly jib is being raised/lowered, additional ground preparation work to spread any higher point loadings should be carried out. Adjacent overhead or underground hazards should be taken into account. If the luffing jib suspension mast protrudes rearwards beyond the arc of the normal tail swing of the crane, any additional hazard should be taken into account.

Most luffing jib configurations are used on large truck-mounted and fixed-base cranes with hydraulic outrigger systems that provide accurate levelling. For luffing jib configurations on crawler cranes (sometimes known as "mast cranes"), that are not fitted with outriggers to assist in levelling, the appointed person should ensure that effective means are provided to set and keep the crawler crane/luffing jib combination within the limits of level specified by the crane manufacturer throughout the lifting operation.

Wind effects can be significant on a luffing jib configuration. The appointed person should ensure that the safe system of work requires an anemometer to be fitted to the top of the main jib, or that one is available on the site of the lifting operation, to register wind speed at the working height. The safe system of work should cover precautions to be taken if the wind speed exceeds the safe limit.

7.10 Main jib extensions

NOTE 1 Telescopic jib cranes can be fitted with manually set extension sections. These sections can significantly affect the rated capacity of the crane and can place restrictions on the duty chart. One restriction used by manufacturers is to relate the lifting capacities on a jib with a manual extension to jib angle instead of radius. Deflection of the jib under load makes it almost impossible for the crane driver to set the crane in the correct position to lift the load even when the exact weight of the load is known.

It is essential that the appointed person, when selecting a crane with a manual extension, provides clear information to the crane supervisor on the exact position where the crane is to stand. When deciding the position of the crane, the following should be considered:

— whether additional space is required on site to fit the extension;

— whether the crane driver requires assistance when fitting the extension;

— whether additional craneage is required when fitting the extension.

Allowance should be made for jib deflections under working load when converting angles on the duty chart to distances on the ground.

Jib deflections may be greater than expected so the exact weight should be increased by a minimum factor of 10 %. Estimated values should be similarly increased in addition to the recommendations given in the note to **4.3**a).

The supervisor and crane driver should be given clear instructions concerning the setting of the length of the main telescoping jib during briefing on the safe system of work. The crane duty chart should give the manufacturer's requirements that apply to the use of manual extensions (these usually require the main jib to be fully telescoped).

NOTE 2 Main jib extensions have several forms and may have other names (e.g. "power-pinned fly", "swing around", "lattice extension").

7.11 Special operations

Some lifting operations are suitable for some types of crane but not other types. It is essential for safety that the appointed person assesses the risks to personnel and to the crane from the planned operation, before selecting the most suitable type of crane or deciding that a mobile crane should not be used.

The following special operations should be carried out as specified:

— piling operations: annex A;

— demolition and balling operations: annex B;

— dismantling operations: annex C;

— lifting of persons: annex D;

— dynamic compaction: annex E.

8 Safety

8.1 General

The person or organization with overall control of the place of work and the employers of personnel involved in the lifting operation should be responsible for safety. For responsibility to be effectively discharged, the appointed person (see **4.2**) should have sufficient authority to ensure that appropriate safety systems are in operation.

The following safety matters relating to lifting operations should be taken into consideration:

— use, maintenance, repair, and renewal of safety equipment;

— instruction of, and allocation of responsibilities to, various personnel in relation to the equipment.

All personnel not directly involved in the lifting operation should be kept clear of the area. Where practical, loads should not be carried or suspended over occupied areas.

8.2 Identification of person directing crane movements

The person directing crane movements (slinger or signaller) should be easily identifiable to the crane driver (e.g. by high visibility clothing, by using radio call signs). When choosing high visibility clothing, backgrounds, type of illumination and other relevant factors should be considered.

8.3 Personal protective equipment

The appointed person should ensure the following:

a) that personal protective equipment appropriate for the conditions of the location (e.g. helmets, safety spectacles, safety harness, safety boots, ear defenders) is available;

b) that equipment is inspected before and after use, and maintained in good working order or replaced, as appropriate;

c) that a record of inspection and repairs is maintained, as appropriate.

Certain protective equipment (e.g. helmets and safety harnesses) may deteriorate with age and should be renewed in accordance with the manufacturer's instructions. Damaged safety equipment should be replaced immediately.

8.4 Use of personal protective equipment

All personnel working on, visiting, or in the vicinity of the crane should be made aware of requirements relating to personal safety and to the use of the personal protective equipment provided.

Personnel should be instructed in correct use of the personal protective equipment provided and should be required to use it.

8.5 Use of safety harnesses

When erecting a jib configuration, the crane driver or other person may be required to work at a height that exceeds 2 m (e.g. when walking on the main jib). Legislation may require that a safety harness is worn by these personnel, but as safety harnesses can restrict the freedom of movement of the wearer, the appointed person should carry out a risk assessment on all erection/dismantling operations and should provide an appropriate safe system of work. If a safety harness is incorporated into the safe system of work, then it is essential to consider the attachment of the harness, to ensure sufficient freedom of movement of the wearer.

NOTE If freedom of movement of the wearer of the safety harness is restricted, the hazard could be increased.

Safety harnesses, ladders and ancillary equipment should be used in accordance with the safety procedures specified in the crane manual.

The crane driver should be trained in correct use of all personal protective equipment required to safely erect and dismantle the crane, and that personal protective equipment is used at all times.

8.6 Access and emergency escape

8.6.1 *General*

Safe access and means of emergency escape should be provided and maintained in good condition for the driving position(s) of the crane and for inspection, maintenance, repair, erection, and dismantling of the crane.

8.6.2 *Boarding and leaving the crane*

Persons should not be permitted to board or leave the crane without first obtaining the crane driver's permission. The crane driver should be aware of and should comply with precautions that apply while the person is boarding or leaving the crane. If the boarding or leaving point is out of sight of the crane driver, means should be provided to ensure that the crane driver is aware of the whereabouts of the other person. A notice specifying the boarding procedure should be posted at the boarding point.

8.6.3 *Instruction of personnel*

Personnel should be instructed how to use the proper access points and means of emergency escape.

8.7 Fire extinguishers

Fire extinguishers should conform to BS 5306-3, and should be appropriate for the hazards associated with the particular crane. Fire extinguishers mounted on the crane or at the site should be scheduled for periodic inspection and renewed as necessary.

8.8 Crane safety equipment

8.8.1 *Rated capacity indicator/rated capacity limiter*

Warnings and motion-cut features from rated capacity indicators and rated capacity limiters are intended only as aids to safety in unforeseen circumstances. If the lifting operation is properly planned and executed these devices should not be activated.

The accuracy of rated capacity indicators and rated capacity limiters should be checked at regular intervals, using test weights and a high quality linear measuring tape, as part of the crane's planned maintenance schedule. Weights, radii and configurations should be selected to activate warning and limiting functions during the test.

NOTE Rated capacity indicators and rated capacity limiters are only required to be accurate at rated capacity values and are not intended to be accurate load weighing instruments.

8.8.2 *Radius indicator*

NOTE As the radius measurement provided by the rated capacity indicator is only required to be within the specified accuracy when the crane lifts the rated load, the rated capacity indicator may not give accurate readings for other load states because of the deflections induced in the crane structure by the different loads. These deflections can be insignificant on a crane with a short strut jib, but can be significant with a cantilever telescopic jib and any luffing jib combination.

Some rated capacity indicators/rated capacity limiters incorporate microprocessor systems that estimate the increase in radius that takes place with the increase in load between zero and the rated capacity for a particular jib angle. This feature can be a valuable aid to driver control of the crane in the initial stage of lifting. Properly trained and experienced crane drivers can use this feature to check the approximate lifting and landing radii if the preferred method of checking by measuring tape is not possible because of an intervening structure.

8.8.3 *Motion limit devices*

NOTE In addition to motion limiting provided by the rated capacity limiter, other devices may be fitted to prevent the crane driver from continuing to operate a control that takes the crane into an unsafe condition.

The safe system of work should not depend on utilization of motion limit devices to ensure that the crane remains in a safe operating mode at all times (e.g., by using an over hoist limit switch to stop an upward motion, if there is a height restriction). Other means should be used for this purpose (e.g., a visual or audible signalling system).

All motion limiting devices should be checked by the crane driver at the beginning of each working shift, if practicable, and any malfunction reported immediately.

8.8.4 *Means to check wind speeds*

The appointed person should obtain information on wind conditions prior to starting a lifting operation (e.g. by obtaining a local weather forecast or by using an anemometer).

The lifting operation should be stopped, or the mobile crane secured in an out-of-service condition, as appropriate, when the wind speed limits for the crane are exceeded. The following other factors should also be taken into account:

— the direction of the wind acting on the crane structure;

— the direction of the wind acting on the load;

— the shape, area and weight of the load;

— the likelihood of wind gusts.

The factors listed above may entail stopping the lifting operation at wind speeds below the wind speed limits specified by the manufacturer. If full control of the load and accuracy of placement of the load into position are important considerations, then these should be taken into account if the lifting operation is carried out in windy conditions. Crane supervisors, crane drivers and other members of the lifting team should be instructed to stop operations if there are any doubts concerning lifting operations in windy conditions.

8.9 Thorough examination and testing of cranes

8.9.1 *General*

Thorough examinations should include suspension of calibrated weights on the crane for at least one configuration, to ensure that the rated capacity indicator is accurate to within the tolerances given in BS 7262. At each successive thorough examination, a different configuration should be chosen so that eventually all configurations are systematically covered.

NOTE The Lifting Operations and Lifting Equipment Regulations (LOLER) requires crane users to implement an "examination scheme" or a "specified period" approach to examination (see **8.9.2** and **8.9.3**).

8.9.2 *Examination scheme approach*

The examination scheme appoach to thorough examinations, if used, should be based on regular assessments of the crane in accordance with usage (this is usually known as condition monitoring).

NOTE Guidance on condition monitoring for cranes is given in ISO 12482-1. Implementation of ISO 12482-1 requires co-operation of the crane supplier (manufacturer), crane user (owner) and expert engineer (competent person). The crane supplier should provide limiting criteria based on the crane design (e.g. the number of load cycles, load spectrum, critical parts, exceptional circumstances). These criteria should not be based on time alone.

The crane user (owner) and competent person (**3.12**) should take into account the limiting criteria from the crane supplier when devising an examination scheme in accordance with LOLER. Data logging equipment should greatly facilitate collection of information concerning crane usage for comparison with the crane design criteria.

8.9.3 *Specified period approach*

8.9.3.1 *General*

The specified period approach to thorough examinatons, if used, should be carried out in accordance with **8.9.3.2** to **8.9.3.4**.

8.9.3.2 *Six monthly thorough examination*

Six monthly thorough examinations should be carried out as follows. Cranes used to lift persons should be examined by a competent person at least once every 6 months, unless a lesser interval is agreed by the competent person.

Lifting accessories should be thoroughly examined by a competent person at least once every 6 months.

8.9.3.3 *Twelve monthly thorough examinations*

Twelve monthly thorough examinations should be carried out as follows. Mobile cranes should be examined by a competent person at least once every 12 months. After carrying out the thorough examination the competent person should specify when the next thorough examination should be carried out.

8.9.3.4 *Overload testing and thorough examination*

Overload testing and thorough examinations should be carried out as follows. Overload testing of mobile cranes should be carried out in accordance with BS 7121-2 at least once every 4 years, except for on cranes with a rated capacity that exceeds 500 t. Cranes with a rated capacity that exceeds 500 t should be overload tested in the configuration with which the rated capacity indicator is calibrated during the twelve monthly examination.

8.9.4 ***Major repair or modification***

Mobile cranes should be thoroughly examined and overload tested after major repairs or modifications.

8.10 Records

Records should be maintained for each crane so that the condition of the crane can be determined, and the fitness for operation properly assessed.

Records should include the following:

a) technical information, including EC declaration of conformity, maintenance instructions, and performance data provided by the manufacturer;

b) test certificates (as applicable), reports of thorough examinations and records of inspections carried out on the crane (including ropes);

c) records of significant repairs and modifications to the crane, including renewal of major parts and confirmation of completion including signatures of responsible person(s);

d) details of occurrences that are of more than short-term relevance, e.g.:

1) any incidents or accidents, however slight;

2) shock loads, however these occur;

3) dangerous occurrences or reportable accidents;

e) the "hours worked".

Except if specific forms are required by legislation, records can be kept in any format. However, records should detail a relevant and coherent history of the crane, that can be readily retrieved. Records should be clearly identifiable with the associated crane.

Records should be kept of any extended periods of continuous and arduous operation that could affect the long term fitness of the crane.

NOTE The classification of many mobile cranes is based on intermittent use and an average load spectrum factor.

8.11 Documentation

NOTE 1 The Supply of Machinery Regulations (SMR) 1992, the Lifting Operations and Lifting Equipment Regulations (LOLER) 1998 and the Provision and Use of Work Equipment Regulations (PUWER'98) 1998 specify some new requirements for documentation in relation to lifting operations. These requirements do not nullify any valid current documentation (e.g. test certificates) issued in accordance with previous legislation that has been revoked/repealed/amended by the new regulations.

To assist in verification of conformity to legal requirements, when a mobile crane arrives at a site for a lifting operation, the following should be available:

a) a report of the last thorough examination for the crane, and for any accompanying lifting accessories and/or personnel lifting equipment;

b) records of test, including the following:

1) records to show that the calibration of the RCI and RCL have been checked, by application of known loads to the crane, within the previous 12 months;

2) for cranes fitted with data loggers from new, and for which the manufacturer has developed a scheme, records to show that all relevant testing (normally NDT) required by the scheme has been carried out;

3) for all other cranes, records to show that the crane has been overload tested within the previous 4 years, or after any major repairs or modifications;

c) record of weekly inspections;

d) "duty charts";

e) records of maintenance;

f) the manufacturer's operating manual;

g) records of crane driver training;

h) a method statement, including any plan showing the positioning of the crane (if it is a contract lift).

NOTE 2 If the lifting operation is with a hired crane, the crane driver should be provided with a method statement on arrival at the site.

9 Siting of cranes

9.1 General

The siting of the crane should take into account any factors that could affect safe operation. The following should at least be taken into consideration:

a) the crane standing and support conditions;

b) the presence and proximity of other hazards;

c) the effect of wind during in-service and out-of-service conditions;

d) the suitability of access/egress to allow placing or erection of the crane in the working position and for dismantling and removing the crane following completion of lifting operations.

9.2 Crane standing or support conditions

9.2.1 *General*

The appointed person should ensure that the loads imposed by the crane can be sustained by the ground or any means of support, by assessment of a competent person.

NOTE Further guidance on crane standing or support conditions is given in CIRIA special publication 131, *Crane Stability on Site*.

The loads imposed by the crane should be obtained from the crane manufacturer or other authority on crane design and construction. The loadings should include the combined effects of the following:

a) the dead weight of the crane (including any counterweight, ballasting or foundation, as appropriate);

b) the dead weight of the load(s) and any lifting attachment(s);

c) dynamic forces caused by movements of the crane;

d) wind loadings resulting from wind speeds up to the maximum permitted, taking into account the degree of exposure of the site (see CP 3-2).

Out-of-service conditions and erection/dismantling conditions should be taken into consideration as well as in-service conditions. Vertical and horizontal forces are not likely to be uniformly distributed, and allowance should be made for these and for any other unpredictable effects.

The appointed person should ensure that the ground or any means of support are suitable for the crane to operate within the levels and other parameters specified by the manufacturer.

9.2.2 *Use of outriggers/stabilizers*

NOTE 1 Cranes can be fitted with outriggers or stabilizers to enhance stability and to significantly increase lifting duties. Loads caused by the dead weight of a crane with outriggers or stabilizers plus any suspended load are transmitted to the ground beneath the crane as point loads through the outrigger/stabilizer beams and jack pads, instead of by the tyres, as with fully mobile wheeled cranes.

When siting a crane, point loads through the outrigger/stabilizer beams and jack pads should be spread over a sufficient area to support the outrigger pad and to prevent the crane overturning or becoming unstable. Any packing should be suitably designed for the purpose.

The crane driver should not place any packing material on an uneven surface that could cause the packing to excessively distort or fail. There should be no gaps between any separate pieces of packing used within any layer (see Figure 1).

NOTE 2 A bed of sand between the underside of the bottom layer of packing and the ground can provide a more even distribution of ground pressure, as well as prevent damage to the packing material.

The pressure of the outrigger mat can be considered to pass into the ground at an angle of 45° from the outside edges, so that the distance between the edge of the outrigger mat and the toe of an unsupported excavation should always be greater than the depth of the excavation (see Figure 2). An outrigger mat can be placed close to an edge that is suitably supported (e.g. by sheet piling), but the appointed person should seek expert advice if there is any doubt concerning this.

NOTE 3 See **12.5**.

When selecting the siting of a crane for a lifting operation, the appointed person should ensure that the siting can accommodate the crane with the outriggers extended and set as specified in the duty chart, plus any area required for ground matting.

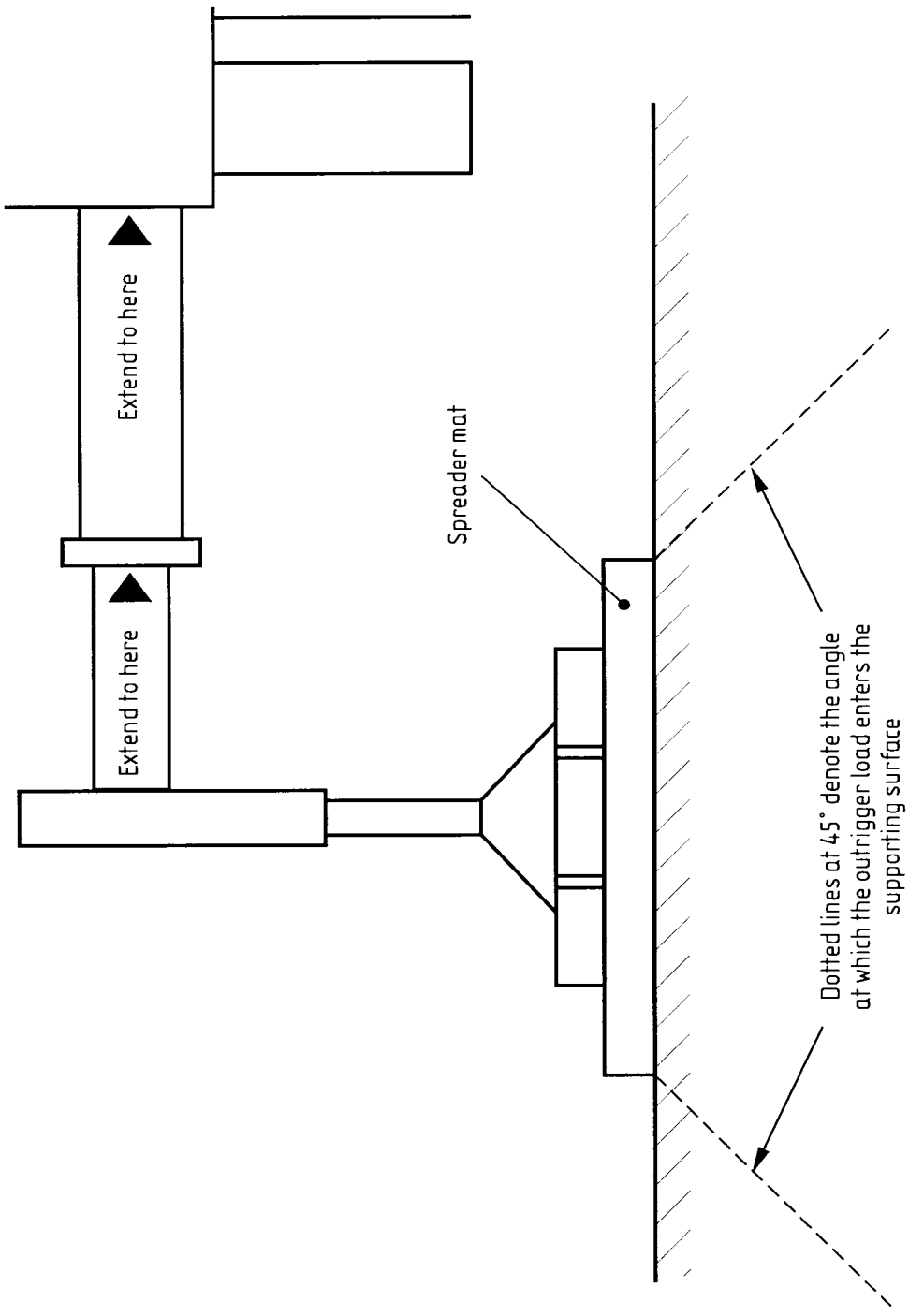

Figure 1 — Packing for outriggers/stabilizers

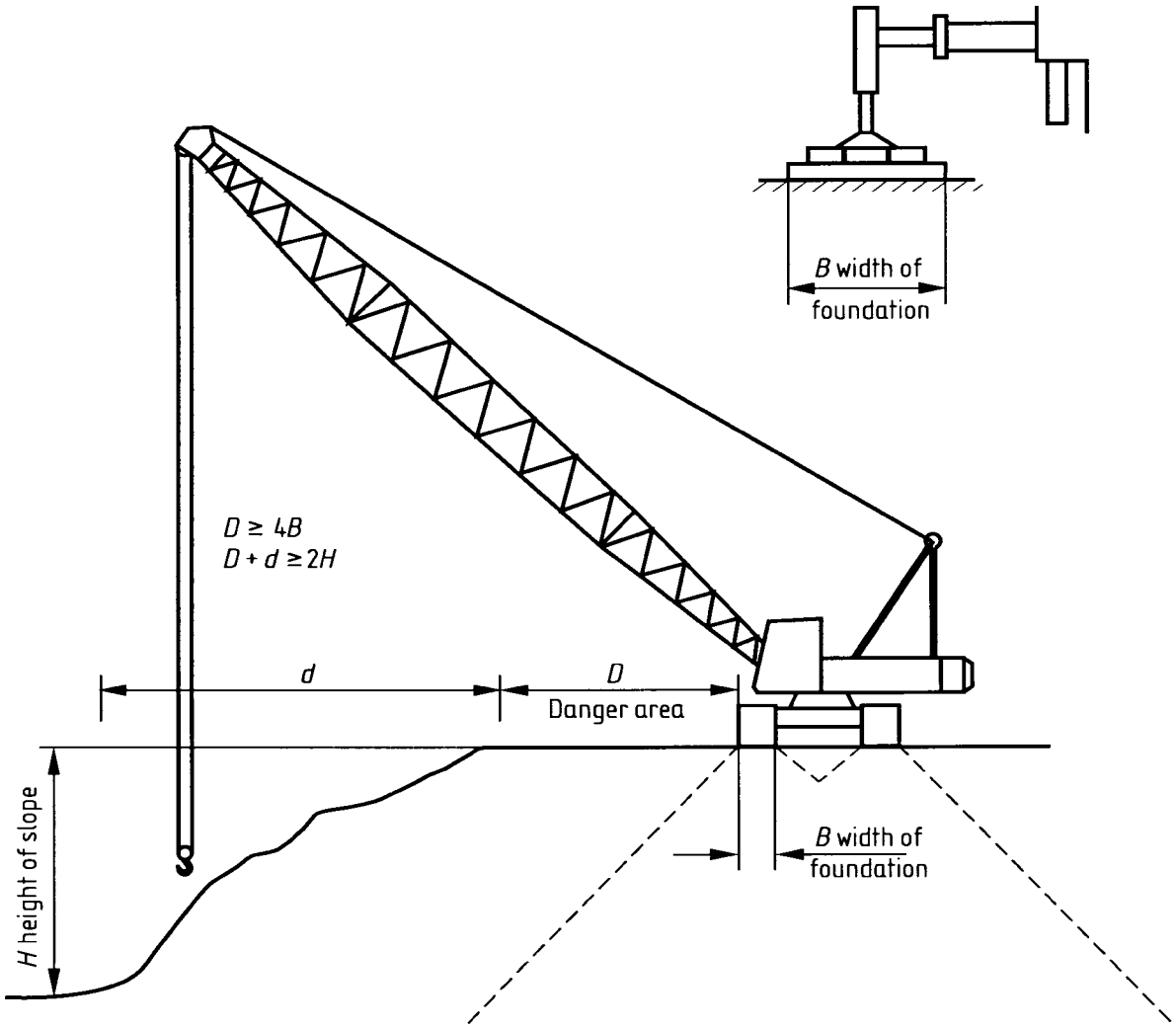

Figure 2 — Position of outrigger mat

9.3 Proximity hazards

9.3.1 *General*

Consideration should be given to proximity hazards (e.g. overhead electric lines or cables, nearby structures, live plant, other cranes, vehicles, ships being loaded or unloaded, stacked goods, public access areas including highways, railways, and rivers).

If any part of the crane or load cannot be kept clear of proximity hazards, the appropriate authority should be consulted.

Danger to or from underground services (e.g. gas mains, electric cables) should be taken into consideration. Precautions should be taken to ensure that the crane foundation is clear of any underground services or, if this is not possible, that the services are properly protected against damage.

At any place where a crane or load passes an obstacle, the following should apply:

a) If practicable, the crane path should be clearly defined by marking to ensure that it is kept free from obstruction, and a clearance of not less than 600 mm arranged between any part of the crane and any obstacle. If it is not reasonably practicable to achieve this clearance, effective precautions should be taken to prevent access to any trapping hazards.

b) If goods are regularly stacked near a crane, boundary lines for stacking of the goods should be permanently marked on the ground.

9.3.2 *Overhead electric lines and cables*

WARNING If any part of a crane, including rope, slings or load, touches or even approaches overhead electric lines or cables, there is a serious risk of fatal accident.

The appointed person should ensure that the guidance given in HSE Guidance Note GS 6 is complied with, and that the local offices of the electricity board or other line operator are consulted, if the crane is used within:

— 15 m plus the maximum jib length of overhead lines on steel towers; or

— 9 m plus the maximum jib length of overhead lines on wood, concrete or steel poles.

All distances should be measured at ground level from a position estimated by eye to be vertically below the outermost conductor at a tower or pole position, and should include an allowance for the load.

WARNING Overhead lines and other electrical apparatus should be considered live unless declared "dead" and "safe" by the line operator. If there is any doubt, advice should be sought. A notice bearing the following wording should be placed in the cab of any crane that could operate in the vicinity of overhead electric lines or cables:

"If machine makes contact with live electric line or cable, observe the following precautions:

— Remain inside cab.

— Warn all other personnel to keep away from the crane and do not to touch any part of the crane, rope or load.

— Try, unaided, and without anyone approaching the machine, to move the crane until it is clear of the power line or cable.

— If the machine cannot be moved away, remain inside the cab. If possible, alert someone outside the crane to inform the electricity supply authority immediately. Do not take any action until safe conditions are confirmed.

— If it is essential to leave the cab (e.g., because of fire), jump clear as far away from the crane as possible. Do not touch the crane and the ground at the same time.

— Inform the responsible engineer of the works or other authority immediately, and until assistance is received, position someone near the crane to warn of danger."

Devices designed to fit on a crane to provide warning if the crane approaches within a predetermined distance from overhead electric lines and cables should not be used and should not be considered as a substitute for a safe system of work.

9.3.3 *Crane control in the vicinity of aerodromes/airfields*

The appointed person should consult the aerodrome/airfield manager for permission to use a crane if the following apply:

— the crane is to be used within 6 km of the aerodrome/airfield; and

— the height of the crane exceeds 10 m, or the height of surrounding structures or trees.

NOTE It is an offence under the Air Navigation Order to act recklessly or negligently in a manner that could endanger aircraft.

9.3.4 *Railways*

If a crane is required to lift a load on or adjacent to rail tracks, and there is a risk of the load or part of the crane obstructing the track if the crane fails or overturns, the appointed person should arrange for an appropriate "occupation period" of the tracks, during which no rail traffic can use the tracks, with the railway authority prior to carrying out the lifting operation.

NOTE The railway authority has legal powers to enforce this requirement. Erection and dismantling of crane(s) are also covered by legal requirements. If the lifting operation is carried out for the railway authority, it should be controlled by the railway authority. The legal powers granted to the railway authority cover any lifting operation using a crane, by a contractor or individual, adjacent to the railway tracks.

9.3.5 *Highways*

For lifting operations beside a highway or other road used by vehicles or pedestrians, the appointed person should establish a safe system of work to ensure that injuries to persons cannot be caused by the crane and/or the load when the crane is preparing for or carrying out the lifting operation. Arrangements should be made for traffic to be stopped or diverted away from the working area if appropriate. It is essential that the local highways and police authority are consulted prior to carrying out any lifting operation next to a highway or other road.

9.3.6 *Live plant*

If a crane is required to lift a load inside a process plant while the plant remains in operation, the appointed person should assess any additional hazards that could apply.

NOTE 1 Nuclear installations, refineries and chemical plants, in particular, may present greatly increased risks to personnel and property in the event of an accident during a lifting operation. It may be appropriate to reduce the rated capacity of the cranes if the plant cannot be closed down.

NOTE 2 Additional hazards may be present even after processes are shut down. Power units and control systems of any equipment that enters the location of the lifting operation may require special suppressing equipment to be fitted if explosive atmospheric conditions could occur.

If appropriate, the appointed person should include emergency instructions on cessation of work and site evacuation in the lifting operation plan, and should ensure that all personnel are fully briefed.

10 Erection and dismantling

WARNING Persons should not be permitted within or underneath a pinned jib section while it is being erected/dismantled. Falling pinned jib sections present a serious risk of fatalities.

Mobile cranes may require partial erection on each occasion prior to the lifting operation.

NOTE Erection operations are usually carried out by the crane driver or under the crane driver's supervision.

If more complex configurations are to be installed and additional labour and craneage are used, the appointed person should plan the operation prior to carrying out. When planning the safe system of work, the appointed person should consider the following:

a) Additional space may be required for erecting the configuration to be used.

b) It may be necessary to erect the crane away from the lifting position and to travel it into place.

c) It may be necessary to give separate consideration to the dismantling operation, as the load could impinge on the dismantling area or block the exit route for the crane.

d) A safe means of access and egress should be provided to any part of the crane where persons are required to work.

e) Personal protective equipment (e.g. safety harnesses) should be provided as appropriate.

f) An erection manual for the crane should be available and clearly understood by the erection team.

g) Any departure from the prescribed procedures should be approved by the designer of the crane or other competent engineer.

h) All personnel should have a sound knowledge of their part in the operation.

i) The manufacturer's recommendations for the method of moving the crane from the place of erection to the place of work should be followed.

j) The crane should be level within the limits specified by the manufacturer.

k) Correct parts and components should be used.

l) Component parts should be clearly identifiable as to which crane they belong, and to their position and orientation in the assembly.

m) Components manufactured from special materials should be clearly marked (e.g. nuts and bolts manufactured from high tensile steel should be marked so that they can be distinguished from other nuts and bolts).

n) High strength friction grip bolts should not be reused.

All considerations concerning a) to n) should be included in the method statement.

11 Procedures and precautions

11.1 Crane operation

All crane movements, whether or not a load is lifted, should be carried out by a competent crane driver (see **6.3**) nominated by the appointed person.

NOTE 1 The appointed person may nominate a trainee crane driver if the trainee crane driver is directly supervised by a competent crane driver who has also been nominated for the purpose by the appointed person.

Maintenance personnel who are required to move cranes during maintenance work and testing should be competent and trained in crane driving to the extent required to enable them to carry out duties safely.

NOTE 2 Special arrangements may be required when carrying out maintenance or repairs on the crane (see **11.2** and **11.5**).

11.2 Working on cranes

11.2.1 *General*

If personnel are required to work on cranes for inspection, maintenance or other reasons, a system should be in operation to ensure that they are not endangered by movement of the crane and that a secure working place is provided. For cranes with which the crane driver has a clear view of all the moving parts, the system may be by verbal communication provided that it is clearly defined and readily understood by all personnel. If vision is restricted, an appropriate permit to work system should be used if required.

11.2.2 *Permit to work*

An effective permit to work system should be used to ensure that the crane cannot move (e.g. by removal of fuses) before written authority is given to the person nominated to carry out the work. The system should include a specifically designed form or certificate that is issued only when the safety precautions required to achieve the safe system of work have been taken.

The recipient of the permit to work should sign and keep the document when the work is fully understood and the personnel associated with the work decided. On completion of the work, the recipient of the permit to work should sign the clearance section of the form or certificate to certify the following:

— that all personnel have been withdrawn;

— that all gear, tools and loose materials have been removed;

— that all guards have been replaced; and

— that all safety devices are in operation.

After clearance of the form or certificate and cancellation by the issuer, the permit to work system safety precautions can be removed and the crane returned to its normal mode of operation.

To achieve and maintain a safe system of work for implementation of a permit system, the following minimum conditions should apply:

a) Responsibilities for co-ordinating, monitoring, issuing, receiving, clearing, and cancelling permits to work should be allocated.

b) The crane should be clearly identified along with its associated plant and apparatus.

c) An effective means of isolation of the crane should be installed.

d) A secure means of retaining any keys, fuses or other devices for maintaining isolation of plant and apparatus should be installed.

e) Demarcation or other special precautions to maintain a safe working area should be carried out.

Any corrective action taken on defects in the crane prior to returning to service, and the results of all tests in the programme should be documented in the crane records (see **8.10**).

11.3 Reporting of defects and incidents

The appointed person should ensure that there is an effective procedure for reporting defects and incidents. This should include notification of defects and incidents to the appointed person, a record of action taken, and clearance of the crane for further service. Items for immediate notification should include the following:

a) any defects found during daily or weekly checks;

b) defects found at other times;

c) incidents or accidents, however slight;

d) shock loads, however these occur;

e) dangerous occurrences or reportable accidents, as specified in The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995.

The reporting procedure should include provision for an examination by a competent person after any incident, whether or not a repair is necessary, to ensure that the crane is fit for further service.

11.4 Leaving the crane unattended

The crane driver should always be present when a load is suspended from a crane.

WARNING Cranes should not be left unattended, even for a short period, unless all loads are removed from the lifting attachment and the lifting attachment is left in a safe position. The power supplies to all motions should be switched off or the engine stopped, and appropriate motion brakes and locks applied to render the machine in a safe condition. The ignition key and any other keys should be removed from the crane whenever the crane driver is absent from the machine.

If the crane is left unattend for a long period, and for out-of-service conditions, all switches should be locked off, fuel supplies should be cut off, and any access doors to machinery or control cabs should be locked to prevent unauthorized access. Machinery should be left in the out-of-service condition as specified in the operating instructions.

11.5 Maintenance

11.5.1 *General*

Provision should be made to ensure that the crane and other equipment used in a lifting operation are maintained in a safe condition.

The appointed person should be satisfied that sufficient information on maintenance (e.g. the manufacturer's instructions) is available and that maintenance is carried out by trained personnel with knowledge of the correct procedures. The frequency and extent of maintenance should take into account all factors that affect the crane in carrying out lifting operations.

11.5.2 *Planned maintenance*

To ensure safe and satisfactory operation of the crane, a properly planned maintenance system should be established. Manufacturer's instructions normally recommend that specific tasks are carried out at stated intervals, and these intervals should not be exceeded. Manufacturer's instructions also specify the lubrication points that should be checked and maintained, the interval or frequency of greasing and oil changes, and the grades and quality of lubricant that should be used. Instructions on replacement of filters, draining intervals of air receivers, recommended tyre pressures, frequency for checking the security of fixing bolts, and recommended torque settings and other adjustments (e.g. on clutches and brakes) should be complied with.

NOTE Statutory examination of the crane requires a competent person to assess whether or not the crane is fit for service at the time of the examination. The examination does not cover the absolute legal requirements to ensure that the equipment is properly maintained. To conform to these requirements, more frequent inspections should be carried out, taking into account the frequency of use of the crane and the environmental conditions.

The planned maintenance system should include prohibition of use of the crane until essential maintenance work is carried out.

In addition to any statutory regulations, records (see **8.10**) should be kept, for each crane, of the major components used in manufacture (e.g. rope diameters, lengths, construction and breaking loads, tyre sizes and ply ratings, make and model of motors, pumps, gear boxes, winches, drives, electrical and hydraulic equipment, and switch gear). The availability and source of replacement items should be checked and noted in the record. Consideration should be given, as appropriate, to maintaining a stock of expendable items and other parts to minimize down time in the event of crane breakdown.

11.5.3 *Replacement components*

Replacement components should conform to the manufacturer's specification or an equivalent standard.

11.5.4 *Use of special materials in crane construction*

Modern cranes may include special steels in their construction, and if repairs are carried out on any parts of the structure, it is essential that the correct procedure as specified by the manufacturer is followed. Excessive heat that can change the properties of steel should not be applied.

11.6 Periodic checks and inspections

11.6.1 *General*

The appointed person should ensure that all periodic checks and inspections are properly carried out.

NOTE The appointed person may authorize the crane driver to carry out periodic checks and inspections, in accordance with the crane driver's level of competence.

11.6.2 *Daily checks*

At the beginning of each shift or working day that the crane is in use, the following routine checks, as appropriate for the type of crane, should be carried out:

a) daily checks specified in the manufacturer's handbook;

b) a check that all ropes are correctly positioned on their sheaves and that drums are not displaced;

c) a visual check that electrical equipment is not exposed to contamination by oil, grease, water, or dirt;

d) a visual check, by inspecting relevant levels and/or components, that no loss of fluids (e.g. lubricating oil, coolant) is apparent;

e) a check for correct operation of all limit switches or cut-outs and the dead man's handle or lever, applying caution during checking in case of malfunction;

f) a check that the automatic safe load indicator is correctly set and that the manufacturer's daily test is carried out;

g) a check that the radius scale is appropriate to the jib configuration fitted, if the equipment is separate from the equipment in item f);

h) a check, by varying the load lifting attachment radius without load, for correct movement of the equipment in items f) and g);

i) a check that the correct air pressure is maintained in any pneumatic control system (e.g. brakes);

j) a check that lights, windscreen wiper(s) and washers operate efficiently;

k) a visual check for security of wheels and the condition of tyres, on wheel-mounted cranes;

l) a check for correct function of all crane controls without load;

m) a check for correct operation of audible warning devices;

n) a check that the crane is in tidy condition and free from tins of oil, rags, tools, or materials other than those for which storage provision is made, and that sufficient access and egress are provided, and that appropriate fire fighting equipment is available;

o) a check that there are no obstructions in the path of travel of the crane.

11.6.3 *Weekly checks*

Once a week, when the crane is in use, in addition to the checks recommended in **11.6.2**, the following inspections (as appropriate for the type of crane) should be carried out:

a) weekly checks specified in the manufacturer's handbook;

b) a check of the rated capacity indicator/limiter in accordance with the operating instructions;

c) a visual inspection of all ropes for broken wires, flattening, basket distortion, or other signs of damage, excessive wear and surface corrosion;

d) a check of all rope terminations, swivels, pins, and retaining devices, and a check of all sheaves for damage, worn bushes or seizure (see clause **13**);

e) an inspection of the crane structure for damage (e.g. missing and bent bracings on bridges and strut jibs, bulges, indentations and unusual rubbing marks on telescopic jibs, cracked welds, and loose bolts and other fasteners);

f) a check of hook(s) and other load lifting attachments, safety catch(es), and swivel(s) for damage, free movement or wear, and a check that the hook shank thread and securing nut does not move indicatively of wear or corrosion;

g) a check for correct operation and adjustment of controllers;

h) a check for creep of hydraulic rams (on hydraulic machines);

i) a check of the effectiveness of brakes and clutches;

j) a check of tyres for correct pressure and for damage and wear on walls and tread, and a check of wheel nuts for tightness, on wheel-mounted mobile cranes;

k) a check of the slew lock, if fitted;

l) a check of the steering, brakes (foot and parking), lights, indicators, horn, windscreen wipers, and washers, on rubber tyred cranes.

The results of all checks should be entered in the records of inspections.

11.6.4 *Crane not in regular use*

If the crane is not in regular use, it may be necessary to carry out a special programme of checks each time before use. The extent and thoroughness of special programme of checks should be decided on the length of the period that the crane is out of use and also on the location of the crane during this period.

NOTE A crane standing out of use under cover or inside a workshop may only require the checks recommended in **11.6.2** and **11.6.3**. A crane that is left out of use exposed to the weather, atmospheric pollution, etc., may require an extensive appraisal to ensure fitness for use.

An appraisal carried out on a crane left out of use exposed to the weather, atmospheric pollution, etc., should include at least the following:

a) any checks recommended by the manufacturer;

b) an examination of all crane ropes for signs of corrosion and damage, and a check to ensure thorough lubrication;

c) an examination of all control linkage for evidence of seizure or partial seizure and a check to ensure correct lubrication;

d) a test of each crane motion, for several minutes, without load, each motion individually at first then by simultaneous combination of two or more motions, as appropriate, and then a repeat of the test with load;

e) a check of the correct functioning of all crane safety devices;

f) a check of hoses, seals and other components for evidence of deterioration.

11.7 Welding operations

When a crane is required to hold a load while electric welding operations are being carried out on the load it is essential that the earth return of the welding set is fixed as close as possible to the arcing point. There is then no chance of large currents earthing through the crane and possibly causing damage to the slew ring and electronic systems.

11.8 Out-of-service conditions

11.8.1 *General*

When the crane is out-of-service, even for overnight, it should be left in the condition specified in the manufacturer's instructions to ensure that it is not adversely affected by the weather conditions at the site. The appointed person should ensure that weather forecasts are obtained for the location of the lifting operation and that the appropriate information is passed to the crane supervisor, along with any specific instructions for action in response to the forecast conditions.

11.8.2 *Thunderstorms*

A crane jib, particularly a long one, could act as a conductor and attract a lightning strike during a thunderstorm. If there are clear signs of an approaching thunderstorm, lifting operations should cease and all personnel should be moved out of the vicinity of the crane, until the possibility of danger passes.

A crane struck by lightning can be seriously damaged both structurally and mechanically. A thorough examination should be carried out before a crane struck by lightning is returned to service.

NOTE A thorough examination may not reveal internal damage to some parts (e.g. the slew ring, which may not show signs of deterioration until many hours usage).

11.9 On-site travel

11.9.1 *General*

On-site travel of a fully rigged crane should only be carried out if there is no possible alternative. On-site travel of a fully rigged crane should be planned, supervised and carried out with the same thoroughness as lifting of loads.

Manufacturer's operating manuals should provide all relevant information on safe procedures for travelling mobile cranes, and these should be complied with as appropriate.

11.9.2 *Wheeled cranes*

Wheeled cranes that are required to be travelled on site for some distance should be covered in the safe system of work for the lifting operation. The crane travel route should be checked to determine whether it is able to take the wheel loads and to ensure that there are no overhead hazards (e.g. pipes and cables) with insufficient clearance above the crane. Checks should be carried out for recently backfilled excavations, and sufficiently safe clearance allowed to the nearest passing wheel. Surface areas of which the load bearing capacity is in doubt should be avoided, or, if this is not possible, should be covered with steel plates and/or good quality timber.

NOTE Wheel loads on cranes can be considerable, especially when rigged in the "ready-for-work" condition, with additional counterweight and jib sections.

If the crane has a telescopic jib it should be set to the fully closed position and placed on the jib rest, as for road travel. If the safe system of work requires travel with the jib extended or elevated, any inclines and cross-falls on the route should be checked, prior to movement of the crane, and any risk of the crane becoming unstable minimized by appropriate measures. The slew lock should be fully engaged during travel, with the outriggers extended and the jack feet or floats kept just clear of the ground. Wind loading can cause serious hazards to partially rigged cranes when travelling, particularly if conditions are gusty and there is a likelihood of wind funnelling between buildings. Travel should be carried out at the lowest speed compatible with smooth progress.

An attendant should accompany any crane travelling on-site. As it is difficult for the crane driver to judge, from the driving position, the clearance of an overhead obstruction and to decide whether or not there is a risk of part of the crane or equipment coming into contact with the hazard, the crane driver should walk the route prior to travelling the crane, to identify the locations where any special precautions may be required. The attendant should accompany the crane driver and discuss how problem areas should be negotiated.

11.9.3 *Crawler-mounted cranes*

NOTE Crawler cranes are able to travel, rigged ready for lifting, over uneven, sloping and unmade-up ground, but this ability is limited by the site conditions and the chosen crane and jib configuration. Long jib combinations increase the potential hazards of travel on site.

The manufacturer's manual should be consulted to determine the limits for the chosen jib configuration. Guidance should cover all the available combinations of jibs and counterweight, as well as any limiting ground inclination and prevailing wind speed. All recommendations should be taken as the upper limits that apply. The appointed person should ensure that all physical and environmental factors are taken into account at the planning stage, if the manufacturer's recommended maximum limits are to be used. This phase of the lifting operation should be included in the planning brief to all personnel involved in the lifting operation.

11.10 Movement to site

11.10.1 *Wheeled cranes*

NOTE Wheeled cranes that do not conform to the definition of a heavy motor car in the Road Traffic Regulations are only permitted to travel on public highways as a "special type" vehicle. These cranes are subject to restrictions, and formal notification to the police and other authorities is required prior to any proposed movement. The required advance notice varies from two to five working days depending on the total weight. Only a very few truck-mounted cranes can be considered a heavy motor car, and it is most likely that any low headroom, all-terrain crane or truck-mounted crane should only travel on the highways after appropriate notice is given to the police, and after any indemnity against damage caused by excessive weight is given to the authorities for highways, railways and waterways. Some authorities may waive submission of indemnity forms for cranes of lower weights, or may have agreed arrangements with crane users that regularly travel within the authority's jurisdiction area. The appointed person should check any arrangements regularly to ensure that legal requirements are complied with.

Access routes to the site of the lifting operation may have height as well as weight limitations. The appointed person should check that any over-bridges on the route do not have a clearance height below the travelling height of the crane(s). The crane driver should ensure that the crane is in the correct road travel mode before setting out, and that the jib is correctly placed on the jib rest or secured in the lowest position recommended by the manufacturer.

11.10.2 *Crawler cranes*

Before deciding to use a crawler crane for the planned lifting operation, the appointed person should consider any problems associated with transportation of the crane and equipment to the site, including any consultation required with the relevant authority concerning weight and height restrictions on the route to the site.

It is essential that advance notice of movement of the crawler crane is given to the police, as well as indemnity to other authorities (see **11.10.1**).

A specialist transport company may be contracted to carry out movement of the crawler crane. In this case, the appointed person should be satisfied that the specialist transport company carries out the operation in accordance with the specified procedure, and that no delays occur to the planned operation.

12 Operating conditions

12.1 Rated capacity

The rated capacity of the crane and lifting accessories should not be exceeded other than for testing purposes, under supervision by a competent person.

Care should be taken to prevent pendulum swinging of the load, by careful control of the operating motions to match the swing of the load and to keep it under control at all times (see Figure 3).

Rated capacity loads apply only to freely suspended loads. No crane motion (hoisting, slewing, derricking, telescoping, or travelling) should be used to drag any load along the ground with the hoist rope out of the vertical position. Before lifting a load, the hoist line should be plumb (see Figure 3).

WARNING If the crane is used with the hoist line out of the vertical position, crane stability can be affected, and loadings (stresses) can result in excess of the design limits. Even with a rated capacity indicator fitted, structural failure can occur without warning.

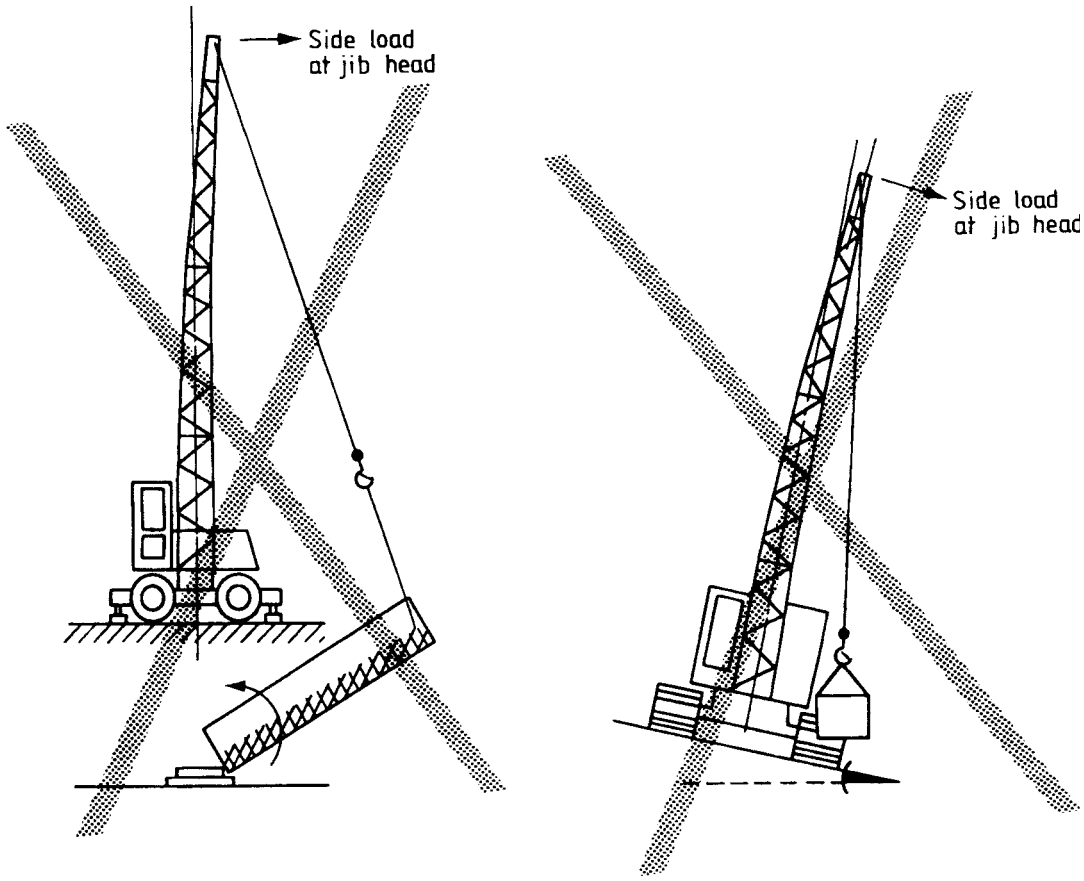

Figure 3 — Control of pendulum swinging of load

12.2 Mode of operation and control

12.2.1 *Identification of controls and direction of movement*

To ensure safe use of the crane each control should be marked to identify the motion controlled and the direction of movement. Markings should be in English or by internationally agreed symbols. The following should apply before commencing any lifting operation:

a) The crane driver should be familiar with the controls and the control layout.

b) The crane driver should ensure that the rated capacity indicator/limiter is set to the configuration for the crane.

c) The crane driver should have a clear and unrestricted view of the load and operational area, or should be assisted by directions from the slinger or an authorized signaller, positioned with a clear and uninterrupted view.

NOTE In some circumstances this may be a legal requirement.

d) The crane driver should ensure that the lift can be carried out without causing damage.

e) The crane driver should ensure that loads and crane hoist ropes are clear of obstructions.

f) If telephone, radio or closed-circuit television communications are used, the crane driver and signaller should ensure that the calling signal functions correctly and that verbal messages can be clearly heard.

g) If air or hydraulic systems are used, the crane driver should ensure that the gauges function and that the systems are at the correct operating pressures.

The hoist rope or, if applicable, the hoist chain should be vertical throughout the hoisting operation. The load should be initially lifted just clear of the supporting surface and then brought to rest while the slings, balance of the load, etc., are checked, before proceeding. Care should be taken by the crane driver to avoid shock or side loadings on the jib or structure. Care should be taken to avoid the lifting accessory coming into contact with the structure of the crane. Motion motors should not be reversed before the motor comes to rest, unless the control gear is specifically designed to allow this.

The crane safety devices should not be used as a routine means of stopping the motion(s).

Travelling cranes that move close to positions where personnel pass or work should be distinguished at the leading end of the crane by a suitable warning device (e.g. lamp, hooter).

12.3 Crane level

Danger can occur if side loadings are introduced during a lifting operation when a crane is out of level (see Figure 3) causing instability and/or structural damage. This is particularly the case with modern mobile cranes that can use long slender jib combinations to lift loads to significant heights. Devices to indicate the degree of level of the crane are mounted on all wheeled mobile cranes fitted with outriggers, and these should be used whenever the crane is set up to lift a load. All devices should be checked for accuracy at regular intervals as part of the crane's planned maintenance schedule.

NOTE A crane fitted with stabilizers may not be equipped with a level indicating device, and other methods may be required to ensure that the crane is set to the manufacturer's degree of level.

A check on the degree of level of a crane set-up can be made using the crane's unladen hoist rope as a plumb line. The following sequence should be followed:

a) Using the maximum length of jib (or combination) set at minimum radius, lower the hoist block without load, until it is just clear of the ground.

b) Slew the superstructure at right angles to the chassis.

c) Observe the position of the suspended hook block from a point some distance along the line running through the centre of rotation at right angles to the chassis.

d) If the hook or hoist line appears in the middle of the jib foot, then the crane is level along the line of the chassis.

e) Rotate the superstructure through 90° and reobserve the position of the hook from a point along the line of the chassis.

f) If the hook lies in the middle of the jib foot, the crane is level all way round.

Corrective action should be taken at each stage by appropriate adjustment of the outrigger jacks. For accuracy, the procedure listed above should be carried out when there is no wind to affect the unladen hoist line.

12.4 Telescopic jib alignment

NOTE Although side load can be detrimental to any crane, a crane with a cantilever, telescopic jib is at greater risk than other types of crane, especially if the jib section width is less than the depth. Lifting loads with a crane with a cantilever, telescopic jib that is badly aligned, can also cause a crane to lose stability or suffer structural damage. As with the out of level condition, the risk of failure increases with longer jib lengths set at smaller radii.

Regular inspection of the side restraint system of the jib should be included in the planned maintenance schedule for the crane, and any corrective action required should be carried out immediately. Any report by the crane driver of unusual side deflection or movement should be investigated immediately.

12.5 Outriggers/stabilizers

12.5.1 *General*

Most wheeled mobile cranes are equipped with hydraulically operated outriggers or stabilizers. Some crawler cranes may also be fitted with these, either to give the crane enhanced duties, or to allow the erection of longer jib combinations. Crawler cranes lose mobility if these devices are set. The crane duty or rated capacity chart should provide details of any restrictions that apply to duties or mobility.

12.5.2 *Lifting using outriggers/stabilizers*

If outriggers are used, the beams should be extended in accordance with the duty charts to the positions marked on the beams. The jacks should be extended sufficiently to level the crane with all the crane tyres clear of any supporting surface.

12.5.3 *Partially extended outriggers*

Some cranes can lift loads with partially extended outriggers. The manufacturer's duty charts should be consulted. The position of partial extension should be clearly marked on each outrigger beam, so that the crane supervisor can see that the outriggers are set correctly in accordance with the planned safe system of work.

NOTE See Figure 1 for an example of rigger beam marking.

Use of partially extended outriggers should be carefully planned and controlled by the appointed person.

Partial extension may increase the loading imposed by the outrigger jacks, and extra packing should be provided to spread the loading if required. Partial and full extension should not be used simultaneously.

WARNING When designing outrigger extension beams, the manufacturer include reinforcement at the loading points for full and/or partial extension, so beams should not be set at any other intermediate points.

12.5.4 *Lifting without outriggers*

Wheeled cranes equipped with outriggers/stabilizers may have duties for lifting "free on wheels". This capacity should only be used if included in the safe system of work. The appointed person should brief the crane supervisor and crane driver as appropriate. Because a wheeled crane equipped with hydraulically operated outriggers or stabilizers can be set up with minimal delay, lifting "free on wheels" should only be carried out if there is no alternative. If lifting "free on wheels", the set-up of the crane (the level and condition of tyres) should be within the recommendations given in the crane operating manual.

NOTE See **12.3**.

12.5.5 *Pick and carry*

NOTE Some wheeled cranes are designed to pick and carry loads. "Pick and carry" is not available on all cranes that are permitted to lift free on wheels.

Maximum speed of travel, load position, tyre and ground conditions, etc., should not exceed the restrictions specified in the crane duty chart and operator's manual. Pick and carry operations should be carried out in accordance with the safe system of work. Travel speed should be the minimum compatible with smooth motion and any swing of the load should be carefully controlled using hand lines.

12.6 Special duties

12.6.1 *General*

In all cases involving special duties, guidance should be sought from the crane manufacturer or other competent person.

The weight of any special lifting attachments should be included as part of the load. The attachment should be tested, certified and clearly marked with the rated capacity and weight of the attachment. Attachments should only be used for their design purpose.

12.6.2 *Grabbing and magnet crane services*

12.6.2.1 *General*

When using cranes for special duties such as grabbing or magnet crane service, allowance should be made not only for the weight of the grab, magnet or other attachments, together with load, but also for additional loadings imposed on the crane resulting from fast slewing, grab suction effects, impacts, etc. Consequently the weight of the grab and contents, or the weights of the magnet and load, should be less than the corresponding rated capacity for normal crane duty. Reference should be made to the crane designer or another competent engineer for details of special duty ratings.

12.6.2.2 *Grabbing service*

Truck mounted cranes, all terrain cranes and rough terrain cranes, if fitted with telescopic jibs, should not be used for grabbing duties.

WARNING These types of crane are designed using low factors and coefficients of utilization, and are not suited to grabbing duties.

NOTE 1 Use of these types of crane for cyclic operations can lead to early development of fatigue cracking in structural welds and premature failure of components such as the slew ring and gearing.

Grabbing should be carried out using a double rope-operated grab.

NOTE 2 Some models of truck mounted cranes and all-terrain cranes are fitted with two hoist drums and ropes, but the single line pull is usually too low to permit lifting of a rope operated grab of useful capacity. If the crane is suitably adapted, a hydraulically operated grab may be used on the main hoist line, suitably reeved for the laden grab weight, but because a down rating factor is required, and the operation is slow, this could be inefficient and costly.

For grabbing cranes, the lifted load is the weight of the grab and its contents. The weight of the contents depends on the density of the material. It is essential that any grab used should be of appropriate capacity for the material, with regard to the rated capacity of the crane. A weight check should be carried out in case of doubt.

12.6.2.3 *Magnet service*

A load supported by a magnet is not as secure as a load supported by a hook. Precautions should be taken to ensure that there are no hazards to personnel caused by unexpected release of the load. The magnet should be marked with the rated capacity as determined by tests using weights of the same characteristics (size, material) as the intended load.

The power to the magnet should not be switched on until the magnet is lowered on to the load. The magnet should be carefully lowered on to the load and should not be allowed to strike a solid obstacle while in use. It should not be used on hot metal unless specifically designed for this duty.

When not in use, the power should be switched off to avoid the magnet becoming too hot. The magnet should be rested on a wooden platform when not in use. It should not be deposited on the ground.

12.6.3 *Vacuum lifting devices*

12.6.3.1 *General*

Vacuum lifting attachments should be regularly inspected to ensure that sufficient suction can be maintained over the required period.

Vacuum lifting devices should be fitted with a visual indicating device that shows the crane driver the state of the vacuum at all times. The device should also give an audible warning to the crane driver and any person in the vicinity of the crane at ground level if the vacuum falls to 80 % or less of the designed working vacuum, and/or if the vacuum-inducing pump fails.

Vacuum lifting devices should have a means to ensure that, if the vacuum-inducing pump fails, sufficient vacuum is maintained to continue to support the load for the time required (including a safety margin) to safely deposit the load from the maximum lift height of the crane to ground level. All vacuum lifting devices should be fitted with a vacuum gauge, of sufficient size, and situated where it can be easily read at the attachment and release position of the load. The gauge should be distinctively marked, in red, with the level of vacuum below which the appliance should not be used. Vacuum lifting devices should only be used to lift loads with a surface suitable for vacuum lifting pads.

12.6.3.2 *Use*

Vacuum devices should be used as follows:

a) Each vacuum pad should support an equal part of the load, as far as practicable.

b) The contact surface of the load should be suspended horizontally, as far as practicable.

c) The surface of the load should be clear of any loose material that could prevent the surface of a vacuum pad from making effective contact.

12.6.3.3 *Inspection and test*

Before using for the first time, or after any substantial repair, the vacuum device should be tested by a competent person using a test load. The test load surface should, as far as practicable, be similar to the surface with most non-adhering texture on which the device is intended to be used.

The vacuum device (especially the hoses and vacuum pads) should be inspected before use at the beginning of each day or shift, and the warning device should be tested at the beginning of each week.

13 Slinging and handling of loads

13.1 Weight and centre of gravity of the load

13.1.1 *Weight of the load*

It is essential that the weight of the load is known accurately. The weight should be determined by any of the following procedures:

a) Check to see if the weight is marked on the load. If so, check to ensure that it is the weight of all parts of the load (a machine tool, for example, may not include the drive motor).

b) Check the weight stated on any documentation.

c) Look at a drawing of the load. If the weight is marked, check to ensure that it includes all parts of the load.

d) If the load is still on a trailer or truck, use a weighbridge.

e) Estimate the weight of the load using tables of weights. (See BS 4-1 for the weight of rolled steel sections.)

NOTE The weight of the load can be roughly estimated using the densities given in Table 1.

Table 1 — Densities of materials

Material	Density kg/m^3
Aluminium	2 700
Brass	8 500
Brick	2 100
Coal	1 450
Copper	8 800
Concrete	2 400
Earth	1 600
Iron–steel	7 700
Lead	11 200
Magnesium	1 750
Oil	800
Paper	1 120
Water	1 000
Wood (hard)	500 to 1 000
Wood (soft)	350 to 1 000

NOTE These densities are average densities only and actual densities can vary in accordance with composition, water content, etc.

If the load is hollow, it should be checked to see if it contains anything and whether or not the contents could moving during the lifting operation.

13.1.2 *Centre of gravity*

13.1.2.1 *General*

It is essential that the centre of gravity of the load is ascertained prior to carrying out the lifting operation.

NOTE The centre of gravity is the point at which the total weight of the load can be estimated as concentrated (i.e. the point about which the parts of the load exactly balance each other).

13.1.2.2 *Regularly shaped load(s)*

For regularly shaped loads (e.g. a rolled steel joist), the centre of gravity should be estimated by measuring the midpoint in each direction.

13.1.2.3 *Complex-shaped loads and irregularly shaped loads*

For complex-shaped loads, the centre of gravity should be estimated for the various parts, and then combined to obtain a centre of gravity for the whole.

NOTE See the *Code of Practice for the Safe Use of Lifting Equipment* for more information on how to determine the centre of gravity of complex-shaped loads.

For irregularly shaped loads (e.g. machine tools), for which the centre of gravity is not easily estimated, it is essential that the centre of gravity is determined by trial, without lifting the load completely off the ground. When this is established, the lifting gear should be adjusted to ensure that the load is evenly balanced for lifting, without toppling over, and that no part of the load is subjected to excessive strain that could damage the load. Slings should be protected against any sharp edges on the load. The weight of all slings and lifting gear/beams should be included as part of the total weight of the load.

13.2 Lifting accessories

Only lifting accessories with a valid test certificate and that have been thoroughly examined within the previous 6 months should be used.

Lifting accessories should be clearly marked with the rated capacity and an identification number. Lifting accessories should be visually inspected before each use. When not in use lifting accessories should be maintained in a serviceable condition in a storage area, and only released from this area on the instruction of the person in charge of the accessories.

It is essential that slings are not knotted. If used to lift molten metal or slag, the rated capacity of all lifting accessories should be derated by 50 %. Checks should be made to ensure that lifting accessories can withstand the working environment and that they are protected from mechanical damage and other hazards.

It is essential that chains are not joined using bolts or wire. It is essential that the correct pins are fitted if shackles are used. Chains and slings should not be dragged along the ground.

NOTE See the *Code of Practice for the Safe Use of Lifting Equipment* for more information on selection and use of lifting accessories.

13.3 Hooks and hook blocks

Hooks and hook blocks should be of sufficient capacity for the load. It is essential that hooks and hook blocks are not loaded beyond the rated capacity.

NOTE Hooks can be over stressed by application of a load to the point.

Hooks should either:

— have a safety catch or other efficient device to prevent displacement of the sling or load; or

— should be of a shape that minimizes risk of the sling or load becoming detached (e.g. a Liverpool hook).

Only one sling should be placed on any hook. The sling should be attached to a ring, link or shackle and then placed on the hook. Rings, links and shackles should ride freely on the hook.

WARNING If the sling is not attached to a ring, link or shackle before placing on the hook, the hook could be strained due to spreading of the sling, or the hook safety catch could be damaged, or the sling could slip over the nose of the hook.

If setting a load down using a single fall of hoist rope, and consequently relieving the tension of the rope, the hook can spin. The slinger should take care when approaching a hook to disconnect the slings.

13.4 Slinging operations

Slingers should be properly trained in all aspects of slinging loads. Slingers should be authorized by the appointed person.

If lifting eyes are provided as an integral part of the load they should be used. If lifting eyes are provided on containers (tanks, silos, etc.) the appointed person should ascertain whether the containers can be lifted full or empty. Slings should be attached to the eyes by shackles of at least the same capacity as the slings. If lifting eyes are not provided, slings should be attached to points on the load with sufficient strength to take any additional loads that could be induced by the slinging method. Slings should be protected by suitable packing material to prevent contact with any sharp edges that could cause damage. If the packing could be dislodged during or at the end of the lifting operation, it should be lashed securely in place.

Once the slings are attached they should be monitored as the tension increases, to ensure that they do not slip or become fouled during the initial raising of the load.

NOTE 1 Additional personnel may be required for this.

Just before the load is lifted clear of the support, the signaller should check for any out of balance of the load, or inclination in the hoist line, and should direct the crane driver to make corrections.

NOTE 2 Loads lifted on telescopic jibs can be subject to large, load induced deflections.

Care should be taken to ensure that the hook remains directly over the centre of gravity as the load comes clear of its support. The crane driver should make progressive corrections to the jib angle as the hoist rope tension is increased, so that the load leaves the support with no horizontal movement.

NOTE 3 Any out of level of the crane, or poor adjustment of the side wear pads of a telescopic jib, can lead to side deflections that could cause structural damage to the crane or make the load swing sideways as it is lifted clear.

Slingers/signallers should be positioned in a safe area during this part of the lifting operation, but should be able to direct the crane driver to take any appropriate action.

NOTE 4 A rated capacity indicator that incorporates radius compensation for load induced jib deflection can be useful at this stage of the lifting operation.

13.5 Web belt slings

Web belt slings should only be used if authorized by the appointed person as part of the safe system of work. The safe system of work should include any special instructions to protect the slings from damage. Slingers should be instructed to take care to prevent web slings from slipping during the initial tensioning stage of the lifting operation, as this is when the material of the sling is most susceptible to wear or damage.

Web belt slings should be checked carefully each time before attachment to and after removal from the load. Web belt slings should be withdrawn from use immediately if there are any signs of cuts or fraying in the fabric.

13.6 Use of hand lines

Hand lines should be used if there is a possibility that the load could come into contact with any other object during the lifting operation. A single hand line should normally be sufficient, but the safe system of work should identify how many should be used and their attachment points on the load.

Care should be taken to ensure that hand lines do not become caught on anything as the load is moved, making the load swing dangerously. Guidance of the load should be by manual application only, and not by belaying the line round a fixed point.

NOTE Hand lines are especially useful for controlling the load during placing, and essential if any degree of precision is required.

WARNING Persons holding hand lines should not wrap the line around any part of themselves.

14 Current legislation

The following legislation currently applies to use of mobile cranes:

— The Health and Safety at Work, etc. Act 1974;

— The Supply of Machinery (Safety) Regulations 1992, plus amendments;

— Lifting Operations and Lifting Equipment Regulations 1998 (plus code of practice plus HSE guidance);

— The Construction (Design and Management) Regulations 1994;

— The Construction (Health Safety and Welfare) Regulations 1996;

— The Management of Health and Safety at Work Regulations 1999 (plus approved code of practice);

— The Provision and Use of Work Equipment Regulations 1998 (plus code of practice plus HSE guidance);

— The Workplace (Health, Safety and Welfare) Regulations 1992 (plus approved code of practice);

— The Manual Handling Operations Regulations 1992 (plus code of practice plus HSE guidance);

— The Personnel Protective Equipment Regulations 1992;

— The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995;

— Docks Regulations 1988;

— The Noise at Work Regulations 1989;

— The Electricity at Work Regulations 1989 (plus code of practice plus HSE guidance);

— Road Traffic Act 1962;

— The Road Vehicles (Construction and Use) Regulations 1986.

Annex A (normative)
Piling operations

A.1 Hydraulic equipment

Hydraulic equipment for driving or extracting piles usually includes hoses to supply and return oil from the power pack to the clamps and motors. The additional weight of the hoses can be significant and an allowance should be made for this, especially if working at height. Hoses can become caught on obstructions, and care should be taken to prevent this to avoid side loading of the crane jib and damage to high pressure hydraulic services. Visual or other means of communication should be established between the crane driver and the operator of the pile driver/extractor if these controls are not in the crane cabin.

A.2 Driving piles

Mobile cranes can be used for most types of steel sheet and load-bearing pile driving operations. The appointed person should consider the following prior to deciding which type of mobile crane to use:

a) Impacts or dangerous vibrations should not be transmitted from the driving device to the crane.

b) If the driving device remains attached to the crane hook by a sling during operation, the sling should be of sufficient length to accommodate the speed of driving, so that no unplanned load is taken by the crane.

c) The crane driver should be experienced in pile driving operations and should be briefed on the ground characteristics, so that the driving device can be followed down at a rate that prevents excessive load on the crane.

d) Strut jib cranes are most suitable for pile driving operations, but telescopic jib cranes may be used provided account is taken of the increased deflection involved with telescopic jib cranes. The available jib length should provide sufficient margin of headroom for clutching of sheet piles.

NOTE If precast piles are used, with a drop hammer and hanging leaders attached to the jib of a crawler crane, the crane is then part of a piling machine and is not covered by this code of practice.

A.3 Extracting piles

All hazards should be carefully considered prior to selecting a mobile crane for extracting piles. Telescopic jib cranes should not be used if the crane is required to provide a resultant upward pull on a hammer or vibrating extraction device. The appointed person should consider the following prior to deciding which type of mobile crane to use to extract piles:

The condition of the piles should be determined and an estimation made of the resistance to extraction. Piles that have been in the ground for a long time may be corroded and friction in the pile clutches high. Information should be sought on any difficulties encountered when the piles were driven. If the foot of a pile encounters rock it can curl up, or clutches can split, making extraction impossible even with a heavier extractor and an increase in crane size.

The crane supervisor should be trained and experienced in pile extracting and should be given clear instructions on how to report back if any difficulties are encountered.

The crane driver should be experienced in handling the type of extractor in use, and should not exceed the load specified in the safe system of work.

Rated capacity indicators can be adversely affected by pile extracting operations, and additional checks and maintenance should be carried out on these after operations are carried out.

Welds, ropes, fixings, sheaves, etc., should be inspected once per week during pile extracting operations.

Annex B (normative)
Demolition and balling operations

NOTE For further guidance on demolition, see BS 6187.

B.1 General

Mobile cranes with telescopic jibs should not be used for balling operations. Impact loads caused using a quick release device to drop the ball could damage the jib, while swinging a ball by slewing action could put excessive side loads on the jib, also leading to damage.

WARNING No attempt should be made to push over walls or other structures by telescoping out the jib, as this is not safe practice.

For balling operations, a round or pear-shaped weight (a breaking ball) is suspended from the hoist rope of a crane and caused to move to strike a building, other structure or other object so that the impact causes it to collapse or break.

During balling operations dynamic loadings are imposed on the jib structure and other parts of the crane by movement and impact of the ball. To rate a machine for balling operations the crane manufacturer assumes certain dynamic loading values. In practice the magnitude of these varies widely, in accordance with the method of using the breaking ball, the skill of the crane driver, and the impact resistance of the object. Manufacturer's recommendations and working loads should be regarded as guidance only. Lower loads and/or shorter jibs should be used as determined by the crane driver. The crane driver should have prior practical experience of the same type of crane in similar applications.

NOTE Some manufacturers do not recommend their cranes for balling operations, or may only approve use with certain conditions (e.g. with restrictions in the method of use or the maximum jib length).

Crane drivers engaged in balling operations should be skilled and experienced in use of the equipment and the methods of balling. Crane drivers should be familiar with the machine in use, and aware of the potential dangers and possible causes of these.

It is essential that the ball is not swung by operation of the derricking mechanism.

Operational methods should be used that do not overstrain the jib or endanger the stability of the crane. Swinging techniques should be restricted to machines designed for arduous or heavy duty service. The weight of the ball should not exceed the capacity of the crane at the required radius (a maximum of 50 % of the rated capacity should be used).

A rope from the second drum of the crane should be attached to the ball to prevent an inadvertent increase in radius that could lead to overloading. The breaking ball should be connected to the hoist rope using a free-running swivel, if no method of preventing the ball from turning is in use.

If a tyre is used to minimize shock transfer to the crane, a lazy chain or strop should be fitted so that if the tyre fails the ball remains attached to the crane.

The operation should be managed so that the ball does not strike the crane or jib. As a protection against the jib springing over the cab on release of the ball, jib angles should not exceed 60° from horizontal. Jib safety stops should be fitted on the crane and proper protection against flying debris provided for the crane driver.

For free-standing cranes the ball should only be used when the crane is standing stationary on firm and level ground. It is essential that the crane is positioned so that debris does not fall onto it. Appropriate exclusion zones and safe working spaces should be used.

If demolishing masonry arches, suspended floor slabs, etc., care should be taken to avoid the ball becoming trapped, as a sudden collapse of the structure could overload the crane. If the ball does become trapped, it should be lowered off before being freed, as a dragging or lifting action might cause the structure to collapse on top of the ball, pulling the crane over.

B.2 Vertical drop balling

NOTE 1 Breaking by drop balling is carried out by raising the ball vertically above the object and then allowing it to drop down on to the object.

The ball may be attached to the hoist rope of a crane with a free-fall capability. It should then be raised a short distance, held by the hoist brake, and allowed to fall until the object is struck. Sudden application of the brake while the ball is still moving should be avoided as shock loads from this could cause structural damage to or overturning of the crane. The distance that the ball is allowed to drop should only be increased after the characteristics of the struck object are determined and heavier impacts are considered safe by the crane driver.

If the point of impact is above ground level or above an underground void, the ball could miss the point of impact, pass through the object, or bounce off. In this case the drop distance should be kept to a minimum, and sufficient length of rope should be left on the crane at the intended point of impact to allow the ball to be brought to rest by the brake.

For demolition operations, consideration should be given to adopting the following sequence:

a) a number of heavy impacts are made, to cause multiple cracking of the object;

b) a number of lighter impacts are then made, until part of the object is broken;

c) further heavy impacts are made to another part of the structure, etc.

If it is not suitable to use a crane with free-fall ability, the ball may be dropped by application of a quick release mechanism (sometimes called a “monkey”). The ball should be carefully positioned above the object and then raised as before. The mechanism should normally be released by a downward force on a light rope or hand line, that is either pulled manually or automatically tensioned as the lifting hook is raised. When the ball is released it has a completely free fall to the point of impact, and so care should be taken to ensure that the ball is contained in the working area and that all personnel are outside the area, and suitably protected from flying debris.

NOTE 2 Free drop balling can also be carried out by lifting the ball using an electromagnet and then releasing the magnetic force, or using a grab or similar device.

B.3 Swinging the ball in line with the jib

To swing the ball in line with the jib, an additional rope from a second drum on the crane is attached to the ball and used to pull the ball in towards the crane. The pulling rope is then released to allow the ball to swing outwards, in the plane of the jib, and to strike the object. The pulling rope is also used to control and limit the outward swing of the ball. Care should be taken to ensure that the stability of the crane is not endangered by allowing the ball to swing outwards beyond the maximum safe working radius.

NOTE This method is limited to low level objects as the ball cannot be swung effectively when positioned at more than half the available height of lift. However, it is the safest method, as it produces the least strain on the crane.

B.4 Swinging the ball by slewing

The ball is suspended 3 m or more below the jib head. The slew motion is engaged, causing the ball to swing in an arc and strike the object. The slew motion should be disengaged and the slew brake applied to stop the jib at a point in line with the point of impact. A second rope should be used to prevent the ball swinging out of the safe radius.

Considerable torsional loadings can be applied to the jib and other elements of the crane using this method, although these can be reduced to almost nil by good crane driver control. The actual strain depends on a number of factors including the following:

— the length of the jib and the operating radius;

— the distance of the ball below the jib head;

— the rate of acceleration of the slewing motion;

— the speed of the ball at impact and the impact resistance of the object;

— the position of the jib head relative to the ball when it strikes the object;

— the rate of checking the slewing motion;

— the weight of the ball.

Annex C (normative)
Dismantling operations

C.1 General

The appointed person should ensure that the complete dismantling operation is properly planned. If possible, the original drawings for the structure should be obtained and used to draw up a schedule of the individual loads. The schedule should contain details of the weights and dimensions of each load, so that the most suitable cranes, ancillary equipment and personnel can be selected. The appointed person should check all drawings against the existing structure, to verify the drawings' relevance and to see if any changes that could affect the schedule of lifting operation have been made to the structure.

If the structure to be dismantled is a process plant, some build up of process material could be present. Allowance should be made for the extra weight that deposits of process material could add to the schedule of weights. A minimum allowance of 20 % should be added to the weight of the load, if the deposit build up is estimated to have occurred throughout the lifetime of the process plant.

Even if a full set of drawings and information on individual weights are available, the appointed person should arrange for a thorough inspection of the structure and plant before a final lifting plan is drawn up. The inspection should include an analysis of the effects of corrosion (from environmental and processing causes). Dynamic effects that could occur from movement of fluid, etc., in containers should be considered prior to making the final crane selection.

If no authenticated information is available on the weights to be lifted, the appointed person should draw up a schedule of parts to be lifted and make accurate calculations for the weight of each part. The schedule should also include all dimensions so that the dismantling operation can be thoroughly planned and a safe system of work drawn up. Each item on the schedule should be thoroughly inspected to ensure that there are no deposits on or inside any item, that could increase the weight by any significant amount. An appropriate increase should be made to the calculated weight to ensure a sufficient margin of safety.

The safe system of work should include steps to ensure that all loads are free from adhesion to any supporting surface prior to lifting.

NOTE Steel wedges can be used to part corroded flanges. Jacking equipment can be used to break suction.

The safe system of work should include insructions for a final inspection of the load, by the crane supervisor, before the operation begins.

Objects should not be dismantled from a point above ground if it is not possible to return them to the original position. If this is unavoidable, however, the crane should be attached to a structural part at some distance above the ground, and cutting gear used to free the object from its surroundings. The appointed person should ensure that the crane has a rated capacity of twice the calculated weight of the object to be freed.

Annex D (normative)
Lifting of persons

D.1 General

Raising and lowering people by equipment that is not specifically designed for this purpose should only be carried out in exceptional circumstances, when it is not practicable to do so by other less hazardous means.

Careful planning should be carried out prior to each raising and lowering operation, in accordance with the Lifting Operations and Lifting Equipment Regulations 1998.

D.2 Carrier

A carrier is a device that supports persons during lifting and lowering. The type of carrier selected should depend on a risk assessment and may vary according to the application (e.g. construction, forestry, rescue).

D.3 Compatibility of carrier and crane

D.3.1 *Capacity*

The crane selected to lift the carrier should have a rated capacity on the fixed load lifting attachment of at least twice the minimum rated capacity of the crane configuration in use.

D.3.2 *Motion control system*

The crane should be equipped with a motion control system that brings motion to rest automatically when the controls are released.

The crane should be equipped with power lowering. Cranes with free-fall capability should not be used to lower and raise persons unless the free-fall facility is locked out.

Load bearing hydraulic cylinders should be fitted with a device to stop movement in case of hose rupture or pipe fracture.

The crane control system should be able to provide a smooth transition of the carrier. The working speed of the carrier should be limited to a maximum of 0.5 m/s on all motions.

Means should be provided so that if the power supply or control system fails, the carrier can be positioned to enable access/egress without risk.

D.3.3 *Ropes*

Ropes used for hoisting and lowering the carrier should have a diameter of at least 8 mm.

D.3.4 *Hook*

The crane hook should be provided with a safety catch.

D.4 Other devices

D.4.1 *Anemometer*

The crane should be fitted with an anemometer or other device to monitor in-service wind speeds.

D.4.2 *Storage*

Storage accommodation for equipment, including any emergency egress equipment (e.g. safety harness, lanyard), should be provided in the carrier.

D.4.3 *Rated capacity limiter/rated capacity indicator*

The rated capacity limiter/rated capacity indicator on the crane should be maintained in good working order and used.

Limit switches should be provided to prevent over-hoisting, over-lowering or over-derricking.

Limit switches should be checked for correct operation each day before personnel carrying operations are carried out. Limit switches are not necessarily fail safe and therefore care should be taken if motion limits are approached.

A fail safe procedure should be provided to ensure that sufficient hoist rope remains on the winch drum at all times to prevent the end of the rope running off the drum while lowering the carrier.

To ensure that sufficient rope remains on the drum at all times, the carrier should be lowered to the bottom of the shaft, cofferdam or caisson as follows:

— the first time it is lowered;

— after each time the shaft, cofferdam or caisson depth increases;

— if the crane hoist rope is replaced.

Care should be taken when the crane is moved to different locations to ensure that sufficient rope is fitted for each operation.

Operation of limit switches, check valves and similar devices could prevent some motions of the crane with the carrier still suspended. Precautions should be taken to ensure that persons in the carrier are not left suspended for an excessive period, and/or a procedure for raising or lowering the carrier to a safe position should be provided.

D.5 Use

D.5.1 *Organizational requirements*

Lifting, lowering and supporting the carrier should be carried out in controlled conditions directed by an appointed signaller.

The crane driver should always be present at the normal crane control station when the carrier is occupied. Visible and audible communication should be possible between the persons in the carrier and the crane driver at all times during the lifting operation.

During the operation:

— A person should be present to perform any emergency recovery procedure.

— The crane driver and signaller should not perform any other work at the same time. The crane driver and signaller should only be responsible for operating one crane or directing one carrier.

— Machines should not operate simultaneously in the same place if there could be a risk of collision.

— All movements should proceed gently and should not exceed 0.5 m/s.

Load lifting attachments for carriers should not be used for any other purpose.

Carriers should not be used in the following conditions:

— winds exceeding 7 m/s (25 km/h);

— electrical storms;

— snow or ice;

— fog;

— sleet; or

— other weather conditions that could affect the safety of personnel.

Unintenional rotation of the carrier should be prevented (e.g. by using guide ropes or anchoring). The means of preventing unintenional rotation should not inhibit any emergency procedures and should not otherwise interfere with safe operation of the carrier.

Carriers should not be occupied while the crane is travelling.

Lifts should not be made on any other hoist lines of the crane while any person occupies a carrier attached to the crane.

The crane, load lifting attachments and carrier should be inspected every day during use.

D.5.2 *Personnel*

The payload of the carrier should not be exceeded.

The stability of the carrier should not be affected by the operation.

Additional care should be taken if the carrier is of a length that could lead to excessive tilting through movement of persons or tools within the carrier.

Persons in carriers should fasten safety harness onto the personnel baskets, if the carrier could tip up (e.g. if it becomes entangled or during lowering to the ground).

Any tools/materials in the carrier should be secured to prevent displacement, tipping and/or falling out.

Personnel should remain entirely inside the carrier during raising, lowering and positioning to avoid pinch points. Personnel should not stand on or work from any handrail, intermediate guard rail or toe board of the carrier.

Carriers should be secured so that access and egress can be accomplished without danger.

D.6 Work from a carrier

NOTE 1 Exposed electrical conductors in the vicinity of the lifting operation can present electrical hazards. Exposed high voltage conductors can cause electric shocks or burns even if not touched. If there are electrical conductors adjacent to the work area, seek advice from the owner of the conductor. Overhead lines usually belong to the local electricity supplier or the National Grid company. These suppliers can provide advice on safe working distances from electrical conductors.

If electric arc welding is carried out from a carrier, precautions should be taken to prevent stray welding return currents from flowing through the load lifting attachments, crane hoist rope, or other part of the crane. Electric arc welding should be carried out in accordance with HS[G] 118. The return welding current lead should be secured to the welded part, as close as practicable to the point of the weld.

NOTE 2 Complete insulation of the crane hoist rope or use of clean dry webbing lifting attachments can also prevent stray currents.

Electric powered hand tools, if used, should be battery powered.

Power cables provided to the carrier should not interfere with safe operation of the carrier.

Power cables should not be used as steady lines.

Annex E (normative)

Dynamic compaction

Dynamic compaction operations may be carried out with mobile cranes. The appointed person, when selecting a crane, should take into account the very high adverse loads induced in the crane structure by the sudden release of a heavy weight over long periods of time. The appointed person should ensure that a proper record is kept, in the crane history file, of the length of time the crane spends carrying out this type of operation, and other condition monitoring techniques should be used to ensure that fatigue failures and other related problems are minimized.

Bibliography

BS 5744:1979, *Code of practice for safe use of cranes (overhead/underhung travelling and goliath cranes, high pedestal portal jib dockside cranes, manually-operated and light cranes, container handling cranes and rail-mounted low carriage cranes).*
CP 3010:1972, *Code of practice for safe use of cranes (mobile cranes, tower cranes and derrick cranes).*

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