BRITISH STANDARD

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Code of practice for

Safe use of cranes —

(overhead/underhung travelling and goliath cranes, high pedestal and portal jib dockside cranes, manually-operated and light cranes, container handling cranes and rail-mounted low carriage cranes)

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Cooperating organizations

The Mechanical Engineering Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices Technical Committee*
Association of Consulting Engineers
Association of Hydraulic Equipment Manufacturers
Association of Mining, Electrical and Mechanical Engineers
British Compressed Air Society
British Electrical and Allied Manufacturers' Assocation (BEAMA)
British Gas Corporation
British Gear Manufacturers' Association
British Internal Combustion Engine Manufacturers' Association
British Pump Manufacturers' Assocation
British Steel Corporation
British Steel Industry*
British Valve Manufacturers' Association
Chartered Institution of Building Services
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Telecommunication Engineering and Manufacturing Association (TEMA)
The Society of Motor Manufacturers and Traders Ltd.
Water-tube Boilermakers' Association

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Ports Association
British Railways Board
British Transport Docks Board
Bureau of Engineer Surveyors
Chain Testers' Association of Great Britain
Contractors Plant Association
Control and Automation Manufacturers' Association (BEAMA)
Council of Ironfoundry Associations
Department of the Environment (Building Research Establishment)
Federation of Civil Engineering Contractors
Federation of Wire Rope Manufacturers of Great Britain
High Commission of India
Institute of Materials Handling
Institute of Quality Assurance
Institution of Civil Engineers
Institution of Industrial Safety Officers
Institution of Structural Engineers
National Federation of Building Trades Employers
Oil and Chemical Plant Constructors' Association
Port of London Authority
Royal Society for the Prevention of Accidents
Welding Institute
Individual experts

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Contents

Foreword

This code of practice, which has been prepared under the direction of the Mechanical Engineering Standards Committee, deals with the various types of crane most commonly employed in industrial premises, and for the movement of goods and materials at docks or transport termini. The code covers overhead/underhung travelling and goliath cranes, high pedestal and portal jib dockside cranes, manually-operated and light cranes, container handling cranes and
rail-mounted low carriage cranes.The code is complementary to CP 3010 which deals with mobile cranes, tower cranes and derrick cranes.

Preparation of this code was prompted by concern at the continuing number of accidents involving these types of crane which, apart from the costly damage sustained, frequently result in serious personal injury or death.

Cranes are being employed in an ever wider variety of job applications and environmental conditions and, with the introduction of novel designs of crane offering greater technical sophistication, increased lifting capacities and new extremes of operating range, the accident rate will not be diminished unless positive measures are taken. The most significant cause of crane accidents lies in the misuse (maloperation) of the crane itself. This often derives from the lack of knowledge, understanding, skills or training of the driver/operator, together with the lack of knowledge and understanding of the supervisor/management. It is ignorance rather than intent or negligence that is the main contributory factor.

The aims of this code of practice are therefore:

a) to describe the principal characteristics of the cranes covered;

b) to draw attention to some of the more common hazards and potential dangers which may be encountered in their use;

c) to recommend general precautions to be taken and procedures to be followed to promote safety in the use of these cranes.

This code was prepared by a committee of representatives from different branches of industry associated with the use and manufacture of cranes. Their combined experience and specialist knowledge in the fields of crane design, manufacture, application and safety ensure that the content is well founded and practical. It was recognized by the committee that the safe use of a crane ultimately rests with the operating personnel and the committee were unanimous in their views that there is a need for the introduction of systems for ensuring that drivers operate only those types of cranes for which they have received training and have demonstrated their competence.

HOWEVER, MANAGEMENT HAVE THE OVERALL RESPONSIBILITY FOR SAFETY AND SUPERVISION AND IT IS TO MANAGEMENT THAT THIS CODE OF PRACTICE IS PRIMARILY DIRECTED. IT IS HOPED THAT THE CODE WILL BE USED BY MANAGEMENT BOTH AS A WORKING GUIDE AND IN THE TRAINING OF PERSONNEL, AND THAT APPROPRIATE INFORMATION AND RECOMMENDATIONS WILL BE INCORPORATED IN THEIR COMPANY STANDING INSTRUCTIONS FOR THE SAFE USE OF CRANES.

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

Summary of pages

This document comprises a front cover, an inside font cover, pages i to iv, pages 1 to 56, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This code gives guidance for the safe use of overhead/underhung travelling and goliath cranes, high pedestal and portal jib dockside cranes, manually-operated and light cranes, container handling cranes and rail-mounted low carriage cranes. Subjects covered include general recommendations for selection, installation, testing, operation and maintenance of cranes and for the selection of drivers, slingers and signallers.

Reference is also made to relevant legislation and attention is drawn to statutory requirements for the testing and examination of cranes.

Section one contains guidance notes and general information pertaining to the safe use of cranes of the types covered in sections 2 to 6.

2 References

The titles of the publications referred to in this code are listed on the inside back cover.

3 Definitions

FOR THE PURPOSES OF THIS CODE THE FOLLOWING DEFINITIONS APPLY. Where appropriate, definitions from existing British Standards have been used. Where more than one term is shown for a definition, the first listed is the preferred term. The second term, shown in brackets, is an alternative in common use.

3.1
automatic safe load indicator

a device fitted to a crane, or incorporated in its design, that automatically gives visual indication to the driver when the load being lifted or carried by the crane approaches the safe working load, and that also gives a continuous audible warning to the driver and other persons in the vicinity when the load being lifted or carried exceeds the safe working load (see definition of "safe working load"). Under certain statutory regulations the automatic safe load indicator must be of a type approved by HM Chief Inspector of Factories. See also "load radius indicator"

3.2
competent person

for the purposes of this code, a person is deemed to be competent if he has such practical and theoretical knowledge and such experience of the crane, as is necessary for him to carry out the function to which the term relates in each particular context

3.3
container (freight container)

an article of equipment having an overall volume greater than 1 m^3, either rigid or collapsible, suitable for repeated use in the carriage of materials in bulk or package form, and capable of transfer between one or more forms of transport

3.4
gantry

the structure for supporting the track of an overhead travelling crane

3.5
limit switch

an automatically actuated device to stop a particular crane motion at its extremity(ies) or limit(s) of operation

3.6
load radius indicator

a device fitted on a crane that shows the radius of the hook and the corresponding safe working load

3.7
radius

the horizontal distance between the point at which the centre of rotation of the crane meets the ground, and the vertical centreline through the hook (see Figure 1)

3.8
rail clamps

fittings that can be engaged with the rail to prevent a rail-mounted crane from being blown along the track; e.g. wedges, claws, railhead pads, inverted twistlocks and cam brakes which may be hand-operated, gravity-operated or power-operated

3.9
safe working load

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

3.10
service conditions

a) **in-service** .with the crane handling loads up to the safe working loads in permissible wind pressures specified in the appropriate British Standard (see **5.1**).

b) **out-of-service**. with the crane either not required for use, or out of use when wind pressures exceed those permitted for in-service conditions, and without load on the hook.

3.11
spreader

a mechanism suspended from the hook of a container crane, that can be attached to, or detached from, containers, for lifting and handling. They may be either of fixed dimensions or adjustable to accommodate containers of different lengths

3.12
travelling (long travel)

movement of a crane along the ground or track (see Figure 1)

3.13
traversing (cross travel)

movement of a crab, trolley or load carriage along the bridge girders or running beam

4 Legislation

In addition to the general requirements of the Health and Safety at Work etc. Act 1974, the following legislation applies to cranes covered by this code, dependent upon the circumstances of use.

The Factories Act 1961

The Construction (General Provisions) Regulations 1961

The Construction (Lifting Operations) Regulations 1961

The Construction (Lifting Operations) Certificates Order 1962

The Construction (Lifting Operations) Prescribed Particulars Order 1962

The Construction (Lifting Operations) Reports Order 1962

The Construction (Working Places) Regulations 1966

The Docks Regulations 1934

The Electricity (Factories Act) Special Regulations 1908 and 1944

The Shipbuilding and Ship Repairing Regulations 1960

The Shipbuilding and Ship Repairing Regulations (Northern Ireland) 1960

Mines and Quarries Act 1954 and General Regulations made thereunder

The Factories Act (Northern Ireland) 1965

The Construction (Lifting Operations) Regulations (Northern Ireland) 1963

The Docks Regulations (Northern Ireland) 1934

5 British Standards

The following British Standards relate to cranes referred to in this code of practice and to certain accessories and attachments used in lifting operations.

5.1 Cranes

BS 357, *Power-driven travelling jib cranes (rail-mounted low carriage type).*

BS 466, *Electric overhead travelling cranes for general use in factories, workshops and warehouses.*

BS 2452, *High pedestal or portal jib cranes.*

BS 2573, *Permissible stresses in cranes and design rules.*

BS 2573-1 *Structures.*

BS 2573[1)]-2,*Mechanisms.*

BS 3243, *Hand-operated chain pulley blocks.*

BS 3579, *Heavy duty electric overhead travelling and special cranes for use in steel works.*

BS 3810, *Glossary of terms used in materials handling.*

BS 3810-4, *Terms used in connection with cranes.*

[1)] In course of preparation.

5.2 Accessories and attachments

BS 302, *Wire ropes for cranes, excavators and general engineering purposes.*

BS 449, *The use of structural steel in building.*

BS 461, *Bordeaux connections.*

BS 462, *Bulldog grips.*

BS 463, *Sockets for wire ropes.*

BS 464, *Thimbles for wire ropes.*

BS 590, *Mild steel chain Grade 30 short link and pitched or calibrated for lifting purposes.*

BS 1290, *Wire rope slings and sling legs.*

BS 1663, *Higher tensile steel chain Grade 40 (short link and pitched or calibrated) for lifting purposes.*

BS 2902, *Higher tensile steel chain slings and rings, links alternative to rings, egg links and intermediate links.*

BS 2903, *Higher tensile steel hooks.*

BS 3017, *Mild steel forged ramshorn hooks.*

BS 3032, *Higher tensile steel shackles.*

BS 3037, *Tyres for crane rail wheels.*

BS 3037-1, *Double-flanged parallel-tread tyres .*

BS 3037-2, *Forged or rolled steel double-flanged rail wheels and tyres (metric units).*

BS 3113, *Alloy steel chain, Grade 60. Short link, for lifting purposes .*

BS 3114, *Alloy steel chain, Grade 80. Polished short link calibrated load chain for pulley blocks.*

BS 3458, *Alloy steel chain slings.*

BS 3481, *Flat lifting slings.*

BS 3481-1, *Wire coil flat slings.*

BS 3481-2, *Flat woven slings made of man-made fibre, for general service.*

BS 3481-3, *Disposable flat lifting slings.*

BS 3551, *Alloy steel shackles.*

BS 4278, *Eyebolts for lifting purposes.*

BS 4942, *Short link chain for lifting purposes.*

BS 4942-1, *General conditions of acceptance.*

BS 4942-2, *Grade M non-calibrated chain.*

BS 4942-3, *Grade M calibrated chain.*

BS 5281, *Ferrule secured eye terminations for wire ropes.*

6 General considerations

Cranes are used under a wide variety of conditions but the following minimum requirements generally apply.

a) A crane should not be used unless it has the appropriate current test certificates. All test certificates or copies of certificates should be available for inspection.

b) Periodic examination and inspections, systematic maintenance, repairs, renewals and any heat treatment as applicable should be carried out and recorded. Records should be available for inspection.

c) Cranes and lifting attachments should be clearly marked with their safe working loads and identification as given on the current test certificates.

7 Recommended requirements for driver, slinger and signaller

7.1 General requirements. The safety of a lifting operation depends on many considerations, a major one being the efficient organization of the team comprising the crane driver, the slinger and the signaller. The proper training of drivers, slingers and signallers is essential to ensure good team-work in the working situation.

The slinger will usually be visible to the driver and a signaller will not be necessary. However, where a slinger will not be visible to the driver, or in the absence of a slinger, a signaller should be employed to direct the crane driver.

Where neither a slinger nor a signaller can be seen by the crane driver, additional means of communication, such as a telephone, radio or closed-circuit television are necessary.

7.2 Requirements for driver. The crane driver should:

a) be not less than 18 years of age;

b) be medically fit, with particular regard to eyesight, hearing and reflexes;

c) have the stature to operate the crane safely;

d) have been adequately trained in the operation of the type of crane being driven and be able to judge distances, heights and clearances;

e) have sufficient knowledge of the working of the crane to carry out routing procedures as described in **11.2**;

f) have been authorized to operate the crane; the authorization should take training and recent experience into account;

g) understand fully the duties of the slinger and be familiar with the signal code shown in Figure 2 in order to implement safely the instructions of the slinger or signaller;

h) be familiar with the fire appliances on the crane, and be trained in their use.

NOTE For manually-operated and light cranes, see the requirements for the operator given in clause **54**.

7.3 Requirements for slinger. The slinger should:

a) be not less than 18 years of age;

b) be medically fit, with particular regard to eyesight, hearing and reflexes;

c) be agile and have the physique to handle lifting equipment and tackle;

d) have been trained in the general principles of slinging and be able to establish weights and judge distances, heights and clearances;

e) be capable of selecting tackle and lifting gear suitable for the loads to be lifted;

f) understand the signal code shown in Figure 2 for the crane being operated and be able to give clear and precise signals;

g) be capable of directing the movement of the crane and load in such a manner as to ensure the safety of personnel and plant;

h) have been authorized to carry out slinging duties by the competent person in charge of the lifting operation;

i) be clearly identifiable by the crane driver.

7.4 Requirements for signaller. The signaller should:

a) be not less than 18 years of age;

b) be medically fit, with particular regard to eyesight, hearing and reflexes;

c) understand the signal code shown in Figure 2 for the crane concerned and be able to transmit the instructions of the slinger to the crane driver in a clear and precise manner;

d) be capable of directing the movement of the crane and load in such a manner as to ensure the safety of personnel and plant;

e) have been authorized to carry out signalling duties by the competent person in charge of the lifting operation;

f) be clearly identifiable by the crane driver.

7.5 The driver, slinger and signaller should all be aware of each other's respective responsibilities, which should be clearly defined by the competent person in charge of the lifting operation.

8 Description of types of crane

This code of practice covers the types of crane described below.

8.1 Overhead/underhung travelling cranes. This crane consists of a bridge girder or girders mounted on end carriages housing the long travel wheels which travel along a gantry track.

The girders support a crab fitted with hoisting machinery having a hook, magnet or grab, and traversing machinery. The crab may support a fixed or slewing underhung jib or mast.

The crane is normally operated from a cabin either suspended from the main girders or attached to the crab.

8.2 Goliath cranes. These cranes have the bridge girder or girders mounted on vertical legs. The crane may be fixed, rail-mounted or on steerable wheels.

The girders support a crab fitted with hoist and traverse motions.

The crane is normally operated from an elevated cabin.

8.3 High pedestal and portal jib dockside cranes. This type of crane is specifically designed for the rapid loading or unloading to or from ships, barges, etc., of general or break bulk cargo.

These cranes are usually mounted near a quay edge on rails or in a fixed position. The rails may be at quay level or be elevated to facilitate the movement of cargo and transport along the quay. The cranes are usually of the portal type, having a structure which allows transport to pass beneath. The elevated superstructure gives better visibility for the driver and improved clearance for the crane jib. The superstructure of the crane is capable of being slewed, and, although the jib may be of the fixed type, it is more usually of the luffing type with level luffing included in the design. Level luffing is an arrangement whereby the hook moves approximately horizontally when the jib is derricked or luffed.

Cranes of this type are characterized by their high hoisting, luffing and slewing speeds.

Cranes of this type range in size from those suitable for light cargo handling to very heavy lift types.

8.4 Manually-operated and light cranes. These include manually-operated and light cranes which can be either complete units or those from which the lifting appliance can be removed from its support. The jibs/runways/tripods/shear legs may be cantilevered, horizontal, movable or fixed and the hoisting mechanism may be operated manually, electrically, hydraulically or pneumatically.

8.5 Container handling cranes. These cranes are specifically designed for the purpose of handling containers and incorporate a purpose-built spreader in their construction.

8.6 Rail-mounted low carriage cranes. These cranes are usually equipped, in basic form, with a derricking jib, and may or may not be capable of travelling under their own power with a suspended load (see Figure 1). They are suitable for use at such locations as docks, shipyards, sidings, factories, etc. where railway tracks are readily available. Cranes designed specifically for railway breakdown or track laying/maintenance purposes are not covered by this code.

8.7 General considerations for selection

8.7.1 The above types of crane are available with a number of different characteristics. The various cranes available should be considered against the job requirements when selecting the type, number and size of crane(s) to be used for a particular application.

Points to be considered in making the selection include:

a) weights, dimensions and types of loads;

b) heights of lift and distance/areas of movement of loads;

c) number, frequency and types of lifting operations;

d) length of time for which the crane will be required;

e) site and environmental conditions, space available for crane access, erection, operation and dismantling;

f) any special operational requirements or limitations imposed.

8.7.2 Reference should be made to the relevant clauses of the appropriate section of this code for details of the different types of crane and their operational characteristics.

8.7.3 Having decided upon the type of crane to be used on a site and knowing the overall requirements for the intended use, a crane having a working margin with respect to load, radius and height of lift should be selected.

9 Siting of cranes

In siting a crane for operation, particular attention should be given to the following factors:

a) the crane foundation or support conditions;

b) the presence of proximity hazards.

9.1 Support conditions

9.1.1 *Crane foundation.* The ground or foundations, supporting structure and anchorages for cranes should be of sufficient strength to withstand the maximum loadings imposed under in-service and out-of-service conditions without failure, settlements or deflections which might endanger the stability or safety of the crane. The siting of the crane, the assessment of maximum loads and the design of foundations, supporting structures and ancillary details should be approved by a competent engineer or authority experienced in crane design or construction. Particular care should be taken to ensure that the imposed loadings are not underestimated, and also a careful estimate of probable wind pressures should be made, taking into account the degree of exposure of the site and any other special factors. Crane manufacturers' data relating to the dead weight of the crane and the dynamic forces which can occur during operation of the crane should always be obtained.

Under working (in-service) conditions, the loads imposed on the crane foundation or support are usually due to the combined effects of:

a) the dead weight of the crane (including any counter-weight and/or ballasting);

b) the weight of the load and any lifting attachments;

c) dynamic forces caused by movement of the crane and load during operations;

d) wind loadings, resulting from operation in wind speeds up to the maximum permitted for in-service conditions, acting in any direction on the crane and load.

When the crane is not being used (out-of-service) the loads imposed on the crane foundation or support are usually due to the combined effects of:

a) the dead weight of the crane (including any counter-weight and/or ballasting);

b) wind loadings, acting in any direction, due to the maximum wind pressures. These can be calculated by a competent engineer and guidance may be found in BS 2573-1.

Particular care should be taken to estimate dynamic forces arising during operation, for which data should be obtained from the crane manufacturer. A generous margin should be allowed for unpredictable effects. When cranes are mounted on temporary elevated structures, it is essential that due account be taken of torsional reactions arising from slewing of the crane with load.

The overall stability and safety of a crane should be carefully checked in relation to local conditions.

The analysis of the forces imposed by a crane on its foundation or support is a vitally important matter which should always be checked by a competent engineer. The vertical and horizontal forces imposed are not uniformly distributed; their magnitude may be much greater than the loadings that cause them and will vary according to the position and movement of the crane load and direction and speed of the wind. Although crane manufacturers' instructions may specify maximum wind speeds for service conditions, they cannot give recommendations for survival wind conditions on a particular site. On tall cranes wind forces will have a considerable influence on the strength requirements of the foundations and supports and adequate allowance must be made in the fitting-up and fixing of any holding-down devices, rail clamps, temporary connections or anchorages.

9.1.2 *Crane tracks.* The track on which any crane is used should be level to tolerances agreed by the manufacturer and have an even running surface, be sufficiently and adequately supported and be of adequate section. Railway track should be securely fastened to sleepers or bearers or a continuous supporting structure, with properly made joints as necessary, such that no undue movement of the rails occurs. Holes in rails should be drilled; on no account should they be flame-cut since this may cause failure. Special precautions are necessary when welding rails.

The track should be laid so that at all times the crane can be moved freely without danger of derailment. Stops or buffers should be installed at the ends of every track.

9.2 Proximity hazards, etc. Consideration should be given to the presence of proximity hazards such as overhead electric lines or conductors, nearby structures, cranes, vehicles being loaded or unloaded, stacked goods, public access areas including highways, railways and rivers, etc. The danger to or from underground services, such as gas mains or electric cables, should not be overlooked. Precautions should be taken to ensure that the crane foundation is clear of any underground services or, where this is not possible, that the services are adequately protected to safeguard against damage being caused.

Where the whole of the crane or its load cannot be kept clear of passenger railway lines, highways or rivers, the appropriate authority should be consulted.

At any place where a crane passes fixed obstacles, stacked goods or vehicles being loaded or unloaded, the following points should be observed.

a) The crane path should be clearly defined by marking to ensure that it is kept free from obstruction. Where practicable a clearance of not less than 900 mm should be arranged between the crane and any obstacle. Where it is not reasonably practicable to achieve this clearance, effective precautions should be taken to prevent access to any trapping hazards.

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

9.2.1 *Electric lines and cables.* Many fatal accidents have occurred owing to part of a crane or its load touching, or even coming near to, electric lines or cables. When a crane is installed in the vicinity of, or can travel under, overhead lines or cables, the District Engineer of the local Electricity Board or Generating Board, or the responsible engineer of the works or authority concerned should be consulted well in advance. He will advise on safety precautions to be taken and these should be incorporated in an overall safe system of work.

Devices are available which are designed to be fitted on cranes to give warning when the crane comes within a predetermined distance of the power line. Such devices have limitations and should not be considered as a substitute for a safe system of work.

9.2.2 *Visibility.* When visibility is restricted due to manufacturing processes, consideration should be given to fitting a proximity device to reduce the possibility of accidents.

10 Installation

10.1 Manufacturer's instructions. It is essential that the crane manufacturer's instruction book is available and is strictly adhered to. Any departures from the specified procedures may impose excessive loadings on structural and mechanical parts and should be checked by the manufacturer.

Only correct parts and components should be used.

10.2 Ropes. General comments on the installation, use and maintenance of ropes are given in clause **14**.

10.3 Electrical supply. The following points should be noted.

a) *Supply voltage.* Before connecting the crane to an electrical supply it should be ensured that the characteristics of the power supply and of the crane equipment are compatible.

b) *Connections*. Where practicable the power supply to a travelling crane should be through a cable-winding drum, a catenary system or a properly installed, insulated and protected collector system. The use of uninsulated collector systems is not recommended.

If a trailing cable is used it should be mechanically protected, e.g. with wire armour, and it should incorporate an earthing core and be suitably terminated at each end. Care should be taken to ensure that the trailing cable is not damaged during operational movement or when travelling the crane. The distance travelled should be well within the length of the trailing cable.

c) *Isolation*. In addition to any isolator within the crane, capable of cutting off the electrical supply to the crane motions, there should be an identified isolator remote from the crane which can be used to cut off the electrical supply to the crane itself. All isolators should be capable of being locked in the "off" position where possible and should be identifiable with the crane power supplies they control.

11 Procedures and precautions

11.1 Leaving the crane unattended. Precautions are necessary when a crane is left unattended. For details of methods to safeguard particular types of crane, reference should be made to the appropriate section of this code, and the crane manufacturer's instruction book.

11.2 Routine procedures. At the beginning of each working day, the driver, or other competent person, should carry out the routine procedures for the crane which, if applicable, should include the following.

a) Look at the structure for damage.

b) Observe the ropes, the rope terminal fittings and anchorages for obvious damage and wear.

c) Ensure, by visual inspection, that no electrical equipment is exposed to contamination by oil, grease, water or dirt.

d) Confirm that the oil level(s), fuel level and lubrication are satisfactory.

e) In the interests of safety and fire prevention, ensure that the crane is in a tidy condition and free from tins of grease and oil, rags, tools, or materials other than those for which storage provision is made.

f) Drain any water from air or oil receivers.

g) Ensure that no maintenance or other personnel are on or in the immediate vicinity of the crane.

h) Ensure that the operating pressures in the air and/or hydraulic system(s) are adequate.

i) Ensure the satisfactory operation of the crane through all motions, with particular attention to brakes to ensure that these are operating effectively.

j) Ensure as far as possible that the automatic safe load indicator and load radius indicator are functioning correctly.

NOTE It should be noted that the test button provided on certain automatic safe load indicators only confirms that the electrical circuit and power supply are satisfactory. Such test buttons cannot confirm the correct functioning of the indicator mechanism which can only be effectively checked by lifting a known load at the appropriate radius.

k) Confirm the operation of all limit switches or cutouts and the dead man's handle or lever, using caution in making the checks in case of non-operation.

These procedures are intended to determine whether any part of the crane or the gear has any visible defect likely to affect the continued safety of the crane. The extent to which these procedures are applicable will depend on the frequency of planned preventative maintenance.

11.3 Reporting of defects. Should the driver or maintenance staff find any defect or abnormality in the crane or in the operation of the crane, or should the crane be damaged, this should be reported immediately to the person responsible for the safe use of the crane. The crane should be taken out of service until the faults have been corrected and/or clearance is given by the responsible person.
A notice should be attached to the crane stating that the crane must not be used.

11.4 Safe system of work. Before any repairs, adjustments or examinations are carried out on a crane, a safe system of work should be established to protect the personnel carrying out the task against the crane being moved or its power system being activated.

Reliance on verbal instructions alone is not enough to ensure a safe system of work. A formal system should be devised to ensure effective communication between all parties concerned, e.g. drivers, maintenance staff and/or contractors.

A means of achieving this may be by the provision of a permit to work system. Under such a system, a nominated person, having isolated and locked off the electrical supply or other power sources, issues the person who is to undertake or supervise the work a certificate to the effect that it is safe to work on that crane. On completion, the person who has carried out the work signs that he has removed all tools, etc., and warned any person who is under his charge that it is no longer safe to work on that crane. On receipt of this declaration, the nominated person can restore the crane to service.

The essential details of a permit to work system are as follows:

a) that isolation is adequate for the work being undertaken;

b) that isolation remains secure whilst the permit to work is in force;

c) that the crane is clearly identified;

d) that no work other than that specified is carried out;

e) that the safe working area is clearly defined;

f) any special precautions should be stated;

g) the system should be monitored.

11.5 Safe means of access. There are statutory requirements that safe means of access shall be provided:

a) to the driving position of the crane;

b) to enable inspections and maintenance work to be carried out.

Personnel should be instructed to use only the proper means of access provided.

No person should be permitted to board a crane without the driver's permission. Where the point of access is out of sight of the driver, special precautions need to be taken.

Precautions also need to be taken when boarding or leaving a crane with pendant or radio control.

a) In the case of a crane with pendant control, a second person should be made responsible for protecting the person boarding the crane.

b) When only one person is to board a radio-controlled crane, this person should switch the radio transmitter off, remove the key from its keylock switch and retain possession of the transmitter when boarding the crane.

When more than one person is to board the crane, the person in charge of the radio transmitter should be made responsible for all persons on the crane.

It is essential that provision is made for means of escape in an emergency.

12 Safe working loads and operational conditions

12.1 Safe working loads. The safe working load of a crane is the maximum load **UNDER SPECIFIED CONDITIONS** for which the crane should be used and, if exceeded, could lead to structural failure or in certain cases, to overturning. The difference between the safe working load and the load that would cause failure or overturning allows for various forces which act on the crane in operation. These include allowance for wind loading and dynamic forces set up by movements of the crane and load. It is essential, and in most cases a statutory requirement, that the safe working load is clearly marked in a prominent position on the crane.

Care should also 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 as shown in Figure 3.

Safe working loads apply only to freely-suspended loads. It is expressly forbidden to use the crane hook or slewing, traversing or travelling motions of a crane to drag any load along the ground. Also, before lifting a load, the hoist line should be plumb (see Figure 4). Failure to observe these points may hazard the stability of the crane or introduce loadings (stresses) into the crane for which it has not been designed, and, even with an automatic safe load indicator fitted, a structural failure may result without any warning being given.

Crane manufacturers' safe working loads are based on and apply only to cranes in good condition. It should be ensured that the structure is not damaged, with structural members bent or kinked or with welding defective or cracked. If the structure is damaged or should become damaged in service, such as might occur if the load strikes the structure, the driver should report this at once to the person responsible for the safety of the crane.

Reference should be made to the crane manufacturer's handbook or the appropriate machine specification to ensure the restrictions, limitations or special conditions applicable to a particular crane are known and taken into account during the operation of the crane.

Further reference should be made to the sections of this code that contain safe working loads for different types of crane and the factors affecting the safe working loads.

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 identifiable with the motion it controls and with the direction of motion that results from operation of the control.

On no account should the driver tamper with any controls, mechanisms or equipment either to enable the crane to function outside the operational range or loads specified by the crane manufacturer or other competent person, or to attempt to correct any suspected defect.

Before starting any lifting operation with a crane the following should be observed.

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

b) The driver should have a clear and unrestricted view of the load and operational area. If not, the driver should act under the directions of the slinger or an authorized signaller who is positioned to have a clear and uninterrupted view; in some circumstances this may be a legal requirement. It is particularly important that the driver should ensure that lifts can be carried out without causing damage to cargo or property; the driver should therefore ensure that loads and crane hoist ropes are well clear of obstructions, i.e. walls and roofs of buildings, hatchway coamings, masts, rigging and structure of ships, etc.

c) Where telephone, radio or closed-circuit television communications are being used, the driver should ensure that the calling signal is functioning and that verbal messages can be clearly heard.

d) Where air or hydraulic systems are used the driver should ensure that the gauges are functioning.

e) Where air or hydraulic systems are used the driver should ensure that the system(s) is/are at the correct operating pressure(s).

It is essential to ensure that the hoist rope, or if applicable the hoist chain, is vertical at the commencement of, and throughout, the hoisting operation. The load should initially be lifted just clear of the supporting surface and be brought to rest while the slings, balance of the load, etc. are checked, before proceeding. Proper care should be exercised by the driver at all times to avoid shock or side loadings on the jib or structure. Care should also be taken to avoid the hook coming into contact with the structure.

If it is necessary during normal operations to hold a load suspended for any period of time, the driver should remain at the controls so that the crane is fully operational to meet any emergency arising.

It is undesirable, where motion motors are to be reversed, to put the controller over to the reverse position before the motor has come to rest, unless the control gear is specifically designed to allow this to be done.

It is undesirable, for safety reasons, to subject the crane motion safety devices to continual operation. Care should therefore be taken when approaching the motion limits to avoid their frequent operation.

In areas which are not adequately illuminated, all travelling cranes which move close to where personnel have to pass or work should be distinguished at the leading end of the crane by a suitable warning lamp.

Before any crane is moved along its track, a warning should be given by the person in charge of the lifting operation to all personnel whose safety is likely to be endangered. A warning bell or klaxon may be fitted for this purpose.

12.2.2 *Radio-controlled cranes.* It is essential that the radio-controlled crane incorporates a controlled range feature which enables the operating range to be positively limited to a safe distance determined by the competent person responsible for safety. The practical effect of this is that if the driver tries to send the crane beyond the controlled range, the main contactor of the crane will open automatically and the crane should come to rest under the action of its automatically operated progressive form of long travel brake.

It is important that the controlled range feature should be tested at suitable intervals and it is necessary that at the beginning of each shift, or where there is a change in driver, the controlled range should be checked to ensure that it is in accordance with the limits specified for its operation.

To prevent unauthorized use, the driver of a radio-controlled crane should:

a) retain the transmitter in his physical possession;

b) remove the key from its keylock switch and, for short periods, retain the key in his possession;

c) for longer periods, or when the crane is not in use, deposit the transmitter in safe storage.

NOTE Provision should be made for the security of the transmitter when the crane is not in use.

When the radio transmitter is fitted with a bolt or harness, the driver should be wearing the harness before switching on the transmitter so that accidental operation of the crane is prevented.

The transmitter should only be switched on when operating the crane and should be switched off before removing the harness.

12.3 Handling of loads near persons and carrying of persons

12.3.1 *Handling of loads near persons.* When loads have to be handled in the vicinity of persons, extreme care should be exercised and adequate clearances allowed. Drivers and signallers should pay particular attention to possible dangers of persons working out of sight, e.g. working in holds or cargo spaces of ships.

All persons should stand clear of the load being lifted. When lifting from a heap, all persons should stand away from the heap in case other adjacent material or objects are displaced.

Lifting of loads over highways, railways, rivers or other places to which the public have access should be avoided. If this is not possible, permission should be obtained from the appropriate authority and the area kept clear of traffic and persons.

12.3.2 *Carrying of persons by cranes.* The carrying of persons by crane is subject to certain statutory regulations. (See Regulation 47 of the Construction (Lifting Operations) Regulations 1961.) Requirements include provision of a properly designed safety chair or suitable skip or cradle. Skips which can tip should not be used.

12.4 Tandem lifting

12.4.1 *General considerations.* Lifting a load with two cranes can be a potentially dangerous operation because of the effects of the relative motions between the two cranes, the load, and any lifting gear used and the consequent difficulty in monitoring and evaluating these relative motions during a lifting operation. Tandem lifts should therefore be considered only where the physical dimensions, characteristics, weight or required manipulative movement of the load prevent the operation being carried out by a single crane.

A tandem lift requires to be planned with extreme care by a competent person, and should include an accurate assessment of the portion of the load to be carried by each crane. It is essential that the reason for and the extent to which the hoist rope(s) may come out of plumb should be evaluated. Neither crane should be subjected to forces in excess of those which occur when it is handling its safe working load. Additional forces would cause a prima facie breach of statutory safety regulations and, depending on the size of the additional forces, may affect the stability or structural strength of the crane(s), either immediately or in the longer term.

12.4.2 *Factors to be considered in planning the lifting operation.* If all the factors governing the distribution of the load between the two cranes can be accurately determined, it is theoretically possible to use each crane up to its safe working load. In practice it is unlikely that factors can be evaluated with precision and, therefore, it is essential to assess the possible inaccuracies, consider their effect on the distribution of the loadings on the cranes, and make such reduction in the acceptable load on each crane as may be appropriate to the particular operation and conditions. The principal factors to be considered are as follows.

a) *Weight of the load.* The total weight and its distribution should be either known or calculated. Where the information is taken from a drawing, due allowances should be made for casting and rolling margins and manufacturing tolerances.

b) *Position of the centre of gravity.* Owing to the variable effect of manufacturing tolerances and rolling margins, quantity of weld metal, etc., the position of the centre of gravity of the load must lie within a spheroid of uncertainty and in consequence the proportion of the whole load being carried by each crane is subject to error.

c) *Weight of the lifting gear.* The weight of the lifting gear is part of the calculated load on the cranes. When handling heavy or awkwardly shaped loads, the deduction from the safe working load(s) of the cranes to allow for the weight of the lifting gear may well be significant. The weight of the lifting gear and its distribution should therefore be accurately known.

In cases where the crane ropes are reeved round pulleys that are part of a specially designed piece of lifting gear, e.g. a lifting beam, it is acceptable to take the weight of the removed hook block and hook into consideration when determining the net weight of the lifting gear.

d) *Capacity of the lifting gear.* The distribution within the lifting gear of the forces which will arise during the lifting operation should be established. The lifting gear used should, unless specially designed for the particular lifting operation, have a capacity margin in excess of that needed for its proportioned load. Special lifting gear may be necessary to suit the maximum variation in distribution and direction of application of loads or forces which can occur during tandem lifting.

e) *Synchronization of crane motions.* If the variation in the direction and magnitude of the forces acting on the crane during the tandem lift are to be kept to a minimum, it is essential that the crane motions are synchronous in their effect. Thus, whenever possible, cranes of equal capacity and similar characteristics should be used. In practice there will always be some variation due to differences in response to the activation of the motion controller and the setting and efficiency of the braking system.

The safe working load of a crane is based on the premise that the load will be raised and lowered in a vertical plane. The crane structure will have been designed to withstand any lateral loads imposed by accelerations in the various crane motions, but it is unsafe to rely on this lateral strength to withstand horizontal components of out-of-plumb lifts. Since it is unlikely, particularly if the cranes have dissimilar characteristics, that the motions of the two cranes will be accurately synchronized, an assessment should be made of the effect of variation in plumb of the hoist ropes, which may arise from inequalities of speed, together with a determination of the means for keeping such inequalities to a minimum.

12.4.3 *Recommended margins on the safe working load.* The conclusion to be drawn from a) to e) of **12.4.2** is that although the effects of the various factors can be assessed and controlled to a certain extent they cannot be eliminated. It is therefore necessary that each crane should have a reserve of capacity over and above its calculated share of the load. The following recommendations are made.

a) In the case of rail-mounted low carriage cranes, or others if the crane stability is the significant criterion for safety, the safe working load of each crane for the required jib length and operating radius should be at least 25 % in excess of the calculated share of the load to be handled by each crane during the tandem lift.

b) In the case of other cranes covered by this code the safe working load of each crane should be at least 10 % in excess of the calculated share of the load to be handled by each crane during the tandem lift.

These percentages should only be reduced if the person planning the tandem lift can establish without any doubt that the variable factors do not warrant such percentages.

12.4.4 *Control and supervision.* The procedure for a tandem lift should be prepared by a specially appointed person, who should ensure that all personnel involved in the operation, including supervisors, crane drivers, and slingers are acquainted with and understand the procedure to be followed. The procedure should be well rehearsed to ensure that the personnel involved appreciate their role in the operation. The code of signals to be used throughout the operation should be understood by all persons involved.

12.5 Special duties. In all cases involving special duties, manufacturer's guidance should be obtained.

The weight of any special lifting attachments should always be included as part of the load to be lifted. Attachments should be tested, certified and plainly marked with the safe working load and weight of the attachment. They should only be used for the purpose for which they were designed.

12.5.1 ***Grabbing and magnet crane service***

12.5.1.1 *General considerations.* 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, will be less than the corresponding safe working load for normal crane duty. Reference should be made to the crane manufacturer for details of special duty ratings.

12.5.1.2 *Grabbing service.* In the case of grabbing cranes, the load lifted is the weight of the grab and its contents; the latter weight depends on the density of the material handled. It is essential that any grab used is of appropriate capacity for the material, having regard to the safe working load of the crane. A weight check should always be made in case of doubt.

12.5.1.3 *Magnet service.* It should be appreciated that a load supported by a magnet is not as secure as a load supported by a hook. Precautions are therefore necessary to ensure that there is no hazard to personnel caused by unexpected release of the load.

The magnetic device should be marked with the safe working load as determined by tests using weights of the same characteristics as the load for which the device is intended to be used.

The power to the magnet should not be switched on until after the magnet has been lowered on to the load to be lifted.

The device should be carefully lowered on to the load and not dropped and should not be allowed to strike a solid obstacle whilst in use.

The device 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 magnets becoming too hot.

When not in use, the device should not be deposited on the ground. It should be left suspended or, if detached from the crane, it should be rested on a wooden platform.

12.5.2 *Vacuum lifting devices.* Vacuum lifting attachments should be regularly inspected to ensure that adequate suction is maintained over the required period.

Every vacuum lifting device should be fitted with a device that gives a visual indication to the driver of the crane of the state of the vacuum at any time and an audible warning to the driver and any person working in the vicinity at ground level when the vacuum is 80 % or less of the designed working vacuum and/or in the event of the vacuum inducing pump ceasing to operate.

12.5.2.1 Every vacuum lifting device should:

a) be fitted with means that, in the event of failure of the vacuum inducing pump, will maintain sufficient vacuum to continue to support the load suspended for a sufficient time, together with a safety margin, for that load to be safely deposited from the maximum height of lift of the crane to ground level;

b) be fitted with a suitable vacuum gauge.

1) The gauge should be of sufficient size and situated in a position where the gauge reading may be easily read at the attachment and release position of the load.

2) The gauge should be distinctively marked with a red mark to indicate the lowest vacuum below which the appliance should not be used.

A vacuum lifting device should only be used to lift loads that have a surface suitable for vacuum lifting pads.

12.5.2.2 The vacuum device should be used in such a way that:

a) each pad supports as far as is practicable an equal part of the load;

b) the contact surface of the load is suspended horizontally as far as this is possible;

c) the surface of the load to be handled is clear of any loose material that would prevent any vacuum pad from making an effective contact with the surface.

12.5.2.3 It is recommended that the vacuum device should:

a) be tested by a competent person before being taken into use for the first time or after any substantial repair, by application of a test load. The test load surface should, as far as is practicable, be similar to the worst type of surface on which the device is intended to be used;

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

12.6 Weather conditions

12.6.1 *Wind.* Cranes intended for use in positions exposed to wind are designed to operate in "steady wind conditions". Gusting wind conditions may have an adverse effect on safe handling of the load and the stability of the crane. Even in relatively light wind conditions it is prudent to avoid handling loads presenting large wind-catching surfaces which might result in loss of control of the load or overturning of the crane despite the dead weight of the load being within the normal working capacity of the crane.

Instructions issued by the crane manufacturer advising of conditions under which a crane should be taken out of service and recommending the conditions in which it should be secured, should be strictly followed. In addition, written instructions regarding local conditions should be issued which should state the maximum operating wind speed above which the crane should be taken out of service. Further reference is made in **44.5** and **75.4** to instructions for taking a crane out of service and securing during adverse weather conditions.

An anemometer should be available to indicate wind speeds in the vicinity of the crane. In the case of high cranes the anemometer should be mounted at the highest point of the crane structure.
The anemometer should be checked at regular intervals to ensure not only that it is working but also that it is giving an accurate indication.

A conversion chart covering wind speeds and pressures is shown in Figure 5.

12.6.2 *Rain, snow and fog.* If the visibility or range of sight of the driver is impaired by snow, fog or other adverse weather conditions, suitable means of communication should be provided for the safe operation of the crane; alternatively, crane operations should be temporarily suspended.

Brake or clutch units on all cranes should be protected against rain or other adverse weather conditions. Following shut down periods and before starting lifting operations, all friction brakes and clutches should be cautiously tested for efficiency to ensure freedom from moisture.

13 Testing and examination

Various tests and a thorough examination are required to ensure that a crane can be safely used. Table 1 gives the legal requirements under certain statutory regulations for the testing and thorough examination of cranes. Additional tests and thorough examination may be necessary following any substantial alteration or repair to the crane. The requirements detailed in Table 1 apply to all cranes unless otherwise stated. However, the schedule does not give requirements for lifting gear and tackle.

13.1 Thorough examination. A thorough examination should be understood to mean the following.

a) A detailed visual examination carried out as carefully as the conditions permit, in order to arrive at a reliable conclusion as to the safety of the appliance examined.

b) Whenever considered necessary by the competent person, the visual examination can be supplemented by methods of non-destructive testing that determine the condition of any part of the crane without causing any detrimental change in the material.

c) Where the competent person considers it necessary, parts of the lifting appliance should be dismantled by a skilled person, to the extent required by the competent person.

13.2 Ballasting and anchorage test. Cranes that depend on adequate anchorage and/or ballast for safe operation should be tested after erection or any alteration likely to affect the adequacy of the anchorage and/or ballast.

13.3 Overload test. An overload test generally requires the crane to be operated through all motions with an applied load in excess of the intended safe working load. In certain circumstances the statutory requirements prescribe the value of the load to be applied, e.g. the Docks Regulations 1934 and the Shipbuilding and Ship Repairing Regulations 1960.

In other circumstances the value of the test load will be prescribed by the competent person conducting the test.

Before any overload test is carried out, it should be established by reference to a person or authority experienced in crane design and construction that the design of the crane allows for the imposition of an overload of a decided value and for the position at which the overload may be handled. It should be noted that the maximum load may be limited by the structural strength of the crane and not by the stability of the crane, in which case a structural failure may occur, e.g. the structure might buckle or collapse, without warning, before the crane starts to tip.

During each test each motion in turn should be manoeuvered in both directions and the crane should sustain full control of the load. The crane should show itself capable of dealing with the overload without difficulty but it will not be necessary for the crane motions to achieve speeds specified for the safe working load.

The competent person conducting the test will take due account of the actual condition of the crane, this being particularly important when retesting a used crane. It should be noted that an overload test is not the sole criterion for assessing the safe working load of the crane.

The results of the overload test may make it necessary to reduce the safe working load.

When the overload may cause damage to the automatic safe load indicator, the indicator should be disconnected during the period that the test overload is being applied to the crane. On completion of the test, the indicator should be reconnected and carefully checked to ensure correct functioning, following which the appropriate certificate should be issued.

13.4 Automatic safe load indicator test. Automatic safe load indicators should be tested, using known weights, after erection, installation or removal likely to have affected the operation of the indicator. In certain circumstances this is a legal requirement.

It should be noted that the test button provided on certain indicators only confirms that the electrical circuit and power supply are satisfactory. Such test buttons cannot confirm the correct functioning of the indicator mechanism which can only be effectively checked by lifting a known load at the appropriate radius.

14 Ropes

14.1 Selection. Many factors influence selection of a wire rope for a particular application on a crane. The strength of a rope, although of major importance, is only one of these factors; it is essential, therefore, to use only ropes of the correct size, type and construction as specified by the crane manufacturer, competent engineer or authority experienced in rope selection and usage.

14.2 Rope lengths. It should be ensured that the correct length of rope is fitted for the intended application and duty of the crane and it is essential to ensure that at least 2.5 dead turns of rope remain on the drum when the rope is paid out to its maximum working length.

Particular care should be exercised on cranes with variable jib lengths, as it may be necessary to change the rope and to fit a specific length of rope for a particular jib length and rope reeving combination. Too short a rope could result in the rope completely paying out and all the load would be taken by the anchorage. An extremely dangerous situation could arise following a rope or jib length change if the first lift is from an elevated position to ground level, e.g. in a dismantling operation. Too long a rope may exceed the drum spooling capacity and result in the rope riding over the flanges and becoming trapped in the machinery causing severe damage and possibly premature failure.

After changing the length of jib, or the length and/or number of falls of the hoist rope, it is good practice to check the adequacy of the rope length before making the first operational lift. This is particularly important where abnormal conditions occur, such as when a load is to be lowered to below ground level. Before lifting operations commence, the jib should be raised to its maximum working angle and the hook lowered to ground level or a lower point, if required, to ensure that at least 2.5 dead turns remain on the drum; the hook should then be raised to the highest point to check that the drum capacity is not exceeded.

14.3 Rope handling and installation. Careless handling of a new rope can lead to damage, short life and unsatisfactory performance in service. Rope manufacturers' recommendations on rope handling and installation should be followed. When installing a rope on a crane drum, care should be taken to avoid kinking or twisting of the rope as this will damage the rope and adversely affect spooling and may cause the vertical falls of the hoist rope to twist together during operation. Also, to ensure correct initial spooling, a tension should be applied to the rope as it is guided onto the crane drum.

If the rope is supplied in a coil, this should be uncoiled by rolling along the ground in the same way that a fireman runs out a hose. Alternatively, a rope supplied on a reel should be uncoiled either by rolling the reel along the ground or by rotating the reel, mounted on a support axle. In no circumstances should the rope be pulled from a coil or reel lying flat on the ground (see Figure 6).

When it is necessary to lay a rope out on the ground, care should be taken to ensure that the surface is free from any matter likely to be injurious to the rope.

14.4 Rope spooling. If at any time during crane operation the hoist rope is relieved of tension by over-lowering and the rope on the drum becomes slack and cross-coiled or trapped in part of the crane machinery, no further lifting operations should be undertaken until the rope has been paid out, examined for possible damage by a responsible person and replaced or re-spooled correctly.

14.5 Rope guards. Where rope guards are fitted to pulleys or drums it is essential that these remain in their correct positions and are removed only for the purposes of maintenance, inspection, examination or adjustment. This is of particular importance where, in certain circumstances, the rope system may be relieved of tension. Failure to observe this procedure may allow a rope to run off the pulley or drum and become trapped.

14.6 Guide rollers and guide pulleys. Rollers or guide pulleys are sometimes fitted on the jib to ensure that the rope does not rub against the jib structure. Where these are fitted it is essential to check frequently that they are free to rotate. A seized roller or pulley will cause serious damage to a rope, leading to its premature failure.

14.7 Rope drums and pulleys. Where drums or laggings are replaceable it should always be ensured that the correct drum or lagging is fitted for the size of rope used and the duty requirements.

Rope drums and pulleys should be examined at regular intervals, for if they are badly worn this will have an adverse affect on rope life. Where replacement is necessary, only items supplied or approved by the crane manufacturer should be fitted. Some designs may allow for drum and pulley grooves to be re-machined, but this operation should only be undertaken in accordance with the manufacturer's instructions. There is a limit to the amount of metal that can be removed before the strength of the component will be affected.

Pulleys should revolve freely on their supporting shafts and particular attention should be paid to lubrication.

14.8 Rope terminations. The means of securing ropes to a drum, hook block or structure of the crane should be as specified by the manufacturer. Care should be taken to ensure that anchorage points are securely fastened in accordance with instructions.

For wedge and socket terminations, particular attention should be paid to the details given in **14.9** and Figure 7.

14.9 Wedge and socket terminal fittings

14.9.1 *Assembly of wedge and socket terminal fittings for ropes.* The following points should be noted.

a) It is essential to use only a wedge and socket of the correct size and strength for the rope fitted. Failure to do so may result in the rope pulling through the fitting as soon as a load is applied.

b) Wedges and sockets for a particular size of rope obtained from different manufacturers may not be interchangeable owing to dimensional differences. The mixing of components obtained from different suppliers should be avoided and the fit of the wedge (with rope) in the socket should always be checked at the time of assembly. Too large a wedge, or a wedge of incorrect taper, will not sufficiently enter the socket to give a secure termination; too small a wedge will protrude too far through the socket and the local loading may cause the socket to crack and open out, allowing the wedge to pull through.

c) The rope should be fitted so that the live or loaded part of the rope is not kinked where it leaves the socket, but pulls directly in line with the point of attachment of the socket, as shown in Figure 7. Incorrect fitting will result in premature failure of the rope.

d) When making up the termination, a dead-end length of rope not less than 15 times the diameter of the rope should be left protruding from the socket, e.g. 195 mm (7¾ in) dead-end length for a 13 mm rope. If a rope with a tapered end is used, the tapered section should be clear of the socket fitting.

e) After making or remaking a wedge and socket termination, it is essential that the wedge and rope are properly seated in the socket before the crane is put into service. Failure to do so may allow the rope to pull through the fitting or, particularly when using a new rope, the wedge to be sprung out of the socket.

Initially the wedge should be hammered home, protecting the fitting and rope against damage, by using a wooden packer. Simultaneously a second man should be pulling on the ends of the rope. The load should then be raised and left suspended to seat the wedge and rope firmly into the socket before the crane is used operationally.

In the case of a hoist rope, the dead-end length of rope protruding from the socket should be looped back on itself and secured by a wire rope grip to form the loop. The loop should be lashed to the live part of rope by suitable means, such as soft binding wire, to prevent flexing of the rope in service. This technique of termination should not be used if there is the possibility of interference of the loop with the working structure. (See Figure 7.)

14.9.2 *Special care applications.* Special care is necessary in any application where there is a possibility of the rope dead-end in a wedge and socket termination coming into contact with an obstruction which might loosen the wedge, causing the rope to pull free. In such cases it is recommended that the dead-end length of rope is lashed to the live rope using soft binding wire.

14.9.3 *Inspection.* During inspection particular attention should be paid to:

a) rope damage, as might be evidenced by broken wires or deformation of the rope where it emerges from the socket;

b) the condition of the socket, i.e. that there are no cracks in the socket as might be expected if the wedge is seen to protrude excessively;

c) the security and tightness of the wedge fitting.

The socket and wedge and part of the rope lying inside the fitting should be examined each time the socket is disassembled for any reason. If necessary an undisturbed portion of the rope should be used when remaking the anchorage.

Wedges found to be damaged by rope indentation should be replaced by new wedges of correct size for the rope in use. Sockets should be cleaned and carefully examined for cracks or other signs of damage and replaced as necessary.

14.9.4 *Exceptions to use.* The use of rope wedge and socket terminations is not recommended in any case where a crane hoist rope supports a man-carrying skip or platform.

14.10 Examination of ropes. Thorough examination is necessary periodically to ensure the safety of rope systems. Ropes should be thoroughly examined by a competent person for wear, damage and corrosion. Particular attention should be paid to the splices, the area lying close to terminal fittings and to any other section of rope which has from previous experience been shown to be liable to early deterioration. In the case of ropes which are composed of more than one layer of strands, such as non-rotating ropes, deterioration may occur internally at the interface between the layers and where this is suspected it is essential that the rope be opened up and the inner strands examined. This is an operation needing care and understanding and should only be undertaken by an experienced person. Where multi-layer drums are used, it is necessary to examine not only that part of the rope which is in constant use but also the rope which may remain spooled and inoperative on the drum for long periods.

Particular attention should be paid to the possible effects due to climatic and environmental conditions, especially where a crane is operating in a saline or other corrosive atmosphere or in the presence of abrasive dust in the atmosphere.

Current legislation requires examination of ropes at specified intervals and attention is drawn to the relevant section in the statutory instruments listed in clause **4**.

14.11 Rope care and lubrication. New ropes will have been lubricated during manufacture and this lubricant will be adequate for initial storage and the early stages of a rope's working life. This initial lubrication should normally be supplemented at regular intervals with a dressing in accordance with the crane manufacturer's instructions or as approved by the rope maker. However, before a rope preservative dressing is applied, it is essential that the rope is thoroughly clean and free from matter that may be injurious to rope life. Also, consideration is to be given to the environmental conditions in which the rope is to be used. In applications where driving sand, fly ash or abrasive dust may adhere to the treated surface, the rope manufacturer should be consulted before any dressing is applied. The use of other dressings, such as old lubricating oil, is deprecated, since these frequently contain chemicals which may have an injurious effect on the ropes.

14.12 Rope storage. Replacement or alternative ropes should be stored preferably on reels with the outer surface covered to protect the rope and prevent the ingress of water or matter injurious to the rope. Where storage is required over long intervals, it is good practice to examine the ropes periodically and to apply an approved dressing as necessary.

Ropes that have been removed from a machine should be thoroughly cleaned and dressed before being stored under clean and dry conditions.

15 Chains

15.1 Selection. Many factors influence the selection of chain for a particular application on a crane. The strength of chain, although of major importance, is only one of these factors; it is essential therefore to use only chains of the correct size, type and construction as specified by the crane manufacturer, competent engineer or authority experienced in chain selection and usage.

Chains provided for hand operation of the hoist unit should not be used in any way directly for raising, lowering or suspending a load.

15.2 Chain lengths. It should be ensured that the correct length of chain is fitted for the intended application and duty of the crane to avoid the chain anchorage being subjected to the full load.

15.3 Chain handling and installation. Careless handling of a new chain may lead to damage, short life and unsatisfactory performance in service. The chain manufacturer's recommendations on chain handling and installation should be followed.

When installing a chain on a sprocket, the following should be observed.

a) Care should be taken to avoid twisting of the chain, as this will damage the chain, the chain sprocket or guides and may cause vertical falls of the hoist chain to twist together during operation.

b) Care should be taken to ensure that each end of the chain, i.e. load-bearing or loose end, is connected to the correct chain terminal/anchorage, using the method laid down by the manufacturer of the lifting appliance.

c) Care should be taken that the chain seats properly in the sprocket with the welds in the vertical length on the outer periphery.

15.4 Chain guards. Where chain guards are fitted to pulleys it is essential that these remain in their correct positions and are removed only for the purposes of maintenance, inspection or adjustment. This is of particular importance where, under certain circumstances, the chain system may be relieved of tension. Failure to observe this procedure may allow a chain to run off the pulley and become trapped.

15.5 Sprockets, pulleys and chain guides. Sprockets, pulleys and chain guides should be examined at regular intervals, since, if they are badly worn, they will cause jamming and have an adverse effect on chain life. Where replacement is necessary, only items supplied or approved by the crane manufacturer should be fitted.

Pulleys should revolve freely on their supporting shafts and particular attention should be paid to lubrication.

15.6 Examination of chains. Thorough examination is necessary periodically to ensure the safety of chain systems. Particular attention should be paid to sections of chain lying close to terminal fittings.

Particular attention should be paid to the possible effects due to climatic and environmental conditions, especially where a crane is operating in a saline or other corrosive atmosphere or in the presence of abrasive dust in the atmosphere. Current legislation requires examination of chains at specified intervals and attention is drawn to the relevant section in the statutory instruments listed in clause **4**.

15.7 Use, care and maintenance. The following points should be borne in mind when using chains.

a) Never overload a chain.

b) Never use a chain in which the links are locked, stretched or are without free movement.

c) Never hammer a chain to straighten a link or to force a link into position.

d) Never use an excessively pitted, corroded or worn chain.

e) Special care should be taken to avoid snatch or sudden loads.

f) Chain should be protected with a coating of suitable oil/lubricant which should be examined regularly and renewed as necessary. In corrosive conditions, or where driving sand, fly ash or abrasive dust may adhere to a treated surface, the chain manufacturer should be consulted before any lubricant is applied.

g) Steel and alloy chains should not be subject to annealing, heat treatment or repairs by welding except as advised by the chain manufacturer.

h) Mild steel and wrought iron chains may still be in use on some cranes and particular points to be considered are as follows.

1) Wrought iron chains may require annealing as prescribed by statutory regulations.

2) Care should be taken that any attachments made from steel are not annealed.

3) Care should be taken in operating these chains in extremes of temperature.

15.8 Chain storage. Replacement chains should be stored under clean, dry and well ventilated conditions.

16 Slinging and handling of loads

(See also Appendix A.)

16.1 Correct use of slings and tackle[2)]**.** All slings, excepting fibre rope slings, require a valid test certificate. In addition all slings must have been thoroughly examined within the previous six months, or three months in the case of the Shipbuilding and Ship Repairing Regulations (see Table 1). Slings and tackle should be clearly marked with the safe working load and an identification number (for test record purposes). All slings and tackle should be released from the store only on the instruction of a responsible person. All slings and tackle should be checked by the slinger for any obvious defects likely to affect their safe use.

Slings and tackle should not be subjected to excessive heat or allowed to come into contact with any acid, alkali or other substance likely to be harmful to them.

When handling hot metals or hot slag the recommendations of the manufacturers should be taken into account in assessing the safe working load.

Slings and tackle should never be dragged along the ground (or floor) or from under a load. Where the sling passes under the load it is good practice to lower the load onto suitable chocks or supports to ensure that the sling does not become trapped.

Where an eyebolt is used care must be taken to ensure that the eyebolt thread is correctly matched with the threaded hole.

16.1.1 *Chain slings.* British Standards that relate to these items are listed in **5.2**.

[2)] A British Standard code of practice covering the safe use of wire rope slings is in the course of preparation.

Chain(s) should not be joined by means of bolts or wire, and when shackles are used it is essential that the proper pins be fitted. Under no circumstances should chains be knotted.

Chain slings should only be repaired by the manufacturer of the sling or by a competent repair organization.

16.1.2 *Flat lifting slings.* British Standards relating to wire coil flat slings and flat woven slings made of man-made fibre are listed in **5.2**. Recommendations on the use, care and maintenance, and inspection of these slings are given in the related standards and attention is also drawn to the recommendations which are made regarding the use of choke hitches.

16.2 Multi-legged slings. At the present time a revised method of determining the safe working load for multi-legged slings is being adopted. By this method a single value of safe working load is applicable to multi-legged slings for all leg angles up to a normal maximum working limit of 90°. Reference to a chart to establish the safe working load for different leg angles is not now necessary. The upper terminal fitting of assembled slings carries an inscription giving the safe working load in kilograms (kg) or tonnes (t) and also the permitted range of leg angles for which the slings may be used, e.g. 0° to 90°. The specific angle in the case of three-leg slings is the included angle between any two adjacent legs and, for four-leg slings, the included angle between any two diagonally opposite legs (see Figure 8). This method does not preclude the use of slings up to an angle of 120° in special cases provided that the slings are derated.

Until existing slings in use have been re-certified and marked in accordance with the revised practice, the safe working load for multi-legged slings should be established as before, from a chart showing the permitted loads for different leg angles. Sling charts should be prominently displayed in the sling storage area and for site operations a copy of the chart should be carried on the crane. Ideally this should be fitted on the crane in a suitable location for reference by the slinger. It should be noted that the safe working load of multi-legged slings indicated in the charts assumes equal distribution of load between the legs of the sling. If the load tilts excessively when lifted, it should be put down and the slinging points adjusted so that the load hangs level, i.e. the sling points are equidistant from the centre of gravity of the load (see Figure 8).

The length of sling used should be sufficient to avoid requiring wide angles between the legs which, in any event, should not exceed the maximum angle specified. Where headroom does not permit use of long slings, a spreader beam or lifting frame should be used.

NOTE When eye bolts are used with multi-legged slings they should be of the collared type as specified in BS 4278 and used in the manner recommended therein.

16.3 Bulldog grips. Although the practice is not recommended, if it is necessary to form the eye by the use of rope grips (bulldog grips), the grips should be attached with the "U" bolt on the dead-end of the rope (see Figure 9). Where appropriate, a rope thimble should be used to protect the rope when making a connection with grips. As a general rule the centre distance between grips should be six times the diameter of the rope; the minimum number of grips used will depend on the diameter of the rope but should in no case be less than three (see BS 462). After a short period of service, nuts on a new grip attachment should be re-tightened. Grips should be inspected regularly thereafter to check that the nuts are tight and the rope has not slipped.

16.4 Slinging of special loads. When handling irregularly shaped loads, such as machine tools, where the position of the centre of gravity cannot be readily ascertained, it is essential to determine this by trial and error without lifting the load completely off the ground. Having established this, the tackle should be adjusted to ensure that the load is evenly balanced for lifting without tendency to topple over, and that no part of the load is subjected to excessive strain which might cause damage to the load (see Figure 8). Slings should be protected against any sharp edges on the load.

16.5 Assessment of weights. Whereas loads should be of known weight and clearly marked, the occasion will arise when the weight of a load will have to be assessed. This should be done by calculation, making ample allowance for unknown factors.

In cases where assessment of the load is difficult, e.g. when handling timber or scrap, a crane fitted with an approved type of automatic safe load indicator or weighing device should be used.

16.6 Signalling systems. In the interests of safety it is recommended that copies of the signal code shown in Figure 2 be issued to all crane drivers, slingers and any other persons concerned, so that a standard signalling code may be adopted.

In certain situations and where special lifts are involved it may be necessary to supplement or replace hand signals by other forms of communication such as radio, telephone or closed-circuit television.

Equipment used for giving sound, colour or light signals for hoisting, lowering or transporting loads should be efficient, properly maintained and protected from accidental interference.

EMERGENCY STOP SIGNALS SHOULD ALWAYS BE OBEYED, REGARDLESS OF WHO GIVES THEM.

16.7 Hooks and hook blocks. To prevent detachment of a sling or load it is desirable that the hook should be provided with a safety catch or other efficient device. Alternatively, the hook may be of such a shape (e.g. a Liverpool hook which is shaped like the letter "C") as to minimize, as far as possible, the risk of the sling or load becoming detached. Either of these alternatives are legal requirements on sites subject to the Construction (Lifting Operations) Regulations 1961.

Where a ramshorn hook is fitted, care should be taken to ensure that the hook is loaded symmetrically. No load should be lifted on one horn of the hook.

Whenever possible, the placing of more than one sling on a hook should be avoided and the slings should instead be attached to a ring which is then placed onto the hook. This prevents the danger of the hook being strained owing to the spread of the slings and also the danger of a sling fouling the safety catch and/or slipping over the nose of the hook. All end links, rings or shackles should ride freely upon any hook on which they are used.

When a crane is provided with more than one hook, the hook(s) not in use should be free of load and lifting tackle and elevated to the maximum height.

The effect of setting down a load when working with the crane rope in single fall is to relieve the tension in the rope. This release of energy will cause the rope end, and perhaps the hook, to spin. The slinger therefore should always exercise caution in approaching the hook to disconnect the sling(s).

Hooks and hook blocks should never be dragged along the ground or floor.

Worn or damaged hooks should not be repaired by welding.

17 Maintenance

17.1 Testing and examination. Clause **13** gives details of testing and examination requirements for cranes. These requirements are complementary to the maintenance recommendations contained in this clause.

17.2 Planned maintenance. In order that cranes may operate safely and efficiently, it is essential to plan maintenance work so that the risk of accidents and stoppages owing to breakdowns are reduced to a minimum. Manufacturers' instruction books recommend that specific tasks be carried out at stated intervals, and these periods should not be exceeded. In addition to any statutory regulations, a record or log should be kept of all cranes, giving information such as diameters, lengths and construction details of ropes, hours worked, adjustments, insulation checks, renewal of parts, thorough examinations, maintenance and repairs. Based on this record a programme of planned maintenance and repair should be introduced to contribute towards trouble-free and safe operation.

Any repairs or replacement components should be in accordance with the manufacturer's recommendations or specifications. To ensure that the crane can be maintained in a safe condition, consideration should be given to the provision of a suitable stock of expendable components.

Any fire extinguishers carried on the crane should be scheduled for periodic inspection and renewed as necessary.

17.3 Competence of maintenance personnel. Maintenance staff should have an adequate working knowledge of the machinery they are required to maintain and have access to the manufacturer's relevant literature. Where special machinery is involved, personnel should be properly instructed, for instance, by attending maintenance, service and operating courses given by the manufacturer of the equipment.

17.4 Safety of maintenance personnel. All maintenance staff should be fully aware of the hazards involved in working on cranes and the supervisor should be responsible for instructing the staff in all aspects of safe working, including the use of tools and equipment.

See **11.4** for safe systems of working and **11.5** for safe means of access. In addition a secure working platform should be provided where necessary to ensure the safety of maintenance personnel.

Section 2. Overhead/underhung travelling and goliath cranes

18 Description of types

This section of the code covers overhead travelling cranes and underhung cranes which consist of a bridge girder or girders mounted on end carriages housing the long travel wheels which travel along a gantry track. It also deals with goliath cranes and semi-goliath cranes with the bridge girder or girders mounted on vertical legs. The latter may be fixed, rail-mounted or on steerable wheels.

The cranes referred to may be operated electrically, hydraulically, pneumatically, or manually.

18.1 Types of control. Types of controls for these cranes may be as follows.

a) *Cabin operated:* by cranked lever or joystick-operated electrical controllers which may be supplemented with foot or hand-operated braking systems.

b) *Non-cabin operated:*

1) pendant control by control box of the pushbutton type, generally suspended from the bridge structure, along which it may be movable, or, alternatively, suspended from the crab/trolley;

2) radio control, basically consisting of a radio transmitter and receiver, each channel controlling an individual motion, the system being such that the operator cannot operate the crane from a greater distance than that determined safe by the competent person responsible for safety;

3) remote control, as for cabin control generally, but the controllers are mounted remote from the crane.

c) *Manual operation:* by crank lever or hauling chain.

18.2 Types of bridge girder. The bridge girders spanning the distance between the centres of track rails may be of single or double type, constructed of structural girders attached to end carriages. The form of construction may be single web members, or alternatively plate box or lattice type construction. On special machines the path of travel may be circumferential.

19 Definitions

See clause **3**.

20 Legislation

See clause **4**.

21 British Standards

See clause **5**.

22 General considerations

General considerations relating to the use of all types of cranes are given in clause **6**. Also, in cases where the lifting unit (e.g. hoist blocks) and/or its runway trolley may be changed, separate test certificates should be available for the lifting unit, trolley and main structure.

23 Recommended requirements for driver/operator, slinger and signaller

For remote/cabin controlled cranes see the appropriate subclauses of clause **7**. For pendant and radio-controlled cranes see the appropriate items listed in clause **54**.

Where manual operation is required the operator must be of adequate physique.

24 Choice and selection of crane

In selecting the correct crane for a particular installation the manufacturer should be consulted regarding the duty to be performed which will determine the classification use in the design of the crane. Not only should the more obvious requirements of load capacity, range of lift, below and above datum/ground level be taken into account, but also the following additional considerations:

a) the approaches, in relation to each gentry track and end of long travel;

b) clearances, with regard to headroom and width of the building extremities as well as in relation to roads and railway tracks.

Gantry girders should be designed to comply with the requirements of BS 449 and must withstand the maximum vertical and horizontal loads imposed by the crane wheels; the crane manufacturer should be consulted for this data.

In the case of more than one crane operating on the same track, account must be taken of the combined loadings from adjacent cranes. Gentry girders which are of inadequate rigidity or are inaccurately aligned or levelled cause operating problems and may lead to dangerous conditions.

Other duties. When a crane's capacity and/or duties are changed subsequent to the original installation so that they are not within the original requirements, the manufacturer, competent engineer or authority experienced in crane design or construction, should be consulted as to the suitability of the crane for its new capacity and/or duty.

25 Siting of cranes

General comments on the siting of cranes are given in clause **9**, to which reference should be made.

25.1 Proximity hazards. In positioning a crane for operation, due regard should be given to any proximity hazards. Drivers should always be located with a clear view of any adjacent cranes.

25.2 Visibility. When visibility is restricted for any reason, means should be provided to ensure the safe use of the crane or the crane should be taken out of service.

25.3 Overtravel. Accidents occur due to collision with end stops at ends of longitudinal travel; the fitting of travel limits may also be necessary.

25.4 Modifications to the structure or services. Clearances should be verified when modifications to the structure or nearby services have been made.

26 Installation

26.1 General comments. It is recommended that these cranes should be erected and dismantled by the manufacturer of the crane. If this is not possible, it is essential that the manufacturer's instructions on the method and sequence of erection/dismantling are strictly followed, and the appropriate precautions given in clause **10** observed.

All operations should be carried out under competent supervision by personnel who have been adequately trained and who have experience of erecting/dismantling the particular type of crane involved.

Particular care should be taken in the design and construction of all supporting structures, connections and anchorages.

26.2 Electrical supply. The electric power supply to the crane, and the cable used, should be as recommended by the manufacturer to suit the electrical system of the crane.

Longitudinal and cross travelling conductors should be installed to the manufacturer's specification, and protected to safeguard all personnel.

Where bare overhead trolley wires are used there should be one or more illuminated signs suitably placed and automatically energized whenever the trolley wires are alive.

26.2.1 *Protection of bare conductors.* Where bare conductors are installed for the purpose of picking up current they should be placed out of reach or protected to prevent accidental contact by persons using the crane. This includes screening to prevent accidental contact with bare conductors by persons entering or leaving the crane cabin or platform. If bare conductors are mounted on a crane bridge adjacent to a walkway along the bridge, they should be completely protected from this walkway.

NOTE In cases where there may be danger to persons working at floor level by making contact with live conductors whether directly or indirectly through handling long lengths of conducting materials, the Electricity (Factories Act) Special Regulations require that the long travel conductors be portected to prevent such contact throughout their full length. The crane maker is not responsible for compliance with this provision, so far as the long travel conductors are concerned, unless called for by the purchaser at the time of tendering.

In all cases the position of bare long travel conductors should be such that screening can be added later, should this become necessary.

26.2.2 *Earthing.* The crane structure, motor frames and metal cases of all electrical equipment, including metal conduit and cable guards, should be effectively and directly connected to earth.

In the case of cranes mounted on rails it is recommended that at least one rail track should be electrically bonded at each joint and that track should be effectively earthed. If the track is not supplied by the crane manufacturer, the responsibility for earthing the track should rest with the purchaser, unless agreed to the contrary. If track rails are fixed to timber baulks or reinforced concrete beams, they should be made electrically continuous by bonding.

Reliance on the use of crane wheels for earthing is not recommended.

26.3 Safety devices. Safety devices should be correctly installed and tested according to the manufacturer's instructions.

26.4 Procedures on completion of erection. After erection the following routine procedures, as appropriate, should be carried out by the erector.

a) Confirm that oil levels are correct and that lubrication has been carried out as specified.

b) Visually inspect the ropes, the rope terminal fittings and anchorages for obvious damage and wear.

c) Visually inspect the structure for damage.

d) In the interests of safety and fire prevention, ensure that the crane is in a tidy condition and free from tins of grease and oil, rags, tools or materials other than those for which storage provision is made.

e) Operate the crane through all motions, paying particular attention to brakes to ensure that these are operating efficiently and that they are free from oil, grease, water and dirt.

f) Confirm the operation of all limit switches or cut-outs, using caution in making the tests in case of non-operation.

g) Ensure, by visual inspection, that all electrical equipment is free from oil, grease, water and dirt.

h) Where appropriate, confirm by travelling the crane along the track that the cable-reeling drum is operating satisfactorily and that the cable does not foul any part of the crane structure or wheels.

i) The final check on the crane shall ensure that all loose materials are removed and that all guarding and covers are in position.

j) Before the crane is used, ensure that there are adequate clearances with no obstructions over the full length of the crane travel.

27 Procedures and precautions

27.1 Leaving the crane unattended. When a crane is left unattended for short periods, precautions should be taken to ensure that it is left in a safe and secure condition. This should include application of the brake, isolation of motion power supplies and, wherever possible, removal of the load and setting the hook in a safe position.

For longer periods, for out-of-service conditions and at all times when adverse weather conditions are expected:

a) isolation should be made permanent, i.e. switches locked off;

b) all control handles should be in the neutral position, the main switch opened and the brakes applied;

c) all windows and doors should be closed;

d) where applicable, rail clamps should be fixed in position;

e) where applicable, withdraw the main supply plug, replace the cap on the socket, allow the trailing cable to rewind on the drum, and secure the plug in a safe position on the crane with the contacts down.

27.2 Routine procedures. At the beginning of each shift or working day the procedures listed in **11.2** should, where applicable, be carried out. Where special equipment such as a weighing device or vacuum lifting device is fitted, check that it is operating properly.

For cranes operating outdoors the following additional procedures should be carried out, as applicable:

a) confirm the track is not obstructed;

b) ensure all rail clamps and out-of-service anchorages are released;

c) ensure the electrical supply cable has been plugged in.

27.3 Reporting of defects and authorization for use
See **11.3**.

27.4 Safe system of work. See **11.4**.

27.5 Safe means of access. See **11.5**. A safe means of access and egress should be provided at all points along the crane gantry for cabin-controlled cranes. Wherever this is not possible, a position should be specified at which access to the cab can be gained by the driver.

At this position a secure landing platform should be provided so that the driver can move between the platform and the crane without risk.

Access to the landing platform should be from a walkway, stairway or a ladder. If space is limited within the building the stairway can often be taken outside the building. If the stairway or ladder exceeds a vertical distance of 9 m, intermediate rest platforms should be provided at intervals not exceeding 9 m.

Where safe means of access and egress are not available at all points along the crane gantry, emergency escape facilities should be provided.

When personnel are working on or near the wheel track of a crane, it is necessary to ensure that the crane does not approach close to such personnel. Under the Factories Act 1961 this approach distance should be not less than 20 ft (6 m). Various methods and systems may be used for this purpose, including the following:

a) interrupting the power supply to the crane by sheathing the supply wires;

b) putting flags or strings of flags, preferably fluorescent, across the workshop;

c) putting warning detonators on the track (this technique should be used with caution since the unexpected noise of the detonation may affect the safety of other personnel);

d) putting stop blocks on the track;

e) using a safe system of work as outlined in **11.4**.

This is not a complete list of methods and systems available. Whatever method or system is used it is essential that all personnel are aware of their role and play their part in ensuring the safety of the personnel working on or near the crane track.

27.6 Movement of crane. Care should be taken to ensure the stability of goliath cranes when operating on or over uneven ground or slopes.

27.7 Movement of the load. When using a crane where there is no manual or powered mechanism for traversing the crab or runway trolley with the load suspended, the preferred method of moving the load horizontally is to push it manually, rather than to pull it.

27.8 Travelling on crane. No person, other than the driver, should travel on the bridge of the crane whilst the crane is in normal operation.

When, for the purpose of maintenance and/or testing, a person has to travel on the crane a safe position should be provided and, in the case of a cabin-operated crane, the person should be in sight of the driver or a reliable system of audio or visual communication should be established, using a third person if necessary. On other cranes, the person on the bridge should have control of the crane.

In both the above cases the travelling position should be determined with due consideration of the clearances between the crane, any roof members or any other obstructions.

Maintenance of items other than that of the crane itself, such as luminaires or ventilation fittings, may only be carried out from the bridge or cab of a crane providing that a secure working platform is fitted. Where such a working platform is provided no person should remain on this platform while the crane is being moved.

28 Safe working loads and operational conditions

28.1 Safe working loads. See **12.1** for general considerations.

It should be noted that if a crane is converted from manual to electrical power operation it is necessary to reassess the capacity of the crane, after consultation with the manufacturer or a competent person. Re-certification of the crane will also be necessary.

28.2 Mode of operation and control. In addition to the requirements of **12.2**, **12.3** and **12.4**, the following points should be observed.

a) Reliance on a hoist limit for normal operation should be discouraged. If the normal operations necessitate approaching this limit frequently, an additional safety device should be fitted. This device should operate independently.

b) The load should be arranged in a stable and safe condition.

c) The crane should not be used for hauling vehicles or cargo.

d) A crane should not be moved without care being taken to ensure that there are no persons standing on or near to the tracks or in its path of travel.

28.3 Special duties. See **12.5**.

28.4 Weather conditions. (See **12.6**.) In the event of high wind conditions being expected, and where the crane is unprotected from the effects of wind, the rail clamps on the travel bogies should be applied, where applicable, to prevent the crane from being blown along its track.

29 Testing

See clause **13** and **17.1**.

29.1 General. Before the crane is taken into service, whether when new or after re-installation on a different gantry track, the crane should be tested. In addition, further tests may be required following any substantial alteration or repair to the crane. The test loads will normally be provided by the user of the crane unless other agreed arrangements have been made.

29.2 Test loads. The value of the test load should be decided by the competent person conducting the test, taking proper notice of any prescribed figures quoted in safety legislation and any requirements of relevant British Standards.

The test load will usually be 25 % in excess of the intended safe working load.

29.3 Gantry tracks. It is desirable that the test on cranes also confirms the adequacy of the gantry track and its supports to withstand the effects of normal working. To achieve this the test load should be traversed to the minimum approach condition to each track and the crane travelled for the full length of the track in both directions where practicable.

After any alterations, repairs or extensions to the gantry track, its support, or means of suspension, the tests previously mentioned should be carried out to confirm that the gantry track is still adequate.

30 Ropes

See clause **14**.

31 Chains

See clause **15**.

32 Slinging and handling of loads

See clause **16**.

33 Maintenance

See **11.4**, **11.5** and clause **17**.

Section 3. High pedestal and portal jib dockside cranes

34 Description of types

This section covers cranes specifically designed for the purpose of rapid loading or unloading to or from ships, barges, etc. of general or break bulk cargo.

This section is not intended to apply to mobile cranes when handling cargo. Advice on the use of mobile cranes is given in CP 3010.

These cranes are usually mounted near to a quay edge, on rails or in a fixed position. The rails may be at quay level or be elevated to facilitate the movement of cargo and transport along the quay. The cranes are usually of the portal type, having a structure that allows transport to pass beneath. The elevated superstructure gives better visibility for the driver and improved clearance for the crane jib. The superstructure of the crane is capable of being slewed, and, although the jib may be of the fixed type, it is more usually of the luffing type with level luffing included in the design. Level luffing is an arrangement whereby the hook moves approximately horizontally when the jib is derricked or luffed.

Cranes of this type are characterized by their high hoisting, slewing and luffing speeds.

The safe working load is usually the same for all radii of the jib, but may sometimes have an increased value applicable up to a limited intermediate radius.

When mounted on rails the types of crane covered by this code are shown in Figure 10.

35 Definitions

See clause **3**.

36 Legislation

See clause **4**. It should be noted that the following legislation is particularly applicable to high pedestal and portal jib dockside cranes.

The Docks Regulations 1934

The Docks Regulations (Northern Ireland) 1934

The Health and Safety at Work etc. Act 1974

The Electricity (Factories Act) Special Regulations 1908 and 1944

37 British Standards

See clause **5**.

38 General considerations

General considerations relating to the use of all types of cranes are given in clause **6**.

Dockside cranes have an intermittent pattern of use in that they are called upon to work intensively during loading and unloading periods and may stand idle for lengthy periods in between. They are subjected to adverse weather conditions. The weight of the loads that the crane is called upon to lift is often not accurately known owing to the effects of the atmosphere on the load during shipment or owing to inaccuracies in the documentation which describes the load. Proper account should be taken of these factors when determining the crane to be used.

39 Recommended requirements for driver, slinger and signaller

See clause **7**.

40 Choice and selection of crane

In selecting the correct crane for a particular installation not only should the more obvious requirements of load capacity, radius, range of lift below and above datum/quay level be decided, but also the type of carriage to be used. The portal can span either single or multiple rail tracks, whilst the semi-portal is used to span multi-tracks in close proximity to warehouses, etc. See Figure 10(a) and Figure 10(b).

When the crane's capacity or duties are changed subsequent to the original installation so that they are not within the original requirements, e.g. a crane supplied for attachment of load direct to the hook being used for magnet or grabbing duties, the manufacturer, competent engineer or authority experienced in crane design or construction should be consulted as to the suitability of the crane for its new capacity or duty.

41 Siting of cranes

General comments on the siting of cranes are given in clause **9**, to which reference should be made.

41.1 Proximity hazards. In positioning a crane for operation due regard should be given to any proximity hazards. Drivers should always be located with a clear view of any adjacent cranes.

Where there is danger to the crane from the overhang of a vessel being berthed, the crane may have to be travelled to a safe position.

If the crane cannot be sited as recommended above, adequate safety precautions should be observed.

41.2 Visibility. In addition to the requirement of **9.2.2**, cranes should be sited to give the driver the maximum visibility of the working area, so that lifts can be carried out without damage to cargo or property and also to permit the rotating superstructure to be slewed through the maximum designed angle without striking any building, crane, ship's superstructure or other obstruction.

If the crane cannot be sited as recommended above, adequate safety precautions should be observed.

42 Installation

42.1 General comments. It is recommended that these cranes should be erected and dismantled by the manufacturer of the crane. If this is not possible it is essential that the manufacturer's instructions on the method and sequence of erection/dismantling are strictly followed, and the appropriate precautions given in clause **10** observed.

42.2 Electrical supply. See **10.3**.

42.2.1 *Protection of bare conductors.* Where bare conductors are installed for the purpose of picking up current they should be placed out of reach or protected to prevent accidental contact by persons using the crane. This includes screening, which in some cases may be in the form of local guards fitted to the crane, to prevent accidental contact with bare conductors by persons entering or leaving the crane cabin or platform.

42.2.2 *Earthing.* The crane structure, motor frames and metal cases of all electrical equipment, including metal conduit and cable guards, should be effectively and directly connected to earth. In addition it is recommended that at least one rail track should be electrically bonded at each joint and that particular track effectively earthed. If the track is not supplied by the crane manufacturer, the responsibility for earthing the track should rest with the purchaser unless agreed to the contrary. If track rails are fixed to timber baulks or reinforced concrete beams, they should be made electrically continuous by bonding.

Reliance on the use of crane wheels for earthing is not recommended.

42.2.3 *Isolation.* If the isolator within the crane [see **10.3** c)] is not readily accessible from the ground level it is recommended that there should be a further isolator on the crane leg operable from the ground level and capable of cutting off all electrical supplies to the crane.

42.3 Safety devices. Safety devices should be correctly installed and tested according to the manufacturer's instructions.

42.4 Procedures on completion of erection. After erection the following routine procedures, as appropriate, should be carried out by the erector.

a) Confirm that oil levels are correct and that lubrication has been carried out as specified.

b) Visually inspect the ropes, the rope terminal fittings and anchorages for obvious damage and wear.

c) Visually inspect the structure for damage.

d) In the interests of safety and fire prevention, ensure that the crane is in a tidy condition and free from tins of grease and oil, rags, tools or materials other than those for which storage provision is made.

e) Operate the crane through all motions, paying particular attention to brakes to ensure that these are operating efficiently, and that they are free from oil, grease, water and dirt.

f) Confirm the operation of all limit switches or cut-outs, using caution in making the checks in case of non-operation.

g) Ensure by visual inspection that all electrical equipment is free from oil, grease, water and dirt.

h) Confirm by travelling the crane along the track, that the cable reeling drum is operating satisfactorily and the cable does not foul any part of the crane structure or wheels.

i) The final check on the crane should ensure that all loose materials are removed and that all guarding and covers are in position.

j) Before the crane is used, ensure that there are adequate clearances with no obstruction over the full length of the crane travel.

43 Procedures and precautions

43.1 Leaving the crane unattended. In no case should the crane be left unattended, even for short periods, unless all loads have been removed from the hook and motion power supplies isolated. This requirement does not preclude heating and lighting circuits remaining energized.

For longer periods:

a) isolation should be made permanent, i.e. switches locked off;

b) the jib should be fully luffed in parallel to the quay and the hoisting rope suspended above the driver's cab; grabs, when fitted, should be landed on the quay;

c) all control handles should be in the neutral position, the main switch opened and the slew brake applied;

d) all windows and doors should be closed;

e) anchoring and securing devices should be in position.

For out-of-service conditions, or where adverse weather conditions are expected, in addition to a) to e) above:

f) the main supply plug should be withdrawn and the cap replaced on the socket. The trailing cable should be rewound onto the drum and the plug secured in a safe position on the crane, with the connectors protected.

43.2 Routine procedures. At the beginning of each working day, the procedures listed in **11.2**, as applicable, should be carried out in addition to the following:

a) confirm the track is not obstructed;

b) ensure all rail clamps and out-of-service anchorages are released, as necessary;

c) ensure the electrical supply cable has been plugged in.

43.3 Reporting of defects and authorization for use
See **11.3**.

43.4 Safe means of access. See **11.5**.

44 Safe working loads and operational conditions

44.1 Safe working loads. See **12.1**.

44.2 Mode of operation and control. In addition to the requirements of **12.2** and **12.3** the following points should be observed.

a) The load should be arranged in a stable and safe condition.

b) Lowering of the hook or lifting gear onto the quay or floor of the hold should be avoided as far as possible as this can cause damage to these items.

c) Cargo should not be broken out or dragged from under the coamings of ships' hatches or from loopholes or doorways of buildings by the crane.

d) The crane should not be used for hauling vehicles or cargo or for shifting craft or vessels.

e) No person should be permitted in the hold of the ship or any other place where he would be likely to be struck by the load or any part of the load falling from the crane. In the case of a ship with tween-decks, no person should be permitted beneath the square of the hatch.

f) No person should use a hold ladder in the square of a hatch when loads are being raised or lowered in the hold and, as far as practicable, no load should be raised or lowered when any person is using a hold ladder.

g) Drivers should be especially careful to avoid collisions between the jibs of adjacent cranes.

44.3 Tandem lifting. See **12.4**.

44.4 Special duties. See **12.5**.

44.4.1 *Grabbing and magnet crane service.* In addition to the requirements of **12.5.1** particular care should be taken when operating cranes provided with grabs to avoid catching the grab in the coaming or overhangs of a ship. With multi-rope grab cranes it is important to avoid an excessive amount of slack rope in either the holding or the closing line.

Scrap iron and steel in a ship's hold is more consolidated and constricted than the same material in an open site. When grabbing this material, care should be taken to ensure that the grab load is free to disengage from the surrounding scrap.

44.4.2 *Vacuum lifting devices.* See **12.5.2**.

44.5 Weather conditions. See **12.6**. For dockside cranes that operate in the open, special attention should be paid to any local instructions relating to the wind speed at which the crane should be taken out of service, since high wind speeds can have a significant effect on the handling of large cargo items.

High winds can rise very quickly in exposed dockside areas and it is good practice to secure the rail clamps to the rails after each crane movement and only release them immediately before the crane is required to travel to a new position.

In addition, written instructions regarding local conditions should be issued which should state the maximum operating wind speed above which the crane should be taken out of service.

45 Testing

45.1 General. It is a statutory requirement that all cranes be tested by a competent person before being taken into use. Reference should be made to clause **13**, **17.1** and the schedule of legal requirements listed in Table 1.

In addition, further tests may be required following any substantial alteration or repair to the crane.

45.2 Overload test. See **13.3**.

45.3 Safe load indicator test. See **13.4**.

46 Ropes

See clause **14**.

47 Slinging and handling of loads

See clause **16**.

48 Maintenance

In addition to the requirements of **11.4**, **11.5** and clause **17**, particular attention should be paid to the following aspects.

a) Because of their duty, dockside cranes are particularly subject to superficial damage to access ladders, platforms and handrailing by collision with swinging loads, vehicles, etc. Such damage should be promptly repaired whenever it constitutes a danger to personnel.

b) Dockside cranes are exposed to marine and industrial atmospheric conditions and corrosion may be severe if protective coatings break down. Special attention to this aspect is necessary when inspecting and maintaining structures and access facilities.

Section 4. Manually-operated and light cranes

49 Description of types

This section covers manually-operated and light cranes which can be either complete units or those in which the lifting appliance can be removed from its support. The jibs/runways/tripods/shear legs can be cantilevered, horizontal, movable or fixed and the hoisting mechanism can be operated manually, electrically, hydraulically or pneumatically. Typical cranes of this type are shown in Figure 11.

This section does not include overhead travelling cranes as defined in section 2, and cranes mounted on vehicles.

A light crane is defined as one in which at least one of its motions is manually-operated.

Such cranes are used for a wide range of loads where the frequency of operation does not justify the provision for power operation of all motions.

49.1 Types of controls

a) Power-operated (electrical) push-buttons either suspended by pendant or from a fixed point.

b) Power-operated (compressed air or hydraulic) either operating the valves directly or indirectly; in some cases the hydraulic power is obtained by means of a manually-operated pump.

c) Manual operation by cranked lever or hauling chain.

50 Definitions

See clause **3** and Figure 11.

51 Legislation

See clause **4**.

52 British Standards

In addition to the relevant British Standards listed in clause **5**, reference may also be made to BS 2853.

53 General considerations

General considerations relating to the use of all types of cranes are given in clause **6**. In cases where the lifting machine, e.g. chain block, and/or its runway trolley may be removed and installed elsewhere, separate test certificates should be available for the component parts of the crane.

54 Recommended requirements for the operator

The operator should:

a) be medically fit, with particular regard to eyesight, hearing and reflexes;

b) have the stature to operate the crane safely, be agile and have the physique to be able to handle lifting gear;

c) have been adequately trained in the operation of the type of crane and be able to judge distances, heights and clearances;

d) have been trained in the general principles of slinging and be able to establish weights;

e) be capable of selecting lifting gear suitable for the loads to be lifted;

f) be capable of directing the movement of the crane and load in such a manner as to ensure the safety of personnel and plant.

55 Choice and selection of crane

In selecting the correct crane for a particular application, due consideration should be given to the nature of the load to be handled, the height of the lift required, floor conditions and the facility of movement, where appropriate.

56 Siting of cranes

In siting a crane for operation, particular attention should be given to two factors; the crane foundation or support conditions and the presence of proximity hazards.

56.1 Foundation and support conditions. The overall stability and safety of a crane should be carefully checked in relation to local conditions. In cases where beams are supported by roof trusses or suchlike members it is important that the superimposed forces are assessed by a competent engineer. The analysis of the forces imposed by a crane on its supports or foundations is a vitally important matter which should always be checked by a competent engineer. The vertical and horizontal forces imposed are not uniformly distributed; their magnitude may be much greater than the loadings which cause them and will vary according to the position and movement of the crane load.

56.2 Proximity hazards, etc. Consideration should also be given to the presence of proximity hazards such as overhead electric lines or conductors, nearby structures or other cranes. Precautions should be taken to ensure that when the crane is positioned or travelled, it is clear of any underground services or, where this is not possible, the services are adequately protected to safeguard against any damage being caused.

57 Installation

See clause **10**.

58 Procedures and precautions

See clause **11**, as applicable.

58.1 Movement of crane. Care should be taken to ensure the stability of light portable cranes when operating over uneven ground or slopes.

When moving on a gradient the load should be on the uphill side of the crane to avoid toppling.

58.2 Movement of the load. When using a crane where there is no manual or powered mechanism for traversing the crab or runway trolley with the load suspended, the preferred method of moving the load horizontally is to push it manually, rather than to pull it.

Care should be taken to ensure that any load sustaining device on manually-operated motions is engaged before releasing the operating lever.

59 Safe working loads and operational conditions

See clause **12**, as applicable.

60 Testing

See clause **13** and **17.1**.

61 Ropes

See clause **14**.

62 Chains

See clause **15**.

63 Slinging and handling of loads

See clause **16**.

64 Maintenance

See clause **17**.

Section 5. Container handling cranes

65 Description of types

This section covers cranes specially designed for the purpose of handling containers, and which incorporate a purpose-built spreader beam. Typical cranes of this type are shown in Figure **12** and Figure **13**.

This section is not intended to apply to the use of other types of cranes for handling containers.

66 Definitions

See clause **3**.

67 Legislation

See clause **4**.

68 British Standards

In addition to the British Standards listed in clause **5**, reference may also be made to the following standards publications.

BS 3951, *Freight containers.*

BS 4654, *Hooks for lifting freight containers of up to 30 tonnes.*

BS 5073, *The carriage of goods in freight containers.*

BS 5237, *Lifting twistlocks.*

69 General considerations

General considerations relating to the use of all types of cranes are given in clause **6**.

70 Recommended requirements for driver, slinger and signaller

See clause **7**.

Where the crane is fitted with a power-operated spreader controlled by the driver, a slinger is not usually necessary. However, in the exceptional circumstances referred to in clause **78** a slinger should be used.

71 Choice and selection of crane

These cranes should be selected to form part of a special installation which is intended for the handling of containers between different modes of transport, and having regard to the local operating requirements and conditions.

72 Siting of cranes

General comments on the siting of cranes are given in clause **9**, to which reference should be made.

73 Installation

73.1 General comments. It is recommended that the cranes should be erected and dismantled by the manufacturer of the crane. If this is not possible it is essential that the manufacturer's instructions on the method and sequence of erection/dismantling are strictly followed, and the appropriate precautions in clause **10** observed.

73.2 Electrical supply. See **10.3**.

73.2.1 *Protection from bare conductors.* Where bare conductors are installed for the purpose of picking up current, they should be placed out of reach or protected to prevent accidental contact by persons using the crane. This includes screening to prevent accidental contact with bare conductors by persons entering or leaving the crane cabin or platform.

73.2.2 *Earthing of rail-mounted cranes.* The crane structure, motor frames and metal cases of all electrical equipment, including metal conduit and cable guards, should be effectively and directly connected to earth. In addition, it is recommended that at least one rail track should be electrically bonded at each joint and that particular track effectively earthed. If the track is not supplied by the crane manufacturer, the responsibility for earthing the track should rest with the purchaser unless agreed to the contrary.

Reliance on the use of crane wheels for earthing is not recommended.

73.2.3 *Isolation.* If the isolator within the crane [see **10.3** c)] is not readily accessible from the ground level it is recommended that there should be a further isolator on the crane leg operable from the ground level and capable of cutting off all electric supplies to the crane.

73.3 Safety devices. Safety devices should be correctly installed and tested according to the manufacturer's instructions.

73.4 Procedures on completion of erection. After erection the following routine procedures, as appropriate, should be carried out by the erector.

a) Confirm that oil levels are correct and that lubrication has been carried out as specified.

b) Visually inspect the ropes, the rope terminal fittings and anchorages for obvious damage and wear.

c) Visually inspect the structure for damage.

d) In the interest of safety and fire prevention, ensure that the crane is in a tidy condition and free from tins of grease and oil, rags, tools, or materials other than those for which storage provision is made.

e) Operate the crane through all motions, paying particular attention to brakes to ensure that these are operating efficiently, and that they are free from oil, grease, water and dirt.

f) Confirm the operation of all limit switches or cut-outs, using caution in case of non-operation.

g) Ensure, by visual inspection, that all electrical equipment is free from oil, grease, water and dirt and also that any temporary connections or jumpers used for testing purposes have been removed.

h) For rail-mounted cranes, confirm by travelling the crane along the track that the cable reeling drum is operating satisfactorily and the cable does not foul any part of the crane structure or wheels.

i) The final check on the crane should ensure that all loose materials are removed and that all guarding and covers are in position.

j) Before a rail-mounted crane is used, ensure that there are adequate clearances with no obstructions over the full length of the crane travel.

k) Test that all interlocking systems on the crane and spreader are functioning correctly.

l) Ensure that electric cables and hydraulic connections to the spreader coil freely into and out of their basket or onto and off their reeling drums, when either of these are fitted.

74 Procedures and precautions

74.1 Leaving the crane unattended. In no case should the crane be left unattended, even for short periods, unless all loads have been removed from the spreader and motion power supplies isolated. This requirement does not preclude heating and lighting circuits remaining energized.

For longer periods:

a) isolation should be permanent, i.e. switches locked off;

b) all the control handles should be in the neutral position, the main switch opened and brakes applied;

c) all windows and doors should be closed;

d) anchoring and securing devices should be in position;

e) when a container crane is fitted with a hinged or retractable cantilevered boom, the boom should be raised.

For out-of-service conditions or where adverse weather conditions are expected, in addition to a) to e) above:

f) the main supply plug should be withdrawn and the cap replaced on the socket. The trailing cable should be rewound onto the drum and the plug secured in a safe position on the crane, with the connectors protected.

74.2 Routine procedures. At the beginning of each working day the procedures listed in **11.2**, as applicable, should be carried out in addition to the following:

a) where applicable, confirm that the rail track is not obstructed;

b) ensure all anchoring and securing devices are released;

c) where applicable, ensure that the electrical supply cable has been plugged in correctly.

74.3 Reporting of defects and authorization for use
See **11.3**.

74.4 Safe means of access. See **11.5**.

74.5 Stowing and parking arrangements for rail-mounted cranes. Arrangements for stowing cranes fall into two broad categories:

a) *Those providing positive stowage at specific points along the track.* The "drop-in" type anchor pin engaging with a hole or slot in the quay is frequently used and there are several variants of this device. Care should be taken that the pin is not dropped on the quay near the hole and the crane then driven to the stowage point, since this can result in damage to the pin sleeve and brackets. Owing to crabbing of the crane it is sometimes necessary to engage one pin and then jog the crane until the second pin is aligned.

Wind forces on the crane can rise quickly and can exceed the adhesion between the wheels and rails and therefore stowage points at short intervals should be provided.

Some anchor pins require to be wound down and additional time must be allowed for this operation.

Allowing for the circumstances referred to, the intervals between the stowage points should be so arranged that it should take not longer than 10 min to stow a crane, and this time should take account of all associated motions including setting down the load and applying the anchor devices.

b) *Those providing stowage at any point along the track.* The hydraulic or gravity-operated claw, the wedge, the rail head pad, the inverted twistlock (for track made up with twin rails) and the cam brake are some of the devices used for this purpose. This category may not restrain the crane against high wind conditions and it is therefore recommended that category a) devices should be installed additionally.

75 Safe working loads and operational conditions

75.1 Safe working load. See **12.1**. The maximum loaded weight of ISO[3)] freight containers is limited according to size and it is reasonable for the crane driver to assume that the container will not exceed the maximum permitted weight for that size of container. The crane driver should, however, be alert for any indications of overloading or excessively uneven weight distribution.

75.2 Mode of operation and control. In addition to the requirements of **12.2** and **12.3**, the following points should be observed.

a) The load should be arranged in a stable and safe condition.

b) The crane should not be used for hauling vehicles or cargo or for shifting craft or vessels.

c) Container crane spreaders contain complex mechanisms and the operating requirements make them particularly vulnerable and prone to damage. Particular care must be exercised in landing the spreader and to prevent collision between the spreader and other objects.

d) Care should be taken to ensure that all four spreader twistlocks have been properly located in the corner fittings of a container, and have fully rotated, before the hoisting motion is started. An interlock system should be incorporated between the twistlocks and the hoisting motion. It is equally important to ensure that all twistlocks are free of the corner fittings before hoisting a spreader clear of a container which has been set down.

[3)] International Organization for Standardization.

e) Similarly, in the case of bottom lifting of containers using grappler arms, care should be taken to ensure that they are properly engaged in the pockets provided for this purpose in the container. Before hoisting a spreader clear of a container which has been set down, it is important to ensure that all grappler arms are free.

f) Care should be taken to ensure that the devices securing a container to a road or rail vehicle or to the ships deck or hatch covers have been released before an attempt is made to lift the container off the vehicle.

g) In the case of telescopic spreaders, care should be taken to ensure that the extension device is positively locked to the selected spreader length before the hoisting motion is started.

h) No unauthorized persons should be permitted to be in the vicinity of a container crane when it is handling containers. All authorized persons should wear high-visibility outer garments.

i) If it is necessary for any person to climb onto the top of a container, that person should be in visual, radio or telephone communication with the crane driver and the driver should obey only the instructions received from that person. Also, if it is necessary for a person to undertake such an operation, a safe means of access should be provided.

75.3 Special duties. See **12.5**. In all cases involving special duties, the manufacturer's guidance should be obtained.

75.4 Weather conditions. See **12.6**. Special attention should be paid to any local instructions relating to the wind speed at which the crane should be taken out of service, since high wind speed can have a significant effect on the handling of containers.

75.5 Rail-mounted cranes. In the event of high wind conditions being expected, the crane should be anchored to the special anchorage points provided to prevent the crane being blown along its track. (See **74.5**.)

The crane manufacturer's instructions on parking the crane should be strictly followed. However, in the absence of such precise instructions it is recommended that the following procedure be adopted. The container should be lowered to the ground and released from the spreader. The crane should be travelled upwind to the nearest positive stowage (parking) position.

If the procedure above is not possible, the crane should be travelled downwind slowly but with frequent stops to ensure that adhesion between the wheels and the track is not lost. This latter procedure can be hazardous and should only be undertaken under supervision.

Notwithstanding what is said in **12.6.1**, it is recommended that each container crane should be fitted with its own wind speed indicator.

76 Testing

It is a statutory requirement that all cranes be tested by a competent person before being taken into use.

Reference should be made to clause **4**, **17.1** and the schedule of legal requirements listed in Table 1. In addition, further tests may be required following any substantial alteration or repair to the crane.

76.1 Overload test. See **13.3**.

77 Ropes

See clause **14**.

78 Handling of containers

Containers are normally handled by means of the purpose-built spreader of the crane. In exceptional circumstances, such as the handling of damaged containers, beams and slings may be used. In these situations the arrangement of the lifting gear should be related to the size of the container.

79 Maintenance

See **11.4**, **11.5** and **17**. It is important to recognize that a good adhesion coefficient between the crane wheels and rails is of little use if the long travel brakes on the crane cannot match it. Regular and meticulous brake maintenance is especially important with cranes that have a low proportion of driven and braked wheels.

Spreaders contain complex mechanisms and are particularly vulnerable and prone to damage and it is therefore important that these are regularly inspected and maintained in accordance with the manufacturer's recommendations.

Section 6. Rail-mounted low carriage cranes

80 Description of types

This section deals with rail-mounted low carriage cranes which are usually equipped, in basic form, with a derricking jib, and which may or may not be capable of travelling under their own power with a suspended load (see Figure 1). These cranes are suitable for use at such locations as docks, shipyards, sidings, factories, etc., where railway tracks are readily available. Special cranes designed specifically for railway breakdown or tracklaying/maintenance purposes are not covered by this code.

Some cranes are fully mobile and able to travel with any load, up to their maximum safe working load, suspended from the hook. Others may be restricted in respect to the load they can carry when travelling and may require to be stationary and to use outriggers, or other supplementary means, in order to handle their maximum safe working loads.

Most cranes are capable of continuous slewing through an unlimited number of revolutions in either direction. Other designs are limited in their degree of slewing whilst some cranes are not fitted with any slewing mechanism and must be travelled to obtain the equivalent translation of the load.

Jibs may be of the strut or cantilever or telescopic type. They may be of open lattice or plate box-section construction. Many designs make provision for lengthening of the basic jib either by the introduction of additional structural elements into the basic jib structure, or by telescoping of the jib which incorporates extending members in the basic structure.

81 Definitions

See clause **3**.

82 Legislation

See clause **4**.

The Locomotives and Wagons (Used on Lines and Sidings) Regulations 1906 is also applicable to rail-mounted low carriage cranes.

83 British Standards

See clause **5**.

84 General considerations

General considerations relating to the use of all types of cranes are given in clause **6**.

85 Recommended requirements for driver, slinger and signaller

See clause **7**.

86 Choice and selection of crane

In selecting the right type of crane for a particular job, not only should the more obvious job requirements of load capacity, reach and height of lift be considered, but also the type of crane mounting and jib that will best suit the conditions of operation and clearance between slewing parts and trucks on adjacent tracks (see clause **87**).

It is also important to determine that the railway track and ground and any other supporting structure are suitable (see clause **87**).

87 Siting of cranes

General comments on the siting of cranes are given in clause **9**, to which reference should be made.

Siting of these cranes is constrained by the tracks on which they run. Nevertheless, the points given in this clause should be borne in mind.

87.1 Crane standing or support conditions. Unless appropriate precautions are taken, the crane should only be operated provided it is standing on properly laid track capable of safely supporting the maximum loading imposed on it by the crane in service.

A common mistake in calculating maximum bearing pressures of the crane on the ground or supporting surface is to assume an average value equal to the total weight divided by the ground contact area. In fact, maximum values will generally be far in excess of this average bearing pressure. This is often a critical factor.

Where possible, the lifting of loads should be avoided when the crane is standing on points. Where this cannot be avoided, rail clips should be used.

87.1.1 *Soft ground.* Soft or waterlogged ground is not a suitable foundation for track for supporting a rail-mounted crane in operation. However, for temporary working, special steps may be taken to provide a satisfactory standing for the crane. Mats, steel plates, timber sleepers or a concrete raft, etc., used to distribute the operational loads under the support points of the crane, should ensure that the bearing strength of the ground is not exceeded.

87.1.2 *Inclined track.* The operation of a crane on a gradient should be avoided where possible. When the track is canted, either it should be levelled or the crane operated at a suitably reducing rating.

87.1.3 *Ground cavities.* A careful investigation should always be made to ensure that the crane is not positioned or travelled over inadequately compacted ground as might exist where earth filling has taken place or following demolition of buildings. Where the track passes over any service ducting, it should be suitably supported.

87.1.4 *Nearby excavations.* Particular care and appropriate precautions should be taken when a rail-mounted crane is required to work in the vicinity of any excavation. The weight of the crane and load may affect the stability of the excavation wall and a slip may occur, causing the crane to overturn and hazarding the safety of personnel both on the bank and in the excavation.

87.1.5 *Made-up ground.* Particular care and appropriate precautions should be taken when a rail-mounted crane is required to work near the edge of made-up ground, e.g. slag-heaps. The weight of the crane and load may affect the soil stability and a slip may occur, causing the crane to overturn and hazarding the safety of personnel.

87.1.6 *Bridges or arches.* Lifting operations with the crane positioned over a bridge or arch should be avoided unless authorized by a competent engineer.

87.2 Proximity hazards. See **9.2**.

87.2.1 *Overhead electric lines and cables.* Many fatal accidents occur when a crane is travelling or operating due to the jib approaching or contacting an overhead conductor. By the nature of their duties, rail-mounted cranes may be exposed to this hazard and attention is drawn to the following requirements, which should be carefully studied by all concerned with the selection, use and operation of rail-mounted cranes.

a) The crossing route should be plainly marked and "goal posts" erected each side of the crossing approach, to ensure that the jib or moving parts are lowered to a safe position (see Figure 14).

b) The dimensions of the goal posts and their distance from the nearest power cable should be decided in consultation with the District Engineer of the local Electricity Board or Generating Board or the responsible engineer of the works or authority concerned. Large notices should be posted stating:

"DANGER — ELECTRIC LINES"

c) Crossing routes should be located as close to the power line support tower or pole as possible, in order to take advantage of the greater ground clearance. When working parallel to overhead power cables, a string of warning markers should be erected at a safe distance from the cables. The string should be supported on posts at convenient intervals and each post should carry the warning notice described above.

d) In addition to the above, notices as shown in Figure 15 should be displayed in the driver's cabin of all cranes likely to operate in the vicinity of overhead electric lines and cables.

87.2.2 *Overhead obstructions.* In general, where there is a danger of the jib or of any part of the crane fouling any overhead or other obstruction, such as bridges, gantries, pipework, scaffolding, buildings or walls, suitable precautions should be taken. Examples of suitable precautions include the following.

a) The driver should operate only under the direction of a slinger or signaller so positioned as to have a clear view of the crane and the obstruction and able to assess whether there is adequate headroom and clearance. For purposes of visual siting and warning it is recommended that the point of the jib and the front and the rear of the crane should be painted in a distinctive manner.

b) The provision of suitable notices at each obstruction and sufficient information in the crane cab to enable the driver to negotiate the hazard safely.

87.2.3 *Proximity of other cranes.* In positioning a crane for operation, regard should be given to the proximity of other cranes, especially when their working areas overlap. Even when such cranes are operating with different lengths of jib, the possibility of the hoisting rope or suspended load fouling the adjacent crane should not be overlooked.

Cranes should always be sited in such a way that the drivers have a clear view of any other cranes operating in the collision danger area.

88 Erection, dismantling and transportation

Rail-mounted low carriage cranes are not normally subjected to dismantling and erection. Should the necessity arise, it is particularly important to follow the instructions approved by the manufacturer, competent engineer or authority experienced in crane design and construction (see clause **10**).

88.1 Safety devices. During erection and dismantling operations, it may sometimes be necessary to disconnect or by-pass load indicators, overload cut-outs or motion limit switches. Before the crane is put into operation a careful check should be made to ensure that all such devices have been reconnected and are functioning correctly. It can be highly dangerous to use a load-radius indicator with the incorrect scale fitted or an automatic safe load indicator with the wrong setting.

NOTE It is usually necessary to make adjustment to the visual load-radius indicator(s) and to the automatic safe load indicator(s) each time the crane condition is varied, e.g. for changes in jib length, falls of hoist rope, etc., and also between operations with or without outriggers set.

88.2 Crane stability, erection and dismantling procedures. Unless otherwise specified in the crane manufacturer's instructions, it is always advisable, and may be essential, when erecting and dismantling a jib to perform this operation with the jib axis in line with the rail track, i.e. in the position offering greatest stability to the crane.

89 Procedures and precautions

89.1 Leaving the crane unattended. When a crane is left unattended for short periods, precautions should be taken to ensure that it is left in a safe and secure condition. This should include the application of all motion locks and brakes, isolation of motive power supplies, removal of the load and the setting of the hook and jib in a safe position.

To prevent unauthorized use of a crane, the driver should, where provision for this is made, lock off the crane so that it cannot be operated and retain possession of the key.

For longer periods, or where the crane is not in use, the key should be deposited in safe storage.

89.2 Routine checks. Attention is drawn to **11.2** of this code.

In addition, before starting operations the crane driver should check that the crane has not moved during the period it has been unattended. Also, the level of the crane should be verified and a check made to confirm that there has been no sinking of outrigger feet or settling of the track.

89.3 Reporting of defects and authorization for use
See **11.3**.

89.4 Safe system of work. See **11.4**.

89.5 Safe means of access. See **11.5**.

90 Safe working loads and operational conditions

General precautions, in respect to safe working loads and operational conditions, are given in clause **12** and have particular relevance to rail-mounted cranes.

90.1 Safe working loads. See **12.1**.

90.1.1 *Limitations.* Crane manufacturers' safe working loads may be limited by either of the following:

a) stability of the crane, which is a function of the weight and weight-distribution of the crane and the stability of the track and its foundation;

b) the structural or mechanical strength of the crane or components, such as the jib, machinery, ropes, etc.

It should, therefore, be carefully noted that stability is not always the limiting criterion for the safe operation of the crane. Safe working loads should not be exceeded in any circumstances.

90.1.2 *General.* It is good operational practice to avoid working at extremes of load or reach wherever possible. The feature of mobility should be used to position the crane in the most favourable position. It should be noted also that derricking-out the jib increases the radius of the load and will generally result in a reduced lifting capacity.

Fierce movements of any operational control should at all times be avoided as these could be dangerous and damaging to the structure or machinery of the crane, even when working without a load on the hook. In particular, great care should be exercised when operating cranes with extended telescopic jibs at longer radii. Under these conditions the influence of the dynamic effect of the jib itself on the overturning moment may be very large in comparison with that of the suspended load. Operational controls, and in particular the jib derricking control, should be operated sensitively and smoothly.

The specified load-radius dimension is the radius of the hook WITH THE SAFE WORKING LOAD SUSPENDED, unless otherwise stated. When a load is picked up, owing to the stretch in the loaded jib suspension ropes and/or deflection of the jib structure, the hook radius will increase. With near-maximum safe working loads, this increase may take the load outside the permitted radius, as shown in Figure 16. Before the lift is continued the load should be brought back into radius. Sudden setting-down or release of loads should always be avoided in order to prevent the jib springing backwards, or the machine will become unstable in a backwards direction.

90.1.3 *Axle-locking device.* Rail-mounted cranes with a sprung suspension are sometimes fitted with a means for locking-out or reducing the spring effect of the suspension during crane operations. Where such a device is fitted, the manufacturer's instructions should be followed in respect of its use.

90.1.4 *Cranes without powered travel.* A crane without powered travel should be fixed in its working position by the use of properly designed wedges or other effective devices.

90.1.5 *Outriggers.* If a crane is fitted with outriggers and is to operate in a manner which requires these, the following should be observed.

a) All operational outriggers should be fully extended and locked in position.

b) All outrigger jacks should be correctly fitted with feet and carefully tightened in accordance with the manufacturer's instructions to provide a firm and level base for the crane.

c) Prior to tightening the outrigger jacks, plates or packing should be inserted underneath the feet to distribute the operational loading to ensure that the bearing capacity of the supporting surface is not exceeded.

90.2 Near-maximum working loads. When operating with near maximum working loads, the weight of the load should be established as reliably as possible before attempting to lift the load. As a check on the operational stability, a trial lift should then be made, raising the load just clear of the ground and at a radius corresponding to the maximum radius at which the load is to be handled. The load should then be replaced on the ground to check if adjustments to the outriggers, slinging and radius are required before making the final lift. Proper care should be exercised by the driver, at all times, to avoid shock or side loadings being imposed on the jib.

It should be noted that any automatic safe load indicator fitted should be used only as a check that the load is within the capacity of the crane. It may be dangerous to depend solely on the indicator.

90.3 Travelling

90.3.1 *General.* When travelling the crane along its track, the driver should give an audible warning of his approach to any level crossing or any corner where sight is interrupted, or any other place where there may be danger to other personnel.

If the crane is pushing wagons, suitable effective precautions should be taken to ensure there is no risk of injury to personnel.

Cranes should not be towed by any other locomotive, power-driven crane or other wagon that moves on an adjacent line of rails, nor should the crane be used for towing any wagons on any adjacent line of rails. Cranes without powered travel should only be moved by the use of a prop or pole when no other reasonable means can be adopted. If used, the prop should be of steel or strong timber suitably reinforced to prevent splitting.

90.3.2 *Suspended load.* Where a crane is to travel with a suspended load, safe working loads appropriate to mobile operation should not be exceeded. Any special restrictions imposed by the crane manufacturer should be followed.

As a general rule, when travelling with a suspended load, the jib should be positioned in line with the track and pointing in the direction of travel of the crane.

In all cases, travelling acceleration and braking motions should be operated gently to limit the swing of the load. To prevent pendulum motion, steady lines should be attached to the load. This is particularly important if the load is of an awkward size or when it is likely to be affected by wind conditions.

When the crane is travelling, the load should be held just clear of the rail or ground at a minimum height sufficient to ensure that the load does not come into contact with the rail or ground due to bounce of the jib or load.

Where necessary a further person should assist the driver in the crane movement and give warning of hazards.

90.4 Other duties. When a rail-mounted crane is to be used for duties such as magnet or grabbing crane service, working loads should be reduced according to the duty conditions applying. The manufacturer's recommendations should in all cases be followed.

90.5 Handling of cranes near persons and carrying of persons. See **12.3**. Personnel should not be allowed to travel on rail-mounted cranes unless there are properly designed facilities which permit this practice. These facilities should include proper handholds and proper footplaces for personnel carried standing.

90.6 Slewing clearances and safety of personnel. In order to prevent trapping of personnel, adequate clearance sufficient for persons to pass in safety should be allowed between the nearest obstruction and any part of the crane. Consideration must be given to the movement of rotating parts such as the rear of the superstructure. Where it is not practicable to maintain such clearance or where only limited swing of crane is possible, special precautions should be taken to avoid a trapping hazard. Personnel should not be allowed to approach near a crane when it is operating or travelling as there is a danger that they may be struck or trapped between fixed and moving parts of the crane, e.g. between the slewing superstructure and non-rotating mounting of the crane. It is advisable to paint "keep clear" notices on the slewing upper works to be visible from the sides and rear of the machine.
The counterweight or rear-end should also be painted distinctively.

A further notice should be displayed on the crane to the effect: "NO PERSON IS ALLOWED ACCESS TO ANY PART OF THE CRANE WITHOUT THE PERMISSION OF THE DRIVER". Personnel should not be allowed to crawl or pass underneath the crane or associated wagons unless all precautions have been taken to ensure that there will be no movement of the crane and the location of the crane and associated wagons does not produce risk of danger from passing traffic.

Personnel working near to the crane and its tracks should be protected by the placing of warnings on either side of the crane. These should take the form of red fluorescent flags supplemented by red lights during periods of poor visibility and at night.

Except where the construction of the crane and associated wagons is such that coupling and uncoupling can be safely and conveniently performed without any part of the person's body being within the space between the crane and its connected wagons, coupling and uncoupling should be carried out by means of a coupling pole or other suitable mechanized appliance.

91 Testing

See clause **13**.

92 Ropes

See clause **14**.

93 Slinging and handling of loads

See clause **16**.

94 Maintenance

Details of statutory requirements, comments on plant maintenance and the competence of maintenance personnel are given in clause **17**. Attention is also drawn to **11.3**, **11.4** and **11.5** which relate to the reporting of defects and authorization for use, safe system of work and safe means of access.

Table 1 — Schedule of legal requirements for the testing and examination of cranes

Authority	Before first being taken into use	Weekly	12-monthly	14-monthly	4-yearly	After substantial alteration or repair	Before erection. Before being taken into use after each erection, adjustment, removal or exposure to weather conditions affecting anchorages or ballasting of cranes
The Docks Regulations 1934	Test and examination Regulation 18(a)		Inspection of derricks Regulation 18(b) i Thorough examination of all other cranes Regulation 18(b) ii		Thorough examination of derricks Regulation 18(b) i		
The Shipbuilding and Ship Repairing Regulations 1960	Test and thorough examination Regulation 34(1)		Thorough examination Regulation 34(2)			Test and thorough examination Regulation 34(1)	
The Factories Act 1961	Test and thorough examination Section 27(6)			Thorough examination Section 27(2)			
The Construction (Lifting Operations) Regulations 1961	Test and thorough examination Regulation 28(1) Test of automatic safe load indicators 30(1) and (2)	Inspection Regulation 10(1) (c) Inspection of automatic safe load indicators Regulation 30(1) and (2)		Thorough examination Regulation 28(3)	Test and thorough examination Regulation 28(1)	Test and thorough examination Regulation 28(2) and (3)	Examination of anchorages and/or ballasting Regulation 19(3) and (7) Test of anchorages and ballasting Regulation 19(4) Test of automatic safe load indicators regulation 30(1) and (2)
The Quarries (General) Regulations 1956				Thorough examination Regulation 13(1)			
Miscellaneous lines (General) 1956				Thorough examination Regulation 51(1)			

NOTE 1 The requirements specified apply to all cranes unless otherwise stated.

NOTE 2 Reference should be made to the full text of the Act or Regulation indicated.

NOTE 3 Copies of the Statutory Instruments and the prescribed reports and certificates associated with the requirements above are obtainable from Her Majesty's Stationery Office (HMSO).

Appendix A The use of lifting attachments and accessories

Whilst some of the following text is included in the main body of this code, this appendix is included as a brief guide for the use of lifting attachments and accessories.

A.1 Lifting gear should not be:

a) dropped from a height;

b) subjected to snatch loads.

This is particularly important in cold conditions.

A.2 A sling should not be:

a) used crossed, twisted, kinked or knotted;

b) used to roll a load over, using the crane for this purpose;

c) dragged from beneath a load by a crane unless the load is resting upon dunnage strips of adequate size;

d) subjected to excessive heat or allowed to come into contact with any acid, alkali or other substance likely to be harmful to the sling.

A.3 A shackle should only be used on a sling when it is fitted with a proper shackle pin. An ordinary bolt or piece of steel bar is not a safe substitute for the proper shackle pin.

A.4 The links of a chain should not be joined together by a nut and bolt, wiring, or by passing one link through another and inserting a bolt or nail to hold it in place. This does not preclude the use of purpose-designed assemblies.

A.5 A chain, fibre rope, wire rope or webbed sling should not be allowed to come into contact with any sharp or jagged edges of the load but should be protected by means of wood or other suitable packing.

A.6 When a sling has been detached from the load, and before the hoisting signal is given to the driver of a crane, it should be ascertained:

a) that ths ling is completely free of the load;

b) that any hook or other lifting device at the end of the sling is hooked or attached to the upper ring of the sling;

c) where b) is not practicable, that steps are taken to ensure that the hook or other lifting device does not catch or foul any fixed object.

A.7 A load should not be lifted by its wire strapping or banding or other fastenings unless they have been designed for this purpose. The hook should not be attached adjacent to any join in the fastening.

A.8 No hook should be attached to the rim or chain of a drum or barrel unless the hook is of suitable shape and the rim or chain is of adequate strength and depth for the purpose and is not distorted or otherwise damaged.

A.9 No hook should be inserted into the attachment of a load unless the attachment is of sufficient size for the load to be freely supported on the "seat" of the hook; in no circumstances should the load be applied to the point of the hook or the hook be "hammered" in.

A.10 When lifting a heavy or bulky load, care should be taken not to crowd the hook of the lifting device with slings.

If a large number of slings cannot be avoided, one or more shackles should be used to connect slings to the hook.

A.11 When handling irregularly shaped loads, such as a machine tool, or very long loads where the position of the centre of gravity may be appreciably away from the vertical geometric centreline, a number of trial lifts should be made by partially lifting the load and adjusting the sling positions until the load, when suspended, is as level as practicable.

Where it is necessary to shorten one or two legs of a chain sling for securing equal balance, proper devices such as a chain claw should be used. In no circumstances should shortening be done by knotting the sling.

A.12 When lifting long loads such as tubes, girders, etc. or a long metal sheet, a spreader beam or lifting frame should be employed.

The load should be fitted with guys so that twist or swing of the load may be controlled by personnel stationed on the guys.

A.13 When lifting loads such as tubes, girders, etc. that are of insufficient length to warrant the use of a spreader beam or lifting frame, each sling leg should be passed around the load twice before the sling hook is attached to the standing part ("choke hitch") in order to reduce the tendency for the slings to slide towards each other when under tension.

A.14 When using plate clamps, the following points apply.

a) The clamp should be of adequate size and strength for the loads handled and all the teeth on the clamp face and/or locking cam should be sound.

b) In the case of a plate clamp used to raise or lower a metal plate by gripping one edge of the plate, the latter hanging vertically, the clamp should not be directly attached to the hook of the lifting device but it should be connected to it by a short length of chain.

c) Where two clamps secured to a two-legged sling or two separate slings are used to raise or lower a plate by gripping one edge of the plate, the latter hanging vertically, the clamps should be applied such that their centrelines are in line with the respective sling legs.

d) A self-locking clamp should not be used unless it is fitted with a safety catch to prevent the clamp inadvertently releasing the load in the event of the tension upon it becoming momentarily slack.

A.15 When the hook of a multi-legged sling is attached to any eye-fitting on a pallet, load, etc., it should be inserted into the eye from the inside of the load, so that, in the event of a leg of the sling becoming momentarily slack, the hook will remain engaged in the eye.

A.16 When handling logs, the following points apply.

a) The weight of the log should be based on its being in a saturated condition, and only lifting gear having a generous excess margin of safe working load should be used.

b) When tongs or scissor clamps are used:

1) the tongs should be placed as near as practicable above the centre of gravity of the logs, and trial lifts made, as necessary, for this purpose;

2) the tongs should bite into the wood beneath the bark, the bark being removed at the lifting points if there is any doubt;

3) the person applying the tongs should stand well clear when the lift, including a trial lift, is made.

A.17 A reel of cable or wire should be lifted by attaching the sling legs to a bar of steel of ample strength and length which passes through the hole in the centre of the reel. Coils of wire should be lifted using a pole lift or flat webbing slings.

A.18 When not in use, lifting gear, such as chains, wire rope and fibre rope, should be stored under cover in clean, dry, well ventilated places where they are free from excessive heat and protected against corrosion.

Lifting gear in storage should be raised from the ground, and not be in contact with damaging agents such as ashes, clinker or coke breeze.

Lifting gear awaiting repair should be separately and suitably stored.

Lifting gear taken out of service and that is beyond repair should be scrapped immediately.

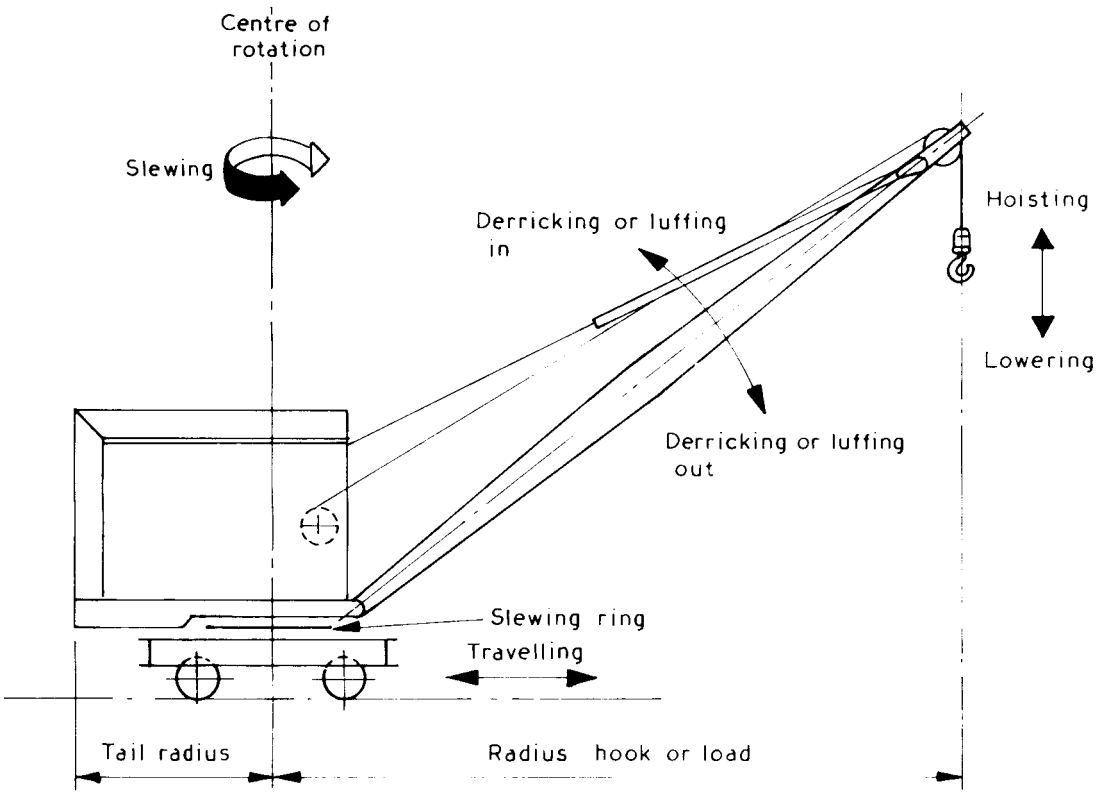
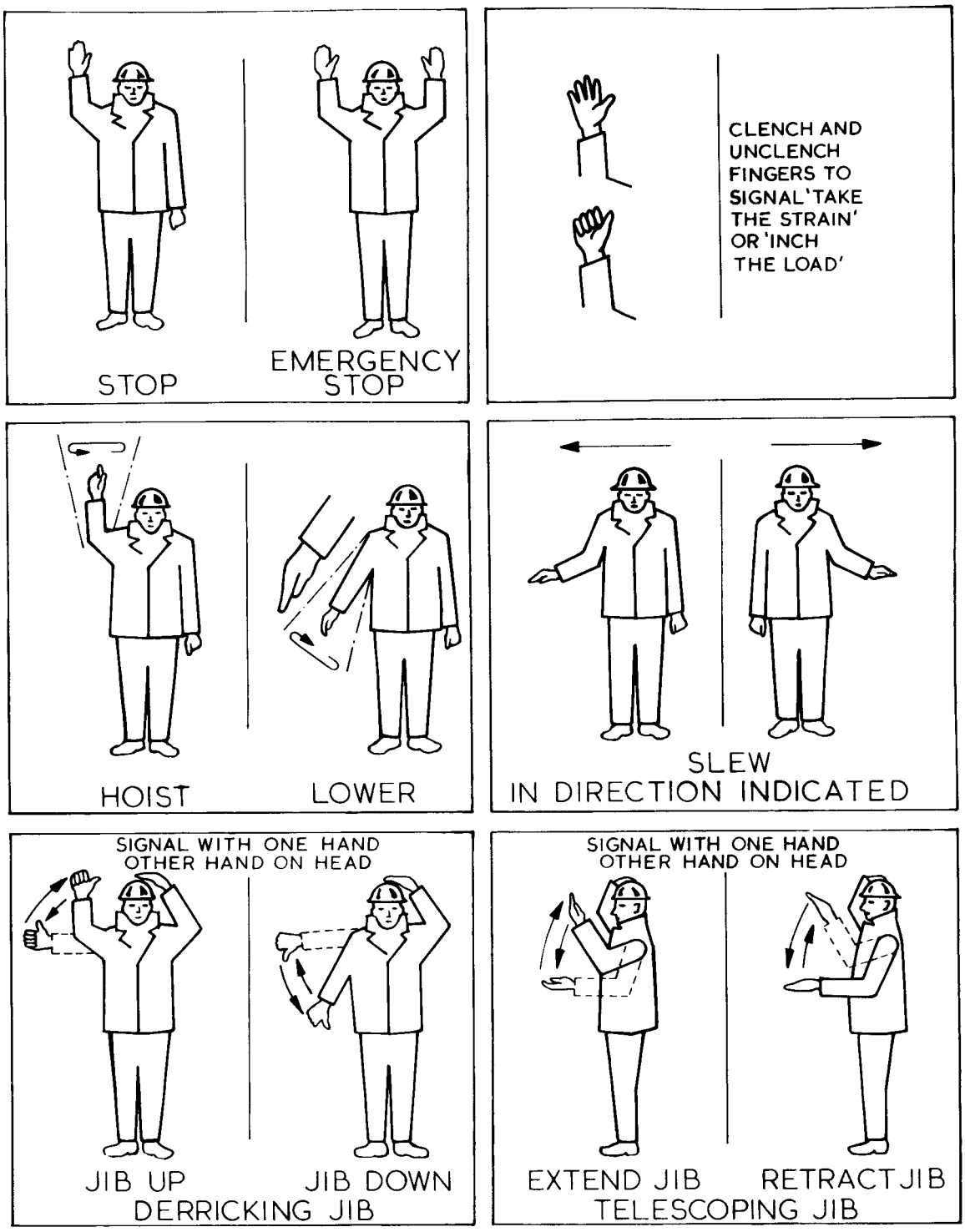


Figure 1 — Illustrated basic terminology for typical jib crane (see clause **3**)



NOTE The signaller should stand in a secure position where HE CAN SEE THE LOAD AND CAN BE SEEN CLEARLY by the driver. Face the driver if possible. Each signal should be distinct and clear.

Figure 2 — Recommended crane signals

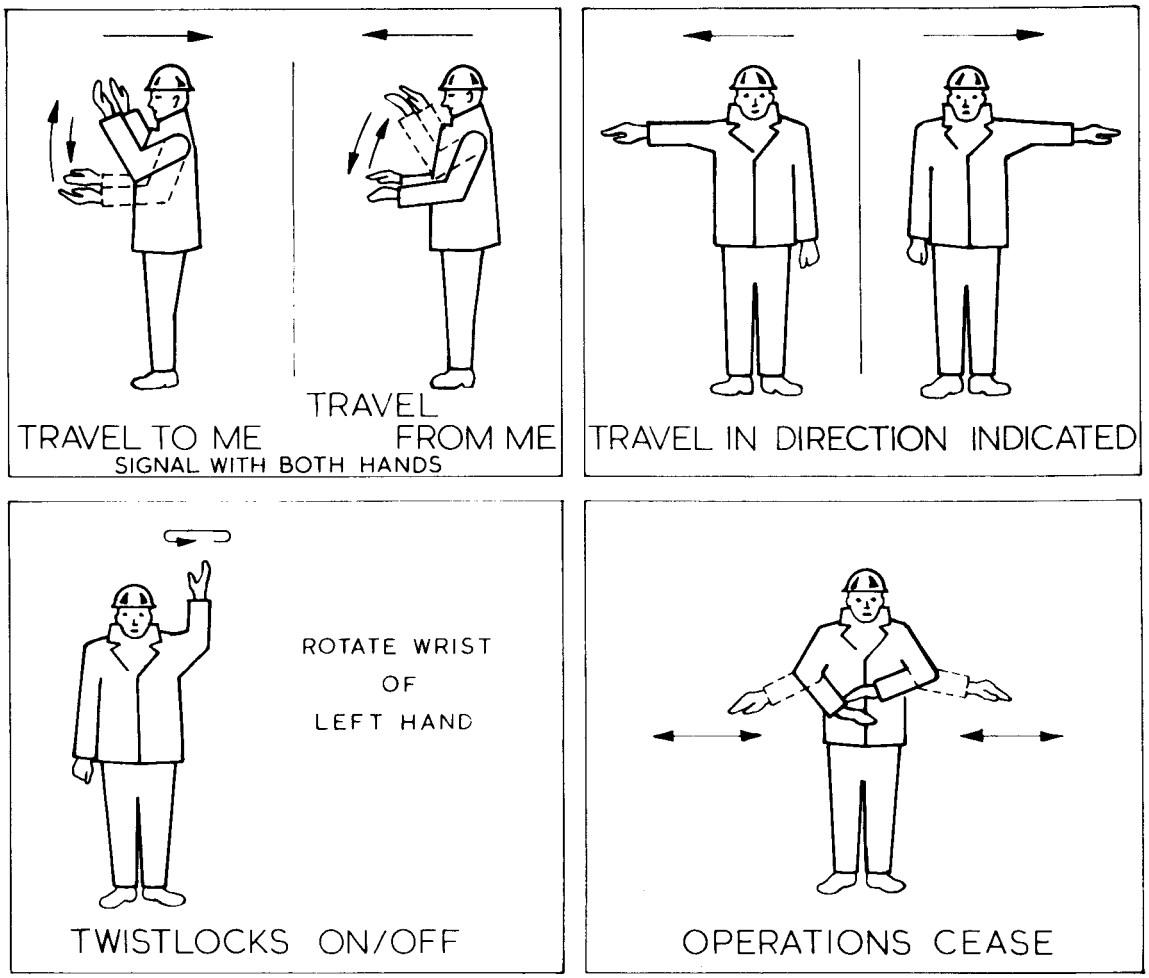
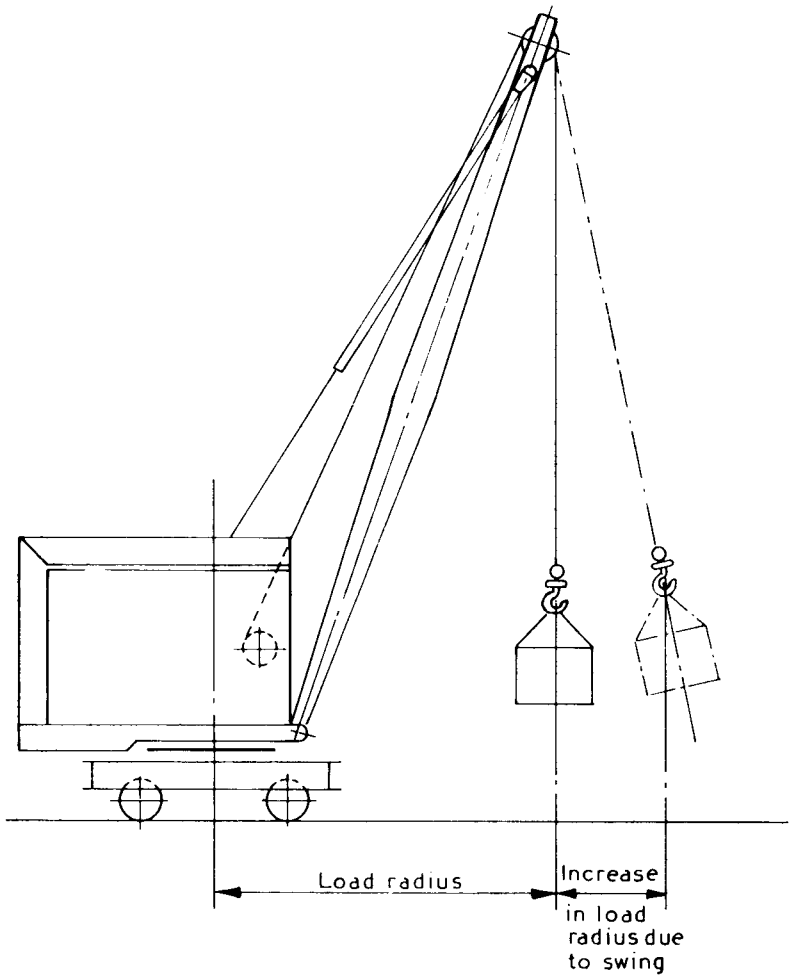


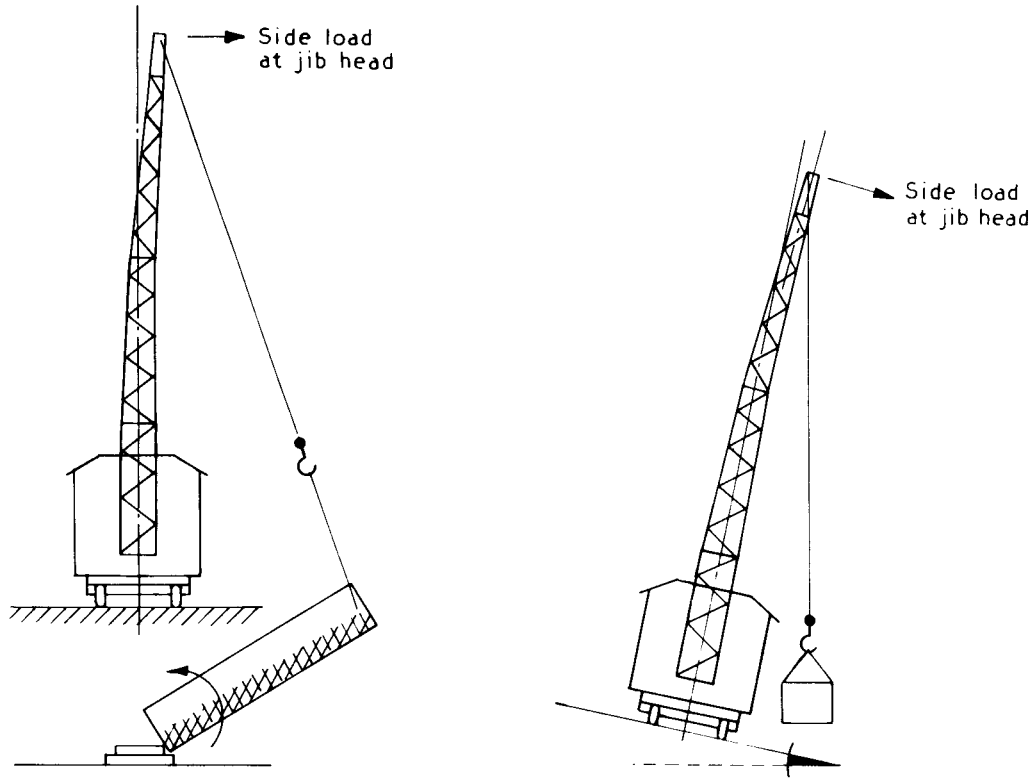
Figure 2 — Recommended crane signals *(concluded)*



Always lift loads gently and operate crane motions smoothly to avoid loads swinging. (A swinging load will increase the overturning moment of the cranes.) Use steady lines where necessary and where the load presents a wind catching area. Always travel with the load near to ground level so load swinging can be controlled.

KEEP THE LOAD UNDER CONTROL

Figure 3 — Effect of a swinging load on load radius (see **12.1**)



(a) Pulling a load sideways.

(b) Travelling across a slope.

Figures show typical operational conditions imposing a side loading on the jib of a crane. Jibs are not designed for high side loads in crane service. Do not pull or drag loads sideways using either the slewing motion or hoist line. The hoist line should always be in the plane of the jib and hanging plumb.

AVOID SIDE LOADING THE JIB

Figure 4 — Side loading on jib (see **12.1**)

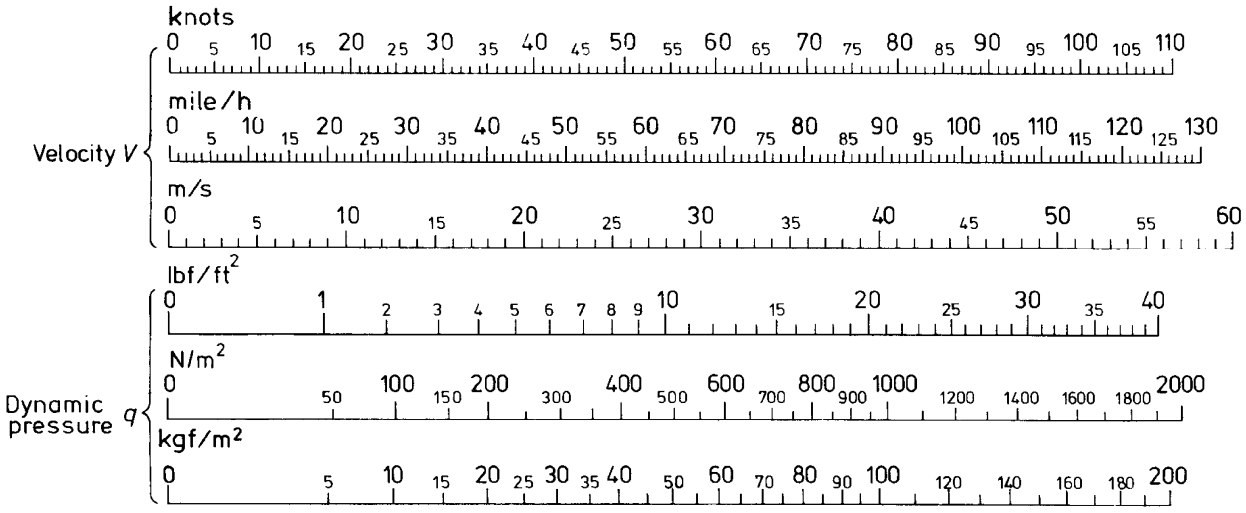
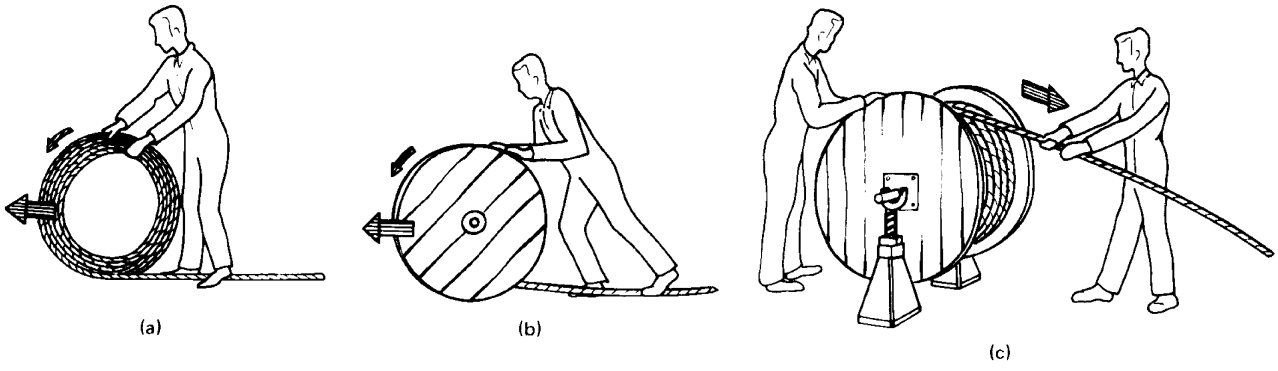


Figure 5 — Conversion chart for wind speed and pressure (see **12.6.1**)



The figures above show three correct methods of uncoiling wire ropes. The methods shown in (d) and (e) below should not be used.

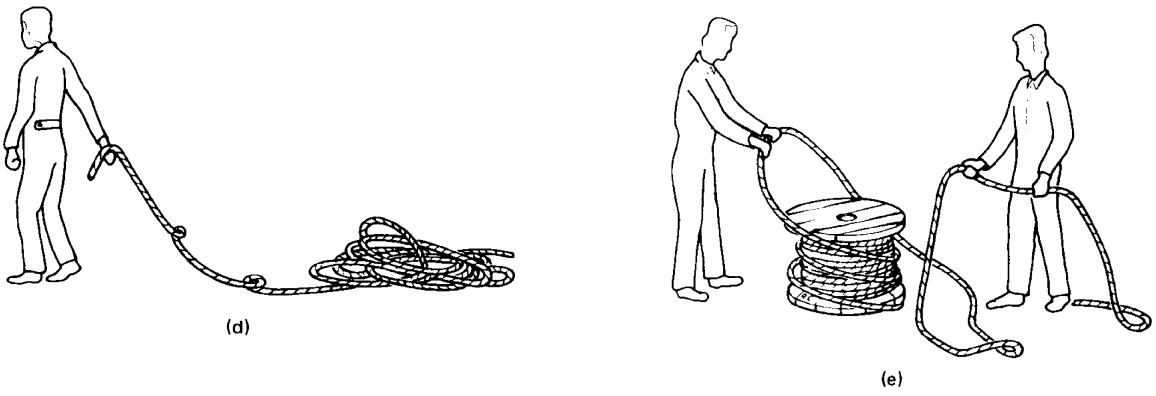


Figure 6 — Rope handling (see **14.3**)

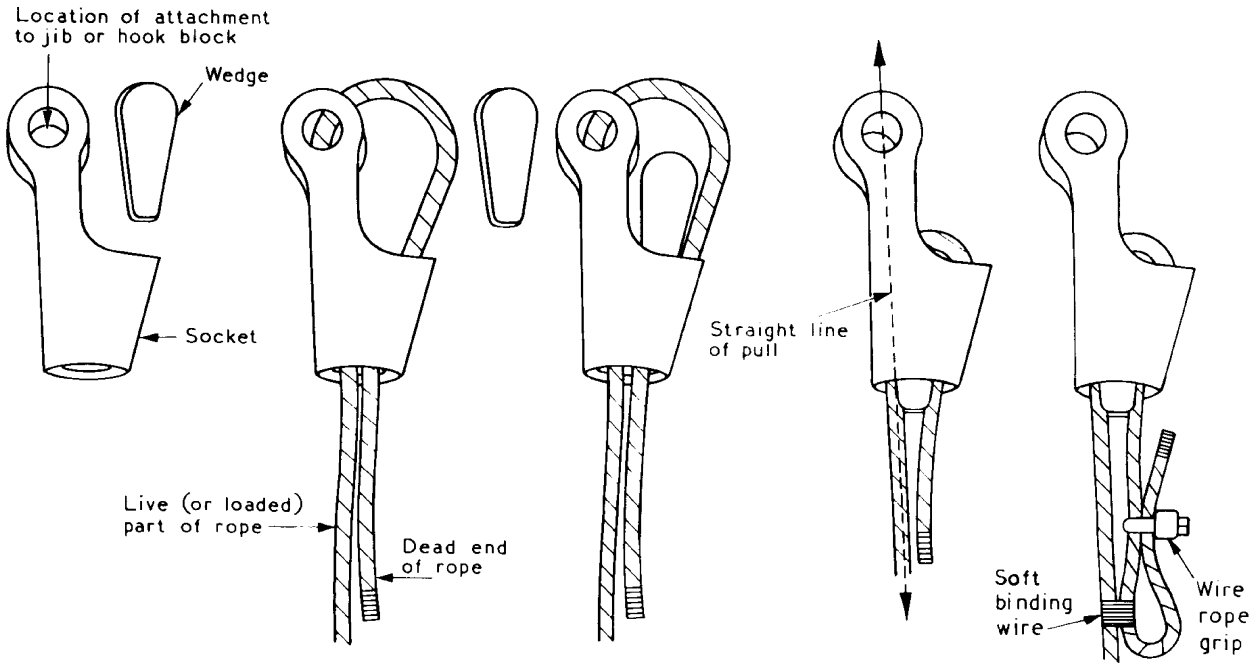
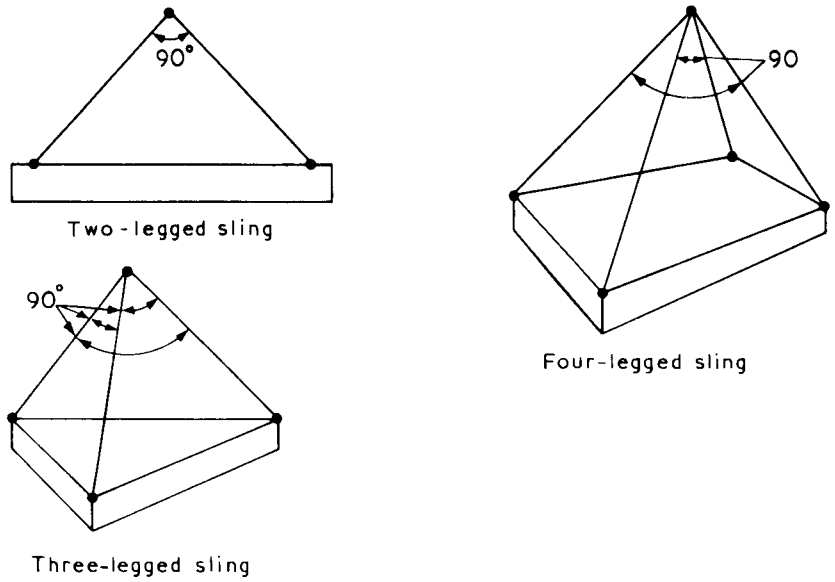
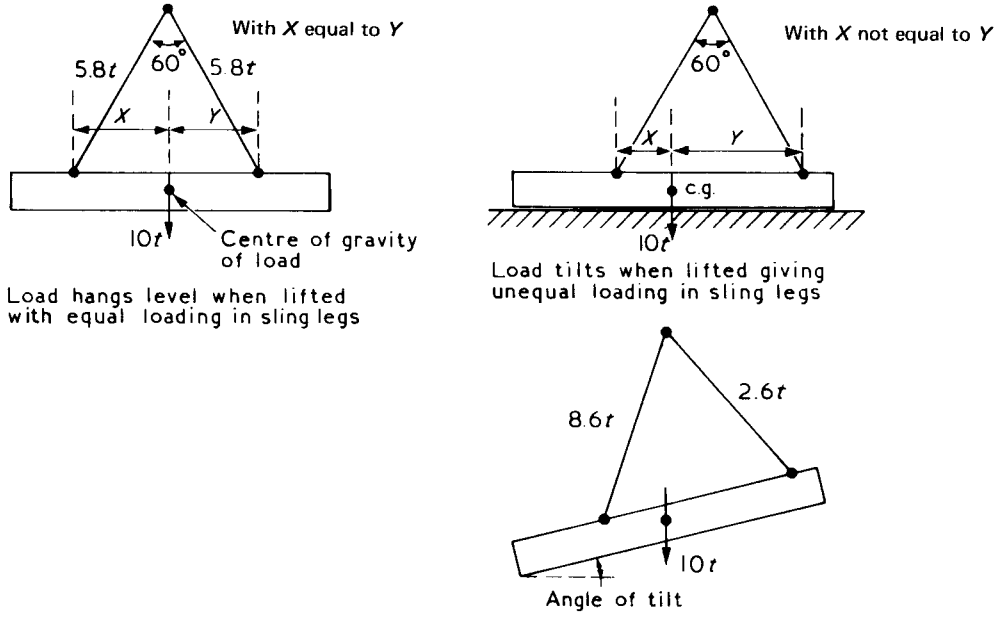


Figure 7 — Wedge and socket rope terminations (see **14.9**)



(a) Maximum leg angles



(b) Distribution of load between sling legs (typical example only)

Figure 8 — Multiple-legged slings (see **16.2**)

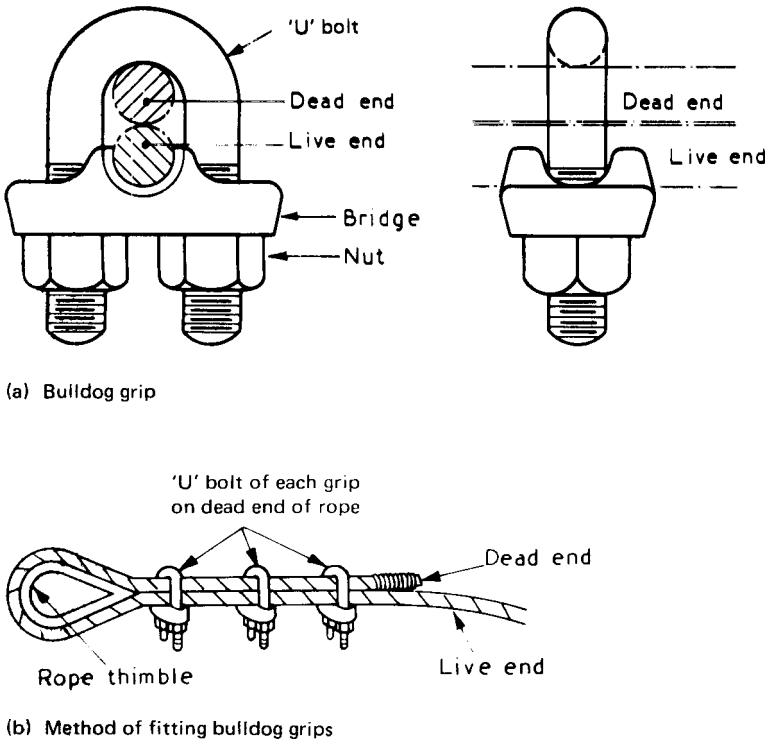
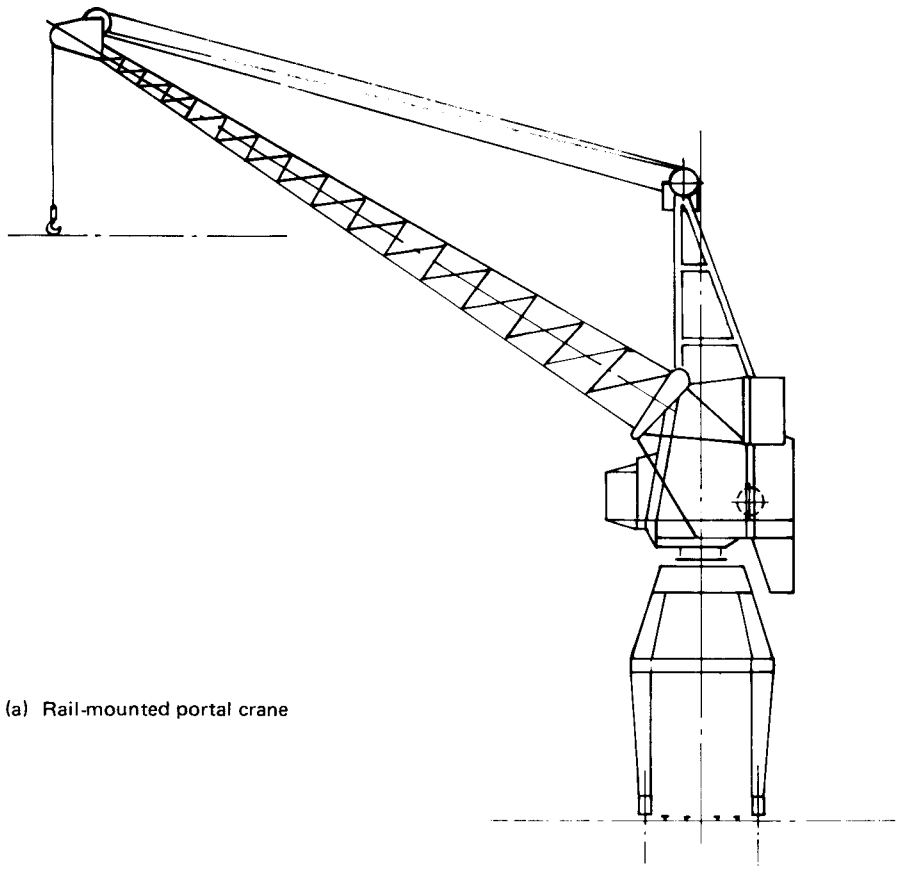
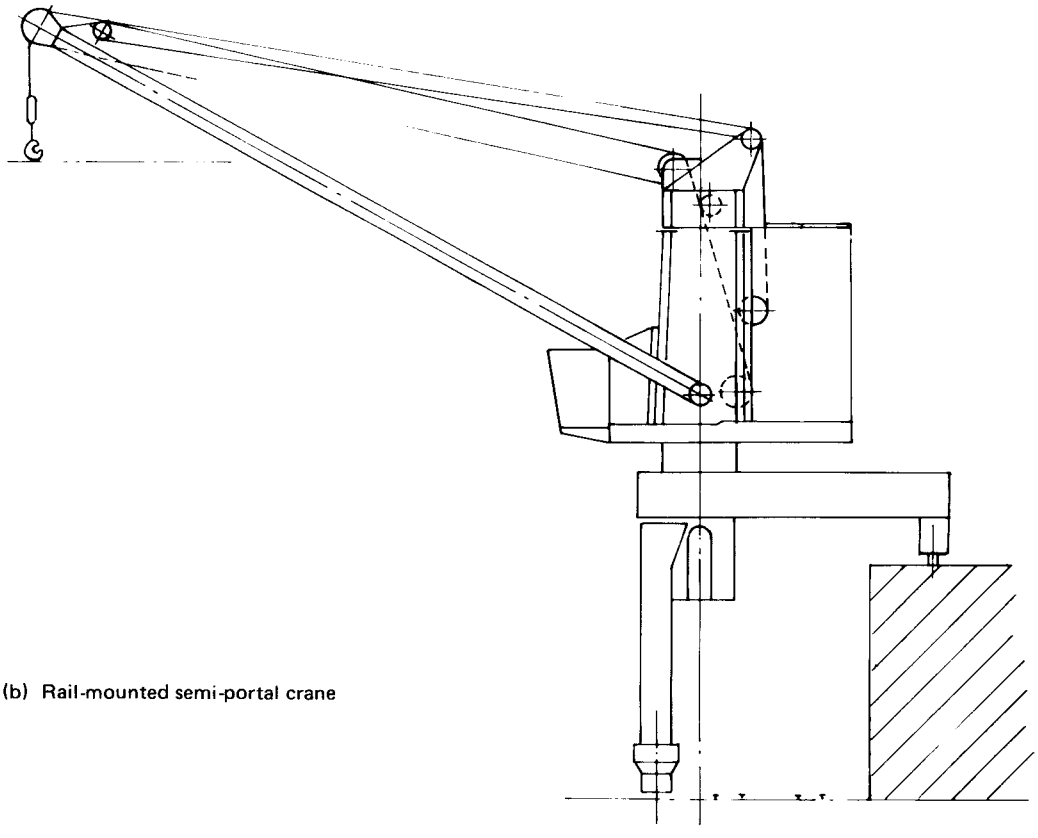


Figure 9 — Use of bulldog grips (see **16.3**)

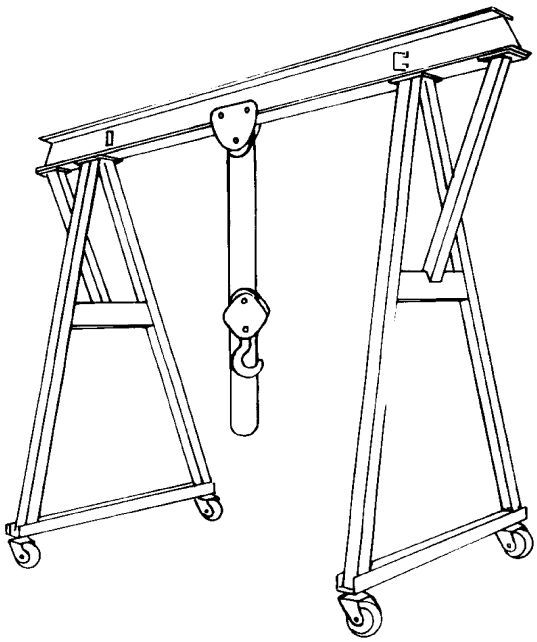


(a) Rail-mounted portal crane

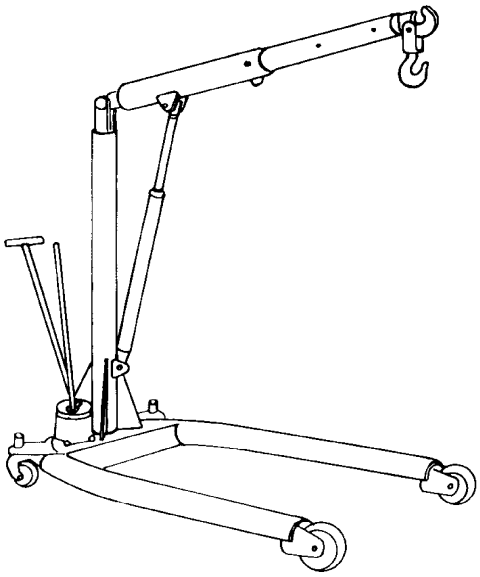


(b) Rail-mounted semi-portal crane

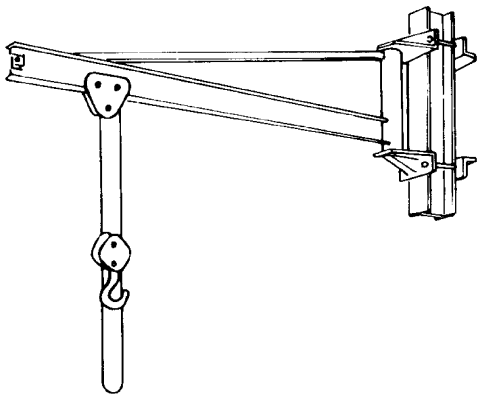
Figure 10 — High pedestal and portal jib dockside cranes



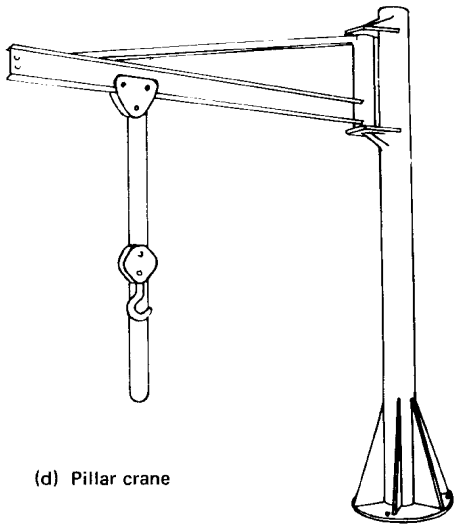
(a) 'A' Frame gantry



(b) Floor crane



(c) Wall crane



(d) Pillar crane

Figure 11 — Types of hand-operated crane (see clause **49**)

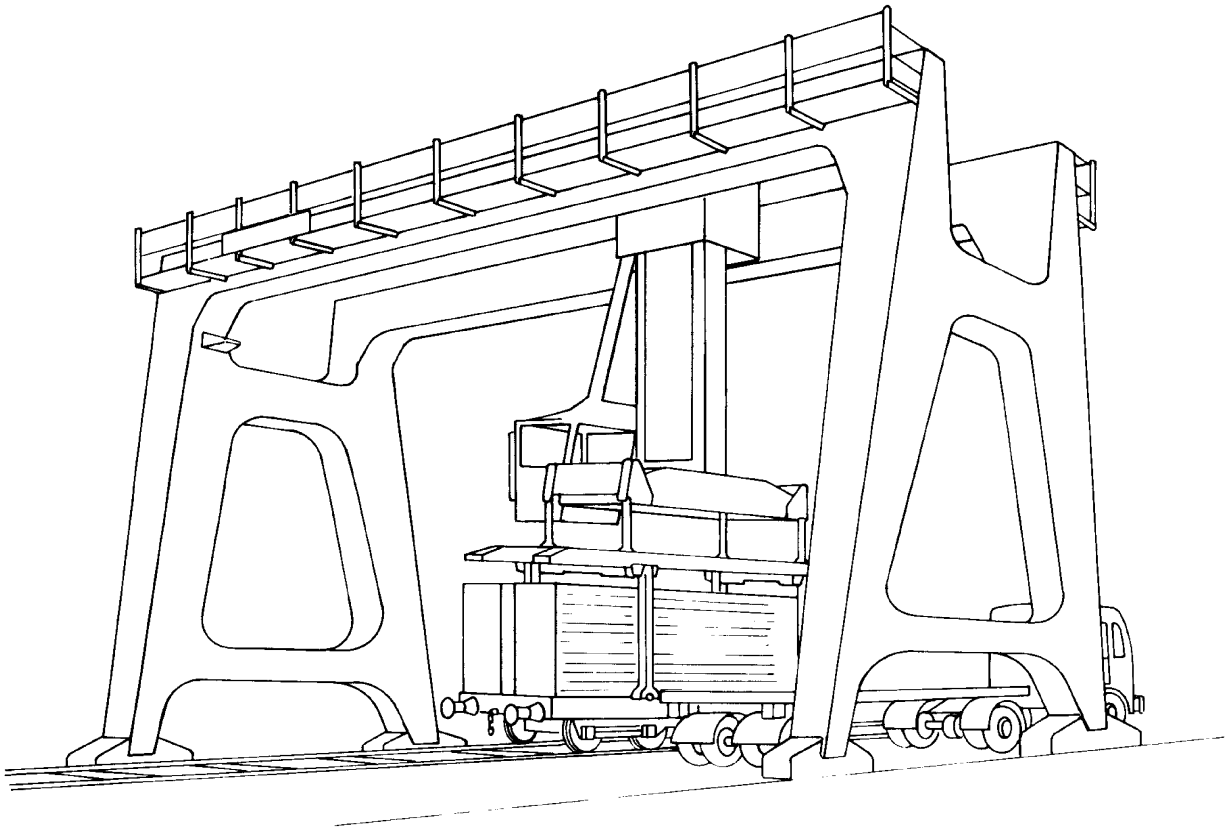


Figure 12 — Typical container crane (see clause **65**)

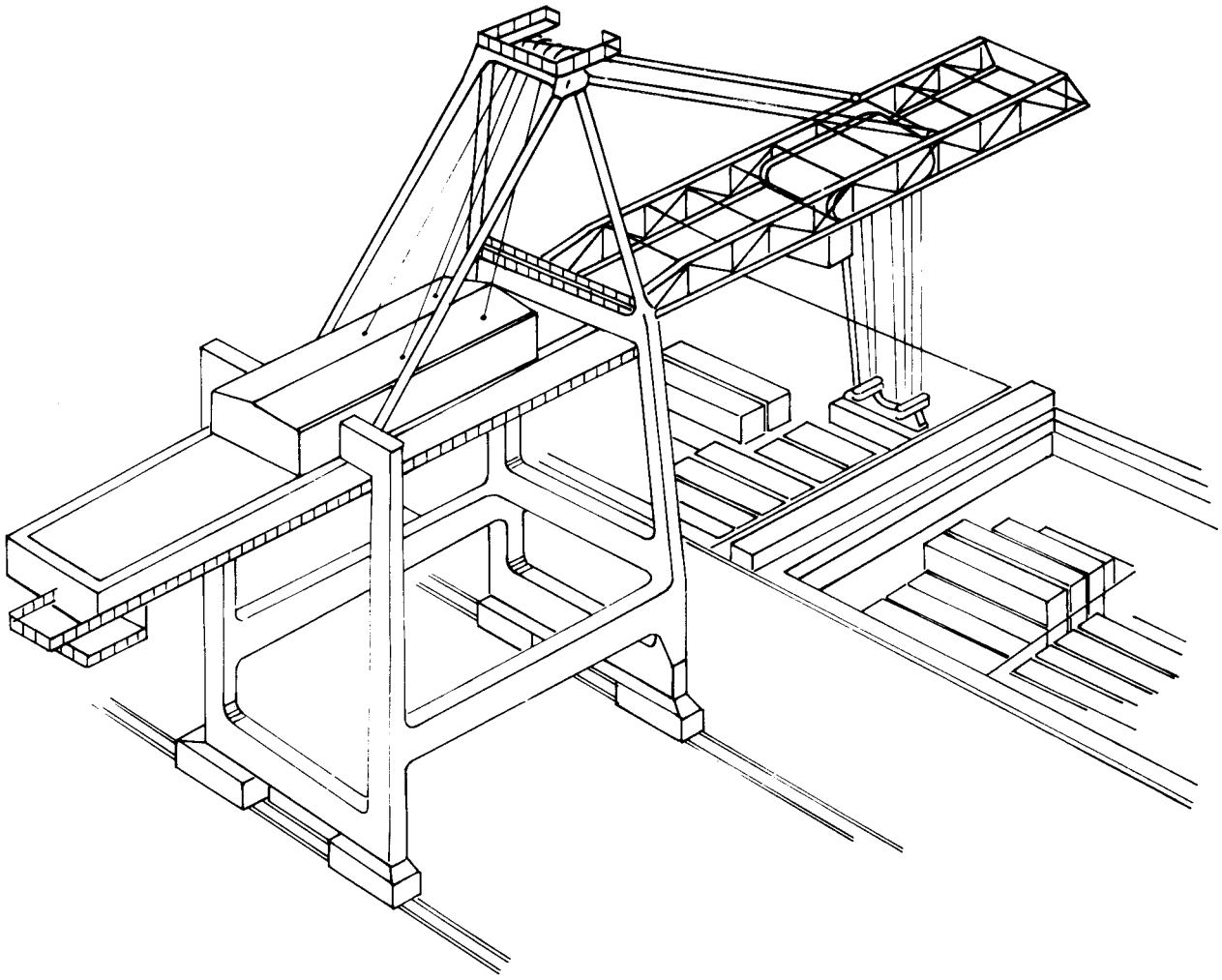


Figure 13 — Typical container crane (see clause **65**)

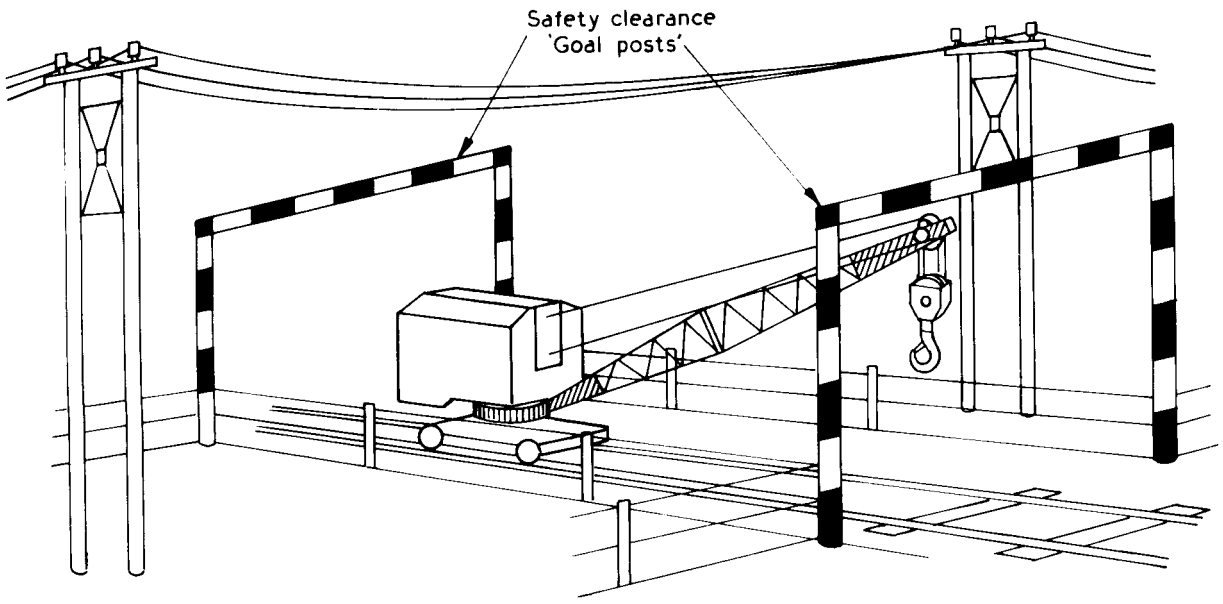


Figure 14 — Travelling under overhead electric lines and cables (see **9.2.1**)

WARNING

When working near electric lines or cables, unless otherwise agreed by the District Engineer of the local Electricity Board or the responsible engineer of the works or authority concerned, the crane should be positioned no closer to the plumb of the nearest line or cable than a distance equal to the length of the crane jib fitted, plus 6 m (20 ft) measured along the ground. Failure to comply with these instructions can kill you and/or other people working in the vicinity of your crane. If in doubt or difficulty, consult the local Electricity Board Engineer or the responsible engineer of the works or authority concerned.

Never travel a crane in the vicinity of overhead electric lines unless guided by an experienced slinger. Always try to keep the overhead lines in view when manoeuvring the crane, but remember it is difficult to estimate the heights or clearance distances of the lines by normal methods of observation.

If at any time the machine makes electrical contact with a live electric cable, observe the following precautions.

a) Remain inside the cab.

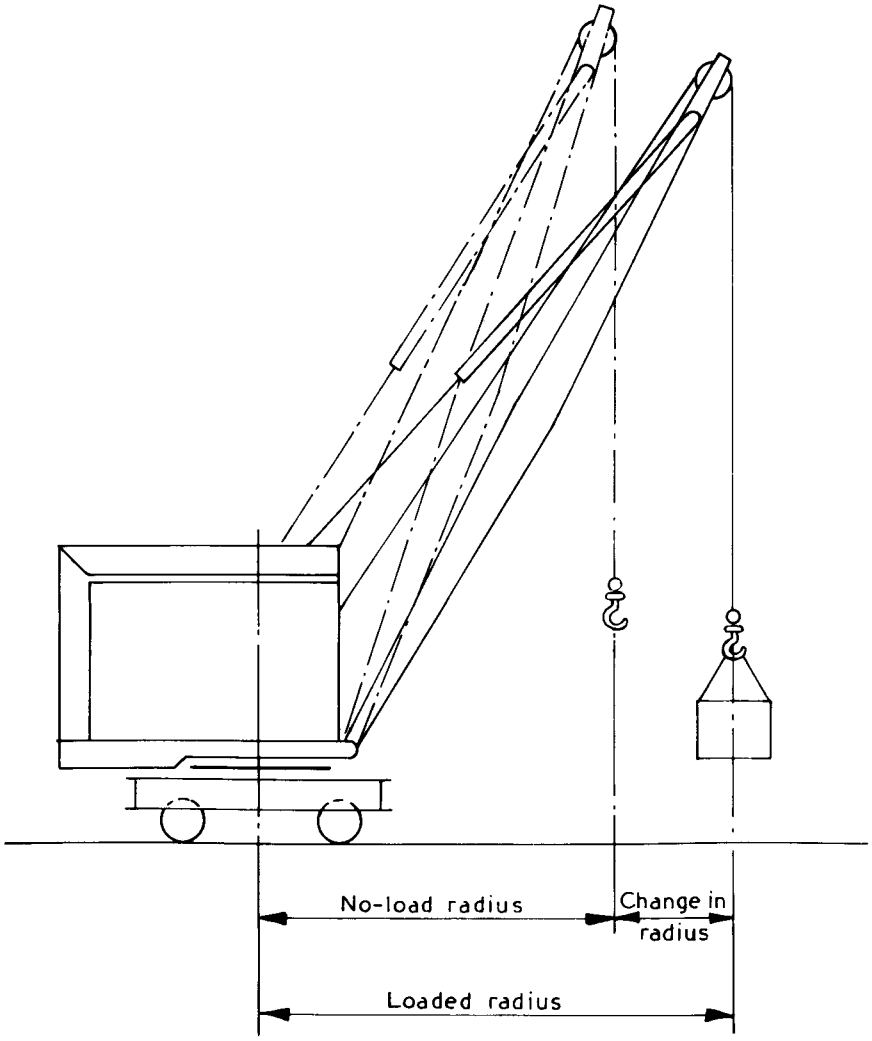
b) Tell all other personnel to keep away from the machine and not to touch any part of the crane, rope or load.

c) Try, unaided, and without anyone approaching the machine, to back off the crane until it is well clear of the power line.

d) If the machine cannot be self-propelled away or disentangled from the line, remain inside the machine. If possible get someone to inform the Electricity Board or other supply authority at once. Take no action until they confirm that conditions are safe.

e) However, if it is essential to leave the cab because of fire or some other reason, then, to avoid being electrocuted, jump clear as far away from the machine as possible and avoid touching the machine and the ground at the same time. The District Engineer of the Local Electricity Board or Generating Board or the responsible engineer of the works or authority concerned should be informed of the situation immediately, but until assistance is received someone should remain near the crane to warn of the danger.

Figure 15 — Warning notice: proximity of electric lines or cables (see **9.2.1**)



The figure shows the effect on radius when picking up or setting down loads due to stretch in jib suspension ropes and jib and machine deflection. Where necessary, re-adjust the radius after lifting the load just clear. Always place loads gently. When operating near to minimum radius ensure that the jib does not strike closed back stops when the load is set down, otherwise the jib may collapse or be damaged.

CHECK THE LOAD RADIUS OPERATION

Figure 16 — Influence of rope stretch on load radius (see **12.1**)

Publications referred to

BS 302, *Wire ropes for cranes, excavators and general engineering purposes.*
BS 357, *Power-driven travelling jib cranes.*
BS 449, *The use of structural steel in building.*
BS 461, *Bordeaux connections.*
BS 462, *Bulldog grips.*
BS 463, *Sockets for wire ropes.*
BS 464, *Thimbles for wire ropes.*
BS 466, *Electric overhead travelling cranes for general use in factories, workshops and warehouses.*
BS 590, *Mild steel chain Grade 30, short link and pitched or calibrated for lifting purposes.*
BS 1290, *Wire rope slings and sling legs.*
BS 1663, *Higher tensile steel chain Grade 40 (short link and pitched or calibrated) for lifting purposes.*
BS 2452, *High pedestal or portal jib cranes.*
BS 2573, *Permissible stresses in cranes and design rules.*
BS 2573-1, *Structures.*
BS 2573-2, *Mechanisms*[4)].
BS 2853, *The design and testing of steel overhead runway beams.*
BS 2902, *Higher tensile steel chain slings and rings, links alternative to rings, egg links and intermediate links.*
BS 2903, *Higher tensile steel hooks.*
BS 3017, *Mild steel forged ramshorn hooks.*
BS 3032, *Higher tensile steel shackles.*
BS 3037, *Types for crane wheels.*
BS 3037-1, *Double-flanged parallel-tread tyres.*
BS 3037-2, *Forged or rolled steel double-flanged rail wheels and tyres (metric units).*
BS 3113, *Alloy steel chain, grade 60. Short link, for lifting purposes.*
BS 3114, *Alloy steel chain, grade 80. Polished short link calibrated load chain for pulley blocks.*
BS 3243, *Hand-operated chain pulley blocks.*
BS 3458, *Alloy steel chain slings.*
BS 3481, *Flat lifting slings.*
BS 3481-1, *Wire coil flat slings.*
BS 3481-2, *Flat woven slings made of man-made fibre, for general service.*
BS 3481-3, *Disposable flat lifting slings.*
BS 3551, *Alloy steel shackles.*
BS 3579, *Heavy duty electric overhead travelling and special cranes for use in steel works.*
BS 3810, *Glossary of terms used in materials handling.*
BS 3810-4, *Terms used in connection with cranes.*
BS 3951, *Freight containers.*
BS 4278, *Eyebolts for lifting purposes.*
BS 4654, *Hooks for lifting freight containers of up to 30 tonnes.*

[4)] In course of preparation

BS 4942, *Short link chain for lifting purposes.*
BS 4942-1, *General conditions of acceptance.*
BS 4942-2, *Grade M non-calibrated chain.*
BS 4942-3, *Grade M calibrated chain.*
BS 5073, *The carriage of goods in freight containers.*
BS 5237, *Lifting twistlocks.*
BS 5281, *Ferrule secured eye terminations for wire ropes.*
CP 3010, *Safe use of cranes (mobile cranes, tower cranes and derrick cranes).*

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