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"पुराने को छोड नये के तरफ"
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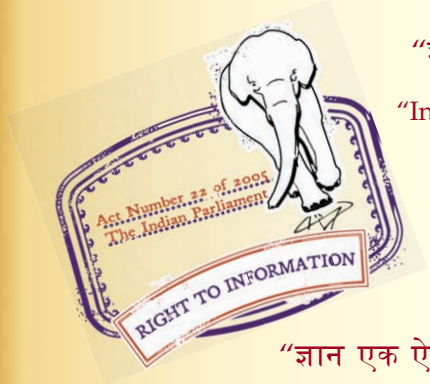
"Step Out From the Old to the New"

IS 13367-1 (1992): Safe use of cranes - Code of practice, Part 1: General [MED 14: Cranes, Lifting Chains and Related Equipment]



"ज्ञान से एक नये भारत का निर्माण"
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"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 13367 (Part 1) : 1992
(Reaffirmed 2003)

भारतीय मानक

क्रेनों का सुरक्षित उपयोग – रीति संहिता

भाग 1 सामान्य

Indian Standard

SAFE USE OF CRANES – CODE OF PRACTICE

PART 1 GENERAL

UDC 621·873 : 614·8

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 1992 Price Group 11

CONTENTS

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Cranes, Lifting Chains and Associated Equipment Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

It is in the interest of all those involved in lifting operations to ensure that lifting operation are carried out efficiently and safely. It is the aim of this code to assist crane users to achieve these objectives.

It is felt that management and organization of such operations are the foundation stones on which the successful operations may be built. These foundation stones are essential to all operations regardless of the type of crane being used.

(Continued on third cover)

Indian Standard

SAFE USE OF CRANES — CODE OF PRACTICE

PART 1 GENERAL

1 SCOPE

1.1 This standard gives guidance for the safe use of all types of cranes. Subjects covered include safe system of work, management, planning, general recommendations for selection, installation, testing, operation and maintenance of cranes and for the selection of drivers, slingers and signallers.

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

2 REFERENCES

The following Indian Standards are necessary adjuncts to this Standard:

IS No.	*Title*
808 : 1989	Dimensions for hot-rolled steel beam, column, channel and angle sections (*third revision*)
8324 :1976	Code of practice for safe use and maintenance of non-calibrated round steel link lifting chains and chain slings

3 DEFINITIONS

3.0 For the purposes of this code, the following definitions shall apply.

3.1 Appointed Person

The person appointed by the management or organization requiring the lifting operation to be undertaken who will be responsible for all aspects of the lifting operation.

3.2 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 also* **3.7**). Under certain statutory regulations the automatic safe load indicator should be of a type approved by the Chief Inspector of Factories (*see also* **3.5**).

3.3 Competent Person

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

3.4 Driver

The person who is operating the crane for the purpose of positioning loads.

Driver does not include any person who is operating a crane for erection of the crane itself.

3.5 Load Radius Indicator

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

3.6 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* Fig. 1).

3.7 Safe Working Load

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

3.8 Service Conditions

a) *In-Service* — With the crane handling loads up to the safe working loads in permissible wind pressures specified in the appropriate Indian Standard.

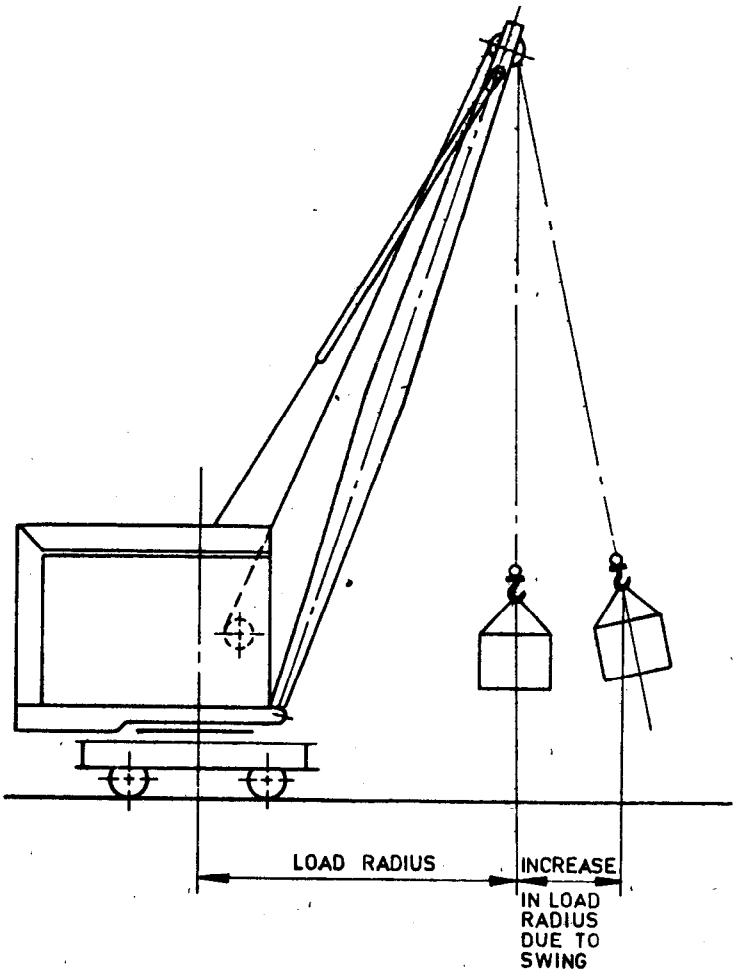
b) *Out-of-Service* — With the crane either not required for use, or out of use when wind pressures exceed those permitted for in-service conditions, and without load on the hook.

4 MANAGEMENT OF THE LIFTING OPERATION

4.1 Safe System of Work

A safe system of work (*see* **9.3**) should be established and followed for every lifting operation. This should include the planning of the operation, the provision, selection, maintenance and examination of the correct equipment and the provision of properly trained, competent personnel with adequate supervision.

The lifting operation should be taken to include any necessary preparation of a site and erection and dismantling of the crane or cranes.



Always lift loads gently and operate crane motions smoothly to avoid load 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 countrolled.

FIG. 1. EFFECT OF A SWINGING LOAD ON LOAD RADIUS

The same principles should be applied when a series of lifting operations are being carried out at one site or the crane is a permanent fixture, for example, in a factory or at a dock.

4.2 Appointed Person

The management of the organization requiring the lifting operation to be undertaken should appoint a person with appropriate training and experience who should be competent. This person should be known as the appointed person.

The appointed person need not be an employee of the organization and will not normally undertake the duties of crane driver, slinger or signaller.

4.3 Duties of the Appointed Person

The management of the organization requiring the lifting operation to be undertaken should specify the duties of the appointed person which should include:

a) The assessment of the lifting operation to provide such planning, selection of crane(s) lifting gear and equipment, instruction and supervision as is necessary for the task to be undertaken safely. This should include consultation with other responsible bodies, if necessary (*see* **9.3**), and ensuring that where different organizations are involved they collaborate as necessary.

b) Ensuring that there is an effective procedure for reporting defects and incidents (*see* **12.3**) and that adequate maintenance of the equipment is carried out.

c) Responsibility for the organization of the team involved in the lifting operation.

d) The nomination of persons to undertake the duties required for the operation including those listed in **5** or ensuring that this responsibility is delegated to an appropriate person or organization.

e) Responsibility for control of the lifting operation. This duty may be delegated to another person where considered appropriate

by the appointed person. It is undesirable that this duty should be undertaken by the crane driver because of the need for the crane driver to be at the crane controls throughout the operation.

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

5 PLANNING OF THE LIFTING OPERATION

5.1 General

Every lifting operation including crane erection and dismantling should be planned to ensure that it is carried out in a safe manner. The extent of detailed planning will depend on the complexity of the overall operation but no operation should be considered so simple that the planning can be ignored. The plan should never permit exceeding the safe working load of the crane or equipment.

5.2 Planning

For a lifting operation where there are obstructions and hazards, or where ground conditions are suspect, or the load being handled is in any way unusual, a high degree of detailed planning including determination of the load and its characteristics (including centre of gravity), the investigation of the ground conditions, the nature of any obstructions and hazards and the method of slinging and of controlling the movement of the load throughout the lifting operation should be carried out. An essential feature of this planning should be the production of plans and elevations of the lifting operation at all critical phases from the initial siting of the crane to the final landing of the load. A written statement outlining the duties of, and action required from, each member of the team should be produced and all members of the team should be fully aware of the contents of this statement.

If the crane(s) called for by the planning, has to be erected before commencing work and dismantled after completion then these phases form part of the overall operation and the appointed person should ensure that all relevant factors including space, suitability of ground and access are given due consideration. In any case, safe access to the site of lifting operations is always an important consideration.

Lifting operations involving the simultaneous use of more than one crane carry a higher risk factor than those using only one crane so that additional care should be taken in their planning (*see* **13.4**). It is also essential that the drivers, slingers and the person in charge are thoroughly briefed with particular emphasis on the effect that the operation of one crane has on the other(s). Three dimensional scale models should be considered a useful aid to the team briefing for particularly complicated lifts.

5.3 Planning for the Permanently Installed Crane

Where a crane is installed to carry out a number of operations or is installed as a permanent fixture, the planning should be carried out prior to the selection and installation of the crane. Account should be taken of the continuing lifting requirements and the loads that are likely to be lifted. The operations should be reviewed periodically to check that the size and nature of the loads have not altered significantly and that the crane and equipment are still suitable for the duty required of them.

5.4 Minimum Planning

Lifting operations whose consideration shows that there are no hidden difficulties with access, erection and dismantling, obstructions, hazards or other complications should only require minimum planning. Following the selection of a suitable crane and range of lifting gear and equipment for the loads to be lifted, such operations may be delegated to the team of slinger(s) and crane driver after they have been fully briefed on their task.

6 SELECTION OF PERSONS

6.1 General

Safe lifting depends on the selection of suitable persons who are competent to carry out the required duties. The appointed person should ensure that persons involved in the operation are efficiently oganized to ensure good team work in the working situation and that no member of the team has his efficiency impaired because of alcohol or other drugs. All persons in the team should be aware of their duties which should be as listed in **6.2.1** to **6.2.5.** Responsibility should only be delegated to an extent that is appropriate, taking into account the ability, competence and authority of the person concerned.

The appointed person should choose persons who are fit and either competent or who are under appropriate training and supervision. The recommended attributes for persons involved in lifting operations are given in **7.1** to **7.5.**

6.2 Duties of Persons

6.2.1 *Crane Driver*

The crane driver should be responsible for the correct operation of the crane in accordance with the manufacturers instruction book and the plan. In some cases, the crane driver may be responsible for erection and dismantling of the crane. The crane driver should at any one time only respond to the signals from one slinger/signaller who should be clearly identified.

6.2.2 *Slinger*

The slinger is responsible for attaching and detaching the load to and from the crane hook and for the use of

the correct lifting gear and equipment in accordance with planning of the operation.

The slinger is responsible for initiating and directing the safe movement of the crane [*see* **7.2(h)**]. At any one time, dependent upon the physical position of the slinger or slingers, only one slinger should have this responsibility.

Where this slinger is not visible to the crane driver, another slinger or a signaller should be employed to relay the signals to the crane driver. Alternatively, other audio or visual methods should be used such as telephone, radio or closed-circuit television.

To cover the possibility of failure of the audio or visual method, a separate system should be available to enable movement of the crane(s) or load(s) to be safely halted. There should be no further movement of the crane(s) or load(s) until means of signalling have been restored.

If responsibility for directing the crane and load is to be transferred to another person, the slinger should retain responsibility until such time as the slinger considers it necessary to transfer the responsibility. At this time:

a) the slinger should clearly indicate to the crane driver that this responsibility is being transferred and to whom;

b) the slinger should clearly indicate to the new slinger or signaller that this transfer is taking place;

c) the driver and new slinger or signaller should clearly indicate that they accept the transfer of responsibility.

6.2.3 *Signaller*

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

6.2.4 *Crane Erector*

The crane erector is responsible for the erection of the crane in accordance with the manufacturers instructions (*see* **11**).

Where two or more crane erectors are required, one should be nominated as 'erector-in-charge' to control the operation.

6.2.5 *Maintenance Personnel*

The maintenace personnel should be responsible for maintaining the crane to ensure its safe and satisfactory operation. They should carry out all necessary maintenance in accordance with the safe system of work and permit to work (*see* **9.3** and **9.4**).

7 RECOMMENDED MINIMUM ATTRIBUTES

7.1 Crane Driver

The crane driver should:

a) be competent;

b) be more than 18 years of age except when under the direct supervision of a competent person for the purpose of training;

c) be fit, particularly with regard to eyesight, hearing, reflexes, the stature to operate the crane safely, ability to judge distances, heights and clearances;

NOTE — Evidence that the driver is medically fit to drive a crane should be obtained at not more than 5 yearly intervals and should be made available to the appointed person.

d) have been adequately trained in the type of crane being driven and have sufficient knowledge of the crane and its safety devices;

e) understand fully the duties of the slinger and signaller and be familiar with the signal code shown in Fig. 2 and any alternative methods of relaying the signals which are to be used for the operation being undertaken in order to implement safely the instruction of the slinger or signaller;

f) be familiar with the fire appliances on the crane and be trained in their use;

g) have been authorized to operate the crane. The appointed person in giving this authorization should take competence, training, recent experience and fitness into account.

NOTE — It is also recommended that a record of the drivers training and experience is maintained. Such records should be made available to the appointed person.

7.2 Slinger

The slinger should:

a) be competent;

b) be more than 18 years of age except when under the direct supervision of a competent person for the purpose of training;

c) be fit, with particular regard to eyesight, hearing, reflexes, agility, having the physique to handle lifting gear and equipment and be able to establish weights, balance loads and judge distances, heights and clearances;

d) have been trained in the techniques of slinging;

e) be capable of selecting lifting gear and equipment from that provided, suitable for the load to be lifted;

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

g) be capable of giving precise and clear verbal instructions where audio equipment (e.g., radio) is used and be capable of operating the equipment;

h) be capable of initiating and directing the safe movement of the crane and load; and

j) have been nominated by the appointed person to carry out slinging duties.

7.3 Signaller

The signaller should:

a) be competent;

b) be more than 18 years of age, except when under the direct supervision of a competent person for the purpose of training;

c) be fit with particular regard to eyesight, hearing, reflexes, mobility, ability to judge distances, heights and clearances;

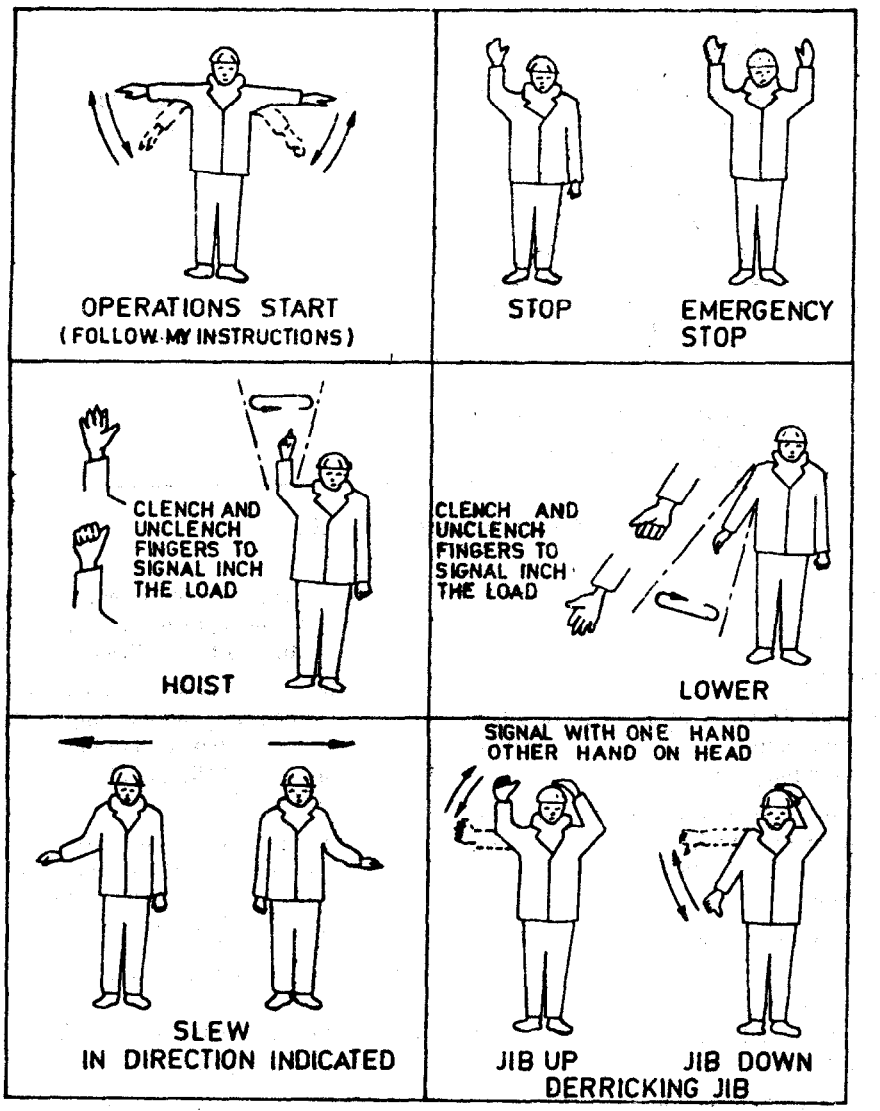
d) understand the signal code shown in Fig. 2 for the crane being operated and be able to give clear and precise signals;

e) be capable of giving precise and clear verbal instructions where audio equipment (e.g., radio) is employed and be capable of operating the equipment;

f) be capable of directing the safe movement of the crane and load;

g) have been nominated by the appointed person to carry out signalling duties; and

h) be aware of the responsibilities allocated by the appointed person to the crane driver and slinger.



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

FIG. 2 RECOMMENDED CRANE SIGNALS — *Contd*.

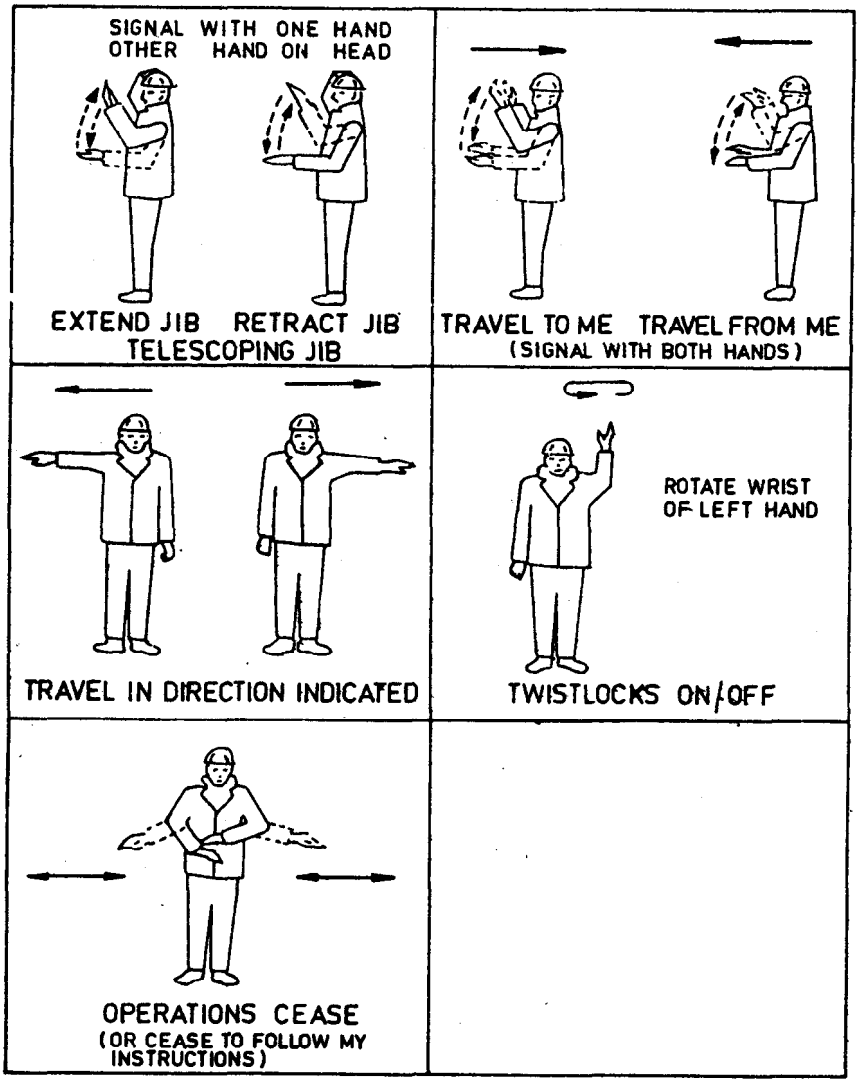


FIG. 2 RECOMMENDED CRANE SIGNALS

7.4 Crane Erector

The crane erector should:

a) be competent;

b) be more than 21 years of age except when under direct supervision of a competent person for the purpose of training;

c) be fit with particular regard to eyesight, hearing, reflexes and have the stature and agility to safely handle the loads involved in crane erection;

d) be able to work confidently and safely at heights;

e) be aware of personal responsibilities under the law (civil and criminal), for personal safety and that of others;

f) be able to establish weights, balance loads and judge distances, heights and clearances;

g) have been trained in the techniques of slinging;

h) be capable of selecting lifting gear and equipment from the that provided; suitable for the load to be lifted;

j) be adequately trained in the erection, dismantling and working of the type of crane being erected, also in the safe use and setting up of any lifting appliance used in the course of these duties; and

k) be adequately trained in the setting and testing of the safety devices fitted to the crane being erected and those on any lifting appliance being used for the erection.

7.5 Maintenance Personnel

The maintenance personnel should:

a) be competent;

b) have adequate knowledge of the machinery they are required to maintain;

c) have access to manufacturer's relevant literature; and

d) be properly instructed and trained. Where special machinery is involved this should include attending appropriate courses given by the supplier of the equipment.

8 DESCRIPTION AND SELECTION OF TYPES OF CRANES

This code of practice covers the types of cranes referred to in **8.1** to **8.10**

8.1 Mobile Cranes

These cranes consist of a jib mounted on a purpose designed chassis either road wheel mounted or crawler tracked. They may be permitted, when specified, to move on their wheels or tracks when carrying loads or may require the use of stabilisers or outriggers to permit the lifting of their design loads. Larger mobile cranes may consist of separate units which when assembled for crane duties operate on a fixed base. Enhanced duties may be obtained in special cases by the attachment of additional structural members and counterweight or by mounting the mobile crane on a special base or track, or by a combination of both.

8.2 Lorry Loaders (Jib Type)

This type of lorry loader consists of a jib crane mounted on a load carrying vehicle primarily intended for handling loads on or off the vehicle to which it is attached.

8.3 Tower Cranes

These cranes consist of a jib mounted at an elevated level on a vertical tower, the jib being capable of slewing through 360° or more.

Tower cranes may be mounted on a fixed base, crawler tracks, rails or wheels or may be mounted onto another structure.

8.4 Derrick Cranes

These cranes consist of a jib which is supported by ropes from a mast which in turn is supported either by guy ropes, stays or other means.

8.5 Overhead/Underhung Travelling Cranes

These cranes consist 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.

8.6 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 traversing motions.

The crane is normally operated from an elevated cabin.

8.7 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.

8.8 Manually and Power Operated Light Cranes

These include manually and power operated 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 canti-levered, horizontal, movable or fixed.

8.9 Container Handling Cranes

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

8.10 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. They are suitable for use at such locations as docks, shipyards, sidings, factories, etc, where railwaytracks are readily available. Cranes designed specifically for railway breakdown or track laying/maintenance purposes are covered by this code.

8.11 General Considerations for Selection for the Operation

Each of the types of crane referred to in **8.1** to **8.10** are available in a number of different forms and the characteristics of the various machines should be considered against the job requirements. Points to be considered in making the selection include:

a) weights, dimensions and characteristics of loads;
b) operational radii, speeds of various operations, heights of lifts and areas of movement;

c) number, frequency and types of lifting operations;

d) length of time for which the crane will be required or anticipated life expectancy for a permanently installed crane;

e) site, ground and environmental conditions or restrictions arising from the use of existing buildings;

f) space available for crane access, erection, travelling, operation and dismantling; and

g) any special operational requirements or limitations imposed.

Reference should be made to the relevant Parts of this Code of Practice for details of the different types of crane and their operational characteristics.

Having decided upon the type of crane to be used, on the site or building and knowing the overall requirements to be involved, a crane having an adequate working margin in respect both to load, radius and maximum hook height should be selected. It is important that the crane will meet all the requirements of the planned lift.

9 SAFETY

9.1 General

Both the person or organization having overall control of the site and the employers of people involved in the lifting operation have responsibility for safety. In order that this responsibility may be effectively discharged the appointed person (*see* **4.2**) should be given the necessary authority to ensure that adequate systems to achieve safety are in operation. For safety matters relating to lifting operations this will include the use, maintenance, repair and renewal of safety equipment and the instruction and responsibilities of various personnel in relation to the equipment.

9.2 Identification of Person Directing Crane Movements

The person directing crane movements (slinger or signaller) should be easily identifiable to the crane driver by wearing high visibility clothing or by other means.

9.3 Safe System of Work

For every lifting operation and before any maintenance, repairs or adjustments or any inspections are carried out on a crane, a safe system of work should be established to ensure the safety of all personnel. The system should prevent any inadvertent restoration of the power or movement of the crane.

The safe system of work should be clearly documented as reliance on verbal instructions alone is not enough to ensure safety.

The system should ensure effective communication between all parties concerned.

9.4 Permit to Work

Where it is required to carry out work on a crane at its place of work, a permit to work system may be necessary to achieve a safe system of work. This requires a specially designed form or certificate to be issued only when the requirements of the safe system of work have been implemented. Upon completion of the work the person(s) who have carried out the work should sign the form or certificate to certify that all tools have been removed from the crane, that all guards have been replaced, that all safety devices are operating and that all persons working on the crane have been advised that it is no longer safe to do so.

The work permits shall be given and received back after completion by only one authorised person. The crane shall be declared safe for operation only by that authorised person.

Following the signing of the certificate, the crane can be restored to service.

The essential details of a permit to work system are:

a) the crane is clearly identified;

b) the degree of power isolation is adequate for the work being undertaken;

c) isolation remains secure against unauthorized restoration of power whilst the permit to work is in force;

d) no work other than that for which the permit specifies should be carried out unless the permit is endorsed for the extra work and all persons involved are notified;

e) where more than one group of people work, each person shall be given the work permit and crane shall be declared safe for operation only after all work permits are returned to the person authorised to issue work permits for repairs;

f) all special precautions are stated;

g) the safe working area around the crane is clearly defined;

h) the safe working load is clearly identified; and

k) that the system be monitored.

9.5 Personal Safety Equipment

The appointed person should ensure that:

a) personal safety equipment such as safety gloves, helmets, safety spectacles, safety harness, safety boots, ear defenders, etc, appropriate for the conditions of the location is available;

b) the equipment is inspected before and after use and maintained in good working order; and

c) a record of inspection and repairs is maintained.

NOTE – It should be noted that certain safety equipment (for example helmets) may deteriorate with age or be damaged by impact and should therefore be renewed periodically or after impact even though no deterioration may be apparent.

9.6 Use of Personal Safety Equipment

Personal safety equipment appropriate to the conditions pertaining to the location of the crane should be provided to all personnel working on, or visiting the location of the crane.

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

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

9.7 Access and Emergency Escape

9.7.1 *Safe Means of Access and Emergency Escape*

Safe means of access and emergency escape should be provided and maintained in good condition :

a) for the driving position(s) of the crane;
b) for inspection, maintenance, repair, erection and dismantling of the crane; and
c) suitable rope, wherever necessary may be provided for emergency escape.

9.7.2 *Boarding the Crane*

No person(s) should be permitted to board a crane without first obtaining the driver's agreement. The driver should be aware of what precautions the driver should take whilst the person(s) is/are boarding and should carry these out.

Where the point of access is out of sight of the driver a system should be provided to ensure that the driver is aware of the other person's whereabouts.

In the case of a crane with pendant control, a second person should be made responsible for ensuring that the pendant is not operated whilst the person(s) is on the crane.

When only one person has 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 while the person is on the crane.

Where more than one person is to board a radio controlled crane, a driver should be placed in charge of the radio transmitter to ensure that the crane is only moved with the agreement of all persons on the crane. Such movements should only be permitted for maintenance and/or inspection of the crane and persons on the crane should only give permission to the driver for movements to be made, after they have ensured that they are in a safe position.

9.7.3 *Instruction of Personnel*

Personnel should be instructed to use (and should use) only the proper means of access and emergency escape.

9.8 Fire Extinguishers

These shall be provided in all the cabins on crane installations. Any fire extinguishers at the location including any mounted on the crane should be scheduled for periodic inspection and renewed as necessary.

9.9 Crane Safety Equipment

9.9.1 *Automatic Safe Load Indicator*

An automatic safe load indicator is required on certain jib cranes to give warning of an approach to the safe working load and a further warning when an overload occurs.

9.9.2 *Load Radius Indicator*

A load radius indicator is required on certain jib cranes. It should be clearly visible to the driver and indicate the appropriate safe working load and radius for whatever configuration of the crane is used.

9.9.3 *Motion Limit Devices*

Where motion limit devices are fitted to limit hoisting, travelling, slewing, traversing, climbing or any other crane motion, they should be regularly inspected and maintained in good working order.

9.9.4 *Overload Cut Out Devices*

Switches, or other devices, may be fitted to cut out any selected crane motion when the crane is in an overload situation. The devices should be maintained in good working order.

9.9.5 *Level Indicator*

Where fitted, level indicators should be used in accordance with the instruction manual and maintained in good working order.

9.9.6 *Anemometer*

Anemometers, or other wind speed measuring devices, should have their indicators mounted in clear view of the crane driver or where appropriate, the person controlling the lift being undertaken. The correct operation of these devices should be regularly verified and they should be maintained in satisfactory condition.

9.9.7 *Machinery Guarding*

All guarding should be properly fitted whenever the crane is in use and maintained in good condition.

9.10 Documentation

9.10.1 *Safe Working Load Charts*

Safe working load charts applicable to the various specified operating conditions of the crane, with appropriate de-rating for special applications such as magnet or grabbing duties, should be prominently displayed to the driver. Operation of the crane outside these parameters even in an unloaded situation may give rise to danger.

9.10.2 *Instruction Manuals*

Instruction manuals containing adequate information on the erection, use and dismantling of the crane

should be kept regularly available at the location of the crane.

9.10.3 *Test Certificates*

All current test certificates for cranes and lifting gear should be kept readily available.

9.10.4 *Records*

a) Records should be maintained for each crane that are sufficient to enable the condition of the crane to be determined and its fitness for further operation to be properly assessed.

b) The records should include:

i) technical information including maintenance instructions and performance data provided by the manufacturer;

ii) test certificates, records of thorough examinations and inspections including ropes and brakes (*see* **16.7.1**) (whether statutory or not) carried out on the crane;

iii) records of significant repairs and modifications to the crane including renewal of major parts;

iv) details of occurrences which are of more than short term relevance [*see* **12.3** (c), **12.3** (d) and **12.3** (e)].

c) Except where specific forms are required by legislation, the format in which records are kept is not important. Whatever method is used should be adequate to ensure that the records allow a relevant and coherent history of the crane to be retrieved. The records should be clearly identifiable with the crane to which they refer.

10 SITING OF CRANES

10.1 General

During the planning operation the appointed person should give careful consideration to the siting of the crane. This should take account of all the factors that may effect its safe operation particularly:

a) the crane standing and support conditions;

b) the presence of proximity and other hazards;

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

d) the adequacy of access to allow the placing or erection of the crane in its working position and for dismantling and removal of the crane following completion of lifting operations.

10.2 Crane Standing or Support Conditions

The appointed person should ensure that the loads imposed by the crane can be sustained by the ground or any means of support and that these are assessed by a competent person.

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

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

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

c) dynamic forces caused by movements of the crane; and

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

It is likely that in-service conditions will produce the greater imposed loading but out-of-service and erection/dismantling conditions should be taken into consideration.

It should be appreciated that the vertical and horizontal forces are unlikely to be uniformly distributed and an allowance should therefore be made for these and for any other unpredictable effects.

The appointed person should ensure that the ground or any means of support is such that the crane can operate within the levels and other parameters specified by the manufacturer.

10.3 Proximity Hazards

10.3.1 *General*

Consideration should be given to the presence of proximity hazards such as overhead electric lines or conductors, oil/gas/steam, etc, pipelines nearby structures, cranes, vehicles being loaded, unloaded, stacked goods, public access areas including highways, railways, rivers, etc.

Where any part of the crane or its load cannot be kept clear of such hazards the appropriate authority should be consulted.

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.

At any place where a crane or its load passes any obstacle, the following points should be observed:

a) Where practicable the crane path should be clearly defined by marking to ensure that it is kept free from obstruction and a clearance of not less than 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.

10.3.2 *Overhead Electric Lines and Cables*

Many fatal accidents have occurred due to some part of a crane touching, or even coming near to overhead electric lines or cables, without actually touching.

The appointed person should ensure that the local offices of the Electricity Board are consulted if the crane is to be used within 15 m of overhead lines on steel towers, or 9 m of overhead lines on wood, concrete or steel poles. This includes not only the crane but also the jib at its maximum length. All distances should be measured at ground level from a position estimated by eye to be vertically under the outermost conductor at a tower or pole position.

WARNING NOTE

'TREAT ALL OVERHEAD LINES AND OTHER ELECTRICAL APPARATUS AS LIVE UNLESS DECLARED 'DEAD' AND 'SAFE' BY THE LINE OPERATOR OF THE ELECTRICITY BOARD. IF IN DOUBT, SEEK ADVICE'.

Where a crane must travel underneath an overhead line 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* Fig. 3).

The dimensions of the goal posts and their distance from the nearest overhead conductor should be decided in consultation with the Engineer of the Electricity Board. Large notices should be posted stating:

'DANGER, OVERHEAD ELECTRIC LINES'.

When working parallel to overhead lines, a string of warning markers should be erected at least 6 m measured horizontally along the ground from the outermost conductor at a tower or pole position — where the minimum distance could be encroached by the jib or the crane it should be extended. The actual distance should be agreed upon with the Electricity Board.

In addition, a notice should be placed in the cab of all cranes likely to work in the vicinity of overhead electric lines giving the following information:

If machine makes contact with live electric cable, observe following precautions.

a) Remain inside cab.

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

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

d) If the machine cannot be moved away, remain inside the cab. If possible get someone to inform the electricity supply authority at once. Take no action until it has been confirmed that conditions are safe.

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

f) Inform the responsible engineer of the works or authority concerned of situation immediately and until assistance is received someone should remain near the crane to warn of the danger.

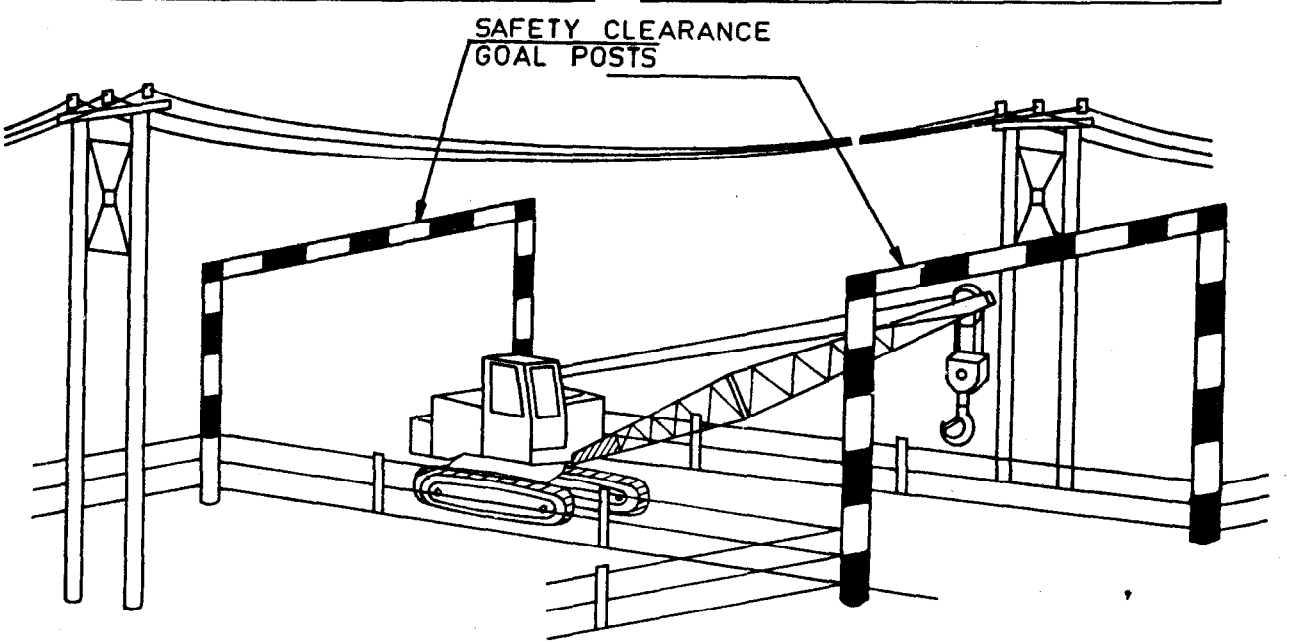


FIG. 3 TRAVELLING UNDER OVERHEAD ELECTRIC LINES AND CABLES

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

10.3.3 *Crane Control in the Vicinity of Airfields*

The appointed person should consult the airfield manager for permission to work whenever a crane is to be used in the vicinity of an airfield.

NOTE – The Air Navigation Order makes it an offence to recklessly or negligently act in a manner likely to endanger aircraft and conversely for any person likewise to permit an aircraft to endanger persons or property.

11 ERECTION AND DISMANTLING

11.1 Planning

Erection and dismantling of the crane should be thoroughly planned and properly supervised in the same way as the lifting operation (*see* **5**).

NOTE – The planning should take account of the need to dismantle the crane after use.

A correctly planned erection and dismantling procedure should ensure that:

a) erection of the crane does not commence until an instruction manual clearly understood by erection staff, is available for their use;

b) the erection/dismantling manual is appropriate to the particular crane and bears the crane manufacturer's serial and type number and the owner's identification;

c) the entire erection and dismantling operation is controlled by the erector in charge (*see* **6.2.4**);

d) all personnel involved have a sound knowledge of their part in the operation;

e) any departure from prescribed procedure is approved by the designer or another competent engineer;

f) only correct replacement parts and components are used.

11.2 Manufacturer's Erection and Dismantling Instructions

The crane manufacturers instructions should be closely followed. Any departure from the specified sequential procedure should be verified by the designer or another competent engineer, to ensure stability of the crane and that structural and mechanical parts are not subjected to excessive loading.

11.3 Identification of Components and Materials

11.3.1 *Components*

All major components that form part of a crane and are dismantled for transportation, particularly those which are load bearing or ensure the stability of the assembled crane, should carry a clear identification mark.

Diagrams and drawings in the crane instruction manual, covering erection and dismantling in the crane that show the correct location and orientation of components, should use the same system of marking.

NOTE – Under certain Regulations it is necessary to identify any part of a crane jib that can be removed so as to indicate the crane of which it is a part.

Care should be taken to avoid a mis-match of thread forms of fasteners (nuts and bolts) for example imperial or metric.

11.3.2 *Materials*

Where components (for example Jib sections) have been manufactured from special materials they should be so marked. This is to enable the correct repair procedures to be used, particularly where control of temperature during the repair is necessary.

Nuts and bolts manufactured from high tensile steel or other special steels should be clearly marked so that they can be distinguished from other nuts and bolts.

11.4 Electrical Supply

The following points should be noted where the crane is electrically operated from a source external to the crane.

a) Electrically operated cranes should have an effective earth connection. In the case of cranes mounted on rails, at least one rail track should be electrically bonded at each rail joint and the track should be effectively earthed. Crane wheels should not be used for earthing the crane.

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

c) The characteristics of the power supply and of the crane equipment should be checked for comptability before connection.

d) Cables providing power to the crane should be enclosed, positioned or constructed to protect them from mechanical damage:

i) by running in conduit, trunking or on trays; or

ii) by being clipped to a structure in a position where they are protected from mechanical damage; or

iii) by being of armoured construction.

Where the method of protection is of conducting material, it should be bonded to earth at each end. In no case should the protection be used as an earth conductor.

e) Where practicable, the power supply to a travelling crane should be through a cable winding drum or a properly installed, insulated and protected collector system.

f) Care should be taken to ensure that any trailing cable is not damaged during operational movement or when the crane is travelling.

The travel distance should be well within the length of the trailing cable.

g) In addition to any isolator within the crane capable of cutting off the electrical supply to the crane motions, there should be an identified isolation 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 and should be identifiable with the crane power supplies they control.

12 PROCEDURES AND PRECAUTIONS

12.1 Crane Operation

Whenever a crane is moved and whether it is lifting a load or not it should only be driven by a competent driver (*see* 7.1) nominated by the appointed person.

This should not inhibit the appointed person from nominating a trainee driver provided that such a driver is under the direct supervision of a competent driver who has also been nominated for that purpose by the appointed person.

NOTE – Special arrangements may be necessary when carrying out maintenance or repairs on the crane.

12.2 Periodic Checks

12.2.1 *General*

The appointed person should ensure that the routine checks given in **12.2.2** and **12.2.3** are carried out.

NOTE – The crane driver may be authorized to carry out periodic checks to the extent that he is considered to be competent.

12.2.2 *Daily*

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

a) Checks as required by the manufacturers handbook.

b) Check that all ropes are correctly positioned on their sheaves and have not been displaced.

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

d) Confirm the operation of all limit switches or cut outs and the dead man's handle or lever, using caution in making checks in case of maloperation.

e) Check proper functioning of all brakes.

f) Check that the automatic safe load indicator is correctly set for the condition of the crane.

g) Check that the load-radius scale is appropriate to the jib combination fitted if this equipment is separate from item (e).

h) By varying the hook radius without load, check the correct movement of **12.2.2** (f) and **12.2.2** (g).

j) Check lubricating oil level(s), hydraulic oil level(s) and engine coolant level(s).

k) Check that there has been no excessive loss of air pressure since the machine was last used.

m) Check build-up time of air pressure for efficiency of system (s).

n) Check that lights, windscreen wiper(s) and washers conform with the requirements of the Road Traffic Act.

p) Check visually the condition of tyres on wheel mounted cranes.

q) Check correct function of all crane controls without load.

r) Check satisfactory operation of audible warning device.

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

12.2.3 *Weekly*

Once a week, in addition to the checks in **12.2.2** the following additional checks as appropriate for the type of crane concerned should be carried out:

a) Check the automatic safe load indicator in accordance with the operating instructions.

b) Visually inspect the hoist rope(s), trolley travel rope (tower cranes), derricking rope(s) and static suspension ropes for broken wires, flattening, bird caging or other signs of damage, excessive wear and surface corrosion (*see* **16**).

c) Check all rope terminations, swivels, pins and retaining devices. Also check all sheaves for damage, worn bushes or seizure. (*see* **16**).

(d) Inspect the structure for damage, for example missing and bent bracings on bridges and strut jibs, bulges, indentations and unusual rubbing marks on telescopic jibs, cracked welds, etc.

e) Check hook(s), safety catch(es) and swivel(s) for damage, free movement or wear. Check the hook shank thread and securing nut for wear or corrosion.

f) Check operation and adjustment of controllers.

g) Check brake and clutch friction linings and drum paths for visible wear and reset, if necessary.

h) Check for creep of hydraulic rams in case of hydraulic machines.

j) On wheel mounted mobile cranes, check tyres for pressure as well as damage and wear on walls and tread. Also check wheel nuts for tightness.

k) On rail mounted cranes, check rails, end stops and also ties where these are fitted. Check existence and condition of guards to remove foreign material from rails.

m) Check slew lock, if fitted.

n) On rubber tyred cranes check, steering, brakes both foot and parking, lights, indicators, horn, windscreen wipers and washers.

p) Generally inspect the crane to ensure that it is safe for use.

q) Enter results of checks in the records of inspections.

12.2.4 *Crane Out of Use for a Considerable Period*

If a crane is not to be used for a period exceeding three or four weeks, precautions may have to be taken to prevent deterioration or damage.

In cases where a crane has been out of use for more than three or four weeks, it may be necessary to carry out a programme of checks in addition to those specified in **12.2.2** and **12.2.3.**

The extent and thoroughness of this programme will depend not only on the length of the period of out-of-use, but also on the location of the crane during this period. A crane standing under cover, or inside a workshop, may require very little in addition to the checks detailed in **12.2.2** and **12.2.3,** but a crane which has been out-of-use in the open, exposed to the action of weather and atmospheric pollution, etc, will require an extensive appraisal to ensure its fitness for work.

In general terms the following points should be covered as a minimum:

a) All crane ropes should be examined for signs of corrosion and damage and thoroughly lubricated.

b) All control linkages should be examined for evidence of seizure or partial seizure and correct lubrication undertaken.

c) Every crane motion should be tested for several minutes without load, each motion individually at first then by combination of two or more motions simultaneously as appropriate.

d) The test of all crane motions should be repeated under load.

e) The correct functioning of all the crane safety limits should be checked, in particular the automatic safe load indicator should be tested by lifting a known weight.

The result of all the tests in the programme should be documented in the crane records (*see* **9.10.4**) along with details of any corrective action taken to overcome any defects prior to the crane being returned to service.

12.3 Reporting of Defects and Incidents

The appointed person should ensure that there is an effective procedure for reporting defects and incidents. This procedure should include notification to the appointed person, the recording of action taken to rectify any defects and clearance of the crane for further service.

This procedure shall include the immediate notification of :

a) any defects found during daily or weekly periodic checks;

b) defects found at any other time;

c) incidents or accidents however slight;

d) shock loads in whatever manner they occur; and

e) dangerous occurrences or accidents (*see* **15**).

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

12.4 Leaving the Crane Unattended

In no case should a crane be left unattended even for short periods, unless all loads have been removed from the hook which should be left in a safe position, the power supplies to all motions switched off or the engine stopped, and appropriate motion brakes and locks applied to put the machine in a safe condition. The ignition key and any other keys should be removed from the crane whenever the driver is absent from the machine.

For longer peiods and for out-of-service conditions, isolation should be more permanent, that is, switches locked of, fuel supplies cut off and any doors giving access to machinery or control cabs locked to prevent unauthorised access. machinery should be left in the out-of-service condition as described in the operating instructions.

For details of methods to safeguard particular types of cranes, reference should be made to the appropriate section of this Code.

12.5 Maintenance

12.5.1 *General*

Provision should be made to ensure that throughout its use, the crane and other equipment used in the lifting operation are maintained in a satisfactory condition.

The appointed person should be satisfied that the maintenance is carried out by trained personnel who have adequate knowledge of the correct procedures. The frequency and extent of such maintenance should take account of all factors that affect the crane in carrying out its work.

12.5.2 *Planned Maintenance*

To ensure safe and satisfactory operation of the crane a properly planned maintenance system should be established and used.

Manufacturers instruction books recommend that specific tasks be carried out at stated intervals, and these periods should not be exceeded. They will also specify the lubrication points that require attention, the interval or frequency of greasing and oil changes and the grades and quality of lubricant to be used. They will also cover other essential maintenance such as the replacement of filters, draining intervals of air receivers, recommended tyre pressures, the frequency for checking the security of fixing bolts and the recommended torque settings and other adjustments, for example, clutches, brakes, etc.

The statutory examination of the crane requires the competent person to assess whether the crane is fit for service at the time of the examination. This examination does not cover the absolute legal requirements to ensure that the equipment is properly maintained. To satisfy this requirement a more frequent inspection should be carried out recognizing the frequency of use of the crane and the environmental conditions.

An effective planned maintenance system should recognise the possible need to prohibit the use of the crane until essential maintenance work is carried out.

In addition to any statutory regulations, a record (*see* **9.10.4**) should be kept of every crane, giving information on the major components used in the crane manufacture, such as rope diameters, lengths, construction and breaking loads, tyre sizes and ply ratings, make and model of motors, pumps, gear boxes, winches, drives, electrical equipment and switchgear, etc. The availability and source of replacement items should be checked and noted in the record. Consideration should be given where appropriate to stocking certain expendable items and other parts to minimize down time in the event of crane breakdown.

The record, together with the results of all examinations and inspections including those carried out to meet the statutory requirements, should form the basis of the record for each crane. The record should contain details of hours worked, repairs carried out as a result of defects found during the examinations and inspections. The record should record the clearance of any defect noted and the signature of the person responsible for rectification.

12.5.3 *Replacement Components*

Replacement components should conform with the manufacturer's specification.

12.5.4 *Use of Special Materials in Crane Construction*

Modern cranes make extensive use of high yield steels and if it is necessary to carry out any repairs to any part of the crane structure, it is essential that the correct procedure laid down by the manufacturer is strictly followed. In particular excessive heat that can change the properties of the steel should be avoided and the use of special welding rods is required. It is essential that the material is identified and the correct procedure laid down by the manufacturer strictly followed.

12.5.5 *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.

12.5.6 *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* **9**). Where necessary a secure working platform should be provided to ensure the safety of maintenance personnel.

13 OPERATING CONDITIONS

13.1 Safe Working Load

The safe working load of the crane should not be exceeded other than for the express purpose of a test of the crane under the supervision of a competent person. The safe working load of any item used to attach the load to the crane should not be exceeded other than for the express purpose of a test of the item under the supervision of a competent person.

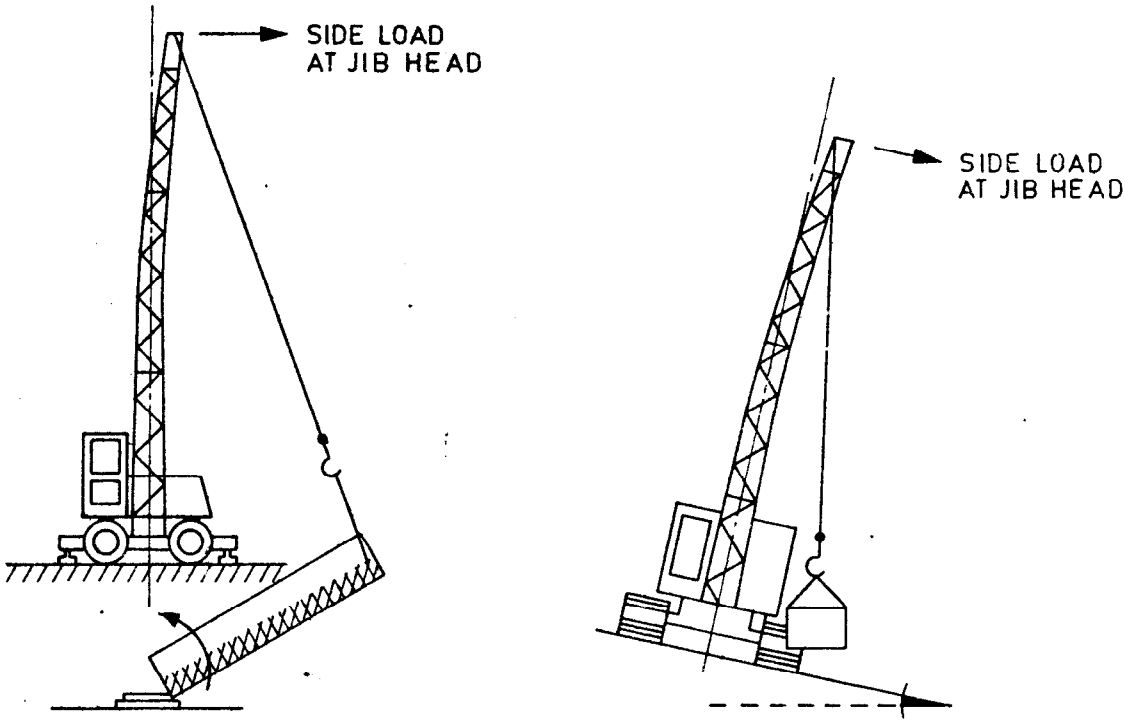
Care should be taken to prevent pendulum swinging of the load, by careful control of the operating motions to match the swing of the load and to keep it under control at all times as shown in Fig. 1.

Safe working loads apply only to freely suspended loads. The crane hoisting, slewing, traversing, luffing or travelling motions of a crane should not be used to drag any load along the ground with the hoist rope out of the vertical position. Before lifting a load, the hoist line should be plumb (*see* Fig. 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.

13.2 Mode of Operation and Control

13.2.1 *Identification of Controls and Direction of Movement*

To ensure safe use of the crane, each control should be



(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

FIG. 4 SIDE LOADING ON JIB

marked to identify the motion controlled and the direction of movement.

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. The driver should therefore ensure that loads and crane hoist ropes are well clear of obstructions.

c) Where telephone, radio or closed-circuit television communications are being used, the driver should ensure that the calling signal is functioning satisfactorily 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).

The hoist rope, or if applicable, the hoist chain should be 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.

It is undesirable, where motion motors are to be reversed, to put the controller over 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.

13.2.2 *Radio-Controlled Cranes*

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; and

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 belt 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.

The controlled range feature, where provided on a radio controlled crane, 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.

13.3 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.

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.

13.4 Multiple Lifting

13.4.1 *General*

Lifting a load with two or more cranes requires greater attention to planning and supervision because the effects of the relative motion between the cranes may induce additional loadings on the cranes, the load and the lifting gear in use.

Because of this and the difficulty in monitoring these additional loads, multiple lifting should only be used when the physical dimensions, characteristics, weight or required movement of the load prevent the operation being carried out by a single crane.

Multiple lifting should be planned with extreme care (*see* 5) 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. Additional forces may overload the cranes causing them to overturn or fail either immediately or in the longer term. The cranes should not be subjected to forces in excess of those which would occur were they handling their safe working loads as single lifts.

13.4.2 *Factors to be Considered in Planning the Multiple Lifting Operation*

If all the factors governing the distribution of the load between the cranes can be accurately determined it should be possible to use each crane up to its safe working load. In practice it may be difficult to evaluate all the factors accurately and their effect on the distribution of load between the cranes so it may be necessary to make a reduction in the load that each crane is permitted to take.

The principle 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 may not be known accurately and the proportion of the load being carried by each crane may therefore be uncertain.

c) *Weight of the lifting gear* — The weight of the lifting gear should be 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, for example 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 multiple lifting.

e) *Synchronization of crane motions* — If the variation in the direction and magnitude of the forces acting on the crane during the multiple 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.

Instruments are available to monitor the angle of inclination and load in each hoist rope constantly throughout the lifting operation. The use of such instruments and the restriction of the motion speeds together with the strict use of one motion at any one time can assist in the control of the loads on the cranes within the planned values.

13.4.3 *Recommended Safe Working Load During Multiple Lifting*

If the person planning the multiple lift is satisfied that all the factors identified in **13.4.2** (a) to **13.4.2** (e) have been accurately identified or are being monitored, the cranes may be used up to their safe working loads.

If the person planning the lift cannot accurately evaluate all the factors then an appropriate downrating should be applied to all the cranes involved. The downrating may be 10 percent of the crane's safe working load but where stability of the crane(s) is likely to be affected the downrating may have to be 25 percent or more.

13.5 Special Duties

In all cases involving special duties, the designer's or another competent engineer's guidance should be obtained.

The weight of any special lifting attachments should always be included as part of the load to be lifted. Attachment 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.

13.5.1 *Grabbing and Magnet Crane Service*

13.5.1.1 *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 designer or another competent engineer for details of special duty ratings.

13.5.1.2 *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.

13.5.1.3 *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. A battery back-up service of at least 10 minutes is essential for magnet service cranes (in case of power failure). In such a case manual release shall also be provided for hoist brakes.

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.

13.5.2 *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 percent or less of the designed working vacuum and/or in the event of the vacuum inducing pump ceasing to operate.

13.5.2.1 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.

13.5.2.2 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.

13.5.2.3 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.

13.6 Weather Conditions

13.6.1 *General*

For cranes operating in situations where they are likely to be affected by the weather careful attention should be given to this aspect. Certain weather conditions such as strong wind, heavy rain, ice or snow can impose loads on a crane and adversly affect the safety or crane operations.

13.6.2 The crane should not be operated in wind speeds that are in excess of those specified in the operating instructions for the crane. Gusting wind conditions may have an additional adverse effect on the safe handling of the load and the safety of a crane. Even in relatively light wind conditions, extra care should be taken when handling loads presenting large wind catching areas.

The limitations on wind speed for erection, testing and dismantling the crane may be lower than the limitation for normal operation and in cases of doubt the designers' or another competent engineer's advice should be obtained. The testing of a crane should not be carried out in an area which is known to be subject to freak weather conditions.

Instructions issued by the crane manufacturer advising of the 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.

13.6.3 *Wind Speed Indication*

In the case of high cranes, an anemometer should be mounted at a suitable high point of the crane structure or at a similar height and exposed position on the site.

13.6.4 *Visibility*

In poor visibility, suitable means of communication should be provided to ensure the safe operation of the crane. In extreme conditions crane operations should be stopped until there is sufficient improvement in visibility to enable operations to be safely resumed.

13.6.5 *Rain, Snow or Ice*

During adverse weather conditions, the appointed person should ensure that adequate precautions are taken to avoid danger when the crane or the load are affected by rain, snow or ice.

14 TESTING AND EXAMINATION

14.1 General

14.1.1 *Testing and Examination*

Various tests and a thorough examination by a competent person are required to ensure that a crane is safe for use. Item 15 gives the legal requirements for the testing and thorough examination of cranes. Additional tests and thorough examinations are usually necessary following any substantial alteration or repair to the crane. Any lifting gear to be used with the crane in normal duties or for the purpose of testing the crane, should already have been tested separately from the crane.

14.1.2 *Test Certificates and Documentation*

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. Tests will be required following substantial repairs or alteration, and/or periodically as prescribed by legislation.

b) Periodic examination and inspections, systematic maintenance, repairs, renewals and any necessary heat treatment (as applicable) should be carried out and recorded.

c) The safe working load should be clearly marked on the crane or the charts affixed to it.

d) Any lifting attachments should be clearly marked with their safe working loads.

e) A copy of the operating instructions should be with the crane.

f) All test certificates and records related to the above should be available for inspection. (*see* **9.10.4**)

14.1.3 *Thorough Examination*

A thorough examination should be understood to mean the following:

a) A detailed examination sufficient to ensure that the crane is safe for use.

b) Whenever considered necessary by the competent person, 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 to the material.

c) Where considered necessary, parts of the crane should be dismantled by a skilled person to the extent required by the competent person.

d) The examination should be carried out with the crane in operation and at rest.

14.1.4 *Test Site*

Careful consideration should be given to the conditions of the site where the tests are to be conducted. It should be remembered that the recommendations provided in the operating instructions for the crane relate to operations within the safe working load and that more stringent requirements apply when loads are being applied for the purpose of testing.

The following general requirements apply to all types of cranes. Further guidance is given in other parts of this standard covering specific crane types:

a) The ground should be well consolidated and capable of withstanding the loads that will be applied to it. Care should be taken to ensure that there are no hidden dangers such as cable ducts, drains, pipes, back-filled areas, cellars or other subterranean weaknesses.

b) The ground should be level to within the limits appropriate for testing the particular crane.

c) The site should be of sufficient area and have unrestricted overhead clearance to allow the unobstructed movement of the crane and load throughout all its appropriate test movements, for example, slewing, derricking travelling, etc.

d) A test is designed to prove a crane and it must be borne in mind that the crane might for some hidden reason not withstand the loading. It is therefore necessary to ensure that all personnel not essential to the test are kept away from the area. Test personnel should be so positioned that they are unlikely to be injured should there be any mishap. It is recommended that the test area be roped off and notices posted prohibiting unauthorized entry. The test site should be well clear of places where the public has access such as roads, railways etc. For similar reasons the site should be clear of plant and property which, as well as inhibiting the test, could also be damaged.

14.1.5 *Weather Conditions*

Apart from the obvious danger to personnel it should be recognized that weather conditions such as wind, ice and snow can impose loads on the crane. For this reason test sites should preferably not be in areas which are known to be subject to freak weather conditions. The limitations on wind speed for testing of the crane may be lower than the limitation for normal operation and in cases of doubt, the designer's or another competent engineer's advice should be sought.

The competent person in charge of the test should ensure that adequate precautions are taken when the windspeed exceeds the limit or the crane or load are heavily coated with ice or snow.

Tests should never be undertaken when the crane or load cannot be clearly seen because of a limitation on visibility caused by rain, snow, mist or fog, etc.

14.2 Test Requirements for the Crane

14.2.1 *Conduct of the Test*

The tests should be carried out under the control of the competent person appointed for this purpose who should clearly indicate when the tests start and when they have been completed. The driver, signaller and/or slinger should for the duration of the tests accept instructions only from the competent person.

Immediately prior to the tests, the competent person should ensure, by thorough examination (*see* **14.2.2**) that the condition of the crane is satisfactory for the tests and that the site and weather conditions are suitable (*see* **14.1.4** and **14.1.5**).

During the tests the load should be kept close to the ground. Shock loading which may be caused by rapid acceleration of crane motions, sudden braking, erratic or sudden steering movements or movement of the crane controls should be avoided.

At all times care should be exercised to avoid danger to personnel and damage to plant and surrounding property.

Precaution — Where safety devices have been overridden or disconnected their correct functioning should be restored and checked.

14.2.2 *Overload Testing*

The testing of the crane requires the application of loads in excess of the safe working load. Prior to the application of overloads, it should be established by reference to an authority on the design and construction of the crane, for example the manufacturer, that the design of the crane will permit the imposition of the overloads at the appropriate positions at which they will be applied. This is necessary because the overloads may be limited by the structural strength and not the stability of the crane. Under such circumstances, the structure might buckle or collapse without warning before the crane gives any sign of tipping.

Before commencing the overload test, the crane should be thoroughly examined by a competent person for any significant defects or limiting condition of the crane, for example, insufficient falls of rope for the load under consideration, which require to be rectified before application of the overload.

The crane should be operated through the motions for which it is designed to carry load. These motions will include:

a) hoisting and lowering;

b) derricking in and derricking out;

c) slewing in both directions through the maximum angle for which load carrying is permitted;

d) telescoping through the permitted range of movement; and

e) travelling and traversing in both directions.

NOTE — Precautions should be taken to limit swinging of the load. The crane should show itself capable of sustaining full control of the load throughout these tests. There should be an adequate supply of known weights with means of handling them.

14.2.3 *Anchorage and Ballasting Test*

The security of the anchorage and/or adequacy of ballasting should be tested after erection or any alteration. This test requires the imposition of an overload above the appropriate maximum safe working load as specified by the relevant Indian Standard to be lifted by the crane at a position where there is a pull on each anchorage or by the imposition of a reduced load at an increased radius to give an equivalent test of the anchorage or ballasting arrangements. Care should be exercised to avoid possible overstressing of crane components (*see* **14.2.1**).

14.2.4 *Testing of Automatic Safe Load Indicator*

Automatic safe load indicators should be tested at the time of testing the crane and in some circumstances it should be noted that this is a statutory requirement.

The Construction (Lifting Operations) Regulations 1961 require automatic safe load indicators to be of a type approved by the Health and Safety Executive and for them to be inspected once a week.

NOTE — 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.

14.3 Thorough Examination After Test

A thorough examination (*see* **14.1.3**) should be carried out by a competent person to ensure that the crane has satisfactorily withstood the test loadings without signs of structural damage that will effect the safety of the crane, such as:

a) cracking;

b) permanent deformation,

c) paint flaking, and

d) loosening of or damage to structural connections.

The examination should confirm that all mechanisms function correctly and are free from defect.

14.4 Certification

After any test or examination the results should be recorded. Where a machine is used temporarily under a different set of regulations then the certificates issued for the prime use of the machine should be considered as acceptable.

Where, for any reason, the competent person considers it necessary to restrict the use of a machine (for example site limitations prevent the testing of the full range of duties of the machine) then the restrictions

should be noted on the certificate and the use of the crane should be subject to these restrictions. The markings/tables of safe working loads on the machine should be amended to reflect these restrictions.

15 LEGAL REQUIREMENTS

15.1 General

Employers and the self-employed shall ensure, so far as is reasonably practicable, the health and safety at work of all their employees and that undertakings are conducted in such a way as to ensure, so far as is reasonably practicable, that persons not in their employment who may be affected are not thereby exposed to risks to their health and safety.

This duty not only includes the provision and maintenance of plant which is, so far as is reasonably practicable, safe and without risks to health but also the provision and maintenance of systems of work, information, instruction, training and supervision as are necessary to ensure, so far as is reasonably practicable, the health and safety at work of employees.

Employees have a duty to take reasonable care for the health and safety of themselves and of other persons who may be affected by their acts or omissions at work. They also have the duty to co-operate with their employers so far as is necessary, to enable the employers to comply with their legal duties.

15.2 Specific Legislation

The following legislation contains provisions which apply to the provision, maintenance, examination and use of cranes:

The Factories Act, 1948

The Mines and Minerals Act, 1957

The Coal Mines Safety Act, 1939

The Merchant Shipping Act, 1958

The Indian Ports Act, 1908

The Calcutta Port (Pilotage) Act, 1948

The Indian Electricity Rules, 1956

16 ROPES

16.1 Rope Replacement

Only ropes of the correct size, type, strength and construction as specified in the crane manufacturers' handbook should be fitted to the crane unless an alternative rope has the prior approval of the crane designer, rope manufacturer or other competent engineer.

16.2 Rope Length

The length of the rope used should be sufficient for the particular application for which the crane is to be used but in no circumstances should it be such that in the extreme positions:

a) there is less than two turns of rope left on the drum, and

b) the drum flanges project less than two rope diameters or 50 mm whichever is less, beyond the outer layer of the rope in all circumstances.

16.3 Handling, Storage and Installation

16.3.1 *Offloading*

To avoid physical damage, ropes should be offloaded with care. The reels or coils should not be dropped. A steel bar should be placed through the centre hole of the reel and lifted by means of a suitable sling. Coils of wire rope should not be lifted by their securing bands, unless it is known that the bands are especially designed for this purpose.

16.3.2 *Storage*

Ropes should be stored in a cool, dry building and should not be in contact with the floor.

Ropes should never be stored where they are liable to be affected by chemical fumes, steam or other corrosive agents.

Ropes in store should be examined periodically and a rope dressing applied, if necessary.

Ropes that have been removed from a machine for future use should be thoroughly cleaned and a dressing applied before being stored.

Ropes having a length in excess of 30 m should be stored on a drum.

16.3.3 *Uncoiling and Handling*

16.3.3.1 *General*

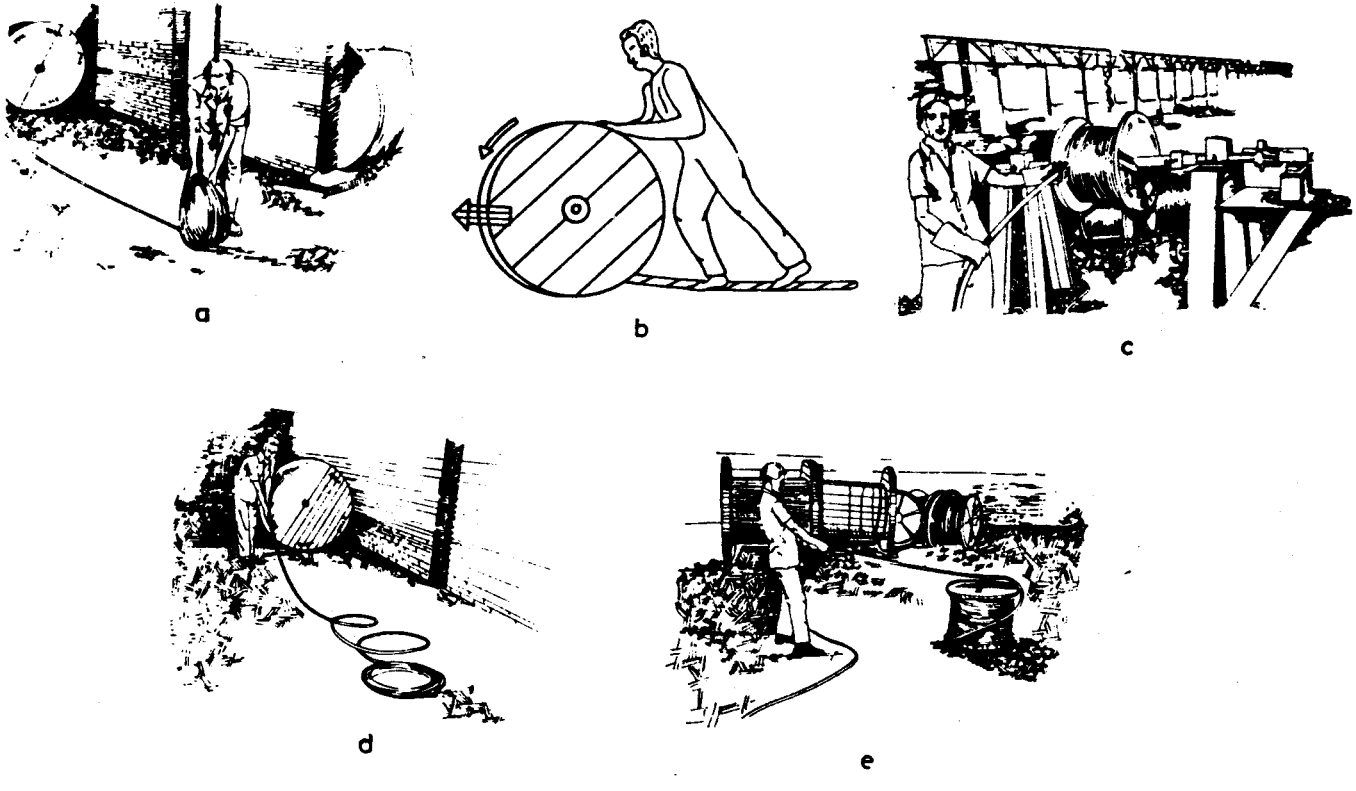
To prevent the possibility of kinking or disturbance of the lay, ropes should be paid out without slack and in a straight line.

Coils of rope should preferably be paid out from a turntable. Alternatively, where the coil is short, one end can be made free and the remainder rolled along the ground. For ease of handling the inside end should first be secured to an adjacent turn. A rope should never be unwound by throwing off turns with the coil or reel flat on the ground. (*see* Fig. 5) The rope should be kept as clean as possible during this operation.

Before any rope is cut it should be tightly served or secured on either side of the intended cut. Fig. 6 shows a common method.

16.3.3.2 *Multi-strand ropes*

Great care should be taken with multi-strand ropes to ensure that they are installed without imparting any rotation to the rope. A free end will have no pronounced tendency to rotate but caution should be exercized to ensure that the lay of the rope is not



Figures a, b and c show methods of uncoiling ropes which are good practice. Methods shown in two figures d and e below are not recommended.

FIG. 5 CORRECT METHOD OF PAYING OUT ROPE

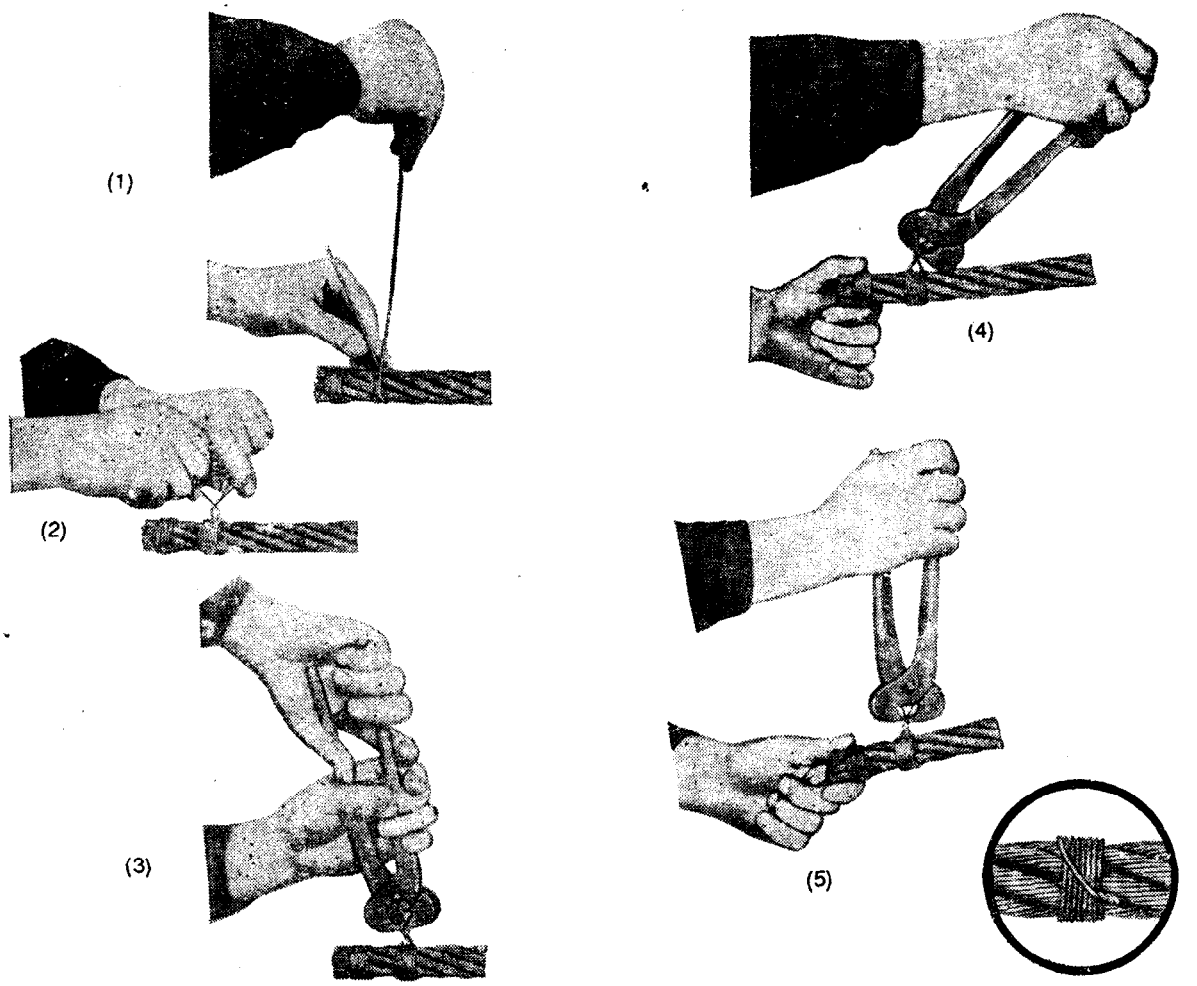


FIG. 6 SERVING OF ROPES (BEFORE CUTTING)

disturbed, either by turns in or turns out. If the strands are disturbed, malformation of the rope may develop during subsequent use.

16.3.4 *Installation*

The lay of the rope should not be disturbed during installation, that is, turn should not be put in nor taken out of the rope. Ordinary lay ropes are usually stable but special care should be taken with Lang's lay and multi-strand ropes. When winding a rope from a reel to a drum, it should be bent in the same direction. Re-reel from the top of the reel to the top of the drum. A tensioning load should also be applied to the rope to achieve good coiling. A simple brake such as a plank rigged to bear against the reel flanges, may provide ample rope tension. The reel and the drum should be spaced well apart to facilitate even coiling (*see* Fig. 7).

16.3.5 *Running-In*

After fitting a new running rope, it is advisable to run through its operating cycle for a number of operations at reduced speeds and loads to permit the new rope to adjust to the working conditions. This is particularly important for multi-strand ropes.

All new ropes when first installed will stretch due to the wires and strands bedding in. This will normally be accommodated by the installation. If not it may be necessary to cut and re-terminate.

16.4 Rollers and Guide Sheaves

Rollers or guide sheaves are sometimes fitted on the jib of the crane to ensure that the rope does not rub against the jib structure. A siezed roller, or sheave will cause serious damage to a rope, leading to its premature failure and they should therefore be checked at regular intervals [*see* 12.2.3 (c)] to ensure that they are free to rotate.

16.5 Rope Drums and Sheaves

Where alternative drums and/or laggings can be fitted, it should always be ensured that the drum or lagging is

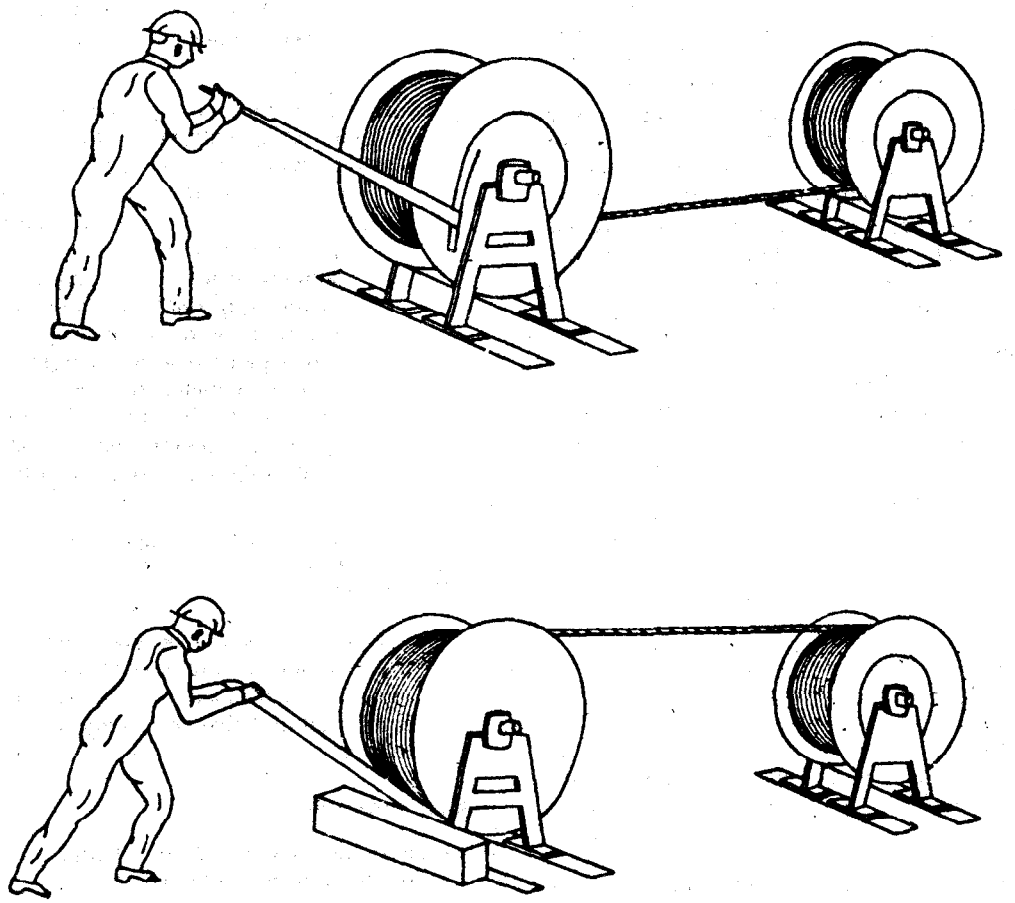


FIG. 7 TRANSFERRING ROPE FROM REEL TO DRUM

compatible with the size of rope and the duty requirements.

Sheaves are usually manufactured from ferrous materials, but the use of plastics sheaves and sheaves with plastic inserts is increasing. For many uses, plastics sheaves and inserts give an increase in rope life, but there may be a change in the failure mode of the rope. Special attention should be given to the examination of ropes used with plastics sheaves and inserts (*see* **16.8.2.3**).

16.6 Rope Terminations

16.6.1 *General*

Only rope termination as specified by the crane and/or rope manufacturer should be used to attach a rope to a drum, hook block or the structure of the crane. Care should be taken to ensure that anchorage points are securely fastened.

Terminations should be examined for mechanical damage, for example elongation of the holes of clevis type fittings, for the presence of broken wires (*see* **16.8.2**) and for evidence of the rope pulling through the termination. Consideration should be given to the possibility of internal corrosion: discard after a period specified by the rope/crane manufacturer may be the only solution to this problem.

Rope terminations can be of permanent or non-permanent type and special attention should be given to the assembly and use of the latter which normally take the form of a wedge and socket that can be fitted to the rope at site. Guidance is given in **16.6.2** to the procedures that are necessary to ensure that this type of fitting is safely assembled.

Wire rope grips as the sole means of terminating a rope can be dangerous and they should not therefore be used for this purpose.

16.6.2 *Wedge and Socket Terminations for Ropes*

16.6.2.1 *Assembly*

The following points should be noted when assembling wedge and socket terminations:

a) It is essential that only wedge and socket assemblies of the correct dimensions and strength for the particular rope are used. Failure to do so may result in the rope pulling through the fitting.

b) Wedges and sockets for a particular size of rope should be matched to each other and should not therefore be obtained from different manufacturers. The fit of the wedge (with rope) in the socket should always be checked at the time of assembly. An oversize wedge, or a wedge of incorrect taper, will not enter the socket sufficiently to give a secure termination; too small a wedge will protrude too far through the socket and the high localised 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. Incorrect fitting will result in premature failure of the rope.

d) When the termination is made up, the tail-end length of rope left protruding from the socket should be long enough for the securing method used [*see* **16.6.2.**(h)].

e) Multi-strand ropes tend to show distortion when they are bent around small radii and may require temporary serving, for example with electricians' tape during the fitting of the socket. The serving should be subsequently removed as far as possible to allow for rope inspection.

f) After a wedge and socket termination has been made or remade, it is essential that the wedge and rope are properly seated in the socket before the equipment is put into service. Failure to do so may allow the rope to pull through the fitting or particularly when the rope is new, the wedge to be sprung out of the socket.

g) Initially the wedge should be hammered home using a wooden packer to protect the fitting and rope against damage and simultaneously a second person should pull on the ends of the rope. A substantial load should then be raised and left suspended (but not unattended) to seat the wedge and rope firmly into the socket before the assembly is put into service.

h) There are two ways of securing the dead-end lengths of rope protruding from the socket depending on the circumstances of use:

i) The tail-end may be looped back on itself and secured by a wire rope grip or clamp to form a loop. The loop should be lashed to the live part of the rope by suitable means, such as soft binding wire, to prevent flexing of the rope in service. If this method is used, the tail-end length of the rope should be about 15 times the diameter of the rope for example 195 mm tail-end length for a 13 mm diameter rope. The clamp or wire rope grip should not be allowed to encroach on the fused end of the rope.

ii) Where there is a possibility of the loop interfering with an obstruction, such as the working structure, which might cause the wedge to loosen and the rope to pull free, the tail-end length of the rope should not be looped back but should be fitted with a simple clamp or wire rope grip and laid parallel to the live rope. If a wire rope grip is used a distance piece, or a short length of rope of the same diameter, will be necessary to ensure that the rope is adequately gripped. If necessary the tail-end may be lashed to the live part with soft binding wire.

NOTE — In both (i) and (ii), the clamp is used to ensure that the rope cannot slip through the anchorage before the wedge has seated properly.

j) Special care should be taken when tension may be completely removed from the rope, for example when a load is set down, where there is a possibility that the wedge may become loosened.

16.6.2.2 *Inspection*

When inspecting wedge and socket rope anchorages particular attention should be paid to;

a) rope damage, for example broken wires or deformation of the rope where it emerges from the socket;

b) the condition of the socket, for example cracks, particularly if the wedge is seen to protrude excessively. The socket lugs should be examined for possible deformation, cracks, or other defects;

c) the security and tightness of the wedge fitting.

The wedge and socket and the part of the rope lying inside the fitting should be examined each time the termination is dismantled for any reason.

A wedge and socket termination found to be damaged should be replaced.

A length of rope that has previously been fitted with a wedge and socket termination should not be straightened and use for load-bearing purposes.

16.7 Maintenance Examination and Discard Criteria

16.7.1 *General*

The continued safe operation of wire ropes depends on the regular assessment of the condition of the ropes and the equipment with which they are used.

Some cranes operate in conditions where the ropes and equipment are particularly liable to damage. In such circumstances, the assessment of the condition of the

rope and the equipment should be carefully carried out, and the rope removed from service when the damage is such as to affect its safe operation.

Good maintenance will, in general, increase the rope life. Regular cleaning and service dressing is a necessary part of good maintenance.

Guidance regarding rope maintenance, inspections and examinations and discard criteria are given in **16.7.2** to **16.8.6**. If the person inspecting the rope has any doubts about its safe operation, the rope should not be used until it has been examined and declared fit for further service by the competent person.

Records should be kept of the maintenance, examination and discard of wire ropes (*see* **9.10.4**).

16.7.2 *Rope Maintenance*

The maintenance of wire ropes is normally confined to cleaning and application of dressings. The dressings are usually of mineral oil origin and are used to provide lubrication of the wires and strands and to provide protection against corrosion.

Corrosion is a common cause of deterioration of ropes, especially those working out of doors. Internal as well as external corrosion can occur. The former is more dangerous because it can lead to an appreciable reduction in the strength of the rope before the deterioration becomes apparent.

The dressings used for these ropes should therefore:

a) penetrate easily into rope,

b) displace moisture from metal surfaces,

c) give good corrosion protection,

d) be resistant to wash off by water,

e) be reasonably resistant to emulsification, and

f) not cause build up on surface so as to cause displacement of the rope.

In certain environmental conditions, the application of a dressing might aggravate the wear, for example by retaining abrasive materials and in these situations the application of dressings should be avoided unless it is required to protect the rope against corrosion.

The dressing should be compatible with the type of lubricant applied during the manufacture of the rope and in this respect the rope maker's advice should be sought.

16.7.3 *Frequency of Dressing*

This depends very much on the installation and environment in which the rope is working. There are, however, certain general principles to be followed in order to obtain the best rope life. These are:

a) wherever practical a dressing should be applied when the rope is fitted to the crane;

b) the dressing should be re-applied at regular intervals and before the rope is showing signs of corrosion or dryness.

16.7.4 *Application of Dressing*

There are several methods of applying dressings and the most suitable for any particular rope depends upon the viscosity of the dressing and the length of rope involved. The methods of application include brushing, spraying, dripfeed or by automatic applicators.

For maximum effect the lubricant should be applied if possible to the rope where it 'opens up' as it travels over a sheave or winds onto a drum.

If the existing dressing on the rope is heavily loaded with dirt, sand, grit, etc, or if loose corrosion products are present, these should be removed with a wire brush or other suitable means.

16.8 Assessment of Rope Condition and Discard Criteria

16.8.1 *General*

When carrying out inspections and examinations to assess the fitness of the rope for further service, it is necessary to consider both general deterioration and localized deterioration or damage. It is therefore necessary to examine the whole length of the rope, paying particular attention to the rope adjacent to the terminations, lengths which have been running or stationary over drums, sheaves and deflection pulleys, and any other areas likely to sustain damage (*see* Fig. 8).

The criteria in **16.8.2** to **16.8.6** should be considered and are likely to occur in combination. The competent person should assess for each, the severity of deterioration between the perfect condition and the discard condition and the cumulative effect on the rope. A combination of two or more criteria should be viewed more seriously than one occurring on its own.

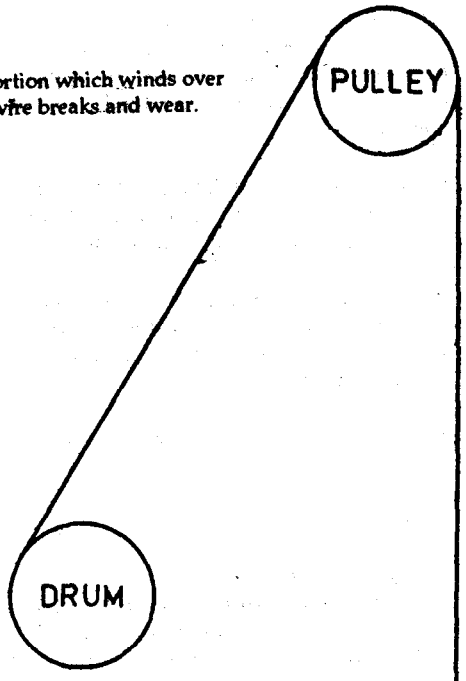
16.8.2 *Broken Wires*

16.8.2.1 *Generally distributed broken wires*

The number of generally distributed broken wires permissible before the rope is discarded are given in the Construction (Lifting Operations) Regulations 1961 and the Shipbuilding and Ship Repairing Regulation 1960, which also specify maximum periods between thorough examinations.

In other cases that are not covered by these regulations the total number of visible wire breaks should not exceed ten in any length of rope of eight rope diameters.

Breaks that occur on the crown of the rope are typical of deterioration by abrasive wear and bend fatigue. breaks that occur in the valley area between the strands



(6) Examine portion which winds over pulley for wire breaks and wear.

(1) Examine termination of rope at drum.

(2) Examine for defective coiling, which causes deformations (flattened portions) and wear, which can be severe at cross-over positions.

(3) Examine for wire breaks.

(4) Examine for corrosion

(5) Look for deformations caused by snatch loading.

(10) Points of attachment

— check for wire breaks and corrosion;

— similarly, check section of rope which lies on or adjacent to compensating pulleys.

(11) Look for deformation

(12) Check rope diameter

PULLEY BLOCK

LOAD

(7) Examine carefully length which runs through pulley block, particularly that length which lies on the pulley when the appliance is in a loaded condition.

(8) Examine for wire breaks or surface wear.

(9) Examine for corrosion.

FIG. 8 PARTS OF THE CRANE TO BE CONSIDERED DURING THE EXAMINATION

are typical of deterioration of the core by wear, fatigue or corrosion.

In the case of multistrands ropes wire breaks will frequently occur in the valley area between strands and may become visible if the rope is flexed, or opened for internal inspection.

16.8.2.2 *Localized broken wires in the vicinity of terminations*

The rope should be discarded when there are three or more visible wire breaks in the immediate vicinity of termination. Detachable terminations such as a wedge and socket should be examined for broken wires within and under the terminations.

If the rope is shortened so that the broken wires are removed then it may be considered for re-termination and reuse. Wire breaks at or adjacent to the termination, even if low in number, are indicative of high stresses at this point and may be caused by incorrect fitting of the termination. The causes should be investigated before the rope is reterminated.

16.8.2.3 *Ropes operating in plastics sheaves*

When any rope operates either solely or partly with plastics sheaves or metal sheaves having plastics lining, wire breaks may occur in large numbers internally before there is any visible evidence of wire breaks or substantial wear on the periphery of the rope.

Particular attention should be paid to any localized area which exhibits a dryness or denaturing of the lubrication.

The rope or crane manufacturers advise should be sought regarding discard criteria but in any case this should be not less onerous than those applicable to multistrand ropes working over metal sheaves.

16.8.3 *Wear*

Wear may be either general or localized and results from contact of the rope with sheaves, or drums, or other hard surfaces or rope to rope pressure. Wear may be uniform along or around the rope, or may occur along one side of the rope only.

When working over metal sheaves, the rope should be discarded when the rope diameter anywhere is reduced to 90 percent of the nominal diameter in the case of 6 and 8 strand ropes.

In the case of multistrand ropes, internal wear or damage is frequently more critical than external wear. This may also be accompanied by an accumulation of internal debris. If the rope diameter falls to 97 percent of the nominal, or rises to 105 percent of the nominal, a more detailed examination should be carried out to ascertain the significance and discard may be necessary. The rope should in any case be discarded when the diameter has reduced to 90 percent of the nominal diameter.

If wear is not even, the cause should be ascertained and corrective action taken.

16.8.4 *Corrosion and Chemical Attack*

Corrosion and chemical attack may be external or internal, general or localized, and is significant when the surface of the wires is severely roughened or pitted, or if the wires are slack within the strands due to wastage. If any of these phenomena is present either locally or generally the rope should be discarded.

Slight rusting of the surface is not normally detrimental but may be an indication that the rope is in need of lubrication.

Internal corrosion or chemical attack are not always easy to detect and are therefore particularly dangerous. Indications are an unusual increase or decrease in rope diameter, lack of gap between the strands, drynesss and deterioration of the lubricant, discoloration in the valleys between the strands, and increase in stiffness in bending. If a rope shows any of these signs it should be carefully examined and if not requiring discard it should be re-dressed (*see* **16.7.2**).

16.8.5 *Localized Damage or Distortion*

Other forms of damage or distortion that may affect the safe working of wire ropes are:

a) *Waviness* — Waviness is a deformation where the longitudinal axis of the wire rope takes the shape of a helix. While not necessarily resulting in any immediate loss of strength, the deformation may transmit a pulsation which after prolonged working will give rise to wear and wire breaks. In the case of waviness that affects the operation of the equipment, the wire rope should be discarded.

b) *Basket distortion (or birdcage)* — Basket distortion occurs in ropes when the outer layer of strands has been dislocated or when the outer layer becomes longer than the inner layer of strands. Such a condition may occur as a result of abrupt (snatch) loading of the rope from a slack condition, incorrect installation or incorrect termination. A basket formation is justification for discard.

c) *Strand or core protrusion* — Strand or core protrusion is frequently associated with basket deformation and is justification for immediate discard of the rope.

d) *Wire extrusion* — In this condition certain wires or groups of wire rise up on the opposite side of the rope to the sheave groove, in the form of loopes. This feature usually results from shock loading. If the condition is severe (3 wires), there is justification for discarding the rope.

e) *Local increase in diameter of rope* — Local increase in rope diameter may occur and could affect a relatively long length of the rope. The condition usually relates to corrosion (*see* **16.8.4**) or to swelling of a fibre core owing to the effect of moisture. If the condition is severe, the rope should be discarded.

f) *Local decrease in diameter of rope* — A local decrease in the diameter of the rope is frequently associated with fracture of the core. Positions close to terminations should be carefully examined for such deformations.

If the condition is severe the rope should be discarded.

g) *Bends and Kinks* — Bends are angular deformation of the rope.

A kink is a deformation created by a loop in the rope which has been tightened without allowing for rotation about its axis. Unbalance of lay length occurs, which will cause excessive wear, and in severe cases the rope will be so distorted that it will have only a small proportion of its strength remaining.

If the bend or kink is severe there is justification for immediate discard of the rope.

h) *Damage due to heat or electric arcing* — When there is evidence that the rope has been in any way affected by electric arcing, or substantially affected by heat, the rope should be discarded. Indicators are dryness or loss of lubrication, bluing of the wire surfaces, fusion of wire surfaces and the presence of weld splatters.

16.8.6 *Cumulative Effect of Individual Criteria*

Clauses **16.8.2** to **16.8.5** provide guidance regarding individual criteria that needs to be considered in deciding whether a rope should be discarded. The competent person should also assess the cumulative effect of two or more criteria within each affected part of the rope.

The severity of deterioration should be assessed between Zero percent (perfect condition) and 100 percent (discard condition). When a cumulative intermediate condition of 80 percent or more is reached, the competent person should specify the period of time for which the rope may be used and may recommend a reduction in time between inspections or thorough examination of the rope.

Tables 1 and 2 show the estimation of the severity of deterioration and typical examples of the cumulative effect.

Table 1 Severity of Deterioration of Steel Wire Ropes
(*Clause* 16.8.6)

Factor of Deterioration	Estimated Percentage of Severity of Deterioration					
	Perfect Condition	Intermediate Condition				Discard Condition
Wire breaks	0	20	40	60	80	100
Reduction in rope diameter	0	20	40	60	80	100
External corrosion	0	20	40	60	80	100
Deformations	0	40	40	40	40*	100

*Deformations rate as either acceptable (40) or severe and justifying discard of the rope (100).

Table 2 Typical Examples of Cumulative Effect of Deterioration of Steel Wire Ropes
(*Clause* 16.8.6)

Typical Examples	Estimated Percentage of Severity of Deterioration					
	Wire Breaks	Reduction in Rope Diameter	External Corrosion	Deformations	Total	Remarks
1	0	20	40	0	60	Safe to use
2	20	20	0	0	40	Safe to use
3	20	20	20	0	60	Safe to use
4	20	20	40	0	80	Discard within a specified period
5	20	40	0	40	100	Discard within a specified period

17 SLINGING AND HANDLING OF LOADS

17.1 Load Estimation, Weight and Centre of Gravity

17.1.1 *Weight of the Load*

It is important that the weight of the load to be lifted is known with reasonable accuracy. To obtain this information

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

b) Check the weight stated on any documentation.

c) Look at the drawing of the load. If the weight is marked check as in (a) above to ensure it includes all parts of the load.

d) If the load is still on a trailer or truck, weigh it.

e) Estimate the weight of the load by using tables of weights. In this respect IS 808 : 1989 gives the weight of rolled steel sections. Table 3 gives weights for other materials.

Table 3 Weight of Materials
[*Clause* 17.1.1 (e)]

Material	Weight kg/m³
Aluminium	2 700
Brass	8 500
Brick	2 100
Coal	1 450
Copper	8 800
Concrete	2 400
Earth	1 600
Iron, steel	7 700
Lead	11 200
Magnesium	1 750
Oil	800
Paper	1 120
Water	1 000
Wood	800

NOTES

1 In some cases the above figures are average only and the actual weight may vary according to the particular composition/water content, etc.

2 All figures have been rounded for convenience of use.

3 When dealing with a hollow body check whether it contains anything and whether any such contents are liable to move.

17.1.2 *Centre of Gravity*

It is important to know the position of the centre of gravity. This is the point at which the total weight of a body may be regarded as being concentrated.

Another way of saying this is that the centre of gravity is the point about which the parts of a body exactly balance each other.

17.1.2.1 *The Regularly shaped load*

With a regularly shaped load (for example a rolled steel joist) the position of the centre of gravity easily may be judged by measuring out the midpoint in each direction.

17.1.2.2 *The more complex or irregularly shaped load*

For more complex shapes, it may be necessary to estimate the centre of gravity of the various parts of the load and then combine them to get a centre of gravity for the whole.

When handling irregular shaped loads such as machine tools where the position of the centre of gravity is not readily ascertainable 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 a tendency to topple over and that no part of the load is subjected to excessive strain which might cause damage to the load. Slings should be protected against any sharp edges on the load. The weight of all slings tackle and lifting beams should be regarded as part of the load to be lifted.

17.2 Use of Lifting Gear

Only slings and lifting gear for which a valid test certificate has been issued and which have been thoroughly examined within the previous six months should be used. Slings and lifting gear should be clearly marked with the safe working load and an identification number (for test record purposes). All slings and lifting gear should be visually inspected on each occasion before use. When not in use such lifting gear should be maintained in a serviceable condition in a suitable store Lifting grear should be released from the store only on the instruction of a responsible person.

When use in connection with the handling of molten metal or slag the safe working load of all lifting gear should be de-rated to half the normal safe working load.

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.

Chains and slings should never be dragged along the ground or floor (*see* IS 8324 : 1976).

17.3 Hooks and Hook Blocks

Hooks and hook blocks should be of adequate capacity for the loads to be lifted and should never be loaded beyond their safe working load. It should be noted that

hooks can be readily overstressed by the application of a load to the point of the hook.

To prevent displacement of the sling or load the hook should be provided with a safety catch or other efficient device. Alternatively the hook should be of such a shape (for example, a c-hook) as to minimize as far as possible the risk of the sling or load becoming detached.

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

When setting the load down whilst using a single fall of hoist rope, consequently relieving the tension of the rope, the hook may spin. The slinger should always exercise caution in approaching the hook when disconnecting the slings.

18 RAISING OR LOWERING OF PERSONS

The raising or lowering of persons by cranes, should only be carried out on cranes fitted with automatic brakes such that when the controls are released the motions are brought to rest ('Dead mans' handle type of control). It should only be possible to lower persons under power controlled conditions (that is not under free fall).

Persons should only be carried in properly designed chairs or cradles provided with suitable means to prevent persons or tools from falling out (for example with wire mesh or similar protection to a height of 1 m). Means should be provided to prevent the chair or cradle from spinning (for example by the provision of a swivel or the use of multi-fall ropes) or tipping and it should be clearly and permanently marked with the load that it can safely carry. The chair or cradle should be inspected to ensure that it is still in a safe condition to carry persons, at intervals not exceeding three months. Where the chair or cradle is subjected to arduous usage more frequent inspection may be necessary. The chair or cradle should be thoroughly examined by a competent person at least every twelve months. A record of all inspections and thorough examinations should be kept.

19 BALLING OPERATIONS

19.1 General

In balling operations a round or pear-shaped weight, known as a breaking ball, is suspended from the hoist rope of a crane and caused to move to strike the building, structure or other object so that the impact causes collapse or breakage.

During balling operations dynamic loadings are imposed on the jib structure and other parts of the crane by movement and impact of the ball. In rating a machine for this service, the crane manufacturer will assume certain dynamic loading values, but in practice the magnitude of these will vary widely according to the method of using the breaking ball, the skill of the driver in controlling the ball and the impact resistance of the object being broken. Manufacturers' recommendations and working loads should, therefore, be regarded only as a guide. Lesser loads and/or shorter jibs should be adopted in the light of practical experience of the driver in the use of the particular machine in similar applications and according to the technique adopted and the proven skill of the driver.

NOTE — It should be noted that certain manufacturers do not recommend use of their machines for balling operations or may only approve this conditionally such as with restriction in the technique to be followed, the maximum jib length to be used, etc.

The ball should never be swung by operation of the derricking mechanism.

The drivers of cranes engaged in balling operations should be skilled and experienced in the use of the equipment and techniques of balling, familiar with the machine in use and aware of the potential dangers and their possible causes. Operational methods should be used which do not overstrain the jib or hazard the stability of the crane.

The use of swinging techniques should be restricted to machines designed for arduous or heavy duty service. The weight of the ball should always be less than the capacity of the machine at the required radius and a maximum of 70 percent of the safe working load is recommended.

A rope from the second drum of the crane should also be attached to the ball to prevent an inadvertent increase in radius which might result in an overload situation. The ball should be connected to the hoist rope by means of a free running swivel if no method of preventing the ball from turning is to be used.

When an old commercial vehicle type is used to minimize shock transfer to the crane a lazy chain or strap should also be fitted so that if the tyre were to fail the ball will remain attached to the crane.

Care should be taken to prevent the ball striking the crane and jib or objects other than that to be broken. As a protection against the jib springing over the cab on release of the ball, jib angles greater than 60° from the horizontal should not be used. Jib safety stops should always be fitted on the crane and adequate protection against flying debris provided for the driver.

In cases of free standing cranes the ball should be used only when the crane is standing stationary on firm and level ground. A crane should never stand within a building that it is demolishing. When demolishing masonry arches, suspended floor slabs, etc., care should be taken to avoid the ball becoming trapped, as a sudden collapse of the structure could overload the crane. If the ball does become trapped, it should be lowered off before being freed as a dragging or lifting

action might cause the structure to collapse on top of the ball, so pulling the crane over.

In practice the operational techniques given in **19.2** and **19.4** are used in balling operations.

19.2 Vertical Drop Balling

The breaking of objects by drop balling is achieved by raising the ball vertically above the object and then allowing it to drop onto the object by force of gravity.

The ball may be attached to the hoist rope of a crane with a free fall capability. It should then be raised a short distance, be held by the hoist brake then be permitted to fall until the object is struck. Sudden application of the brake while the ball is still moving should be avoided as shock loads which would be produced by such action may cause structural damage to, or overturning of the crane. The distance which the ball is allowed to drop should only be increased once the characteristics of the object being struck have been determined and heavier impacts are considered to be safe. Where the point of impact is above ground level or above an underground void there is a possibility of the ball missing the intended point of impact, passing through the object or bouncing off. In such circumstances the drop distance should be kept to a minimum and at the intended point of impact there should be sufficient length of rope left on the crane to allow the ball to be brought to rest by the brake to avoid endangering the crane. In operations such as demolition it is often advisable to effect a number of heavy impacts to cause multiple cracking and to follow with a number of lighter impacts until part of the object is broken and then to repeat the exercise.

Where it is not possible or not desirable to use a crane with a free fall capability, the ball may be dropped by application of a quick release mechanism often referred to as a 'Monkey'. The ball should be carefully positioned above the object to be struck and then be raised as before. The mechanism is normally released by a downward force on a light rope or handline which is either pulled manually or is automatically tensioned as the lifting hook is raised. Once the ball is released it is permitted a completely free fall to the point of impact and therefore great care should be exercised to ensure that the ball is contained in the working area and that all personnel are outside that area and are suitably protected from flying debris.

Free dropping can also be carried out by lifting the ball by use of an electro magnet and then releasing the magnetic force or by use of a grab or similar device.

19.3 Swinging the Ball in Line with the Jib

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

This method is limited to relatively low level objects as the ball cannot be swung effectively when positioned at much more than half the available height of lift. It is, however, the most advisable method as it produces the least strain on the crane.

19.4 Swinging the Ball by Slewing

By this technique the ball is suspended some three metres or more below the jib head and the slew motion is engaged causing the ball to swing in an arc and strike the object. The slew motion should be disengaged and the slew brake applied to stop the jib at a point in line with the point of impact. Again a second rope should be used to prevent the ball swinging out of the safe radius. Considerable torsional loadings can be applied to the jib and other elements of the crane by use of this technique though these can be reduced to almost nil by good driver control. The actual strain will be governed by a number of factors including:

a) length of jib and operating radius,

b) distance of ball below the jib head,

c) rate of acceleration of slewing motion,

d) speed of ball at impact and the impact resistance of the object,

e) position of the jib head relative to the ball when it strikes the object,

f) rate of checking the slewing motion, and

g) weight of ball.

20 SIGNALLING SYSTEMS

Copies of the code of hand signals shown in Fig. 2 should be issued to all crane drivers, slingers and other persons concerned in the carrying out of a lifting operation to ensure that a standard signalling code is used.

In those situations where special lifts are involved or where hand signals along are inadequate other forms of communication should be used, either by means of radio or telephone to supplement the hand signals code.

When radio is used as a means of signalling, the channel selected should be kept clear of all other communications. All personnel involved in the signalling should be given a clear and unique call sign and all communications should be preceded by this call sign. The crane driver should not respond to any command that is not preceded by the given call sign.

During the carrying out of the lifting operation hand signals and any voice instruction to the crane driver/drivers should only be given by one person at any one time.

(*Continued from second cover*)

Accordingly, Part 1 of this code deals with management and organization and other common features of cranes. Subsequent parts of the code would deal with specific features of the specific type of cranes as follows:

Part 2 Mobile cranes

Part 3 Lorry loaders

Part 4 Tower cranes

Part 5 Derrick cranes

Part 6 Overhead/underhung travelling and goliath cranes

Part 7 High pedestal and portal jib dockside cranes

Part 8 Manually operated and light cranes

Part 9 Container bandling cranes

Part 10 Rail mounted cranes

This code contains information which should provide means for reducing the present unacceptable number of accidents involving the use of cranes.

This part of the code is based on Doc 85/72574 'DC Draft British Standard Code of practice for safe use of cranes: Part 1 General (Revision of CP 3010 and BS 5744, Section 1)' issued by the British Standards Institution (BSI), UK.