British Standard

BRITISH STANDARD

BS 466:1984

Specification for

Power driven overhead travelling cranes, semi-goliath and goliath cranes for general use

UDC 621.874.2/.4

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mechanical Engineering Standards Committee (MEE/-) to Technical Committee MEE/41 upon which the following bodies were represented:

Associated Offices Technical Committee
Association of Consulting Engineers
British Constructional Steelwork Association
British Ports Association and The National Association of Ports Employers
British Transport Docks Board
Bureau of Engineer Surveyors
Construction Plant-hire Association
Crown Agents for Oversea Governments and Administrations
Department of the Environment (Building Research Establishment)
Department of the Environment (Property Services Agency)
Department of Trade and Industry (Mechanical and Electrical Engineering Division)
Engineering Equipment and Materials Users' Association
Federation of Civil Engineering Contractors
Federation of Manufacturers of Construction Equipment and Cranes
Federation of Wire Rope Manufacturers of Great Britain
Gambica (BEAMA Ltd.)
Health and Safety Executive
Independent Engineering Insurers' Committee
Institute of Materials Handling
Institution of Mechanical Engineers
Institution of Production Engineers
Institution of Structural Engineers
Mechanical Handling Engineers' Association
Ministry of Defence
National Federation of Building Trades Employers
Welding Institute
Coopted member

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Contents

Foreword

This British Standard has been prepared under the direction of the Mechanical Engineering Standards Committee. It supersedes BS 466:1960 which is withdrawn.

This standard was first published in 1932 and was revised in 1947 and 1960 and has now been updated to reflect current trends and technological progress within the industry; the major new provisions are:

a) the introduction of the new classification system based on that adopted by the International Organization for Standardization (published as ISO 4301);

b) the reference where appropriate to the design procedures contained in BS 2573-1 and BS 2573-2;

c) the recommendation of preferred lifting capacities, lifting heights and working speeds.

SI units are adopted throughout this standard.

The new classification system provides a means of defining the anticipated duty of an appliance and its mechanisms which serves as the basis of agreement between the purchaser and the manufacturer, and supplies information on which much of the design analysis can be based. The classification of the appliance as a whole is first defined from the number of operating cycles and from the anticipated loading it will experience during its life; secondly the class of each mechanism of the appliance is defined, from their individual operating times and the loading that they will experience during their life. The duty of the appliance and its mechanisms is therefore fully defined to give a sound basis for rational design along with economic production.

It is important that the noise from cranes should be within levels that will avoid their endangering health, and Appendix E draws attention to Health and Safety Executive documents covering this subject.

As inadequate design and construction of crane gantries can seriously affect the safety and operation of the crane, it is important that careful consideration is given to their design and construction in accordance with BS 449.

Cranes are designed and constructed to operate satisfactorily on tracks that are within certain tolerances and Appendix F has therefore been included to bring the necessary information to the attention of gantry designers and erectors.

Appendix G gives details of United Kingdom and EEC legislation relating to electric overhead travelling cranes.

Appendix J comprises a list of British Standards for materials and equipment applicable to the manufacturing of cranes.

This standard forms one of a series for cranes; the other British Standards in the series are:

BS 327, *Power-driven derrick cranes.*

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

BS 1757, *Specification for power-driven mobile cranes.*

BS 1761, *Single bucket excavators of the crawler mounted friction-driven type.*

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

BS 2573, *Rules for the design of cranes — Part 1 Specification for classification, stress calculations and design criteria for structures — Part 2 Specification for classification, stress calculations and design for mechanisms.*

BS 2799, *Power-driven tower cranes for building and engineering construction.*

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

BS[a], *Specification for wire rope hoists.*

BS[a], *Slewing jib cranes.*

[a] In course of preparation.

Attention is drawn to BS 5744 which covers the safe use of cranes.

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

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 44, an inside back cover and a back cover.

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

Section 1. General

1 Scope

This British Standard specifies requirements for power-driven overhead travelling cranes, semi-goliath and goliath cranes for general use.

NOTE 1 Typical crane types are shown in Figure 1.

The clauses of this standard that deal specifically with the means of power do not apply to d.c., hydraulic or pneumatic powered cranes, but the remainder of the standard can be applied to the design and construction of cranes of these types where relevant.

This standard does not apply to fixed runways (usually single track) of the type dealt with in BS 2853 or jib cranes.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard, the following definitions apply.

2.1
crab (or trolley)

an assembly incorporating one or more lifting units that traverses the bridge of the crane

2.2
duty cycle

a cycle of electrical input(s) to a motor(s) that commences when a load is picked up and ends when the crane picks up the next load

2.3
goliath crane

a crane comprising a bridge supported by legs and capable of travelling on tracks at ground or deck level

2.4
semi-goliath crane

a crane comprising a bridge supported at one end by leg(s) and at the other end by an end carriage(s) capable of travelling along tracks, one at ground or deck level and the other elevated

2.5 Operational characteristics of control

2.5.1
complete start

operation of the controller by holding the control in a fixed position until nominal rated speed is reached

2.5.2
jogging operation

operation of the controller to give partial starts

2.5.3
electrical braking

motor torque applied in the direction opposite to the existing motion (i.e. as a braking torque)

2.6
overhead travelling crane

a crane comprising a bridge supported by end carriages capable of travelling along elevated tracks

2.7
safe working load of a crane

the maximum load that, under specified conditions, is permitted to be safely handled by the crane

NOTE This includes all lifting attachments, magnets, etc. but not the hook block (when fitted) (see Figure 2).

2.8
safe working load of a lifting attachment

the maximum load that, under specified conditions, is permitted to be safely handled by the lifting attachment (see Figure 2)

2.9 Service conditions

2.9.1
in service

the conditions that apply to a crane whilst it is in use unladen, or with any load up to the safe working load, or in physical readiness for use, and it is under the control of the crane driver

2.9.2
out of service

the condition that applies to a crane whilst no load is suspended and it is not under the control of the crane driver

2.10
span

the horizontal distance between the centres of the tracks that support the crane

2.11
speeds of operation

the ranges of speeds at which crane motions operate

NOTE The speeds of operation of crane motions are as follows:

overspeed	greater than 100 %	
full speed (nominal rated speed)	100 %	
fast speed	50 % to	100 %
slow speed	15 % to	50 %
creep speed	0 % to	15 %

2.12
top running crane

an overhead travelling crane supported, for its long travel motion, on the top surface of elevated tracks on which it travels

2.13
wheel base (of a crane)

the distance between the centres of the wheels running on the same track. On end carriages with more than two wheels the wheel base is taken as the distance between the centres of the outside wheels

2.14
wheel base (of a crab)

the distance between the centres of the wheels on the same track

2.15
underslung crane

an overhead travelling crane supported, for its long travel motion, from the bottom flanges of tracks on which it travels

2.16
bridge

the structural member(s) on which the crab(s) is supported

NOTE The bridge may be cantilevered beyond the leg(s)/end carriages.

2.17
hoisting

the motion of lifting or lowering of the load in a vertical direction

2.18
cross traverse

motion of the crab(s) along the bridge

2.19
long travel

motion of the whole crane along the track

3 Information to be provided

3.1 Information to be provided by the purchaser

The purchaser should provide information in accordance with Appendix A to enable the crane manufacturer to offer the most suitable crane and equipment to satisfy the duty requirements and service conditions.

NOTE Attention is drawn to Appendix B where, to aid economic manufacture of the crane, it is recommended that lifting capacities, lifting heights and speeds of operation are selected from preferred values.

3.2 Information to be provided by the manufacturer

The manufacturer shall provide information to the purchaser of the crane being offered in accordance with Apendix C.

4 Classification

The classification of the crane as a whole and of each mechanism shall be based on the information provided in accordance with Appendix A and shall be determined in accordance with Appendix D.

5 Service conditions

5.1 Normal service conditions. For normal service conditions, the crane shall be supplied for:

a) indoor use;

b) use at ambient temperature between – 10 °C and 40 °C with no sources of high local heating, such as furnaces or radiant panel heaters;

c) use at an altitude not exceeding 1 000 m above sea level;

d) use in clean still air of normal humidity and free from contamination and deposits.

5.2 Special service conditions

5.2.1 *General.* The manufacturer shall take any special service conditions required by the purchaser into account and agree with the purchaser how he proposes to meet each of these requirements and any limitations imposed in consequence of the special conditions.

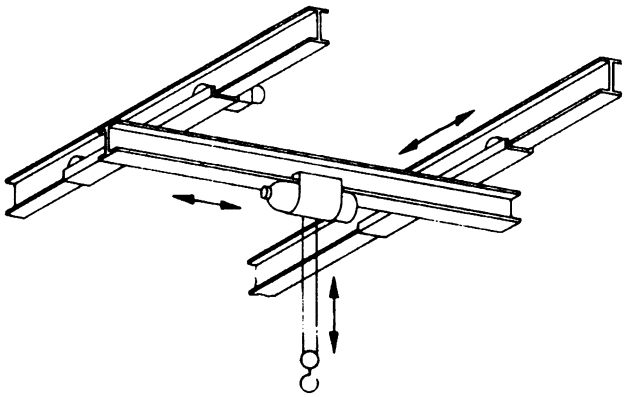
NOTE Attention is drawn to Appendix A which gives examples of special service conditions that may require special attention.

5.2.2 ***Additional requirements***

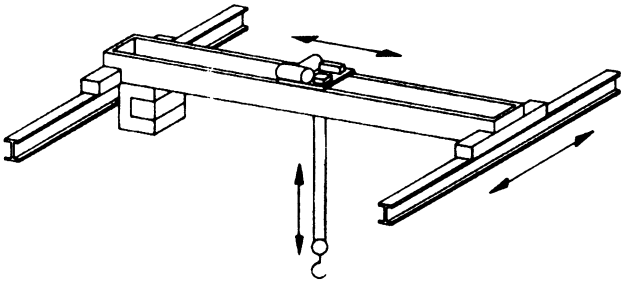
5.2.2.1 *Handling molten metal.* For cranes used for handling molten metal, the minimum classification for the lifting unit mechanism relative to the hazardous load shall be M5 (see Table 13) and the lifting rope shall have a metal core.

If the crane has excess capacity to a lower classification for other use, then the crane markings (see **45.1**) shall specify the maximum permissible weight of the hazardous load, i.e. “Maximum full ladle weight ... tonnes”.

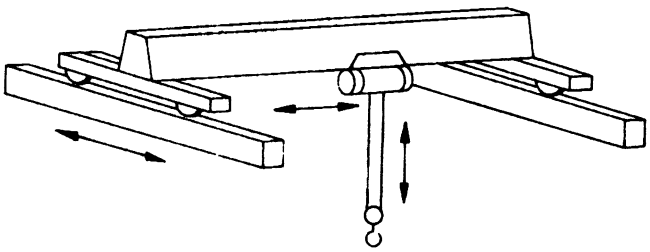
5.2.2.2 *Potentially explosive atmosphere.* Cranes for potentially explosive and flammable atmospheres shall be designed to meet the appropriate ignition protection requirements corresponding to the environmental conditions under which they will be required to work as specified in BS 5345.



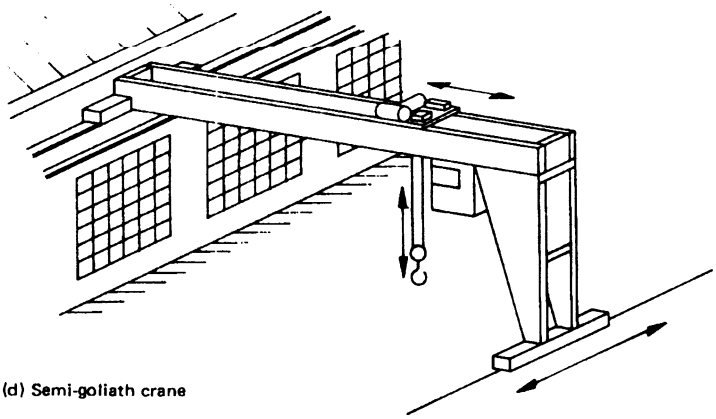
(a) Underslung crane (single girder)



(b) Top running crane (double girder)

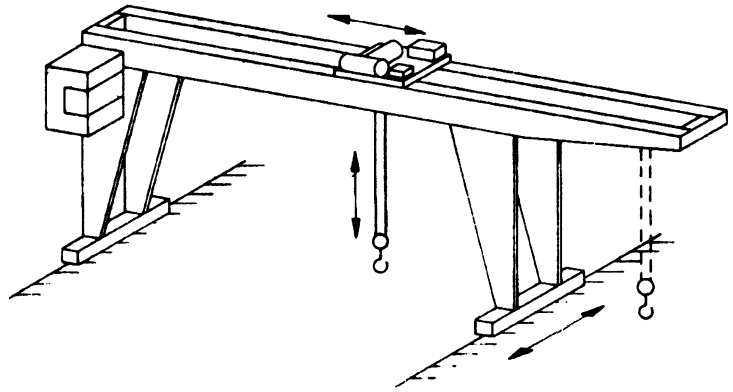


(c) Top running crane (single girder)

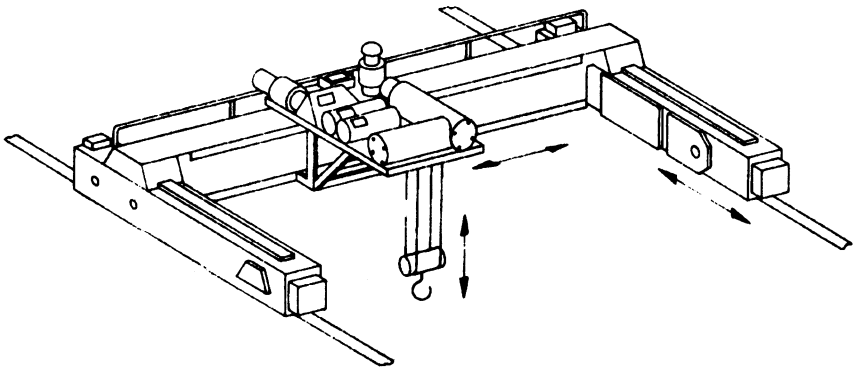


(d) Semi-goliath crane

Figure 1 — Typical crane types



(e) Goliath crane (with cantilevered extension)



(f) Offset crab crane

Figure 1 — Typical crane types (concluded)

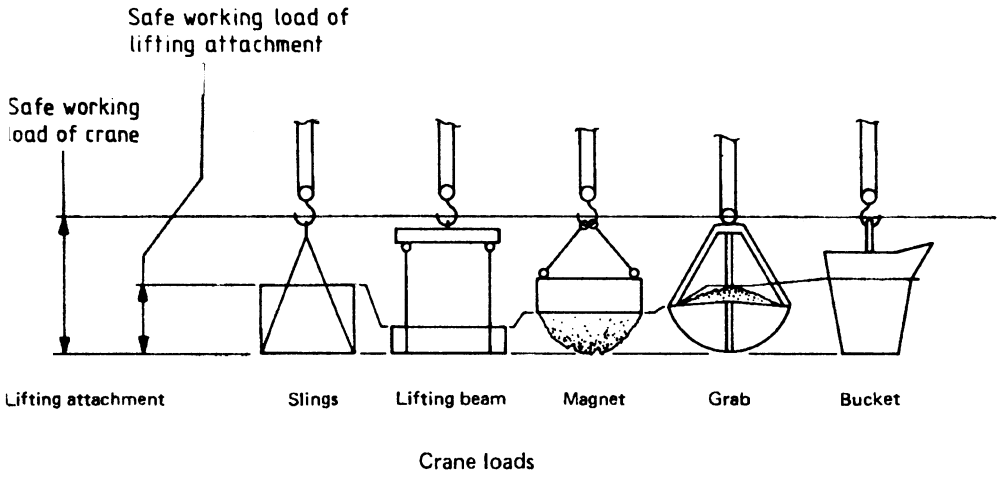


Figure 2 — Illustration of typical lifting attachments in relation to safe working load

5.2.2.3 *Outdoor use*

5.2.2.3.1 *Weather protection.* The manufacturer shall arrange weather protection for all electrical and mechanical equipment, as necessary, to meet the conditions specified.

The weatherproofing shall make allowances for the temperature rise of equipment under normal operating conditions.

The weatherproofing shall afford ready access for the routine inspection and maintenance of the protected equipment.

5.2.2.3.2 *Wind loads.* The crane shall be designed and constructed for in-service and out-of-service wind loads as specified in BS 2573-1.

NOTE If the siting of a particular crane affects the wind loadings as outlined in BS 2573-1, the purchaser should specify the actual wind loadings to be used in the design of the crane (see **3.1** and **5.2.1**).

5.2.2.3.3 *Storm anchors.* The crane shall be provided with suitable means for anchoring when left unattended or under storm conditions.

5.2.2.3.4 *Brakes.* The long travel motion shall be fitted with a parking brake that shall be automatically applied when the crane is taken out of service. The cross traverse motion shall be fitted with a brake.

Section 2. Structural

6 Permissible stresses in structures

6.1 General. The permissible stresses and design of crane structures shall comply with **6.2** and BS 2573-1.

6.2 Inertia forces. Inertia forces shall comply with BS 2573-1 with the exception that the horizontal inertia forces shall be taken as not less than 1/15 (nor more than 1/5 for metallic wheels on rails) of the vertical load on the driven or braked wheels.

For the purposes of structural analysis, the horizontal inertia force due to the weight of each bridge girder, inclusive of any attachments thereto, shall be taken as a distributed load on the bridge girder. For concentrated elements, such as crabs and large items of machinery, the loads shall be considered as forces concentrated at the respective centres of mass. The effect of the suspended load shall be considered as a concentrated force at the point of suspension.

7 Vertical deflection

The bridge shall be designed so that the vertical deflection caused by the safe working load and the weight of the hoist or crab in the central position shall not exceed 1/750 of the span.

8 Vibration of crane structure

Due consideration shall be given to the crane structure's vibration characteristics to avoid adverse effects on:

a) accurate load positioning and control where these are critical;

b) safety, comfort and working efficiency of the operator on cab-controlled cranes.

NOTE For further information, see DD 32.

9 Structural sections

9.1 Corrosion allowance. For cranes working outdoors or in other corrosive environments, a corrosion allowance shall be added to the thickness required for structural strength considerations.

9.2 Exposure to accidental damage. Special consideration shall be given to the thickness of members that are likely to be exposed to accidental damage. Any increase of thickness required for this purpose shall be additional to the corrosion allowance.

9.3 Enclosed sections. Larger enclosed sections shall be designed so that every part is accessible for periodic inspection, brushing and painting. Drain holes shall be provided where water is likely to collect. Smaller enclosed and tubular sections, where access is impracticable, shall be sealed to prevent the ingress of moisture. Where tubular members are drilled to take bolts, precautions shall be taken to ensure that the joints are waterproof.

10 Joints

The strength of a bolted joint at any section of a structural member shall be at least 1.25 times the minimum strength of the section required at that point.

11 Bridge girder

11.1 Effective section. Where the rail is secured to the top beam or flange of a crane bridge girder, the rail shall be regarded as part of the effective section of the beam or flange for load carrying purposes provided that:

a) the means adopted to secure the rail are sufficient to resist the horizontal shear loading between the rail and the flange or beam under the applied loads, in addition to the lateral force resulting from the inertia of the lifting unit and load calculated in accordance with **6.2**;

b) any joints in the rail that are located within the middle third of the span are full penetration welds and any joints that are not full penetration welds are in such a position that the interruption of the rail area by the joint will not cause the stress in the remaining section of the girder to exceed the permissible maximum;

c) when calculating the section contributed by the rail, allowance is made for 6 mm wear in the depth of the rail.

Where the rail is not secured as specified in a) or not welded as in b), the cross section of the rail shall not be included when calculating the effective section of the girder.

11.2 Effect of wheel loads

11.2.1 *General.* Consideration shall be given to localized effects of wheel loadings on the stresses in the bridge girder.

11.2.2 *Load directly over web.* When a wheel load is placed directly over the web of a bridge girder, it shall either be assumed to be distributed over a distance of three times the distance from the application of the wheel load to the point at which the stress is being calculated, taking into account any discontinuance in the materials, or a more detailed calculation shall be made.

Particular attention shall be given to all the resulting stresses passing through the connection between the web and the flange. If full penetration butt welds are not used for this connection, it shall not be assumed that there is direct contact between web and flange parent materials.

11.2.3 *Load between webs.* Where the wheel load is carried between the webs, that part of the flange plate between the webs shall not be assumed to give adequate support. If necessary, the flange plate shall be supported at intervals to transmit the load to the girder webs.

11.2.4 *Load on lattice girders.* Braced or lattice girders shall withstand, in addition to the direct tensile or compressive stresses in the flanges, the local bending stresses due to the maximum wheel or roller loads and their own weight between the panel points.

11.3 Braced and lattice girders

11.3.1 *Local bending moments.* Local bending moments used in the calculation of stresses shall be not less than $WL/6$ at the panel centre and $WL/12$ at the panel points where W is the total vertical load on the member arising from live load and the weight of the member, and L is the distance between panel points.

11.3.2 *Tension members.* Where single angle bars connected by one leg are used as tension members, the effective sectional area shall be taken as the net sectional area of the connected leg added to one-half of the sectional area of the free leg. When the outstand leg is cleated at the end connections, the net sectional area of the angle shall be taken.

11.3.3 *Compression members.* The latticing of compression members shall be proportioned to resist a transverse shear at any point in the length of the member not less than 2.5 % of the axial load in the member.

11.3.4 *Flat lattice bars.* The thickness of flat lattice bars shall be not less than 1/40 of the shortest distance between the centres of connections, in the case of single latticing, and 1/60 in the case of double latticing connected at the intersection.

12 End carriages

12.1 Length. The length of the end carriages shall be such that they prevent contact by any other part of the crane in the event of a collision between cranes on the same tracks or with the end stops.

12.2 Wheelbase. The wheelbase of an end carriage shall satisfy the following minimum requirements where applicable.

a) *Top running crane.* The wheel base shall be not less than 1/7 of the crane span.

b) *Underslung crane.* The wheel base shall be not less than 1/7 of the crane span where the travel speed of the crane is more than 40 m/min and 1/8 where the travel speed of the crane is 40 m/min or less.

12.3 Withdrawal of track wheels. End carriages shall be designed so as to enable the track wheels to be withdrawn readily.

13 Buffers

13.1 Resilient buffers. Resilient buffers shall be fitted to cross traverse and long travel motions unless motion limiting devices (see **21.2**) are provided or the speeds are less than 40 m/min.

13.2 Two or more units on the same tracks. Where two or more units (i.e. cranes or crabs) are on the same tracks, resilient buffers shall be provided between them unless anti-collision devices are fitted (see **21.2**) or the maximum potential collision speed is less than 40 m/min.

14 End stops

The manufacturer shall provide end stops on the crane bridge to prevent the crab(s) from over-traversing.

NOTE The purchaser will be responsible for providing stops on the gantry rail(s) to prevent over-travelling of the crane.

15 Drop stops

The end carriages and crab(s) shall be fitted with drop stops to prevent a drop of more than 25 mm in the event of breakage of a track wheel bearing or axle.

16 Access platforms, walkways, ladders and stairs

16.1 General. Access platforms, walkways, ladders, stairs, handholds and footholds shall be provided as necessary to give safe access to the driver's cabin (when fitted) and to parts of the crane requiring routine inspection and maintenance. Where these are mounted on or form part of the crane they shall be provided by the manufacturer.

NOTE 1 Where these do not form part of the crane, the responsibility for supply should be agreed between the manufacturer and the purchaser.

NOTE 2 Recommendations for headroom clearances, platform and walkway widths are given in Appendix H. (See also item 11 of Apendix C.)

16.2 Guard rails and toe boards. The outer sides of platforms and walkways shall be securely fenced with toe boards and double tiered guard rails. The guard rails shall have a minimum height of 1 m above the walking surface and the toe board shall have a minimum height of 50 mm above the walking surface.

16.3 Openings in platforms and walkways. All openings in platforms and walkways shall be fenced as specified in **16.2**.

16.4 Walkway surfaces. Walkway surfaces shall be non-slip.

16.5 Ladders. Ladders shall comply with BS 4211 except that safety hoops are not required where equivalent protection is provided.

NOTE Ladders should not be less than 300 mm wide.

16.6 Stairs. Stairs shall comply with BS 5395 where applicable. Where space is limited, stairs shall in no case be less than 430 mm wide.

17 Emergency escape provision

Where a driver cannot descend safely from an elevated cabin by his normal route if the crane is stranded away from the normal access point, or in a case of emergency, an alternative means of escape shall be provided.

18 Driver's cabin

18.1 General. Where a driver's cabin is fitted, it shall have a clear headroom of not less than 1.80 m.

The internal dimensions of the cabin shall provide for any control gear, or apparatus therein and give the driver adequate space for safe operation. Electric cables and hydraulic pipes shall be arranged to avoid accidental damage.

NOTE 1 The cabin should afford the driver as clear a view as possible of the load and the surroundings. The controls should be positioned so that the driver can readily operate the crane whilst viewing the load, irrespective of its position.

NOTE 2 Any special requirements for the driver's cabin should be the subject of agreement between the purchaser and the manufacturer. This should include requirements for protection against excessive heat radiation or toxic fumes or dust, the need for air conditioning or heating (see clause **37**) and the provision of fire extinguishers, etc.

18.2 Access. Whenever access to the cabin is not via the crane bridge platforms but is directly from a fixed access point in the building, an access platform shall be provided, attached to the cabin, complete with handrails and safety gate or chain.

18.3 Enclosure. Control cabins shall be either open type or totally enclosed, depending on the operating conditions and the environment.

Totally enclosed cabins shall be fitted with safety glass and provision shall be made to prevent the driver from falling through the glass. The windows shall be arranged so that they can be cleaned.

Open cabins shall be provided with guard rails 1 m high or equivalent protection for the driver. Toe boards of 50 mm minimum height shall be fitted to the walking surface.

18.4 Illumination. Where natural or artificial illumination is inadequate, additional illumination shall be provided to afford safe access to the crane and to enable the driver to operate the crane safely.

18.5 Audible warning device. An audible warning device shall be fitted to cranes operated from a cabin to enable the driver to give warning to persons in the vicinity.

Section 3. Mechanical

19 Permissible stresses in mechanisms

19.1 General. The permissible stresses and design of crane mechanisms shall comply with BS 2573-2.

19.2 Wheels running on rails or tracks

19.2.1 *Lateral location.* Provision shall be made to ensure the lateral location of the wheels on the rails or tracks.

19.2.2 *Metal wheels.* Metal wheels shall be machined to size and any flanges tapered and radiused to ensure smooth running.

19.3 Ropes and rope reeving components

19.3.1 ***Wire ropes***

19.3.1.1 *General.* Wire ropes shall comply with BS 302, BS 3530 or ISO 2408 with the exception that selection shall be based on the group classification of the mechanism (*M*) (see clause **4**) and the requirements of BS 2573-2.

NOTE For ropes used on cranes that handle molten metal, see **5.2.2.1**.

19.3.1.2 *Two or more ropes in a system.* Where two or more ropes are used in a system, means shall be provided for ensuring that the tensile forces in the ropes are distributed in the designed proportions.

19.3.2 ***Rope drums***

19.3.2.1 *Drum width.* Where a rope drum is of insufficient width to accommodate the rope in one layer, special arrangements shall be provided to ensure the correct reeling of the rope. The capacity of the drum shall be sufficient to ensure that for the height of lift specified;

a) no fewer than two dead turns remain on the drum at each anchored end at the lower limit of hoisting;

b) the drum will accommodate one further turn of rope at the upper limit of hoisting.

19.3.2.2 *Flanges.* The drum shall have flanges at both ends, except where a rope guide is fitted that effectively guides the rope into the drum grooves and ensures that it is retained therein. Flanges shall project not less than two rope diameters above the rope.

NOTE A gear or other wheel secured to the drum may be regarded as forming one of the flanges.

19.3.2.3 *Rope anchorages.* Rope anchorages shall be readily accessible.

19.3.2.4 *Drum surfaces.* Rope drum surfaces shall be finished smoothly and be free from surface defects liable to damage the rope.

19.3.2.5 *Grooves.* The contour at the bottom of the grooves shall be circular over a minimum angle of 120°. The radius of the groove shall be not less than 0.53 times the nominal diameter of the rope.

The groove pitch for single layering shall be not less than:

a) 1.08d for ropes of less than 38 mm diameter, where d is the nominal rope diameter; or

b) d + 3 mm for ropes of 38 mm diameter and above.

The groove pitch shall also ensure that the rope leaving the drum does not contact the adjacent turn of rope under any condition of operation.

The lead angle of the rope shall not exceed 1 in 12 either side of the helix angle of the groove in the drum.

19.3.3 ***Rope pulleys***

19.3.3.1 *Rope pulley surfaces.* Rope pulley surfaces shall be finished smoothly and be free from surface defects liable to damage the rope.

19.3.3.2 *Grooves.* Rope pulleys shall be grooved to a depth not less than 1.5 times the diameter of the rope.

The contour at the bottom of the groove shall be circular over a minimum angle of 120° and have an included angle of 52°.

19.3.3.3 *Angle of fleet.* The angle of fleet between the rope and a plane perpendicular to the axis of the pulley shall not exceed 1 in 12 for the minimum pulley diameter to rope diameter ratio permitted by BS 2573-2.

NOTE For larger pulley diameter to rope diameter ratios, consideration should be given to decreasing this angle to prevent interference between the rope and the pulley flange.

19.3.3.4 *Pulley guards.* Pulleys carrying ropes that are likely to be unloaded in service shall be provided with guards to retain the ropes in the grooves.

19.4 Lifting hooks. Lifting hooks shall comply with BS 2903 or BS 3017 as applicable.

Swivelling hooks shall be mounted on anti-friction bearings.

NOTE 1 If required by the purchaser, hooks complying with BS 2903 may be provided with a device to prevent the displacement of the sling or the load from the hook.

NOTE 2 If required by the purchaser, a locking device may be fitted to prevent rotation of the hook.

19.5 Shackles. Shackles shall comply with the requirements for strength and safety specified in BS 3032 or BS 3551. Shackles used for attaching the hook shall be provided with screwed pins.

NOTE Slotted heads in countersunk screwed pins are not recommended.

If angularly loaded, shackles shall not be subjected to a load exceeding one-third of the specified proof load. When the shackle is a permanent fitting, the pin shall be effectively locked.

20 Brakes

20.1 General. Brakes shall comply with the following.

a) Drums and discs shall be manufactured from hard wearing material. The rubbing surface shall be smooth and free from defects.

b) Brake drums and discs shall have adequate thermal capacity for the duty required.

c) The bearing pressure on the linings shall be conducive to uniform braking and long life.

d) Power released brakes shall be applied automatically by spring(s) or weight(s) when the power supply to the brake is interrupted. Power applied brakes shall not be fitted without a back-up system of the power released type.

e) Brakes shall be provided with means of adjustment to compensate for wear.

f) Springs for electromechanical brakes shall be of the compression type and shall not be stressed in excess of 80 % of the elastic limit of the material.

g) Under service conditions brakes applied by hand shall not require a force greater than 110 N (25 lbf) at the handle. Brakes applied by foot shall not require a force of more than 180 N (40 lbf) on the pedal.

h) Brakes shall be protected from hostile environments likely to adversely affect their operation, including rain, oil and grease.

20.2 Hoist brake. A hoist brake shall be provided which, when the power is cut off or fails, will arrest the motion and hold at rest any load up to and including the overload test load (see clause **44**) at any position of the lift. The load shall be brought to rest in the shortest time consistent with safe crane operation.

Provision shall be made to enable any load capable of overcoming the friction in the system up to and including the overload test load to be lowered safely in a controlled manner in the event of power failure.

The brake shall be designed to exert a restraining torque of at least 50 % greater than the maximum torque transmitted to the brake drum from the suspended load under service conditions. In estimating this torque, the effects of friction in the transmission system between the load and the brake shall be ignored.

20.3 Long travel motion brakes. Cranes shall be fitted with a long travel motion brake(s) capable of bringing a fully loaded crane to rest, without shock, from the highest speed it can attain (see also **5.2.2.3.4**).

When a foot operated brake is provided in a cabin mounted on the crane bridge, the brake pedal shall be designed and positioned to facilitate safe operation of the crane by the driver.

When a crane is controlled from other than a cabin mounted on the crane bridge, the long travel motion brake(s) shall be of the "power released" type.

20.4 Cross traverse motion brakes. The cross traverse motion of a crane shall be provided with a brake(s) if:

a) the specified traversing speed under full load is greater than 32 m/min;

b) the crab is mounted on anti-friction bearings;

c) the driver's cabin is attached to the crab;

d) the crane is for outdoor use (see **5.2.2.3.4**).

The cross traverse motion brake(s) shall be capable of bringing the fully loaded crab to rest, without shock, from the highest speed it can attain.

21 Motion limiting devices

21.1 Hoisting. A positively operated motion limiting device shall be provided that stops the upward motion when a predetermined level is reached.

NOTE 1 The limiting device should be regarded as a safety feature and not as a routine operational means of stopping. Where normal operation of the crane necessitates frequent approach to the upward limit, an additional motion limiting device should be provided that operates independently and requires manual resetting.

Where required by the purchaser (see item 22 of Appendix A), a device shall be provided to stop the downward motion when a predetermined level is reached.

NOTE 2 Such a device should be fitted if the operator cannot see the load in its lower position.

21.2 Cross traverse and long travel limiting devices. Limiting devices, when fitted (see item 22 of Appendix A) shall:

a) prevent over-traversing and overtravelling;

b) prevent collision where two or more units (e.g. cranes or crabs) operate on the same track.

NOTE 1 Limiting devices may also be required to prevent collision of cranes on overlapping tracks, or to separate two or more cranes on the same track so as not to overload the gantry.

NOTE 2 The limiting devices should be regarded as a safety feature and not as a routine operational means of stopping. Where normal operation of the crane necessitates frequent approach to the travel limits, additional motion limiting devices should be provided that operate independently.

22 Load indication and limiting devices

Load indication and limiting devices, when fitted, (see item 22 of Appendix A) shall sense the load on the crane by means other than the current consumed by the hoist motor.

NOTE Such devices are recommended if weights of objects to be lifted are not known accurately.

23 Gearboxes

23.1 Lubrication. Gearboxes shall be designed so that the gears which they enclose will be automatically lubricated at all operating speeds. The boxes shall prevent escape or contamination of the lubricant and breathing shall be provided.

Where oil replacement is necessary, facilities for filling, drainage and means of indicating clearly the correct level shall be provided.

23.2 Change-gear levers. Manually operated change-gear levers shall be positively locked in position on hoist gearboxes. Provision shall be made to prevent the block overhauling whilst changing gear.

23.3 Inspection covers. If inspection covers are fitted to the gearbox, they shall be of quick release type that do not require the use of a tool for their removal so that the gear teeth can be inspected and lubricated by hand methods (see **26.2**).

24 Lubrication of bearings

Provision shall be made for the service lubrication of all bearings unless sealed or lubricated for life. Ball and roller bearings shall, in addition, be suitably lubricated before assembly. Lubricating nipples shall comply with BS 1486-1 or BS 1486-2. All nipples on a crane shall be of the same type and size.

25 Keys, keyways, splines and serrations

25.1 Keys and keyways. Keys and keyways shall comply with BS 4235.

25.2 Splines and serrations. Splines and serrations shall be of straight-sided or involute form. Straight-sided splines and serrations shall comply with BS 2059 and involute splines shall comply with BS 3550.

26 Guarding

26.1 General. Guard design shall comply with BS 5304.

NOTE 1 Where reasonably practicable, all potentially dangerous parts of the crane should be guarded.
NOTE 2 Where practicable, guard design should permit inspection of critical parts of crane mechanisms without the removing of guards or covers and without the need to dismantle components of the crane.
NOTE 3 See Appendix G for statutory requirements.

26.2 Inspection covers. Where an inspection cover is provided, the possibility of access to dangerous parts when the cover is removed shall be prevented (e.g. by a wire mesh screen) unless the cover is secured by fasteners that require the use of a tool to open the cover.

26.3 Gear wheels, pinions and chain drives. All gear wheels, pinions and chain drives shall be completely encased unless such parts are so situated in relation to the structure of the crane as to be as safe as if complete encasement were provided.

26.4 Revolving shafts and couplings. Guards shall be provided for revolving shafts and couplings unless they have no protruding sets screws, bolts or keys and are so situated in relation to the structure of the crane as to be as safe as if guards were provided.

NOTE Where a long travel drive shaft is considered to be safe by virtue of its position, loose sleeves on the shaft are recommended.

26.5 Hook blocks. Hook blocks shall be fitted with guards to prevent the possibility of trapping between a sheave and an in-running rope.

Section 4. Electrical

27 General

The electrical installation of the crane shall start at the long travel collectors or other means of power pick-up, and this shall be the point to which data on the incoming supply shall be referred.

NOTE 1 Attention is drawn to the IEE Wiring Regulations for Electrical Installations which form the basis for the design of the overall electrical installation of the crane. Terminology from these regulations has been used throughout the electrical clauses in this standard.
NOTE 2 Attention is drawn to the legal requirements of the Electricity (Factories Act) Special Regulations 1908 and 1944.
NOTE 3 Attention is drawn to the recommendations given in BS 5304.
NOTE 4 The electrical clauses do not apply to d.c. power supplies.

28 Power supply

The crane shall be designed to operate on the power supply specified by the purchaser (see item 12 of Appendix A).

29 Earthing

The crane structure shall be connected to earth. The motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be bonded to earth or the crane structure by a protective conductor.

The crane wheels shall not be used as the means of earthing.

NOTE Attention is drawn to **26.2.2** of BS 5744:1979 which gives recommendations for earthing and bonding of the crane track. Attention is also drawn to the requirements for earthing electrical equipment given in **31.2** and **31.6.2**.

30 Power distribution

30.1 Isolation. A means shall be provided on the crane for isolating the crane from the power supply close to the collectors or other means of power pick-up. This shall take the form of isolating devices fed in parallel:

a) for the motion drives;

b) for the auxiliary circuits;

c) for the lifting magnet if fitted.

The isolating devices shall comply with BS 5419. Provision shall be made for locking each of these isolating devices in the off position.

The isolating device for motion drives shall be capable of interrupting the stall current of the largest electric motor fitted to the crane.

30.2 Short circuit protection. Short circuit protection shall be provided at each of the isolator positions specified in items a) to c) of **30.1**.

30.3 Power switching in the driver's cabin. If power cables are brought into the driver's cabin, an additional switch isolator shall be provided in the cabin capable of cutting off the supply to the motion drives.

30.4 Main contactor. A main contactor capable of cutting off the power supply to the motion drives shall be provided. This contactor shall be operated from the control position by reset/stop device(s).

30.5 Emergency stop device. An emergency stop device shall be provided at each control facility to de-energize the main contactor for the motion drives (see BS 5304).

NOTE The stop device specified in **30.4** may be regarded as fulfilling this requirement provided it complies with the recommendations of BS 5304.

31 Control equipment

31.1 Control supply. Control circuits shall be supplied at a nominal voltage not exceeding 115 V.

NOTE 1 It is, however, recommended that the control circuit voltage should be as low as practicable.

NOTE 2 If specified by the purchaser, means may be provided to re-instate the supply to the control circuits for testing purposes after the isolating device for the motion drives has been opened. In this case it should not be possible to re-close the isolating device to the motion drives whilst the control circuit supply is energized for testing.

31.2 Control circuit earthing. One end of the secondary winding of a control circuit transformer shall be earthed via a bolted link.

In the case of d.c. control circuits one pole of the rectifier shall be earthed via a bolted link.

One end of the coil of all relays and contactors shall be connected to the earth side of the control circuit supply and this connection shall not be interrupted by any fuse or contact.

31.3 Contactors. Contactors shall comply with BS 5424-1. Reversing contactors shall be interlocked so that only one directional contactor can be in the closed position.

31.4 Control circuit transformers

31.4.1 *General.* Control circuit transformers shall comply with BS 3535. An earthed screen shall be provided between the primary and secondary winding. The transformer frame shall be earthed.

31.4.2 *Fusing.* The primary winding of the control circuit transformer shall be protected by a fuse in each line connection. The unearthed pole of the secondary winding shall also be fused.

31.5 Control devices

31.5.1 *General.* If power is lost for any reason, it shall not be possible to restart the drive on restoration of the supply unless the control device has first been returned to the "off" position.

NOTE 1 Consideration should be given to the need for control devices to be of a type which, when released, cuts off the electrical supply to the motor systems.
NOTE 2 Control devices should be arranged to allow the driver, when in his normal operating position, ample room for their operation and, as far as is practicable, an unrestricted view of the load.
NOTE 3 Control devices that are at a fixed position relative to the crane should, when practicable, move in the directions of the motions that they control.

31.5.2 *Selection of control facilities.* Cranes having alternative control facilities shall be provided with means to prevent operation from more than one facility at any one time.

31.5.3 *Push buttons.* Push button control devices, with the exception of emergency stop buttons, shall be shrouded.

31.5.4 *Markings at the controls.* On or adjacent to each control device there shall be a durable marking identifying the motion controlled, and the direction of movement.

31.5.5 *Markings on the crane.* When the control devices are other than in a fixed position relative to the crane, the designation of horizontal directions marked on the control device shall be marked on the crane so that it is clearly visible to the driver.

31.6 Pendant controls

31.6.1 *General.* Cranes with pendant controls shall not have long travel speeds in excess of 63 m/min.

31.6.2 *Earthing.* If the pendant control enclosure is of metal, it shall be earthed. The earth shall not depend on chains or hooks for continuity.

31.6.3 *Support and construction.* The weight of the pendant control shall be supported independently of its electrical conductors.

NOTE The pendant control should be constructed so that it is capable of withstanding rough handling.

31.7 Non-conductive controls. Equipment that operates the crane by radio, induction or other non-conductive means shall include the following.

a) A key switch or equivalent security device on the transmitter that can be used to prevent unauthorized use of the transmitter.

b) The sending of a continuous or continuously repeating secure signal when the transmitter is in use, which the crane receiver can identify.

NOTE 1 A signal is regarded as secure when it includes at least three characteristics separately recognizable by the receiver.

c) Automatic shutdown of crane operation if the secure signal is not identified by the receiver during a period of 2 s.

d) An emergency stop device. The system used for c) shall only be used for emergency stop where it introduces no additional inbuilt time delay.

e) A carrying harness, belt, shoulder strap or lanyard, on the transmitter.

NOTE 2 It is recommended that a device is fitted to the crane to give warning that the crane is under non-conductive control.
NOTE 3 Consideration should be given to the need, for safety reasons, to incorporate a limited range feature so that the crane will stop when the extent of that range is reached. The range should be capable of being preset by means not available to the operator.
NOTE 4 The transmitter should be constructed so that it is capable of withstanding rough handling.

32 Resistor rating

Resistors shall be rated such that the temperature rise does not exceed the limits specified in BS 587. The ratings shall be 5 min for groups M3 to M5, 10 min for group M6 and not less than 10 min for groups M7 to M8, according to service conditions.

33 Motors for crane motion drives

33.1 General. Motors shall comply with BS 5000-99 and with **33.2** and **33.3**. Motors shall be capable of withstanding a maximum speed of not less than 2.5 times rated speed or 2 000 r/min, whichever is the lesser.

33.2 Service conditions and rating. Motors shall be suitable for the normal service conditions and any special service conditions advised by the purchaser in accordance with clause **5**. The rating of each motor shall be selected such that the limits of temperature rise do not exceed those given in BS 4999-32 for the class of insulation employed.

A duty type rating shall be determined for each motor with reference to BS 4999-30 by:

a) determining a duty cycle based on information provided by the purchaser (see item 10 a) of Appendix A); or

b) an assessment based on the cyclic duration factor and the starting class in accordance with Table 1.

NOTE Method a) is the preferred method of determination.

33.3 Torque. The pull-out torque of hoisting motors supplied at rated voltage and frequency shall be not less than 2.25 times the rated torque for slip ring motors and not less than two times the rated torque for squirrel cage motors.

34 Enclosures

34.1 Protection. Enclosures shall be provided for all electrical equipment. The minimum degree of protection for enclosures shall be IP44 of BS 5490 with the exception of motors which shall have a minimum degree of protection of IP23 and resistors which shall have a minimum degree of protection of IP21.

Table 1 — Duty type factors

Mechanism group	Cyclic duration factor[a]	Starting class (C)[b] (equivalent starts per hour)
	%	
M3 to M4	25	150
M5	25 to 40	150 to 300
M6	40	300
M7	60	300
M8	60	300 to 600

[a] The values given are based on the following formula: cyclic duration factor $= \frac{\text{operating time} \times 100}{\text{operating time} + \text{idle time}}$

applicable for durations not exceeding 10 min.
Where the use is outside these parameters, special consideration should be given to heat dissipation.

[b] The starting class (C) assumes numbers of complete starts, jogging operations and electrical braking operations as follows:

$$C = S + K_1 J + K_2 B$$

where

S	is the number of complete starts;
J	is the number of jogging operations;
B	is the number of electrical braking operations;
K_1	is 0.1 for slip ring motors or 0.5 for squirrel cage motors;
K_2	is 0.8 for slip ring motors or 3.0 for squirrel cage motors.

34.2 Access. Means of access to enclosures containing exposed equipment operating at nominal voltages exceeding 115 V shall:

a) be interlocked with their isolator operator devices; the incoming terminals of all supplies shall be screened to prevent accidental contact; or

b) require the use of a tool to open them; or

c) require the use of a key to open them, in which case a warning notice complying with **A.2.8** of BS 5378-1:1980 shall be attached.

35 Brakes

35.1 Magnet and thrustor motor ratings. As a minimum the ratings of brake magnets and thrustor motors shall be compatible with the associated drive motor ratings as given in **33.2**.

35.2 Brake magnet operating voltage. The brake shall lift off when the voltage at the coils is a minimum of 85 % of rated voltage.

35.3 Connection of hoisting motion magnetic brake coils. In the arrangement of connections to the hoisting motion brake coils means shall be provided to ensure that when the associated drive motors are de-energized, the stored electrical energy in their motors will be diverted away from the brake coils (e.g. into an energy dump) so as not to delay the application of the brake.

36 Power supplies for auxiliary equipment

36.1 General. Where required by the purchaser, provision shall be made for the power supplies given in **36.2** to **36.5**.

36.2 Permanent lighting, heating and auxiliary circuits. Permanent lighting, heating and auxiliary circuits shall operate at a nominal voltage not exceeding 250 V. Each circuit shall be controlled by a double pole switch.

36.3 Portable lighting. Hand lamps shall be operated at not more than 25 V. The supply shall be taken via a fuse from one end of the secondary winding of a transformer, the other end of the secondary winding being earthed.

36.4 Portable tools. Socket outlets for portable electric tools shall operate at a nominal voltage of not more than 110 V. The supply shall be taken from the secondary winding of a transformer, the centre tap of which shall be earthed. Both ends of the secondary winding shall be fused.

36.5 Socket outlets. Socket outlets shall comply with BS 196 or BS 4343 and interchangeability between socket outlets and plugs of different voltages shall be prevented by positive means.

37 Heaters

When provided, electric heaters shall be fixed and totally enclosed to prevent contact with live electrical parts.

38 Radio interference

If necessary, provision shall be made to prevent equipment causing radio interference. This provision shall be in accordance with BS 800 and BS 833.

39 Cables and conductors

39.1 Protection of cables. Cables shall be enclosed, positioned or constructed to protect them from mechanical damage:

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

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

c) by being of armoured construction.

Trunking shall comply with BS 4678-1. If cables are drawn into a steel tube, the tube shall be heavy gauge welded or solid drawn in accordance with class B of BS 31 or BS 4568.

39.2 Conductors. Conductors shall be stranded or flexible. Single strand cables shall not be used.

39.3 Minimum size. Conductors for power wiring to electric motors shall have a sectional area not less than 1.5 mm^2. For control circuits and auxiliary wiring, cables shall have a section area of not less than 1.0 mm^2.

39.4 Cable rating. The current carried by the cables in circuits related to mechanism group M8 shall be not greater than the appropriate values given in the Institution of Electrical Engineers (IEE) Wiring Regulations with respect to ambient temperature, type of excess current protection and volt drop.

NOTE Cables in circuits related to mechanism groups below M8 may be uprated in accordance with Table 2, in which case the voltage drop should be considered in accordance with the IEE Wiring Regulations.

39.5 Power pick-up conductors. Power pick-up conductors shall be protected to prevent persons, including maintenance and inspection personnel, making accidental contact with the conductors.

NOTE Shrouding that prevents such accidental contact is recommended as the minimum requirement for the protection of long travel conductors.

Table 2 — Uprating of cables for mechanism groups

Mechanism group	Stator circuit	Rotor circuit
	IEE rating multiply by:	IEE rating multiply by:
M3	1.7	2.0
M4	1.7	2.0
M5	1.7	2.0
M6	1.4	1.5
M7	1.4	1.5
M8	1.0	1.0

Section 5. Protection and painting

40 Protection and painting of metalwork

Protection of metal work up to and including a primary coat shall be in accordance with BS 5493 as a minimum requirement.

NOTE Where cranes are supplied for use in abnormal working conditions, e.g. high humidity, low temperature, corrosive atmosphere, special protection may be necessary.

41 Surface condition of structural members

41.1 Structural members. Materials used in the manufacture of structural members shall be free of scale and surface corrosion.

41.2 Protection of bolted (or riveted) joints. Where surfaces are permanently joined together during assembly or erection, they shall be treated up to the primary stage (see clause **40**) before being brought together.

Where joints are fastened with friction grip bolts, the surfaces shall be untreated before assembly unless due allowance has been made in the design.

42 Protection of machinery

Machinery other than bright or otherwise protected parts shall be treated up to the priming stage (see clause **40**).

Unplated bright parts shall be protected with an anti-corrosion treatment.

Areas that are inaccessible after assembly or erection shall be treated before assembly or erection.

Section 6. Testing, marking and certification

43 Testing at manufacturer's works

All electrical and mechanical equipment shall be tested in accordance with the appropriate British Standard at the crane or equipment manufacturer's works.

44 Testing after final assembly and before putting into service

44.1 General. Tests shall be carried out after final assembly and before putting the crane into service in accordance with **44.2** to **44.7**.

NOTE The provision of test weights at the purchaser's premises, unless otherwise agreed, should be the responsibility of the purchaser.

44.2 Insulation tests. After completion of erection and before connection of the power supply, the insulation of the electrical systems shall be tested. The voltage used shall be a d.c. voltage of not less than twice the rated voltage of the system concerned and all phases shall be checked for each crane motion or system.

The insulation resistance of the systems tested shall be not less than 0.5 MΩ. If necessary, it shall be permissible to disconnect individual items of equipment to prevent damage while making this test.

If a reading less than 0.5 MΩ is obtained, the systems under test shall be subdivided. Each subdivision shall then show a reading of not less than 0.5 MΩ.

44.3 Earth continuity. Earth continuity of the equipment shall be checked to ensure that at no point is this greater than 0.5 Ω.

44.4 Functional tests. After the supply has been connected, tests shall be carried out to ensure the correct operation of controls, switches, contactors, relays and other devices.

The function and correct adjustment of brakes and limit switches shall be checked and tests carried out to ensure that primary safety and emergency systems are operating correctly.

The correct operation of each motion of the crane throughout its range of operation shall be checked.

44.5 Overload tests

44.5.1 *General.* The crane shall be tested such that each lifting unit, each crab and the crane as a whole are subjected to 125 % of their safe working load(s).

During the test(s) the crane motions shall be tested as follows.

a) *Lifting units.* The lifting unit drum(s) shall be rotated through one revolution such that all gear teeth are tested under overload conditions.

b) *Crabs.* The crab(s) shall be traversed from one end of the bridge to the other.

c) *Long travel.* The crane shall be moved sufficiently to ensure that each gear tooth of the long travel motion is subjected to the overload condition. This test shall be repeated with the crab(s) at each end of their traverse.

NOTE Full motion speeds need not be attained during overload tests.

44.5.2 *Acceptance criteria.* The tests shall be considered successful if no crack, permanent deformation, paint flaking or damage that affects the function and safety of the crane is visible and no connection has loosened or been damaged.

44.6 Deflection test. A test shall be carried out to verify that the vertical deflection of the crane bridge does not exceed that specified in clause **7**.

44.7 Performance tests. Performance tests shall be carried out on each motion of the crane with the safe working load suspended to ensure that they are capable of meeting the specified speeds of operation within a tolerance of plus or minus 10 % at the designed supply voltage and frequency. During these tests the correct functioning of the mechanism(s) and brake(s) shall be verified.

During these tests the crane shall be operated in accordance with the manufacturer's instructions.

45 Marking

45.1 Marking of safe working load (SWL). The crane bridge structure shall bear a permanent inscription on each side, readily legible from ground level, stating the safe working load(s) of the crane in tonnes (or in kilograms if it is less than 1 t).

Where more than one lifting unit is fitted, the safe working load of each lifting unit shall be shown on the crane bridge inscriptions.

Where safe working load is related to the speed of the lifting unit, this shall be indicated.

45.2 Crane identification. The crane shall be prominently and permanently marked with the following information:

a) the manufacturer's name or trademark;

b) the manufacturer's serial number;

c) the year of manufacture;

d) the crane classification with state of loading and class of utilization;

e) the classification of each mechanism with state of loading and class of utilization;

f) a note stating:

"Any repairs or replacement components must be in accordance with the manufacturer's recommendations".

46 Technical information

The manufacturer shall provide the following technical information prior to commissioning of the crane:

a) general arrangement drawings showing all leading dimensions and installation details;

b) circuit wiring diagrams;

c) operating and maintenance instructions.

47 Test certificates

Test certificates in accordance with relevant statutory requirements shall be supplied to the purchaser.

Appendix A Information to be supplied with enquiry or order

The purchaser shall supply the following information with the enquiry or order.

1. Name . . . . . .

2. Address . . . . . .

3. Telephone . . . . . 4. Contact . . . . . .

5. Crane to be installed in . . . . . (town) . . . . . (country)

6. Quantity . . . . . .

7. Capacity (see **B.1**): main . . . . . (tonnes)
   aux. . . . . (tonnes)

8. Span, centre to centre of gantry rail(s) . . . . . mm

9. Type . . . . . .

10. Classification of the appliance and its mechanisms.

(a) Where detailed information is available of the operations that the appliance is expected to perform and of the individual loads to be carried at each stage of the operations, it should be provided as follows.

Utilization: Main hoist: av. lift . . . . . m No. of lifts/h . . . . . .
Aux. hoist: av. lift . . . . . m No. of lifts/h . . . . . .
Traverse: av. movement . . . . . m No. of moves/h . . . . . .
Travel: av. movement . . . . . m No. of moves/h . . . . . .
Crane operating hours per day . . . . . .
or per month . . . . . .

Loads: Actual load if known . . . . . .
or % of lifts with approximate full load . . . . . } including lifting attachment
% of lifts with approximate 75 % load . . . . . } including lifting attachment
% of lifts with approximate 50 % load . . . . . } including lifting attachment
% of lifts with approximate 25 % load . . . . . } including lifting attachment
Weight of lifting attachment . . . . . .

Intended design life: . . . . . years

(b) Where insufficient information is available of the operations that the appliance is expected to perform, the purchaser should request the manufacturer to recommend the most suitable crane for the anticipated duty.

11. Location: Indoor/outdoor/both . . . . . .

12. Power supply at the crane long travel collectors
   V . . . . . (nominal) Phase . . . . . Hz . . . . . .
   Conductors . . . . . Is there a neutral? . . . . . .
   If so, is it earthed? . . . . . .

13. Vertical movement of hook required (see **B.2**): above floor (H_1) . . . . . mm
   below floor (H_2) . . . . . mm

14. Nature of load . . . . . .

15. Type of hook or lifting device . . . . . .

16. Controls: whether control is from (a) cabin or (b) by pendants or (c) by non-conductive controls.

If (a): Position: on crab . . . . . .
or on bridge . . . . . .
or at end or mid span . . . . . .
Type: open . . . . . .
glazed . . . . . .
Special features . . . . . .
. . . . . .

If (b): From fixed point on bridge . . . . . .
From crab . . . . . .
Mobile on separate track . . . . . .
Any special control requirements . . . . . .
. . . . . .

If (c): Is limited range feature required? . . . . . .
Is a warning device required on crane? . . . . . .

17. General state of atmosphere or climate. . . . . .

18. Average ambient temperature . . . . . °C
Maximum temperature . . . . . °C
Minimum temperature . . . . . °C

19. Special service conditions

Specify any special service conditions that apply typically.

(a) Handling molten metal.
(b) Use in hazardous gases, vapours, solids or volatile liquids.
(c) Use in mines and/or quarries.
(d) Certain processes, such as galvanizing, pickling and hot dipping.
(e) Use in saline atmospheres when the degree of exposure should be stated.
(f) The presence of any local heat sources, such as furnaces or radiant space heating panels.
(g) The need for special precautions against termites.
(h) Any physical obstructions not apparent from the dimensions provided for clearances.
(i) In the case of pedestrian controlled cranes, any differences in the operating floor level.
(j) Any variation in electrical supply greater than ± 6 % on the nominal voltage.
(k) Any particular requirements concerning headroom above servicing platforms and if the crane servicing platforms are to be used for other activities. The need, if any, for fine mesh screens to prevent the dropping of articles from the servicing areas.
(l) Wind loading.
(m) Any other conditions.

20. Gantry: existing or new. . . . . .

21. Are long travel conductors to be included? Yes/No Length . . . . . m
Preferred type or make . . . . . .
Are existing conductors to be used? Yes/No Type . . . . . .

NOTE. Information regarding the type of conductors is necessary to enable the crane manufacturer to provide suitable pick-up shoes.

22. Load and motion limiting devices and load indicating devices
State requirements . . . . . .
. . . . . .

23. Are platforms required on bridge? . . . . . .

Position of access point(s) . . . . . .

Requirements for emergency escape . . . . . .

24. Speeds of operation: (see B.3)	**Full speed** m/min	**Other speeds** (if required) m/min
Main hoist	. . . . .	. . . . .
Aux. hoist	. . . . .	. . . . .
Traverse	. . . . .	. . . . .
Travel	. . . . .	. . . . .

25. Is any special painting or protective finish required? . . . . . .

. . . . . .

26. Any special requirements, statutory or technical? . . . . . .

. . . . . .

. . . . . .

27. Are there any other cranes on gantry or in the vicinity? Yes/No

If so, advise whether

(a) special devices are required to prevent collision of the cranes or their loads;

(b) there is any provision to be made for cranes to be separated by a minimum distance in order not to overstress the gantry structure;

28. Dimensions (see figure 3):

Crane no. or ref. . . . . Bay or Dept . . . . . .

Dimensions stated looking (N, S, E, W) . . . . . .

S (span) . . . . . mm (actual/nominal)

A_1	. . . . . mm	A_2	. . . . . mm
N_1	. . . . . mm	N_2	. . . . . mm
D_1	. . . . . mm	D_2	. . . . . mm
H_1	. . . . . mm	H_2	. . . . . mm
L_1	. . . . . mm	L_2	. . . . . mm
M_1	. . . . . mm	M_2	. . . . . mm
E_1	. . . . . mm	E_2	. . . . . mm
T_1	. . . . . mm	T_2	. . . . . mm
P_1	. . . . . mm	P_2	. . . . . mm
C	. . . . . mm		
W	. . . . . mm	X	. . . . . mm
Y	. . . . . mm	Z	. . . . . mm

29. Portable lighting and tools

Advise whether provision is to be made for:

(a) portable lighting;

(b) portable tools.

30. Advise whether cabin heating is required.

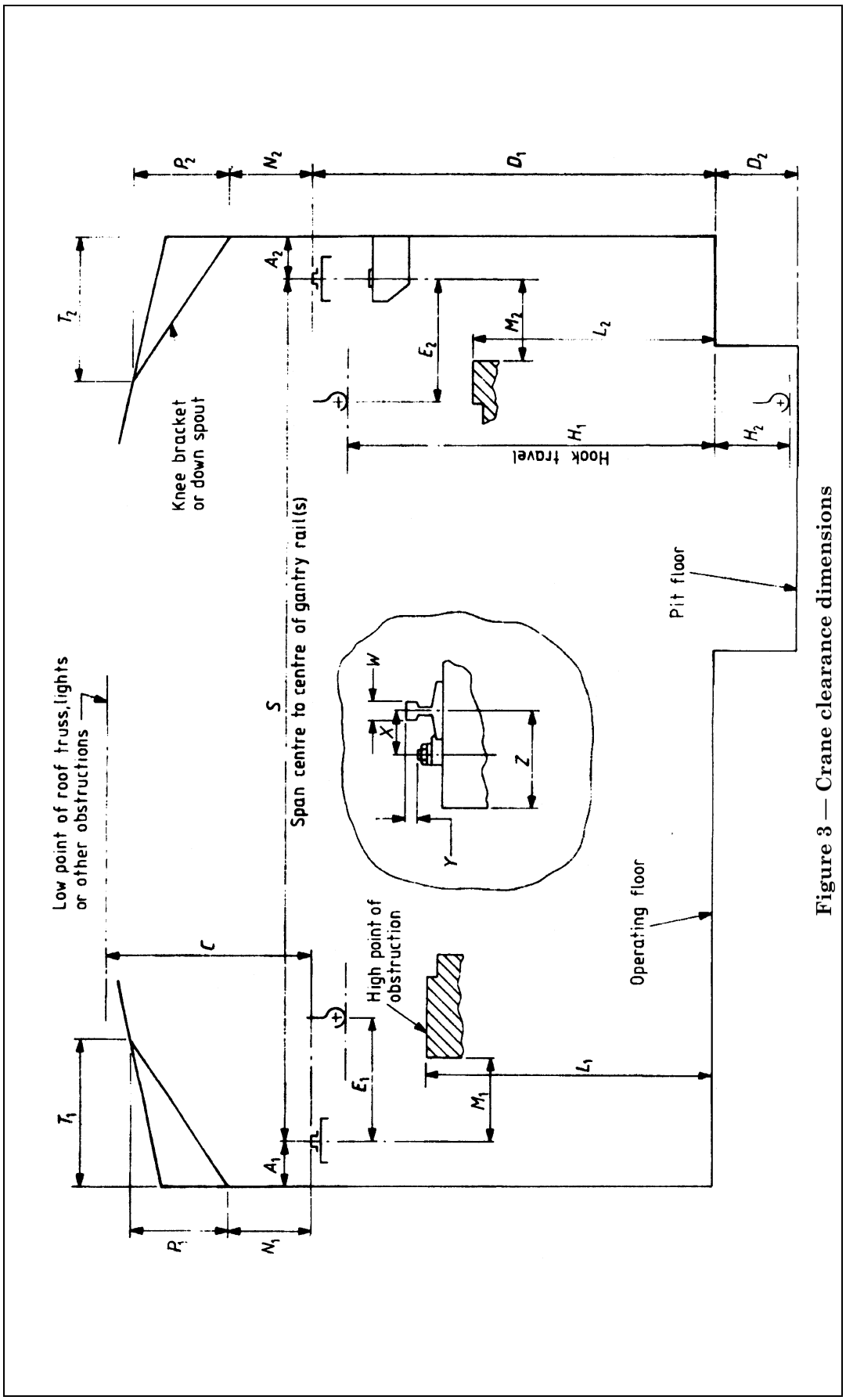


Figure 3 — Crane clearance dimensions

Appendix B Crane performance

B.1 General. To aid economic manufacture it is recommended that the crane parameters given in **B.2** to **B.4** be selected from a progression based upon the preferred number series given in BS 2045.

B.2 Preferred lifting capacities. (R10 up to and including 125 t and R20 above.) The preferred lifting capacities (in tonnes) are as follows.

1.0	3.2	10	32	100	225	400
1.25	4.0	12.5	40	125	250	450
1.6	5.0	16	50	140	280	500
2.0	6.3	20	63	160	320	560
2.5	8.0	25	80	200	360	etc.

B.3 Preferred lifting heights. (R5 up to and including 16 m, R10 above this figure.) The preferred lifting heights (in metres) are as follows.

2.5	10	25	50
4.0	16	32	63
6.3	20	40	etc.

B.4 Preferred speeds of operation (full speeds). (R5 and R10 respectively.) The preferred speeds of operation (in metres per minute) are as follows.

0.63	1.6	4.0	10	25	63	160
0.8	2.0	5.0	12.5	32	80	200
1.0	2.5	6.3	16	40	100	
1.25	3.2	8.0	20	50	125	

Typical speeds relative to mechanism classifications are shown in Table 3.

Table 3 — Typical full speeds relative to mechanism classification

Safe working load (t)	Motion	Typical full speeds (m/min)					
		Mechanism classification					
		M3	M4	M5	M6	M7	M8
	Long travel	16 to 80		32 to 125		50 to 200	
	Traverse	10 to 32		20 to 50		32 to 80	
Up to and including 5	Hoist	2.5 to 12.5		10 to 25		16 to 40	
5 to 10		2 to 10.0		8.0 to 16		12.5 to 25	
10 to 16		2.0 to 8.0		6.3 to 12.5		10 to 20	
16 to 32		2.0 to 6.3		5.0 to 10		8.0 to 16	
32 to 63		2.0 to 5.0		4.0 to 8.0		6.3 to 12.5	
63 to 100		1.6 to 4		3.2 to 6.3		5.0 to 10	
125 to 160		1.25 to 2.5		2.0 to 4.0		3.2 to 6.3	
160 plus		1 to 2		1.6 to 3.2		2.5 to 5	

NOTE Long travel speeds in excess of 63 m/min are not permitted for pendant controlled cranes (see **31.6**).

Apendix C Information to be supplied by manufacturer

The following information shall be supplied by the manufacturer.

1. Enquiry ref. no . . . . . 2. Tender ref. . . . . .

3. Quantity . . . . . 4. Safe working load . . . . . .

5. Span . . . . . 6. Type . . . . . .

7. For use . . . . . .

8. Appliance classification. . . . . .

Group classification of lifting unit. . . . . .

Group classification of traverse mechanism . . . . . .

Group classification travel mechanism . . . . . .

		m/min	Details of motor kW (each)	No.	r/min	Type
Main hoisting speed:	full	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
	other	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
Aux. hoisting speed:	full	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
	other	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
Traverse speed:	full	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
	other	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
Travelling speed:	full	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
	other	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .

9. Power supply for which crane is to be supplied . . . . . .

10. Type of speed control of various motions . . . . . .

. . . . . .

11. Crane clearance diagram including the dimensions given in figure 3, also details of any restrictions in platform and walkway widths and headroom (see **16.4** and appendix H).

12. Type of main girder . . . . . .

13. Crane control . . . . . .

14. Control position . . . . . .

15. Maintenance platform(s) on the crane . . . . . .

16. Cross traverse electrical supply system . . . . . .

17. Long travel electrical supply system. . . . . .

18. Limiting devices: (a) motion . . . . . .

(b) load . . . . . .

19. Electrical equipment protection systems. . . . . .

20. Crab/trolley gross weight . . . . . .

21. Crane gross weight (including lifting unit) . . . . . .

22. Wheel loads and spacing: driven . . . . . excluding impact

trailing . . . . . excluding impact

23. Recommended gantry rail section . . . . . .

24. Information for design of gantry end stops . . . . . .
25. Operator's cabin access point . . . . . .
26. Emergency escape devices . . . . . .
27. Additional safety features . . . . . .
28. Other information not scheduled above . . . . . .
. . . . . .

Appendix D Classification of cranes and crane mechanisms

D.1 Classification of the crane as a whole

D.1.1 *General.* To provide a rational and uniform basis for certain aspects of the design of the crane structure, a group classification for the crane as a whole in the range of A1 to A8 (see Table 6) shall be established in accordance with **D.1.2** to **D.1.4**.

NOTE The group classification of the crane as a whole provides a framework of reference between purchaser and manufacturer for contractual and technical purposes by means of which a crane may be matched to the service for which it is required. It also enables a fatigue analysis of the design to be based on the specified life and conditions of service.

Cranes shall be classified into groups according to:

a) the class of utilization, as determined from the required number of operating cycles for the crane, in accordance with **D.1.2**;

b) the state of loading, as determined from the conditions of loading to which the crane will be subjected, in accordance with **D.1.3**.

D.1.2 ***Class of utilization***

D.1.2.1 *General.* The class of utilization of the crane shall be determined from its assumed total number of all operating cycles during its intended life. For the purposes of classification, an operating cycle shall be considered to commence when a load is picked up and end at the moment when the crane is ready to pick up the next load.

D.1.2.2 *Determining the class of utilization*

D.1.2.2.1 Where sufficient information is available, the number of operating cycles shall be calculated from a knowledge of the duties that the crane will be expected to perform, e.g. for a crane performing part of a continuous, repetitive process, the number can readily be derived from the number of operating cycles per hour and the total number of working hours during the intended life.

The class of utilization of the crane shall then be selected from Table 4 according to the tabulated number of operating cycles that is nearest to, but not less than, the number calculated by the procedure previously outlined.

D.1.2.2.2 Where insufficient information is available for calculating the total number of operating cycles, as may be the case when the crane is used for a variety of duties, a suitable value, estimated on the basis of experience, shall be used. Where there is difficulty in assigning a suitable value, the next highest figure in Table 4 shall be taken.

NOTE Typical classes of utilization normally associated with particular types of crane and crane applications are given in Table 7 to Table 10.

Table 4 — Class of utilization for the crane as a whole

NOTE The number of cycles used in selection the class of. utilization is a figure used only for classification purposes and as a design parameter. It does not imply a guaranteed life.

Class of utilization	Max. number of operating cycles	Remarks
U1	3.2×10^4	Infrequent use
U2	6.3×10^4	
U3	1.25×10^5	
U4	2.5×10^5	Fairly frequent use
U5	5×10^5	Frequent use
U6	1×10^6	Very frequent use
U7	2×10^6	Continuous or near continuous use
U8	4×10^6	
U9	Greater than 4×10^6	

D.1.3 ***State of loading and nominal load spectrum factor***

D.1.3.1 *General.* The state of loading of the crane and the corresponding nominal load spectrum factor shall characterize the extent to which the crane lifts the maximum permitted load for the configuration, or smaller loads.

NOTE 1 They depend both on the magnitudes of the lifted loads relative to the maximum permitted load, and on the number of cycles in which each is lifted relative to the total number of cycles.

Assessment of the state of loading shall be based on the same cycles as are used in **D.1.2.2** to determine the class of utilization. Also, the weight of the lifted load shall include the weight of any lifting attachment, such as bucket, grab, magnet or lifting beam, whether permanently fitted or detachable, and the weights of other suspended components, such as the bottom block, hook and hoist rope that are lifted together with the load. The maximum permitted load is thus the specified safe working load plus the weights of any such lifted components or attachments that are not included in the specified safe working load.

NOTE 2 Typical states of loading normally associated with particular types of crane and crane applications are given in Table 7 to Table 10.

D.1.3.2 *Determining the load spectrum factor*

D.1.3.2.1 Where details are available of the magnitudes of the loads and the number of times each will be lifted during the intended life of the crane, the load spectrum factor, K_P', shall be calculated as follows:

Let:

P_i be the magnitudes of the individual lifted loads characteristic of the duty of the crane (i.e. P_1, P_2, P_3, ... ,P_n);

P_{max} be the maximum permitted load (see **D.1.3.1**);

C_i be the estimated number of cycles which occur at the individual load level P_i (i.e. C_1, C_2, C_3, ... ,C_n);

C_t be the total number of all the individual cycles at all load levels

$$= \sum C_i = (C_1 + C_2 + C_3 + \ldots + C_n)$$

Then:

$$K'_p = \sqrt[m]{\left[\sum \left\{\frac{C_i}{C_t}\left(\frac{P_i}{P_{max}}\right)^m\right\}\right]}$$

For the purpose of classification of the crane as a whole, $m = 3$.

Expanded, the above equation becomes:

$$K'_p = \sqrt[3]{\left\{\frac{C_1}{C_t}\left(\frac{P_1}{P_{max}}\right)^3 + \frac{C_2}{C_t}\left(\frac{P_2}{P_{max}}\right)^3 + \right.}$$
$$\left. + \frac{C_3}{C_t}\left(\frac{P_3}{P_{max}}\right)^3 + \ldots + \frac{C_n}{C_t}\left(\frac{P_n}{P_{max}}\right)^3\right\}$$

The state of loading shall be selected from Table 5 according to the tabulated value of nominal load spectrum factor K_p that is the nearest to, but not less than, the calculated value of K'_p.

D.1.3.2.2 Where details of the numbers and weights of the lifted loads during the intended life of the crane are not known, the descriptive definitions in Table 5 shall be used to assist the selection of an appropriate state of loading and corresponding nominal load spectrum factor. Where there is doubt in the selection of appropriate values, the next highest figure in Table 5 shall be used.

Table 5 — State of loading for the crane as a whole

State of loading	Nominal load spectrum factor, K_p	Descriptive definition
Q1 Light	0.5	Cranes that hoist the safe working load very rarely and, normally, light loads
Q2 Moderate	0.63	Cranes that hoist the safe working load fairly frequently and, normally, moderate loads
Q3 Heavy	0.8	Cranes that hoist the safe working load frequently and, normally, heavy loads
Q4 Very heavy	1.0	Cranes that are normally loaded close to safe working load

D.1.4 *Determination of group classification of the crane.* The group classification of the crane shall be determined from Table 6 using the class of utilization and state of loading obtained in accordance with **D.1.2** and **D.1.3**.

No change in the group classification of a crane, or in its combination of state of loading and class of utilization within the same group classification, shall be made without reference to the manufacturer or having a thorough design check carried out by a competent person.

Table 6 — Group classification for the crane as a whole

State of loading	Nominal load spectrum factor K_p	Class of utilization and maximum number of operating cycles of the crane								
		U1	U2	U3	U4	U5	U6	U7	U8	U9
		3.2×10^4	6.3×10^4	1.25×10^5	2.5×10^5	5×10^5	1×10^6	2×10^6	4×10^6	$> 4 \times 10^6$
Q1 Light	0.5	A1	A1	A2	A3	A4	A5	A6	A7	A8
Q2 Moderate	0.63	A1	A2	A3	A4	A5	A6	A7	A8	A8
Q3 Heavy	0.8	A2	A3	A4	A5	A6	A7	A8	A8	A8
Q4 Very heavy	1.0	A3	A4	A5	A6	A7	A8	A8	A8	A8

NOTE The group classifications resulting from the classes of utilization and the states of loading normally associated with particular types of crane and crane applications are given in Table 7 to Table 10.
The lists of crane types and applications are not comprehensive. Full account should be taken of any particular requirements when determining the appropriate group classifications.

Table 7 — Typical classification for overhead travelling industrial type cranes (O.T.C.)

Type and/or applications	Class of utilization	State of loading	Group classification
Power stations	U2 to U4	Q1	A1 to A3
Light work shop duty (maintenance, repairs, assembly, etc.)	U2 to U4	Q1 to Q2	A1 to A4
Light stores duty	U2 to U4	Q1 to Q2	A2 to A4
Medium and heavy duty (workshop, warehouse and general hook service)	U4 to U6	Q1 to Q3	A4 to A6
Crane for grabbing work	U5 to U8	Q4	A7 to A8
Ladle crane for foundry work	U4 to U5	Q3 to Q4	A6 to A7
Magnet crane for stockyard work	U5 to U6	Q2 to Q3	A6 to A7
Magnet crane for scrapyard work	U5 to U6	Q3 to Q4	A6 to A8
Process crane	U6 to U7	Q2 to Q3	A6 to A8
Shipyard crane	U5 to U6	Q2 to Q3	A5 to A7

Table 8 — Typical classification for overhead travelling steelworks cranes

Type and/or application	Class of utilization	State of loading	Group classification
Ladle crane	U5 to U7	Q4	A7 to A8
Pig/scrap breaking crane	U6 to U8	Q4	A8
Ingot stripper Soaking pit mould handling crane Vertical ingot charger	U6 to U8	Q4	A8
Furnace charging crane	U6 to U8	Q4	A8
Forging crane	U6 to U9	Q3 to Q4	A7 to A8
Process crane: on line	U6 to U8	Q3 to Q4	A7 to A8
Process crane: off line	U5 to U6	Q2 to Q3	A5 to A7
Heavy mill service crane	U6 to U8	Q2 to Q3	A6 to A8
Service and maintenance crane	U4 to U5	Q1 to Q2	A3 to A5

Table 9 — Typical classification for transporters

Type and/or application	Class of utilization	State of loading	Group classification
Medium duty: general use	U5 to U6	Q2 to Q3	A5 to A6
Heavy duty: intermittent grabbing and magnet work	U6 to U7	Q3 to Q4	A7 to A8
Extra heavy duty: continuous grabbing and magnet work	U8 to U9	Q3 to Q4	A8

Table 10 — Typical classification for freight container cranes

Type and/or application	Class of utilization	State of loading	Group classification
Freight container transporter	U5 to U7	Q2	A5 to A7
Goliath or bridge crane for container handling duty	U4 to U7	Q2	A4 to A7

D.2 Classification of mechanisms

D.2.1 *General.* Mechanisms shall be classified into groups according to their desired service life and the conditions of loading to which they are subjected.

NOTE The purposes of such classification is to provide a rational and uniform basis for the design of mechanisms and their components that takes account of these considerations. It also provides a framework of reference between the purchaser and the manufacturer.

The two factors considered in determining the group to which a mechanism belongs shall be its class of utilization and its state of loading.

D.2.2 *Class of utilization.*The class of utilization for a mechanism shall be determined from its assumed service life in hours. This is the total number of hours for which the mechanism will be in motion. Where the appliance of which the mechanism is part has known duties, such as would be the case where it performed part of a continuous, repetitive process, the service life shall be calculated from the actual daily utilization time for the mechanism, the number of working days per year and the number of years of expected service. In the absence of such information regarding the duty of the appliance, an assumed daily utilization time shall be used.

The class of utilization shall be selected according to the value of service life given in Table 11 that is nearest to, but not less than, the assumed service life determined by the procedure previously outlined.

Table 11 — Classes of utilization for mechanisms

Class of utilization	Service life	Remarks
	h	
T1	400	Irregular use
T2	800	
T3	1 600	
T4	3 200	Regular light use
T5	6 300	Regular intermittent use
T6	12 000	Regular intensive use
T7	25 000	Continuous intensive use
T8	50 000	
T9	50 000	
NOTE Typical classes of utilization of mechanisms normally associated with particular types of crane and crane applications are given in Table 14 to Table 17.		

D.2.3 ***State of loading***

D.2.3.1 The state of loading characterizes the extent to which a mechanism is subjected to its maximum loading and to smaller loadings.

D.2.3.2 Where details are available of the loading that the mechanism will experience, the nominal load spectrum factor, K_m, and corresponding state of loading shall be determined as follows.

Let:

P_i be the individual load magnitudes (loading levels) characteristic of the duty of the mechanism (i.e. P_1, P_2, P_3, ..., P_n);

P_{max} be the maximum loading applied to the mechanism;

t_i be the individual durations of use of a mechanism at the individual loading levels P_1, P_2, P_3, etc., (that is t_1, t_2, t_3, ..., t_n);

T be the total duration of use at all loading levels = (t_1+ t_2 + t_3 +..., t_n);

then the spectrum factor, K'_m, is given by the formula

$$K'_m = \sqrt[3]{\left\{\frac{t_1}{T}\left(\frac{P_1}{P_{max}}\right)^3 + \frac{t_2}{T}\left(\frac{P_2}{P_{max}}\right)^3 \ldots + \frac{t_n}{T}\left(\frac{P_n}{P_{max}}\right)^3\right\}}$$

The nominal load spectrum factor and the corresponding state of loading are obtained from Table 12 by selecting the value of K_m that is nearest to, but not less than, the calculated value of, K'_m.

D.2.3.3 When details of the loading to which the mechanism will be subjected are not known, an appropriate nominal state of loading shall be selected and the descriptive remarks in Table 12 used to assist in such cases.

NOTE Typical states of loading of mechanisms normally associated with particular types of cranes and crane applications are given in Table 14 to Table 17.

D.2.4 *Determination of group classification.* When the class of utilization and the state of loading have been determined in accordance with **D.2.2** and **D.2.3**, the group classification of a mechanism shall be determined from Table 13.

No change in the group classification of a mechanism, or in its combination of state of loading and class of utilization within the same group classification shall be made without reference to the manufacturer or having a thorough design check carried out by a competent person.

Table 12 — States of loading for mechanisms

States of loading	Nominal load spectrum factor, K_m	Remarks
L1 Light	0.50	Mechanisms subjected very rarely to their maximum load and, normally, to very light loads
L2 Moderate	0.63	Mechanisms occasionally subjected to their maximum load, but, normally, to rather light loads
L3 Heavy	0.80	Mechanisms frequently subjected to their maximum load and, normally, to loads of medium magnitude
L4 Very heavy	1.00	Mechanisms regularly subjected to their maximum loads

Table 13 — Group classification for mechanisms

State of loading	Classes of utilization								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
L1	M3	M3	M3	M3	M4	M5	M6	M7	M8
L2	M3	M3	M3	M4	M5	M6	M7	M8	M8
L3	M3	M3	M4	M5	M6	M7	M8	M8	M8
L4	M3	M4	M5	M6	M7	M8	M8	M8	M8

NOTE The mechanism classifications resulting from the classes of utilization and the states of loading normally associated with particular types of crane and crane applications are given in Table 14 to Table 17.
The lists of crane types and applications are not comprehensive.
Full account should be taken of any particular requirements when determining the appropriate mechanism classifications.

Table 14 — Typical classification for overhead travelling industrial type crane (O.T.C) mechanisms

Type of crane	Motion	Mechanism classification		
		Class of utilization	State of loading	Group of mechanism
Power stations	Hoist and aux. hoist	T3	L1 to L2	M3
	Cross traverse	T3	L1 to L2	M3
	Long travel	T3	L2	M3
Light workshop duty (maintenance, repairs, assembly, etc.)	Hoist and aux. hoist	T3	L1 to L2	M3
	Cross traverse	T3	L1 to L2	M3
	Long travel	T3	L2	M3
Light stores duty	Hoist and aux. hoist	T3	L1 to L2	M3
	Cross traverse	T3	L1 to L2	M3
	Long travel	T3	L2 to L3	M4
Medium and heavy duty (workshop, warehouse and general hook service)	Hoist and aux. hoist	T4 to T5	L1 to L2	M3 to M5
	Cross traverse	T4 to T5	L1 to L2	M3 to M5
	Long travel	T4	L2 to L3	M4 to M5
Crane for grabbing work	Hoist	T5 to T7	L3	M6 to M8
	Closing motion	T5 to T7	L3	M6 to M8
	Cross traverse	T5 to T7	L3	M6 to M8
	Long travel	T5 to T6	L3	M6 to M7
Ladle crane for foundry work	Hoist	T5 to T6	L2 to L3	M5 to M7
	Cross traverse	T5 to T6	L2 to L3	M5 to M7
	Long travel	T5	L3	M6
Magnet crane for stockyard work	Hoist	T5 to T6	L3	M6 to M7
	Cross traverse	T5 to T6	L3	M6 to M7
	Long travel	T5	L3	M6
Magnet crane for scrapyard work	Hoist and aux. hoist	T5 to T6	L3	M6 to M7
	Cross traverse	T5 to T6	L3	M6 to M7
	Long travel	T5	L3	M6
Process crane	Hoist	T6 to T7	L2 to L3	M6 to M8
	Cross traverse	T5	L3	M6
	Long travel	T6	L3	M7
Shipyard crane	Hoist	T5 to T6	L3	M6 to M7
	Cross traverse	T5 to T6	L3	M6 to M7
	Long travel	T5 to T6	L3	M6 to M7

Table 15 — Typical classification for overhead travelling steelworks crane mechanisms

Type of crane	Motion	Mechanism classification		
		Class of utilization	State of loading	Group of mechanism
Ladle crane	Hoist and aux. hoist	T6 to T7	L4	M8
	Cross traverse	T5 to T6	L4	M7 to M8
	Aux. traverse	T5 to T6	L3	M6 to M7
	Long travel	T6 to T7	L4	M8
Pig/scrap breaking crane	Hoist	T5 to T6	L4	M7 to M8
	Cross traverse	T5 to T6	L4	M7 to M8
	Long travel	T5	L3	M6
Ingot stripper	Hoist	T7 to T8	L3	M8
Soaking pit mould handling crane	Aux. hoist	T5 to T6	L2	M5 to M6
Vertical ingot charger	Cross traverse	T6 to T8	L4	M8
	Long travel	T6 to T7	L4	M8
	Slewing	T6 to T7	L3	M7 to M8
	Closing tong motion	T6 to T7	L4	M8
Furnace charging crane	Hoist and aux. hoist	T7 to T8	L3	M8
	Cross traverse	T7 to T8	L3	M8
	Aux. traverse	T5 to T6	L2	M5 to M6
	Long travel	T7 to T8	L3	M8
Forging crane	Hoist	T6 to T8	L3	M7 to M8
	Cross traverse	T5 to T6	L3	M6 to M7
	Long travel	T6 to T8	L3	M7 to M8
Process crane: on line	Hoist	T7	L3	M8
	Cross traverse	T5	L3	M6
	Long travel	T6	L3	M7
Process crane: off line	Hoist	T6 to T7	L2	M6 to M7
	Cross traverse	T5	L2	M5
	Long travel	T6	L2	M6
Heavy mill service crane	Hoist	T5 to T6	L2	M5 to M6
	Aux. hoist	T4	L2	M4
	Cross traverse	T5	L2	M5
	Long travel	T5 to T6	L2	M5 to M6
Service and maintenance crane	Hoist and aux. hoist	T4 to T5	L1 to L2	M3 to M5
	Cross traverse	T4 to T5	L1 to L2	M3 to M5
	Long travel	T4	L2 to L3	M4 to M5

Table 16 — Typical classification for transporter mechanisms

Type of crane	Motion	Mechanism classification		
		Class of utilization	State of loading	Group of mechanism
Medium duty: general use	Hoist	T5	L2 to L3	M5 to M6
	Cross traverse	T5	L2 to L3	M5 to M6
	Long travel	T5	L2 to L3	M5 to M6
	Boom hoist	T4	L1	M3
Heavy duty: intermittent grabbing and magnet work	Hoist (hold and close)	T6 to T7	L3 to L4	M7 to M8
	Cross traverse	T6 to T7	L3 to L4	M7 to M8
	Long travel	T6	L2 to L3	M6 to M7
	Boom hoist	T4	L1	M3
Extra heavy duty continuous grabbingand magnet work	Hoist (hold and close)	T8 to T9	L4	M8
	Cross traverse	T7 to T8	L4	M8
	Long travel	T7	L3	M8
	Boom hoist	T4	L1	M3

Table 17 — Typical classification for freight container crane mechanisms

Type of crane	Motion	Mechanism classification		
		Class of utilization	State of loading	Group of mechanism
Freight container transporter	Hoist	T5 to T7	L2 to L3	M5 to M8
	Traverse	T5 to T7	L2 to L3	M5 to M8
	Travel	T5 to T7	L2 to L3	M5 to M8
	Boom hoist	T2	L3	M3
Goliath or bridge crane for container handling duty	Hoist	T5 to T7	L2 to L3	M5 to M8
	Traverse	T5 to T7	L2 to L3	M5 to M8
	Travel	T5 to T7	L2 to L3	M5 to M8

Appendix E Noise

E.1 General. Noise emitted from a crane that is likely to be injurious to hearing should be reduced to the lowest level reasonably practicable. Noise emitted from a crane should not cause unreasonable annoyance to persons working in or resident in the vicinity of the crane.

E.2 Crane construction and operation. Cranes should be constructed and operated, so far as is reasonably practicable, in accordance with the relevant recommendations contained in HSE's "Code of practice for reducing the exposure of employed persons to noise"[1)]. In addition, crane designers should take into account the recommendations contained in HSE's Technical Data Note No. 12 entitled "Notes for the guidance of designers on the reduction of machinery noise"[2)]. Crane manufacturers should ascertain the levels and doses of noise produced by their cranes; HSE's Guidance Note EH14 entitled "Level of training for technicians making noise surveys"[1)] may be of assistance.

[1)] Obtainable from Her Majesty's Stationery Office, Atlantic House, Holborn Viaduct, EC1P 1BN.

[2)] Obtainable from the Health and Safety Executive.

Appendix F Crane gantries

F.1 Track joints, wheel running and guidance surfaces

Any misalignment of running faces or gaps occurring between sections of track will have an adverse effect on the performance and life of the crane.

Joint arrangement should ensure accuracy in the alignment of running faces or guidance faces to provide a smooth transition path for the wheel between sections of track.

Track running and guidance faces should be free of obstruction and should be left unpainted. These faces should also be free from damage and pitting or other surface defects.

F.2 Dimensional and geometrical tolerances of tracks for top running and underslung cranes

F.2.1 *General.* Tracks should be within the tolerances given in **F.2.2** to **F.2.5** when not supporting the crane.

NOTE The tolerances shown for underslung cranes apply to single span only, i.e. running on one pair of tracks. Multiple span cranes running on three or more tracks require special consideration, and tolerances and levels for them should be subject to negotiation between crane manufacturer and supplier of the tracks. For example, on multiple span cranes it may be beneficial to install inner tracks at different levels from outer tracks, to allow for deflection of the supporting structure from which the tracks are suspended.

F.2.2 *Tolerance on span.*The tolerance on span should be as follows (see Figure 4):

$\Delta S \leq 3$ mm where $S \leqslant 15$ m

$\Delta S \leq 3 + 0.25\ (S - 15)$ mm where $S > 15$ m

ΔS max. = 15 mm

F.2.3 *Misalignment of track running surfaces in the vertical plane.* The tolerance on track misalignment should be as follows (see Figure 4):

$\Delta H \leq 0.001\ S$

ΔH max. = 10 mm

F.2.4 *Tolerance on track width (underslung only).* The tolerance on track width (underslung only) should be as follows (see Figure 4):

$\Delta W = 0.025\ W$

F.2.5 ***Track straightness tolerances***

F.2.5.1 *Permissible deviation in the lateral plane.* For the total length of track, the maximum lateral deviation from the straight line mean datum should not exceed 10 mm (see Figure 5).

The straight line mean datum is the line about which deviations of track on each side will be equal, when sum-mated over the whole length of track.

Local lateral deviation at any point of the track should not be greater than $L/2\ 000$, measured over a length of not less than 2 m on a line parallel to the straight line mean datum.

F.2.5.2 *Permissible deviation in the vertical plane.* For the total length of the track, the maximum vertical deviation from the theoretical datum line should not exceed 10 mm (see Figure 6). The theoretical datum line may be the true horizontal line or a theoretical camber line.

Local vertical deviation at any point of the track should not be greater than $L/2\ 000$, measured over a length of not less than 2 m on a line parallel to the theoretical datum.

F.2.6 *Running surface permissible traverse inclination from the horizontal datum position.* The maximum permissible traverse inclination from the horizontal datum position should be as shown in Figure 7.

F.3 Measurement of crane tracks. When measuring crane tracks, calibrated steel measuring tapes should be used. It is important that the readings obtained are corrected to allow for sag in the tape and for temperature variation. All track measurements for a particular crane should be made with the same measuring tape and the same applied tension force.

Appendix G United Kingdom and EEC legislation relating to power driven overhead travelling cranes

G.1 United Kingdom

G.1.1 *General.* In addition to the general requirements of the Health and Safety at Work etc. Act 1974, the following legislation, applicable at the date of publication of this standard, applies to cranes covered by this standard, dependent upon the circumstances of use.

The Factories Act 1961

The Electricity (Factories Act) Special Regulations 1908 and 1944

The Construction (General Provisions) Regulations 1961

The Construction (Lifting Operations) Regulations 1961

The Construction (Working Places) Regulations 1966

The Docks Regulations 1934

The Mines and Quarries Act 1954 and General Regulations made thereunder

The Shipbuilding and Ship-repairing Regulations 1960

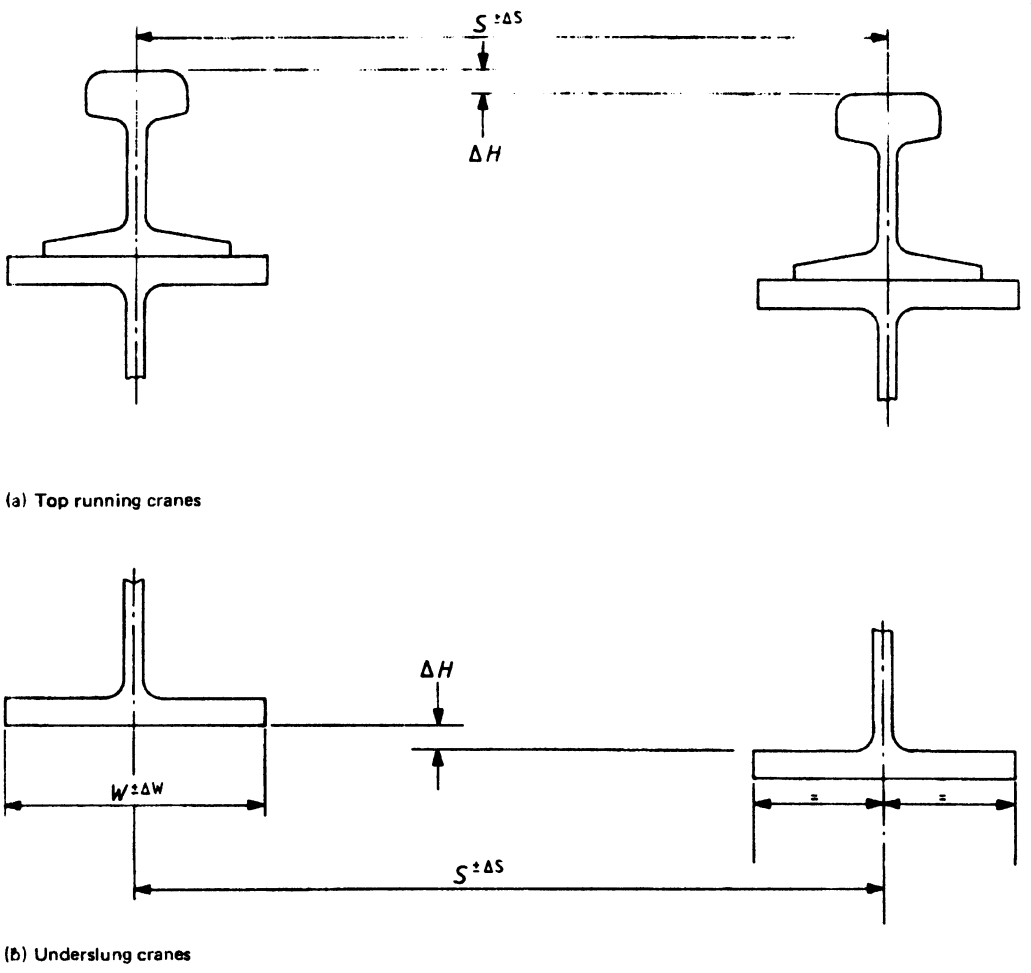


Figure 4 — Tolerances on crane tracks

Orders have been made in pursuance of the above acts and regulations covering prescribed particulars, registers, reports and certificates. Corresponding acts and regulations apply in Northern Ireland.

G.1.2 *Supplier*. The following legislation is of particular relevance for the supplier of a crane.

Section 6 of The Health and Safety at Work etc. Act 1974

Section 17 of The Factories Act 1961

The supplier should also take into consideration the responsibilities of the crane user.

G.1.3 *User*. The following legislation is of particular relevance for the user of a crane.

Section 2 of The Health and Safety at Work etc. Act 1974

Sections 12 to 16 and 26 to 29 of The Factories Act 1961 (or corresponding legislation for users of cranes other than in factories).

The Electricity (Factories Act) Special Regulations 1908 and 1944

NOTE Use of the crane includes maintenance, inspection and examination of the crane.

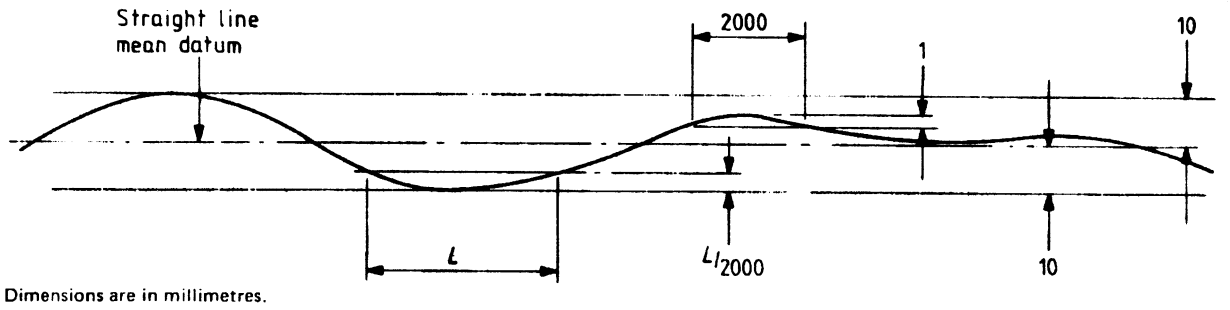


Figure 5 — Permissible deviation of track straightness in lateral (horizontal) plane

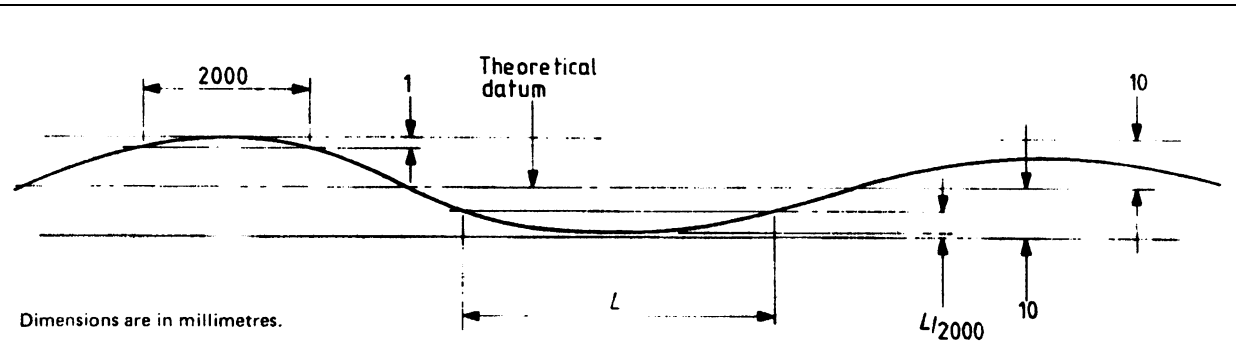


Figure 6 — Permissible deviation of track straightness in vertical plane

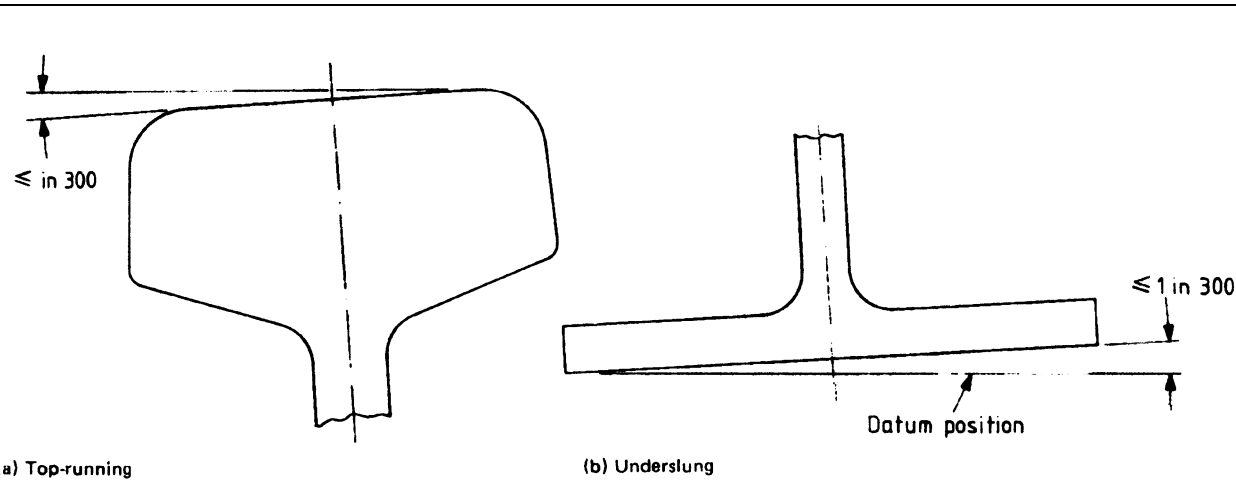


Figure 7 — Permissible transverse inclination of tracks

G.1.4 *References.* Further information is available from the following references.

Health and Safety Series Booklet HS (R) 6 "A guide to the HSW Act".

Guidance Note GS 8 from the Health and Safety Commission "Articles and substances for use at work".

Health and Safety Executive Booklet SHW 928 "Memorandum on the Electricity Regulations".

Health and Safety Executive Publications Catalogue (available from Her Majesty's Stationery Office).

G.2 EEC requirements. No EEC Council Directive on the approximation of the laws of the Member States relating to requirements for electric overhead travelling cranes has been adopted or indeed proposed at the time of publication of this standard.

A Council Directive on the harmonization of the laws of Member States relating to electrical equipment, designed for use within certain voltage limits (73/23/EEC) was adopted on 19 February 1973 commonly referred to as the "Low Voltage Directive". This Directive requires, inter alia, that the Members States shall take all appropriate measures to ensure that electrical equipment may be placed on the market only if, having been constructed in accordance with good engineering practice in safety matters in force in the Community, it does not endanger the safety of persons, domestic animals or property when properly installed and maintained and used in applications for which it was made.

Appendix H Head room clearances, platform and walkway widths

It is recommended that headroom clearances, platform and walkway widths should comply with the following.

a) Platforms and walkways should have a clear headroom of 2.0 m.

b) The vertical distance from the top of any guard rail on the bridge of the crane to the lowest roof member or other obstruction under which the crane passes should be not less than 630 mm.

c) The vertical clearance between the top of any part of the crane and the lowest roof member or other obstruction under which the crane passes should be not less than 75 mm for floor operated cranes of up to 10 t safe working load and with no platforms or walkways on the bridge, and not less than 150 mm for other cranes.

d) Platforms should be at least 600 mm wide and walkways at least 430 mm wide.

e) Platforms and walkways where live conductors are exposed during maintenance and testing should be at least 920 mm wide.

f) Where an electrical switchboard is installed inside a crane bridge, access should be provided from both ends of the switchboard.

Where these requirements cannot be achieved due to restrictions of space or obstructions, the manufacturer should agree alternative requirements with the purchaser.

Appendix J List of British Standards for materials and equipment suitable for use in the manufacture of cranes

Crane detail	BS No.	Title
1. Permissible stresses	2573[a]	Rules for the design of cranes
		Part 1 Specification for classification, stress calculations and design criteria for structures
		Part 2 Specification for classification stress calculations and design criteria for mechanisms
2. Materials		
Castings, iron	2789	Iron castings with spheroidal or nodular graphite
grey	1452	Specification for grey iron castings
malleable blackheart	310	Blackheart malleable iron castings
malleable whiteheart	309	Whiteheart malleable iron castings
castings, steel	3100	Specification for steel castings for general engineering purposes
Castings, copper and alloys	1400	Copper alloy ingots and copper alloy castings
Steel, structural	4360	Specification for weldable structural steels
Rivet materials	4620	Rivets for general engineering purposes
Steel bars for machined parts, shafts and axles	970	Specification for wrought steels for mechanical and allied engineering purposes
Springs, coil and spiral	24	Railway rolling stock material
		Part 3B Helical and volute springs and spring steels
	5216	Patented cold drawn steel wire for mechanical springs
	1429	Specification for annealed steel wire for general engineering springs
3. Structural details, etc.		
Bolts and nuts	916	Black bolts, screws and nuts
	1083	Precision hexagon bolts, screws and nuts (BSW and BSF threads)
	1768	Unified precision hexagon bolts, scress and nuts (UNC and UNF threads).
		Normal series
	3139	High strength friction grip bolts for structural engineering
	3294	The use of high strength friction grip bolts in structural steelwork
	3410	Metal washers for engineering purposes
	3692	ISO metric precision hexagon bolts, screws and nuts
	4190	ISO metric black hexagon bolts, scress and nuts
	4395	High strength friction grip bolts and associated nuts and washers for structural engineering
	4604	The use of high strength friction grip bolts in structural steelwork.
		Metric series
Rivets (dimensions)	275	Dimensions of rivets (½ in to 1¾ in diameter)
	4620	Rivets for general engineering purposes
Tyres	3037	Tyres for crane rail wheels
Welding	5135	Metal-arc welding of carbon and carbon manganese steels
4. Machinery and machinery details		
Bearings, ball and roller	292	Rolling bearings; ball bearings, cylindrical and spherical roller bearings
	3134	Metric tapered roller bearings
Oil retaining	4480	Plain bearings, metric series
		Part 1 Sintered bronze bushes
Chains and chain wheels	228	Transmission precision roller chains and chainwheels

[a] Referred to in the text.

Crane detail	BS No.	Title
Gearing, spur	436	Spur and helical gears
		Part 1 Basic rack form, pitches and accuracy (diametral pitch series)
		Part 2 Basic rack form, modules and accuracy (1 to 50 metric module)
bevel	545	Specification for bevel gears (machine cut)
worm	721	Worm gearing
Keys and keyways	46	Keys and keyways and taper pins
		Part 1 Keys and keyways
	4235	Metric keys and keyways
		Part 1 Parallel and taper keys
Limits and fits	1916	Limits and fits for engineering
	4500	ISO limits and fits
Lubricating nipples	1486[a]	Lubricating nipples
		Part 1 Lubricating nipples and adaptors for use on machinery and vehicles
		Part 2 Heavy duty lubricating nipples
Screw threads	1580	Unified screw threads
	3643	ISO metric screw threads
Splines and serrations	2059[a]	Straight-sided splines and serrations
	3550[a]	Involute splines
Taper pins sold and split	46	Keys and keyways and taper pins
		Part 3 Solid and split taper pins
5. Electrical machinery and equipment		
Cables	6004	PVC-insulated cables (non-armoured) for electric power and lighting
	6007	Rubber-insulated cables for electric power and lighting
	6231	Specification for PVC-insulated cables for switchgear and controlgear wiring
	6346	PVC-insulated cables for electricity supply
	23	Copper and copper cadmium trolley and contact wire for electric traction
Circuit breakers	4752	Specification for switchgear and controlgear for voltages up to and including 1 000 V a.c. and 1 200 V d.c.
		Part 1 Circuit-breakers
Conduit	31[a]	Steel conduit and fittings for electrical wiring
Controllers and resistors	587[a]	Motor starters and controllers
Hand lamps	4533	Luminaires
		Section 2.3 Electric hand-lamps
Motors	5000[a]	Rotating electrical machines of particular types or for particular applications
		Part 99 Machines for miscellaneous applications
Transformers	3535[a]	Safety isolating transformers for industrial and domestic purposes
Contactors	5424[a]	Specification for controlgear for voltages up to and including 1 000 V a.c. and 1 200 V d.c.
		Part 1 Contactors
6. Lifting equipment		
Hooks	2903[a]	Specification for higher tensile steel hooks for chains, slings, blocks and general engineering purposes
Shackles	3032[a]	Higher tensile steel shackles
	3551[a]	Alloy steel shackles
Wire ropes	302[a]	Wire ropes for cranes, excavators and general engineering purposes
Wire rope fittings	461	Bordeaux connections

[a] Referred to in the text.

Crane detail	BS No.	Title
	462	Specification for wire rope grips
	463	Sockets for wire ropes
		Part 1 Inch units
		Part 2 Metric units
	464	Thimbles for wire ropes

7. Protection

Paint	2523	Lead-based priming paints
	3698	Calcium plumbate priming paint
	4652	Metallic zinc-rich priming paint (organic media)
Surface preparation	4232	Surface finish of blast-cleaned steel for painting
	CP 3012	Cleaning and preparation of metal surfaces

[a] Referred to in the text.

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Publications referred to

BS 31, *Steel conduit and fittings for electrical wiring.*

BS 196, *Protected-type non-reversible plugs, socket-outlets, cable-couplers and appliance couplers, with earthing contacts for single phase a.c. circuits up to 250 volts.*

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

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

BS 587, *Motor starters and controllers.*

BS 800, *Specification for radio interference limits and measurements for household appliances, portable tools and other electrical equipment causing similar types of interference.*

BS 833, *Radio interference limits and measurements for the electrical ignition systems of internal combustion engines.*

BS 1486, *Lubricating nipples.*

BS 2045, *Preferred numbers.*

BS 2059, *Straight-sided splines and serrations.*

BS 2573, *Rules for the design of cranes.*

BS 2573-1, *Specification for classification, stress calculations and design criteria for structures.*

BS 2573-2, *Specification for classification, stress calculations and design for mechanisms.*

BS 2853, *The design and testing of steel overhead runway beams.*

BS 2903, *Specification for higher tensile steel hooks for chains, slings, blocks and general engineering purposes.*

BS 3017, *Mild steel forged ramshorn hooks.*

BS 3032, *Higher tensile steel shackles.*

BS 3530, *Small wire ropes.*

BS 3535, *Safety isolating transformers for industrial and domestic purposes.*

BS 3550, *Involute splines.*

BS 3551, *Alloy steel shackles.*

BS 4211, *Steel ladders for permanent access.*

BS 4235, *Metric keys and keyways.*

BS 4343, *Industrial plugs, socket-outlets and couplers for a.c. and d.c. supplies.*

BS 4568, *Steel conduit and fittings with metric heads of ISO form for electrical installations.*

BS 4678, *Cable trunking.*

BS 4678-1, *Steel surface trunking.*

BS 4999, *General requirements for rotating electrical machines.*

BS 4999-30, *Duty and rating.*

BS 4999-32, *Limits of temperature rise and methods of temperature measurement.*

BS 5304, *Code of practice for safeguarding of machinery.*

BS 5345, *Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosive processing and manufacture).*

BS 5378, *Safety signs and colours.*

BS 5378-1, *Specification for colour and design.*

BS 5395, *Code of practice for stairs.*

BS 5419, *Specification for air-break switches, air-break disconnectors, air-break switch disconnectors and fuse combination units for voltages up to and including 1 000 V a.c. and 1 200 V d.c.*

BS 5424, *Specification for controlgear for voltages up to and including 1 000 V a.c. and 1 200 V d.c.*

BS 5490, *Specification for degrees of protection provided by enclosures.*

BS 5493, *Code of practice for protective coating of iron and steel structures against corrosion.*

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

DD 32, *Guide to the evaluation of human exposure to whole-body vibration.*

ISO 2408, *Steel wire ropes for general purposes — Characteristics.*

ISO 4301, *Lifting appliances — Classification.*

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