

Specification for

Power-driven mobile cranes

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- Associated Offices Technical Committee
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- British Constructural Steelwork Association Ltd.
- British Ports Association and the National Association of Ports Employers
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- Institution of Mechanical Engineers
- Institution of Production Engineers
- Institution of Structural Engineers
- Mechanical Handling Engineers' Association
- Ministry of Defence
- Welding Institute
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- Association of Lorry-Loader Manufacturers and Importers
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Foreword

This British Standard has been prepared under the direction of the Mechanical Handling Standards Committee. It supersedes BS 1757:1981 which is withdrawn.

This British Standard, originally published in 1951, was revised in 1964 and 1981. In view of the growing use of articulated jib cranes mounted on load carrying vehicles (lorry loaders), it is now updated to give wider coverage to such cranes. It is one of a series of standards relating to cranes and excavators.

As with all British Standards for cranes, the primary object of the specification is to ensure reliability and safety without placing restrictions on the general design of cranes or the methods employed in their construction.

Other standards in this series are:

BS 327, *Power-driven derrick cranes.*

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

BS 466, *Power-driven overhead travelling cranes, semi-goliath and goliath cranes for general use.*

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 of mechanisms.*

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

In updating the standard, due regard has been given to the work of ISO/TC 96 as far as the classification of the crane as a whole is concerned but it is still considered that the work in relation to the classification of mechanisms is not yet clear and the requirements for mechanisms of the 1981 edition of the standard have therefore been retained at this stage.

Attention is drawn to Appendix A to Appendix G. Appendix A enumerates the information that should be supplied with the enquiry or order to enable the crane maker to supply the most satisfactory crane for the purpose, while Appendix B sets out the particulars required by the user of the crane to enable him to obtain the most satisfactory service from it.

Appendix C gives a list of British Standards covering materials and equipment used in the manufacture of cranes and Appendix D sets out the statutory requirements that have to be taken into consideration in connection with cranes to be operated in the United Kingdom.

Appendix E covers the calculation of the stability of lorry loaders and Appendix F provides a typical form of test certificate covering testing of the crane.

Appendix G indicates the likely tipping line for typical crane configurations, when considering crane stability.

Attention is also drawn to CP 3010 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 vi, pages 1 to 48, 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 the design, construction and testing of power-driven mobile and semi-mobile cranes either road wheel mounted, tracked or of fixed base, including any combination of the following characteristics.

- a) Fully mobile.
- b) Semi-mobile.
- c) Portable.
- d) Fully slewing.
- e) Part-slewing.
- f) Non-slewing.

The standard covers articulated jib cranes mounted on load carrying vehicles and generally referred to as lorry loaders.

Typical mobile crane types and jib configuration including typical lorry loader features are shown in Figure 3 to Figure 9.

NOTE 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

anchorage

means of securing the base of an articulated jib crane to a vehicle chassis, or a steel wire rope to a drum or to the crane structure

2.2

articulation

the ability to pivot about a pin joint

2.3

articulated jib

a jib having two or more members capable of articulation

2.4

blocking-up base (blocked condition)

the effective dimensions of the supporting base when outriggers or other supporting means are used

2.5

coefficient of utilization

the ratio of the minimum breaking load of the rope to its working load limit

2.6

derricking or luffing

angular movement of the crane jib in a vertical plane

NOTE Cranes which lift their loads by derricking the jib while the load is suspended from a fixed hook on the jib should be described as lifting their loads by derricking only.

2.7

height of lift

the vertical distance between the floor level or datum level, and the lowest point of the throat of the hook when the hook is in the highest working position

2.8

hoisting

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

2.9

jib angle

jib angle is the angle subtended between the horizontal plane and a jib axis as defined by the manufacturer

2.10

jib length

the shortest distance between the centres of the fulcrum of the jib and the jib head pulley pin

2.11

minimum breaking load

the minimum breaking load value given in the appropriate standard or specification below which a sample of the rope will not fail when tested in the prescribed manner

2.12 mobile crane

2.12.1

fully mobile

cranes capable of travelling under their own power with loads up to the maximum for which they are designed, suspended at any point within the working range

2.12.2

semi-mobile

cranes which are not designed to travel with loads suspended

2.12.3

portable

cranes which are designed for easy transportation and erection but unable to travel under their own power. This will include cranes which have the means of transportation removed to leave them operating on a fixed base

2.12.4

lorry loader

a combination of a load carrying vehicle (or lorry) and an articulated jib crane that is used for the handling of goods on or off the vehicle

**2.13
outreach**

the horizontal distance from the centreline of the lifting hook to the nearest point of the machine other than the jib. (This dimension varies in accordance with the operating conditions of the machine)

NOTE For the purpose of this definition, outriggers are considered to be part of the machine.

**2.14
outrigger beam**

a supporting device that can be extended at the side of a mobile crane and is normally capable of being used to jack the crane into a level attitude

**2.15
positive overload prevention device**

a device that prevents the operator moving a load into an overload condition

**2.16
radius**

the horizontal distance measured at ground level between the centreline of the hook and a perpendicular projected through the centre of rotation

NOTE In the case of a non-slewing crane, the horizontal distance from the centreline of a lifting hook to the centreline of the nearest axle, bogie or track, measured at ground level, can be assumed to be the radius for the purpose of this definition.

**2.17
safe working load (SWL)**

the maximum load which can be safely handled by a crane at a specified position and under specified conditions. The safe working load includes the weight of the hook or load handling device unless otherwise specified

2.18 slewing

Rotary motion of a crane jib and super-structure about a vertical axis.

**2.18.1
fully-slewing**

the ability to slew continuously in either direction with a load, up to the maximum for which the crane is designed, suspended

**2.18.2
part-slewing**

the ability to slew but unable to comply with the definition of **2.18.1**

**2.19
stabilizer**

a load supporting leg usually extended outwards from the side of a crane or lorry loader to provide a more stable base. The leg can be extended to reach the ground either manually or hydraulically. It requires to be retracted, stowed and secured for transit

**2.20
tail radius**

the maximum distance between the centre of rotation and any part of the revolving superstructure other than the jib

**2.21
telescoping**

the extension or retraction of the jib along its longitudinal axis by movement of the sections contained within the jib

**2.22
tipping**

a crane is deemed to be in a condition of tipping when it is subjected to an overturning moment which cannot be increased, even by a small amount, without causing the crane to overturn

**2.23
stable**

a crane is said to be stable when the sum of the stabilizing moments is greater than the sum of the overturning moments

**2.24
working load limit**

the maximum load which an item of equipment is designed to raise, lower or suspend

3 Information to be supplied with the enquiry or order

All the necessary information regarding the conditions under which the crane is to be used, together with the information enumerated in Appendix A, should be supplied with the enquiry or order.

4 Information to be supplied by the manufacturer at the time of tender

The manufacturer shall supply with the tender the appropriate information enumerated in Appendix B regarding the construction of the crane.

5 Service conditions

The crane shall be deemed to be under service conditions when it is operating with or without load. The loading shall include the load imposed by wind pressure as specified in BS 2573-1 or as specified by the manufacturer (see 6.2).

6 Design of the crane

6.1 Design criteria

The design of the crane structure shall comply with BS 2573-1 with the exception of classification and wind speeds which shall comply with 6.2.

The design of the crane shall either be based on the crane being levelled to 1 in 100, or the manufacturer shall specify the limitations to which the crane shall be levelled in order to comply with the specified design parameters.

NOTE The mechanism classifications shown in BS 2573-2 should be used for general guidance only and it is essential to recognise that experience of crane mechanisms under known service conditions is the most valuable and reliable basis for design.

6.2 Classification and wind speeds

The group classification of the crane shall be in accordance with BS 2573-1 and Table 1.

Table 1 — Mobile crane group classification

Type and/or application	Group classification
Cranes for general hook duties, not used for continuous service	A1
Crane equipped with bucket, grapple or magnet	A3
Heavy duty, for example container handling or general dock service	A4
NOTE Normally in the United Kingdom mobile cranes are designed to a group classification of A1. If such cranes are derated to 80 % of the normal crane safe working load for grabbing and magnet duties, it may be assumed that they comply with a group classification of A3.	

The crane shall be designed for the wind speeds specified in BS 2573-1 or for lesser values. Where in-service wind speeds less than those given in BS 2573-1 are used in the stability calculation, the manufacturer shall specify the wind speeds used in the design and:

- the crane shall be fitted with an anemometer;
- the operating instructions for the crane shall state that the crane shall not be operated in wind speeds in excess of those specified and shall specify the conditions in which a crane should be left when out-of-service.

7 Identification

7.1 For the purpose of identification the crane shall bear the manufacturer's name and serial number.

7.2 A notice shall be attached to the crane drawing attention to the need to consult the manufacturer's handbook before repairs are undertaken.

8 Materials

8.1 All materials and equipment used shall comply with the requirements of the relevant British Standards as set out in Appendix C.

8.2 Timber shall not be used for any structural member of the crane. For this purpose blocks under stabilizing jacks or outriggers are not regarded as part of the crane structure.

8.3 Materials, equipment or fittings used for repairing purposes shall be as specified in the manufacturer's handbook.

9 Stability

9.1 Verification of stability

9.1.1 General. Calculations shall be made to verify that the crane is stable under the conditions specified in 9.1.2 and 9.1.3.

9.1.2 Operating in service conditions (with wind)

- applied load = $1.1p$
- wind load = w_1
- inertia forces = D

where

- p is the safe working load for the crane as defined in 2.17 at the appropriate radius;
- w_1 is the wind loading applied by in-service winds at speeds (see BS 2573-1 and 6.2);
- D are the inertia forces. For machines on which operating accelerations cannot be varied, the resulting inertia forces shall be taken into account.

9.1.3 Static stability (hook loading simulating dynamic conditions)

- Articulated jib cranes (e.g. excavators used as cranes and lorry loaders);
applied load = $1.4p$
- Cargo handling cranes;
on outriggers or crawler tracks, applied load = $1.33p$
for free on wheels, applied load = $1.5p$
- Other cranes including fully mobile;
applied load = $1.25p + 0.1F$

where F is the load from jib weight G and fly jib weight g referred to the head of the jib F_1 or that of the fly jib F_2 (see Figure 1).

This calculation does not include any allowance for the effect of wind during testing. The manufacturer shall make allowance for this so that the crane is capable of being tested in wind speeds of up to 8.3 m/s.

9.1.4 Static without load (backward stability)

9.1.4.1 General. Counter-weighting shall be limited by the weight distribution given in **9.1.4.2** and **9.1.4.3**, the appliance being in the following conditions:

- a) placed on a firm level supporting surface;
- b) equipped with the shortest specified jib set at the minimum radius specified by the manufacturer;
- c) with hook, hook block or other load handling equipment resting on the ground;
- d) equipped with the longest specified jib or jib and fly jib combination set at the maximum angle and with in-service wind acting from the least favourable position.

The specified weight distribution criteria shall be satisfied for each counterweight condition with the crane rotated to the least stable positions permitted by the manufacturer.

9.1.4.2 Crawler crane. The horizontal distance between the centre of gravity of the crane and the axis of rotation shall not exceed 70 % of the radial distance from the axis of rotation to the backward tipping line in the least stable direction.

9.1.4.3 Truck and wheel mounted cranes. With the longitudinal axis of the rotating superstructure of the crane at 90° to the longitudinal axis of the carrier, the total load on all wheels or stabilizers on the side of the carrier under the boom shall be not less than 15 % of the total weight of the crane.

With the longitudinal axis of the rotating superstructure of the crane in line with the longitudinal axis of the carrier in either direction, the total load on all wheels or stabilizers under the lighter loaded end of the carrier shall be not less than 15 % of the total weight of the crane.

9.1.5 Static without load in out-of-service conditions (as specified by the manufacturer). The effect of the overturning moment due to out-of-service wind shall be calculated from the appropriate wind loadings specified in BS 2573-1.

9.2 Additional requirements

9.2.1 The stability calculations shall be made with the crane in the least favourable position; moreover, all the loads, dead loads, counterweights, accessories, etc. that have an influence on the stability shall be taken into consideration as being in the least favourable condition as regards their value and their position.

9.2.2 The manufacturer shall stipulate the special precautions to be taken by the user when the crane is out-of-service and the working limits when subjected to wind.

NOTE Lines about which cranes on various mountings can tip and which are used to calculate the stabilizing moment are shown in Appendix G. These are indicative only and in practice are dependent on particular details of individual designs.

9.3 Grabbing or similar duties

For grabbing or magnet cranes the safe working load shall not exceed 80 % of the values calculated in **9.1**.

9.4 Travelling on gradients

In normal travelling order, all cranes shall be stable on or across maximum gradients specified by the manufacturer.

Section 2. Structural

10 Frame structures including jibs: equivalent inertia forces

With the exception of crawler cranes with a maximum safe working load of less than 30 t, for design purposes a side load of 2.5% of the safe working load shall be assumed to act at the jib head provided that the design of the slew gear is such that smooth varying rates of slewing acceleration and deceleration can be readily accomplished.

For crawler cranes with a maximum safe working load of less than 30 t and for cranes where smooth operation of the slew gear cannot be accomplished, a side load of 6 % of the safe working load shall be assumed as acting at the jib head.

11 Joints

11.1 Strength of joints

The calculated strength of riveted joints or joints made by friction grip bolts in structural members shall be not less than the calculated net strength of the member.

The calculated strength of other bolted joints in structural members shall be not less than the net strength of the member plus 25 %.

The calculated stress in rivets, bolts and welds shall not exceed the permissible stresses given in BS 2573-1.

11.2 Rivet and bolt holes (except those for friction grip bolts)

11.2.1 General. All rivet and bolt holes shall be drilled accurately and all arrises and burrs shall be removed before assembly.

Where bolts are used in shear, they shall be fitted into reamed holes. Black mild steel bolts shall not be used for joints in stress-bearing members.

11.2.2 Friction grip bolts. Friction grip bolts shall comply with the requirements of BS 4395-1 and shall be fitted in accordance with the recommendations of BS 4604-1.

11.2.3 Rivet spacing. The distance between the centres of rivets for stress-bearing parts shall be not less than 2.5 times the diameter of the rivet, and shall not exceed 16 times the thickness of the thinnest outside plate or angle. Where two lines of staggered riveting are used in the same angle or flange, the maximum distance between the rivets on each line can be taken as 1.5 times those given above.

The distance between centres of rivets and the sheared or hand flame cut edge of a plate shall be not less than 1.75 times the diameter of the rivet, and between the centre of the rivet and a rolled, machined, or machine flame cut edge, shall be not less than 1.5 times the diameter of the rivet.

11.3 Welding

All welding shall comply with the requirements of BS 2573-1.

Section 3. Mechanical

12 Steel wire ropes

12.1 General

12.1.1 The selection of steel wire ropes shall be as specified in BS 2573-2, where relevant, for mobile crane service and shall comply specifically with the requirements of the following clauses.

12.1.2 Where two or more ropes are used in a system, means shall be provided for ensuring that tensile forces in the ropes are distributed in the designed proportions. Arrangements entailing reverse bends shall be avoided as far as possible. A rope reeving diagram shall be provided.

12.1.3 Derricking ropes shall be of sufficient length to permit the jib to be raised from, or lowered to, the horizontal position during the erection or inspection of the crane.

12.2 Coefficient of utilization

12.2.1 The coefficient of utilization of the rope shall comply with the following requirements for service and erection conditions.

12.2.2 In determining the coefficient of utilization, allowance shall be made for friction losses at the pulleys, the safe working load of the crane (including lifting attachments such as slings, lifting beams, etc.) and the hook block, but excluding the weight of suspended rope. For grabbing or magnet cranes, the load shall be assumed to be the weight of the grab or magnet and its burden.

12.2.3 Under service conditions, the coefficient of utilization for running ropes and standing ropes that pass over pulleys shall be not less than 4.5 for cranes to group classification A1, and 5.5 for cranes to group classification A3 and A4. For straight standing ropes, the ratio shall be not less than 3.5 for cranes to group classification A1, and 4.0 for cranes to group classifications A3 and A4.

12.2.4 Under erection conditions, the coefficient of utilization for running ropes and standing ropes that pass over pulleys shall be not less than 3.75. For straight standing ropes, the coefficient of utilization shall be not less than 3.

NOTE For the purpose of calculating friction losses, the efficiency of pulleys is assumed to be 98 % when fitted with anti-friction bearings and 96 % when fitted with plain bearings.

12.3 Fly jib pendent ropes

Where ropes are used to support a fixed offset fly jib, the distances between the support point centres shall be specified by the manufacturer to enable the fly jib offset to be correctly set under working conditions.

12.4 Rope termination

The rope termination (i.e. the terminal fitting together with the means of its attachment to the rope) shall be capable of withstanding not less than 80 % of the minimum breaking load of the rope.

NOTE Recommended methods of attaching terminal fittings are given in appendices to each appropriate British Standard, e.g. Appendices A and B of BS 461:1970; Appendix A of BS 462:1983; Appendix B of BS 463-2:1970; Appendix A of BS 464:1958.

12.5 Rope anchorage to drum

Rope anchorages shall be protected by not less than two dead turns remaining on the drum when the rope is paid out to its maximum working length.

Rope anchorages shall be secure and readily accessible. If two or more ropes lead off a drum, provision shall be made for adjustment of the rope length at the anchorage end.

13 Drums and rope reeving components

13.1 General

13.1.1 Drums shall be either plain or grooved.

13.1.2 Means shall be provided to prevent the rope inadvertently leaving the drum. The drum flanges shall project a distance of not less than two rope diameters beyond the outer layer of rope in all circumstances.

NOTE A spur or other wheel secured to the drum can form one of the flanges provided it is adequately guarded.

13.1.3 The inclination of the rope at the point of a lead-off from the drum shall not exceed 1 in 12 each side of a centreline which represents the true lead-off.

13.1.4 If a rope leads off against the helix angle of the drum grooving, care shall be taken to prevent the rope rubbing against an adjacent turn. In extreme cases the clearance between turns can be increased in order to meet this requirement.

13.2 Drum diameters

The minimum winding diameter of a plain drum or of a grooved drum measured at the rope centres shall be not less than 15 times the rope diameter, irrespective of the rope construction.

13.3 Drum groove

13.3.1 Grooving shall be smooth and free from surface defects liable to damage the rope. The edges shall be rounded.

13.3.2 The contour at the bottom of the groove shall be circular over a minimum angle of 120°.

13.3.3 The radius of the groove shall exceed the radius of the ropes by not less than the value given in Table 2.

Table 2 — Minimum groove radii for rope drums and pulleys

Nominal diameter of rope (<i>d</i>)	Minimum amount by which groove radius shall exceed rope radius
mm	mm
Up to and including 16	0.8
Over 16 up to and including 26	1.2
Over 26 up to and including 28	1.6
Over 28	2.4

13.3.4 The grooves shall be so pitched that the clearance between adjacent turns of rope is not less than the dimension given in Table 3.

Table 3 — Minimum rope clearances for drum grooves

Nominal diameter of rope (<i>d</i>)	Minimum clearance between turns
mm	mm
Up to and including 13	1.6
Over 13 up to and including 28	2.4
Over 28	3.2

13.3.5 If compensating links are used on the free or returned ends of two parts of rope to equalize the load, the drum grooves shall be of identical diameters to ensure that the two parts of the rope wind equally, and the difference in the length of the ends of rope is maintained within the capacity of the compensating links throughout the full range of lift.

14 Lifting hooks

14.1 Lifting hooks shall comply with the requirements of BS 2903 or BS 3017, as applicable. Hooks complying with the requirements of BS 2903 shall be provided with an efficient device to prevent the displacement of the sling or the load from the hook.

14.2 Swivelling hooks shall be mounted on anti-friction bearings suitable for the purpose. If required, a locking device shall be fitted to prevent rotation of the hook.

15 Shackles

Shackles shall comply as regards strength and safety with the requirements of BS 3032 or BS 3551. Shackles used for attaching the hook shall be provided with screwed pins. Slotted heads in countersunk screwed pins are not recommended.

16 Overhauling weight

If an overhauling weight is used on the rope, it shall have a smooth hole and be bell-mouthed at the top and bottom to accommodate and prevent damage to the rope and rope termination. Provision shall be made for the examination of the part of the rope passing through the weight.

The overhauling weight shall be designed so as to avoid catching on obstructions.

17 Rope pulleys

17.1 Pulley diameters

The diameter of rope pulleys at the rope centres shall be not less than 18 times the rope diameter. Compensating pulley diameters shall be not less than 15 times the rope diameter.

17.2 Pulley grooves

Rope pulleys shall be grooved to a depth not less than 1.5 times the diameter of the rope. The grooves shall be finished smoothly and shall be free from surface defects liable to damage the rope. The edges shall be rounded.

The contour at the bottom of the groove shall be circular over an angle of not less than 120°. The radius of the groove shall comply with the requirements of 13.3.3.

The included angle of flare of the sides of the pulley groove shall be a maximum of 60° for an angle of lead of 1 in 12.

NOTE The angle of flare may be reduced for smaller angles of lead provided that the flange does not interfere with the rope.

17.3 Angle of lead (or fleet angle)

The angle of lead between the rope and a plane perpendicular to the axis of the pulley shall not exceed 1 in 12.

17.4 Guarding

Provision shall be made to retain the rope in the groove.

17.5 Supports

Suitably designed supports shall be fitted, where necessary, on the jib and other parts of the structure to prevent chafing of the ropes.

18 Gearing

Gearing shall be in accordance with BS 2573-2.

19 Rotating and fixed shafts and axles

Rotating and fixed shafts and axles shall be in accordance with BS 2573-2.

20 Keys, keyways and splines

20.1 Keys and keyways shall comply with the requirements of BS 4235.

20.2 Splines shall comply with the requirements of BS 2059 or BS 3550.

21 Clutches

21.1 General

Clutches shall be designed to transmit the maximum torque for the motion for all conditions of usage.

21.2 Sprag clutches

When sprag type clutches are used in hoist and derricking systems, they shall incorporate a positive mechanical lock against failure or be designed to transmit twice the maximum torque imposed by the maximum line pull.

22 Brakes for crane motions

22.1 General

22.1.1 Springs for applying brakes shall be of the compression type and shall not be stressed in excess of 80 % of the torsional elastic limit of the material.

22.1.2 Brakes applied by hand shall not require a force greater than 108 N (25 lbf) at the handle. If applied by foot they shall not require a force greater than 314 N (70 lbf) on the pedal to exert the restraining torque specified in **22.2**. All control levers and pedals shall be designed and positioned to take account of the requirements of clause **26**.

22.1.3 The wearing surfaces of all brake drums or plates shall be machined and shall be smooth and homogenous.

22.1.4 Brake weights, if fitted, shall be positioned and fixed securely to their levers.

22.1.5 Brake linings shall be adequately and permanently secure during their effective life.

22.1.6 Brake blocks and linings shall be protected from rain, oil, grease or other environmental conditions.

22.1.7 Brakes shall be provided with a simple and easily accessible device to compensate for the wear of the linings. This device shall be self-compensating whenever practicable.

22.1.8 Brakes for securing a hoist or derricking motion shall be held in the applied position by a positive actuating device. Brake mechanisms that rely upon air or fluid under pressure or an electrical mechanism for application shall be supported by an additional positive mechanical mechanism.

22.1.9 For electro-mechanical brakes, energization of the brake magnet due to back e.m.f. of the motor shall be prevented by the control gear in the “off” position isolating the brake magnet, after tripping of the overtravel limit or other appropriate protective device.

22.1.10 If electric braking is adopted, the conductors and contact surface of the motor and the control gear shall be proportioned so that the additional duty will not cause overheating (see **32.5**).

22.2 Individual brake motions

22.2.1 General. Means shall be provided for arresting each motion of the crane, and if controlled by a brake, the following minimum requirements shall apply.

22.2.2 Hoisting motion brakes. Hoisting motion brakes shall be designed to exert a restraining torque at least 25 % 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.

If free lowering is possible, the temperature of the friction surfaces of the brake shall not exceed the maximum working temperature specified by the manufacturer of the brake linings, after the maximum safe working load has been raised and lowered on the brake five times without pause through the specified height of lift.

22.2.3 Derricking motion brakes. For cranes with a derricking motion operated by rope and drum system, the brake shall be designed to exert a restraining torque at least 25 % greater than the maximum torque transmitted to the brake drum from the suspended load under service or erection conditions, whichever is the greater. In estimating this torque, the effects of friction on the transmission system between the load and the brake shall be ignored.

The main derricking motion brake shall be automatically applied when the derricking control lever is moved to the “off” or “neutral” position.

22.2.4 Cranes with derricking jibs. On cranes having a derricking jib operated through a clutch with the exception of those noted below in a) and b), an effective interlocking arrangement shall be provided between the derricking clutch and the pawl sustaining the derricking drum. The inter-locking arrangement shall ensure that the clutch cannot be disengaged unless the pawl is in effective engagement with the derricking drum, and the pawl cannot be disengaged unless the clutch is in effective engagement with the derricking drum.

NOTE This need not apply to any crane in which:

- a) the hoisting drum and derricking drum are independently driven;
- b) the mechanism driving the drum is self-locking.

22.2.5 Slewing motion brakes

22.2.5.1 Slewing brakes. Except when the slewing motion is controlled by reversing clutches, an effective slewing brake shall be provided, designed to exert an adequate restraining torque which will not subject the jib to a deceleration greater than that for which it is designed.

22.2.5.2 Slewing holding brakes. If restraint is applied by a slewing clutch, a holding brake, capable of preventing movement of the superstructure under service conditions, shall be fitted.

22.2.5.3 Slewing lock. A positive lock or sprag shall be provided to retain the superstructure in a fixed position.

22.2.6 Travelling brakes. Effective travelling and parking brakes shall be fitted, capable of securing the unloaded crane on a slope of not less than that on which the machine is designed to travel and in no case shall this be less than 10 %. This shall be achieved without the use of chocks.

Where the vehicle is subject to road traffic regulations, the conditions specified for brakes in those regulations shall apply.

23 Lubrication

All bearings shall be adequately lubricated. Plain bearings or their shafts shall have oil or grease grooves. All lubrication nipples should be of similar size and type and shall be readily accessible.

Where access for lubrication is difficult, bearings shall be such that lubrication is required as infrequently as possible or facilities for lubrication from a remote position shall be provided.

Lubricating nipples shall comply with the requirements of BS 1486.

A lubrication diagram shall be provided.

24 Slewing

For cranes on which the slewing motion is power operated, the slewing mechanism shall be so designed that it is not damaged due to fierce acceleration, braking or reversal of motion.

The mechanism shall be designed to withstand the forces specified in clause 10.

In the case of proprietary slewing rings, it is particularly important that the manufacturer is consulted and given full details of the loads and duty involved. Attention shall be given to the method of mounting and the bolting requirements for which the manufacturer's recommendations shall be taken into account.

25 Guarding

25.1 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.

25.2 Effective guards shall be provided for revolving shafts and couplings unless every set screw, bolt or key on any revolving shaft is sunk, shrouded, or otherwise effectively guarded.

25.3 All other dangerous parts of the machine shall be guarded in accordance with BS 5304.

26 Controls

26.1 Control positions and markings

Operating levers or wheels shall have clear markings, on or adjacent to them, to indicate their function and mode of operation.

If the design of a crane is such that the effect of the steering wheel or any other motion is reversed when the jib is slewed through 180°, an appropriate notice or other indication clearly drawing attention to this shall be provided.

NOTE 1 Where motions can be reversed it is recommended that self-correcting controls are incorporated.

NOTE 2 All practical measures should be taken to prevent accidental movement of controls.

NOTE 3 All controls should be placed in a position in accordance with best ergonomic practice with control levers and pedals placed in such positions as to allow the driver/operator, when in his normal position, ample room for operation, as far as possible an unrestricted view of the load and as clear a view as possible of the immediate surroundings, both forward and to each side of that position.

26.2 Motion controls

Control arrangements can be specifically designed for "joy-stick" control of two movements simultaneously, otherwise they shall be so designed that selection of one movement cannot cause any other movement unless it is for the operation of a safety device or interlock.

Control valve systems shall be designed to return to the neutral position when released, except when operational characteristics dictate otherwise.

27 Manual operation

Arrangements for any operation relying wholly on manual effort (i.e. without power assistance) shall be such that an operator turning a handle, a wheel, or pulling a lever shall not be required to exert a mean force in excess of 108 N (25 lbf) continuously or 177 N (40 lbf) as a maximum at a mean speed of 46 m/min (150 ft/min).

28 Crane driver's station

Except for lorry loaders or unless stated to the contrary by the purchaser, a cabin shall be supplied by the manufacturer. The cabin shall:

- a) afford the driver protection from the weather;
- b) be fitted with safety glass complying with the requirements of BS 5282;
- c) have a lock fitted to the door to prevent unauthorized entry when the crane is left unattached;
- d) have a securely fixed adjustable seat for the driver;
- e) be provided with a heater to satisfy statutory requirements;
- f) be provided with a means of ventilation;
- g) have either natural or artificial illumination to ensure that all charts and instruments are visible to the driver;
- h) have safe access to the driver's cabin.

NOTE 1 The driver should as far as is practicable be provided with a clear and unrestricted view of the load and the jib in all normal working positions and as clear a view as possible of the extremity of any forward projection and of the road ahead when the crane is travelling.

NOTE 2 Guidance for the recommended driver's cabin envelope is given in BS 5538.

29 Internal combustion engines

29.1 Internal combustion engines shall comply with the requirements of BS 5514 and a silencer shall be fitted to the exhaust. The exhaust shall not discharge in such a manner as to cause danger or discomfort to the driver or to any person in the vicinity.

NOTE Where practicable the exhaust from an engine should be discharged vertically as high as possible, and it is recommended that means should be provided to prevent the ingress of water into the exhaust system.

29.2 Fuel tank capacity shall be sufficient for at least 8 h running on normal crane duty, and means shall be provided for ascertaining the quantity of fuel contained in the tank.

29.3 The sump and lubricating system of the engine shall be so arranged that efficient lubrication is maintained in all planes of operation covered by the specification both during travelling and lifting operations.

29.4 Provision shall be made where necessary for draining the water circulating system during frosty weather, the drain cocks being fitted in accessible positions. The arrangement shall be such that it is not possible to leave pockets of water in either the system or the pump casing.

30 Pneumatic tyres

30.1 The crane shall be fitted with tyres that comply with the crane manufacturer's specification.

30.2 The crane shall have a legible and prominent inscription on the chassis giving the correct inflation pressure of the tyres.