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BSI Group
389 Chiswick High Road
London, W4 4AL
United Kingdom

T: +44 20 845 086 9001
F: +44 20 8996 7400
cservices@bsigroup.com
bsigroup.com

British Standards Limited
Registered in England no: 07864997
Registered address: 389 Chiswick High Road
London, W4 4AL, United Kingdom

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POWER-DRIVEN MOBILE CRANES

BRITISH STANDARDS INSTITUTION

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BRITISH STANDARD SPECIFICATION

POWER-DRIVEN MOBILE CRANES

B.S. 1757 : 1951

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Telegrams : Standards, Sowest, London Telephone : Abbey 3333

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THIS BRITISH STANDARD, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the chairman of the Engineering Divisional Council, was published under the authority of the General Council on 26th July, 1951.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 1700, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 7s. 6d. post free.

This standard makes reference to the following British Standards :—

B.S. 800. Limits of radio interference.
B.S. 833. Radio interference suppression for automobiles and stationary internal-combustion engines (limits and methods of suppression).

Attention is also directed to the list of British Standards given in Appendix C.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or edition.

MEE/41/5

CONTENTS

	Page
Co-operating organizations	5
Foreword	6
SPECIFICATION	
1. Scope	6
2. Description of types	7
3. Definitions	7
4. Information recommended to be supplied with enquiry or order	8
5. Information to be supplied by manufacturer	8
6. Materials	8
7. Service conditions	9
8. Load indication	9
9. Factor of safety	9
10. Speeds	10
11. Slewing	11
12. Wind	11
13. Stability	12
14. Jibs	17
15. Crane structure	17
16. Struts (including jibs)	17
17. Joints	17
18. Welding	18
19. Rivets and bolts in crane stucture	18
20. Bolts and set screws, other than those used in crane structure	18
21. Supports for the rotating part of the crane	18
22. Wire ropes	18
23. Size of drums and pulleys	19
24. Rope pulleys	20
25. Lifting hooks	21
26. Shackles	21
27. Overhauling weight	22
28. Gearing	22
29. Pawls	22
30. Rotating and fixed shafts and axles	22
31. Lubrication	22
32. Brakes	23
33. Guarding	24
34. Controls	25

AVA Documents
Document Sharing Hub

	Page
35. Manual power	25
36. Internal combustion engines	26
37. Electrical generators and motors	26
38. Controllers and resistors	26
39. Electrical protective gear	27
40. Electrical cables for power circuits	28
41. Mechanical interlocks	28
42. Limit gear	28
43. Lighting	29
44. Radio interference	29
45. Testing	30
46. Painting	32
47. Wiring diagram	32
48. Identification	32
49. Net working weight	32
50. Audible warning device	33
51. Pneumatic tyres	33

APPENDICES

A. Information recommended to be supplied with enquiry or order	34
B. Information to be supplied by manufacturer	36
C. List of British Standards for materials and equipment to be used in the manufacture of cranes	37
D. List of Statutory Instruments affecting cranes to be operated in the United Kingdom	40
E. Design of struts	41

CHARTS

1. Maximum permissible axial stress F_a	44
2. Values of F_{bc}	45
3. Values of K for B.S. 15 and Grade 15 tubes to B.S. 1775.*	46
4. Values of K for B.S. 548	47
5. Values of K for B.S. 968 and Grade 20 tubes to B.S. 1775.*	48

* B.S. ....., 'Steel tubes for mechanical, structural and general engineering purposes.' (In course of preparation.)

CO-OPERATING ORGANIZATIONS

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

*Admiralty
Air Ministry
*Associated Offices Technical Committee
Association of Consulting Engineers (Incorporated)
British Chemical Plant Manufacturers' Association
British Compressed Air Society
*British Electrical and Allied Manufacturers' Association
British Engineers Association
British Internal Combustion Engine Manufacturers' Association
*British Iron and Steel Federation
*British Railways, The Railway Executive
*Crown Agents for the Colonies
Department of Scientific and Industrial Research
*Engineering Equipment Users' Association
Institute of Marine Engineers
Institute of Petroleum
*Institution of Civil Engineers
Institution of Gas Engineers
Institution of Heating and Ventilating Engineers
*Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Division)
*Institution of Production Engineers
Locomotive Manufacturers' Association
Machine Tool Trades Association
*Ministry of Fuel and Power
*Ministry of Labour and National Service (Factory Department)
*Ministry of Supply
*Ministry of Transport
Ministry of Works
Office of the High Commissioner for India
*War Office

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this standard :—

Association of Crane Makers
British Constructional Steelwork Association
Cable Makers' Association
Dock and Harbour Authorities Association
Engineering and Allied Employers' National Federation
Excavator Manufacturers' Association
Federation of Civil Engineering Contractors
Institution of Engineering Inspection
Institution of Structural Engineers
National Federation of Building Trades Employers

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BRITISH STANDARD SPECIFICATION FOR

POWER-DRIVEN MOBILE CRANES

(ROAD WHEEL MOUNTED, OR TRACKED)

FOREWORD

The object of this British Standard is to secure the general observance of such fundamental principles as appear desirable to ensure reliability and safety without hampering the freedom of the crane maker in his selection of the most appropriate design for the purpose in view. The stipulations of the standard indicate the minimum requirements for power-driven mobile cranes of the types described herein.

Attention is drawn to Appendices A, B, C and D. 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 needed 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 to be used in the manufacture of cranes and Appendix D sets out the statutory requirements that have to be considered in connection with cranes to be operated in the United Kingdom.

Clause 40 which deals with electric wiring and cables refers to the Regulations for the Electrical Equipment of Buildings, published by the Institution of Electrical Engineers. The twelfth edition of these regulations includes a new table giving factors for half-hour and one-hour ratings of vulcanized-rubber-insulated cables and paper-insulated and varnished-cambric-insulated cables.

See Amdt No. 1.

Another feature of the standard is Appendix (E) dealing with the design of struts. This has been prepared to follow the general method of application of the Perry-Robertson formula for struts, as adopted in other British Standards.

SPECIFICATION

SCOPE

Amdt No. 1.

1. This British Standard covers class 2 & 3 power-driven mobile cranes, either road wheel mounted or tracked, of the following types :—

Type 1. Fully mobile full-slewing type.
Type 2. Fully mobile part-slewing type.
Type 3. Fully mobile non-slewing type.
Type 4. Lorry mounted fully mobile full-slewing type.
Type 5. Lorry mounted fully mobile part-slewing type
Type 6. Lorry mounted fully mobile non-slewing type.
Type 7. Semi-mobile types of any of the above classes.
Type 8. Portable types.

DESCRIPTION OF TYPES

2. *Type 1. Fully mobile full-slewing cranes.* Cranes having a superstructure capable of slewing through unlimited revolutions in either direction, able to handle loads up to the maximum for which they have been designed, and able to travel under their own power with such loads suspended at any point in their full circle of slewing.

Type 2. Fully mobile part-slewing cranes. Cranes similar to Type 1, but having a limited arc of slewing.

Type 3. Fully mobile non-slewing cranes. Cranes similar to Type 1, but having a non-slewing superstructure, and which obtain the slewing effect only by manoeuvring the complete crane by means of its steering and travelling mechanism.

Type 4. Lorry mounted fully mobile full-slewing cranes. Cranes mounted on chassis having characteristics substantially the same as those of a lorry and possessing the usual lorry arrangement of engine transmission, and road wheels or tracks with or without springs. The crane superstructure and handling of loads are the same as those described for Type 1 cranes.

Type 5. Lorry mounted fully mobile part-slewing cranes. Cranes having chassis as described for Type 4, but possessing a superstructure and load handling abilities as described for Type 2 cranes.

Type 6. Lorry mounted fully mobile non-slewing cranes. Cranes having chassis as described for Type 4, but possessing a superstructure and load handling abilities as described for Type 3 cranes.

Type 7. Semi-mobile cranes of any of the above classes. Cranes which substantially comply with the requirements of any of the above classes, with the exception that they require the use of outriggers to enable them to handle their designed maximum loads, or have limitations with regard to travelling with loads.

Type 8. Portable cranes. Cranes which are unable to travel under their own power but which have power-driven hoisting motions with or without power or hand derricking and/or slewing motions.

NOTE. Cranes which lift their loads by derricking the jib while the load is suspended from a fixed hook on the jib should be stated to lift their loads by derricking.

DEFINITIONS

3. For the purposes of this standard the following definitions shall apply :—

a. Hoisting. The raising of the load by means of a rope or chain which passes over a pulley fitted in the jib.

b. Slewing. The rotary motion of the crane jib in a horizontal plane.

c. Derricking. The movement of the crane jib when it is pivoting in a vertical plane.

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d. Jib centre distance or length. The shortest distance between the pivoting point of the jib and the centre of rotation of the jib head pulley. (When jibs have a portion which extends to the rear of the pivoting point, that portion is ignored when stating the jib centres or length.)

e. Radius. The horizontal distance from the centre line of the lifting hook to the centre about which the jib slews or, in the case of a non-slewing crane, the horizontal distance from the centre line of lifting hook to the nearest base line as shown in Figs. 1 to 6.

f. Stability reach. The distance of the jib head pin from the point of intersection of the nearest base line and the vertical plane passing through the centre line of the jib. (This dimension will vary for different positions of the hook in the course of one revolution during slewing, but for the purposes of calculating the stability the maximum value of this dimension is taken). (See Figs. 1 to 6.)

g. Outreach. The horizontal distance from the centre line of the lifting hook to the nearest point on the chassis.

h. Stability base. The effective span of the supporting base (see Figs. 1 to 8.)

j. Margin of stability. The percentage additional load required to bring the crane to the condition of tipping when it is handling the safe working load at any radius.

k. Blocking-up base. The effective span of the supporting base when out-riggers, jacks or blocks are used to increase stability by virtue of making contact with the ground at points further from the centre line of the crane than the normal wheels or tracks.

l. Tail radius. The maximum distance from the centre of rotation to the tail of the revolving superstructure.

INFORMATION RECOMMENDED TO BE SUPPLIED WITH ENQUIRY OR ORDER

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

INFORMATION TO BE SUPPLIED BY MANUFACTURER

5. The manufacturer shall, if required by the purchaser, supply with the tender the information enumerated in Appendix B regarding the construction of the crane.

MATERIALS, ETC.

6. The materials and equipment used in the construction of the crane shall comply where applicable with the British Standards given in Appendix C.

No timber shall be used for any stress bearing part of the crane structure.

SERVICE CONDITIONS See Amdt No. 1

7. The crane shall be deemed to be under service conditions when it is handling any load up to the maximum for which it has been designed (hereinafter referred to as the maximum safe working load), that is, when it is lifting and holding or lowering the load and/or the jib, and/or is slewing and/or travelling in any direction, and when it is being subjected to the stresses resulting from wind pressure of 5 lb/sq. ft., computed in the manner described in Clause 12.

LOAD INDICATION

8. The crane shall bear a legible and prominent inscription naming the length or lengths of jib, the maximum safe working load, and the appropriate radius.

For cranes of variable radius, clear indication of the safe working loads at the various radii, when the crane is on hard level ground, shall be given by means of an indicator which shall be in full view of the operator. When different lengths of jib, or when different change speed gear or alternative reeving is used on the hoisting motion, the safe working loads for each condition shall be clearly indicated.

Unless otherwise specified by the purchaser, an automatic safe load indicator of a type approved by the Chief Inspector of Factories, shall also be fitted to warn the operator by means of visible warning of approach to the safe working load, and to give adequate audible warning to persons within the zone of operation of the crane when an overload occurs at any radius.

NOTE. In some cases the provision of this indicator is a statutory requirement.

A clear statement of any limitations of the crane with regard to travelling with loads shall be given in the manufacturer's specification, and this shall be clearly marked on the crane.

FACTOR OF SAFETY See Amdt No. 1

9. The crane shall be so designed and constructed that when it is working under service conditions the stress induced in any part shall not exceed either :

a. the minimum breaking strength of the material divided by the specified factor of safety, or

b. the maximum stress specified below.

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For the purpose of this British Standard the factor of safety shall be determined by dividing the lowest ultimate strength of the material that will comply with the relevant British Standard (see Appendix C) by the computed stress when the crane is working under service conditions.

The factor of safety for all parts of the crane structure shall be not less than 4½, except where a maximum permissible working stress is hereinafter specified, as it is for struts (see Clause 16) and rivets and bolts (see Clause 19). This factor and the permissible working stresses include allowances for impact, acceleration and inertia, except those referred to in Clauses 11 and 14, for which specific allowances must be made.

The factor of safety, or the permissible working stress, for parts other than those used in the crane structure shall be as specified in the following clauses :—

Bolts and set screws	Clause 20
Wire ropes	Clause 22
Gearing	Clause 28
Brakes	Clause 32

The factors of safety do not cover prime movers.

Under assumed 50 per cent overload conditions and 5 lb/sq. ft. wind pressure the calculated stress in any member shall not exceed two-thirds of the elastic limits, or of the crippling loads, of the respective materials.

NOTE. The minimum factors of safety and the permissible working stresses referred to above are only applicable to cranes intended for ordinary duty. A higher factor of safety and proportionately lower permissible working stresses are essential for duty of greater severity, or where there is a liability to accidental overloads, as may occur in the operating of dockside, quarrying, or magnet cranes. For instance, a grabbing crane may be cited as an example where an increase of the minimum factors of safety by 40 per cent, with proportionately lower permissible working stresses, is recommended. Alternatively, where a crane designed for ordinary duty is to be used in conjunction with a grab, it is recommended that the combined weight of the grab and its contents should not exceed 75 per cent of the maximum safe working load at the appropriate radius.

SPEEDS

10. The following speeds, upon reasonably hard level road of good surface, are recommended as maximum values for a crane handling loads up to the maximum for which it has been designed :—

Travelling speed

Combined weight of crane and load tons	Up to 5	Over 5 and up to 10	Over 10 and up to 15	Over 15 and up to 20	Over 20
Travelling speed with load (miles/hour)	6	5	4	3	2

Slewing speed

Combined weight of crane and load tons	Up to 5	Over 5 and up to 10	Over 10 and up to 15	Over 15 and up to 20	Over 20
Rate of slewing speed (r.p.m.)	4	3½	3	2½	2

Hoisting and lowering speeds

Safe working load tons	Up to 2½	Up to 3½	Up to 5	Up to 7	Over 7
Hoisting speed (ft/min.)	80	50	40	25	20

The hoisting and lowering speeds are recommended maximum speeds for normal crane duty for lifts up to 20 ft., but they may be increased for higher lifts, or special duty cranes.

Where a governor brake, or other device is used to control the lowering speed it should be arranged to limit the maximum lowering speed to twice the normal full load hoisting speed.

When unloaded and travelling on the highway, travelling speeds shall comply with the appropriate Regulations. (See Appendix D.)

SLEWING 2 ft/sec² [Amdt 1]

11. The acceleration and retardation of the slewing motion shall be assumed to be not less than ~~4 ft/sec/sec~~. at the jib head, when the crane jib is working in the position at which the maximum stress is induced.

This clause shall not apply to cranes on which the slewing motion is manually operated.

WIND Amdt No 1.

12. The crane shall be designed and constructed for operating under a steady wind pressure of not less than 5 lb/sq. ft.

When at rest under storm conditions the crane shall be capable of withstanding a steady wind pressure of 35 lb/sq. ft., and the calculated stress under this condition shall not exceed two-thirds of the elastic limit, or of the crippling load for the respective materials.

The calculation under either condition shall be made on an area equivalent to 1½ times the projected area of the unloaded crane, except for cabins, machinery houses, and other single surfaces, of which the projected area only shall be taken.

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STABILITY

13. The margin of stability shall be calculated for the condition when the crane is working on hard level ground and the jib is in the position giving the greatest overturning moment. Where pneumatic tyres are fitted, it shall be assumed that these are inflated to the correct working pressure.

The margin of stability, expressed as a percentage, shall be not less than :

$$\frac{\text{Maximum stability reach}}{\text{Stability base}} \times 12,$$

and shall in no case be less than 50 per cent on a gradient of 1 in 40.

The stability reach will vary for different positions of the hook in the course of one revolution during slewing, but the maximum value of the dimension shall be taken when computing the margin of stability (see definitions in Clause 3 and Figs. 1–8).

For a crane designed to travel with load, the wheels or tracks shall be used to determine the ' stability base,' but for cranes which require to be blocked up when dealing with loads, the blocking up base shall be deemed to be the base of support.

NOTE. The principal factor in the calculation of stability is the ratio of ' reach ' to ' base ' dimensions, and the factor of 12 in the above formula provides a suitable excess of righting moment over the maximum overturning moment to allow for normal working conditions such as braking forces, ground surface irregularities, and wind pressure on both crane and load.

Cranes mounted on pneumatic tyres, except those of Type 7, shall be stable with the rated loads in any position when one tyre is deflated.

All cranes shall be stable in a backward direction when travelling forward or backwards, up or down a smooth hard gradient having the maximum slope specified by the manufacturer. They shall also be stable in any position without load when stationary on a gradient of 1 in 5. In all cases the jib shall be at the minimum working radius.

The crane shall be stable with the jib removed when travelling on a gradient of 1 in 20. (See Figs. 1–8.)

NOTE. It is recommended that in determining the stability of a crane used with a grab or magnet an equivalent hook load of 1·33 times the combined weight of the load and the grab should be assumed.

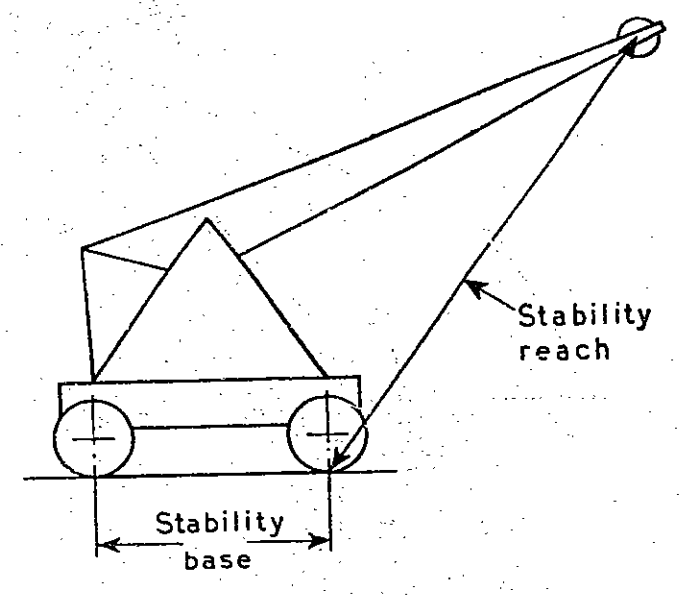

Fig. 1

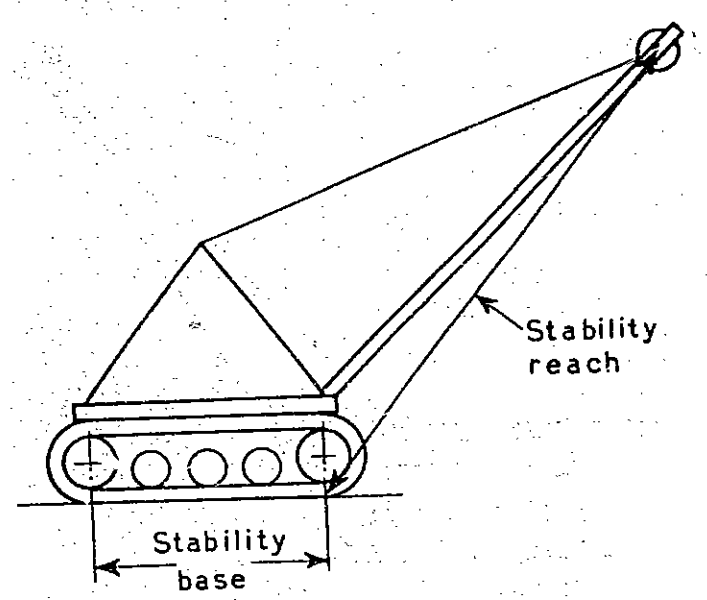

Fig. 2

Figs. 1 and 2. Illustration of terms ' stability base ' and ' stability reach ' for non-slewing 3- or 4-point suspension cranes.

NOTE. These diagrams illustrate typical examples but do not purport to include all possible alternations of jibs and chassis.

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