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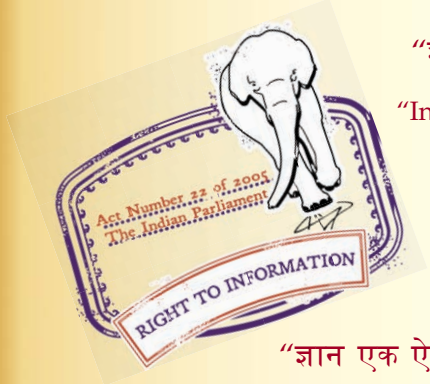

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IS : 4594 - 1968
(Reaffirmed 2006)

Indian Standard

CODE OF PRACTICE FOR DESIGN OF PORTAL AND SEMI-PORTAL WHARF CRANES (ELECTRICAL)

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Indian Standard

CODE OF PRACTICE FOR DESIGN OF PORTAL AND SEMI-PORTAL WHARF CRANES (ELECTRICAL)

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Indian Standard

CODE OF PRACTICE FOR DESIGN OF PORTAL AND SEMI-PORTAL WHARF CRANES (ELECTRICAL)

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 April 1968, after the draft finalized by the Cranes and Allied Appliances Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 As a part of the steel economy programme of ISI, IS : 807 - 1963* was published. After its publication, it was felt that a separate code of practice should be formulated for the mechanical and electrical engineering aspects of design of cranes as well as inspection and testing clauses. With the increased tempo of industrialization, the demand for different types of cranes has also increased during the third five-year plan. In order to meet this demand, a number of units with technical collaboration from various overseas countries came up for manufacturing cranes. In this background, the importance of formulating standard codes of practice for design of various types of cranes was appreciated. Accordingly, in 1964 the panel for code of practice for design, manufacture, erection and testing of cranes and hoists, was reconstituted. It was elevated to the status of a Sectional Committee and redesignated as Cranes and Allied Appliances Sectional Committee. It proposes to formulate a number of 'Indian Standard codes of practice covering design of various types of cranes and hoists' that are manufactured and used in the country, this constitutes one of them.

0.3 This code covers mechanical, electrical, inspection and testing requirements relating to the design, manufacture and erection of portal and semi-portal wharf cranes, level luffing derricking and fixed radius type. Structural design aspects of all types of cranes and hoists including heavy duty overhead travelling cranes for use in steel works are covered in IS : 807-1963*. Mechanical, electrical, inspection and testing aspects as related to design, manufacture, erection and testing of overhead travelling cranes and gantry cranes, other than steel work cranes, are covered separately in IS : 3177 - 1965†. Cranes are broadly classified into four classes in IS : 807-1963* depending on duty and number of hours in service per year. In IS : 3177 - 1965† the different motions of a crane and the design of

*Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.

†Code of practice for design of overhead travelling cranes and gantry cranes other than steel work cranes.

component parts are required to be treated on the basis of mechanism classification defined in terms of the severity of duties to be performed or average life of mechanism or the component part. The same mechanism classification has been adopted in this code also.

0.4 All the necessary information regarding the conditions under which the crane is to be used together with the particulars laid down in Appendix A shall be supplied with the enquiry or order. The manufacturer shall supply with the tender the information in accordance with proforma laid down in Appendix B.

0.5 In the preparation of this standard, the Sectional Committee kept in view the manufacturing and trade practices followed in the country in this field. Furthermore, due consideration was also given to the need for international co-ordination with standards being followed in various countries of the world. Accordingly, considerable amount of assistance has been obtained from B.S. 2452 : 1954 'High pedestal or portal jib cranes' issued by the British Standards Institution.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers mechanical, electrical, inspection and testing requirements relating to the design, manufacture and erection of portal and semi-portal wharf cranes, level luffing derricking and fixed radius type.

SECTION I GENERAL

2. IDENTIFICATION AND RADIUS — LOAD INDICATION

2.1 The crane shall bear one or more nameplates easily visible in a prominent place having the following permanent inscriptions:

a) Manufacturer's name,
b) Safe working load or loads and the radii appropriate thereto,
c) Manufacturer's serial number, and
d) Year of manufacture.

2.1.1 A small plaque shall be located in full view of the operator preferably inside the operator's cab, bearing the safe working load or loads and the speed appropriate thereto, when change-speed gear is used for the hoisting motion.

*Rules for rounding off numerical values (*revised*).

2.1.1.1 If specified by the purchaser, an alarm shall be fitted to the crane to give the crane driver audible and visual warning, when the load exceeds the safe working load, and a device preferably electrical shall be fitted which will automatically stop the hoisting motion when the load exceeds 15 percent of safe working load, which will not preclude the load from being lowered.

2.2 Indication of Load at Different Radii — There shall be provided, in full view of the driver, an indicator, preferably in the driver's cabin, clearly showing to the driver the safe working load at different radii. When change-speed gear is used for hoist motion, corresponding safe working load will be indicated therein.

SECTION 2 MECHANICAL

3. DESIGN OF CRANE MECHANISM

3.1 General — The design of the component parts of the mechanism relating to each motion shall include due allowance for the effects of the duty which the mechanism will perform in service.

3.1.1 In all cases the mechanism shall be classified in accordance with the provisions of **4.3** of IS : 807 - 1963* on the basis of its duty, and the design of the component parts shall be in accordance with the provisions given in this section.

NOTE — The classification of the individual motions of the crane may not necessarily be the same as those of crane structure, and the classification of one motion of a crane may differ from that of another motion of the same crane.

3.2 Design on Strength Basis — In the design of a component on the basis of ultimate strength, the value of stress factor used shall be the product of the basic stress factor and duty factor for the appropriate mechanism class where basic stress factor shall be not less than 5 and duty factor shall be as given in Table 1 for the appropriate mechanism class.

TABLE 1 DUTY FACTOR AND LIFE FOR MECHANISM

MECHANISM CLASS	DUTY FACTOR		AVERAGE LIFE	
	Strength	Wear	Running Time per Day (h)	Total Life (h)
2	1·2	0·5	1·5	Over 9 000
3	1·4	0·6	3·0	Over 20 000
4	1·6	0·7	Over 6·0	Over 40 000

NOTE — The running time per day and total life given in the table relate to mechanism class only.

*Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.

3.3 Design on Life Basis — Components designed on the basis of life shall have a rated life of not less than 20 years of 300 days per year for Class 2 and 333 days per year for Class 3 and Class 4 mechanism. The average running hours per day or the life in hours used for the purpose of the design of such components shall be the value specified in Table 1 for the appropriate mechanism class.

4. STABILITY

4.1 Condition of Tipping — A crane shall be deemed to be in a condition of tipping when it is supporting a load, at the stated radius, and it is impossible to increase this load without imposing stresses on:

a) the centre pin, or centre column (where provided); and

b) any one of the track wheels leaving the track.

4.2 Margin of Stability — When the crane is handling a safe working load at the appropriate radium or is subject to a wind pressure not less than 150 kgf/m^2, the margin of stability is the additional load expressed as a percentage, which is required to bring the crane to the condition of tipping (*see* **4.1**) with the jib adjusted, if necessary, to maintain the same operating radius.

4.3 Stability — The following stability requirements shall be met:

a) *Stability under Storm Conditions* — Under storm conditions, the crane is subject to a wind force of not less than 150 kgf/m^2 and a margin of stability of 25 percent of this wind force shall be met.

b) *Stability under Service Conditions* — The load on the crane in the condition of tipping (*see* **4.1**) at the operating radius for appropriate safe working load, and with the crane in the position of least stability shall not be less than the safe working load +50 percent under condition **4.1**(a) and + 75 percent under condition **4.1**(b), and subject to a wind force of 25 kgf/m^2 acting at the same time.

4.4 Where possible the vertical projection of the centre of gravity of the revolving superstructure shall be kept inside the roller path for all service conditions.

5. JIB

5.1 Jib and its attachments shall be designed to withstand the sum of the stresses arising under working conditions including:

a) all stresses due to load,

b) all stresses due to jib and its attachments,

c) accelerating and retarding forces acting horizontally at the jib head pin due to slewing the load,

d) accelerating and retarding forces acting horizontally due to slewing the jib,

e) stresses due to wind pressure of 25 kg/m^2,
f) transverse shear stress due to 2½ percent of maximum axial load, and
g) stresses due to sudden application of slew and luff brakes.

5.2 If jibs are derricked by ropes, two lengths of rope shall preferably be used and buffer stops shall be provided wherever practicable to restrict the travel of jib beyond minimum radius.

6. WIRE ROPES

6.1 Ropes, unless otherwise specified or agreed by the purchaser, shall comply with the relevant Indian Standards mentioned in Appendix C.

6.1.1 The breaking strength of all splicings, sockets, thimbles and rope anchorages shall be not less than 90 percent of the breaking strength of the rope or ropes to which they are attached.

6.2 Factor of Safety — The factor of safety based on nominal breaking strength and the rated lifted load, will not be less than the figures given in Table 2.

TABLE 2 FACTOR OF SAFETY OF WIRE ROPES

TYPE OF ROPE	CLASSES 2 AND 3	CLASS 4
Hoist rope	6	7·5
Derrick or luff ropes	8	8

NOTE — The duty factors specified in Table 1 shall not be applicable to these factors of safety.

6.3 Ball bearing swivels shall be provided in cases where non-rotating ropes are not used.

6.3.1 Reverse bends shall be avoided as far as possible.

7. ROPE DRUMS

7.1 Material for Drums — Drums shall be made of cast iron, cast steel or mild steel conforming to the following Indian Standards:

a) Grey cast iron — Grade 25 of IS : 210-1962*
b) Cast steel — Grade 2 of IS : 1030-1963†
c) Mild steel — IS : 226-1962‡
IS : 2062-1962§

*Specification for grey iron castings (*revised*)
†Specification for steel castings for general engineering purposes (*revised*)
‡Specification for structural steel (standard quality) (*third re*
§Specification for structural steel (fusion welding quality)

7.2 Strength of Drums — Every drum shall be designed to withstand the stress caused by the wound-on rope and the local bending stress when the rope is winding on.

7.2.1 The bending stress due to beam action of the drum shall also be taken into consideration.

7.2.2 The factor of safety based on ultimate strength of the material used shall be not less than the appropriate value obtained from **6.2** and Table 2.

7.3 Drums shall generally be of such length that there will be not more than one layer of rope on the drum when the rope is in its fully wound position and there will be in addition not fewer than two dead turns at each anchored end and one spare groove at the other end. The drum shall be flanged at both ends and the flanges shall project to a distance not less than two rope diameters above the rope. A spur or other wheel or a ring secured to the drum may be regarded as forming the flange. The lead angle of the rope shall not exceed 5° (1 in 12).

7.4 Drum Diameter — The diameter of drum, measured at the bottom of groove shall be not less than the appropriate value specified in Table 3 according to the construction of the rope and the classification of crane mechanism.

7.5 Grooving of Drums — Rope drums shall be machine grooved and the contour at the bottom of the grooves shall be circular over an angle of approximate 120°. The radius of the groove shall be larger than the radius of the rope by not less than the appropriate amount given in Table 4.

7.5.1 The depth of the groove shall be not less than 0·35 times the diameter of the rope.

7.5.2 The grooves of the drum shall be so pitched that there is between adjacent turns of the rope a clearance of not less than:

a) 1·5 mm for ropes up to and including 12 mm dia,

b) 2·5 mm for ropes over 14 mm and including 29 mm dia, and

c) 3·0 mm for ropes over 29 mm dia.

7.5.3 Grooving shall be finished smooth and shall be free from surface defects likely to injure the rope. The edges between the grooves shall be rounded.

7.6 Rope Anchor — The end of the rope shall be anchored to the drum in such a way that the anchorage is readily accessible.

8. SHEAVES

8.1 Material — Sheaves shall be made of any suitable material as specified for drums.

TABLE 3 DRUM DIAMETERS

(*Clause* 7.4)

Rope Construction	Tensile Breaking Strength of Wire, kgf/mm²	Minimum Diameter of Drum for Mechanism	
		Classes 2 and 3	Class 4
6 × 19	160 to 175	24 d	27 d
	175 ,, 190	28·5 d	30 d
6 × 24	160 ,, 175	21 d	24 d
	175 ,, 190	24 d	28 d
6 × 37	160 ,, 175	19 d	22 d
	175 ,, 190	21 d	24 d
17 × 7 or 18 × 7	175 ,, 190	27 d	30 d
34 × 7	175 ,, 190	21 d	27 d

d = Diameter of rope.

TABLE 4 RADIUS OF GROOVE IN DRUMS AND SHEAVES

(*Clause* 7.5)

Diameter of Rope	Increase over Rope Radius
mm	mm
Up to and including 16	1·0
Over 16 and including 24	1·5
Over 24 and including 29	2·0
Over 29	3·0

8.2 Diameter of Sheave

8.2.1 The diameter of sheaves at the bottom of the groove shall not be less than that of the drums as specified in **7.4**.

8.2.2 The diameter of each non-rotating equalizer sheave at the bottom of groove shall be a minimum of 12 times diameter of wire rope for mechanism class 2 and 3 and 15 times for mechanism class 4.

8.3 Grooving — Sheaves shall be machine grooved to a depth of not less than 1·5 times diameter of rope. The grooves shall be finished smooth and shall be free from surface defects likely to injure the rope. The contour at the bottom of the groove shall be circular over an angle of 130° ± 5° approximately. The radius of the part of the groove shall be

larger than the radius of rope by not less than the appropriate amount given in Table 4.

8.4 Lead Angle — The angle between the rope and a plane perpendicular to the axis of the sheave shall not exceed 5° (1 in 12).

8.5 Sheave Guards — Sheaves shall be adequately guarded to retain the rope in the grooves.

8.6 All sheaves, guide pulleys or rollers shall preferably be mounted on ball or roller bearings.

9. BEARINGS

9.1 Type — Bearings shall be generally of ball, roller or ring-lubricated type. Bush bearings may be used for shafts running at 450 rev/min or below.

9.2 Due allowance shall be made for impact and thrust load. Life of ball and roller bearings shall be calculated in accordance with the manufacturer's recommendations and based on the equivalent running time given in Table 1.

9.2.1 If plain bush bearings are used the bearing pressure shall not exceed 70 kgf/cm^2 on the projected area.

10. SHAFTS

10.1 General — Shaft and axles shall have ample strength and rigidity and adequate bearing surfaces for their purposes. They shall, where necessary, be finished smoothly and if shouldered, shall be provided with fillets as large as possible and/or be tapered to suit.

10.2 Material — All shafts shall be made of steel.

10.3 Shaft Keys — Where practicable, keys, keyways and splines shall conform to the relevant Indian Standards.

11. COUPLINGS

11.1 All couplings shall be of steel or cast iron and shall be designed to suit the maximum torque that may he developed in adverse condition.

11.1.1 Alignment shall be such that solid couplings meet accurately. Flexible couplings shall be initially aligned with the same accuracy as solid couplings.

11.1.1.1 Flexible couplings shall be fitted between motor shafts and extension shafts.

12. GEARING

12.1 General — All gears shall have machine cut teeth except for slew racks where provided and their engaging pinions which may have cast or machine moulded teeth. Slewing racks may consist of steel section with pins for teeth.

12.2 Material — All gears shall be of steel (cast and/or wrought) except as provided below:

a) Wheels may have steel rims secured to cast iron centres.

b) Worm wheels or worm wheel rims shall be of bronze and worm of steel for power operated cranes.

12.3 Design — Gears shall be designed in accordance with relevant Indian Standards using as a minimum the duty factor given in Table 1 for the appropriate class of mechanism.

12.4 Fixing — Keys in gear trains shall be so fitted and secured that they do not work loose in service.

12.5 Gear Boxes — Gear boxes shall be so designed that the gears which they enclose will be automatically lubricated, the gears shall be readily removable and the boxes shall be oil-tight as far as is reasonably practicable. They shall be of rigid construction and fitted with inspection covers and lifting lugs where necessary. Facilities for oil filling, adequate breathing, drainage and means of indicating clearly the correct oil levels shall be provided.

12.5.1 Where worm gearing is used as a first motion drive it shall have under test, the same load and time rating as the driving motor, and the temperature-rise of the oil bath when measured by thermometer shall not exceed 56°C (100°F) above the temperature of the atmosphere.

12.5.2 Gear box feet shall be machined and shall be seated and positively located on an appropriate level surface, preferably machined.

12.5.3 Material for the gear box shall preferably be cast iron, cast steel or mild steel fabricated. The material shall conform to the relevant Indian Standard specifications given in **7.1.**

12.6 If worm gearing is provided in slew motion, a slipping clutch or its equivalent should be provided in the mechanism.

13. TRACK WHEELS

13.1 Track wheels shall have cylindrical tread and be of double or centre flanged. The wheels shall be mounted in such a manner as to facilitate removal and replacement. Provision for inserting lifting jacks shall be kept to permit withdrawal of wheels.

13.2 Material — Track wheels shall be of cast or wrought steel or shall have steel tyres shrunk on and registered.

13.2.1 The steel shall not contain more than either 0·060 percent of sulphur or phosphorus.

13.2.1.1 The hardness of steel shall not be less than 250 HB.

13.3 Diameter of Wheels — The maximum tread diameter of the wheels may be calculated from the formula given below:

$$D = \frac{1{\cdot}5\ W}{a}$$

where

D = tread diameter of wheel in millimetres,

W = wheel load in kilograms, and

a = full width of railhead including radii in millimetres.

13.4 Flanges — The dimensions of flanges of track wheels shall be not less than the values given in Table 5.

TABLE 5 FLANGE DIMENSIONS

Diameter of Wheels	Depth of Flange	Thickness of Wheel Flange at Base
mm	mm	mm
Up to and including 800	25	25
Over 800	30	35

Note — For centre flanged wheels, thickness of the flange should be increased.

14. BOLTS AND SCREWS

14.1 All bolts and set screws in rotating parts shall be locked. Bolts in tension shall be avoided wherever possible.

14.1.1 Washers and taper pads, provided on the under side of steel sections with tapered flanges, shall be tack welded in place.

14.1.1.1 All bolts and nuts shall preferably be in accordance with IS : 1364-1960* and IS : 1367-1961†. The diameter shall be not less than 10 mm in load carrying member.

*Precision and turned hexagonal bolts (6 to 39 mm) with nuts and hexagonal screws (6 to 39 mm).

†Technical supply conditions for threaded fasteners

15. BRAKES

15.1 Hoisting Motion — Each hoisting motion shall be fitted with a failsafe (electro-magnetic or any other type) brake and another emergency brake if required.

15.1.1 Where gravity lowering is used, it is recommended that automatic speed limiting brake is provided.

15.1.2 An emergency holding brake shall be fitted in the load side when a change speed gear is fitted.

15.2 Luffing or Derricking Motion — A failsafe (electro-magnetic or any other type) brake which is capable of arresting the jib with any load up to and including the test load at any radius between maximum and minimum shall be fitted.

15.3 Slewing Brakes — A slewing brake or other means of arresting the slewing motion shall be provided. The brake shall be capable of being secured in the holding position or other means of locking the structure shall be provided.

15.4 Travelling Brake — Electro-mechanical brake shall be provided.

15.4.1 *Anchoring* — Provisions shall be made for anchoring the crane when it is left unattended or under storm condition. This may be done by means of

a) a rail clip or screw jack at each corner, or
b) a chain anchor on each track, or
c) a storm brake which shall be independent.

15.5 General

15.5.1 *Capacity of Brakes* — Hoisting brake when applied shall arrest the motion and sustain any load up to and including the test load at any position of the lift.

15.5.1.1 Provision shall be made to control with safety the lowering of any load up to and including the test load.

15.5.1.2 Brakes in other motions shall be capable of bringing the relevant motions of the fully loaded crane safety to rest, in the shortest possible time, with the least possible shock and shall arrest the motion under all other service conditions.

15.5.2 *Springs* — Springs for electro-mechanical brakes shall be of the compression type and shall not be stressed in excess of 80 percent of the torsional elastic limit of the material.

15.5.3 *Weights* — Brake weights, if provided, shall be securely bolted to their levers, and locked.

15.5.4 *Brake-Drums and Shoes* — The wearing surface of all brake-drums shall be machined, and shall be cylindrical, smooth and free from defects. Brake-drums shall, preferably, be balanced.

15.5.5 *Adjustment* — Brakes shall be provided with a simple and accessible means of adjustment to compensate for wear and removal for relining.

15.5.6 *Brake Effort* — Under service conditions brakes applied by hand shall not require a force greater than 10 kgf at the handle. Brakes applied by foot shall not require a force of more than 15 kgf at the pedal.

15.5.6.1 It is recommended that the stroke of hand levers shall not exceed 300 mm and of pedals 150 mm.

15.5.7 *Locking* — Locking devices shall be provided on brake levers where necessary. Brake pedals shall have a non-slip surface.

15.5.8 Temperature of the rubbing surfaces of all brakes shall not exceed 100°C for fabric lining and 200°C for asbestos or metal lining.

16. LIFTING HOOKS

16.1 General — Lifting hooks shall comply with the relevant Indian Standard specification.

16.2 Types — For loads up to 40 tonnes ordinary shank type or 'C' type hook shall be used. For loads of 40 tonnes and over ramshorn of triangular hooks are preferred.

16.3 Mountings — Swivelling hooks shall be mounted on thrust bearings and a protective skirt shall be provided to enclose the bearings. If required a locking device shall be fitted to prevent rotation of hook and efficient catch provided to prevent displacement of sling or load from hook, or hooks shall be of such shape as to reduce as far as possible the risk of such displacement.

16.4 Shackles

16.4.1 Shackles shall comply with relevant Indian Standard specification and shall be provided with screwed pins which shall be suitably locked.

16.4.2 Each shackle shall be legibly stamped on a non-vital part with an identification number and the pin of the shackle shall bear the same number.

16.4.3 When the load on the shackle is not perpendicular to the axis, the allowable load shall be reduced depending on the angle at which it is applied.

17. OVERHAULING WEIGHT

17.1 If the hook, for single fall hoisting, is connected to the rope by means of a short length of chain, the overhauling weight shall be attached with the chain. When the overhauling weight is attached directly to the rope, the weight shall be machine bored and bellmouthed at the top and bottom. For split overhauling weights, all bolts and nuts shall be sunk and locked.

18. CABIN AND MACHINERY HOUSE

18.1 Cabin — The cabin shall be built with a clear head-room of not less than 2 m. It shall afford the driver an unrestricted view of the load and as clear a view as possible of surroundings including those forward, and to each side of his position.

18.1.1 A seat shall be provided for the driver and shall be so placed that the controller handles are within his easy reach.

18.1.2 Cabins shall be closed, weather-proof type with opening and/or sliding windows and have proper means of ventilation.

18.2 Machinery House — A house shall be fitted over the main machinery arranged for ready access for inspection and maintenance. Provision for adequate ventilaton and sky lights shall be kept.

18.3 The cabin and machinery house may be combined in one structure or be separate.

18.4 Effective provision shall be made to check entry of rain water through the openings in the roof required to pass wire ropes.

18.5 Guard — If the operator's seat is in the centre line of the crane in between two legs of the jib, the window in front of him shall be adequately guarded to protect from the inadvertent swinging of the load.

19. MEANS OF ACCESS

19.1 General — Safe means of access shall be provided to the driver's cabin and to every place where any person engaged on the inspection, repair and lubrication of the crane will be called upon to work; adequate handholds being provided where necessary.

19.2 Platform — Every platform shall be securely fenced with double guard rails and toe beards, Where practicable, an unobstructed gangway not less than 600 mm wide shall be provided between any moving part and guard rail, fencing or fixture.

19.3 Ladders — Sides of ladders shall extend to a reasonable distance above the platforms, or other reliable handholds shall be provided,

Ladders shall, if possible, slope forward. If the slope of ladder exceeds 3 in 1 and its length exceeds 9 m, a resting place shall be provided approximately in midway. Vertical ladders exceeding 3 m in length shall be provided with back safety guard.

20. GUARDING

20.1 All gear wheels, pinions and chain drives shall be totally 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.

20.2 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.

20.3 The sheaves of hook blocks shall be guarded as far as possible to prevent the trapping of a hand between a sheave and the inrunning rope.

20.4 Rail Sweeper — Rail sweeper may be provided when specifically required.

21. CARRIAGE BUFFERS

21.1 When, from the position or duty of the crane, buffers are necessary on the carriage, they shall be of timber or of the spring type and shall for preference, be fixed on the main sills and not on the bogies. The buffers shall be fitted on extensions of the sills where the tails of adjacent cranes would otherwise foul each other.

22. WEATHER PROTECTION

22.1 All electrical and mechanical equipment outside cabin and machinery house shall be adequately protected from weather. All weather proof covers shall be easily removable.

23. PAINTING

23.1 Before despatch of the crane the complete crane covering structural, mechanical and electrical parts shall be thoroughly cleaned of all dirt grease, scale and rust and then given a single coat of primer. The exposed mechanical parts of the crane shall be given one coat of rust preventor.

24. LUBRICATION

24.1 Provision shall be made for lubricating all bearings and this shall be easily accessible from the working platforms of the crane.

24.2 In case centralized lubrication is provided it shall be given in Appendix A. In this case provision shall be made at the bearings to vent excess lubricant pressure.

24.3 Lubricating nipples, pipes, and adopters shall generally comply with the relevant Indian Standards.

24.4 A lubricating chart in the maintenance manual shall be provided indicating all the lubricating points, the type of lubricant and recommended frequency of lubrication.

24.5 Grease lubricated ball and roller bearings shall in addition be packed with grease during initial assembly.

25. SAFETY REQUIREMENTS

25.1 The cranes should comply with the relevant safety regulations under the Factories Act and Indian Electricity Rules prevalent in various States, Indian Dock Labourer's Regulation and other Statutory Regulations.

SECTION 3 ELECTRICAL

26. MOTORS

26.1 Ratings and Enclosures — The ratings shall be such that, under the specified service conditions, the temperature rise will not exceed the limits specified in IS : 325-1961* or other relevant Indian Standards. This shall not preclude use of intermittent rated motors if required.

26.1.1 The enclosures shall suit the specified service conditions and shall be stipulated with the enquiry or order.

26.2 Torque — The pull-out torque of any motor supplied at rated voltage should preferably be not less than 2½ times the rated torque.

26.3 Design and Construction — Motors shall be suitable for reversing, frequent acceleration and braking.

26.3.1 If it is intended to retard or stop the motion of a crane by electric braking, the motor shall be of suitable design to withstand this duty.

26.4 Mounting — Motors shall be so located that the brushgear and terminals are accessible for inspection and maintenance and normal ventilation is not restricted.

26.5 Limiting Speed — Unless specially designed for specified higher speeds, motors shall be capable of withstanding maximum speed of two and half times the rated speed or 2 000 revolutions per minute whichever is lesser.

*Specification for three phase induction motors (*second revision*).

26.6 Terminals — Motor leads shall be brought out from the motor frame to terminals in the terminal box fixed to the frame. When mill type motors are used, it may not be applied.

27. CONTROLLERS

27.1 General — Controllers shall comply with relevant Indian Standards and shall be adequately protected to prevent accidental contact with live parts.

27.2 Rating — Controllers shall be rated to comply with relevant Indian Standards.

27.3 Accessibility — All controllers shall be so disposed that the contacts and terminal arrangements are readily accessible for inspection and maintenance.

27.4 Marking and Direction of Operation of Controllers — Where practicable, controller handles should move in the direction of the resultant load movement. Each controller shall be marked in a permanent manner to show the motion controlled, and wherever practicable of the direction of movement.

27.5 Notching — The notching for the controller handle in the 'OFF' position shall be more positive than the notching in other position. The handle may be provided with a lock, latch, 'dead man' or 'spring return' feature if specially requested by the customer.

27.5.1 The control lever shall be provided with stops and/or catches, to ensure safety and facility of operation. A controller drum fitted with a star wheel shall be regarded as complying with the requirement.

28. RESISTORS

28.1 General — Resistors shall be adequately protected to prevent accidental contact with live parts. The resistors shall preferably be of such material which is resistant to the corrosive action of saline atmosphere.

28.2 Rating — Resistors shall be rated such that the temperature does not exceed the limits specified in the relevant Indian Standards during the operation of the crane under service conditions.

28.2.1 Resistors shall be rated according to the service conditions and the mechanism class of the crane and shall preferably be intermittent rated. Short time rated resistors may, however, be used.

The rating of resistors shall be not less than that as shown below:

Mechanism Class	*Short Time Rated Resistors, Minutes*	*Intermittent Rated Resistors, Seconds*	
		ON	OFF
2	5	15	45
3	5	15	30
4	10	15	15

28.3 Fittings — Resistors shall be enclosed in well-ventilated housings and, wherever necessary, be fitted with suitable covers.

29. CRANE CONTROL

29.1 General — All control handles and pedals shall be placed in convenient positions to allow the driver ample room for operation and permit an unrestricted view of the load.

29.1.1 The hoist motion circuits shall enable any load to be lowered with safety and the hoist motor shall remain under effective control with controller in all positions.

29.2 Control OFF Position — Controllers when in the OFF position shall open all supply lines of the respective motors unless otherwise agreed, in which case a warning notice shall be fixed to the controllers.

29.3 Control Circuits — If the mains supply is alternating current and the control circuits are supplied at reduced voltage, the supply to these circuits shall be from the secondary winding of an isolating transformer or an isolating transformer and rectifier. One pole of this supply shall be earthed and the contactor and relay coils shall be connected to this pole, or other equally effective means shall be adopted to prevent mal-operation owing to sneak circuits or earth faults.

29.4 Schemes of Control — If electrically operated contactor equipment is used for the control of all crane motions, the protective equipment shall be in accordance either with Scheme A, in which each motion has separate protection, or with Scheme B, in which an overload on any motion trips out the crane supply. The two schemes are given below:

Scheme A

a) *Switchgear Common to All Motions* — The main contactors or main circuit-breaker shall open all lines. If a main circuit-breaker is used, it shall be hand operated, unless otherwise specified, fitted with a shunt trip and rated to carry at least the combined full load current of the two motions having the largest horse-powers.

It shall be prominently labelled MAIN CIRCUIT-BREAKER. Instantaneous adjustable electro-magnetic type over current releases on each pole shall be provided to trip the main circuit-breaking device and shall be connected as close to it as possible. The setting of these over-current releases shall be such that the circuit will be tripped instantaneously when the current rises to 250 percent of the value specified above.

b) *Switchgear for Individual Motions* — Each motion shall be separately protected and provided with an under-voltage release. The minimum provision of over-load protection shall be that all supply lines except one to each motion shall be provided with adjustable inverse time-lag, suitable type over-load releases. These shall be connected as close as possible to the contactors they control, and shall be set to trip the circuit of the motion controlled when carrying 200 percent of the full load current of the motor, after a time-lag of approximately 10 seconds.

c) It shall not be possible to reinstate the current supply to the contactor closing coils of a motion until the master controller for the motion is returned to the OFF position.

Scheme B

a) *Switchgear Common to All Motions* — All motions shall be controlled by a common main contactor or contactors or trip free circuit-breaker or circuit-breakers fitted with no-volt release and rated to carry the combined full-load current of the two motions having the largest horse-powers.

b) *Protective Devices for Individual Motor* — Any motor having a horse-power less than one-third that of the largest motor served by the common over-load release shall be protected by separate over-load release. The number of over-load devices and their positions shall normally be in accordance with one of the arrangements shown in Table 6 but if specified by the purchaser, other arrangements giving protection of not less than any of these shall be considered as complying with the specification.

Adjustable electro-magnetic type over-load release shall be provided to trip the main contactor or contactors or circuit-breaker or circuit-breakers and shall be connected as close to it (them) as possible. The minimum provision for over-current protection shall be:

i) One instantaneous release in a common line feeding all motions set to trip the main contactor or contactors or circuit-breaker or circuit-breakers instantaneously when the current rises to 250 percent of the value specified above, and

ii) One inverse time-lag release in each other line feeding each motion, set to trip the main contactor or contactors or

TABLE 6 NORMAL REQUIREMENTS FOR NUMBER OF PROTECTIVE DEVICES FOR MOTOR CIRCUIT

[*Scheme* B (b)]

dc SUPPLY		3-PHASE ac SUPPLY
Neither Line Earthed	One Line Earthed	
1 per motor + 1 in common return line	1 per motor each connected in the non-earthed line	2 per motor in separate phase wire + 1 in the common return line
2 per motor in separate lines	1 per motor + 1 equivalent to that connected in common return line but each connected in the non-earthed line	3 per motor in separate lines

circuit-breaker or circuit-breakers when carrying 200 percent of the full-load current of the line, after a time-lag of approximately 10 seconds.

It shall not be possible to reinstate the current supply to the common main contactor closing coils, or complete the under-voltage circuit of the circuit-breakers until the controllers for all motions are returned to the OFF position.

29.4.1 If drum controllers of mechanically operated contactor controllers are used for the control of all crane motions, the protective equipment shall comply with Scheme B.

29.4.1.1 Where a motion is Ward-Leonard controlled, provision shall be made for:

a) protection in case of motor field failure,

b) protection against the motor creeping when the controller is in the OFF position, and

c) tripping of the generator field circuit with suppression of generator voltages instantaneously, when there is an over-current of 250 percent in the generator-motor loop, or after a time-lag when there is a sustained over-current of lower value.

29.4.1.2 Operation of any of the above protective devices shall automatically apply the electro-mechanical brakes on the relevant motion.

29.4.1.3 If other systems of control or mixed systems are specified, the protective equipment shall be in accordance with the recommendations of the control gear manufacturer.

29.4.1.4 A circuit diagram of the protective equipment shall preferably be provided in the electrical equipment compartment by the manufacturer of the protective panel.

29.5 Control Switch Fuse — A double pole switch fuse connected in the coil circuit of the main contactor shall be provided.

29.6 Control for dc Supply — When a dc control circuit is so designed that the motor acts as a generator in the lowering direction the control shall be such that:

a) with the minimum load on the hook, the motor may not exceed a predetermined maximum rev/min,

b) progressive degree of braking is provided on the various steps of the controller,

c) adequate light hook lowering speeds are provided,

d) arrangements shall be made to prevent the brake from being released by the back emf of the motor when the power supply has been interrupted, and

e) the electro-mechanical brake is automatically applied when the circuit-breaker or contactor is opened, that is, in the case of a crane with a common protective panel this applies to the main circuit-breaker or contactor and in the case of a crane with individual protection for each control panel, this applies to the circuit-breaker or contactor attached to the hoist control panel.

29.7 Pilot Lamp — A pilot lamp with red lens should be located at a visible point. Pilot lamp should either be connected so that it indicates whether the control switch is ON or OFF, or the contactor is CLOSE or OPEN.

29.8 Emergency Push Button — A push button emergency stop shall be so located so as to be readily available for prompt use by the operator in case of emergency. If specified by the purchaser the number of emergency stops may be more than one. Unless otherwise, agreed, the provision of a RESET button is not required.

29.9 OFF Position Interlocking — Electrical Interlocking shall be provided to prevent the main contactor or circuit-breaker from being closed unless all controllers are in the OFF position.

29.9.1 A suitable control circuit may be provided for the main circuit-breaker to prevent it from being closed when the contactor of a particular motor has failed to open although the corresponding controller has been brought to its OFF position.

30. BRAKE

30.1 Service Brakes — Each motion shall have minimum one failsafe (electromechanical or any other type) brake which shall apply automatically, when the power supply fails or when the circuit-breaker is opened.

When the controller handle is brought to the OFF position, the particular brake shall apply.

30.2 Emergency and Parking Brakes — When an electro-mechanical brake is used as an emergency or parking brake, the brake shall remain in circuit when the main circuit-breaker is closed and the brake shall apply automatically when the power supply fails or when the circuit-breaker is opened, but not when the controller handle is brought to the OFF position.

30.3 Electrical Braking — In addition to the specific requirements of this code in regard to the provision of brakes, and irrespective of the supply current, electrical braking is permissible on all motions of electrically operated cranes.

30.4 Brake Magnets — The terminals of brake magnets shall be protected from accidental contact and the connections and windings shall be effectively protected from mechanical damage. Where necessary, magnets shall be provided with an efficient cushioning device. Two duties are recognized for both ac and dc, namely:

a) continuously or heavy duty, and b) normal duty.

30.4.1 Since, with an alternating current brake magnet, the current in the coil is greater for the open position than that when closed, the rating for ac are slightly different from dc as shown in table 7.

TABLE 7 BRAKE MAGNET RATINGS

KIND OF OPERATION	dc MAGNETS	ac MAGNETS
Heavy duty	Suitable for being in circuit not more than 7½ minutes out of every 15 minutes	Suitable for being in circuit continually where the brake coil operates infrequently
	OR	*OR*
	240 operations per hour	For 240 operations per hour where the time that the brake coil is in circuit is not more than 5 minutes out of every 16 minutes
Normal duty	Suitable for 240 operations per hour where the time that the brake coil is in circuit is not more than 5 minutes out of every 15 minutes	Suitable for 120 operations per hour where the time that the brake coil is in circuit not more than 5 minutes out of every 15 minutes

30.4.2 The brake magnets shall operate, for both duties at the current and voltages given in Table 8.

30.5 Brake Release — Appropriate mechanical, electro-hydraulic or any other alternative failsafe brake releasing gear may be used instead of brake magnet if desired.

TABLE 8 BRAKE MAGNET OPERATING CURRENTS AND VOLTAGES

(*Clause* 30.4.2)

Winding		dc Magnets	ac Magnets
Series	For series resistors control	Lift at 60 percent rated current. Hold at 15 percent rated current	—
	Potentiometer	Lift at 40 percent rated current. Hold at 15 percent rated current	—
Shunt		*Lift at 90 percent rated voltage	*Lift at 90 percent rated voltage
		Hold at 50 percent rated voltage	*Hold at 50 percent rated voltage

NOTE — Arrangements shall be made, where necessary to prevent the brake magnets from being energized by the back emf of the motor when the supply has been interrupted.

*This is intended to apply with hot coils corresponding to the duty cycles at rated voltage. The temperature rise of the brake magnet shall not exceed that allowed for the control equipment fitted.

31. ISOLATING SWITCH

31.1 General — A metal clad isolating switch with OFF position lock shall be placed in an accessible position on the crane carriage just after the cable reeling drum or equivalent collector gear. An indicator shall be fitted to show clearly whether the switch is ON or OFF.

31.1.1 Another isolating switch shall be fitted inside the machinery house adjacent to it to cut off the supply of all power driven and associated equipment, but not the auxiliary leads such as lightings.

31.1.2 Means shall be provided in the control cabin, and readily accessible to the driver, for switching off promptly all power to the motors in case of emergency. This may be a main switch or the push-button associated with the crane protective panel, where contactor-type circuit breakers are used, or the main switch, where switch and fuse protection is adopted.

31.2 Isolators for Auxiliary Circuits — Crane lighting, driver's cabin heating, fans, etc, when required shall be supplied from the live side of the main isolating switch and shall be controlled by separate isolating switches. If the supply voltage exceeds 250 volts and lamps are operated in series double pole isolating switches shall be provided.

31.3 Interlocking — If the main isolating switch is combined with the crane protective panel, it shall be mechanically interlocked with the door/

giving access to the panel, and the incoming terminals shall be screened to prevent accidental contact when the door is open. When not so combined, a suitably worded red warning plate shall be attached to the cover of the protective gear and all other panels and controllers, not fitted with interlocked isolators.

32. LIMIT SWITCHES

32.1 General — A limit switch, after being tripped, shall automatically reset itself within a reasonable distance travelled in the opposite direction. This does not prevent the use of change over type limit switches, where the resetting is achieved by a striker when moving in the opposite direction.

32.2 Hoist Limit Switch — A positively acting mechanism which cuts off the current and stops the motion and applies the brake when the hook has risen to a predetermined level with jib in any position shall be provided to prevent overwinding. Limit switches may be fitted if required to prevent overlowering.

32.3 Limit Switches for Luffing — A limit switch shall be provided to limit the level luffing or derricking in either direction.

32.4 Limit Switches for Travel — Limit switches if specified shall be fitted to prevent overtravelling.

33. COLLECTOR RINGS

33.1 For conveying current between the non-revolving and the revolving part of the crane a collector column shall be provided within easy access for maintenance. The column shall consist of collector rings with contact fingers of ample capacity. Rings and fingers shall be readily accessible for examination.

34. CABLE AND WIRING

34.1 Cables — Rubber insulated cables, polyvinyl chloride insulated cables or varnished cambric insulated cables used for crane wiring should comply with the relevant Indian Standard specifications.

34.2 Minimum Size — Cable having conductors smaller than 2·5 mm^2 nominal equivalent copper area of cross-section shall not be used for the power wiring to any of the motors. For control circuits and auxiliary wiring, cables having a sectional area smaller than 1·5 mm^2 nominal equivalent copper area shall not be used.

34.3 Protection — All cables shall be adequately protected against mechanical damage and metal trunking may be used if desired. Electric conduits shall comply with the relevant Indian Standard. If cables are

drawn into a steel tube, the steel tube shall be heavy gauge welded or solid drawn, screw jointed.

34.4 Multicore Cables — Multicore power and control cables suitably clamped to the crane structure may be used. Suitable clamping glads should be provided at both ends of each multicore cable, cables shall be either armoured or unarmoured suitably protected throughout their length. A flexible metallic tube or duct may not form an effective earth connection and shall not be used for that purpose. Taped and braided varnished cambric insulated cables shall not be used for outdoor cranes.

34.5 Current Rating — Ratings of the cables shall comply with the relevant Indian Standard specifications. Where cranes are equipped with one hour rated motors, the stator or armature cables may be rated by a factor of 1·4 above the ratings for continuous duty. Similarly for cranes equipped with half hour rated motors an up-rating factor of 1·7 may be used. Where the cranes are equipped with intermittend duty rated motors the factor for uprating the cable will be equal to $\sqrt{\frac{100}{IDF}}$

where IDF is the intermittent duty factor.

34.5.1 The cables for rotor or armature resistor circuits carry current during accelerating periods only and may, therefore, be still further op-rated. For 10 minutes and 5 minutes rated resistors, the up-rating factors of 1·5 and 2 respectively may be used. For intermittent resistors suitable up-rating factor may be used.

34.5.2 Consideration should be given to such factors as the ambient temperature, grouping and disposition of the cables, and to the limitation of voltage drop, which will influence selection of suitable cables.

35. MAIN SUPPLY

35.1 For travelling cranes the main supply may be obtained from bare conductors or from convenient plug through a flexible cable. In the case of bare conductors, necessary collector gear shall be provided in the crane.

35.1.1 In the case of flexible cable, a cable drum with necessary slip-rings shall be incorporated in the crane. The cable drum may be either automatically or manually operated. When automatically operated a limit switch shall be provided to prevent overdrawing.

36. WIRING DIAGRAM

36.1 A wiring diagram of the crane shall be supplied. The diagram shall give the rating of each of the motors, the cable sizes and such other

information as will tend to facilitate inspection and maintenance of the crane.

36.1.1 A schematic diagram shall be supplied for contactor controlled cranes.

37. FIXED LIGHTING

37.1 General — Sufficient and suitable lighting shall be provided in the driver's cabin, machinery house and at access ladders.

37.2 All connections for lighting shall be from auxiliary isolator (*see* **31.2**).

37.3 All lights shall be fitted with shock absorbers.

38. HAND LAMP

38.1 If a hand lamp is provided it shall not be connected to a circuit exceeding 250 volts dc or 25 volts ac. In the case of an ac circuit the hand lamp shall be fed through a double wound isolating transformer with some part of the secondary winding earthed.

38.2 The primary winding of the transformer shall be controlled by a double pole switch. Fuses shall be provided in each pole of the primary circuit and one pole of each of the secondary circuits.

39. EARTHING

39.1 The crane structure, motor frames, and metal cases of all electrical equipment including metal conduit or cable guards, shall be effectively connected to earth complying with Indian Electricity Rules.

39.1.1 Where the crane is connected to the supply by flexible cord or flexible cable, the crane shall be connected to earth by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord or flexible cable.

39.1.2 Travelling cranes connected to the supply through collectors shall be effectively earthed.

SECTION 4 INSPECTION AND TESTING

40. INSPECTION AND TESTING

40.1 If required by the purchaser and specified in the contract, the purchaser or his authorized representative shall have access to the

manufacturer's works at all reasonable times for the purpose of witnessing the manufacture, inspection and testing of all products concerned and/or the complete crane.

40.2 Any work found defective or which is not in accordance with the drawings or of the terms of this code and/or the contract may be rejected by the inspector.

41. TESTS AND MANUFACTURER'S WORKS

41.1 All electrical and mechanical equipment shall be tested in accordance with the appropriate Indian Standard at either, the crane maker's or equipment manufacturer's work and manufacturer's test certificates provided, if required by the customer.

41.2 If required by the purchaser and specified in the contract, the crane shall be tested at manufacturer's works under full load and 25 percent over-load on hoisting, slowing and luffing. Testing of long travelling motion is not necessary.

41.3 Any test required by the purchaser beyond those called for in the appropriate Indian Standard shall be subjected to mutual agreement and shall be carried out at the purchaser's expense.

42. TESTS AT PURCHASER'S PREMISES

42.1 Insulation Tests — After erection but before the crane is connected to the supply, the insulation of the electrical equipment shall be tested by a suitable instrument and any defects revealed shall be rectified.

42.1.1 The voltage required for the insulation resistance test shall be a dc voltage not less than twice the rated the voltage.

42.1.2 Any reading less than 0·5 megohm obtained with an insulation resistance tester of the unregulated type shall be disregarded and the wiring under test shall be subdivided until a reading higher than 0·5 megohm is obtained. Failure to obtain a higher reading shows an unsatisfactory state of the insulation.

NOTE — A reading below 0·5 megohm obtained with such a tester may indicate that unduly low proportion of the prescribed test voltage is in fact being applied.

If an installation has been subdivided for test purposes, each subdivision shall meet the requirements.

42.1.3 The insulation resistance of each wiring circuit exclusive of connected apparatus shall be not less than 2 megohms. If necessary, it shall be permissible to disconnect individual items of equipment while making this test.

42.2 Tests for Operation — After the supply has been connected and before the complete crane installation is put in to commercial service, tests on firm level ground shall be carried out to prove the following:

a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavourable conditions;

b) The correctness of all circuits and interlocks and sequence of operation;

c) The satisfactory operation of all protective devices;

d) The satisfactory operation of each motion of the crane;

e) The satisfactory operation of load and radius indicator;

f) The crane shall be tested for each motion in each direction under the following conditions:

1) With no load;

2) With each safe working load at its specified maximum radius;

3) With over-load 25 percent in excess of safe working load at its specified maximum radius.

The specified speeds at full load shall be within ± 10 percent. During the over-load test the specified speed may not be attained but the crane will handle over-load without difficulty.

g) All brakes shall be tested with 25 percent over-load on the crane. In addition, it is recommended that each brake on hoisting and derricking motion be tested under full load, from the maximum rated speed to rest, not less than three times in quick succession.

NOTE — In the case of erection of the crane by a party other than the supplier, the purchaser shall satisfy the supplier before the above tests are carried out that the erection of crane has been done according to the supplier's requirements.

43. STABILITY TEST

43.1 When a stability test is required by the purchaser, the load on the hook or grab shall be of static character only, and built up gradually above the amount of the active test load. The load on the crane in the condition of tipping (*see* **4.1**) at the operating radius for appropriate safe working load, and with the crane in the position of least stability shall not be less than the safe working load plus 50 percent under conditions **4.1** (a) and plus 75 percent under condition **4.1** (b), and the crane subjected to a wind force of 25 kgf/m^2 acting at the same time. During this test care shall be taken that the load remains close to the ground. The jib should be in a position which places the crane in a condition of last stability.

43.1.1 The stability requirement given in **43.1** shall normally be deemed to be satisfied by theoretical checks only.

APPENDIX A

(*Clauses* 0.4 *and* 24.2)

INFORMATION TO BE SUPPLIED WITH THE ENQUIRY OR ORDER

A-0. The following information in regard to the details of the crane shall be furnished by the purchaser at the time of enquiry or order. Capital letters in parentheses refer to those in clearance diagram (*see* Fig. 1).

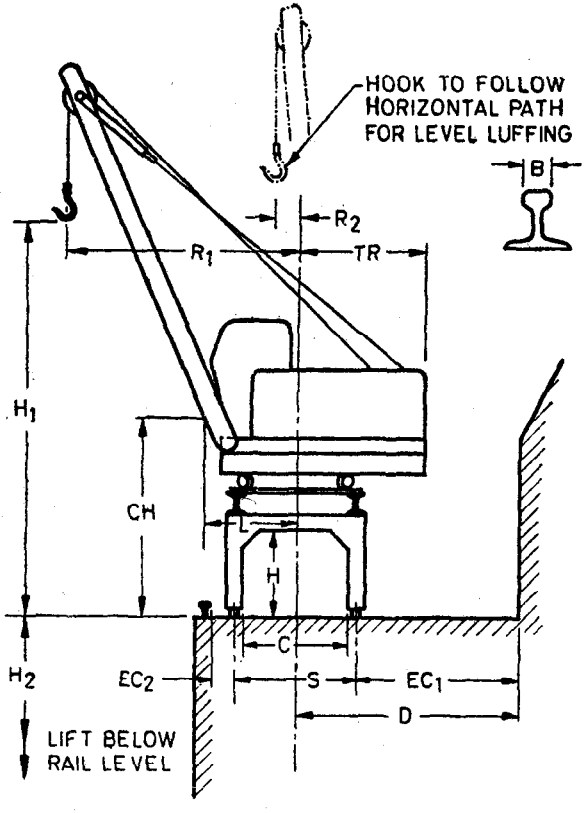

FIG. 1 CLEARANCE DIAGRAM OF HIGH PEDESTAL JIB CRANE

A-1. General

a) Number of cranes.....

b) Duty of class of crane..... (*See* **4.3** of IS : 807-1963*)

1) Crane structure.....
2) Main hoist.....
3) Auxiliary hoist.....
4) Slew.....
5) Derricking .....
6) Long travel.....

} (*See* **4**)

c) Crane capacity in tonnes

1) Main hoist.....at maximum radius (R_1).....m
at minimum radius (R_2).....m
2) Auxiliary hoist.....at maximum radius (R_1).....m
at minimum radius (R_2).....m

d) Range of lift

1) Main hoist (H_1).....metres above rail level at maximum radius (R_1)
(H_2)..... metres below rail level at minimum radius (R_2)
2) Auxiliary hoist (H_1).....metres below rail level at maximum radius (R_1)
(H_2).....metres above rail level at minimum radius (R_2)

e) Is level luffing required ?.....

f) Is crane to be used with hook or grab ? .....

g) Additional information required for grab crane :

1) Nature of material to be handled.....
2) Weight per cubic foot and grain size.....
3) Output in tonnes/hour and operating cycles/hour.....
4) Type of grab.....
5) No. of ropes.....
6) Capacity of grab.....
7) If the purchaser is to supply the grab, give the gross and empty grab bucket weights.....

*Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.

h) Abnormal atmoshperic conditions, if any.....

j) Is change gear required for grain hoist ?.....

k) Travelling track details:

1) Track gauge (S).....m

2) Width of rail head (B).....mm

3) Size and weight/unit length of rail section.....

4) State difference of level if the track rails are not on same level.....

5) Sketch showing crane tracks, clearances and obstruction or any other site restrictions.....

6) Minimum wheel load.....t

m) Any special requirements, such as lighting, limit switches, etc.

-2. Crane performance:

a) Operating speeds:

1) Main hoist:

Slow gear.....m/min

fast gear.....m/min

2) Auxiliary hoist.....m/min

3) Derricking or luffing at full load.....m/min

4) Slewing at full load.....m/min

5) Travelling full load.....m/min

b) Tail radius:

1) Maximum permissible projection from centre line of crane to tail end of crane (TR).....m

2) Distance from centre line of crane to nearest obstructing point (D).....m

3) Minimum clear height (CH) metres to underside of jib or revolving structure at distance (L).....m

4) Minimum end clearances:

i) (EC_1).....

ii) (EC_2).....

c) Portal clearance (if required):

a) (H).....m

b) (C).....m

A-3. Electrical details:

a) Power supply ac or dc:

1) ac supply:
Volts .....No. of phases.....Frequency.....c/s
No. of wires.....Neutral (earthed or not).....

2) dc supply:
Volts.....No. of wires.....
Is one pole earthed ?.....

b) Type and position of conductors or boxes.....

c) If cable reeling drum is required, state whether automatic or hand operated... .....

d) Ambient temperature ....°C

e) Types and rating of motors.....

APPENDIX B

(Clause 0.4)

INFORMATION TO BE SUPPLIED BY MANUFACTURERS

B-0. The following details in regard to the crane should be supplied to the purchaser at the time of enquiry and order.

B-1. Type and class of crane:

a) Crane structure.....
b) Main hoist.....
c) Auxiliary hoist.....
d) Slew .....
e) Derricking or luffing..... .....
f) Long travel.....

B-2. Crane capacity:

a) Main hoist.....t at maximum radius (R_1)..... m
.....t at minimum radius (R_2)..... m

b) Main hoist change gear load...t at maximum radius (R_1)... m
...t at minimum radius (R_2)... m

c) Auxiliary hoist.....t at maximum radius (R_1)... m
...t at minimum radius (R_2)... m

B-3. Range of lift:

a) Main hoist (H_1)...m above rail level at maximum radius (R_1)
b) Main hoist (H_2)...m below rail level at minimum radius (R_2)
c) Auxiliary hoist (H_1).....m above rail level at maximum radius (R_1)
d) Auxiliary hoist (H_2).....m below rail level at minimum radius (R_2)

B-4. Tail radius (TR)..... .....m

B-5. Travelling track:

a) Centre distance (S) of track rails.....m
b) Size of track rail recommended.....

B-6. Operating Speeds:

a) Main hoist: slow gear.....t at.....m/min
b) Main hoist: fast gear.....t at.....m/min
c) Auxiliary hoist .....t at .....m/min
d) Derricking or luffing, full load .....m/min
e) Slewing..... m/min
f) Travelling.....m/min

B-7. Type of hook or where applicable type of grab supplied:

a) Main hoist.....
b) Auxiliary hoist .....

B-8. Gearing

a) Type.....
b) Material.....
c) Type of slewing gear.....

B-9. Travelling wheels:

a) Material ....
b) Maximum wheel load excluding impact..... .....t

B-10. Type of support provided for revolving part of crane:

a) Live ring roller ....
b) Rollers on fixed axles..... .....
c) Centre pillar.....

B-11.

Wire ropes	Diameter (mm)	Construction	Quality of Steel	No. of Falls	Minimum Breaking Strength	Factor of Safety
Main hoist						
Auxiliary Hoist						
Derrick						

B-12. Type of driver's cabin and machinery house

B-13. Description of brakes:

a) Hoist.....

b) Derrick.....

c) Slew.....

d) Travel.....

B-14. Electrical details

B-14.1 Power supply, ac or dc.....

a) Volts .....Phase..... Frequency.....c/s

b) No. of wires.....

B-14.2 Motors:

a) Temperature rise ....°C

b)

Motion	Quantity	Type	Metric Horse Power	Synchronous Speed rev/min	Enclosure	Rating
Main hoist						
Auxiliary hoist						
Slew						
Derrick						
Long travel						

B-14.3 Details of controllers control panel and equipment.....

B-14.4 Particulars of safety devices.....

B-15. Net weight of complete unladen crane.....t

B-16. Tools and accessories supplied.....

B-17. Other information not scheduled above

B-18. General arrangement drawing No. .....

APPENDIX C

(*Clause* 6.1)

LIST OF RELEVANT INDIAN STANDARDS FOR MATERIALS AND EQUIPMENT, AND CODES OF PRACTICE

C-1. MATERIALS

C-1.1 Steel and Castings

IS : 210-1962 Specification for grey iron castings (*revised*)

IS : 226-1962 Specification for structural steel (standard quality) (*third revision*)

IS : 961-1962 Specification for structural steel (high tensile) (*revised*)

IS : 1030-1962 Specification for steel castings for general engineering purposes (*revised*)

IS : 1387-1959 General requirements for the supply of materials and metal products

IS : 1570-1961 Schedule for wrought steels for general engineering purposes

IS : 1875-1961 Specification for carbon steel, bars, billets, blooms and slabs for forgings

IS : 2062-1962 Specification for structural steel (fusion welding quality)

C-1.2 Bolts and Nuts

IS : 1363-1960 Black hexagonal bolts (6 to 39 mm) with nuts and hexagonal screws (6 to 29 mm)

IS : 1364-1960 Precision and turned hexagonal bolts (6 to 39 mm) with nut and hexagonal screws (3 to 39 mm)

IS : 1367-1961 Technical supply conditions for threaded fasteners

C-1.3 Wire Ropes

IS : 2266-1963 Specification for steel wire ropes for general engineering purposes

IS : 2365-1963 Specification for steel wire suspension ropes for lifts and hoists

IS : 3973-1967 Code of practice for selection, installation and maintenance of wire ropes (*under preparation*)

C-2. MECHANICAL AND FABRICATION DETAILS

C-2.1 Keys and Keyways

IS : 2048-1962 Specification for parallel keys and keyways

IS : 2291-1963 Specification for tangential keys and keyways

IS : 2292-1963 Specification for taper keys and keyways

IS : 2293-1963 Specification for gib-head keys and keyways

IS : 2294-1963 Specification for woodruff keys and keyslots

C-2.2 Welding

IS : 816-1956 Code of practice for use of metal arc welding for general construction in mild steel

IS : 818-1957 Code of practice for safety and health requirement in electric and gas welding and cutting operations

IS : 10248 Code of practice for welding of structures subject to dynamic loading (*under print*)

IS : 1323-1959 Code of practice for oxy-acetylene welding for structural work in mild steel for welding of structures

C-2.3 Gears

IS : 2467-1963 Notation for toothed gearing

IS: 2535-1963 Basic rack, modulus, etc, for general engineering purposes

C-2.4 Rivets

IS : 1929-1962 Rivets for general purposes (12 to 48 *Min* dia)

C-3. ELECTRICAL DETAILS

C-3.1 Motors

IS : 325-1961 Specification for three phase induction motors (*second revision*)

IS : 900-1956 Code of practice for installation and maintenance of induction motors

C-3.2 Cables and Conductors

IS : 434 (Part I)-1964 Specification for rubber insulated cables : Part I With copper conductors (*revised*)

IS : 434 (Part II)-1964 Specification for rubber insulated cables : Part II With aluminium conductors (*revised*)

IS : 693-1965 Specification for varnished cambric insulated cables for electricity supply (*revised*)

IS : 694 (Part I)-1964 PVC insulated cables (for voltage up to 1 100 V) : Part I With copper conductors (*revised*)

IS : 694 (Part II)-1964 PVC insulated cables (for voltage up to 1 100 V) : Part II With aluminium conductors (*revised*)

IS : 1596-1962 Specification for polythene insulated and PVC-sheathed cables

IS : 1753-1961 Specification for aluminium conductors in insulated cables

C-3.3 Conduits

IS : 1653-1960 Specification for steel conduits for general engineering purposes

IS : 2509-1963 Specification for rigid non-metallic conduits for electrical installations

C-3.4 Switchgear

IS : 1822-1961 Motor starters of voltage up to 650 volts

IS : 2147-1962 Degrees of protection provided by enclosures for low-voltage switchgear and control gear

C-4. GENERAL CODES

IS : 807-1963 Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists

IS : 3177-1965 Code of practice for design of overhead travelling cranes and gantry cranes other than steel work cranes

IS : 4137-1967 Code of practice for heavy duty electric overhead travelling cranes including special service machines for use in steel works

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