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[MED 14: Mechanical Engineering]

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SPECIFICATION FOR ELECTRIC CHAIN HOISTS

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

Gr 7 ***September* 1972**

Indian Standard
SPECIFICATION FOR ELECTRIC CHAIN HOISTS

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Indian Standard
SPECIFICATION FOR ELECTRIC CHAIN HOISTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 28 April 1972, after the draft finalized by the Lifting Chains and Associated Fittings and Components Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 In the preparation of this specification, considerable assistance has been derived from the following publications:

AS B273-1968 Specification for chain blocks, power operated. Standards Association of Australia.

AS CB2-1960 SAA Code for cranes and hoists. Standards Association of Australia.

HMA 400 — Electric chain hoists. Hoist Manufacturers Association, USA.

0.3 The standard is in general agreement with the applicable requirements of IS : 807-1963* and IS : 3177-1965†.

0.4 A list of Indian Standards relevant to this standard is given in Appendix A.

0.5 Desirable information to be supplied by the purchaser with the enquiry or order and by the manufacturer are given in Appendices B and G respectively.

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.

*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.

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

SECTION I GENERAL

1. SCOPE

1.1 This standard covers the design, testing and operation of all industrial service electric chain hoists up to 5 tonnes capacity of the following types:

a) Lug suspended (*see* Fig. 1),

b) Hook suspended (*see* Fig. 2), and

c) Trolley suspended (*see* Fig. 3).

1.1.1 This standard also lays down the minimum requirements commensurate with safety.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Electric Chain Hoist — An electro-mechanical appliance whose principal function is lifting or lowering, or both, of loads and having a link or roller chain between the sheave and the lifting block.

2.2 Capacity or Safe Working Load — The maximum safe working load in tonnes that the hoist is designed to carry in service. This shall be specified by the manufacturer of the hoist and marked boldly and clearly on the hoist and the load block. Applied loads shall include all handling devices, such as buckets, magnets and grabs.

2.3 Basic and Permissible Stress — All permissible stresses specified in IS : 800-1962*, IS : 806-1968†, IS : 816-1969‡ and IS : 1024-1968§ are basic stresses for the purpose of this standard, and the permissible stresses in this standard are basic stresses multiplied by the applicable duty factor (*see* **5.2**).

2.4 Range of Lift — The distance between the upper and lower limits of the travel of the load block.

2.5 Hoisting Speed — The velocity in metres per minute at which the hoist will lift the rated load. The actual lifting speed shall be within 10 percent of the manufacturer's rating.

2.6 Head Room — Measured with the load hook in the highest position with full load, and it is the distance between the saddle of the load hook

*Code of practice for use of structural steel in general building construction (*revised*).

†Code of practice for use of steel tubes in general building construction *(first revision*).

‡Code of practice for use of metal arc welding for general construction in mild steel (*first revision*).

§Code of practice for use of welding in bridges and structures subject to dynamic loading.

and the following points:

a) The top of the lug or centre line of suspension holes on lug suspended hoists,

b) The bottom of the beam or rail on trolley suspended hoists, and

c) The saddle of the top hook on hook suspended hoists.

2.7 Hook Suspended Hoist — A hoist whose upper suspension member is a hook.

2.8 Lug Suspended Hoist — A hoist whose upper suspension members are lugs.

2.9 Trolley — A truck of carriage on which the hoist is mounted. The trolley may be moved by pushing, hand-geared or motor-driven.

2.10 Trolley Suspended Hoist — A hoist whose upper suspension member is a trolley for the purpose of running the hoist below a suitable runway.

2.11 Electric Brake — An electric motor acting as a brake by regenerative counter torque or dynamic means.

2.12 Electrically Operated Brake — A friction-brake actuated or controlled by electric means.

2.13 Limit Switch — A device to cut off the power automatically at any desired limit of travel.

2.14 Electrical Characteristics — Clearly specified electrical characteristics consisting of voltage, phases, cycles if ac is used, and voltage only if dc is used.

3. CAPACITY AND LIFT RATINGS

3.1 Industrial electric chain hoists shall be rated according to capacities as follows:

0.25, 0.5, 0.8, 1.0, 1.6, 2.0, 3.2 and 5.0 tonnes.

4. CLASSIFICATION

4.1 The hoists shall be classified in four classes with respect to the frequency of application and variation of magnitude of the load (*see* **5**) and the effect of impact (*see* IS : 807-1963*).

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

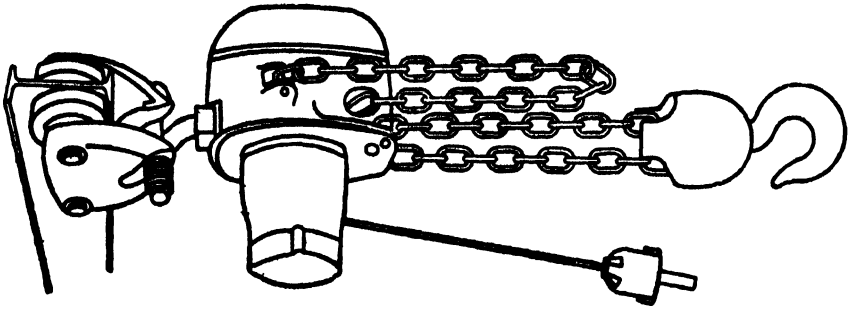


FIG. 3 TROLLEY SUSPENDED ELECTRIC CHAIN HOIST

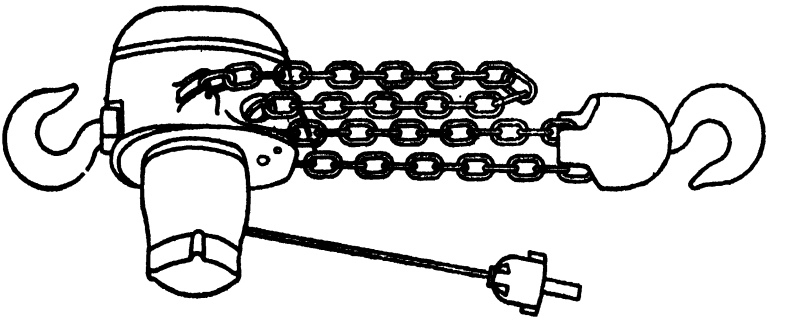


FIG. 2 HOOK SUSPENDED ELECTRIC CHAIN HOIST

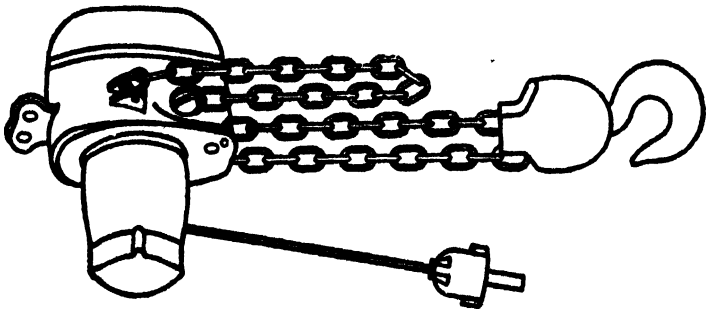


FIG. 1 LUG SUSPENDED ELECTRIC CHAIN HOIST

SECTION 2 MECHANICAL REQUIREMENTS

5. DESIGN AND FABRICATION

5.1 General — The materials used in the construction of hoists shall be properly selected for the stresses encountered when the equipment is used in accordance with the manufacturer's recommendations. The design of the component parts of the hoist shall include due allowance for the effects of the duty which the mechanism will perform in service and shall be in accordance with the requirements of **5.2** and **5.3**.

5.2 Design on Strength Basis — In the design of a component on the basis of ultimate strength, the value of the stress factor used shall be the basic stress factor multiplied by the duty factor for the appropriate hoist class; where basic stress factor shall be not less than 5 and the duty factor shall be as given in Table 1 for the appropriate hoist class. Normally the chain hoists are of Class 1.

TABLE 1 DUTY FACTOR AND LIFE OF MECHANISM

(*Clauses* 4.1, 5.2, 5.3.1, 7.1.3 *and* 7.3.3)

MECHANISM CLASS	DUTY FACTOR		AVERAGE LIFE	
	Strength	Wear	Running Hours Per Day	Total Life Hours
(1)	(2)	(3)	(4)	(5)
1	1.0	0.4	0.5	Over 2 500
2	1.2	0.5	1.5	„ 9 000
3	1.4	0.6	3	„ 20 000
4	1.6	0.7	Over 6	„ 40 000

5.3 Design on Life Basis — Components designed on the basis of life shall have a rated life of not less than 20 years of 250 days per year for Class 1, 300 days per year for Class 2, and 333 days per year for Class 3 and 4.

5.3.1 The running hours per day or the life in hours used for the purpose of the design of the components shall be the value specified in Table 1 for the appropriate class.

5.4 Welding — Steel parts may be joined by any fusion-welding process provided the welding is in accordance with the relevant Indian Standard. The design shall be such that the maximum permissible stresses In the welds shall not exceed those given in IS : 816-1969* and IS : 1323-1966†.

*Code of practice for use of metal arc welding for general construction in mild steel *(first revision)*.

†Code of practice for oxy-acetylene welding for structural work in mild steel.

5.5 Bolts and Nuts — All bolts and nuts shall comply with the relevant Indian Standard

5.5.1 Bolts in tensions shall be avoided wherever possible. Black bolts shall not be used for transmitting lifting loads. Bolts and set screws in rotating parts shall be locked.

5.6 Keys and Keyways — Keys and keyways shall comply with the relevant Indian Standard (*see* **A-2.1**). Keys shall be so fitted or secured that they cannot work loose.

6. LIFTING TACKLE

6.1 Load Chain and Chain Anchorages — Load chain shall be grade 40 or alloys steel calibrated link chain or roller chain to IS : 3109 (Part II)-1970*, IS : 2403-1964†, IS : 3542-1966‡ or IS : 3560-1966§.

6.1.1 The load chain anchorages, associated fittings and framework both at the lifting end and at the slack end shall be at least equal in strength to the general design of the block.

6.1.2 Roller chain anchorages shall be articulated.

6.2 Chain Wheels

6.2.1 *Material* — The load chain drive wheel shall be of a material of adequate strength suitable for use with the load chain employed. Iron castings of spheroidal or nodular graphite conforming to IS : 1865-1968‖ and malleable iron castings (whiteheart or blackheart) conforming to IS : 2107-1962¶ or IS : 2108-1962** may be used.

6.2.2 *Design* — The design of the load chain wheel drive shall be such as will ensure effective operation with the load chain. The load chain wheel shall have pockets accurately shaped to fit the links of the load chain, which shall operate freely and smoothly over the load wheel and without damage to the chain. Sprocket type wheels for roller chain shall be machined.

6.2.3 *Chain Guide* — The load chain drive wheel shall be equipped with chain guides so designed as to ensure that the chain cannot twist on

*Specification for round steel link chain (electric butt welded), Grade 40: Part II Calibrated load chain for pulley blocks and other lifting appliances *(first revision)*.

†Specification for transmission steel roller chains and chain wheels.

‡Specification for extended pitch transmission precision roller, chains and chain wheels.

§Specification for short pitch transmission precision bush chains and chain wheels.

‖Specification for iron castings with spheroidal or nodular graphite *(first revision)*.

¶Specification for whiteheart malleable iron castings.

**Specification for blackheart malleable iron castings.

entry into the chain block or become dislocated from the load chain drive wheel. The guides shall be effective under all operating conditions.

6.2.3.1 Where roller guides are used, the edges of their centre groove shall be radiused or chamfered to prevent damage to the load chain.

6.2.4 *Chain Stripper* — A chain stripper shall be provided to remove the chain from the sprocket.

6.2.5 *Chain Collector* — Slack chain shall be freely suspended and where necessary a chain collector shall be fitted. The chain collector shall be so designed as to permit the chain to enter the chain block in a manner that will not damage the chain or chain block.

6.3 Idler Wheel

6.3.1 *Material* — The idler wheel shall be of a material of adequate strength suitable for use with the load chain employed.

6.3.2 *Design* — For link chain, the design shall be such that the pitch diameter is not less than 16 times the size of the chain unless the wheel is so shaped as to prevent bending action in the direction of the length of the link. Where the design of the idler wheel provides for more than four pockets, the wheel shall have accurately pitched pockets for the reception of the load chain. Idler wheels in bottom assemblies shall be fitted with guards to prevent injury to persons handling the hook block whilst the chain block is in use.

6.3.3 *Chain Guides* — The idler wheel shall be provided with chain guides so shaped as to prevent the chain from twisting or leaving the wheel when passing round the wheel.

6.4 Hooks and Hook Fittings

6.4.1 *Hooks* — Hooks shall comply with the relevant Indian Standards.

6.4.1.1 Where the hook is supplied with a nut, the nut shall be held securely by a pin of diameter not less than one-quarter of the nominal thread diameter with a minimum of 5 mm.

6.4.1.2 The length of shank engaged by the nut on the load side shall be not less than 75 percent of the nominal diameter of the thread before pinning and the outside diameter of the bearing surface of the nut shall be not less than 1.4 times the nominal diameter of the thread.

6.4.1.3 All suspension assemblies which are not readily detachable for inspection for wear of parts, particularly hook shanks, shall be designed to permit the amount of wear to be measured by alternative means.

6.4.1.4 Every hook shall be permanently marked with its safe working load provided that its safe working load docs not exceed that marked on the chain block.

6.4.2 *Crossheads* — Unless otherwise approved, hook crosshead shall be of a single-piece steel construction.

6.4.3 *Trunnions* — Trunnions shall project through the cheek plates of the blocks by not less than 3 mm and shall incorporate means for preventing the spreading of cheek plates. Where a trunnion is of the oscillating type adequate bearing surfaces shall be provided.

6.5 Swivels

6.5.1 *Top Hook* — Where the top hook is required to swivel, it shall be fitted with plain bearings which may incorporate friction washers. Ball or roller bearing shall not be used.

6.5.2 *Bottom Hook* — The bottom hook shall be so designed that it shall be free to swivel in the loaded conditions without twisting the load chain.

7. TRANSMISSION DEVICES AND ANCILLARIES

7.1 Bearings

7.1.1 *Permissible Types* — All running shafts and wheels running on fixed axles or pins shall be fitted with ball, roller or bushed bearings unless otherwise specified.

7.1.2 *Design* — Due allowance shall be made for impact and side thrusts and, where necessary, spherical seatings and separate thrust bearings of suitable dimensions shall be used.

7.1.2.1 Ball and roller bearings shall conform to the dimensions specified in IS : 2513-1963*. Plain bearings shall, where practicable, be of the adjustable-cap type.

7.1.3 *Ball Bearings and Roller Bearings* — Ball bearings and roller bearings shall have a rated life of not less than 20 years, calculated in accordance with the manufacturer's recommendations and based on the equivalent running time given in Table 1.

7.1.4 *Bearing Pressure for Plain and Bushed Bearings* — In the case of plain and bushed bearings, the bearing pressure shall not exceed 7 MN/m^2 (70 kgf/cm^2) of projected area.

*Boundary dimensions for rolling bearings for general engineering purposes.

7.1.5 *Lubrication of Bearings* — Provision shall be made for lubrication of all moving parts and bearings, while the hoist is in service except where life-lubricated bearings are used. Ball and roller bearings shall, in addition, be lubricated before assembly. Lubricating nipples and adapters shall be easily accessible and shall generally comply with the relevant Indian Standards. All exposed bearings shall be suitably sealed or shielded.

7.1.5.1 Lubrication arrangements shall be such as to require infrequent attention.

7.2 Shafts

7.2.1 *General* — Shafts 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 of as large a radius as possible or be tapered or both to suit.

7.2.2 *Material* — All shafts shall be made of steel.

7.2.3 *Shaft Keys* — Where practicable, keys and keyways and splines shall confoim to the relevant Indian Standards.

7.3 Gears

7.3.1 *Types* — The gears used in electric chain hoist shall be machine-cut and shall conform to the relevant Indian Standards.

7.3.2 *Material* — All gears shall be of steel except as provided below:

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

b) High speed pinions may be of bonded fabric or bronze, and

c) Worm wheels or worm wheel rims shall be of bronze or brass and worm of hardened steel.

7.3.3 *Design* — Gears shall be designed for proper strength and surface durability in accordance with the relevant Indian Standards using the duty factor given in Table 1 as minimum for the appropriate class of mechanism.

7.3.4 *Keying* — Keys in gear trains shall be so fitted and secured that they cannot work loose in service.

7.3.5 *Lubrication* — All hoist gearing shall be enclosed and provided with means for ample lubrication.

7.4 Friction Drives — They shall be capable of transmitting a torque 50 percent greater than the torque transmitted when the hoist is lifting its safe working load applied as a direct pull on the sheave at the appropriate speed.

7.5 Brakes

7.5.1 *General* — Every electric chain hoist shall be fitted with an electro-mechanical brake.

7.5.1.1 Hoists handling molten metal or dangerous liquids shall be fitted with an additional brake on the hoisting motion. The additional brake shall be of delayed action type.

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

7.5.1.3 Brakes shall be provided with a simple and accessible means of adjustment to compensate for wear.

7.5.1.4 Suitable provision shall be made for holding the load in the event of the stoppage of the motor or failure of the current.

7.5.1.5 The operating arrangements shall be such that the brakes cannot be released accidentally.

7.5.2 *Capacity of Brakes* — The brake, when applied, shall arrest the motion and sustain any load up to and including the test load at any position of the lift. The brakes shall be capable of exerting a restraining torque 25 percent greater than the torque transmitted to the brake drum from the suspended test load, the friction in the transmission mechanism between the load and the brake not being taken into consideration.

7.5.3 *Brake Components*

7.5.3.1 *Brake drums and shoes* — The wearing surface of all brake drums shall be machined. It shall be cylindrical, smooth and free from defects. Brake lining shall be effectively and permanently secured to the brake shoes during the effective life of the lining. It shall be protected from water, grease, oil or other adverse effects. Under service conditions, the temperature of the rubbing surfaces shall not exceed 100°C with wood or fabric lining or about 200°C with asbestos or metal lining.

7.5.3.2 *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.

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

7.6 Ratchet Wheels and Pawls — These shall be made of steel and be capable of sustaining a load 25 percent above the maximum safe working load of the hoist. All ratchet teeth shall be sharp with sufficient under-cut to prevent inadvertent disengagement of the pawl.

8. TROLLEYS

8.1 Types — Trolleys shall be push type, hand-geared type or motor-operated type.

8.2 Gears — Hand-geared trolley track wheels may have gears with cast teeth.

8.3 Brakes — The trolley shall be provided with a brake if the rated speed of the trolley exceeds 35 m/min.

SECTION 3 ELECTRICAL CHARACTERISTICS

9. GENERAL

9.1 It is necessary that the following precautions are observed in installation and operation of electrical equipment of the electric chain hoist so that safety in operation is ensured:

a) The voltage used on a hoist shall not exceed 500 V;

b) All motors, controllers and switch frames shall be earthed;

c) All electric equipment shall be thoroughly protected from dirt, grease and oil and, where exposed to the weather, shall be thoroughly protected against the weather;

d) Guards for live parts shall be substantial and so located that they cannot be deformed so as to make contact with the live parts; and

e) Name plates shall be fixed in such a manner that it is difficult to remove them.

10. MOTORS

10.1 Rating and Enclosure — The rating shall be such that, under the specified service condition, the temperature-rise does not exceed the limits specified in IS : 325-1970* for three-phase induction motors or in other relevant Indian Standard. This shall not preclude the use of intermittent motors, if required.

10.1.1 The enclosure shall suit the specified working conditions and shall be stipulated with enquiry or order.

10.2 Torque — The pull-out torque of any motor supplied at rated voltage should preferably be not less than 2.25 times the rated torque.

*Specification for three-phase induction motors (*third revision*).

10.3 Degign and Construction — Motors shall be suitable for frequent reversal, braking and acceleration.

10.4 Mounting — Motors shall be so located that the brushgear and terminals are accessible for inspection and maintenance, and do not restrict the normal ventilation.

10.5 Limiting Speeds — Limiting speeds for motors should not exceed those specified by the motor manufacturer.

10.6 Terminals — Motor leads shall be brought out from the motor frame to terminals in the terminal box fixed to the motor frame.

11. PENDANT CONTROL SWITCH

11.1 General — Hoist shall be designated so that remote control may be effected by means of a push-button pendant switch or by means of a hand rope or chain so that the release of the hand rope or chain or push-button immediately and automatically causes the brakes to function. Push-button pendant switches are preferred to hand rope or chain for hoist block-operation and wherever possible, use of hand rope or chain shall be avoided. Pendant control switches shall be adequately protected to prevent accidental contact with live parts.

11.2 Operation — Push-button pendant control shall be electrically operated. Fully magnetic reversing type contactors shall be provided for the hoist and shall be operated by a momentary-contact type push-button station. The push-buttons shall return to 'off' position when pressure is released by the operator. A separate button or a single button providing steps for each speed of multispeed hoists shall be provided. The magnetic contactor shall be mechanically or electrically interlocked.

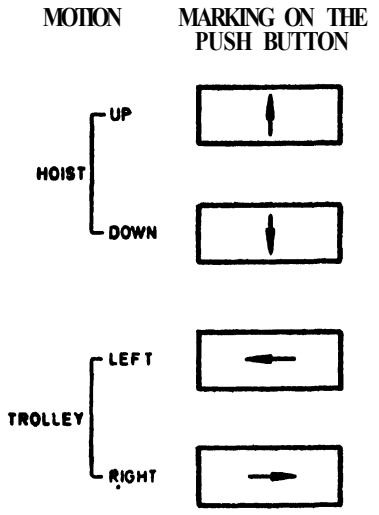
11.3 Accessibility — All controllers shall be so disposed that the contacts and terminal arrangements are readily accessible for inspection and maintenance purposes.

11.4 Pendant Push-Bntton Control Switch — The pendant switch shall be capable of withstanding rough handling without being damaged and the cover shall be effectively secured.

11.5 Suspension of Pendant Switch — The weight of the pendant shall be supported independent of the electric cable by means of chain or wire rope. If the pendant is of metal, it shall be effectively earthed. A chain or hook does not provide an effective earth connection and should not be relied upon for that purpose.

11.6 The push-button station shall be clearly marked as follows to indicate the function of each button. Push-button control voltage shall be not

more than 115 volts for ac. Voltage of 250 volts is permissible on dc or special applications.



12. CONTROLLERS AND RESISTORS

12.1 General — Controllers and resistors, where provided, shall be adequately protected to prevent accidental contact with live parts, and shall comply with the appropriate requirements of IS : 1822-1967*.

12.2 Rating — Controllers and resistors shall be rated such that the temperature-rise does not exceed the limits specified in IS : 1822-1967* during the operation of the hoist under service conditions.

12.2.1 Resistors, where provided, shall be rated according to the service conditions and the class of the hoist, and shall preferably be intermittent rated. Short time rated resistors may, however, be used. The rating of resistors shall be not less than that given below:

Class of Hoist	*Short-Time Rated Resistors, Min*	*Intermittent Rated Resistors, Seconds*	
		On	Off
1	2	10	35
2	5	15	45
3	5	15	30
4	10	15	15

NOTE — *See* Appendix D for rating of resistors.

*Specification for ac motor starters of voltage not exceeding 1 000 volts *(first revision)*.

12.3 Fittings — Unless otherwise specified, resistors shall be enclosed in well ventilated housings and wherever necessary, fitted with suitable covers.

13. CONTROLS

13.1 Control Circuits — If the main supply is ac 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 maloperation owing to sneak circuits or earth faults.

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

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

b) progressive degrees of braking are provided in the various steps of the controller;

c) adequate light hook lowering speeds are provided;

d) arrangements are 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 of contactor attached to the hoist is opened.

13.2.1 All controls of a hoist shall be so arranged that no motion is inadvertently started when the power is supplied for an interruption.

14. BRAKING

14.0 The braking may be electric (electro-dynamic), electro-hydraulic or electro-mechanical.

14.1 Electric Braking — In addition to the specific requirements of this standard in regard to the provision of brakes and irrespective of the supply current, electric braking is permissible on all electric chain hoists.

14.1.1 When electric braking is used provision shall be made to limit the current on reversal to a safe value. Effective means shall be provided for stopping the motion in the event of a power failure and in the case of an emergency.

14.2 Electro-Hydraulic Braking — Use of electro-hydraulic thrust operated brake is also permissible on all motions of the electric chain hoist.

14.3 Electro-Mechanical Braking — The electro-mechanical brake (s, used, shall apply automatically when power supply fails or when the controller handle is brought to the 'off' position.

14.4 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. When necessary, magnets shall be provided with an efficient cushioning device. Two duties are recognized for both ac and dc, namely:

a) continuous or heavy duty, and

b) normal duty.

14.4.1 Since, with an alternating current brake magnet, the current in the coil is greater for the open position than when closed, the ratings for ac arc slightly different from dc as shown in Table 2.

TABLE 2 BRAKE MAGNET RATINGS

DUTY	dc MAGNETS	ac MAGNETS
(1)	(2)	(3)
Heavy duty	Suitable for being in circuit not more than 7.5 minutes out of every 15 minutes or 240 operations per hour	Suitable for being in circuit continuously where the brake coil operates infrequently or For 240 operations per hour where the brake coil is in circuit is not more than 5 minutes out of every 15 minutes
Normal duty	Suitable for 240 operations per hour where 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 brake coil is in circuit is not more than 5 minutes out of every 15 minutes

14.4.2 The brake magnets shall operate, for both operations at the current and voltage given in Table 3.

14.5 Brake Release — Appropriate mechanical, electro-hydraulic or any other alternative brake releasing gears may be used instead of brake magnets, if desired.

15. LIMIT SWITCHES

15.1 Limit switches shall be of the totally-enclosed quick-break type and where wired to three-phase motors, shall interrupt not more than two phases. Those incorporating a spring to provide quick breaking of the

contacts shall be so designed and constructed that failure of the spring does not affect positive opening of the contacts.

TABLE 3 BRAKE MAGNET OPERATING CURRENT AND VOLTAGES
(*Clause* 14.4.2)

WINDING	dc MAGNETS	ac MAGNETS
(1)	(2)	(3)
For series resistor control	Lift at 60 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 magnet from being energised by the back emf of the motor when the supply has been interrupted.

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

15.1.1 Limit switches shall be of the series or shunt type and shall permit the motor to be operated in the reverse direction when the limit switch is opened. The limit switch after being tripped shall automatically reset itself within a reasonable distance travelled in the opposite direction. This docs not prevent the use of the changeover type limit switches, where the resetting is achieved by striker when moving in the opposite direction.

15.2 Hoist Limit Switch — When the hook has risen to a predetermined level, this limit switch shall act and prevent over-hoisting and consequential damage arising therefrom to the hook or hook block, chain and mechanical equipment. The design and adjustment of over-hoisting limit switch shall be such that after opening of the switch under condition of maximum hoisting speed and no load:

a) there shall be an over-run which measured in metres shall not be more than 1/40 of the maximum speed in m/min; and

b) after cessation of motion, there shall be not less than 100 mm of available movement of the hook.

15.3 Limit Switch for Lowering — This shall be fitted to prevent over-lowering.

15.4 Hoisting and lowering limit switches shall be automatically reset when the hook is returned to the normal operating zone.

16. ELECTRICAL PROTECTIVE DEVICES

16.1 Contactor Circuit-Breaker Operated — As minimum equipment of protection, an electro-magnetically operated contactor with inherent undervoltagc protection together with overload devices shall be provided.

16.1.1 The overload protection may be of the electro-magnetic type, with time delay or thermal overload relays in conjunction with high rupturing capacity fuses.

16.1.2 The number of overload devices and their position shall normally be in accordance with one of the arrangements shown in Table 4 but if specified by the purchaser, other arrangements giving protection of not less than any of these shall be considered as complying with this specification.

TABLE 4 NORMAL REQUIREMENTS FOR NUMBER OF PROTECTIVE DEVICES FOR MOTOR CIRCUITS

dc SUPPLY	THREE-PHASE ac SUPPLY	
Neither line earthed	One line earthed	
One in each line	One connected in the non-earthed line	Two in separate phase wire 1 in the common return line
—	—	Three in separate lines

17. CABLES AND CONDUCTORS

17.1 Cables — Rubber, PVC or varnished cambric insulated cables used for hoist wiring shall comply with the relevant Indian Standard. All cables shall be adequately protected against mechanical damage and from damage by weather. When metal conduits or flexible tubes are used, their ends shall be screwed inadequately, to prevent ingress or moisture.

17.2 Minimum Size of Cables — Cables having conductors, complying with the relevant Indian Standard, smaller than 2.5 mm^2 nominal equivalent copper area of cross section shall not be used for the power wiring to the motor. 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.

17.3 Multicore Armoured Cables — Multicore armoured power and control cables suitably clamped may be used to avoid conduits and troughings. Suitable clamping glands should be provided at both ends of each multicore cable.

17.4 Outdoor Hoist Wiring — For outdoor hoists, except where flexible unarmoured cables are essential, cables shall be either armoured or enclosed throughout their length in galvanized trunking or conduit, either flexible or rigid. A flexible metallic tube or duct may not form an effective earth connection and shall not be used for that purpose. Taped, braided or varnished-cambric insulated cables shall not be used for outdoor hoists.

17.5 Current Rating — Rating of the cables shall comply with the relevant Indian Standard. Where hoists are equipped with one hour rated motor, the cables or armature cables may be up-rated by a factor of 1.4 above the ratings for continuous duty. Similarly, for hoists equipped with half-an-hour rated motors an up-rating factor of 1.7 may be used. Where the hoists arc equipped with intermittent duty rated motors the factor for up-rating the cable is equal to $\frac{10}{\sqrt{IDF}}$ where *IDF* is the intermittent duty factor.

17.5.1 Rotor or armature resistor circuit cables carry current during accelerating periods only and, therefore, may be still further up-rated. For 10-minute and 5-minute rated resistors, the up-rating factors of 1.5 and 2 may be used.

17.5.2 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 influences selection of suitable cables.

18. EARTHING

18.1 The hoist structure, motor frames and metal cases of all electrical equipment, including metal conduit, or cable guards shall be effectively connected to earth.

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

19. GUARDS

19.1 Where there is any possibility of any person coming in contact with an exposed part of an electrical circuit, other than one operating at extra low voltage, such part shall be effectively guarded.

19.2 All reciprocating and moving parts which might constitute a hazard shall be guarded.

19.3 All guards shall be securely fastened so that vibration will not loosen them.

SECTION 4 TESTS, CERTIFICATE OF TEST AND COMPLIANCE

20. TESTS AT MANUFACTURER'S WORKS

20.1 All electrical and mechanical equipment shall be tested in accordance with the appropriate Indian Standards at the hoist or equipment maker's works.

20.2 A long running test to determine how well the hoist works and tests on motors and control equipment to determine the operating characteristics shall be conducted.

20.2.1 The hoist shall be tested at manufacturer's works at 125 percent of the safe working load.

20.2.2 *Brakes* — The brakes shall be capable of holding 25 percent in excess of safe working load when the load is suspended by the work.

20.2.3 *Safety Devices* — Test for the effectiveness of the automatic device to limit the upward and downward travel of the hook.

20.3 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.

20.4 Insulation Tests — Before the hoist is connected to the supply, the insulation of the electrical equipment shall be tested by a suitable instrument and any defect revealed shall be rectified.

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

20.4.2 Any reading less than 0.5 MΩ obtained with an insulation resistance tester of the unregulated type shall be disregarded and the wiring under test shall be sub-divided until a reading higher than 0.5 MΩ is obtained. Failure to obtain a higher reading shows an unsatisfactory state of the insulation.

NOTE — A reading below 0.5MΩ obtained with such a tester may indicate that unduly low proportion of the prescribed test voltage is in fact being applied.

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

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

20.4.4 *Tests for Operation* — After the supply has been connected, and before the hoist is put into commercial service, tests 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; and

c) The satisfactory operation of all protective devices

20.3 Overload Tests

20.5.1 After tests but before the hoist is put into service, it shall be tested with overload relays appropriately set to lift and sustain a minimum test load of 125 percent of the working load.

20.5.2 During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

NOTE — Test load and necessary lifting tackle shall be provided by the purchaser.

21. CERTIFICATE OF COMPLIANCE

21.1 Test Certificates — A certified record of the test figures including the speed of the lift for safe working load shall be supplied to the purchaser and recorded on the test certificate which shall also indicate whether the electric wire rope hoist complies with the standard, if required by the purchaser.

NOTE — The requirement that the contract speeds of lifting shall be attained is contingent on the voltage and frequency of the electricity supply to the motor being correctly maintained.

SECTION 5 MARKING AND SUPPLY

22. CONDITION

22.1 Unless otherwise required by the purchaser, every hoist shall be given at least one priming and one finishing coat of paint. Prior to painting, the metal work shall be thoroughly cleaned, dried and shall be free from welding slag, rust, oil and grease. Metal surfaces bolted or riveted together shall be primed before assembly. Paint may be applied by spray gun or brush or by dipping.

23. MARKING

23.1 Capacity Marking — The rated load of each hoist in tonnes shall be marked plainly on the hoist and load block, so as to be clearly legible from the floor below the hoist.

23.2 A name plate containing the following information shall be provided on the hoist at a prominent place:

a) Manufacturer's name, trade-mark or identification;
b) Type or catalogue number;
c) Capacity;
d) Maximum lift;
e) Voltage;

f) Power requirements in kilowatts at minimum rating; and
g) If ac, number of phases and cycles.

23.3 The electric chain hoists may also be marked with the Standard Mark.

23.3.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from tbe Bureau of Indian Standards.

24. DATA TO BE SUPPLIED BY THE MANUFACTURER ALONG WITH THE HOIST

24.1 Test Certificate — A certified record of the test figures shall be supplied to the purchaser with the hoist.

24.2 Installation, Maintenance and Operational Instructions — Each hoist shall be provided with instruction sheets containing full information on the method of installation, operation and electrical wiring of the hoist and components. Each hoist shall be provided with a manual containing maintenance instructions and information regarding ordering replacement parts.

24.3 Wiring Diagram — A wiring diagram of the hoist shall be supplied with each hoist. The diagram shall give the rating of the motor, the cable sizes and such other information as will tend to facilitate inspection and maintenance of the hoist. In case of contactor controlled hoists, a schematic diagram shall be supplied.

APPENDIX A

(*Clause* 0.4)

LIST OF INDIAN STANDARDS FOR MATERIALS AND EQUIPMENT, AND CODES OF PRACTICES RELEVANT TO THE MANUFACTURE OF THE ELECTRIC CHAIN HOISTS

A-1. MATERIALS

A-1.1 Ferrous Material

a) IS : 210-1970 Specification for grey iron castings (*second revision*)

b) IS : 226-1969 Specification for structural steel (standard quality) (*fourth revision*)
c) IS : 961-1962 Specification for structural steel (high tensile) (*revised*)
d) *IS : 1030-1962 Specification for steel castings for general engineering purposes (*revised*)
e) IS : 1387-1967 General requirements for the supply of metallurgical materials *(first revision)*
f) IS : 1570-1961 Schedules for wrought steels for general engineering purposes
g) IS : 1865-1968 Specification for iron castings with spheroidal nodular graphite *(first revision)*
h) IS : 2004-1970 Specification for carbon steel forgings for general engineering purposes *(first revision)*
j) IS : 2062-1969 Specification for structural steel (fusion welding quality) *(first revision)*
k) IS : 2107-1962 Specification for whiteheart malleable iron castings
m) IS : 2108-1962 Specification for blackheart malleable iron castings

A-1.2 Threaded Fasteners

IS : 1367-1967 Technical supply conditions for threaded fasteners *(first revision)*

A-1.3 Chain

a) IS : 2403-1964 Specification for transmission steel roller chains and chain wheels
b) IS : 2429 (Part I)-1970 Round steel short link chain (electric butt welded), Grade 30: Part I Non-calibrated load chain for lifting purposes (*second revision*)
c) IS : 2429 (Part II)-1970 Round steel short link chain (electric butt welded), Grade 30: Part II Calibrated load chain for pulley blocks and other lifting appliances (*second revision*)
d) IS : 3109 (Part I)-1970 Round steel link chain (electric butt welded), Grade 40 : Part I Non-calibrated load chain for lifting purposes (*first revision*)
e) IS : 3109 (Part II)-1970 Round steel link chain (electric butt welded), Grade 40 : Part II Calibrated load chain for pulley blocks and other lifting appliances *(first revision)*
f) IS : 3560-1966 Specification for short pitch transmission precision bush chains and chain wheels
g) IS : 6216-1971 Specification for alloy steel calibrated load chain, Grade 80 for pulley blocks and other lifting appliances

*Since revised.

A-1.4 Lifting Hooks

a) IS : 3813-1967 Specification for 'C' hooks for use with swivels
b) IS : 3815-1969 Specification for point hooks with shank for general engineering purposes
c) IS : 3822-1966 Specification for eye hooks for use with chains
d) IS : 4164-1967 Specification for 'C' hooks for use with chains

A-2. MECHANICAL AND FABRICATION DETAILS

A-2.1 Keys and Keyways Splines

a) IS : 2048-1962 Specification for parallel keys and keyways
b) IS : 2291-1963 Specification for tangential keys and keyways
c) IS : 2292-1963 Specification for taper keys and keyways
d) IS : 2293-1963 Specification for gib-head keys and keyways
e) IS : 2294-1963 Specification for woodruff keys and keyslots
f) IS : 2327-1963 Dimensions for straight sided splines for general engineering use

A-2.2 Gears

a) IS : 2535-1969 Specification for basic rack and modules of cylindrical gears for general engineering and heavy engineering *(first revision)*
b) IS : 3681-1966 Specification for general plan for spur and helical gears

A-2.3 Ball and Roller Bearings

a) IS : 2513-1963 Specification for boundary dimensions for rolling for general engineering purposes
b) IS : 3090-1965 Code of practice for installation and maintenance of rolling bearings

A-2.4 Grease Nipples

a) IS : 4009-1967 Specification for grease nipples
b) IS : 4672-1968 Specification for grease cups

A-2.5 Welding

a) IS : 816-1969 Code of practice for use of metal arc welding for general construction in mild steel *(first revision)*

b) IS : 818-1968 Code of practice for safety and health requirements in electric and gas welding and cutting operations *(first revision)*

c) IS : 1024-1968 Code of practice for use of welding in bridges and structures subject to dynamic loading

d) IS : 1323-1966 Code of practice for oxy-acetylene welding for structural work in mild steel *(revised)*

A-3. ELECTRICAL DETAILS

A-3.1 Motors

a) IS : 325-1970 Specification for three-phase induction motors *(third revision)*

b) IS : 900-1965 Code of practice for installation and maintenance of induction motors *(revised)*

A-3.2 Cables and Conductors

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

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

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

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

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

f) IS : 1596-1970 Specification for polyethylene insulated and PVC-sheathed cables up to and including 250 V *(first revision)*

g) IS : 1753-1967 Specification for aluminium conductors in insulated cables *(first revision)*

A-3.3 Conduits

a) *IS : 1653-1964 Specification for rigid steel conduits for electrical wiring *(revised)*

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

*Since revised.

A-3.4 Switchgear

a) IS : 1822-1967 Specification for ac motor starters of voltage not exceeding 1 000 volts (*first revision*)

b) IS : 2147-1962 Degrees of protection provided by enclosures for low-voltage switchgear and controlgear

APPENDIX B

(*Clause* 0.5)

INFORMATION TO BE SUPPLIED WITH THE ENQUIRY OR ORDER

B-1. Number of hoists required.

B-2. A brief description of the work to be accomplished including the number of lifts per hour or day.

B-3. Capacity in tonnes.

B-4. Type of suspension:

a) Lug,

b) Hook,

c) Manual push trolley,

d) Manual geared trolley,

e) Motor driven trolley, or

f) Base mounted.

B-5. Head room — maximum head room dimension permissible.

B-6. Maximum lift in motors — the distance between the upper and lower limits of travel of the load block.

B-7. Desired hoisting and trolley travel speed in m/min.

B-8. Method of operation — pendant push-button or pendant rope.

B-9. Speed control:

a) Hoist — single speed, two speed or variable speed.

b) Trolley — single speed, hand-operated or motor-operated.

B-10. Type of hook required.

B-11. Operating current:

a) ac — voltage, phases, cycles and number of wires.

b) dc — vdltage.

B-12. Beam or rail size for trolley mounted hoists — height, width, weight per metre and minimum radius in track.

B-13. Special condition, if any, that is, heat, dust, moisture, hazardous atmosphere, etc — explain fully.

B-14. Statutory requirements applicable.

B-15. Compliance with this standard.

APPENDIX C

(Clause 0.5)

INFORMATION TO BE SUPPLIED BY MANUFACTURER

C-1. Description of unit.

C-2. Type and class of hoist.

C-3. Safe working load.

C-4. Motor.....kW at.....min, rating.

C-5. Operating current:

a) ac — voltage, phases, cycles and number of wires.

b) dc — voltage.

C-6. Head room.

C-7. Type of suspension.

C-8. Maximum lift in motors.

C-9. Speed control — single speed, two speed, or variable speed.

C-10. Hoisting speed:

a) If trolley supplied — type of trolley:

1) Hand operated.

2) Motor operated.

b) If motor operated — speed, m/min.

C-11. Methods of operation — pendant push-button or pendant rope.

C-12. Type of drive — if geared, what type?

C-13. Type of drum:

a) Plain or grooved.

b) Diameter of drum (if grooved at bottom of the groove).

C-14. Number of brakes — types.

C-15. Cnain — size in mm, type — roller or link, grade, number of falls, and minimum breaking load.

C-16. Beam or rail size for trolley mounted hoists.

C-17. Factor of safety.

C-18. Beam or rail size for trolley mounted hoists — height, width, weight per metre and minimum radius in track.

C-19. Net weight.

C-20. Any special features.

C-21. Statement to the effect that the hoist conforms to this standard.

C-22. Tools and accessories supplied.

C-23. Drawing of general arrangement and spare parts list.

APPENDIX D

(*Clause* 12.2.1)

RATING OF RESISTORS

D-1. TWO-MINUTE RATING

D-1.1 A resistor having a 'two-minute rating' shall be capable of being left in circuit for a period not exceeding 30 seconds on the first section and for a further period of 90 seconds equally divided between the remaining sections of the resistor, followed by a period of rest of 13 minutes: this cycle being repeated until a stable temperature is reached.

D-2. FIVE-MINUTE RATING

D-2.1 A resistor having a 'five-minute rating' shall be capable of being left in circuit for a period not exceeding 2 minutes on the first section and for a

further period of 3 minutes equally divided between the remaining sections of the resistor, followed by a period of rest of 10 minutes; this cycle being repeated until a stable temperature is reached.

D-3. TEN-MINUTE RATING

D-3.1 A resistor having a 'ten-minute rating' shall be capable of being left in circuit for a period not exceeding 4 minutes on the first section and for a further period of 6 minutes equally divided between the remaining sections of the resistor, followed by a period of rest of 5 minutes; this cycle being repeated until a stable temperature is reached.

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