इंटरनेट मानक

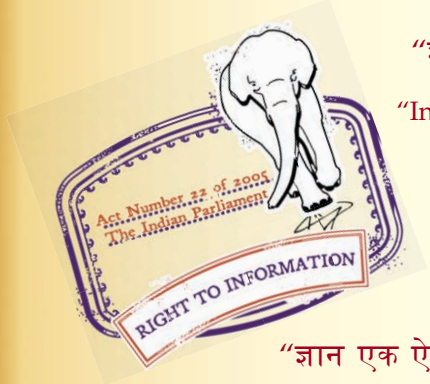
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 3938 (1983): Specification Electric Wire Rope Hoists
[MED 14: Cranes, Lifting Chains and Related Equipment]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

UDC 621·876·1-83 [677·72]

Third Reprint SEPTEMBER 1997
(Incorporating Amendment No. 1)

IS : 3938 - 1983
(Reaffirmed 1992)

Indian Standard

(Reaffirmed 2003)

SPECIFICATION FOR ELECTRIC WIRE ROPE HOISTS

(Second Revision)

CONTENTS

Adopted 24 February 1983

Gr 9

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

SECTION 1 GENERAL

1. Scope — Covers the design, testing and operation of all industrial service electric wire rope hoists, up to 16 t capacity, of the following types:

a) Lug suspended,

b) Hook suspended,

c) Trolley suspended, and

d) Base mounted.

1.1 This standard also lays down the minimum requirements compatible with safety.

2. Terminology — For the purpose of this standard, the following definitions shall apply.

2.1 *Electric Wire Rope Hoist* — An electro-mechanical appliance whose principal function is the lifting or lowering or both, of loads and having a wire rope fixed between the rope drum and the load block used for lifting the load.

2.1.1 *Lug-suspended hoist* — A hoist whose upper suspension member is lug.

2.1.2 *Hook-suspended hoist* — A hoist whose upper suspension member is a hook.

2.1.3 *Trolley-suspended hoist* — A hoist whose upper suspension member is a trolley for the purpose of running the hoist on the bottom flange of a runway beam.

2.1.4 *Base-mounted hoist* — A hoist similar to a trolley suspended hoist except that it has a base or feet and may be mounted overhead, in a vertical plane or in any position for which it is designed.

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, grabs and slings used for lifting the load.

2.3 *Basic and Permissible Stress* — All permissible stresses specified in IS : 800-1962 ' Code of practice for the use of structural steel in general building construction (*revised*) ', IS : 806-1968 ' Code of practice for use of steel tubes in general building construction (*first revision*) ', IS : 816-1969 ' Code of practice for use of metal arc welding for general construction in mild steel (*first revision*) ', and IS : 1024-1979 ' Code of practice for use of welding in bridges and structures subject to dynamic loading (*first revision*) ' 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.

2.6 *Traverse Speed* — Speed of hoist along the track.

2.7 *Head Room* — When measured with the load block in the highest position with full load, it is the distance between the saddle of the hook of the load block 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.

2.8 *Trolley* — A truck or carriage on which the hoist is mounted. The trolley may be push, hand-geared or motor-driven type.

2.9 *Drum* — The cylindrical member around which the ropes for raising and lowering a load are wound.

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

2.11 *Electrically Operated Brake* — A friction brake actuated or controlled by electric means.

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

2.13 *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 — Industrial electric wire rope hoists shall preferably be rated according to capacities as follows:

0·25, 0·5, 0·8, 1·0, 1·6, 2·0, 3·2, 5·0, 6·3, 8, 10, 12·5 and 16 t.

4. Classification — The hoists shall be classified in four classes with respect to the frequency of application and variation of magnitude of the load (*see* **5.3** and Table 1) and the effect of impact [*see* IS : 807-1976 Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists (*first revision*)].

SECTION 2 MECHANICAL REQUIREMENTS

5. Design and Fabrication

5.1 *General* — The material used in the construction of hoists shall be properly selected for the stress 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.

TABLE 1 DUTY FACTOR AND LIFE OF MECHANISM

(*Clauses* 4, 5.2, 5.3.1, 7.1.3 *and* 7.3.3)

Class Designation	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 Classes 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 Standards (see Appendix A). The design shall be such that the maximum permissible stress in the welds does not exceed those given in IS : 816-1969, and IS : 1323-1966 ' Code of practice for oxy-acetylene welding for structural work in mild steel (*revised*) '.

5.5 *Bolts and Nuts* — All bolts and nuts shall comply with the relevant Indian Standard (see Appendix A).

5.5.1 Bolts in tension 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 Standards (see Appendix A) and the bottom corners of the keyways shall be radiused. Keys shall be so fitted or secured that they cannot work loose.

5.7 *Hoisting and Traversing Speed* — The actual speed shall be within ±10 percent of specified speed.

6. Lifting Tackle

6.1 *Rope Drums and Wire Ropes*

6.1.1 *Drums* — Grooved drums shall be used to provide proper support for the ropes and to minimize abrasive wear on the ropes. Grooved drums shall be of such size that there is not more than one layer of rope on the drum when the rope is in its fully wound position.

6.1.1.1 The drum shall be of such length that each lead of rope has a minimum of two full turns on the drum when the hook is at its lowest position (*see* **6.1.6**) and one spare groove for each rope lead when the hook is at its highest position. The drum shall be flanged at both ends if rope guides are not provided; in which case, the flanges shall project to a distance of not less than two rope diameters above the rope. A spur or other wheel secured to the drum may be regarded as forming one of the flanges.

6.1.1.2 The fleet angle of the rope, that is the angle between the rope and a plane perpendicular to the axis of the drum shall not exceed 5° (1 in 12).

6.1.2 *Grooving of drums* — The depth and flare of the groove shall be so chosen as to ensure that the rope is not jammed against the groove flange when entering or leaving a groove. The bottom of the groove shall be a circular arc over an angle of not less than 120° and the sides of the groove shall be flared with an included angle of 30° to 45°. The groove shall be smoothly finished and free from surface defects liable to injure the rope.

6.1.2.1 It is recommended that the groove radius is equal to 0·53 times the rope diameter.

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

6.1.2.3 The grooves of the drum shall be so pitched that there is a minimum clearance between the adjacent turns of the rope as given below:

Diameter of Rope		*Minimum Clearance*
Over	Up to and including	
mm	mm	mm
—	12	1·5
12	20	2·0
20	29	2·5
29	—	3·0

6.1.3 *Material for drums* — Drums shall be made of cast iron, cast steel or mild steel as suitable for duty conditions. The material shall conform to the relevant Indian Standards (*see* Appendix A).

6.1.4 *Strength of drums* — Every drum shall be designed to withstand the compressive stress caused by the wound-on-rope. The local bending stress caused in the drum at the groove when the rope is winding, may be neglected.

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

6.1.5 *Diameter of the drum* — The diameter of the drum, measured at the centre of rope shall be not less than the appropriate value specified in Table 2 according to the construction of the rope used and the classification of the hoist.

6.1.6 *Rope anchorage* — The end of the rope shall be anchored to the drum in such a way that the anchorage is readily accessible. Each rope shall have not less than two full turns on the drums when the hook is at the lowest position.

6.1.7 *Wire ropes* — The hoisting rope, unless otherwise specified or agreed to by the purchaser, shall comply with the relevant Indian Standards (*see* Appendix A). Arrangements entailing reverse bends shall be avoided as far as possible. Suitable design measures shall assure that the leading rope taken by the drum does not slip sideways when slack and it is not caught between the gear wheels.

6.1.7.1 *Factor of safety* — The factor of safety based on the nominal breaking strength and safe working load of the rope shall be not less than 4·5 for Class 1 hoists, 5 for Class 2 and 3 hoists, 6 for Class 4 hoists and 8 for hoist handling hot metals.

Note — The duty factors specified in Table 1 shall not apply to these factors of safety.

6.2 *Load Blocks* — The bottom block shall be of the enclosed safety type and shall guard against the rope jamming in normal usage. Its sheaves shall be carried on suitably sealed or shielded anti-friction or sleeve bearings.

6.2.1 *Sheaves*

6.2.1.1 *Grooving* — The sheave grooves shall conform to the requirements of **6.1.2** and **6.1.2.1** as regards the groove diameter, flare and finish. The depth of the groove shall not be less than 1·5 times the wire rope diameter.

6.2.1.2 *Diameter of sheave* — The diameter of the sheaves at the centre of rope in the sheave shall be not less than that of the drums as specified in Table 2.

TABLE 2 DRUM DIAMETERS

(Clauses 6.1.5 and 6.2.1.2)

Rope Construction	Minimum Diameter of Drum for Hoists of Class		
	1	2 and 3	4
6×37 (18/12/6/1) 8×19 (12/6+6F/1)	15d	17d	22d
8×19 (9/9/1) 34×7	17d	18d	24d
6×19 (12/6+6F/1)	18d	20d	23d
6×19 (12/6/1) 17×7 (6/1) 18×7 (6/1)	19d	23d	27d

d — Diameter of rope.

Note — It is recommended that larger diameters be used wherever possible.

6.2.1.3 *Fleet angle* — The angle between the rope and a plane perpendicular to the axis of the pulley shall not exceed 5° (1 in 12).

6.2.1.4 *Sheave guards* — Sheaves shall be provided with guards to retain the ropes in the grooves.

6.2.1.5 *Equalizing sheaves* — When the load is supported by more than one fall of the rope off the drum and bottom blocks are used, the rope system shall be equalized by using equalizing sheaves or bars.

6.2.1.6 The minimum diameter at the bottom of the grooves of an equalizing sheave shall be 9 times the diameter of the rope used for Class 1, 12 times for Class 2 and 3, and 15 times for Class 4 hoists.

6.2.1.7 *Material for sheaves* — Sheaves shall be made of cast iron, cast steel or mild steel as suitable for duty conditions and shall conform to the relevant Indian Standards (see Appendix A).

6.3 *Lifting Hooks*

6.3.1 Lifting hooks shall comply with the relevant Indian Standards (see Appendix A).

6.3.2 *Mounting* — Swivelling hooks shall be mounted on thrust bearings and protective skirt shall be provided to enclose the bearing. The hook shall swivel freely through 360° rotation with full load. The swivel hook nut shall be locked with set screw or a split pin to prevent it from coming out.

6.3.3 If required by purchaser, the hoist hooks shall be provided with safety locking arrangements to prevent accidental unhooking.

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 relevant Indian Standards (see Appendix A). 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 *Bearings pressure for plain and bushed bearings* — In the case of plain and bushed bearings made of brass or its alloys, the bearing pressure shall not exceed 687 N/cm² (≈70 kgf / cm²) of projected area. In case of bushes made of other material, the manufacturer's recommendations may be followed.

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 (see Appendix A). 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 of suitable composition.

7.2.3 *Shaft keys* — Where practicable, keys and keyways and splines shall conform to the relevant Indian Standards (see Appendix A).

7.3 *Gears*

7.3.1 *Types* — The gears used in electric wire rope hoist shall be machine cut (see IS : 3681-1966 General plan for spur and helical gears and IS : 4460-1967 Method for rating of machine cut spur and helical gears) and shall conform to the relevant Indian Standards (see Appendix A).

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

a) Wheel rims may have steel rims secured to centres of cast iron conforming to Grade 25 of IS : 210-1978 'Specification for grey iron castings (*third revision*)'.

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 (see Appendix A) using as a minimum the duty factor given in Table 1 for the appropriate class of mechanism.

Note — Total life hours' indicated in col 5 of Table 1 does not refer to gears.

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 gear drives with the exception of travel runner wheels of geared type and their driving pinions, shall be enclosed and provided with means for ample lubrication. The oil bath lubrication shall be preferred.

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

7.5 *Brakes*

7.5.1 *General*

7.5.1.1 Every electric hoist shall be fitted with a brake of fail-to-safety type.

7.5.1.2 Hoists handling molten metal or dangerous liquids shall be fitted with an additional brake on the hoisting motion. If electro-mechanical brakes are used for this purpose, they shall be of the delayed action type.

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

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

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

7.5.1.6 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 maximum safe working load at any position of the lift. The brakes shall be capable of exerting a restraining torque 50 percent greater than the torque transmitted to the brake drum from the suspended maximum safe working load, the friction in the transmission mechanism between the load and the brake not being taken into consideration.

7.5.2.1 Traverse brake shall be rated for 100 percent of motor torque.

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 linings 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 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.

8. Trolleys

8.1 *Types* — Trolleys shall be push, hand-geared 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 35m/min. For special applications, if so specified by purchaser [see **B-9** (b)] brakes shall be provided at lower speeds also.

8.4 *Track Wheels*

8.4.1 Track wheels may have cylindrical or straight tapered or spherical tapered tread with flange or any other means to guide hoist trolley effectively to prevent derailment. The wheel shall be mounted in such a manner as to facilitate removal or replacement during maintenance.

8.4.2 The track wheels of hand operated trolleys, shall be manufactured from cast iron conforming to Grade FG 200 of IS : 210-1978 ' Grey iron casting (*third revision*) '. Track wheels of power operated trolleys, shall be manufactured from cast/forged/rolled steel suitably heat treated to have a hardness of not more than 200 HB.

8.4.2.1 For Class 4 duty hoist, the back beam shall be provided with wear plates. The thickness of wear plates shall be not less than 8 mm. The back wheels shall have a minimum hardness of 250 HB.

8.4.3 The minimum diameter of the wheel may be calculated from the following formula and shall conform to R 10 series of IS : 1136-1958 ' Preferred sizes for wrought metal products ' commencing from 100 mm.

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

where

D = Wheel dia in millimetres,

W = Maximum wheel load in kilograms, without impact, and

a = Maximum engaged tread width of the track wheel in millimetres.

8.4.4 The depth and thickness of the flanges of the guiding track wheel shall be not less than the values specified below.

Diameter of Wheels mm	*Depth of Flange* mm	*Thickness of Flange* mm
Upto and including 250	10	6
Over 250 and including 315	15	15

SECTION 3 ELECTRICAL CHARACTERISTICS

9. General — It is necessary that the following precautions are observed in installation and operation of electrical equipment of the electric wire rope hoists so that safety in operation is ensured:

a) The voltage used on a hoist shall be in conformity with IS : 585-1962 ' Voltages and frequency for *ac* transmission and distribution systems (*revised*) ' but in any case, it shall not exceed 500 *V*;

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

c) All electrical equipment shall be thoroughly protected from dirt, grease and oil and where exposed to the weather, shall be 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 conditions, the temperature rise does not exceed the limits specified in IS : 325-1978 ' Specification for three-phase induction motors (*fourth revision*) ', IS : 4722-1968 ' Specification for rotating electrical machines ' or other relevant Indian Standard. This shall not preclude the use of intermittent motors, if required.

10.1.1 The enclosure (see IS : 4691-1968 Degrees of protection provided by enclosures for rotating electrical machinery) 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 shall be not less than 2·25 times the rated torque for Classes 1, 2 and 3, and 2·75 times for class 4 hoists.

10.3 *Design and Construction* — Motors shall be suitable for purchaser's requirements which shall give the details about reversals, braking and starting (see **B-2**).

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 shall not exceed those specified by the motor manufacturer.

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

10.7 *Selection of Motor Sizes for Hoisting and Traversing*

10.7.1 When the duty cycle can be adequately assessed for any hoist motion, the motor may be selected so that the temperature rise in actual service does not exceed the permissible temperature rise taking into account the ambient temperature and class of insulation.

10.7.2 When duty cycle can not be assessed the selection of motor shall be carried out as specified in Appendix C.

11. Pendant Control Switch

11.1 *General* — Hoists shall be designed 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 control shall consist of fully magnetic reversing type contactors 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 with suitable arrangement shall be provided for obtaining each speed of multispeed hoists. The contactors shall be mechanically or electrically interlocked.

11.3 *Accessibility* — All push button actuators shall be so disposed that the contacts and terminal arrangements are readily accessible for inspection and maintenance purpose.

11.4 *Pendant Push-Button 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 metallic, 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; 250 volts is permissible on dc or special applications:

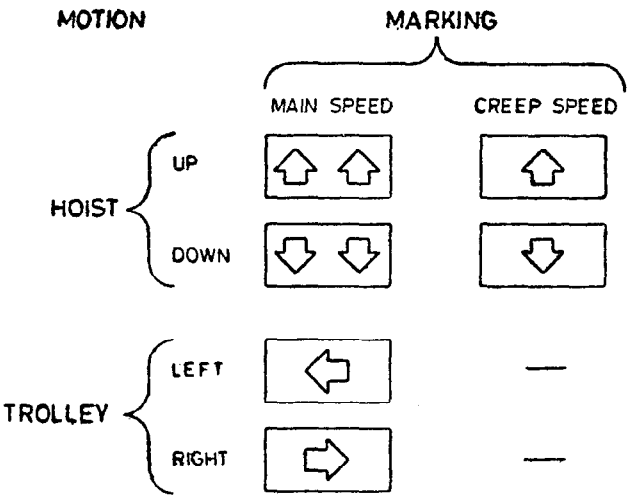


FIG. 1

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

12.2 *Rating* — Controllers and resistors shall be rated such that the temperature 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 resistor ratings.

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 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 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 after an interruption.

14. Braking — The braking may be electrical (electro-dynamic), electro-hydraulical or electro-mechanical.

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

14.1.1 When electrical 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-Hydraulical Braking* — Use of electro-hydraulical thruster-operated brake is also permissible on all motions of the electric wire rope hoist.

14.3 *Electro-Mechanical Braking* — The electro-mechanical brake(s) used, shall apply automatically when power supply fails or when the supply to the respective motor is put off.

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* are slightly different from *dc* as shown in Table 3.

14.4.2 The brake magnets shall operate, for both operations at the current and voltage given in Table 4.

TABLE 3 BRAKE MAGNET RATINGS

(*Clause* 14.4.1)

Duty	dc Magnets	ac Magnets
Heavy duty	Suitable for being in circuit for 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 time for which 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 time that the brakecoil is in circuit is not more than 5 minutes of every 15 minutes	Suitable for 120 operations per hour where the time that the brakecoil is in circuit is not more than 5 minutes of every 15 minutes

TABLE 4 BRAKE MAGNET OPERATING CURRENTS AND VOLTAGES

(Clause 14.4.2)

Winding	dc Magnets	ac Magnets
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 energized 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.

14.5 *Brake Release* — Appropriate mechanical, electro-hydraulical 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 less than two phases for series type limit switches. 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.

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 does not prevent the use of the change over 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, ropes and mechanical equipment. The design and adjustment of over hoisting limit switch shall be such, that after opening of the switch under conditions of maximum hoisting speed and no load:

a) there shall be an overrun which measured in metres shall not be more than one-fortieth of the maximum speed in m/min; and

b) after cessation of motion, there shall be not more than 25 mm of available movement of the hook.

15.3 *Limit Switch for Lowering* — This shall be fitted to prevent overlowering.

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 under voltage protection together with overload devices shall be provided.

16.1.1 The overload protection provided in the hoist may be of the following types:

a) electro-magnetic type, with time delay;

b) thermal overload relays with high rupturing capacity fuses; and

c) thermal sensing devices, sensitive to motor temperature or to temperature and current, in contact with the motor windings.

16.1.2 The number of overload devices and their position shall normally be in accordance with one of the arrangements shown in Table 5 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 5 NORMAL REQUIREMENTS FOR NUMBER OF PROTECTIVE DEVICES FOR MOTOR CIRCUITS

dc Supply		3 Phase ac Supply
Neither Line Earthed	One Line Earthed	
One in each line	One connected in the non-earthed line	2 in separate phase wires 1 in the common return line 3 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 Standards (see Appendix A). 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 in adequately, to prevent ingress of moisture.

17.2 *Minimum Size of Cables* — Cables having conductors complying with the relevant Indian Standard, smaller than 2·5 mm² 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 mm² 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 shall 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* — Ratings of the cables shall comply with the relevant Indian Standards (see Appendix A). Where hoists are equipped with 40 percent CDF or 1 hour rated motors the cables or armature cables may be uprated by a factor of 1·4 above the ratings for continuous duty. Similarly, for hoists equipped with 25 percent CDF or half an hour rated motors an uprating factor of 1·7 may be used. Where the hoists are equipped with intermittent duty rated motors the factor for uprating 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 uprated. For 10 minute and 4 minute rated resistors, the uprating factors of 1·5 and 2 respectively may be used.

17.5.2 Consideration shall 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 The hoist shall be run 5 times. The testing shall start with the first run at 125 percent safe working load. Second, third and fourth run with safe working load shall be conducted without any pause. Fifth run shall be conducted with 125 percent safe working load. The motor currents shall be checked and shall be within the rated full load current of each motor at safe working load. Normal speeds shall be achieved during full load tests.

20.2.1 The hoist shall be tested in accordance with **21.2** at manufacturer's works at 125 percent of the safe working load. The hoist shall be capable of lifting load from mid-air.

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

20.2.3 *Safety device* — 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 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 subdivided 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 0·5 M Ω 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.

21. Tests at Site

21.1 *Test for Operation* — After the supply has been connected, 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.

21.2 *Overload Test*

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

21.2.2 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.

22. Certificate of Compliance and 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.

SECTION 5 MARKING AND SUPPLY

23. Condition — 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.

24. Marking

24.1 *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.

24.2 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 mark;

b) Type or catalogue number;

c) Capacity;

d) Maximum lift;

e) Voltage;

f) Power requirements in kilowatts at minimum ratings; and

g) If ac, number of phases and cycles.

24.3 *Certification Marking* — Details available with the Bureau of Indian Standards.

25. Data to be Supplied by the Manufacturer Along with the Hoist

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

25.2 *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 the components. Each hoist shall be provided with a manual containing maintenance instructions and information regarding ordering replacement parts.

25.3 *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 fecilitate inspection and maintenance of the hoist. In case of contactor controlled hoists, a schematic diagram shall be supplied.

EXPLANATORY NOTE

This standard was first issued in 1967 and revised in 1979. This revision has been undertaken to incorporate the requirements regarding track wheels (*see* **8.4**) and selection of motor sizes (*see* **10.7**).

This standard seeks to establish uniformity in engineering practices in India with respect to electric wire rope hoists.

The standard is in general agreement with the applicable requirements of IS : 807-1976 and IS : 3177-1977 'Code of practice for design of overhead travelling cranes and gantry cranes other than steel work cranes, (*first revision*)'.

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

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

APPENDIX A

LIST OF INDIAN STANDARDS FOR MATERIALS AND EQUIPMENT AND CODES OF PRACTICES RELEVENT TO THE MANUFACTURE OF ELECTRIC WIRE ROPE HOISTS.

(*Clauses* 5.4, 5.5, 5.6, 6.1.7, 6.2.1.7, 6.3.1, 7.1.2.1, 7.1.5, 7.2.3, 7.3.1, 7.3.3, 17.1, 17.5 and Explanatory Note)

A-1. Materials

A-1.1 *Ferrous Material*

a) IS : 210-1978 Specification for grey iron castings (*third revision*)
b) IS : 226-1975 Specification for structural steel (standard quality) (*fifth revision*)
c) IS : 961-1975 Specification for structural steel (high tensile) (*second revision*)
d) IS : 1030-1974 Specification for steel castings for general engineering purposes (*second revision*)
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 : 1570 (Part I)-1978 Schedules for wrought steels for general engineering purposes: Part I Steels specified by tensile and/or yield properties (*first revision*)
h) IS : 1570 (Part II)-1979 Schedules for wrought steels for general engineering purposes: Part II Carbon steels (unalloyed steels) (*first revision*)
j) IS : 1570 (Part III)-1979 Schedules for wrought steels for general engineering purposes: Part III Carbon and carbon-manganese free cutting steels (*first revision*)
k) IS : 1570 (Part V)-1972 Schedules for wrought steels for general engineering purposes: Part V Stainless and heat-resisting steels (*first revision*)
m) IS : 1865-1974 Specification for iron castings with spheriodal or nodular graphite (*second revision*)
n) IS : 2004-1978 Specification for carbon steel forgings for general engineering purposes (*second revision*)
p) IS : 2062-1980 Specification for structural steel (fusion welding quality) (*second revision*)
q) IS : 2107-1977 Specification for whiteheart malleable iron castings (*first revision*)
r) IS : 2108-1977 Specification for blackheart malleable iron castings (*first revision*)

A-1.2 *Threaded Fasteners*

a) IS : 1367-1967 Technical supply conditions for threaded fasteners (*first revision*)
b) IS : 1367 (Part I)-1980 Technical supply conditions for threaded fasteners: Part I Introduction and general information (*second revision*)
c) IS : 1367 (Part II)-1979 Technical supply conditions for threaded fasteners: Part II Product grades and tolerances (*second revision*)
d) IS : 1367 (Part III)-1979 Technical supply conditions for threaded fasteners: Part III Mechanical properties and test methods for bolts, screws and studs with full loadability (*second revision*)
e) IS : 1367 (Part V)-1980 Technical supply conditions for threaded fasteners: Part V Mechanical properties and test methods for set screws and similar threaded fasteners not under tensile stresses
f) IS : 1367 (Part VI)-1980 Technical supply conditions for threaded fasteners: Part VI Mechanical properties and test methods for nut with specified proof loads (*second revision*)
g) IS : 1367 (Part VII)-1980 Technical supply conditions for threaded fasteners, Part VII Mechanical properties and test methods for nuts without specified proof loads (*second revision*)
h) IS : 1367 (Part IX)-1979 Technical supply conditions for threaded fasteners: Part IX Surface discontinuities on bolts, screws and studs (*second revision*)
j) IS : 1367 (Part X)-1979 Technical supply conditions for threaded fasteners: Part X Surface discontinuities on nuts
k) IS : 1367 (Part XVI)-1979 Technical supply conditions for threaded fasteners: Part XVI Designation system and symbols (*first revision*)
m) IS : 1367 (Part XVIII)-1979 Technical supply conditions for threaded fasteners: Part XVIII Marking and mode of delivery (*second revision*)

A-1.3 *Wire Ropes*

a) IS : 2266-1977 Specification for steel wire ropes for general engineering purposes (*second revision*)
b) IS : 2365-1977 Specification for steel wire suspension ropes for lifts elevators and hoists (*first revision*)
c) IS : 3973-1967 Code of practice for selection, installation and maintenance of wire ropes
d) IS : 6594-1977 Technical supply conditions for wire ropes and strands (*first revision*)

A-1.4 *Lifting Hooks*

a) IS : 2758-1969 Specification for mild steel point hooks for use with wire rope thimbles
b) IS : 2759-1969 Specification for higher tensile steel point hooks for use with wire rope thimbles
c) IS : 3813-1967 Specification for 'C' hooks for use with swivels
d) IS : 3815-1969 Specification for point hooks with shanks for general engineering purposes
e) IS : 4164-1976 Specification for lifting 'C' hooks with eye-capacity up to 25 tonnes (*first revision*)
f) IS : 3822-1966 Specification for eye hooks for use with chains

A-2. Mechanical and Fabrication Details

A-2.1 *Keys and Keyways and Splines*

a) IS : 2048-1975 Specification for parallel keys and keyways (*first revision*)
b) IS : 2291-1981 Specification for tangential keys and keyways (*second revision*)
c) IS : 2292-1974 Specification for taper keys and keyways (*first revision*)
d) IS : 2293-1974 Specification for gib-head keys and keyways (*first revision*)
e) IS : 2294-1980 Specification for woodruff keys and keyways (*first revision*)
f) IS : 2327-1963 Dimensions for straight sided splines for general engineering use
g) IS : 3665-1966 Dimensions for involute sided splines
h) IS : 6166-1971 Specification for thin taper keys and keyways
j) IS : 6167-1971 Specification for thin parallel keys and keyways

A-2.2 *Gears*

a) IS : 3681-1966 General plan for spur and helical gears
b) IS : 3734-1966 Dimensions for worm gearing
c) IS : 4460-1967 Method for rating of machine cut spur and helical gears
d) IS : 7403-1974 Code of practice for selection of standard worm and helical gear boxes
e) IS : 7443-1974 Methods for load rating of worm gears

A-2.3 *Ball and Roller Bearings*

a) IS : 2398-1967 Identification code for rolling bearings
b) IS : 3090-1965 Code of practice for installation and maintenance of rolling bearings
c) IS : 6454-1972 Specification for self aligning roller bearings
d) IS : 6455-1972 Specification for single row radial ball bearings
e) IS : 6456-1972 Specification for double row radial ball bearings
f) IS : 6457-1972 Specification for single row cylindrical ball bearings
g) IS : 6458-1972 Specification for double row cylindrical ball bearings
h) IS : 7461-1980 General plan of boundary dimensions for tapered roller bearings (*first revision*)

A-2.4 *Grease Nipples*

a) IS : 4009 (Part I)-1981 Specification for grease nipples: Part I Button head grease nipples (*first revision*)
b) IS : 4009 (Part II)-1981 Specification for grease nipples: Part II Conical head grease nipples (*first revision*)

A-2.5 *Manufacturing Practices and Design*

a) IS : 800-1962 Code of practice for use of structural steel in general building construction (*revised*)
b) IS : 806-1968 Code of practice for use of steel tubes in general building construction (*first revision*)
c) IS : 807-1976 Code of practice for design, manufacture, creation and testing (structural portion) of cranes and hoists (*first revision*)
d) IS : 816-1969 Code of practice for use of metal arc welding for general construction in mild steel (*first revision*)
e) IS : 818-1968 Code of practice for safety and health requirements in electric and gas welding and cutting operations (*first revision*)
f) IS : 1024-1979 Code of practice for use of welding in bridges and structures subject to dynamic loading (*first revision*)
g) IS : 1323-1966 Code of practice for oxy-acetylene welding for structural work in mild steel (*revised*)

A-2.6 *Springs*

a) IS : 7906 (Part I)-1976 Helical compression springs: Part I Design and calculations for springs made from circular section wire and bar
b) IS : 7906 (Part II)-1975 Helical compression springs: Part II Specification for cold coiled springs made from circular section wire and bar
c) IS : 7906 (Part III)-1975 Helical compression springs: Part III Data sheet for specification for springs made from circular section wire and bar
d) IS : 7907 (Part I)-1976 Helical extension springs: Part I Design and calculation for springs made from circular section wire and bar
e) IS : 7907 (Part II)-1976 Helical extension springs: Part II Specification for cold coiled springs made from circular section wire and bar
f) IS : 7907 (Part III)-1975 Helical extension springs: Part III Data sheet for specification for springs made from circular section wire and bar

A-3. Electrical Details

A-3.1 *Motors*

a) IS : 325-1978 Specification for three-phase induction motors (*fourth revision*)
b) IS : 585-1962 Voltages and frequency for ac transmission and distribution systems (*revised*)
c) IS : 900-1965 Code of practice for installation and maintenance of induction motors (*revised*)
d) IS : 4029-1967 Guide for testing three-phase induction motors
e) IS : 4691-1968 Degrees of protection provided by enclosures for rotating electrical machinery
f) IS : 4722-1968 Specification for rotating electrical machines

A-3.2 *Cables and Conductors*

a) IS : 693-1965 Specification for varnished cambric insulated cables (*revised*)
b) IS : 694-1977 Specification for PVC insulated cables for working voltage up to and including 1 100 V (*second revision*)
c) IS : 1554 (Part I)-1976 Specification for PVC insulated (heavy duty) electric cables: Part I For working voltages up to and including 1 100 V (*second revision*)
d) IS : 1596-1977 Specification for polyethylene insulated cables for working voltages up to and including 1 100 V (*second revision*)
e) IS : 8130-1976 Specification for conductors for insulated cables and flexible cords
f) IS : 9968 (Part I)-1981 Specification for elastomer-insulated cables: Part I For working voltages up to and including 1 100 V
g) IS : 9968 (Part II)-1981 Specification for elastomer-insulated cables: Part II For working voltages from 3·3 kV up to and including 11 kV

A-3.3 *Conduits*

a) IS : 1653-1972 Specification for rigid steel conduits for electrical wiring (*second revision*)
b) IS : 2509-1973 Specification for rigid non-metallic conduits for electrical installations (*first revision*)

A-3.4 *Switchgear*

a) IS : 1818-1972 Specification for alternating cuttent isolators (disconnectors) and earthing switches (*first revision*)
b) IS : 2147-1962 Degrees of protection provided by enclosures for low voltage switchgear and control gear
c) IS : 2516 (Part I and II/Sec I)-1977 Specification for alternating current circuit breakers: Parts I and II Requirement and tests, Section I Voltages not exceeding 1 000 V ac or 1 200 V dc (*first revision*)
d) IS : 4064 (Part I)-1978 Specification for Air-break switches, air-break disconnectors, air-break switch-disconnectors and fuse-combination units for voltages not exceeding 1 000 V ac or 1 200 V dc: Part I General requirements (*first revision*)
e) IS : 4067 (Part II)-1978 Specification for air break switches, air-break disconnectors, air-break switch-disconnectors and fuse-combination units for voltages not exceeding 1 000 V ac or 1 200 V dc: Part II Specific requirements for the direct switching of individual motors (*first revision*)
f) IS : 5124-1969 Code of practice for installation and maintenance of ac induction motor starters (voltage not exceeding 1 000 V)
g) IS : 5987-1970 Code of practice for selection of switches (voltage not exceeding 1 000 V)
h) IS : 6875 (Part I)-1973 Specification for control switches (switching devices for control and auxiliary circuits including contractor relays) for voltages up to and including 1 000 V ac and 1 200 V dc: Part I General requirements and tests
j) IS : 6875 (Part II)-1973 Specification for control switches (switching devices for control and auxiliary circuits including contractor relays) for voltages up to and including 1 000 V ac and 1 200 V dc: Part II Push buttons and related control switches
k) IS : 6875 (Part III)-1973 Specification for control switches (switching devices for control and auxiliary circuits including contractor relays) for voltages up to and including 1 000 V ac and 1 200 V dc: Part III Rotary control switches
m) IS : 8544 (Part I)-1977 Specification for motor starters for voltages not exceeding 1 000 V: Part I Direct-on-line ac starters
n) IS : 8544 (Part II)-1977 Specification for motor starters for voltages not exceeding 1 000 V: Part II Star delta starters
p) IS : 8544 (Part III/Sec I)-1979 Specification for motor starters for voltages not exceeding 1 000 V: Part III Rheostatic rotor starters, Section I General requirements
q) IS : 8544 (Part III/Sec 2)-1979 Specification for motor starters for voltages not exceeding 1 000 V: Part III Rheostatic rotor starters, Section 2 Additional requirements for ac rheostatic rotor controllers
r) IS : 8544 (Part IV)-1979 Specification for motor starters for voltages not exceeding 1 000 V: Part IV Reduced voltage ac starters: two-step auto-transformers starters

APPENDIX B

(*Clauses* 8.3, 10.3 and *Explanatory Note*)

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 Metres — The distance between the upper and lower limits of travel of the load block ———————————————

———————————————

B-7. Desired travel speeds 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 with or without brakes———————

———————————————

B-10. Type of Hook Required ———————————————

———————————————

B-11. Operating Current

ac — voltage, phases, cycles and number of wires ———————————————

———————————————

dc — voltage ———————————————

B-12. Whether thermal sensing devices (thermistors) are required to be embedded in motor———Yes/No

B-13. Beam or rail size for trolley mounted hoists: height, width, mass per metre and minimum radius in track

_____

_____

B-14. Special condition, if any, that is, heat, dust, moisture, hazardous atmosphere, etc, — explain fully_____

_____

_____

B-15. Statutory requirements applicable _____

_____

_____

B-16. A statement that the hoist shall comply with IS : 3938-1983 ' Specification for electric wire rope hoists (*second revision*) '.

APPENDIX C

(*Clause* 10.7.2)

SELECTION OF MOTORS FOR HOISTS

C-1. Motors for Hoist Motions

C-1.1 *Director Current Motors* — The motors shall be so selected that its one-hour power rating in kilowatts at 25 percent duty factor for class 1, 2 and 3 hoists and 40 percent duty factor of class 4 hoist is not less than that computed from the following formula:

$$\frac{KMV}{6{\cdot}12E}$$

where

K = service factor depending on the electrical service class of hoist;

M = mass of the rated load on the hook plus mass of the hook block and the wire ropes in tonnes;

V = specified hoisting speed in m/min;

E = combined efficiency of gears and sheaves

$= (0{\cdot}94)^n + (0{\cdot}98)^m$ for sleeve bearings

$= (0{\cdot}96)^n + (0{\cdot}99)^m$ for antifriction bearings;

n = number of pairs of gears; and

m = total number of rotating sheaves between drum and equaliser passed over by each part of the moving rope attached to the drum.

C-1.1.1 Recommended values of ' K ' for series motors operated at 230 V are given below:

Duty Cycle	*Electrical Service Class*	*Service Factor ' K '*
Not more than 20 percent time ON and not more than 15 cycles per hour	1	0·75
21 - 30 percent time ON or 16 - 25 cycles per hour	2	0·75
31 - 40 percent time ON or 26 - 35 cycles per hour	3	0·82
41 - 50 percent time ON or 36 - 45 cycles per hour	4	0·96

C-1.1.2 For voltages other than 230 volts, use the one-hour ratings at the selected voltage, as established by the motor manufacturer.

C-1.1.3 For duty cycle of more than 50 percent time ' ON ' or 45 cycles per hour, the requirements should be submitted to the motor manufacturer for selection of adequate ratings.

C-1.2 *Alternate Current Motors* — The motors shall be so selected that its power rating in kilowatts at 25 percent duty factor for class 1, 2 and 3 hoist and 40 percent duty factor for class 4 hoists is not less than that computed from the following formula:

$$\frac{KMV}{6.12\,E}$$

where

K = service factor depending on the electrical service class of hoist,

M = mass of the rated load on the hook plus of the hook block and the wire ropes in tonnes,

V = specified hoisting speed in m/min,

E = combined efficiency of gears and sheaves,

$= (0{\cdot}94)^n + (0{\cdot}98)^m$ for sleeve bearings,

$= (0{\cdot}96)^n + (0{\cdot}99)^m$ for antifriction bearings,

n = number of pairs of gears, and

m = total number of rotating sheaves between drum and equaliser passed over by each part of the moving rope attached to the drum.

C-1.2.1 Recommended values of '*K*' for ac induction motors are given:

Duty Cycle	*Electrical Service Class*	*Service Factor 'K'*
Not more than 20 percent time ON and not more than 15 cycles per hour	1	1
21 - 30 percent time ON or 16 - 25 cycles per hour	2	1
31 - 40 percent time ON or 26 - 35 cycles per hour	3	1·1
41 - 50 percent time ON or 36 - 45 cycles per hour	4	1·2

C-2. Director Current or Alternate Current Motors for Trolley Traverse

C-2.1 It is assumed that the drive mechanism from the motor to the track wheels will use totally enclosed gearing mounted on antifriction bearings and that the efficiency of the drive end track wheels using antifriction bearings is expected to vary between 0·85 to 0·90 and an average value of 0·875 will generally be adopted in making calculations for motor power and torques.

C-2.2 In general the track wheel bearings shall be antifriction type, in which case rolling friction at these bearings plus the friction between the track wheels and the rails may be assumed at 7·0 kgf / t of mass moved, which with a drive efficiency of 0·875 gives an overall friction factor of 8·0 kgf / t for calculations of motor power or torque. Note that the mass moved is the mass of the load plus the mass of the trolley.

C-2.2.1 Some purchaser, however, may specify that the track wheels are to be mounted on plain bearings. In this case the friction at these bearings plus that between the track wheels and the rails may be assumed to result in an overall friction factor of 13·0 kgf / t of mass moved.

C-3. Selection of Frame Size for Director Current Motors

C-3.1 The selected motor shall have the one-hour power rating which is not less than that computed from the following formula:

$$\text{Selected power in kW} = 0{\cdot}745\,7\,KMVS$$

where

K = a factor which is included for power to overcome friction, to give linear acceleration to the mass moved, and the angular acceleration to the motor armature and the rotating parts:

W = mass moved in tonnes;

V = specified free running speed in m/min; and

S = a service factor aimed at providing adequate motor heat dissipation capacity to cover for the severity of the expected duty cycle.

C-3.1.1 Recommended values for '*K*' and '*S*' are given in Tables 6 and 7.

TABLE 6 VALUES OF SERVICE FACTOR *K* FOR DIRECT CURRENT MOTORS

(*Clause* C-3.1.1)

Acceleration Whilst on the Resistor	Track Wheels on Antifriction Bearing	Track Wheels on Plain Bearings
(1)	(2)	(3)
(cm/s^2)		
15	0·002 5	0·003 3
30	0·003 5	0·004 4

Note — For other values of acceleration between two figures, intermediate values of *K* may be taken.

TABLE 7 VALUES OF SERVICE FACTOR *S* FOR DIRECTOR CURRENT OF MOTORS

(*Clause* C-3.1.1)

Duty Cycle	Electrical Service Class	Trolley Service Factor
(1)	(2)	(3)
Not more than 20 percent time ON and not more than 15 cycles per hour	1	1·2
21 - 30 percent time ON or 16 - 25 cycles per hour	2	1·3
31 - 40 percent time ON or 26 - 35 cycles per hour	3	1·4
41 - 50 percent time ON or 36 - 45 cycles per hour	4	1·5

C-3.1.2 At trolley free running speed, the acceleration becomes zero and hence the power to be furnished by the motor is:

Case I Track wheels on antifriction bearings

$$\text{Power required} = \frac{6\,MV}{4\,562} = 0{\cdot}001\,30 \text{ kW}$$

Case II Track wheels on plain bearings

$$\text{Power required} = \frac{9{\cdot}7\,MV}{4\,562} = 0{\cdot}002\,12 \text{ kW}$$

C-4. *Selection of Alternate Current Motors*

C-4.1 Alternate current motors for trolley traverse shall be so selected that its power rating at 40 percent duty factor is not less than that computed from the following formula:

$$\text{Selected power in kW} = \frac{MVS}{6\,117\,T}\left(F + \frac{100\,a}{981\,E}\right)$$

where

M = mass moved in tonnes including safe working load and weight of hoist;
V = specified free running speed in m/min;
S = service factor as adopted for selection of dc motors;
T = A factor introduced by the permissible motor torque during acceleration exceeding the motor-rated torque. As a general guidance, value of T may be taken as 1·3 to 1·7 for motors having pull out torque of 225 percent full load torque. Lower values of T should be taken for corresponding lower values of pull out torque;
F = overall friction factor according to **C-2.2** and **C-2.2.1** and having a value of 8·0 or 13·0 kgf/t for trolley wheels on antifriction or plain bearings respectively;
E = mechanical efficiency of gearing which may be taken as or 0·97 per reduction; and
a = average linear acceleration of trolley in cm/sec upto 90 percent of the free running speed and will be as given in Table 7 for dc motors.

C-4.2 At trolley free-running speed the acceleration becomes zero and hence the horse power to be furnished by the motor will be as given in **C-3.1.2** for dc motors.

APPENDIX D

(Note under clause 12.2.1)

RATING OF RESISTORS

D-1. Two-Minute Rating — 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 — A resistor having ' 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 10 minutes; this cycle being repeated until a stable temperature is reached.

D-3. Ten-Minute Rating — 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.

APPENDIX E

(Explanatory Note)

INFORMATION TO BE SUPPLIED BY MANUFACTURER

E-1. Description of unit ———————————————

E-2. Type and class of hoist ———————————————

E-3. Safe working load in tonnes ———————————————

E-4. Motor power ——————— kW at ——————— min rating.

E-5. Operating Current:

AC — Voltage, phases, cycles and number of wires ———————————————

DC — Voltage ———————————————

E-6. Head room ———————————————

E-7. Type of suspension ———————————————

E-8. Maximum lift in motors ———————————————

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

———————————————

E-10. a) Hoisting speed ———————————————

b) Type of trolley — If trolley is supplied — Hand operated/Motor operated ———————

c) Speed of motor operated trolley ——————— m/min.

E-11. Methods of operation ——————— Pendant push button/pendant rope.

E-12. Type of drive — If geared, what type? ———————————————

E-13. Type of Drum: ——————— Plain or grooved
Diameter of drum

(If grooved)at bottom of the groove — mm.

E-14. Number of brakes : Types of brakes ———————————————

E-15. Wire Rope — Diameter in mm, construction, grade, number of falls, and minimum breaking load ———

E-16. Beam or rail size for trolley mounted hoists ———————————————

E-17. Factor of safety ———————————————

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

E-19. Net weight ———————————————

E-20. Any special features ———————————————

E-21. Precautions to be taken in operation [applicable only if thermal sensing devices (thermistors) are embedded in motor grindings] ———————————————

E-22. Statement to the effect that the hoist conforms to IS : 3938 - 1983 ———————————————

E-23. Tools and accessories supplied ———————————————

E-24. Drawing of general arrangement and spare parts list ———————————————

Printed at Simco Printing Press, Delhi, India