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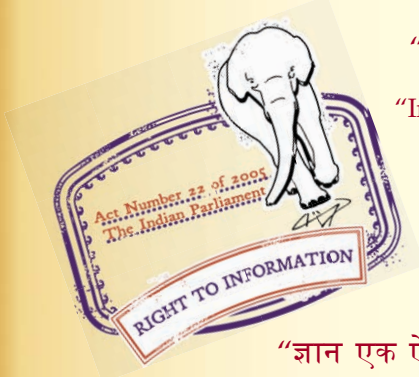
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IS 9507 (1979): Specification for general purpose electric power driven winches for lifting and hauling [MED 14: Cranes, Lifting Chains and Related Equipment]



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“Knowledge is such a treasure which cannot be stolen”





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*Indian Standard*

SPECIFICATION FOR  
GENERAL PURPOSE ELECTRIC POWER DRIVEN  
WINCHES FOR LIFTING AND HAULING

( First Reprint MARCH 1998 )

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

# Indian Standard

## SPECIFICATION FOR GENERAL PURPOSE ELECTRIC POWER DRIVEN WINCHES FOR LIFTING AND HAULING

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(Continued on page 2)

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( Continued on page 19 )

# *Indian Standard*

## SPECIFICATION FOR GENERAL PURPOSE ELECTRIC POWER DRIVEN WINCHES FOR LIFTING AND HAULING

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 24 December 1979, after the draft finalized by the Cranes and Allied Appliances Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** The requirements for cargo winches have been covered in IS : 5112-1972\*. This standard has been prepared in order to guide the industry in the design and manufacture of winches for general purpose.

**0.3** 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.

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### 1. SCOPE

**1.1** This standard specifies requirements for the design, construction, safety, performance, testing and acceptance of power winches for lifting and hauling, which are meant for handling loads by means of a drum and steel wire rope.

**1.2** This standard does not cover the requirements for cargo winches which are covered in IS : 5112-1972\*.

**1.3** The standard does not include requirements for the prime mover used to operate the winch.

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\*General requirements and testing of ac cargo winches (for shipboard use) (first revision).

†Rules for rounding off numerical values (revised).

**2. INFORMATION TO BE SUPPLIED**

**2.1** All the necessary information regarding service requirements of winches as laid down in Appendix A shall be supplied with the enquiry or order.

**3. DEFINITION**

**3.1** The definitions given in IS : 5532-1969\* shall apply in addition to the following.

**3.1.1 Nominal Capacity** — The maximum rope tension in tonnes measured at the drum exit when the winch is lifting or hauling at the design speed with a rope on the drum in the first layer.

**3.1.2 Rope Speed** — The rope speed in m/min measured at the drum exit when the winch is lifting or hauling in at full load of the rope on the drum in the first layer. The nominal loads and speeds are given in Table 1.

**3.1.3 Warping Drum** — Drum used for warping of ropes.

**TABLE 1 DESIGN DATA**

( Clause 3.1.2 )

NOMINAL LOAD	ROPE SPEED	DIAMETER OF STEEL WIRE ROPE
(1)	(2)	(3)
t	m/min	mm
2.0	30.0	13
3.0	18.0	16
5.0	18.0	22
8.0	18.0	28
10.0	15.0	32
12.5	15.0	36
16.0	10.0	40
20.0	7.5	44

\*Glossary of terms for cranes.



#### 4. MATERIAL

4.1 The material used in the construction of winches shall conform to relevant Indian Standards where available (see Appendix B).

#### 5. DESIGN AND CONSTRUCTION

##### 5.1 Disposition

5.1.1 Winches may be designed for right-hand or left-hand operation (see Fig. 1) depending on the position of reduction gear of the drive with respect to the drum, that is at right or left of drum.

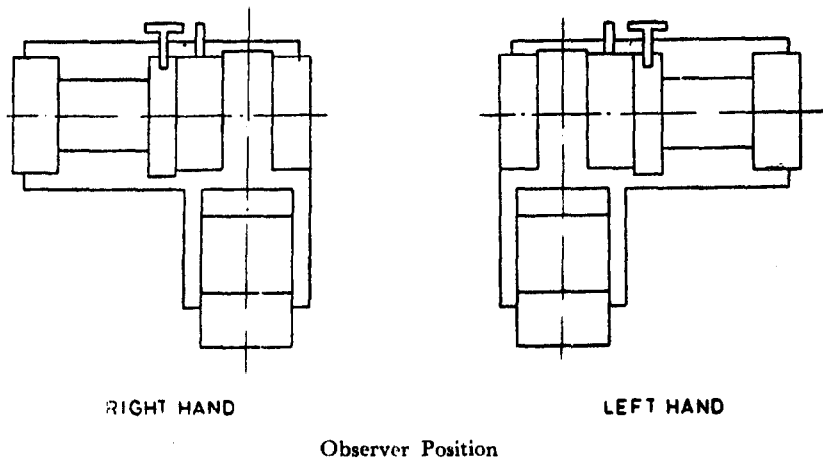


FIG. 1 DISPOSITION OF WINCH

5.1.2 Winches may be designed with or without warping drums at the ends. When warping drums are specified, it shall be necessary to state:

- a) whether one or two warping drums are required;
- b) if only one warping drum is required, at which end of the winding drum it is to be placed; and
- c) whether or not the drum is required to be declutchable.

5.1.3 Suitable holes shall be provided to accommodate foundation or anchoring bolts.

5.1.4 Winches may be mounted on a trolley with wheels suitable to travel on rails. A suitable locking device shall be provided for locking the trolley with the rail.

**5.2 Stress Level** — The stresses in all the components of the winches shall not exceed two-thirds of the yield point of the material for the component under breakdown condition of the motor.

### 5.3 Drum

**5.3.1** A factor of safety of 5 shall be applied to the drum load of the winch to establish the required breaking strength of the rope.

**5.3.2** The drum diameter shall not be less than 18 times the diameter of the steel wire rope.

**5.3.3** The steel wire rope shall be of  $6 \times 19$  steel core construction conforming to IS : 2266-1970\*.

**5.3.4** The drum length shall be sufficient to accommodate the complete length of the rope to be stored on the drum in a number of layers, the number of layers being restricted to five.

**5.3.5** In the case of winches with endless rope, the drums shall be grooved and the number of grooves shall be such as to cover the effective length of travel. The rope shall have not less than three full turns on the drum, not taking into consideration the number of turns required for the operation of the winch. Provision shall be made for tensioning the rope where necessary.

**5.3.6** The drum shall be finished smooth and shall be free from surface defects likely to injure the rope. Where grooves are required the rope drums shall be machine grooved and the contour at the bottom of the grooves shall be circular over an angle of approximately  $120^\circ$ . The radius of the groove shall be larger than the radius of the rope by not less than the appropriate amount given in Table 2.

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**TABLE 2 RADIUS OF GROOVE IN DRUMS AND SHEAVES**

All dimensions in millimetres.

DIAMETER OF ROPE	INCREASE OVER ROPE RADIUS
(1)	(2)
.. and including 16	1.0
Over 16 up to and including 24	1.5
.. 24 .. .. 28	2.0
.. 28	3.0

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\*Specification for steel wire ropes for general engineering purposes (*first revision*).

The depth of the groove shall not be less than 0.35 times the diameter of the rope.

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

- a) 1.5 mm for ropes up to and including 12 mm diameter,
- b) 2.5 mm for ropes over 14 mm up to and including 28 mm diameter, and
- c) 3.0 mm for ropes over 28 mm diameter.

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

**5.3.7** The distance between the top layer of the wire fully wound evenly on the drum and the outer edge of the drum flange shall be at least 2.5 times the diameter of the wire rope.

**5.3.8 Strength of Drums** — Every drum shall be designed to withstand the compressive stress caused by the wound on rope at the groove (where grooves are provided) when the drum is wound, and the bending stress due to the beam action of the drum.

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

## **5.4 Brake**

### **5.4.1 Control Brake System**

**5.4.1.1** Winches shall be provided with an automatic braking system which shall get engaged automatically when the electric motor is switched off or in case of power failure. The brake drum shall be mounted on the load side. The type of brake shall be specified by the purchaser.

**5.4.1.2** For hauling winches, the braking distances shall be not more than the distance in metres equal to one-tenth of the rated speed in m/min.

**5.4.1.3** For lifting winches, the braking distance shall be not more than the distance in metre equal to 1/60th of the rated hoisting speed in m/min.

**5.4.1.4** In case of lifting, the brake system shall be capable of effectively arresting and holding a load at least 1.5 times the normal load.

**5.4.1.5** Winches shall be so designed that the lowering motion under load shall be power controlled without the use of brakes.

#### **5.4.2 Drum Brake**

**5.4.2.1** Winches with a declutchable drum shall be provided with a locking device or a holding brake on the drum.

**5.4.2.2** Brakes applied by hand shall require a force not exceeding 160 N (16 kg) in order to exert a braking torque at least 25 percent in excess of the load torque.

**5.4.2.3** The force applied to foot pedal to exert the above braking torque shall not exceed 300 N (30 kg).

**5.5 Coupling**—Flexible couplings shall be fitted between motor shafts and gear box extension shafts.

**5.6 Track Wheels**—When the winch is mounted on a trolley, the track wheels of the trolley shall conform to the requirements of 5.6.1 to 5.6.5.

**5.6.1** Track wheels may have cylindrical or tapered (conical) tread with flanges or any other means, as and where necessary, to guide the crane effectively and to prevent derailment. The wheels shall be mounted in such a manner as to facilitate removal and replacement.

**5.6.2 Material**—Track wheels shall be of steel (cast or wrought) or shall have steel tyres shrunk on and registered.

The steel shall not contain more than 0.060 percent either of sulphur or phosphorus.

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

NOTE—On request, the manufacturer shall supply the analysis of each cast for contents of carbon, silicon, manganese, sulphur and phosphorus.

**5.6.3 Diameter of Wheels**—The tread diameter of wheels shall preferably be standardized to sizes specified in IS : 1136-1958\* commencing at 150 mm, in the order of preference specified therein.

The minimum tread diameter of the wheel may be calculated from the formula given below:

$$D = \frac{1.5 W}{a}$$

\*Preferred sizes for wrought metal products.

where

$D$  = tread diameter of wheel in millimetres,

$W$  = wheel load in kgf, and

$a$  = full width of rail head including radii in millimetres.

**5.6.4 Flanges** — The dimensions of flanges of track wheels shall be not less than the values given in Table 3.

The thickness of flanges of non-guiding wheels, if flanged, may be less than the values given in Table 3 at the discretion of the winch manufacturer.

**TABLE 3 FLANGE DIMENSIONS**

All dimensions in millimetres.

DIAMETER OF WHEEL		DEPTH OF FLANGE	THICKNESS OF GUIDING WHEEL FLANGE AT BASE
(1)		(2)	(3)
Up to and including	300	15	15
Over 300 up to and including	500	20	20
.. 500 .. ..	1 000	25	25
.. 1 000		30	30

**5.6.5 Width of Tread** — The width of the wheel tread shall be greater than the rail head by an amount which shall suitably allow for the known variations in the rail alignment and rail-track span dimensions.

## 5.7 Guarding

**5.7.1** All gear wheels, pinions and chain drives shall be totally encased unless such parts are so situated in relation to the structure of the winch as to be safe as if complete encasement were provided.

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

## 5.8 Construction

**5.8.1** Materials used for construction of the winch shall be in accordance with the appropriate Indian Standard for material selected.

**5.8.2** The speed reduction may be through worm helical or spur reduction gear box and an open spur gear. If specified the total reduction shall be in an enclosed gear box.

**5.8.3** Welding shall be carried out in accordance with the requirement of relevant Indian Standard.

**5.8.4 Access** — Access openings to prime movers, reduction gearing, bearings, brakes and control mechanisms shall be provided to ensure that adequate inspection and maintenance is facilitated.

#### **5.8.5 Lubrication**

**5.8.5.1** The winches shall be so designed that all bearing surfaces are lubricated during operation.

**5.8.5.2** Adequate and accessible greasing and oiling points shall be provided to ensure that all surfaces requiring lubrication are capable of being properly lubricated.

**5.8.5.3** Lubricating nipples shall be in accordance with the requirements of relevant Indian Standards.

**5.8.5.4** Sumps and oil baths shall be provided with sight glasses or means of measuring oil level.

**5.8.5.5** Wherever necessary, oil and condensation drain plugs shall be provided.

### **5.9 Electricals**

**5.9.1** All electrical equipment used shall be in accordance with the relevant Indian Standard specification.

**5.9.2** Either master or drum controller or push button station shall be provided.

**5.9.3** Controller push button station can be either mounted on the winch frame itself or outside the frame as specified by the purchaser.

#### **5.9.4 Motors**

**5.9.4.1 Ratings** — The ratings shall be such that, under the specified service conditions, the temperature rise will not exceed the limits specified in IS : 325-1978\*.

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

**5.9.4.2 Enclosures** — All winch motors shall be totally enclosed with or without fan cooling arrangement and shall conform to IS : 1231-1974\* or IS : 2223-1971† as appropriate. The enclosures shall suit the specified service conditions and shall be stipulated with the enquiry or order.

**5.9.4.3 Torque** — The pullout torque of any motor supplied at rated voltage should be not less than 2.25 times the rated torque in case of squirrel cage motors and 2.75 times in case of slip ring motors. Starting torque of squirrel cage motors should not be less than two times the full load torque. The rated torque of the motor shall be specified at the rated voltage, frequency and cycle duration factor ( CDF ).

**5.9.4.4 Design and construction** — The motors shall be suitable for reversing, frequency acceleration, mechanical braking and electric braking.

**5.9.4.5 Selection of motor sizes** — When the duty cycles can be adequately assessed, motors may be selected so as to limit the temperature rise as per the relevant Indian Standard taking into account the ambient temperature and the class of insulation.

**5.9.4.6 Mounting** — Motors shall be so located that the brush gear and terminals are accessible for inspection and maintenance and normal ventilation is not restricted.

**5.9.4.7 Limiting speeds** — The speed of the motor shall be limited to two-and-one-half times the rated speed or 2 000 rev/min whichever is less. Otherwise the motors shall be specially designed for higher speeds.

**5.9.4.8 Terminals** — Motor leads shall be brought out from the motor frame to terminals in the terminal box fixed to the motor frame. The terminal box may preferably be mounted on top of the motor.

**5.9.4.9 Insulation** — The motors shall have class E insulation or better as classified in the relevant Indian Standard.

## 5.9.5 Resistors

**5.9.5.1 General** — Resistors shall be adequately protected to prevent accidental contact with live parts.

**5.9.5.2 Ratings** — Resistors shall be rated such that temperature does not exceed the limits specified in the relevant Indian Standards during the operation under service conditions. The ohmic value and current carrying capacity of the resistors shall be computed according to

\*Dimensions of three-phase foot-mounted induction motors ( third revision ).

†Dimensions of flange mounted ac induction motors ( first revision ).

the actual torque characteristics of the motor served and not on the motor size which may be set by thermal requirements. Ratings shall be suitable for the class of service and shall be intermittent rated.

**5.9.5.3 Fittings** — Resistors shall be enclosed in well-ventilated housings and wherever necessary be fitted with suitable covers. Resistor assemblies shall be so mounted as to ensure an adequate flow of cooling air.

### **5.9.6 Control and Protective Equipment**

**5.9.6.1 Isolating switch** — The incoming supply to winch shall be made through a main isolating switch and fuse forming a part of winch control gear and shall cut off supply to winch but not the auxiliary load if any, such as lighting, heating, etc. Alternatively circuit-breaker with short-circuit release may be used if specified.

A separate isolating device shall be installed close to the winch drive in case where the starting gear and the winch controlling devices are not installed in the vicinity of the winch proper. Local starting device may also be provided if specified.

**5.9.6.2 Starting and control gear** — An electro-magnetically operated contactor with inherent under voltage protection shall be used for starting the winch motor. The rating of the contactor shall be suitable for the type and rating of the motor selected and shall conform to IS : 2959-1975\*.

The motor shall be protected against over load with an inverse time lag thermal or magnetic protective device depending upon the requirement.

**5.9.6.3 Other protections** — Provision of other protection devices can be mutually agreed to between the supplier and the purchaser.

**5.9.6.4 Control switch fuse** — A double pole switch-fuse connected in the operating coil circuit of the contactor when fitted, shall be provided. Miniature circuit-breaker as an alternative to control switch fuse may also be used.

**5.9.6.5 Pilot lamp** — A pilot lamp with red lens should be connected so that it indicates that the winch is ready for operation and it shall be so located that it is visible to the operator. The pilot lamps should either be connected so that it indicates whether the control supply is ON or OFF or the contactor is closed or open.

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\*Specification for contactors for voltages not exceeding 1 000 V ac or 1 200 V dc (first revision).



**5.9.6.6 Emergency push button** — A mushroom head push-button emergency stop shall be so located as to be readily available for prompt use by the operator in case of emergency.

**5.9.6.7 Off position interlocking** — Electrical interlocking shall be provided to prevent the inadvertent starting of the motions without the controller being brought to the off position.

**5.9.6.8 Rotor starting gear** — In case of ship-ring motor, the starting resistors shall be cut out in sequence providing smooth acceleration to the drive. The peak torque during starting shall not exceed 1.8 times the rated motor torque when the acceleration is automatically controlled.

**5.9.6.9 Isolator for auxiliary circuits** — Lighting, heating, fans, etc, if any, shall be supplied from the live side of the main isolating switch and shall be controlled by separate isolating switches.

**5.9.7 Limit Switch** — When specified a suitable limit switch of geared type shall be provided to prevent overhoisting in the case of hoist winches and for preventing overtravel in both directions in case of hauling winches.

### **5.9.8 Cables and Conductors**

**5.9.8.1 Cables** — Cables used for wiring should comply with relevant Indian Standards.

**5.9.8.2 Cables for control circuits** — Only copper cables shall be used for control circuits.

**5.9.8.3 Minimum size** — The minimum cross-sectional area of cables shall be as follows:

For power circuits  $2.5 \text{ mm}^2$  for copper or  $6.0 \text{ mm}^2$  for aluminium, and

For control circuits  $1.5 \text{ mm}^2$  for copper.

**5.9.8.4 Protection** — All flexible cables shall be adequately protected against mechanical damage and metal trunking may be used if desired. Electric conduits shall comply with the relevant Indian Standards.

**5.9.8.5 Outdoor wiring** — For outdoor applications 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.

**5.9.8.6 Current rating** — Rating of the cable shall comply with the relevant Indian Standard specifications. The updating factor for the cable shall be equal to  $\frac{8.75}{\sqrt{\text{CDF}}}$  where CDF is the cycle duration factor of the motor. For cable of rotor resistance connections, updating factors of 1.5 and 2.0 shall be used for 10 minutes and 5 minutes rated resistors respectively. Consideration should also be given to such factors as the ambient temperature, grouping, disposition of the cables and to the limitation of voltage drop.

**5.9.9 Earthing** — The winch structure, motor frames and metal cases of all electrical equipment including metal conduits or cable guards, shall be effectively connected to earth complying with the Indian Electricity Rules.

**5.9.10 Safety Requirements** — The winches should comply with the relevant safety regulations under the Factories Act and the Indian Electricity Rules and other statutory regulations as applicable.

## 5.10 Protection of Metallic Surfaces

**5.10.1** The surface shall be free from moisture, oil, grease, dirt, weld spatter, burns and other imperfections before applying the protective finish to metallic surfaces.

**5.10.2** External surfaces shall be painted, given a primer of red oxide and finished with synthetic enamel paint.

**5.10.3** Internal surfaces of gear boxes shall be painted with an oil-proof paint.

**5.11 Weather Protection** — For outdoor applications, all electrical and mechanical equipments shall be adequately protected from the weather. All weather-proof covers shall be easily removable.

## 6. PERFORMANCE

**6.1** The winch shall be capable of exerting the drum load according to its nominal size, when performing at the rated speed specified in Table 1 and subjected to the test requirements of 7.2.

## 7. ACCEPTANCE TEST

**7.1** Test shall be carried out at the manufacturer's works, but where this is not possible the tests may be carried out at site after installation at the purchaser's premises.

**7.2** The following tests shall be carried out:

- a) Full load test, and
- b) Overload test — at 1.25 times the nominal load.

**7.3** During testing, following observations shall be made:

- a) Actual speed of rope,
- b) Working of brake,
- c) Noise level, and
- d) General performance and dimensional check.

**7.4** Duration of test shall be as follows:

- a) *Full Load Test* — 30 minutes of continuous running through a distance of 10 metres allowing 20 seconds pause between consecutive cycles.
- b) *Overload Test* — shall be conducted at least three times for a duration of 10 seconds with a pause of 60 seconds.

## **8. MARKING**

**8.1** All winches shall be permanently marked by means of a rating plate, prominently displayed. The rating plate shall contain such information as is relevant to the winch, including the following:

- a) Manufacturer's name or trade-mark and serial number;
- b) Reference to this standard;
- c) Nominal size;
- d) Type of drive;
- e) Rope diameter and construction; and
- f) Power requirements:
  - i) Rated voltage ( volts ),
  - ii) Rated frequency ( hertz ),
  - iii) Rated current ( amperes ),
  - iv) Rated input ( watts ), and
  - v) Time rating ( half hour, one hour or continuous ).

## A P P E N D I X A

( Clause 2.1 )

### INFORMATION TO BE PROVIDED BY THE PURCHASER

**A-1.** The purchaser should provide the manufacturer of the winch with the following basic information at the time of enquiry:

- a) Nominal size;
- b) Whether left- or right-handed;
- c) Whether warping drums are required, if so at which end;
- d) Whether drum is to be declutchable;
- e) Type of drive required;
- f) Factor of safety on wire rope;
- g) Whether variations are required from standard speeds;
- h) Whether additional tests are to be performed;
- j) Type of brake required;
- k) Power supply available;
- m) Ambient conditions;
- n) Location of controller or push button station;
- p) Class of insulation required;
- q) If limit switch is required;
- r) Type of control required; and
- s) Quantity required.

## A P P E N D I X B

( Clause 4.1 )

### LIST OF RELEVANT INDIAN STANDARDS FOR MATERIAL AND EQUIPMENT

#### B-1. MATERIALS

##### B-1.1 Steel and Castings

- IS : 210-1978 Specification for grey iron castings ( *third revision* )
- IS : 226-1975 Specification for structural steel ( standard quality )  
( *fifth revision* )

- IS : 961-1975 Specification for structural steel (high tensile) (*second revision*)
- IS : 1030-1974 Specification for carbon steel castings for general engineering purposes (*second revision*)
- IS : 1387-1967 General requirements for the supply of metallurgical materials (*first revision*)
- IS : 1570-1961 Schedule for wrought steel for general engineering purposes
- IS : 2062-1969 Specification for structural steel (fusion welding quality) (*first revision*)

### **B-1.2 Threaded Fasteners**

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

### **B-1.3 Wire Ropes**

- IS : 2266-1970 Specification for steel wire ropes for general engineering purposes (*first revision*)
- IS : 2365-1963 Specification for steel wire suspension ropes for lifts and hoists
- IS : 3973-1967 Code of practice for selection, installation and maintenance of wire ropes

## **B-2. MECHANICAL AND FABRICATION DETAILS**

### **B-2.1 Keys and Keyways**

- IS : 2048-1975 Specification for parallel keys and keyways (*first revision*)
- IS : 2292-1974 Specification for taper keys and keyways (*first revision*)

### **B-2.2 Welding**

- IS : 816-1969 Code of practice for use of metal arc welding for general construction in mild steel (*first revision*)
- IS : 823-1964 Code of procedure for manual metal arc welding of mild steel

### **B-2.3 Gears**

- IS : 2467-1963 Notation for toothed gearing

## IS : 9507 - 1979

- IS : 2535-1978 Basic rack and modulus of cylindrical gears for general engineering and heavy engineering (*second revision*)

### B-3. ELECTRICAL DETAILS

#### B-3.1 Motors

- IS : 325-1978 Specification for three phase induction motors (*fourth revision*)
- IS : 900-1965 Code of practice for installation and maintenance of induction motors (*revised*)
- IS : 1231-1974 Dimensions of three-phase foot-mounted induction motors (*third revision*)
- IS : 2223-1971 Dimensions of flange mounted ac induction motors (*first revision*)

#### B-3.2 Cables and Conductors

- IS : 434 (Part I)-1964 Specification for rubber-insulated cables: Part I With copper conductors (*revised*)
- IS : 434 (Part II)-1964 Specification for rubber-insulated cables: Part II With aluminium conductors (*revised*)
- IS : 694-1977 Specification for PVC insulated cables for working voltage up to and including 1 100 V (*second revision*)

#### B-3.3 Switchgear

- IS : 1322-1967 Specification for ac motor starters of voltage not exceeding 1 000 volts (*first revision*)
- IS : 2147-1962 Degree of protection provided by enclosures for low-voltage switchgear and controlgear

*( Continued from page 2 )*

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