


<b>INTER PLANT STANDARD – STEEL INDUSTRY</b>		
 IPSS	<b>SPECIFICATION FOR LIFTING MAGNETS</b> <i>(Third Revision)</i>	<b>IPSS:1-10-001-11</b>
	Corresponding IS does not exist	Formerly : IPSS: 1-10-001-07

## 0. FOREWORD

- 0.1** This Inter Plant Standard has been prepared by the Standards Committee on Electrical components and equipment, IPSS 1:10 with the active participation of the representatives of the steel plants, major consultancy organizations and established manufacturers of lifting magnets and was adopted in May 2011..
- 0.2** Inter Plant Standards for steel industry primarily aim at achieving rationalization and unification of parts and assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment (or while placing orders for additional requirements) by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes/types from among those mentioned in this standard, for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.
- 0.3** This inter plant standard was first published in 1981. It was subsequently revised in 1993. Now this revision has been undertaken to incorporate various technological developments which have taken place in the field of lifting magnets and the valued experience of the user steel plants over the years.

## 1. SCOPE

- 1.1** This Inter Plant Standard covers the requirement and tests of indoor and outdoor heavy duty lifting magnets for handling solid slabs, blooms, billets, pigs, plates and sheets, light finished parts, other finished / semi-finished products such as hot wire rod coils of low carbon and high carbon scraps etc in steel industry.
- 1.2** It covers selected categories of 220 V dc operated circular and rectangular magnets for handling materials up to 600°C.
- 1.3** Standard information to be furnished on enquiry and order for lifting magnets is given at Appendix-A. It may be hot/semi hot/cold etc. This information should be welded on the body of the magnets.

- 1.4 Control panel for lifting magnet and the battery back-up unit & dc power pack for lifting magnets is separately envisaged in IPSS :1-04-037-99 'Magnet panel for cranes.'

## 2. TERMINOLOGY

- 2.1 For the purpose of this standard, the definitions contained in IS 1885 (Part-1):1961 "Electrotechnical vocabulary: Part 1 Fundamental definitions" and IS 1885 (Part-31) :1971 "Electrotechnical vocabulary: Part 31 Magnetism" shall apply.

## 3. SITE CONDITIONS

- 3.1 The following shall constitute the normal site conditions for the purpose of this standard:
- 3.1.1 *Location* – The performance of magnets shall not be adversely influenced by the location having water, fumes, oil, steam etc, wherever mentioned.
- 3.1.2 *Ambient temperature* - The normal ambient temperature shall be 50°C or 45°C unless specified by the purchaser.
- 3.1.3 *Altitude* - The altitude shall not exceed 1000m above sea level.
- 3.1.4 *Relative humidity* - The maximum relative humidity shall be 100%. However, maximum temperature and maximum relative humidity may not occur simultaneously.
- 3.1.5 *Ambient air* - The ambient air may contain a fair amount of conductive and corrosive metallic laden dust. The equipment to withstand saline atmospheric conditions.
- 3.1.6 For special applications where steam and corrosive fumes are present, details shall be as agreed to between the manufacturer and the purchaser.

## 4. SEALING

- 4.1 The magnets shall be Hermetically sealed.

## 5. RATING

- 5.1 **Working voltage** – Rated lifting capacity of magnet shall be with the working voltage of 220 V dc subject to variation of  $\pm 10\%$ .
- 5.2 **Lifting capacity** – The rated lifting capacity of the circular and rectangular magnets shall be as given in Tables 1 and 2. All magnets shall be suitable for a cyclic duration factor of 50% or 75% on 10 minutes rating class as per purchaser's requirement.

## 6. DIMENSIONS

- 6.1 The preferred outside dimensions of the circular and rectangular magnets shall be as given in Table 1 and 2.

**NOTE:**The capacities and dimensions of the magnets specified in this standard are based on the assumption that copper conductors have been used for the coil windings.

## 7. DISCHARGING THE MAGNET

- 7.1 All magnets shall be provided with non-linear type discharge device of rating adequate to suppress all transient voltages. The discharge device shall be so located inside the terminal box that it could be replaced easily.

## 8. DESIGN AND CONSTRUCTION

### 8.1 Coils

- 8.1.1 The conductor material shall be of copper strips, conforming to IS 1897:1983 'Copper strip for electrical purposes (second revision) (superseding IS 3285)' and shall be free from burrs and will not have more than two joints in any single coil/cake. The joints shall be lap jointed and brazed all round. There shall be no joint in the portion of the coil immediately connecting to the leads for at least five turns. The last lap of the coil shall be reinforced with a phosphor-bronze strip.

The coils shall be in the form of cakes. The insulation provided between the coil cakes shall be of class H. Provision of RTDs may be considered

**NOTE:** Rectangular copper conductor shall be covered with double layer varnish bonded glass-fibre, lapped firmly, evenly, closely and continuously around the conductor. These should conform to IS 13730 (Part 0/sec 5) : 2003 The construction and other test parameters shall generally be in line with IS 4685:1968(Part-1) 'Varnish bonded glass-fibre covered copper conductors :(Part-1) Round wires'.

- 8.1.2 The coils shall be suitably insulated with ceramic tape as turn to turn. For layer insulation between the cakes, mica insulation shall be used. Flexible micanite shall be used for body insulation.
- 8.1.3 All magnets shall have minimum class H insulation. The manufacturer shall use class C insulation for handling materials at temperatures higher than 300°C.
- 8.1.4 The annular space between the coil and the magnet body shall be filled with silicon based compound. The filling compound shall be non-hygroscopic and shall have low co-efficient of thermal expansion and high thermal conductivity. It shall be able to withstand the rise in temperature corresponding to the class of insulation and shall be easily removable during the repair of the magnets.

- 8.1.5 The leads shall be firmly secured on to terminals inside the coil assembly and shall be protected from moisture and dust. The leads shall be brought out on the outer part of the coil so that it is safe from fracture caused by expansion/contraction of coil. Leads should be distinctly marked indicating the starting and ending winding.
- 8.1.6 Ceramic sheets of adequate thickness to be provided in between the coil and bumping plate for hot application magnets (for above 300 degree C)..
- 8.2 Magnet Body** – Magnet body shall be cast from high permeability steel conforming to Grade 2 of IS 4491:1994 `Steel casting for high magnetic permeability (third revision)'. The suspension lugs which are attached shall be cast integral with the magnet body.or any equivalent material mutually agreed between the purchaser and the supplier. In case of rectangular magnets, fabricated design may be adopted, using steel of grade Fe 410WC according to IS 2062:2006 `Steel for general structural purposes – Specification (fifth revision) (superseding IS 226)'.
- 8.2.1 The periphery of the shell shall be heavily ribbed to give added mechanical strength and increased radiation surface.
- 8.2.2 The lifting magnet shall be supplied along with suitable chain sling conforming to IPSS:1-07-038-96 `Specification for alloy steel chain sling (first revision)'.
- 8.3 Magnets Poles** – Outer poles must be integral part of the magnet. Inner poles shall preferably be integral part for circular magnet. However in case of bolted design, inner pole shall be fixed on to the magnet body with adequate number of bolts of minimum 19 mm dia. The heads of the bolts should be countersunk into the bodies of the poles and suitably locked.
- 8.4 Bumping plate** – For hot magnets double bumping plate of high manganese non magnetic alloy conforming to Grade ¼ of IS 276:2000 `Austenitic – Manganese steel castings – specification (fifth revision)' shall be provided at the bottom for circular magnets to protect the coil from shock. For rectangular magnets, non-magnetic stainless steel or non-magnetic manganese steel bumping plate of adequate strength shall be provided at the bottom to protect the coil from shock.
- 8.5 Bolts** – High tensile steel bolts shall be used wherever necessary in the magnet construction.
- 8.6 Terminals and Terminal Box** – Each magnet shall have two terminals securely placed in the terminal box, which shall be capable of accommodating continuous duty copper cables. The terminal box shall be so located to prevent damages while loading hitting and shall be of three compartment type. The coil leads shall terminate in first compartment through insulated bushings. The terminal studs in the second

compartment shall be connected permanently to the termination points of the first compartment. The third compartment shall house the non-linear discharge resistor. The external feeding cables shall be connected to the terminal studs of the second compartment by the user. The terminal box shall be suitably enclosed to make it either water, steam, fume and oil proof or water tight or water resistant. Suitable provision for earthing shall be made. An additional identical terminal box with separate set of leads from the winding shall be provided as per mutual agreement between the purchaser and the supplier. One terminal box may be allowed in case of smaller and rectangular magnets. The enclosure protection class of the Terminal Box should be defined like IP-55

**8.7 External leads** - A one meter long 3 core flexible EPR/CSP copper cable of suitable cross-section shall be connected through a water tight gland. A suitable plug-socket shall be provided.

**8.8 Clamping** – Suitable clamping arrangement shall be made near the terminal box of the magnet to hold the feeding cable firmly against jerks or vibration and also to prevent any pull of the leads.

## 9. TESTS

9.1 **Stage inspection** – After the coil is placed and before filling of compound, the party should call for stage inspection.

9.2 Each magnet shall be subjected to the following tests at the factory premises and shall be despatched with a test certificate :

### 9.2.1 Type Test

a) The manufacturer shall perform load test on a representative sample of each lot or batch of each type/size/model of the lifting magnet for the 125% rated lifting capacity of the magnet in accordance with clause 5.2.

b) User shall do selection of the magnet capacity considering service factor.

9.2.2 **Routine Test** – The manufacturer shall perform the following tests on each lifting magnet before despatch :

a) *Operating Current (cold)* – The operating current under cold condition at rated voltage, shall not exceed the maximum values given in Table-1.

*Power Consumption* : The ratio

$$\frac{\text{Power consumption (hot) in steady state condition}}{\text{Power consumption (cold) at the rated voltage}}$$

should be > 0.7.

Note: Steady state condition – until 2 consecutive winding conditions are attained at half an hour interval.

- b) *Temperature Rise Test* – The magnet shall be subjected to repeated operations in cyclic duration factor (see clause 5.2) at rated voltage until steady state temperature condition of the winding is attained.
- c) *High voltage test* – The magnet shall withstand without breakdown in insulation when a high voltage of 2000 V ac at 50 Hz is applied between the coil and the body for one minute.
- d) *Surge voltage test (with discharge device)* – The surge voltage shall be tested with the help of an oscilloscope by breaking dc circuit. The maximum allowable surge voltage shall be 1600 V.
- e) *Insulation Resistance Test*
  - i) The insulation resistance of the magnet coil shall be not less than 50 M-ohm when tested with a 1000 V direct reading portable insulation resistance tester in cold condition after the high voltage test, and
  - ii) The insulation resistance shall be not less than 0.5 M-ohm after the steady state condition is attained.
- f) *Flux density test* – To be measured by Gauss Meter to substantiate the lifting capacity.

## 10. MARKING

10.1 Each magnet shall be provided with metallic name-plate giving the following information :

- a) Type
- b) Manufacturer's name, trade mark & serial No.
- c) Size of magnet
- d) Lifting capacity in kg (hot)
- e) Rated voltage
- f) Current (cold and hot)
- g) Weight of the magnet in kg
- h) Duty cycle
- i) Year of manufacture
- j) Class of insulation; and
- k) Reference to this standard i.e. IPSS:1-10-001-11

10.2 Manufacturer's trade mark, SI No. and class of insulation shall be welded on the magnet body.

**11. INFORMATION TO BE FURNISHED BY THE MANUFACTURER**

11.1 The manufacturer shall supply the following additional information along with each lifting magnet:

- a) **Coil winding data :**
    - i) Conductor material
    - iii) Size of conductor
    - iv) Number of turns
    - v) Material of inter-turn insulation
    - vi) Material of body insulation
    - vii) Number of paths-series in parallel, and
    - viii) Material of filling compound.
  - b) **Coil resistance** – Cold & hot
  - c) **Power consumption** – cold & hot
  - d) **Cross section drawing of magnet**
  - e) **Detailed instruction for repair of magnet;** and
  - f) **Test certificates** (see clause 9)
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TABLE – 1

**TECHNICAL PARAMETERS OF LIFTING MAGNETS**  
(Clauses 5.2, 6, 9.1.2-a and 9.1.2-d)

<b>(A) Circular Magnet</b>				
Size (dia) of Magnet in mm (+ 25 mm)	900	1150	1350	1600
Cold current at 220 V dc and 40°C, Max, A	32.0	45.0	64.6	87.5
Duty cycle, %	50	50	50	50
Rated Lifting capacities in hot condition of magnet in (kg)				
Solid slabs	8000	16000	21500	31000
Skull cracker balls (with normal pole shoes)	4500	7000	8000	10000
Sheet pressed and packed	-	-	-	3000
Heavy steel scraps	300	700	1000	1800
Pig iron castings	300	700	1200	1800
Light steel scraps	250	400	550	800
<b>(B) Rectangular Magnets</b>				
Size of Magnet in mm (+ 25 mm)	900 mm x 600 mm	1400 mm x 600 mm	1700 mm x 700 mm	
Cold current at 220 V dc and 40°C, Max, A	14.5	22.0	27.4	
Duty cycle, %	50	50	50	
Rated Lifting capacities in hot condition of magnet in (kg)				
Solid slabs	8000	11000	14000	
Sheet pressed and packed	2000	3200	5650	
Blooms	-	7200	12800	



TABLE – 2

**ADDITIONAL INFORMATION ON LIFTING CAPACITY OF  
ELECTROMAGNET (Clause 5.2 and 6)**

	Type of material handling	Size of material handling (mm)	Number of magnets in operation	Total lifting (kg)
<b>(A) Circular Magnet 1150 mm dia (<math>\pm</math> 25 mm)</b>				
a)	Steel billet	60 x 60 x 8800	2	3400
b)	Steel billet	64 x 180 x 8800	2	3800
c)	Steel billet	50 x 50 x 8800	2	2500
d)	Steel sheet	60 x 2000 x 6000	1	5700
e)	Steel sheet	26 x 1250 x 7400	2	5800
f)	Steel sheet	8 x 1600 x 12000	4	6000
g)	Steel sheet	12 x 2500 x 12000	4	8500
<b>(B) Circular Magnet 1600 mm dia (<math>\pm</math> 25 mm)</b>				
a	Bloom at 120°C	90 x 110 x 230	1	2000
b	Pressed steel sheet packs	-	1	2000
c	Rolls of steel at 300°C	-	1	10000
<b>(C) Rectangular Magnet 900 mm x 600 mm (<math>\pm</math> 25 mm)</b>				
a	Solid slab	20 x 1000 x 5000	1	8000
b	Solid slab	200 x 1065 x 4575	1	7745
<b>(D) Rectangular Magnet 1400 mm x 600 mm (<math>\pm</math> 25 mm)</b>				
a	Steel sheet	14 x 1000 x 6000	1	1320
b	Steel sheet	200 x 1000 x 4000	1	3200
c	Blooms	450 x 450 x 4500	1	7200
d	Solid slab	300 x 1000 x 4500	1	11000
<b>(E) Rectangular Magnet 1700 mm x 700 mm (<math>\pm</math> 25 mm)</b>				
a)	Solid slab	108 x 1010 x 4200	1	10800
b)	Solid slab	400 x 915 x 4500	1	14000
c)	Solid slab	112 x 760 x 4200	1	14000
d)	Blooms at 200°C	300 x 300 x 4500	1	12800
e)	Blooms at 200°C	270 x 270 x 4500	1	13500
f)	Rails P-50 at 500°C	Length 2500	4	12500
g)	Rails P-65 at 500°C	Length 2500	4	14600
h)	Rails P-75 at 500°C	Length 2500	4	13000
i)	Sheets	7 x 1800 x 7000	2	7000
j)	Squares	65 x 65 x 6000	2	4200
k)	Steel billet	60 x 60 x 8800	2	3400
l)	Steel billet	64 x 180 x 8800	2	3800
m)	Steel billet	50 x 50 x 8800	2	2500

**APPENDIX – A**  
(clause 1.3)

**STANDARD INFORMATION FOR ENQUIRY AND ORDER  
FOR LIFTING MAGNETS**

1. a) Type of magnet : Circular / Rectangular  
b) Dimensions :
  2. Ambient temperature of working place :
  3. Working voltage
  4. Type of material to be handled
  5. a) Temperature of handling material (in °C)  
b) lifting weight of the material (in kg)
  6. Class of insulation of the magnet : H/C
  7. Duty cycle : 50% on 10 minutes  
or  
75% on 10 minutes
  8. Special conditions (if any).
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