INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR RESISTANCE BOXES FOR POWER CIRCUITS** (*First Revision*)	**IPSS: 1-10-002-02**
	Corresponding IS does not exist	Formerly : IPSS : 1-10-002-82

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 resistance boxes and was adopted in February 2002.

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 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.

1. SCOPE

1.1 This Inter Plant standard covers the requirements and tests for resistance boxes to be used in power circuit for various applications including dynamic breaking application, suitable for indoor and outdoor duty with working voltages upto and including 1100V ac or 1200V dc.

2. TERMINOLOGY

2.1 **Resistance Box** – It is a box in which a specific number of resistance elements are suitably mounted and electrically connected.

3. SITE CONDITIONS

3.1 The following shall constitute the normal site conditions : -

3.1.1 *Ambient temperature* - The reference ambient temperature shall be 40°C and maximum ambient temperature can be 55°C & for higher temperature derating factor shall be used accordingly.

3.1.2 *Altitude* - The altitude shall not exceed 1000m.

3.1.3 *Ambient air* - The ambient air in both indoor and outdoor installations may contain fair amount of conductive dust and humidity.

3.1.4 *Humidity* - The relative humidity can be upto the maximum of 100%. However, maximum ambient temperature and maximum relative humidity may not occur simultaneously.

3.2 The resistance box shall be suitable for special applications / installations where steam and corrosive fumes are present, the details shall be as agreed between the manufacturer and the purchaser.

4. ENCLOSURE

4.1 The enclosure of the resistance box, if provided, shall have degree of protection corresponding to IP33 for indoor and outdoor installations with a view to reducing variety. However, outdoor installed resistance boxes shall have a canopy or any other additional protection as required by the purchaser.

4.2 The enclosure of the resistance box shall be such that the load bearing plates shall be of minimum 2.5 mm thick sheet steel and other coverings shall be of minimum 1.6 mm thick sheet steel.

5. RATINGS

5.1 **Voltage** – Resistance boxes shall be suitable for working voltages not exceeding 1100V ac and 1200 dc.

5.2 **Rated current** – Preferred current rating and the values of the total resistance box shall be in accordance with those given in **Tables 1 to 3**. The manufacturer shall supply information in a tabular form regarding the values of current at different cyclic duration factors, for example; 60, 40 & 25% on the basis of 10 minutes duty cycle. The manufacturer shall also furnish derating factors for stacking.

TABLE 1

[Clause 8.2.3.1, 8.2.3.3, 5.2, 5.3, 9.1, 12.1(a), 14.1(d)]

EDGE WOUND RESISTANCE BOXES EQUIVALENT TO RUSSIAN HQ TYPE

Sl No.	Total Resistance value of box	Code no. of Unit Box	Current Rating (A)			
			100%	60%	40%	25%
1.	0.40	EW-R-0.4-97	97A	110	115	122
2.	0.525	EW-R-0.525-83	83A	88	91	97
3.	0.8	EW-R-0.8-69	67	72	75	82
4.	1.2	EW-R-1.2-58	58	60	62	67
5.	1.6	EW-R-1.6-49	49	51	54	60
6.	2.12	EW-R-2.12-42	42	44	46	49
7.	3.1	EW-R-3.1-36	36	38	40	45
8.	4.35	EW-R-4.35-30	30	31.5	33	36
9.	5.6	EW-R-5.6-26	26	28	28	30
10.	7.25	EW-R-7.25-22	22	24	24	26

NOTE : The ratings are based on 40°C ambient temperature and temperature-rise shall be limited to 375°C.

TABLE 2

[Clause 5.2, 5.3, 9.1, 12.1(a), 14.1(d)]

EDGE WOUND TYPE RESISTANCE BOXES

Total Resistance of unit box in Ohms	Code No. of unit box	Current Rating (A)			
		100%	60%	40%	25%
0.1	EW-R-0.1-173	173	208	228	296
0.15	EW-R-0.15-150	150	180	198	256
0.3	EW-R-0.3-100	100	120	132	171
0.5	EW-R-0.5-78	78	94	103	133
1.0	EW-R-1.0-55	55	66	73	94
1.5	EW-R-1.5-45	45	54	59	77
2.0	EW-R-2.0-38	38	46	50	65
3.0	EW-R-3.0-31	31	37	41	53
5.0	EW-R-5.0-25	25	30	33	43

NOTE : The ratings are based on 40°C ambient temperature and temperature-rise shall be limited to 375°C.

TABLE 3

[Clause 5.2, 5.3, 9.1, 12.1(a), 14.1(d)]

PUNCHED STEEL RESISTANCE BOXES

Total Resistance of unit box in Ohms	Code No. of unit box	Current Rating (A)			
		100%	60%	40%	25%
0.11	PS-R-0.110-215	215	225	240	260
0.235	PS-R-0.235-150	150	158	173	190
0.50	PS-R-0.500-100	100	105	108	120
0.90	PS-R-0.900-78	78	80	83	86
1.00	PS-R-1.00-67	67	69	72	80
1.25	PS-R-1.25-55	55	58	60	70
2.00	PS-R-2.00-46	46	47	51	55
3.00	PS-R-3.00-38	38	42	48	55
5.00	PS-R-5.00-26	26	29	33	36

NOTE : The ratings are based on 40°C ambient temperature and temperature-rise shall be limited to 375°C.

5.3 **Rated Resistance** – The resistance box shall be rated in terms of total resistance of the box in ohms and the corresponding values of the current in amperes for continuous duty without the temperature rise exceeding the limits given in **Tables 1 to 3**.

5.4 **Class of duty** – Continuous duty, Duty Type S1, conforming to IS 325:1996 `Specification for three-phase induction motors (*fifth revision*)'.

6. VIBRATION

6.1 The resistance box shall be subjected to vibration test with a view to determining its ability to withstand specified severities of vibration encountered on EOT cranes in the steel plants.

7. COOLING

7.1 The resistance boxes shall be natural / air cooled.

8. CONSTRUCTION

8.1 **General Requirements** – No readily inflammable material shall be used in the construction of the frames, supports or enclosure of the resistance

boxes. Mounting rods shall be embedded in silicon or shellac bonded mica of minimum thickness of 2 mm. Grids shall have phosphor bronze / electrolytic copper washers to ensure proper contact. The physical mounting dimensions of the boxes shall be in accordance with the values given in **Fig.1 and 2**, which shall enable the user to replace any box with ease and minimum disturbance to other boxes. The design of grid elements shall preferably be such that it can be easily changed. It is preferable to have `draw out' design of the box for easy replacement. The intermediate jumpers in resistance boxes shall be bare copper conductor of appropriate cross-section. For ease of identification and replacement, individual grids shall have marks punched or embossed on projected parts.

8.2 The material shall be non-corrodible, free from brittleness and shall have a temperature co-efficient of resistance less than 2.5% per 100°C temperature change. The resistivity of the material shall not be less than 110 microhm.

NOTE : The preferable materials are as follows :
a) As per steel alloy type 6 of IS 12045:1987 (given at clause 2.1)
b) Fecral (Cr: 12-15%, Al: 3.5-4.5%, rest Fe).

8.2.1 Elements for cast grid resistors - The grid elements shall be grey cast iron of grade FG 2000 conforming to IS 210:1993 "Specification for grey iron castings (*fourth revision*).

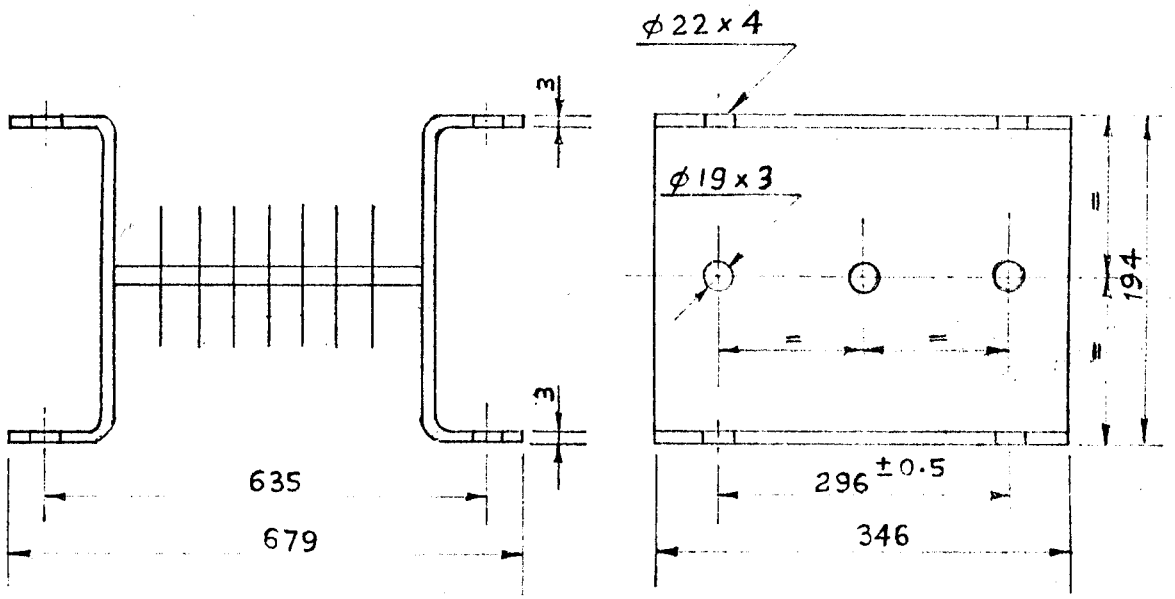
8.2.2 Elements for punched steel resistors – The elements shall be punched out from sheet steel Alloy type 6 of IS 12045:1987.

8.2.3 Elements for edge wound type resistors – The elements shall be made from Fecral sheet (Cr:12-15%, Al: 3.5 – 4.5%, rest Fe).

8.2.3.1 Each of the edge wound resistance boxes mentioned in **Table-1** shall have 5 Nos. of identical edge wound resistance elements of current rating same as that of the corresponding box and of resistance value as $1/5^{th}$ of the total resistance value of the corresponding box. All such elements shall have connection terminals at both the ends and tapings at ½ and ¼ length.

8.2.3.2 For higher current ratings, other variety boxes may be made by making series/parallel combinations of the elements and by using the tappings.

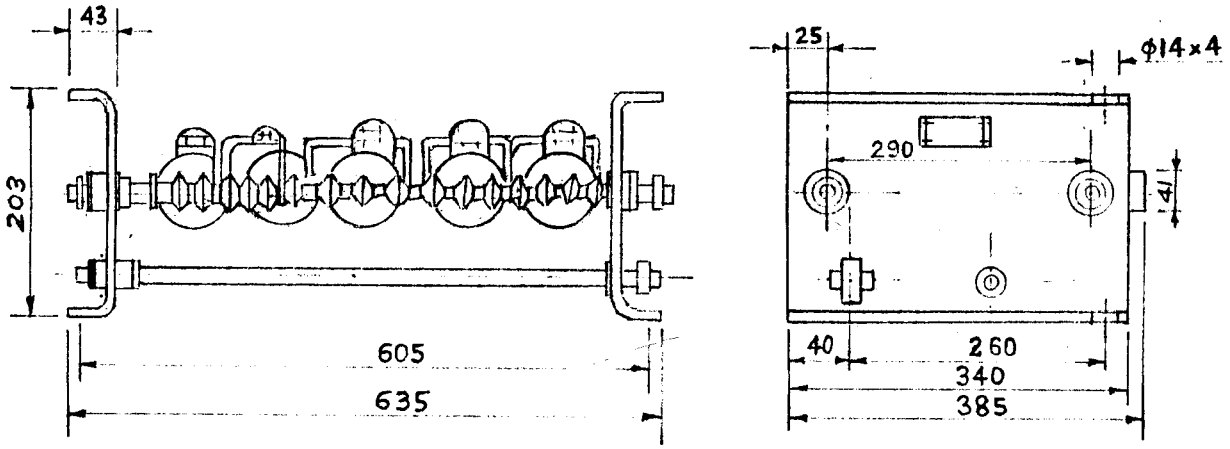
8.2.3.3 For rotor circuits of 3 phase ac slipring motors, tailor made resistance boxes may be made by using elements of various ratings in the same box. But such elements must be any one of the 10 varieties of the standard elements required to make the 10 Nos. boxes of **Table-1**, as mentioned in clause 8.2.3.1 above.



ALL DIMENSIONS ARE IN MILIMETRES

FIG.1 MOUNTING DIMENSIONS OF CAST GRID RESISTANCE BOXES

(CLAUSE 8.1)



ALL DIMENSIONS ARE IN MILIMETRES

FIG.2 MOUNTING DIMENSIONS OF EDGE WOUND TYPE RESISTANCE BOXES

(CLAUSE 8.1)

8.3 **Terminal** – Terminals shall be made of cadmium coated steel/electrolytic copper of adequate current carrying capacity as specified. Terminal clamps or sockets shall be provided for the incoming and outgoing cables whenever specifically asked for. The terminals shall be capable of accommodating aluminium cables. There shall be adequate room for disposition of cables in the box. In the case of punched steel elements, terminals shall form an integral part of the resistance element. In case of cast iron grid elements, terminals with tapping lugs of detachable type shall be provided to have ease and flexibility of using a designed part of resistance out of the total resistance. In case of stainless steel elements, terminal lugs shall be of integral type and in case of chrome aluminium steel alloy, terminal lugs shall be brazed or welded.

8.3.1 *Position of terminal* – The position of the terminals for connecting incoming and outgoing cables shall be such that the heat from any section of the resistance element shall not be detrimental to the cables. As far as possible, the terminals shall be easily accessible for maintenance and wiring purposes.

8.3.2 Inter element connections shall be effected by special links fixed to individual elements so as to maintain a firm electrical connection between them at all times. In no case the arrangement for assembly of the element shall form the means for providing inter element connection.

8.3.3 All tappings shall be brought out to terminals on front side through copper strips/copper rods.

9 TEMPERATURE RISE

9.1 The temperature rise of resistance elements shall not exceed the limits given in **Tables 1 to 3**, at any point when measured by using a thermometer of thermocouple placed in contact with resistance material.

10 EARTHING

10.1 The assembly comprising metallic chassis, frame and the fixed parts of the metal enclosure of the resistance box shall be provided with two separate earthing terminals. These terminals shall be provided over and above all other means provided for securing metallic enclosures, armour or other metallic covering of current carrying cables.

10.2 The earthing terminals shall be readily accessible and placed in such a way that the earth connection of the resistance shall be maintained when the cover is removed. The earthing terminals shall be of adequate size, be protected against corrosion and shall be metallically clean. The earthing

terminals shall be identified by means of the earthing symbol ⏚ marked in a legible and indelible manner or adjacent to the terminals.

11 ELECTRICAL CLEARANCE AND CREEPAGE DISTANCES

11.1 The clearance and creepage distances shall be as large as practicable. The clearance between the live parts of the resistance and the earth shall not be less than 25 mm. The creepage distance shall wherever practicable incorporate ridges in order to break the continuity of conducting deposits which may form.

12 MARKING

12.1 Each resistance box shall be provided with a name plate with the following informations :

a) Code number of the box (*see Tables 1 to 3*),

b) Rated voltage, V

c) Reference drawing number,

d) IPSS No. i.e. IPSS:1-10-002-02

e) Continuous rated current, A

f) Mass of the resistance box,

g) Year of manufacture,

h) Resistance in ohms,

i) Material of the element, and

j) Manufacturer's serial number.

12.2 In addition to the information given in 12.1, Schematic connection diagram with ohmic value of elements shall be provided on a separate plate on the body of the resistance box.

13 TESTS

13.1 The following tests shall be carried out on individual resistance boxes at factory before despatch. Each resistance box shall be despatched along with a factory test certificate.

13.2 Type Test

13.2.1 *Temperature rise test* – This test is to be conducted by passing dc or ac current at rated voltage. For continuously rated parts, the test shall be continued till they attain a constant temperature within $\pm 1^{\circ}C$ for one hour.

During the test, all the current carrying parts shall be in circuit (continuous rated) as the heating of one part may materially affect the temperature of other parts.

13.2.2 *Test for enclosure* – The degree of protection provided by the enclosures shall be tested in accordance with IS 2147:1962 `Degrees of protection provided by enclosures for low voltage switchgear & controlgear', and type test certificate shall be furnished by the manufacturer. The type test shall be carried out on enclosure of electrical equipment in accordance with IS 12063:1987 `Classification of degree of protection provided by enclosures of electrical equipment', if desired by customer.

13.2.3 *Variation in resistance* – Variation of resistance from cold to hot condition shall be within 15%. The manufacturing tolerance at ambient temperature shall be within 10% of the rated resistance value.

13.2.4 *Vibration Test* - The test shall be conducted as specified in IS 9000 (Part 8) : 1981 `Basic environmental testing procedures for electronic & electrical items : Part 8 Vibration (Sinusoidal) Test.' The endurance testing by sweeping shall be conducted according to 9.2.1 of IS 9000 (Part 8) : 1981 with the following severity:

Frequency range	:	10-55 Hz
Amplitude	:	0.35 mm or 49 m/s^2 (5g)
Duration	:	6 hours

13.3 Routine Tests – The resistance box shall withstand without breakdown a high voltage of 2U+1000V ac at 50 Hz with a minimum of 2000V when applied between the conducting part of the resistance element and the body (earth) for one minute. Whenever the resistance boxes are to be used in thyristor convertor circuits, the test voltage shall be 5U+1000 Volts, `U' being the rated voltage.

14 ORDERING SPECIFICATION

14.1 The following information shall be supplied by the purchaser as ordering specifications to the manufacturer :

a) Rated voltage,
b) Total resistance of the box,
c) Material of resistance element,
d) Code number of the box (*conforming to Tables 1 to 3*),
e) Type of enclosure,
f) Special requirements, if any; and
g) Reference drawing.