INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**GUIDELINES FOR SELECTION OF CARBON BRUSHES** (*Second Revision*)	**IPSS:1-03-026-08**
	Based on IS 13586, 13584 & 13466	Formerly : IPSS:1-03-026-99

0. FOREWORD

0.1 This Inter Plant Standard has been prepared by the Standards Committee on Rotating Electrical Machinery, IPSS 1:3 with the active participation of the representatives of all the steel plants/units, reputed consulting organizations and established manufacturers and was adopted in June 2008.

0.2 **Applicability to steel plants** – It is to be appreciated that the steel plants have varieties of rotating electrical machines supplied by many manufacturers employing diverse types and grades of carbon brushes and brush holders. The brush selection follows a trial and error method rather than a cut and dry method. Again, identical machines need sometimes different grades of brushes due to diverse local conditions and by now steel plants have standardized on the carbon brushes to a large extent and this involves bulk of indigenous materials and a little import of carbon blocks too. While this import will be reduced still further, it is felt that it is not advantageous now to standardize the grades depending upon some machine parameters, but to concentrate more on improving the consistency and quality good commutation, which for the purpose of this standard may be defined as sparking grade not poorer than grade 1-1/2 under the worst conditions, with least wear of the commutator and the carbon materials. The carbon dust is dangerous to the machines themselves as well as to the personnel working on them. While the maintenance staff controls all the parameters within their field to achieve good commutation, current sharing etc the quality of carbon brushes have to be good. This standard, therefore, aims only at the good quality of carbon brushes.

0.3 This IPSS (second revision) has been published after updating various Indian Standards & some other changes.

0.4 In preparation of this standard, assistance has been derived form the following:

IS 13586:1993 Definitions and nomenclature for carbon brushes, brush-holders, commutators and slip-rings for electrical machinery

IS 13584:1993 Brush materials for electrical machinery specification (superseding IS 3003(part-1)

13466:1992 Brushes for electrical machine (superseding IS 3003 part 3 &4):1977)

IS 9919:1999 Guide for selection and use of carbon brushes for application in rotating in rotating electrical machine (first revision)

IS 4722:2001 Rotating electrical machines (second revision)

TISCO 16001 (fourth revision):1993 carbon brushes

0.5 Inter Plant Standards for steel industry primarily aim at achieving rationalization and unification of parts and sub-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 (or 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.

1. SCOPE

1.1 This Inter Plant Standard in general, accepts IS 13586, 13584 & 13466 for the specification for carbon brushes for electrical machines. Additional requirements have been specified in this standard.

2. SERVICE CONDITIONS

These are in addition to those described under IPSS:1-02-020-84 Basic parameters for standardization of steel plant equipment.

2.1 Temperature- reference ambient temperature is 40°c with a maximum of 50°c occurring for 3 months per year. The actual working temperature of the carbon brushes will however depend upon the machine parameters.

2.2 Altitude - The altitude does not exceed 1000 m.

2.3 Ambient air – it may contain corrosive gases, conducting and abrasive dust and in some cases, oil and fumes too. In some old type of silicon based **H** class insulated machines, deposition of fine silica around the carbon brushes may occur due to the action of brush sparking on the varnish vapours that are emanated for very long times, especially in totally enclosed machines and these can result in jamming of the brushes with a consequent flash over.

2.4 **Humidity** – A maximum humidity approaching 100% may occur concurrently with the maximum temperature and there may be some local condensation of moisture. It can however be so low as to interfere with good commutation.

3. DUTY CONDITIONS

3.1 Depending upon applications, the motors may be subject to various duties-constant, variable or creeping speeds, stalling and reversing. The current may reach a magnitude of 2.5 In at a rate from 50 to 300 In/sec. The voltage may reach a magnitude of 2 Vn at a rate of 10 kV/sec.

3.2 The machines may be subject to sustained vibration and impacts up to 2g in any direction.

4. BRUSH GRADES

4.1 Due to the diversity in the imported machines, the carbon brush grades and sizes cannot be standardized and all steel plants have to a large extent started using Indian substitutes, depending upon their experience.

While there is a black commutation in a number of well balanced electromagnetic designs of dc machines even under overloaded conditions, it is seen that some carbon brushes in a brush arm tend to spark more necessitating frequent maintenance of the commutator. These sparkings are due to excessive tolerance on the resistivities of carbon brushes and the consequent unequal current distribution among them. It is, therefore, suggested that to attain an acceptable sparking grade of 1.5 (see 14 of IS 4722:2001) under overload condition, the limits to brush properties shall be as under:

Density	$\pm$5%
Hardness	$\pm$10%
Transverse strength	$\pm$10%
Specific resistance	$\pm$10%

5. FLEXIBLE SHUNTS

5.1 **Connection** – unless otherwise stated, the shunts shall have tamped connections with the carbon brushes. For making the temperature stable at higher temperature, graphite powder should be used as tamping compound. This will make the connection stable at higher temperature, oxidation does not occur and the graphite has a co-efficient of expansion very close to that of the brush materials. The tamping holes shall preferably be tapered and undercut, but grooved designs are also acceptable.

The quality of tamping shall be good so as to ensure the following:

a) A minimum pullout strength value at least double than given in Table 3 of IS 13466:1992 reproduced below :

TABLE-3 OF IS 13466 : 1992

VALUES OF PULL OUT STRENGTH
(Clause 5.6)

Maximum Flexible Diameter* (mm)	Minimum pull out Strength (daN)
0.5 to 0.8 (both inclusive)	2
1.0 to 1.3 (both inclusive)	4
1.6	6
1.8 to 2.0 (both inclusive)	8
2.2 to 2.4 (both inclusive	10
2.7	12
3.0	15
3.3	20
4.2	25
4.7 to 6.7(both inclusive)	30

NOTE: The minimum values of pullout strength given in this table shall be doubled for any specially strengthened connections such as in the cost of carbon brushes used in mobile vehicles.

* See Table-1 of IS 13466:1992

b) A high thermal endurance.

5.2 The shunts and terminals shall be tinned.

5.3 Where specified, the shunts shall have flexible glass sleeves around them.

NOTE: However, silicon rubber coated woven glass fibre is not advisable for brushes in totally enclosed machines with operating temperature above 70^0c

5.4 The safe wear line as per IS 13466:1992 shall be provided on all brushes.

5.5 The terminals shall be of quarter hard drawn electrolytic copper sheets of specified thicknesses.

6. BRUSH TOPS

6.1 Where specified (especially for those motors subjected to heavy vibrations like traction motors), the carbon brushes shall have resilient silicon rubber tops bonded on to them. For other applications, the carbon brushes shall have pressure plates of carbon steel strips having a hardness of 134-135 HV 10 and these shall be hot tin dipped. These shall be fixed on to the carbon brushes by large tubular rivets. At the non pressure plate ends, copper washers shall be used under the rivets as an additional precaution against cracking of the brush due to vibrations.

7. GROOVES

7.1 To take care of external and self generated dust, dust grooves as shown in Fig-8 of IS 13466:1992 shall be provide wherever required by the purchaser.

8. MARKING AND PACKING

8.1 The marking on the carbon brushes shall be in accordance with IS13466:1992.

8.2 The manufacturer shall supply the carbon brushes packed in moisture proof resilient card board boxes in specified lots and the boxes shall contain details on:

a) Carbon brush resistivity
b) Test certificate number.
c) Lot number
d) Date of manufacture
e) A reference to this standard i.e. IPSS:1-03-026-08
f) Manufacturer's name
g) Grade of carbon

9. TESTS

The following type tests shall be conducted on the brushes as per relevant standards:

a) Dimensional accuracy test
b) Connection drop test
c) Pigtail pullout strength test
d) Co-efficient of function test
e) Contact voltage drop test
f) Endurance test