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Sri Lanka Standard
SPECIFICATION FOR CARBON BRUSHES FOR ELECTRICAL MACHINES
PART 2 – METHODS OF TEST FOR PHYSICAL PROPERTIES

SRI LANKA STANDARDS INSTITUTION

DRAFTING COMMITTEE ON CARBON BRUSHES FOR ELECTRICAL MACHINES

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SPECIFICATION FOR CARBON BRUSHES FOR ELECTRICAL MACHINES

PART 2 - METHODS OF TEST FOR PHYSICAL PROPERTIES

FOREWORD

This Sri Lanka Standard was authorised for adoption and publication by the Council of the Sri Lanka Standards Institution on 86-05-16 after the draft, finalised by the Drafting Committee on Carbon Brushes for Electrical Machines, has been approved by the Electrical Engineering Divisional Committee.

This standard specifies the procedures for measurement of the electrical resistance of brush flexible connections and the pull strength of tamped or moulded connections. The Part I of this standard deals with the definitions, principal dimensions and terminations of brushes. The Part 3*of this standard will cover requirements for carbon brushes.

All values in this standard have been given in SI units.

In reporting the result of a test or analysis made in accordance with this standard if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with CS 102.

The assistance derived from the publications of the International Electrotechnical Commission (IEC) and the Indian Standards Institution in preparation of this specification is gratefully acknowledged.

* Under preparation

1 SCOPE

This Sri Lanka Standard specifies the procedures for measurement of the electrical resistance of brush-flexible connection and the pull strength of tamped or moulded connection.

2 REFERENCES

SLS ..... Carbon brushes for electrical machines
Part 1 : Definitions, principal dimensions and termination of brushes.

3 DEFINITIONS

For the purpose of this standard, the definitions given in SLS ..... Part 1 shall apply.

4 MEASUREMENT OF ELECTRICAL RESISTANCE OF BRUSH-FLEXIBLE CONNECTION (VOLTMETER, AMMETER METHOD)

4.1 Apparatus

The following apparatus is required.

4.1.1 A direct current source, capable of providing an adjustable current between 0A to 100A.

4.1.2 A millivoltmeter, having an internal resistance of at least 1000Ω/V and a maximum error of 2.5 per cent with suitable ranges for reading not less than 20 per cent of full scale.

4.1.3 An ammeter, having a maximum error of 2.5 per cent with suitable ranges for reading not less than 20 per cent fo full scale.

4.1.4 On-off switch

4.1.5 Clamp or clip, attached to the brush as near as possible to the contact surface and connected with one side of the current source. It should assure electrical connection of the current in the cross section t x a of a brush. The contact pressure of the connection device should be sufficient so that no serious heating occurs.

4.1.6 Suitable voltage probes

4.1.7 A suitable device, to hold up the brush-flexible in order to connect it to the other side of the source. The pressure at the contact should not damage the flexible, but should be sufficient so that there is no heating at this point.

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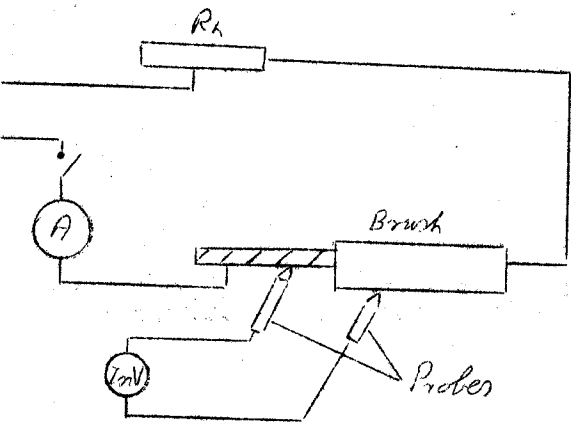
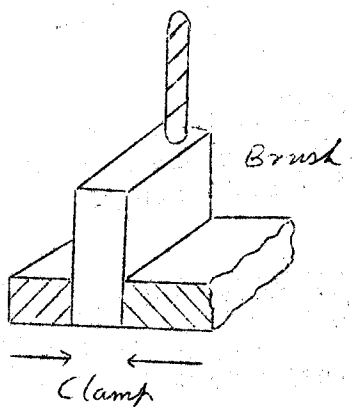
4.2 The electric circuit and brush holding clamps are given in Fig. 1A and Fig. 1B respectively.



1A



1B

FIGURE 1 - Electrical circuit and brush holding device

4.3 Method

4.3.1 Attach the brush and flexible to the connecting clamps and pass the desired current through the test circuit. The value of the testing current in amperers shall be the rated current of the flexible as given in Table 1, subject to a tolerance of $^{+15}_{-10}$ per cent.

TABLE 1 - Cross sectional area and current capacity of the flexible

Nominal cross sectional area (mm^2)	Current per flexible (amp)
0.06	2
0.09	3
0.13	4
0.18	4.8
0.25	5.5
0.35	7
0.5	9
0.75	12
1.00	15
1.25	17.5
1.5	20
2	24
2.5	28
3.2	32
4	38
6.3	50
8	60
10	75
12.5	85
16	100

...../3

4.3.2 Select suitable scales on ammeter and millivoltmeter so that readings of not less than 20 per cent of full scale defelection are obtained.

4.3.3 Place the two voltage probes connected to the millivoltmeter as follows:

a) One, against the flexible at a distance of 5 mm from the brush ; and

b) The other, against the brush in a position as described and illustrated in Fig. 2.

4.3.4 All surfaces of the brush should be free from resin, glue or any other foreign substances. A voltage probe should then be pressed against a cleaned surface of the brush. If the sides of the brush are coppered, the voltage probe should contact the brush 2 mm below the limit of coppering. The readings thus obtained will bear little or no relationship to those on a noncoppered brush.

4.3.5 This method is also applicable to brushes with several flexibles provided they are separated. If the flexibles are united in the same terminal, they should be separated so that they may be supplied with current individually. This test may normally be carried out by the manufacturers before fitting the terminal.

4.3.6 If the connection is made by a rivet, one voltage probe should be pressed against the surface of the brush where the head of the rivet is in direct contact with the flexible.

4.3.7 In order to minimize the heating of the brush-flexible connection which might influence the accuracy of the test, the test should be made within 30 seconds.

NOTE - This method is useful in determining the relative values of connection resistance from brush to brush. The absolute value will be affected by grade resistance and brush configuration.

4.4 Calculation

The resistance of the brush-flexible connection is calcualted by means of the following formula:

$$R = \frac{U_f}{I}$$

where R = resistance, in milliohms ($m\Omega$) ;

U_f = voltage drop between the two probes, in mV ;

I = current in ampere (A).

NOTE - The expected accuracy may not be better than ± 20 per cent.

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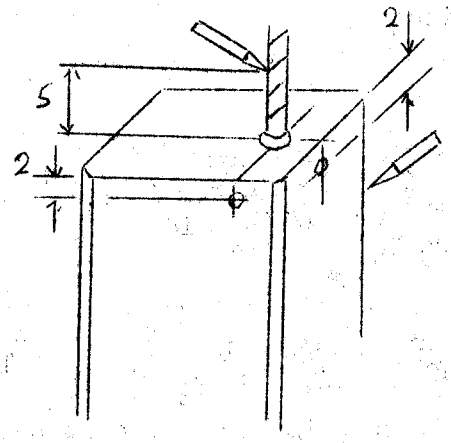
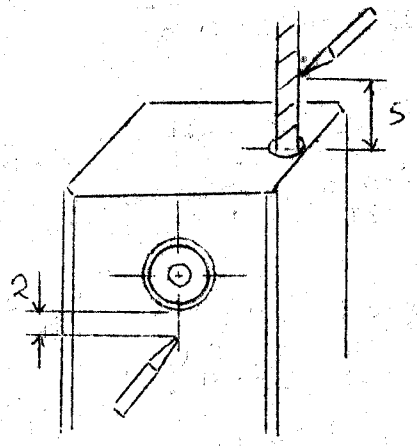
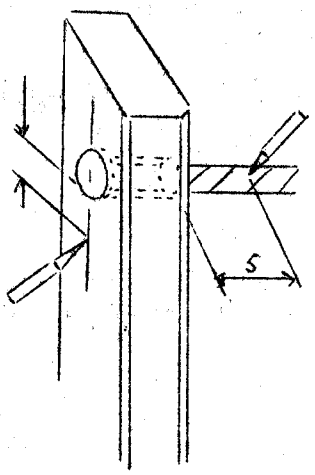


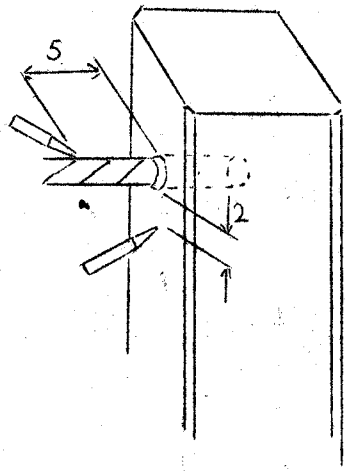
2A For moulded or tamped connections



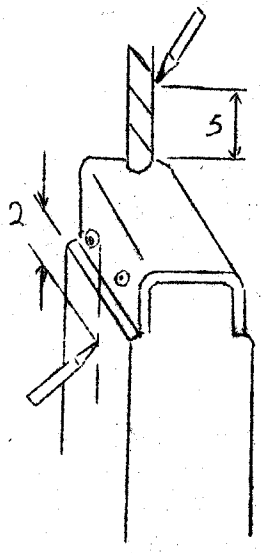
2B For riveted connections



2C For soldered connections



2 D For moulded or tamped connections



2C For metal top soldered or riveted connections

FIGURE 2 - Placing of the voltage probes

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5 MEASUREMENT OF THE PULL STRENGTH OF TAMPED OR MOULDED CONNECTION

5.1 Apparatus

A complete measuring device is shown schematically in Fig. 3 and it comprises the following instruments:

5.1.1 A tensioning device, by which a tensile force can be applied at a uniform rate without shock. The maximum rate of increase should be 50 N/s.

5.1.2 A measuring device, for the measurement of the pull strength with a maximum error of 2.5 per cent, capable of indicating the maximum force produced during the test and strong enough not to be damaged by the sudden unloading at the moment of the failure of the connection. A strongly built dynamometer provided with an idle pointer may be suitable.

5.1.3 A dash pot or any other device, limiting the shock at the moment of failure. This device should be inoperative until the connection has failed.

5.1.4 A device, capable of connecting the flexible of the brush to be tested to the tensioning device. This device should be capable of gripping the flexible adequately without damaging it.

5.1.5 A support, to position the brush so that the direction of the tensile force coincides with the axis of the connection hole. This support should be capable of holding the brush without slipping. The surface in contact with the brush must have a hole through which the flexible can be arranged centrally and at no point overlapping the connection hole.

Figures 4 and 5 show examples of such supports.

5.2 Method

5.2.1 Place a suitable support on the measuring device taking into account the shape of the brush and the axis of the connection hole, so that the tensile force is applied in the direction of the axis of the connection. Pass the flexible through the hole and make sure that the edges of this hole do not cover the connection hole. Connect the flexible to the gripping device described in 5.1.4.

5.2.2 Apply the tensile force at a uniform rate without shock, so that the connection fails in not less than 5 seconds after the force is first applied.

After the failure of the connection, read the indicated maximum force by means of the idle pointer of the measuring device.

This force corresponds to the pull strength of the connection.

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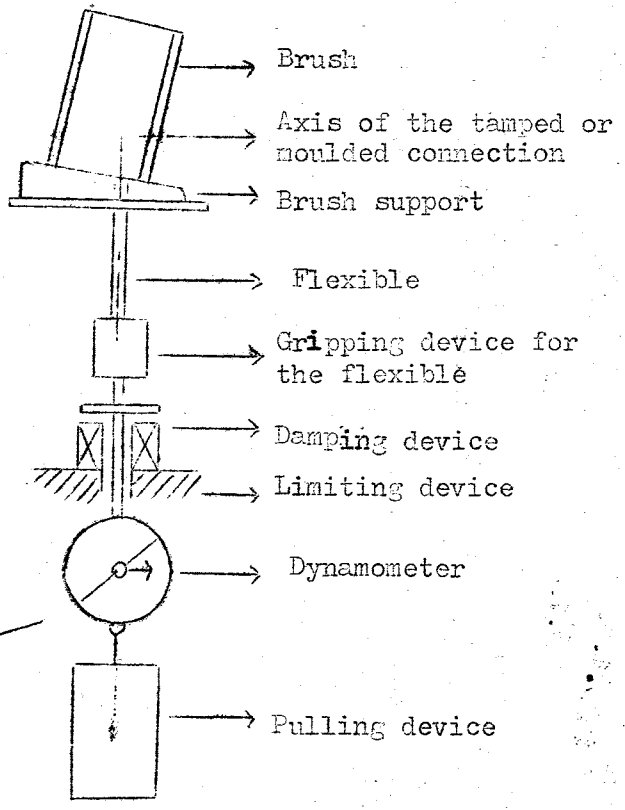
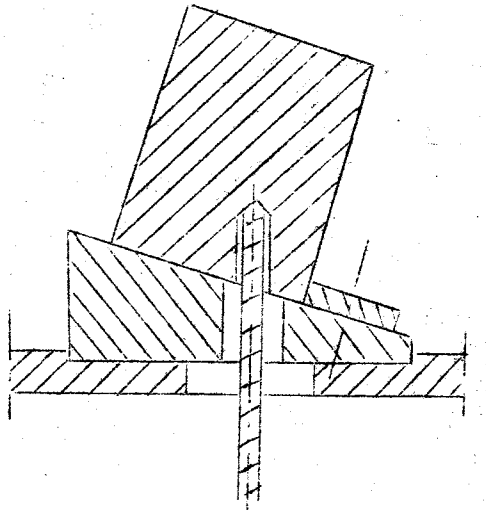
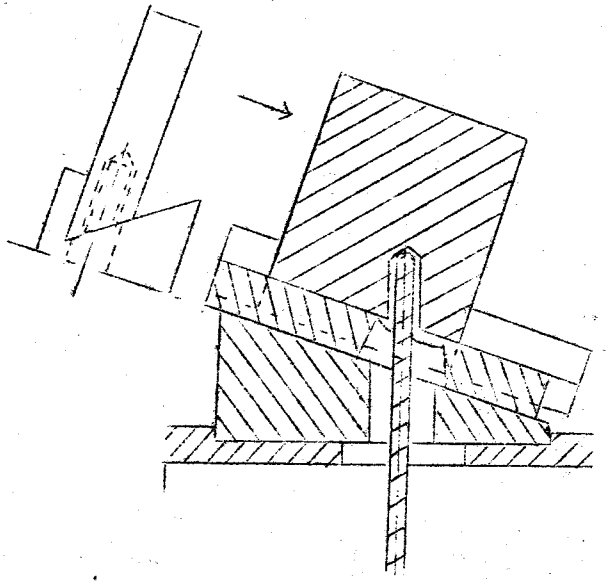


(a)



Brush supports for brushes with inclined connection

(b)



Support for brushes with beveled top and inclined connection

(c)

FIGURE 3 - Schematic diagram measuring device for pull strength