[redacted] Sri Lanka Standard

SPECIFICATION FOR CARBON BRUSHES FOR ELECTRICAL MACHINES

PART 1 - DEFINITIONS, PRINCIPAL DIMENSIONS AND TERMINATIONS OF BRUSHES.

SRI LANKA STANDARDS INSTITUTION.

DRAFTING COMMITTEE ON CARBON BRUSHES FOR ELECTRICAL MACHINES

C O N S T I T U T I O N

NAME	ORGANISATION
Mr. A.J.M. Victoria (Chairman)	The Institution of Engineers, Sri Lanka
Dr. R.N. Ediriweera	Ceylon Institute of Scientific and Industrial Research
Mr. K.S.K. Etipola	Ceylon Petroleum Corporation
Mr. H.N. Gunasekera	Colombo Dockyard (Pvt.)Ltd.
Mrs. R. Ranwala	Ceylon Steel Corporation
Mr. V.de S. Wickramaratne	Brown & Co. Ltd.
Mr. S.G. Vidanage (Secretary)	Sri Lanka Standards Institution.

[redacted] SRI LANKA STANDARD

SPECIFICATION FOR CARBON BRUSHES FOR ELECTRICAL MACHINES

PART 1 - DEFINITIONS, PRINCIPAL DIMENSIONS AND TERMINATIONS OF BRUSHES.

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.

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

The specification on Carbon Brushes for Electrical Machines is presented in three parts as follows :

Part 1 - Definitions principal dimensions and terminations for brushes

Part 2 - Methods of test for physical properties.

Part 3 - Requirements for carbon brushes.*

For the purpose of deciding whether a particular requirement of this specification is complied with, the final value, observed or calculated expressing the result of a test or observation shall be rounded off in accordance with CS:102. The number of significant places to be retained in the rounded off value, shall be the same as that of the specified value in this specification.

The assistance derived from the publications of the International Electrotechnical Commission, the American Standards Institute and the British Standards Institution, in the preparation of this specification is gratefully acknowledged.

*under preparation.

1 SCOPE

This specification covers the definitions, dimensions and terminations of carbon brushes (including the flexibles) for use on cylindrical commutators and slip rings of electrical machines.

2 DEFINITIONS

For the purpose of this specification the following definitions shall apply :

2.1 brush : A brush, as used in the electrical manufacturing industry, is a conductor, usually composed in part of some form of the element carbon, serving to maintain an electrical connection between stationary and moving parts of a machine. Brushes are classified according to the types of material used as follows :

2.1.1 hard carbon : Consists of various forms of amorphous carbon.

2.1.2 carbon-graphite : Consists of a mixture of amorphous carbon and graphite.

2.1.3 natural graphite : Consists principally of graphite.

2.1.4 electrographite : Consists of various forms of amorphous carbon converted during manufacture to artificial graphite.

2.1.5 metal graphite : Consists of a mixture of metal(s) and graphite.

2.1.6 metal impregnated : Consists of carbon or graphite which has been impregnated with molten metal under pressure.

2.1.7 resin bonded : Consists of carbon or graphite bonded with synthetic resin.

2.2 brush dimensions

2.2.1 centre line : The line parallel to the sides and faces and passing through the centre of a section at right angles to the sides and faces.

2.2.2 tangential dimension (t) : The tangential dimension of the brush is the dimension at right angles to the radial dimension in the direction of rotation (see Fig. 2.1 and Fig. 2.2)

2.2.3 axial dimension (a) : The axial dimension of the brush is the dimension at right angles to the direction of rotation (see Fig. 2.1 and Fig. 2.2).

2.2.4 radial dimension (r) : The longest dimension measured parallel to the centre line through the contact surface (see Fig. 2.1 and Fig. 2.2).

..... 2/-

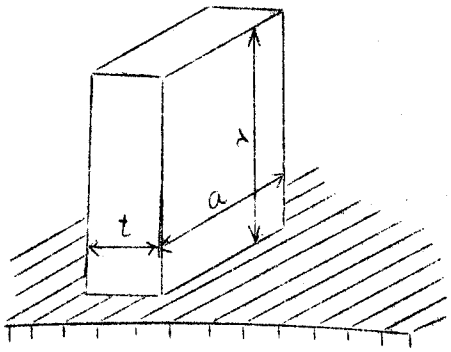


FIGURE 2.1 - Commutator Brush

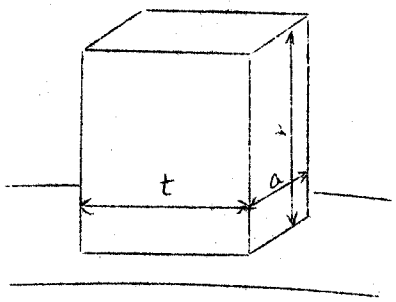


FIGURE 2.2 - Slip ring brush

t = tangential dimension

a = axial dimension

r = radial dimension

The dimension should be stated in the following sequence:

t x a x r

2.3 brush surfaces

2.3.1 contact surface : The surface of a brush which bears on the commutator or slip-ring.

2.3.2 top surface : The surface of a brush remote from the contact surface.

NOTE - Top surface and contact surface are also called top end and bottom end.

2.4 faces : The two surfaces parallel to the axis of the commutator or slip-ring. If the lengths of the two faces are unequal they are distinguished by the terms 'long face' and 'short face'.

2.4.1 front face : The face towards which the commutator or slip-ring is moving.

2.4.2 back face : The face directly remote to the front face.

2.5 sides : The two surfaces of a brush at right angles to the faces and also at right angles to the axis of the commutator or slip-ring (see Fig. 2.3).

2.6 edges : The intersection of any two brush surfaces. The leading edge is the edge at the brush face on the side of the brush into which the commutator or slip-ring rotates. The trailing edge is the edge at the brush face on the side of the brush away from which the commutator or ring rotates. Top edges are formed by the intersection of the top surface with sides and faces. Side edges are formed by the intersection of the sides and faces.

..... 3/-

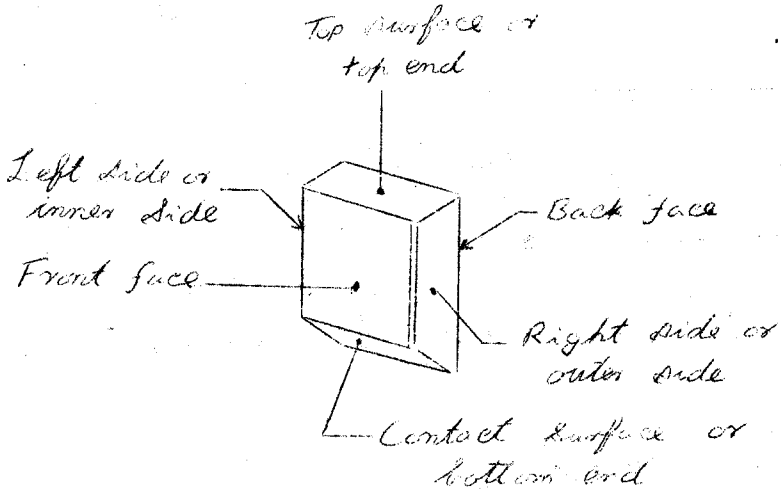


FIGURE 2.3 - Brush surfaces

2.7 chamfer : Slight removal of a sharp edge. The standard angle of chamfer is 45°. The depth of chamfer on side edge shall be measured along the plane of each of the two adjacent surfaces and not the width of the face of the cut portion.

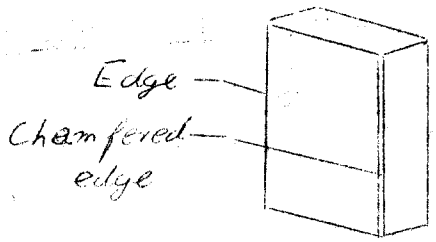


FIGURE 2.4 - Chamfered edge

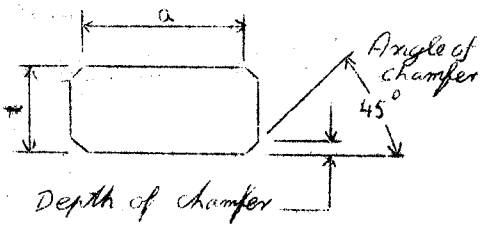


FIGURE 2.5 - Angle and depth of chamfer

2.8 shoulders : A shoulder is formed when the top of the brush has a portion cut away by two planes at right angles to each other. When necessary right or left shoulder shall be specified.

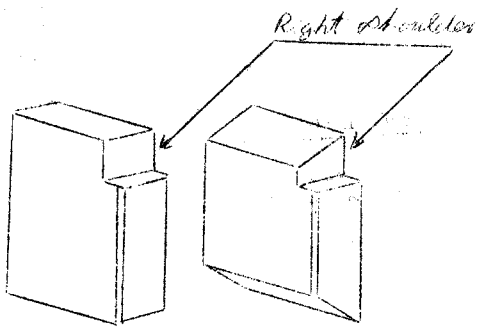


FIGURE 2.6 - Single shoulder

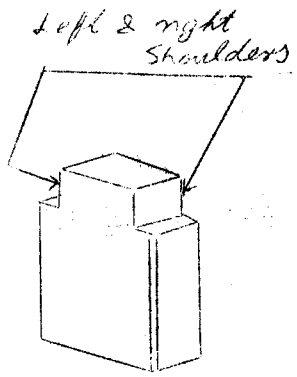


FIGURE 2.7 - Double shoulder

2.9 beveled ends and toes : The bevel angle or cut portion is specified as the angle included between the beveled surface and a plane at right angles to the radial dimension. The toe is the uncut or flat portion on the beveled or beveled and concaved end.

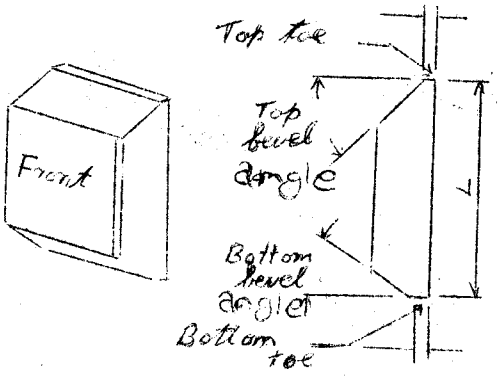


FIGURE 2.8 - Double bevel

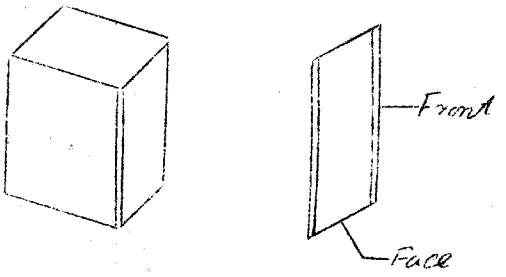


FIGURE 2.9 - Double parallel bevel

2.9.1 beveled edges : A beveled edge refers to a slanting surface formed by the removal of an edge.

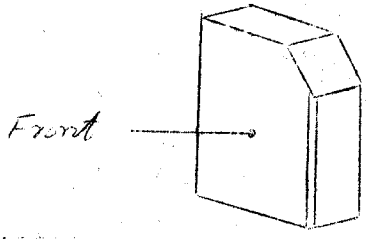


FIGURE 2.10 - Beveled edges

2.9.2 beveled corner : A beveled corner refers to a trangular surface formed by the removal of a corner.

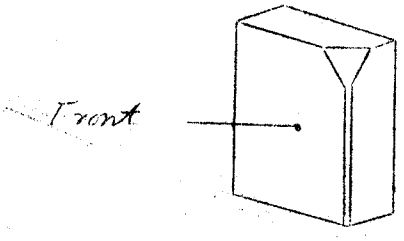


FIGURE 2.11 - Beveled corner

2.10 convex and concave ends, and toes : Brush surfaces of a given radius which may extend fully or partially across the axial dimension (width) of the brush.

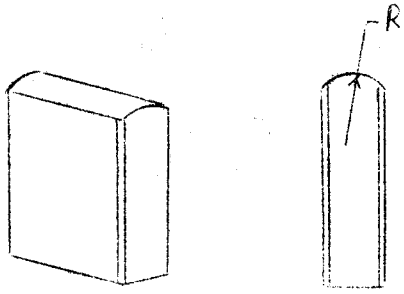


FIGURE 2.12 - Convex end (top)

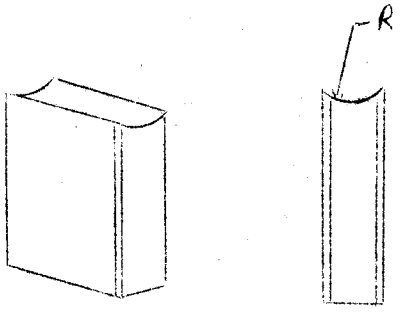


FIGURE 2.13 - Concave end (top)

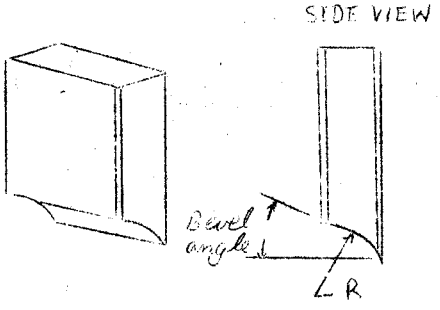


FIGURE 2.14-Concave on beveled end (shown without toes)

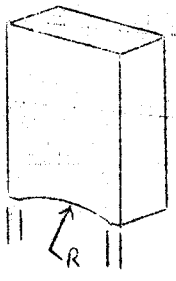


FIGURE 2.15 - Concave end (shown with toes)

2.11 flexible : A flexible conductor attached to the brush to connect it electrically to the machine.

2.12 length of flexible : The length measured from the top surface of the brush to the centre of the fixing hole in the terminal shoe when the flexible is extended out parallel to the radial dimension of the brush (see Fig. 2.16).

..... 6/-

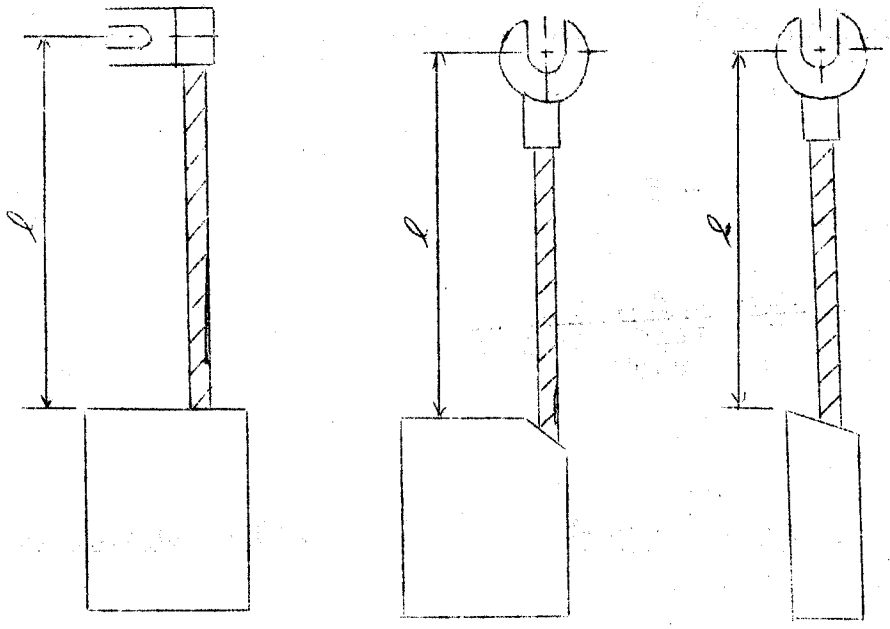


FIGURE 2.16 - Length of flexibles

2.13 Types of brushes

2.13.1 tandem brush : Two identical brushes which are joined together by a common shunt or terminal and inserted into seperate brush boxes. (see Fig. 2.17)

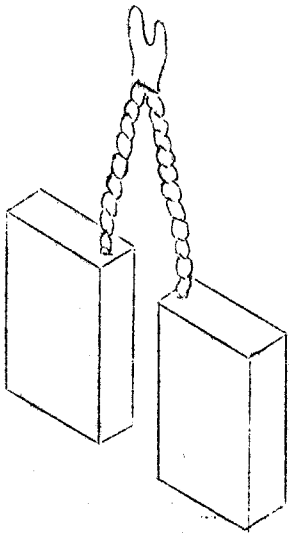


FIGURE 2.17 - Tandem brush

2.13.2 split brush - Two or more brushes fitted in one brush box. (see Fig. 2.18)

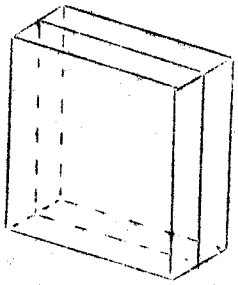


FIGURE 2.18 - Split brush

..... 7/-

2.13.3 sandwich (composite) brush : Two or more layers of brush material bonded together (see Fig. 2.19).

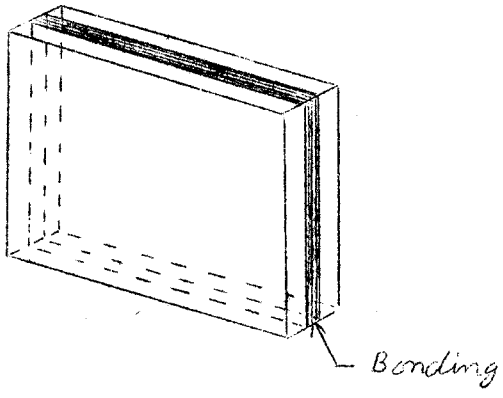


FIGURE 2.19 - Sandwich brush

.1.

2.14 brush clips (metal tops) : Brush clips are attached to the brush and serve to accomodate the spring, pressure finger or hammer. Where these serve to prevent the wear of the carbon due to the pressure finger, they are called 'hammer' or 'finger' clips. Brushes may have clips which serve the dual purpose of lifting the brushes and of preventing wear from the pressure finger. These are generally called 'lifting' clips.

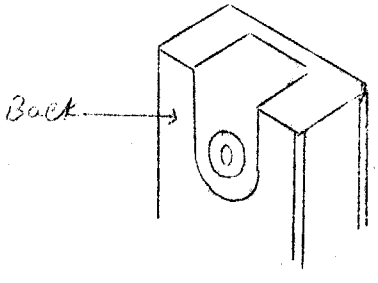


FIGURE 2.20 - Brush clip

3. DIMENSIONS

3.1 Recommended combinations of the principal dimensions t, a and r are given in Table 1.

TABLE 1
(Dimensions in millimetres)

Preferred combinations $t \times a$ are printed in bold-face type, as are the preferred values of r.

t \ a	2	2.5	3.2	4	5	6.3	8	10	12.5	16	20	25	32	40	50	r
1.6	**8**	**8**														8
2		**8**	**8**													8
2.5			8 10	8 **10**	10 12.5											8 10 12.5
3.2		**10**		8 10 12.5	10 12.5	12.5 16										8 10 12.5 16
4		**10**	**10**		10 12.5	12.5 **16**	16 **20**	16 **20**								10 12.5 16 20
5			12.5	12.5		12.5 **16**	16 **20** 25	16 **20** 25	20 **25** 32	20 **25** 32	25 **32**	32 40	32 **40**			12.5 16 20 25 32 40
6.3			12.5	12.5 **16**	16		20 25	20 25 32	20 25 32	25 **32**	25 **32**	32 40	32 **40**			12.5 16 20 25 32 40
8				16 **20**	16 **20**	20		20 25 32	25 32	25 **32**	25 **32**	32 40 50	32 **40** 50			16 20 25 32 40 50
10					16 20	16 **20**	20 25 32		25 32	25 **32**	25 32 40	32 40 50	32 **40** 50	40 50		16 20 25 32 40 50
12.5						20 25	25 32	25 32		25 **32**	32 40	32 40 50	32 40 50	40 50 64	50 64	20 25 32 40 50 64
16						20 25	25 32	25 32	32 40		32 40 50	32 40 50	32 40 50	40 50 64	50 64	20 25 32 40 50 64
20							25 32	25 32 40	32 40	32 40		32 40 50	32 40 50	40 50 64	50 64	25 32 40 50 64
25							32 40	32 40	32 40	32 40 50	32 40 50		40 50 64	40 50 64	50 64	32 40 50 64
32								32 40	32 40	32 40 50	32 40 50	40 50		40 50 64	50 64 80	32 40 50 64 80
40									40 50	40 50	40 50	40 50	40 50 64		80 100	40 50 64 80 100
50											40 50 64	40 50 64	50 64	64 80		40 50 64 80

Square section brushes are not recommended by the I.E.C.

3.2 Dimensions of chamfers are given in Table 2 (see Fig. 3.1).

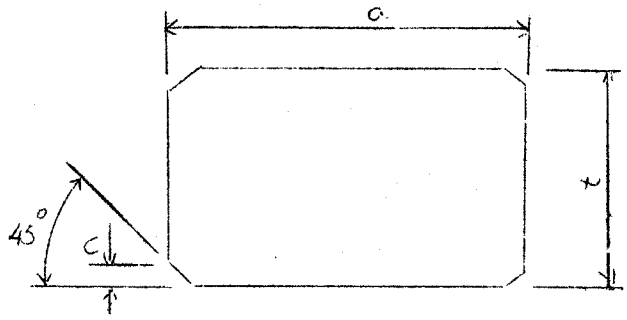
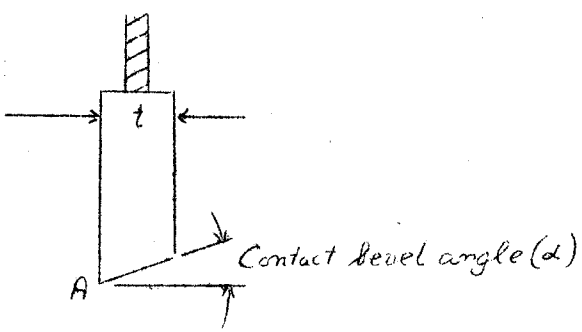


FIGURE 3.1 - Angle and depth of chamfer

TABLE 2 - Dimensions of chamfers

Dimensions 't' or 'a' whichever is the smaller (mm)	Depth of chamfer 'c' (mm)
1.6 to 3.2	$0.2 \pm \begin{smallmatrix}0.1\\0\end{smallmatrix}$
4 to 8	$0.5 \pm \begin{smallmatrix}0.3\\0\end{smallmatrix}$
10 to 20	$1 \pm \begin{smallmatrix}0.5\\0\end{smallmatrix}$
25 and greater	$2 \pm \begin{smallmatrix}0.5\\0\end{smallmatrix}$

3.3 Angles for contact and top bevels are given in Table 3 (see Fig. 3.2 and Fig. 3.3).



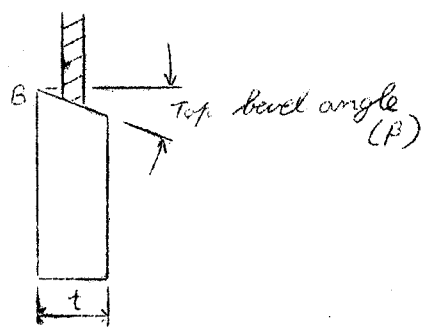


FIGURE 3.2 - Angle for contact bevel

FIGURE 3.3 - Angle for top bevel

TABLE 3 - Bevel angles

α	0°	7.5°	15°	22.5°	30°	37.5°	
β	0°	7.5°	15°	22.5°	30°	37.5°	45°

Tolerance for all angles is ± 1.

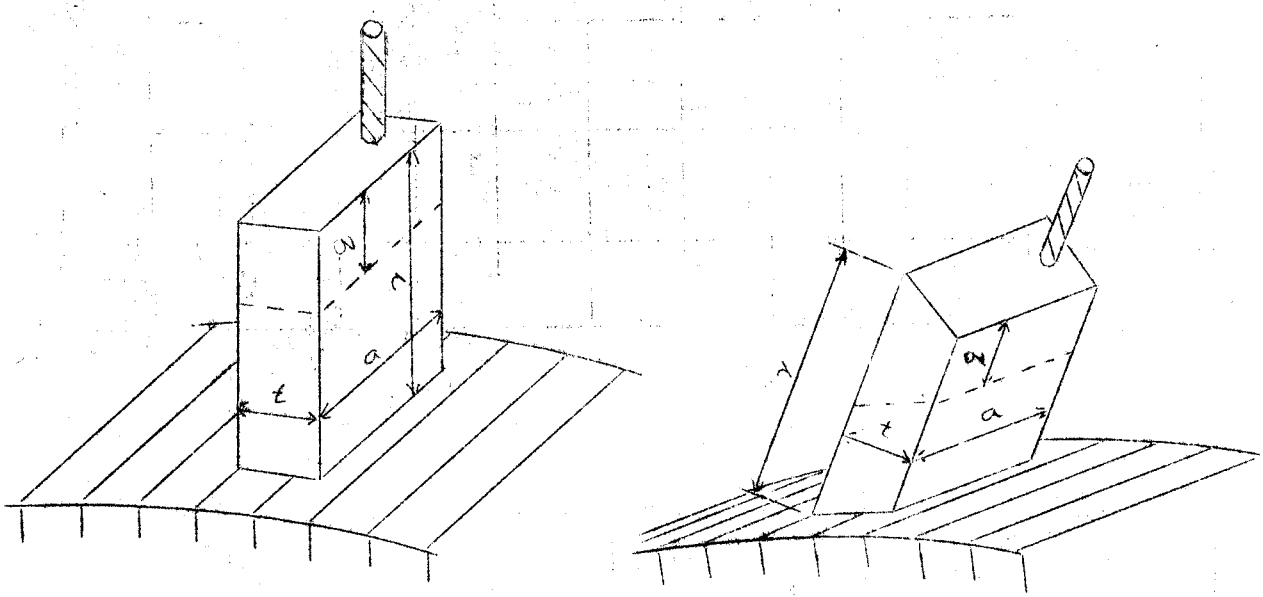
NOTES

1. When α is greater than 15° and t is greater than 8 mm the sharp edge A may be removed by the manufacturer.

..... 10/-

2. When α is greater than 15°, a flat surface of not more than 1 mm width may be left at the apex B.

3.4 Depth of insertion 'q' of the flexible in the brush : The brush manufacturer may use for the insertion of the flexible in the brush material the part of the brush nearest to the top.



3.4 A 3.4 B

FIGURE 3.4 - Depth of insertion

Depth of insertion 'q' is measured parallel to r (see Fig. 3.4A and 3.4B). For brushes with top bevels q is measured from the intersection between the top surface and the smaller face (see Fig.3.4B).

3.4.1 The permitted values of which depends on t and a are given in Tables 4 , 5 and 6 according to the number of flexibles.

3.4.2 The safe length of a worn brush will be slightly in excess of the values of q. A line or other mark, showing the safe worn length, shall be made on the new brush by the manufacturer.

TABLE 4 - Maximum values for q for brushes fitted with one flexible

a (mm) / t(mm)	8	10	12.5	16	20	25	32	40	50
5 6.3	7 8	8 9	9 10	10 11	11 12	12 13	13 14		
8 10	x 10	10 x	11 12	12 13	13 14	14 15	15 16	17	
12.5 16	11 12	12 13	x 14	14 x	15 16	16 17	17 18	18 18	
20 25	13 14	14 15	15 16	16 17	x 18	18 x	18		
32 40		16	17 18	18 18	18		x	x	
50									x

..... 11/-

TABLE 5 - Maximum values for q for brushes fitted with two flexibles.

t(mm) \ a (mm)	8	14	12.5	16	20	25	32	40	50
5 6.3			 7	7 8	8 9	9 10	10 11		
8 10	x 7	7 x	8 9	9 10	10 11	11 12	12 13	 14	
12.5 16	8 9	9 10	x 11	11 x	12 13	13 14	14 15	15 16	16 18
20 25	10 11	11 12	12 13	13 14	x 15	15 x	16 17	18 18	18 19
32 40		13	14 15	15 16	16 18	18 18	x 19	19 x	20 21
50					18	19	20	21	x

TABLE 6 - Maximum values for q for brushes fitted with four flexibles.

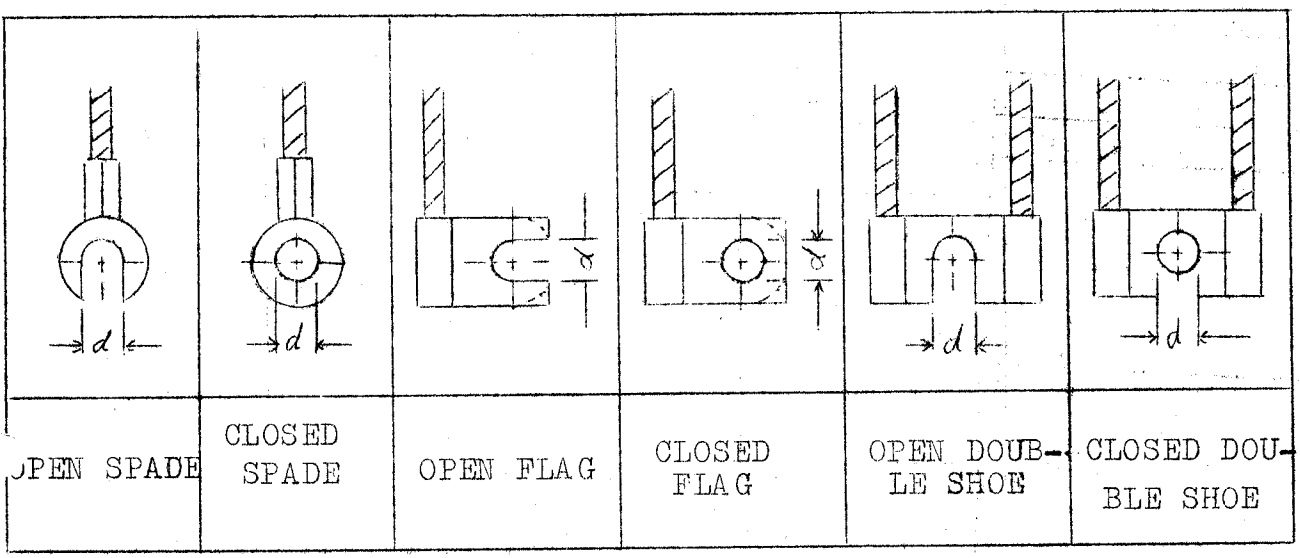
t(mm) \ a (mm)	8	10	12.5	16	20	25	32	40	50
5 6.3									
8 10									
12.5 16								13	13 14
20 25					x	 x	13 14	14 15	15 17
32 40				 13	13 14	14 15	x 17	17 x	19 21
50					15	17	19	21	x

.....12/-

4 TERMINATIONS OF BRUSHES

4.1 Terminal types, slots or holes and suitable screw sizes

4.1.1 The following are some of the generally used types of terminals.



OPEN SPADE	CLOSED SPADE	OPEN FLAG	CLOSED FLAG	OPEN DOUBLE SHOE	CLOSED DOUBLE SHOE

FIGURE 3.5 - Terminal types, slots or holes

4.1.2 The recommended value of d and suitable screw sizes are indicated in Table 7. While the dimensions given in the table are to be adhered to, the details of terminal shapes are left to the manufacturer's descretion.

TABLE 7 - Screw sizes

Slot or hole diameter d (mm)	Screw sizes (mm)
2.8	2.5
3.4	-
4.3	4
5.2	5
6.5	6
8.5	8
10.5	10

Tolerances $\pm \begin{smallmatrix} 0.3 \\ 0 \end{smallmatrix}$ mm

4.2 Length of flexibles : The value given in Table 8 are prefered. (see Fig. 2.16).

TABLE 8 - Length of flexible

l (mm)	
Nominal	Tolerance
16 20 25 32 40	$\pm \frac{3}{0}$
50 56 63 71 80 90 100	$\pm \frac{5}{0}$
112 125 140 160	$\pm \frac{8}{0}$

4.3 Connection of flexible to brush : The methods of connecting the flexible shall be as follows :

4.3.1 Tamping with copper powder : The flexible is inserted into the connection hole of brush and tightly compacted with copper tamping powder (see Fig. 3.6).

4.3.2 Insertion while moulding : The flexible is inserted in the brush material while moulding (see Fig. 3.6).

4.3.3 Riveting with copper tube rivets : The flexible is riveted to the brush by firmly spinning a copper tube rivet (see Fig. 3.7).

4.3.4 Soldering : The flexible is taken through a hole in the brush and splayed out into a metal coated recess and soldered (see Fig. 3.8).

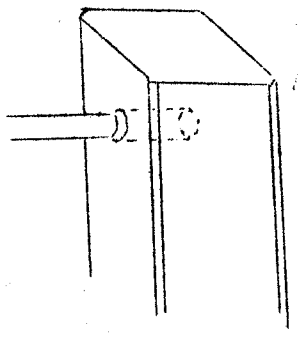


FIGURE 3.6- Tamped or moulded connection

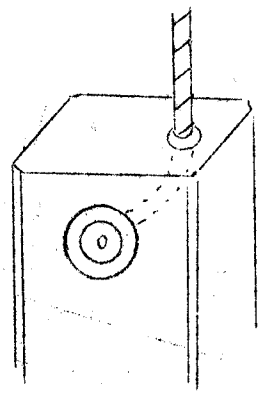


FIGURE 3.7- Riveted connection

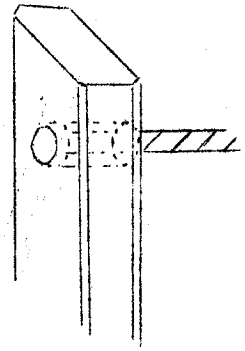


FIGURE 3.8-Soldered connection