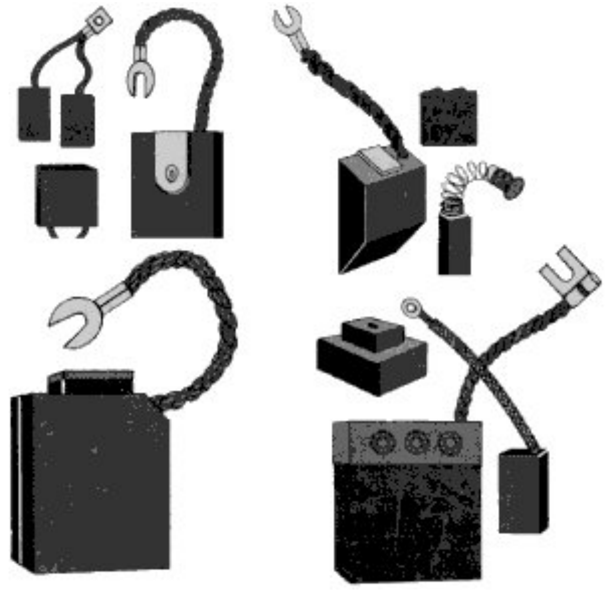


CARBON BRUSH CONSTRUCTIONAL FEATURES

Introduction

These details have been provided to assist those who are concerned with the specification of Carbon Brushes for electrical machine. Essentially it details the correct expression of brush design features because the universal use of these will clarify requirements and save frustrating misunderstandings and delay. Our recommendations in this regard are faithful to the standards prescribed by Bureau of Indian Standard's IS 13466:1992, IS 13586:1993 and IS 13525:1992 (old IS 3003 Part I to IV).

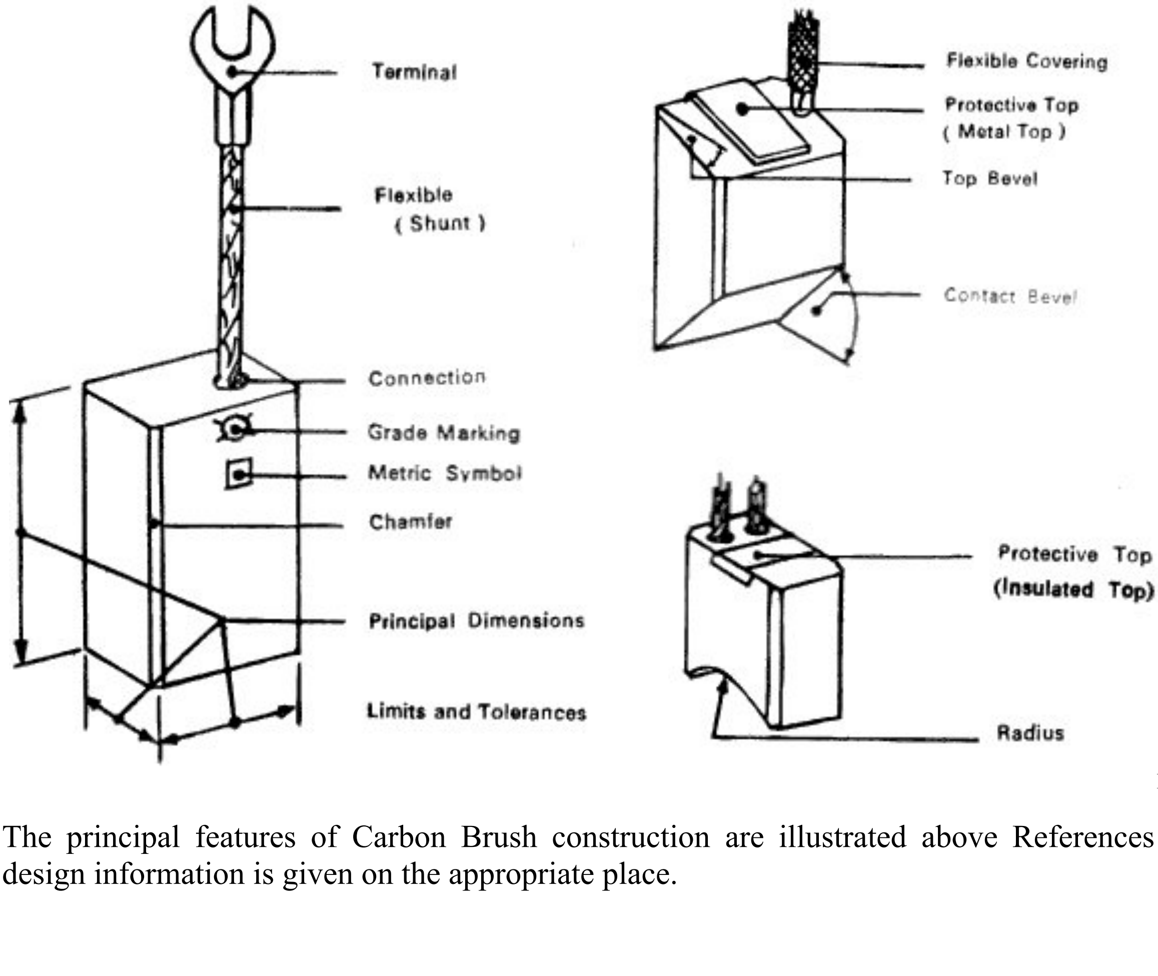


Fig. 1

The principal features of Carbon Brush construction are illustrated above References for design information is given on the appropriate place.

Letter Symbols for the Principal Dimensions of Brushes

Dimensions should always be stated in the sequence t*a*r.

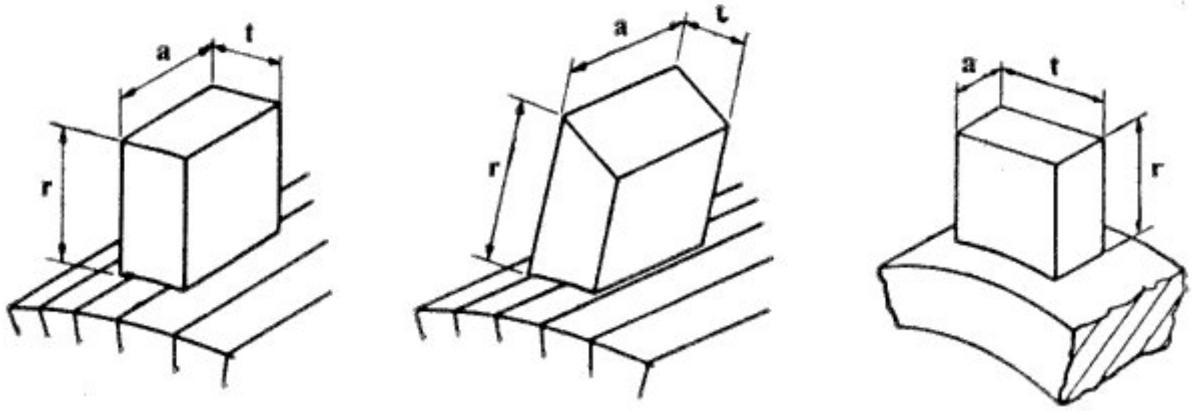


Fig. 2

Standard Dimensions

All dimensions for brush designs should be stated in millimeters and should conform to the recommended combinations of metric dimensions in table 15 with tolerance in table 14 of IS13466: 1992

Brush Shape Dimensions

Five typical shapes of brush are shown below. The size of the brush defined by the dimensions of the rectangular prism which will contain the whole brush shape (see figure 3) It is important that the dimensions are applied in the correct manner and thereby define the position of the brush on its collector. Figure 2 gives an exact guidance on this point

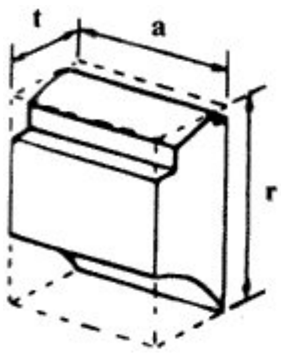


Fig. 3

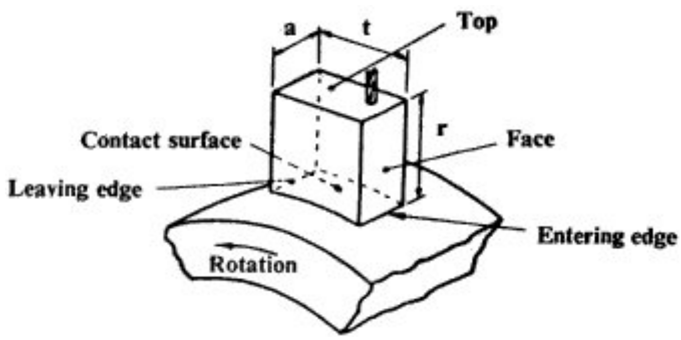


Fig. 4

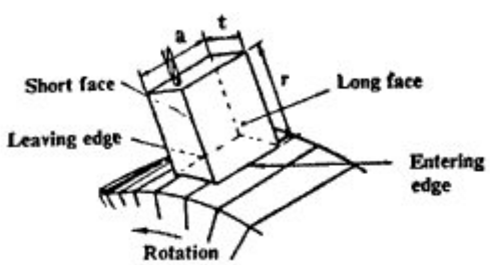


Fig. 5

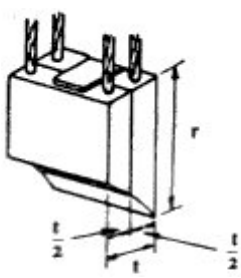


Fig. 6

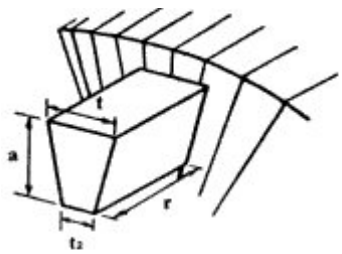


Fig. 7

Two special cases should be noted, however:

(I) When the brush consists of two or more parts which enter the same brush holder compartment, see Figure 6, the total 't' dimension of the assembly which fills the compartment should be quoted, together with the 't' dimension of each components part, thus:

t=20(10+10)

For all other brushes assemblies in which two or more brushes are connected together by a common terminal but do not enter the one brush holder compartment, the 't' dimension quoted should be that of each individual brush

(II) In the case of the wedge shaped brushes it is necessary to give two 't' dimensions. It is best to use the 't' 'a' and 'r' symbols in the way shown in Figures 7, 'r' equals dimensions reduced by wear of the brush.

Brush Terminology

The following is a list of expressions of brush features together with an explanation of them. These expressions should always be used when specifying brushes.

Surfaces (See figures 4 & 5)

Contact Surface: The surface, which bears on the collector (Commutator or Slip ring)

Top: The surface remote from the contact surface

Faces: The two surfaces parallel to the axis of rotation. If the length of these two faces are unequal, they are distinguished by the terms 'long face' and 'short face'.

Sides: The two surfaces at right angles to both contact surface and to the two faces. These should be described as 'inner' and 'outer' the inner being that nearer to the rotating winding of the machine.

Edges (See figures 4 and 5)

Entering Edge: This is the edge formed by the intersection of the contact surface and the face, which first meets the moving collector.

Leaving Edge: This is the edge of the contact surface edge opposite to the entering edge, and at which the moving collector leaves the contact surface.

Side Edges: These are formed by the innersection of the sides and faces.

Top Edges: These are formed by the intersection of top and side or faces.

Bevels

The term 'top bevel' is used with brushes to indicate that the top is not at right angles to the faces of the brush. The term 'contact bevel' is similarly used for the contact surface.

Top Bevel: This is used to promote side thrust on one face of the brush and thereby gives stability of location in the brush holder

Contact Bevel: This is necessary for brushes running in a trailing or reaction position relative to the collector.

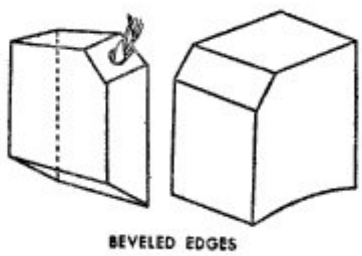


Fig. 8

Chamfers

A chamfer is obtained by the removal of material from the side edges of a brush and is applied so that the brush may enter a brush holder compartment without the risk of jamming at the internal corners of the compartment.

In the case of brushes in grades of high metal content, it may be necessary to apply a small chamfer to other edges to remove burrs.

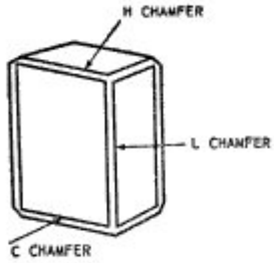


Fig. 9

Contact and Convex Surfaces

Contact radius: This applies to the curvature of the contact surface when it is made concave to suit the curvature of the Commutator or Slip ring.

Rounded top: This applies to the top surface when made convex to suit certain types of pressure fingers.

In both of the above cases the radius dimension required should be stated and also the angle where applicable.

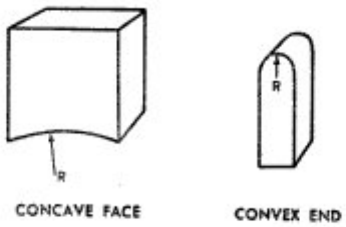


Fig. 10

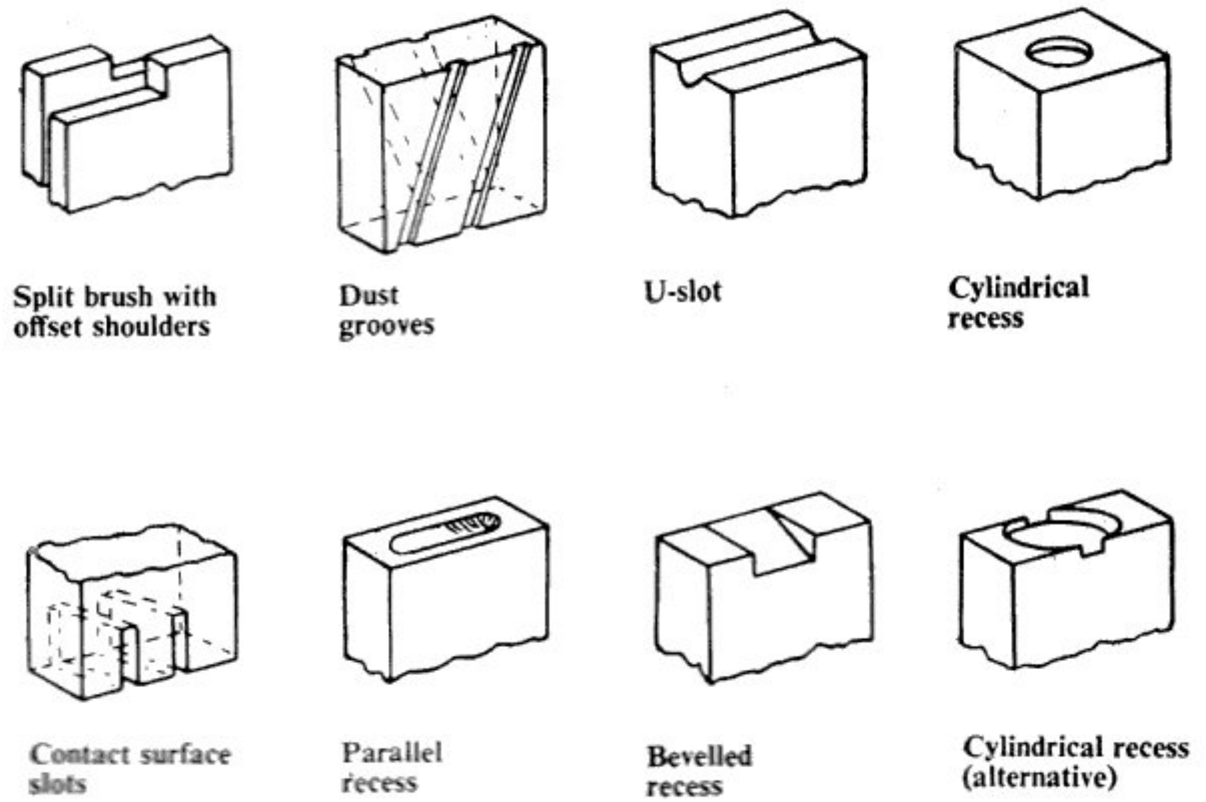


Fig. 11

Shoulders, Grooves, Slots and Recesses

These refer to any special shaping of the brush other than that needed for chamfers connections or protective tops. A complete dimension drawing is required for their exact specification.

Dust Grooves

These are provided on surfaces of Brushes which helps in removal of dust and improve the Brush performance thereby improving Commutation.

Turned Heads

A turned head is a cylindrical or conical portion at the top of the brush. Its purpose is to receive and locate the end of helical spring such as is used in a cartridge type brush holder. Three types of head are shown here.

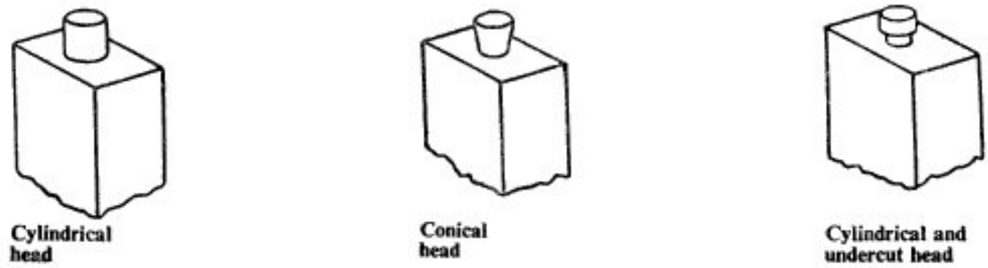


Fig. 12

Types of Connections:

Tamped Connection – 'Battersea'

The flexible shunt is secured to the brush by inserting it into a hole and then tamping metallic powder into the space between the flexible and the wall of the hole. This method gives a connection, which is mechanically strong and has low electrical resistance. It is the type of connection that we generally recommend.

Alternatives to the recommended arrangement are possible to enable this type of connection to be made in very thin brushes. There are other variations for particularly severe operating conditions.

Tube Rivet Connection

The Tube Rivet connection is used when brush proportions or the use of a sandwich grade do not permit a satisfactory connection to be made by the Tamped method. The same rivet may be used to secure a protective metal top when fitted.

In this type of connection, the flexible is looped round a tube rivet and is held under pressure against a copper-coated seating in a counterbored hole when the rivet is spun over at each end.

Screw Connection

This is similar in construction to the Tube Rivet connection except that a screw and nut are used in place of the rivet.

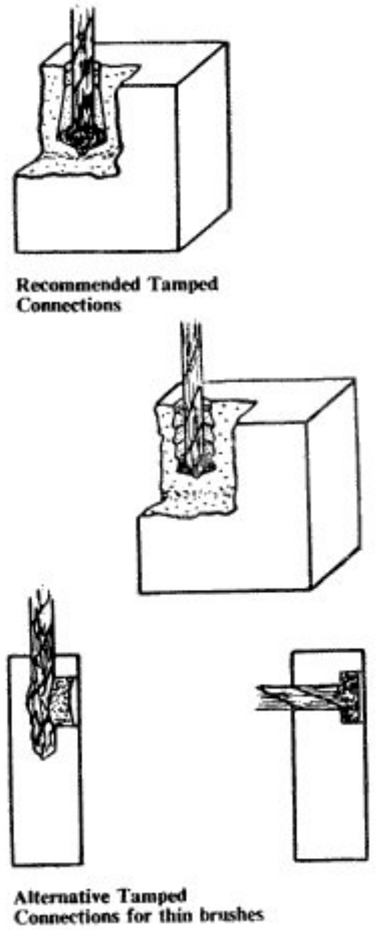


Fig. 13

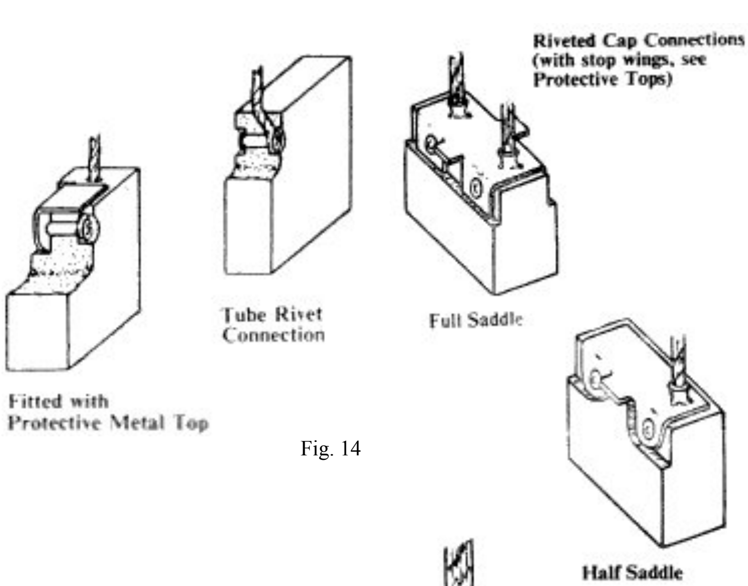


Fig. 14

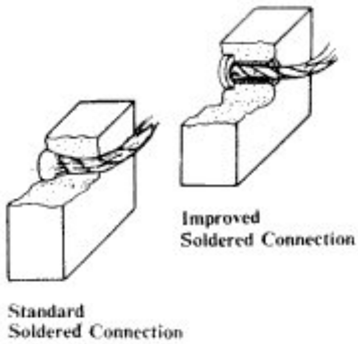


Fig. 15

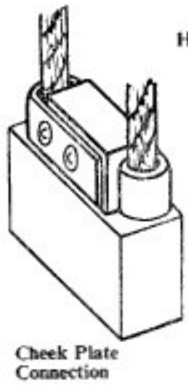


Fig. 16

Soldered Connection

In this connection the flexible is taken through a hole in the brush and the end splayed out. The splayed end is then soldered into a copper-coated countersunk portion of the hole.

An improvement on this arrangement is to insert a flanged sleeve into the hole in the brush, to pass the flexible through the sleeve, to splay the end of the flexible and then to solder the whole together.

"Riveted Cap" and "Cheek Plate" Connections

These types of connection reduce to a minimum the brush length occupied by the connection and also enable larger than normal Flexibles to the fitted on short time-rated heavy - current brushes.

For these methods of connection, the flexible is attached to a metal cap or to a cheek plate, which in turn is riveted to the top of the brush. To obtain good electrical contact between metal parts and Brush, the surface of the Brush under the metal part is copper-coated before the riveting operation. In the case of the cap type a ferrule is formed out of the metal and the flexible is crimped or clamped into this ferrule and then soldered. For the check plate type, the plate is formed round the flexible, which is then soldered in position.

Protective Tops

Protective Tops are made of metal or of an insulating material.

Metal Tops

These are used for number of reasons such as:

i) To give protection to the brush top against indentation by the pressure finger.
ii) To locate the pressure finger on the brush top.
iii) To provide a bridge over the two halves of a split brush.
iv) To provide a lifting clip and or stop wings for the brush
v) To provide an attachment for flexible.

Fig. 17

The Three main types of Metal Tops are:

Half Saddle
This is the most common top and is illustrated above. It is secured into position by means of a tube rivet and if desired can be combined with a tube rivet connection, though not recommended. It can be used with a solid brush or with a split brush as shown.

Extended Half Saddle
This is similar to the half saddle except that it extends beyond the tangential dimension of the brush. In this form it can be used with cantilever brush holders to enable the pressure finger to bear on a point away from the brush axis. It is, therefore, also known as a “cantilever top”.

Full Saddle
In this form the metal is folded over both sides or faces of the brush and is held in position by tube rivets passing through both sides of the top, or by soldering.
One type of full saddle has the flexible or Flexibles attached in a manner similar to that for the riveted cap connection.
Additionally the saddle can be provided with projecting portions of stop wings which after a certain amount of brush wear lodge on the sides of the brush holder and prevent any further wear on the brush and any damage to the collector by the metal top on the brush.

Insulated Tops

An insulated top is usually fitted when there is need to insulate the pressure finger from the brush and so prevent current passing through the pressure finger and to the pivots of the pressure arm. Such current can cause indentation of the brush under the pressure finger and wear at the pivots of the pressure arm. A reinforced plastic material is used and the tops are held in position by means of a suitable adhesive. This type of top also provides protection against mechanical indentation by the pressure finger, and is to be preferred in place of metal tops in many instances particularly where vibration is encountered.

Another form of insulating top has a layer of resilient material (generally synthetic rubber) fitted between the plastic top and the brush and in this form the resilient material acts as a damper for any vibrations imparted to the brush. It also acts as means of distributing the contact force evenly over the parts of a split brush assembly.

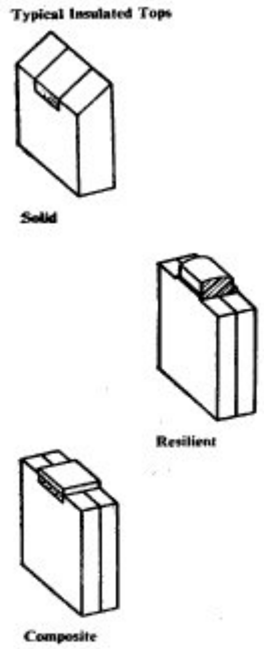


Fig. 18

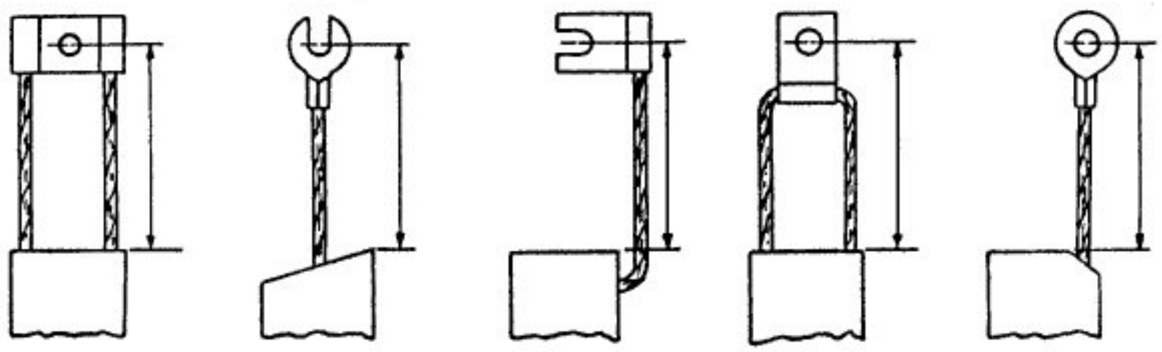


Fig. 19

Flexibles

(Flexible Shunts)

The Flexibles normally fitted into brushes are composed of fine electrolytic grade of copper wire stranded together to form a flexible connection to the body of the brush and conform to IS 13525:1992.

If required by the user, the Copper stranded flexible reinforced with stainless steel wires or Silvered can be used. The value of nominal area, minimum diameter and recommended diameter current for flexible is specified in Table I of IS 13466:1992

The flexible length dimension should be stated from the center of the terminal fixing hole or slot to the top of the carbon as shown in the illustrations above. In the absence of any other specification this rule will be applied. The flexible length should be selected from the recommended lengths with Tolerances given in Para 5.2 of IS 13466:1992.

Flexible Covering

Wherever possible flexible should be left bare in order to obtain maximum flexibility and cooling. If a covering is fitted the size of the flexible may have to be increased.

A covering is fitted over the flexible shunts of certain machine where the Brush Holder and Brushes have been so mounted that there is a risk of the Flexibles touching either the machine frame or Flexibles of another polarity. In other cases an impervious covering is fitted to protect the Flexibles from atmospheric corrosion.

There are **six** main types of material used for the flexible coverings:

Terylene Braid
This is the material generally used on Brushes. It is reasonably flexible and may be used at temperature up to 120º C.

Cotton Braid
This material is the most supple, but has a limiting temperature rating of 90º C.

Woven Glass Fibre
This is a braiding of woven glass fibre and is suitable for use at those temperatures, which would preclude the use of cotton or Terylene.

Silicon Rubber-Coated Woven Glass Fibre
This material is non-fraying and can be used at temperatures up to 180º C. It should not, however, be used on brushes in totally enclosed machines with operating temperatures higher than 70º C.

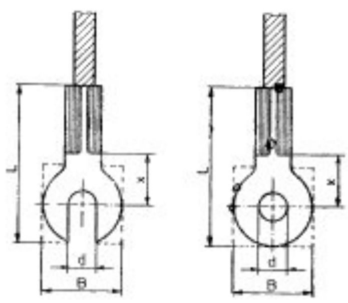
PVC Tubing
This material has been specially selected for imperviousness to gases and offer a considerable amount of protection to the flexible against atmospheric corrosion.

Fibre Sheet Spiral
It is prepared from Vulcanised fiber sheet and varnished. It serves dual purpose of insulation with good cooling and flexibility.

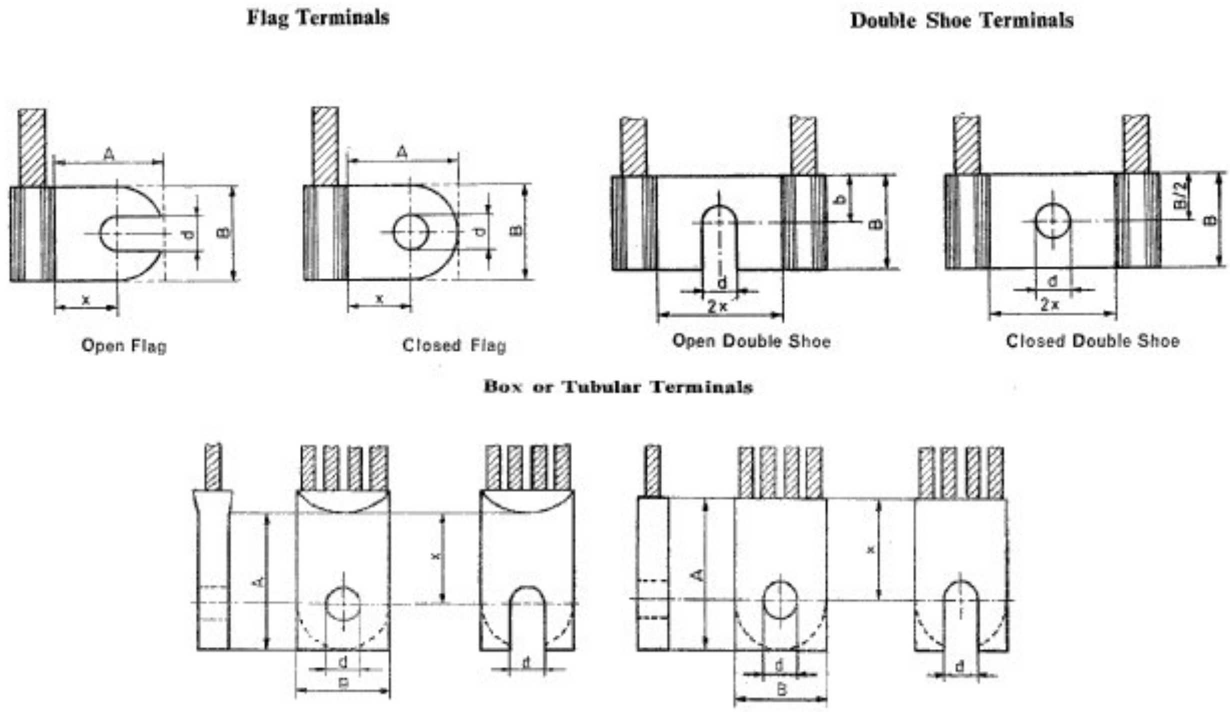
Terminals

The design and range of Terminals in Clause 6.1.1, 6.1.2 and 6.1.3 of IS 13466:1992 are illustrated below.

Spade Terminals



Open Spade Closed Spade



In some cases, terminals require bending to ensure proper fit on the stud. In such cases slot or hole end of the terminal is bent to a specified angle. The angle of bend should be specified as angle from the original plane of the terminal.