

# Carbon Brushes for Industrial and Railway Application



## Brush design

In order to modify the operating performance of carbon brushes quite independently of the material used, a number of types other than block brushes have been developed over the years in order to adapt the sliding contact of the brushes to particular electrical and mechanical conditions and so improve the service properties. The most important basic types are the following:

### Twin and triple carbon brushes

In order to improve the contact conditions, a single block brush is divided into two or three brush sections of equal size set behind each other in a tangential plane. Each of these sections has its own power connection

It is important that the brush sections are pressed uniformly on to the surface of the rotor. This is best achieved (except for flex-less carbon brushes) by means of a rubber or laminate plate laid or glued on to the top surface. Apart from giving uniform pressure distribution, the plate also ensures that the brush sections can move independently for a short distance in a radial direction – which means that the carbon brush can contact the commutator independently from its ovality.

Where a commutator is out of true, the fact that the brush is divided also results in lower

acceleration respectively inertia forces, so that the contact points on the commutator are subject to lower mechanical stress.

Generally, where brush holders with pressure levers are concerned decoupling of the brush and the pressure lever is achieved by means of a flexible rubber plate on the brush head, which also results in a reduction of the reactive forces between the carbon brush and the commutator when vibrations or an out of true commutator are present. The oscillation performance is also altered.

Those types which have a metal clamp on one brush section in order to distribute the pressure offer these advantages to a rather less extent.

Twin and triple carbon brushes have a larger number of contact points between the running surface of the carbon brush and the commutator, with the result that the local current density compared to a block carbon brush is lowered.

At the same time this is associated with an extension of the commutation time so that the current reversal stresses are reduced.

With reversible machines the individual brush sections tilt when there is a change in the direction of rotation, resulting in less displacement of the neutral

zone compared to the block brushes so that the machine becomes more stable.

For mechanical reasons the brush sections must not be too thin. The minimum thickness is 5 mm, and this is also necessary in order to provide a safe connection between the current transmission flexes and the brush sections.

Care should be taken to ensure that the tangential dimension of a brush section does not reach the same value as the segment pitch. Experience has shown that this can cause mechanical instability in the running of the brushes.

### Split carbon brushes with spreading top

This type is a special form of the twin brush. Both brush sections have their upper surface inclined towards the middle of the brush. With lever brush holders they are pressed on to the commutator by inserting a suitable wedge-shaped pressure piece or – with coiled spring holders – directly by the spring.

In each case the two brush sections are spread apart – seen from the brush head side – so that the clearance between the carbon brush and the holder pocket is reduced, or even closed up entirely.

# Brush design

With machines susceptible to oscillation the increased friction between the carbon brush and the wall of the holder (damping) gives better contacting with the commutator.

The minimum thickness of the brush sections are same as for twin carbon brushes.

## Sandwich type carbon brushes

Where commutation is difficult, so-called sandwich brushes may be used in order to avoid any difficulties that may arise, such as excessive sparking, scorching of the bars, heavy wear etc.

In the same way as twin or triple brushes, these consist of two or more brush sections arranged tangentially one after another and glued together with a relatively high resistivity or even an insulating adhesive. As a result of this the cross resistance in the commutation circuit is increased, thus improving the commutation.

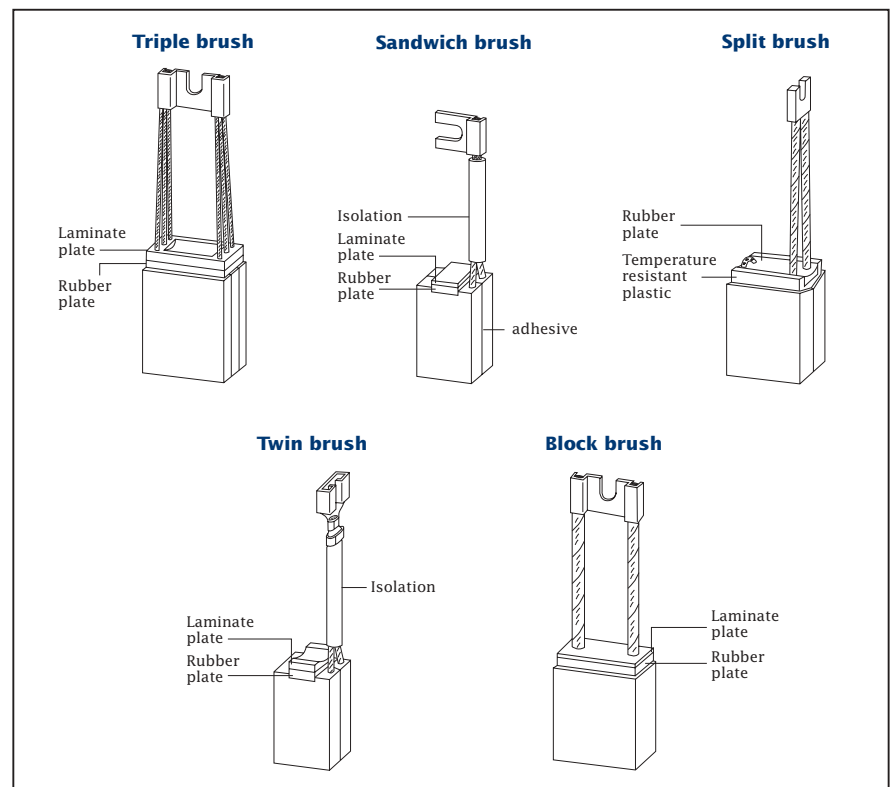
The current supply to this kind of brush is normally arranged that every brush section has its own individual cable. With dual section brushes one of these is tamped into the area of the adhesive layer so that both carbon sections are contacted at the same time. The direct connection

of the individual sections through the current flex has the effect of preventing any excessive increase in the cross resistance. However, in many cases it is sufficient to produce a noticeable improvement can be obtained if the current is fed through a joint carbon headpiece glued in a relatively highly resistive arrangement on to the brush sections.

These are known as sandwich brushes with a high resistance head. However, this design is both complex and expensive.

As well as increasing the cross resistance, the thin but relatively hard adhesive layer produces a slight polishing effect on the contact between the carbon brush and the commutator.

The special properties of the layered carbon brushes will only be utilized to the full if all the brush sections make contact with the commutator at the same time. This can only be achieved if smooth brush running takes place.



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