Technical Information

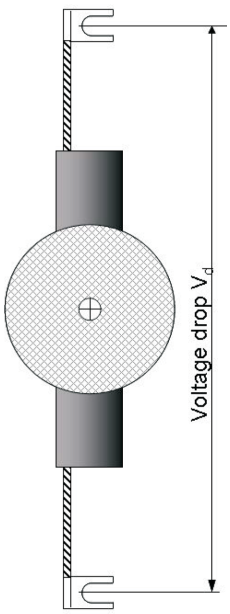
Current sharing

Current distribution is one of the main brush features in practical applications and for OEMs as well, since it has got a big influence g. on maintenance of electrical drives.

A 100% uniform current distribution does not exist. Parallel brushes in each set always transfer slightly different currents. A brush, which in a certain observation moment has transferred less current, might be flown through by more current at a later stage and vice versa.

An explanation for this phenomenon is easy to be given, if one takes the voltage drop / current density curves into consideration, which are also given in our data sheets.

First a short explanation of the used terms:



The sum of the resistance between brush contact surface and ring-/collector surface is called **contact resistance**.

The sum of this value plus the resistance of the brush body and the armature is called the **contact resistance of a carbon sliding contact**.

The voltage drop at the contact resistance between two carbon brushes is called **contact voltage**.

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The contact resistance depends on various parameters, We mention only the most important

- Collector and ambient temperature
- Peripheral speed
- Current density
- Brush pressure
- Environmental conditions
- external vibrations
- friction coefficient
- resistance in the tamped contact
- brush grade .....

Two brushes in parallel have two points of common potential, the collector and the brush arm for their terminals. Each current path has the ohmic resistance of the pig tails, connections and brush material. But the total of these ohmic components is negligible compared with the non-ohmic resistance at the interface between brush and collector, which is approx. 80% of the total value.

As can be seen from the following graph a relatively „slow“ change in voltage drop gives a quite big difference in current density

Example: Any change should give one brush a 5% higher voltage drop and a 5% less value for an other brush. Such small, but quite common changes in practical applications are for example:

- Pressure differences from one holder to the other
- contact changes by vibrations or
- too smooth surfaces

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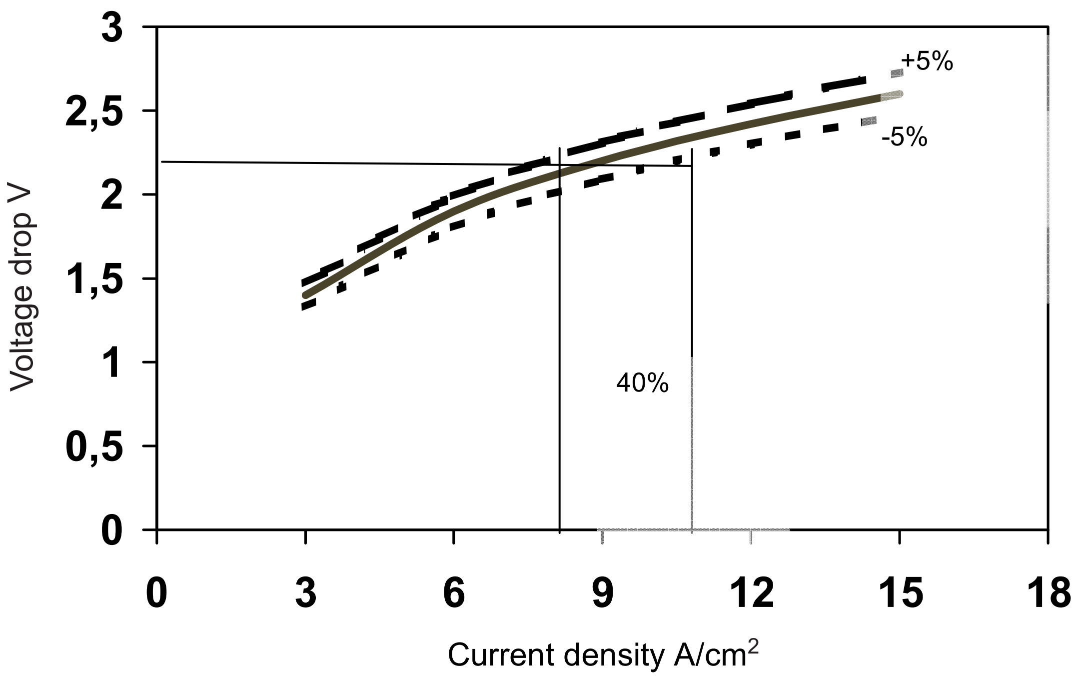
Have a look at a typical data sheet. **You can see, that a small change in voltage drop results in a difference of 40% in current density.**

The shape of the curve becomes even flatter at higher current densities. So the brushes being operated at these higher current densities become more sensitive to current distribution problems



If there is any factor which causes a permanent difference in the current carried by each of the brushes of a set, then the brush carrying the most current will run hotter and wear faster than the remainder. A brush which is running hot tends to have a lower contact drop than its neighbour.

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Sometimes one brush arm will carry more current than other arms of the same polarity. The reason should be sought in some fault in the machine adjustment, for example the non-uniform spacing of brushes round the periphery of a commutator.

On slip rings with high peripheral speed uneven current distribution is a quite common phenomenon. Reason for this problem is the so called aerodynamic effect by air cushion formation. A permanent remedy is only a helical grooving of the slip rings and sometimes additional slots in the brush contact surface

Other applications with slip rings do sometimes also have problems with current distribution. Carbon brushes in galvanic equipments are usually effected by this problem. This effect can be explained easily if you have a look onto the above mentioned. diagram. Galvanic brushes are usually working with high current, therefore you have to concentrate on the flat part of the curve. Particularly in this part small differences in contact drop do have big influences on the current distribution. To cope with these problems bigger flexible diameters and an optimized design of the tamped contact can be used. Problems caused by environmental circumstances, for example corrosion, can be solved by slightly abrasive brush grades .

Brush grades with elevated friction coefficients are less sensitive against bad current distribution. This is one reason for our differentiation between „good commutating grades“ and „good contacting grades“.

Brush grades for high speed slip rings of turbo generators do have a special characteristic of the friction coefficient, this means that the friction coefficient is increasing at higher speeds, which has a stabilizing effect on the current distribution. Therefore only specially designed grades are used in this segment.