Fractional Horsepower Motor Technology

Materials

Schunk Group

Carbon brushes for fractional and subfractional horsepower motors

Materials

Different carbon brush materials are used for fractional and subfractional horsepower motors due to the very different electrical and mechanical requirements. These materials differ both in their composition and their manufacturing process from the carbon brush materials used in other fields of application.

The basic groups and their manufacturing process can be seen in brochure 03.05.

It is the purpose of this brochure to address the practical features of these materials.

Resin-bonded graphite, Location SKT

Identification letter F and G

F = phenol-resin bonded graphite

G = epoxy resin-bonded graphite

Location HOS Identification letter HK and HG

HK = phenol-resin bonded graphite

HG = epoxy resin-bonded graphite

Carbon brushes made of these materials contain natural graphite and/or synthetic graphite with very small amounts of mineral elements. The actual amount of these elements cause low to medium abrasiveness when the brush is in use, so that resulting marks appearing on the surface of the commutator can be ground off.

These materials have a low to very low level of hardness as well as very good vibration damping and sliding friction qualities due to the use of natural graphite and/or synthetic graphite. Therefore carbon brushes made from these materials can be used even with relatively low current loads and/or extreme peripheral speeds.

The F-materials have a high ratio between the direct axis resistance and the cross axis resistance. It is possible to reduce the short-circuit currents between the segments covered by the carbon brush with relatively low active current losses. These materials are used predominantly on motors with a lower electrical power. (This applies only to resin-bonded, hardened materials.)

The F/HK materials can also be manufactured with coked binder resin. In these cases a substantially higher specific current load can be applied. Please see details in brochure 13.14, titled Physical Values.

The G/HG materials have a relatively high to very high specific direct axis resistance, which positively affects service life and radio interference suppression during fast processes of commutation and very high peripheral speeds.

G/HG materials have generally a noticeably lower density than F/HK materials. G/HG materials can be additionally impregnated in order to improve the mechanical run performance. Furthermore G/HG materials exhibit better mechanical vibration damping characteristics and are particularly suitable for high peripheral speeds and larger electrical loads.

Carbon (hard coal), Location SKT Identification letter H

Carbon brushes made of this material are characterized by high strength and hardness. Purposefully mixing in additional abrasive substances creates a good grinding effect during the carbon brush use, so that this material can be used on flush mica insulation. Carbon brushes of this type are able to keep the mica flush despite the abrasion of the segment copper through spark erosion.

It is possible to manufacture materials with relatively high resistivity, with the result of good commutation ability and low radio interference.

Carbon graphite, Location SKT Identification letter L

Location HOS Identification letter HP

Carbon brushes made of this material have the same mechanical strength as carbon, but generally with lower levels of hardness. These materials exhibit a slightly abrasive behavior as well. This prevents markings on the commutator, in particular in the case of electronically fed or controlled motors. However, flush mica is no longer removed. The slightly higher coefficient of friction of the material can be reduced with selective impregnations. Thus brushes made of this material can also be used for high peripheral speeds.

Carbon brushes of this kind can be manufactured with very high resistivity, e. g. in a range of 35 – 3000 µΩm. The result is good commutation ability and the possibility to use these carbon brushes on electrically difficult motors. There are also several possibilities for the reduction of the radio interference. Due to their good mechanical strength, these carbon brushes can be used in various applications on electrically and mechanically highly stressed hand-held electric power tools, household appliances, and washing machine motors.

The admissible electrical load-carrying capacity depends thereby on the resistance of the material. Please see details in brochure 13.14.

Metal graphite Location SKT

A = natural graphite + copper, resin-bonded

K = natural graphite + copper, pitch-bonded

S = natural graphite + silver, pitch-bonded

Location HOS

M = natural graphite + copper, resin-bonded

During the manufacturing process of this material a metallic powder, primarily copper, is added to the graphite. This results in a substantial reduction of the resistivity. In practical operation the possible resistivity values range between approx. 0.1 and 12 µΩm.

Due to the partially metallic points of contacts between the brush surface and the commutator surface there are relatively low transition losses, even in the case of high electrical load. With these metalliferous materials it is necessary to find a compromise between electrical load capacity (efficiency) and commutation quality (lifetime). Since a high copper content positively affects the efficiency, but negatively affects the life time, it is the goal to get by with a metal content as low as possible.

Application areas are among other things:

- Battery-powered, hand-held electric power tools
- Micromotors
- Motors for toys
- Motors in automotive electric equipment

The voltage in these application areas is almost always DC voltage up to 36 V.

Selection criteria and load-carrying capacity can be taken from brochure 13.21.

Electrographite, Location SKT and HOS Identification letter E

This material exhibits a high level of purity and good sliding qualities. This material is to be used exclusively on undercut mica insulation, as it has no cleaning effect. The coefficient of friction is low. The resistivity of electrographite ranges between 15 and 100 µΩm, as a result making the commutation ability of this material lower than that of the carbon graphite materials.

Since costly commutation improvement aids are required to supress radio interference, electrographite materials are only rarely used, except in special cases as for example motors ≤ 120 V.

In this connection we refer to brochure 13.21 as well.

Measuring method:

Resistivity, bulk density, bending strength
DIN IEC 60413
Rockwell Hardness DIN 51917

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13.12e/1000/2008

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