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2005-01

Natural graphite brush for rotating electrical machinery – Basic characteristics

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

NATURAL GRAPHITE BRUSH FOR ROTATING ELECTRICAL MACHINERY – BASIC CHARACTERISTICS

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IEC-PAS 62072 has been processed by IEC technical committee 2: Rotating machinery.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
2/1301A/NP	2/1318/RVN

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned will transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of three years starting from 2005-01. The validity may be extended for a single three-year period, following which it shall be revised to become another type of normative document or shall be withdrawn.

NATURAL GRAPHITE BRUSH FOR ROTATING ELECTRICAL MACHINERY – BASIC CHARACTERISTICS

1 Scope

This PAS applies to brushes for commutators and slip-rings in rotating electrical machinery.

This excludes brushes of electrical appliances such as starters of automobiles and tractors, micro-appliances for household and tools, appliances for aeronautics and space, and others operating in special conditions.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60276, *Definitions and nomenclature for carbon brushes, brush-holders, commutators and slip-rings*

IEC 60413, *Test procedures for determining physical properties of brush materials for electrical machines*

IEC 60773, *Test methods and apparatus for the measurement of the operational characteristics of brushes*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
NG brush material
material, which consists of natural graphite mineral with developed crystal structure and a binder able to take appropriate characteristics as brush

3.2
NG brush
brush for commutator and slip-ring made of NG brush material in accordance with IEC 60276, Clause 2

4 Classification

The NG brushes should be classified in accordance with 4.1 to 4.4.

4.1 According to usage:

a) commutator brush;

b) slip-ring brush.

4.2 According to grade of rotating electrical machinery:

a) for d.c. electrical machine;

b) for turbine generator;
c) for hydro generator;
d) for wound-rotor type asynchronous motor.

4.3 According to voltage used:

a) using up to 100 V;
b) using in the range of 100 V to 500 V;
c) using in the range of 5 00 V to 1 000 V;
d) using in the range of 1 000 V to 3 000V.

4.4 According to operating conditions:

a) operating in current above 600 A;
b) operating in peripheral velocity above 60 m/s;
c) operating in vibrating width above 100 μm;
d) operating in ambient temperature above +40 °C;
e) operating in the on-off times per hour above 20;
f) operating in normal condition.

5 Characteristics

5.1 Physical properties

5.1.1 Bulk density

The bulk density of NG brush material should be in the range of 1,2 g/cm^3 to 1,4 g/cm^3.

5.1.2 Hardness

The hardness of NG brush material should be in the range of 10 to 40 in HR 2,5/3,5.

5.1.3 Resistivity

The resistivity of NG brush material should be in the range of 10 μΩ·m to 80 μΩ·m for commutators and 6 μΩ·m to 12 μΩ·m for slip-rings.

5.1.4 Bending strength

The bending strength of NG brush material should be in the range of 8 MPa to 15 MPa.

5.1.5 Ash

The ash content in NG brush material should be up to 0,5 %.

5.2 Operating characteristics

5.2.1 Total voltage drop

The total voltage drop should be in the range of 2 V to 3 V.

5.2.2 Coefficient of friction

The coefficient of friction should be up to 0,2.

5.3 Recommended operating conditions

5.3.1 Peripheral velocity

The peripheral velocity should be up to 90 m/s.

5.3.2 Current density

The current density should be in the range of 8 A/cm^2 to 12,5 A/cm^2.

5.3.3 Brush pressure

The brush pressure should be in the range of 15 kPa to 35 kPa.

Tables 1 and 2 give basic characteristics of typical NG brushes for commutators and slip-rings respectively.

Table 1 – Basic characteristics of NG brushes in commutators

Designation	Bulk density g/cm^3 Average	Hardness HR 2,5/3,5 Average	Resistivity μΩ · m Average	Bending strength MPa Average	Ash % Max.	Total voltage drop V Average	Coefficient of friction Max.	Peripheral velocity m/s Max.	Current density A/cm^2 Average	Brush pressure kPa Average	Remark
KPNG125	1,2-1,3	20-40	40-60	10-12	0,5	2	0,2	40	10	20-25	NOTE 1
KPNG111	1,2-1,3	20-40	10-15	10-12	0,5	2	0,2	40	12	20-25	NOTE 2
KPNG122	1,2-1,3	20-30	60-80	10-12	0,5	2	0,2	60	10	18-20	NOTE 3
KPNG133	1,35	10-20	40-60	14-15	0,5	2	0,2	50	10	25-35	NOTE 4
KPNG143	1,35	10-20	40-80	14-15	0,5	3	0,2	50	10	25-35	NOTE 5

NOTE 1 DC motor and d.c. generator for tool machines, crane and lifter.

NOTE 2 DC generators for coating, welding, electrolysis.

NOTE 3 Turbine generator's exciter, high-speed d.c. motor.

NOTE 4 DC traction motors for trolley-bus, tram-bus and subway.

NOTE 5 DC traction motors for electrical and internal combustion locomotive.

Table 2 – Basic characteristics of NG brushes in slip-rings

Designation	Bulk density g/cm^3 Average	Hardness HR 2,5/3,5 Average	Resistivity μΩ · m Average	Bending strength MPa Average	Ash % Max.	Total voltage drop V Average	Coefficient of friction Max.	Peripheral velocity m/s Max.	Current density A/cm^2 Average	Brush pressure kPa Average	Remark
KPNG422	1,3-1,4	10-20	6-8	10-12	0,5	2-3	0,2	90	10	15-20	NOTE 1
KPNG526	1,3-1,4	20-30	10-12	10-12	0,5	2-3	0,2	40	10	20-25	NOTE 2
KPNG821	1,2-1,3	20-40	6-8	10-12	0,5	2	0,2	40	8	15-20	NOTE 3

NOTE 1 Turbine generator, dipole synchronous motor.

NOTE 2 Hydro generator, multi-pole synchronous machine.

NOTE 3 Wound-rotor type asynchronous motor.

6 Test methods

The test methods on the physical properties and the operating characteristics of NG brushes shall be performed in accordance with IEC 60413 and IEC 60773 respectively.

Annex A
(informative)

Measurements and performance characteristics

Table A.1 – Measurement of characteristics and particles of NG brushes by international companies*

No	Companies	Date	Contents
1	SGL carbon group (France)	2001.09.21 2002.11.21	Section photograph Measurement of characteristic value
2	Schunkkohlenstofftechnik GmbH (Germany)	1994.05.30	Crystal structure Measurement of characteristic value
3	Graphit Kropfmühl (Germany)	2002.07.12 2003.11.27	Analysed raw material contents
4	ARP, Leoben (Austria)	1994.02.23	Measurement of graphite particle size
5	Toyo carbon corporation (Japan)	1996.06.13	Measurement of characteristic value

Table A.2 shows the results of the operating test of the NG brushes in domestic use.

Table A.2 – Performance characteristics of NG brushes in various applications (measurements performed by the DPR Korea)

Objects	Number of motors	Number of brushes	Period of test h	Running distance km	Brush wear per 10 000 km mm			Wear of commu-tator	Spark	V_t m/s	J_B A/cm^2	P_B kPa
					Initial	Middle	Last					
Traction motor	6	48	6 000	80 000	1,4	1,2	1,04	Not nearly	No	20-30	6-10	3
	6	48	6 000	60 000	1,7	1,4	0,9	Not nearly	No			

Objects	Number of machines	Number of brushes	Period of test h	Brush wear per 1 000 km mm	Wear of slip-ring	Spark	V_t m/s	J_B A/cm^2	P_B kPa
Wound-rotor type asynchronous motor	20	400	30000	0,66	Not nearly	No	10-35	5-8	1,5-2
	300	5 000	30000	1,16	Not nearly	No			
High-speed turbine generator	10	960	4000	7,5	Not nearly	No	90	10	1,5-2

* This information is given for the convenience of users of this PAS and does not constitute an endorsement by IEC.

Annex B
(informative)

Manufacture process of the different brushes

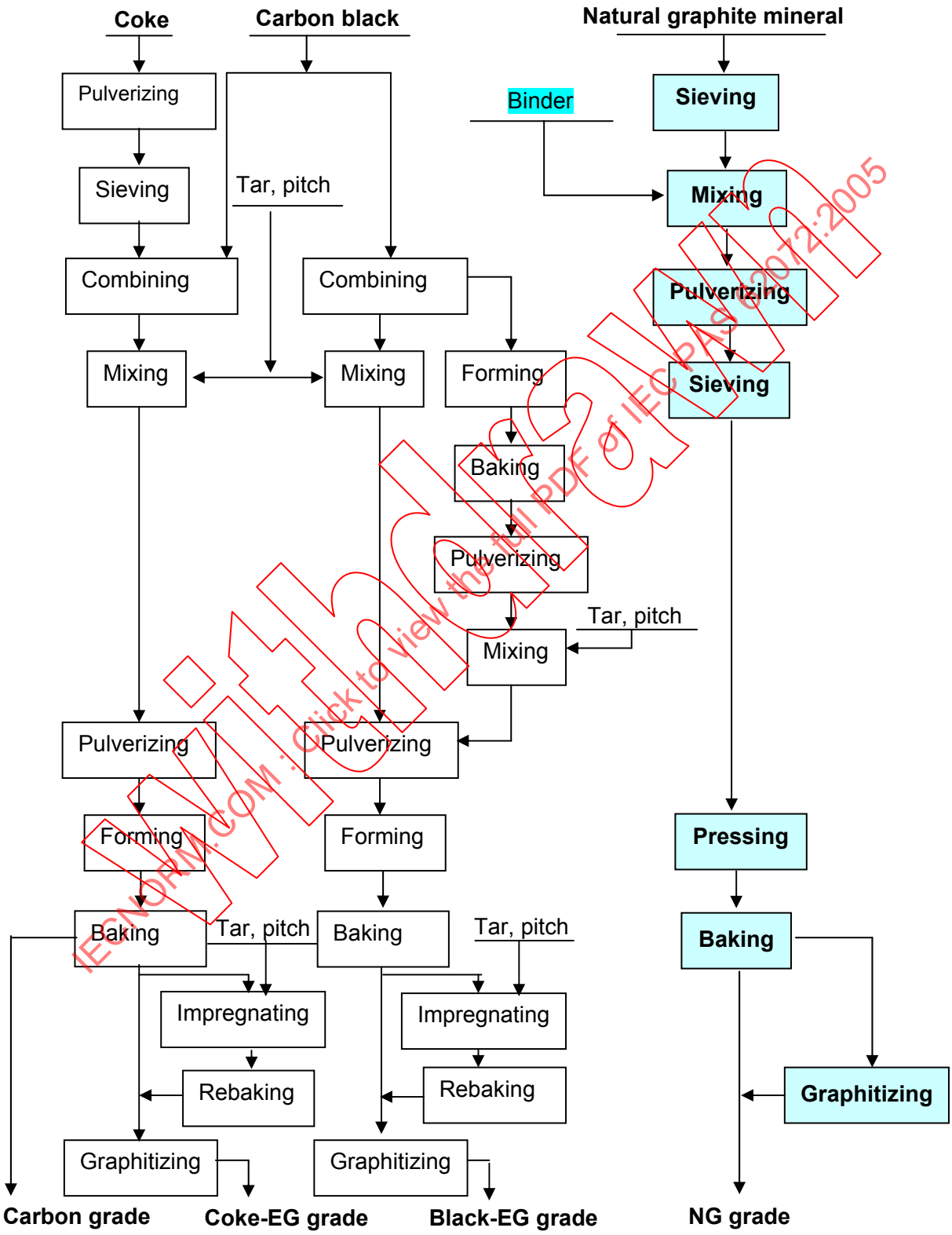

Figure B.1 – Diagram of manufacture process