

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Carbon brushes, brush holders, commutators and slip-rings – Definitions and nomenclature

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Balais de charbon, porte-balais, collecteurs et bagues – Définitions et nomenclature

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CARBON BRUSHES, BRUSH HOLDERS, COMMUTATORS
AND SLIP-RINGS – DEFINITIONS AND NOMENCLATURE**

FOREWORD

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International Standard IEC 60276 has been prepared by IEC technical committee 2: Rotating machinery.

This second edition cancels and replaces the first edition, issued in 1968 and its Amendment 1, issued in 1987. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- Some nomenclature has been deleted or added, whereas remaining definitions have been detailed and clarified, to reflect the technical evolution since 1987.
- Additional definitions have been included to address the request for reviewing this standard, in particular nomenclature of commutator/slip-rings markings, brush markings and commutation sparks codes.

The text of this standard is based on the following documents:

FDIS	Report on voting
2/1898/FDIS	2/1901/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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CARBON BRUSHES, BRUSH HOLDERS, COMMUTATORS AND SLIP-RINGS – DEFINITIONS AND NOMENCLATURE

1 Scope

This document applies to carbon brushes for electrical machinery. For the present, it applies only to carbon brushes for commutators and slip-rings in rotating machines.

Terms and definitions are relative to the brush construction (references 100's to 500's and parts of 900's) and to the markings when operating on a rotating machine (references 600's to 800's).

By extension, terms and definitions may be relevant for any kind of sliding electrical contacts for electrical machinery.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60136, *Dimensions of brushes and brush-holders for electrical machinery*

IEC 60276:2018

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

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3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE Brushes are classified according to the class of grade used, as follows.

3.1 grade

brush material used for the brush body, defined by its composition and its physical properties

3.2 carbon

consists of various forms of amorphous carbon, generally made of a mixture of carbonaceous powders agglomerated with a binder, moulded and baked at suitable temperature to carbonize the binder

Note 1 to entry: Also named hard carbon (or plain carbon).

Note 2 to entry: The material can contain additives and can be impregnated with oils, wax or resin. This material contains principally carbon, because it is not graphitized during baking operation.

3.3
carbon-graphite
carbographitic
CG

consists of a mixture of powdered amorphous carbon and graphite, agglomerated with a binder (pitch or resin), moulded and baked at suitable temperature to carbonize the binder

3.4
electrographite
electrographitic
EG

consists of various forms of amorphous carbon (hard carbon or carbon-graphite) converted during manufacture into artificial / synthetic graphite

3.5
natural-graphite
NG

carbon-graphite grade consisting principally of natural graphite

Note 1 to entry: Sometimes also called soft graphite.

3.6
resin-bonded
bakelite-graphite
BG

consists of powdered carbon and/or graphite bonded with a resin (artificial, synthetic or natural) and polymerized at suitable temperature

3.7
metal-graphite
metallographitic
MG

consists of a mixture of powdered metals and graphite pressed and baked at suitable temperature

Note 1 to entry: Baking is named sintering when a reducing atmosphere is used during baking.

3.8
metal-impregnated
M

consists of carbon, carbon-graphite or electrographite which contains a metal which has been added by an impregnation process.

Metal can be added by:

- melting the metal and impregnating under pressure, or
- impregnating with a metal precursor and decomposition of this precursor during a further baking operation, or
- deposition in vapour phase.

Note 1 to entry: The second and third processes are also called metallization.

4 Symbols and abbreviated terms

4.1 Symbols

- a axial dimension of brush (mm)
- c chamfer dimension (mm)
- I current per brush (A)
- r radial dimension of brush (mm)
- R radius (mm)
- t tangential dimension of brush (mm)
- U voltage (V)
- α contact bevel angle (°)
- β top bevel angle (°)

4.2 Subscripts

- A anodic
- C cathodic
- B brush
- T top of the brush
- c contact

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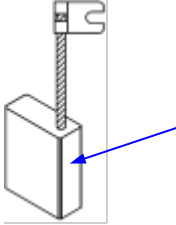
5 Nomenclature

NOTE The definition corresponds to the part highlighted in blue / grey colour or pointed out by an arrow on the corresponding figure (when applicable).

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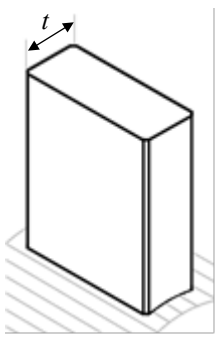
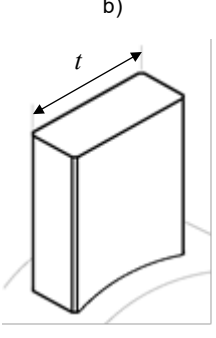
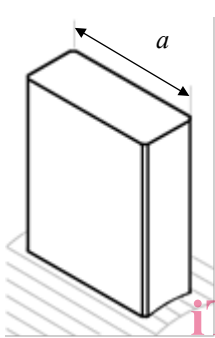
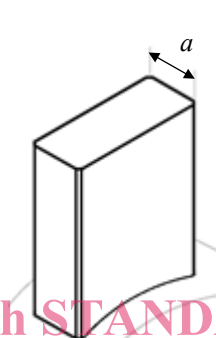
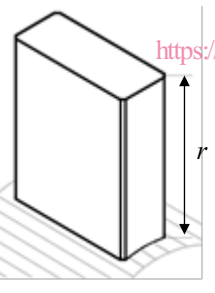
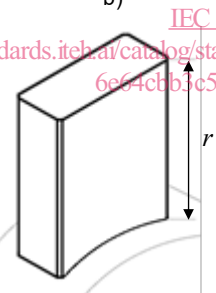
5.1 Brushes

5.1.1 101: Body / block

101		Brush body / block
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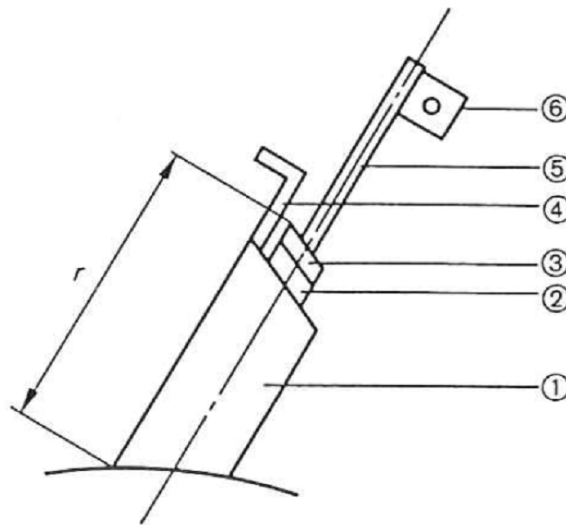
5.1.2 102 to 104: Definitions of t , a and r

References a) and b) below correspond respectively to commutator (DC Motor) and slip-ring (synchronous or asynchronous machine).

<p>102</p>			<p>Tangential dimension</p> <p>t is the brush dimension in the tangential direction defined by the distance between two planes parallel to the centre line (see 105), the planes comprising the faces of the brush (see 121).</p>
<p>103</p>			<p>Axial dimension</p> <p>a is the brush dimension in the axial direction defined by the distance between two planes parallel to the centre line (see 105), the planes comprising the sides of the brush (see 118).</p>
<p>104</p>			<p>IEC 60276:2018 https://standards.iteh.ai/catalog/standards/sist/7a91a612-0799-45fc-8c56-6c64cbb1c5b1/iec-60276-2018</p> <p>Radial dimension</p> <p>r is the brush dimension in the radial direction defined by the distance between two planes normal to the brush centre line (see 105), passing over the extremities of the brush elements, or parts of elements, which take part in the pressure application (see Figure 1). r is the longest dimension parallel to the centre line.</p>

Recommended dimensions for t , a and r , as well as tolerances, are given in IEC 60136.

The pressure systems fitted on brushes are excluded from r . With reference to Figure 1 only the elements marked 1, 2 and 3 take part in the pressure application. The possible litigious cases which could not be justified by the definition of r shall be dealt with by agreement.



Key

- 1 brush material (body)
- 2 soft top pad
- 3 hard top pad
- 4 metal retainer
- 5 brush flexible
- 6 brush terminal

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Figure 1 – Elements of the brush for definition of r dimension

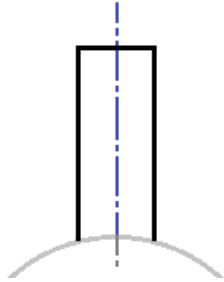
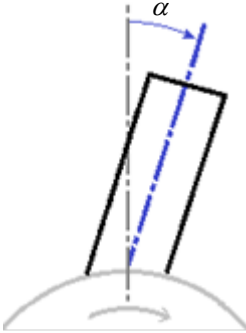
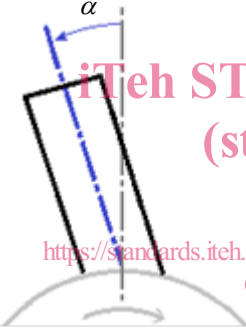
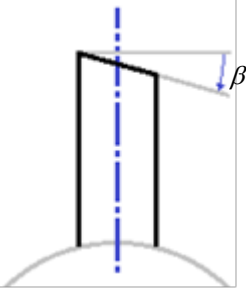
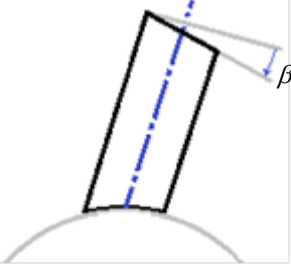
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5.1.3 105 to 112: Angles

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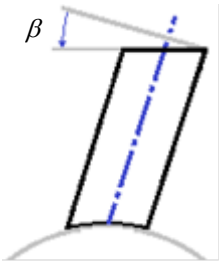
NOTE 1 Figures 106 to 112 are cross-section view of the carbon brush.

105		Centre line
106		Contact bevel angle α Angle between the center line of the brush and the radial axis of the commutator/ring.

107		<p>Radial brush when α is equal to zero</p>
108		<p>Reaction brush when α is positive (in the same direction as the rotation)</p>
109		<p>Trailing brush when α is negative (in the opposite direction of the rotation)</p>
110		<p>Top bevel angle β</p>
111		<p>Positive top bevel angle</p>

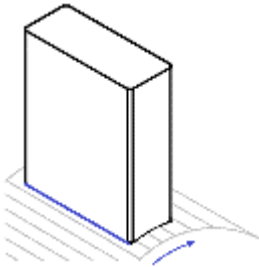
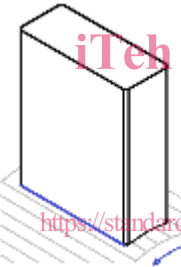
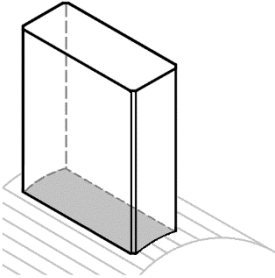
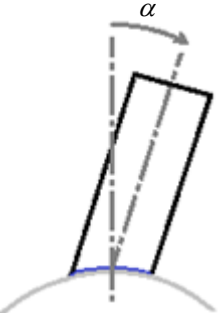
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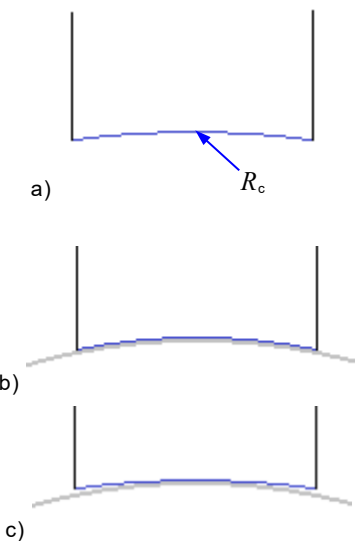
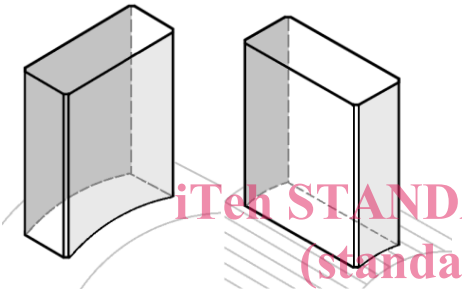
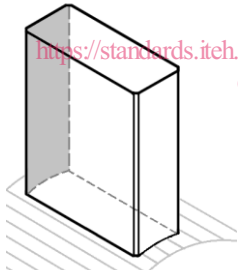
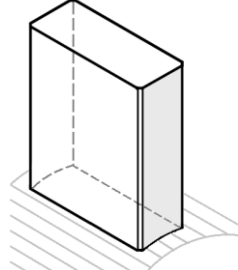
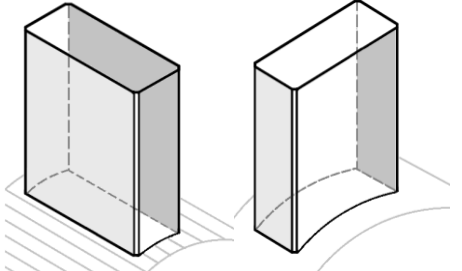
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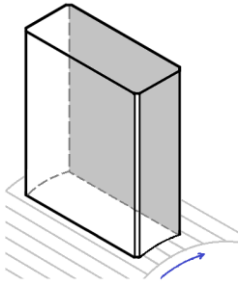
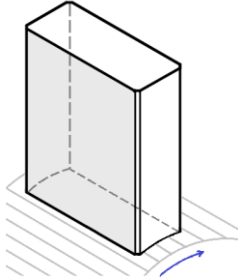
112		Negative top bevel angle
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NOTE 2 IEC 60136 gives some recommendations for values of α and β angles.

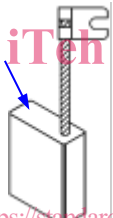
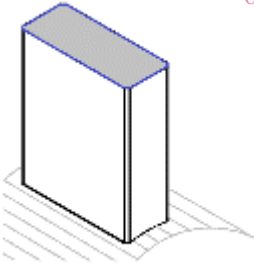
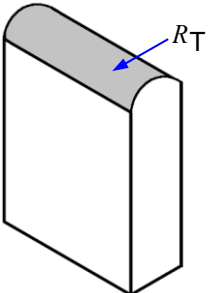
5.1.4 113 to 123: Edges and faces

113		Entering edge (leading edge)
114	 <p style="text-align: center; color: red; font-weight: bold;">iTech STANDARD PREVIEW (standards.itech.ai)</p> <p style="text-align: center; color: red;">IEC 60276:2018 https://standards.itech.ai/catalog/standards/sist/7a91a612-0799-45fc-8e56-6e64cbb3c5b1/iec-60276-2018</p>	Leaving edge (trailing edge)
115		Contact surface (contact face)
116		Bevelled contact surface (bevelled contact face)

<p>117</p>		<p>Radiused contact surface (concave contact face) Figure a) Brush with a radius R_c Figures b) and c) are relative to fitted/bedded brushes Figure b) When the radius is equal to the radius of the commutator/slip-ring</p> <ul style="list-style-type: none"> - after fitting (machining operation), the brush 117 is named fitted brush, - after bedding (machine operating at the specified conditions of speed and current density during a certain time), the brush 117 is named bedded brush. <p>Figure a) when the radius R_c is machined with a dimension slightly superior to the radius of the commutator/slip-ring the brush 117 is named pre-fitted brush.</p>
<p>118</p>		<p>Sides</p>
<p>119</p>		<p>IEC 60276:2018 https://standards.itech.ai/catalog/standards/sist/7a91a612-0799-45fc-8e56-6e64cbb3c5b1/iec-60276-2018 Inner side, i.e. winding side (for commutator) NOTE Winding side is at the rear part of the commutator on the figure.</p>
<p>120</p>		<p>Outer side, i.e. non-winding side (for commutator) NOTE Winding side is at the rear part of the commutator on the figure).</p>
<p>121</p>		<p>Faces</p>

122		Front face (front)
123		Back face (back)

5.1.5 124 to 136: Brush top

124	 <p style="text-align: center;">iTech STANDARD PREVIEW (standards.iteh.ai)</p> <p style="text-align: center;">IEC 60276:2018 https://standards.iteh.ai/catalog/standards/sist/7a91a612-0799-45fc-8e56-6e64cbb3c5b1/iec-60276-2018</p>	Top
125		Top surface
126		Rounded top (convex top) – radius R_T