SLOVENSKI STANDARD
oSIST prEN IEC 60773:2020

01-januar-2020

Rotacijski stroji - Preskusne metode in aparati za merjenje obratovalnih lastnosti ščetk

Rotating machinery - Test methods and apparatus for the measurement of the operational characteristics of brushes

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Méthodes d'essais et appareils pour la mesure des propriétés opérationnelles des balais

Ta slovenski standard je istoveten z: **prEN IEC 60773:2019**

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ICS:

29.160.01	Rotacijski stroji na splošno	Rotating machinery in general

oSIST prEN IEC 60773:2020 **en,fr,de**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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2/1967/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:
IEC 60773 ED2

DATE OF CIRCULATION: **2019-11-01**
CLOSING DATE FOR VOTING: **2020-01-24**

SUPERSEDES DOCUMENTS:
2/1921/CD, 2/1946/CC

IEC TC 2 : ROTATING MACHINERY

SECRETARIAT: United Kingdom
SECRETARY: Mr Charles Whitlock

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:
☐

Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:
☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING
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Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Rotating machinery – Test methods and apparatus for the measurement of the operational characteristics of brushes

PROPOSED STABILITY DATE: 2022

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ROTATING ELECTRICAL MACHINES –

TEST METHODS AND APPARATUS FOR THE MEASUREMENT OF THE OPERATIONAL CHARACTERISTICS OF BRUSHES

FOREWORD

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PREFACE

International standard IEC 60773:XXX has been prepared by IEC subcommittee MT14: Brushes and Brush-Holders for electrical machinery, under the responsibility of IEC technical committee 2:Rotating Machinery.

This second edition cancels and replaces the first edition published in 1983. It constitutes a technical revision.

All changes and additions are too numerous to be listed. However main changes can be summarized as follow:

– The layout has been updated and adjusted to comply with the ISO/IEC Directives, Part 2.

– The clause structure has been modified on the view point of a laboratory testing procedure. The new sequence is as follows: test rig specification (clause 4), general

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testing procedure (clause 5), and each operational characteristic procedure (clauses 6 to 8).

– A new clause 9 has been added to introduce the black band test for the characterisation of the brush grades for DC machines.

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

FDIS	Report on voting
1/####/FDIS	1/####/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 National Committees are requested to note that for this document the stability date is 2029.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

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ROTATING ELECTRICAL MACHINES –

TEST METHODS AND APPARATUS FOR THE MEASUREMENT OF THE OPERATIONAL CHARACTERISTICS OF BRUSHES

1 Scope

This standard applies to test methods for the measurement of the operational characteristics of brushes designed to operate on commutating and slip ring machines under specified test conditions.

By extension some tests may be relevant for other kind of sliding electrical contacts for electrical appliances.

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.

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IEC 60027-1, *Letter symbols to be used in electrical technology − Part 1: General*

IEC 60027-4, *Letter symbols to be used in electrical technology − Part 4: Rotating electrical machines*

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IEC 60034-19:2014, *Rotating electrical machines - Part 19: Specific test methods for d.c. machines on conventional and rectifier-fed supplies*

IEC 60050-411, *International Electrotechnical Vocabulary - Chapter 411: Rotating machinery*

IEC 60136, *Dimensions of Brushes and Brush-holders for Electrical Machinery*

IEC 60276:2018, *Definitions and nomenclature for brushes, brush-holders, commutators and slip rings*

IEC 60560, *Definitions and terminology of brush-holders for electrical machines*

IEC 60584-1:2013, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 60751:2008, *Industrial platinum resistance thermometers and platinum temperature sensors*

IEC/TR 61015, *Brush-holders for electrical machines. Guide to the measurement of the static thrust applied to brushes*

ISO 1190-1:1982, *Copper and copper alloys – code of designation – Part 1: Designation of materials*

ISO 3274:1996, *Geometrical Product Specifications (GPS) - Surface texture: Profile method - Nominal characteristics of contact (stylus) instruments*

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ISO 4287:1997/Amd 1:2009, *Geometrical Product Specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters - AMENDMENT 1: Peak count number*

ISO 15510, *Stainless steel – Chemical composition*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in standards specified in clause 2, some of which are repeated here for convenience, and the following 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

3.1 Terms and definitions

3.1.1
run-out
runout
an inaccuracy of the rotating system, measured on the surface of the ring while turning

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Note 1 to entry: This includes out-of-round (that is, lacking sufficient roundness); eccentricity (that is, lacking sufficient concentricity); or axial bending (regardless of whether the surfaces are perfectly round and concentric at every cross-sectional point).

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3.1.2
roughness
Ra
arithmetic mean of the absolute ordinate value $Z(x)$ of a profile within a sampling length l

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$$Ra = \frac{1}{l} \times \int_0^l |Z(x)| \, \mathrm{d}x$$

Example: Figure 1 below shows an example of profile.

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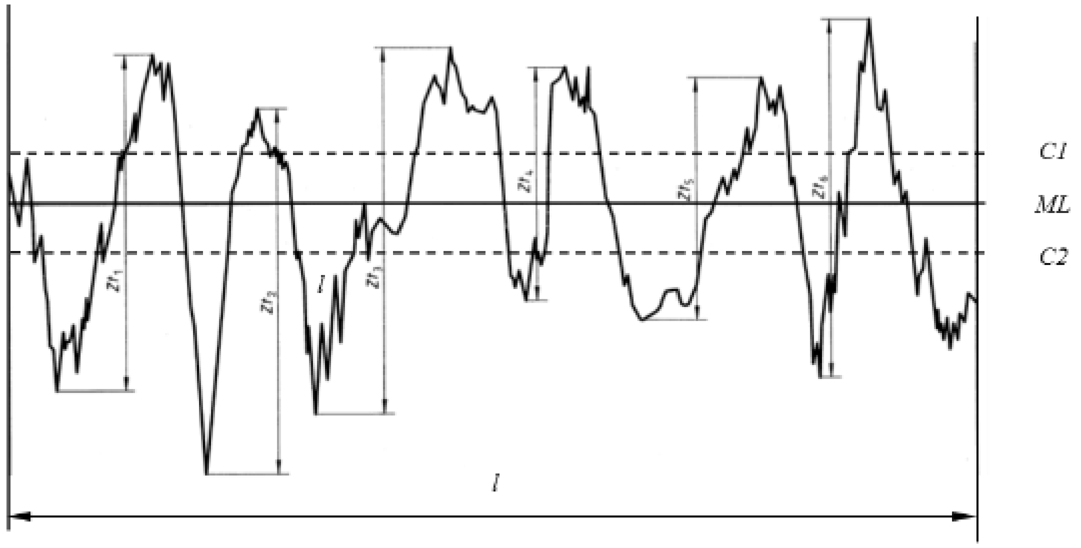

Key:

editorial note 1 for IEC: figure, key and title are expected to be only on one page

Zt_i	profile element i height
l	sampling length
ML	mean line
$C1$ and $C2$	upper and lower intersection lines (respectively)

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Figure 1 – Profile and determination of height of profile elements

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[source: ISO 4287:1997]

3.1.3
peak count
RPc
number of profile elements per centimeter of sampling length which exceed the upper intersection line $C1$ and fall short of the lower intersection line $C2$

Note 1 to entry: Both intersection lines are parallel to the diagram mean line (see figure 1).

[source: ISO 4287/A1:2007]

3.1.4
abrasive stone
material used to grind a surface

Note 1 to entry: The quality of the material and the method of appliance depend on its use. Therefore for this standard purpose we will use the definitions 3.1.5, 3.1.7 and 3.1.8.

3.1.5
grinding stone
abrasive stone used to grind the test ring

Note 1 to entry: It is generally made of hard abrasive grains

3.1.6
brush fitting
operation at the end of which the brush contact surface is matching the ring profile

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3.1.7
fitting stone
abrasive stone used for fitting the brush to the commutator/ring

3.1.8
roughness stone
abrasive stone used to obtain the proper range of roughness to the test ring, generally made of soft abrasive grain

3.1.9
brush contact area
S
area of the brush in contact with the ring surface

Note 1 to entry: When radial brush is used the brush contact surface area S_r is the cross section of the brush:

editorial note 2 for IEC : formula size changes when adding the numbering (2) – same issue with other formula (see note 1 beside the formula)
Original is:

$$S_\alpha = \frac{t \times a}{\cos\alpha}$$

$$S = t \times a \quad (1)$$

...nd axial dimensions of the brush.

...is part of the formula giving the brush contact surface area S_α:

$$S_\alpha = \frac{t \times a}{\cos\alpha} \quad (2)$$

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where α is the contact angle (or bottom angle).

3.1.10
brush specific pressure
p
force per contact area of the brush, given by the the formula below:

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$$p = \frac{F_p}{S} \quad (3)$$

see note 2

where F_p is the force applied by the pressure system
and S is the brush contact surface area

Note 1 to entry: When F_p is expressed in grams force (gf) and brush contact surface in cm² the calculated specific pressure is in gf/cm². To convert into SI units: the result in gf/cm² multiplied by 98,07 gives p in N/m² (98,07 is the gravitational acceleration in m/s² multiplied by 10).

3.1.11
current ripple factor
q_i
ratio of the difference between the maximum value I_{max} and the minimum value I_{min} of an undulating current to two times the average value $\bar{I}$ (mean value integrated over one period):

$$q_i = \frac{I_{max} - I_{min}}{2 \times \bar{I}}$$

Note 1 to entry: For small values of current ripple, the ripple factor may be approximated by the following expression:

$$q_i = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

Note 2 to entry: The above expression may be used as an approximation if the resulting calculated value of q_i is equal to or less than 0,4.

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[source: IEC 60034-1:2017]

3.1.12
stable state
state of a physical system in which the relevant characteristics is considered to be sensibly constant with time

[source: IEC 60050-103-05-01]

3.1.13
sensibly constant
a measurement result is considered as sensibly constant when deviation from mean value of a minimum of 3 consecutive measurements is less than 2,5 % (except otherwise specified)

Note 1 to entry: Stability state may be determined from the time-measurement rise plot when the straight lines between points at the beginning and end of two successive intervals of half hour each have a deviation of less than the criteria of 2,5 %.

3.1.14
friction coefficient
μ
ratio of tangential force F_t acting at the interface to the radial force F_r acting at the interface

it is calculated from the formula (4) below:

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$$\mu = \frac{F_t}{F_r} \qquad (4)$$

see note 2

where F_t is the tangential component of the forces acting at the interface

F_r is the radial component of the forces acting at the interface

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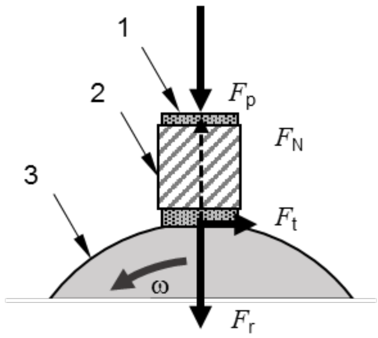
NOTE 1 to entry: Figure 2 illustrates the forces acting on the brush when a radial brush-holder is applied. The numerical value of radial force F_r is equal to the numerica value of the normal reaction force F_N (of the brush contact surface on the ring) and to the numerical value of the pressure system force F_p on the brush top.



Key:

1 Brush

2 Brush-holder

3 Test ring

ω Angular velocity (giving the rotation direction)

Figure 2 – Forces acting on a brush

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3.1.15
brush voltage drop
U_B
total voltage drop between the brush terminal and the slip ring or commutator

NOTE 1 to entry: U_B is a complex parameter which is made up from the sum of the voltage drops U_s, U_f, U_i, and U_c as illustrated in Figure 2 (which concerns a brush with a tamped flexible).

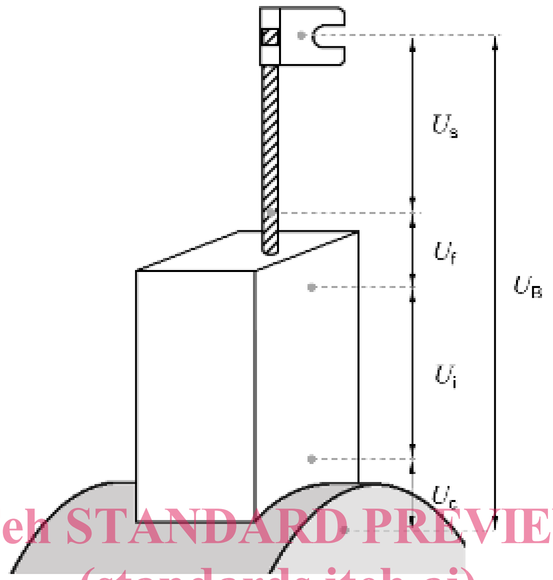

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Figure 3 – Voltage drops in a brush when in operation

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3.1.16
shunt voltage drop
U_s
voltage drop in the shunt (flexible) and in the shunt connection to the brush terminal

3.1.17
connection drop
U_f
voltage drop between the shunt (flexible) and the brush grade

Note 1 to entry: The connection drop U_f measurement is described in IEC 60136

3.1.18
brush internal drop
U_i
internal voltage drop of the brush (due to the brush grade resistance)

3.1.19
brush contact drop
U_c
voltage contact drop between the brush grade and the ring

Note 1 to entry: The brush contact drop U_c is an operating characteristic of a brush. See clause 7.

3.1.20
slot pitch
τ_Q
distance between two consecutive slots of the ring, defined by the periphery of the ring π x D divided by the number of slots Q