IEC 62499

Edition 2.0 2021-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Railway applications – Current collection systems – Pantographs, testing methods for contact strips

Applications ferroviaires – Systèmes de captage de courant – Méthodes d'essai des bandes de frottement des pantographes

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RAILWAY APPLICATIONS – CURRENT COLLECTION SYSTEMS – PANTOGRAPHS, TESTING METHODS FOR CONTACT STRIPS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62499 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways. It is an International Standard.

It is based on EN 50405:2015.

This second edition cancels and replaces the first edition published in 2008. This edition constitutes a technical revision.

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

a) Title modified;
b) The scope of this standard is changed from carbon contact strips to contact strips;
c) Replacement of several reference standards;
d) Several terms and abbreviated terms are introduced;
   - The definitions of metalized contact strip and metal contact strip are introduced according to the metal or carbon content by weight;
   - The definitions of contact strip structures and types are introduced;

e) Requirements for data sheets are introduced;

f) Table 1: Schedule of tests and Table 2: Sequence of tests are introduced;

g) The requirements for certain test methods and test acceptance criteria are updated;

h) Test of metal content for metalized contact strip, test of the coefficient of friction, optional test of the impact resistance of the carbon material and optional test of wear properties are added;

i) Annex A and Annex B are introduced.

The text of this International Standard is based on the following documents:

Draft	Report on voting
9/2762/FDIS	9/2773/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

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

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RAILWAY APPLICATIONS – CURRENT COLLECTION SYSTEMS – PANTOGRAPHS, TESTING METHODS FOR CONTACT STRIPS

1 Scope

This document gives rules for testing methods for newly manufactured pantographs contact strips. Not all tests may be relevant to some designs of contact strips. This document excludes tests using a particular pantograph. Additional supplementary tests, out of the scope of this document, may be necessary to determine suitability for a particular application and are by prior agreement between customer and manufacturer.

NOTE The customer can, among others, be the system integrator, the manufacturer, the purchaser, the operator of the vehicle or the purchaser of the pantograph or a supervisory authority.

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 60413:1972, *Test procedures for determining physical properties of brush materials for electrical machines*

IEC 60773:2021, *Rotating electrical machines – Test methods and apparatus for the measurement of the operational characteristics of brushes*

ISO 148-1:2016, *Metallic materials – Charpy pendulum impact test – Part 1: Test method*

ISO 179-1:2010, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 180:2019, *Plastics – Determination of Izod impact strength*

ISO 6508-1: *Metallic materials – Rockwell hardness test – Part 1: Test method*

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

3.1 General

3.1.1
air flow continuity
uninterrupted flow of air

3.1.2
air flow rate
flow rate, in standard litres per minute, based upon mass flow to be calculated at the standard temperature and pressure (STP)

Note 1 to entry: Referenced at a temperature of 15 °C (288,15 K, 59°F) and an absolute pressure of 101,325 kPa (1,013 25 bar, 1 standard atmosphere (atm)).

Note 2 to entry: Based upon the Standard Temperature and Pressure defined by ISO 13443.

3.1.3
auto-drop detection sensor
function incorporated in the contact strip which initiates the pantograph automatic dropping device

Note 1 to entry: The tests specified in this document relate only to pantograph automatic dropping devices operated by air.

3.1.4
pantograph automatic dropping device
ADD
device intended to lower the pantograph automatically if it is damaged

Note 1 to entry: The damage can include the contact strip and pantograph head, and other parts of the pantograph.

[SOURCE: IEC 60050-811:2017, 811-32-22]

3.1.5
rated current, <of contract strip>
current value that the contact strip is designed to sustain in the expected lifetime of the contact strip without degradation under the specified operating and environmental conditions

3.1.6
shear strength
force which can be withstood without failure of carbon material or the retention between the wearing material and the integral carrier

3.2 Contact strip material

3.2.1
carbon contact strip
inclusive term for a metalized carbon or a plain carbon contact strip

3.2.2
plain carbon contact strip
hard carbon material, without added metal elements

Note 1 to entry: The material can contain additives, such as oil, wax or resin.

3.2.3
metalized carbon contact strip
strip composed of carbon and metal, which contains a metal content 65 % maximum by weight

Note 1 to entry: The material can contain additives and can be impregnated with oil, wax or resin.

3.2.4
metal contact strip
strip which is mainly composed of metal or metal alloy and the content of metal or metal alloy is more than 65

3.3 Contact strip construction

NOTE The designs described in 3.3 may or may not include any of the following:

– Auto-drop detection sensor;

– Integrated end horns;

– Arc protection for integral carrier; either with additional components or coatings or with the carbon enshrouding the supporting carrier.

3.3.1
bonded carbon contact strip
contact strip formed by a carbon contact strip permanently attached to an integral carrier by an adhesive

3.3.2
carrier, <of contact strip>
structure which supports the contact strip, but is not permanently attached to it, and is used as an interface to the base plate of the pantograph head or the mounting point of the pantograph

3.3.3
copper clad contact strip
carbon contact strip housed in a formed copper sheath, with copper on the leading and trailing faces extending from the base to the contact surface of the carbon

Note 1 to entry: Often referred to as a “Kasperowski” contact strip.

3.3.4
fitted carbon contact strip
contact strip formed by a carbon contact material permanently attached to an integral carrier without the application of adhesive or solder

Note 1 to entry: This includes, but is not exclusive to, designs with carbon crimped, rolled or pressed into a carrier.

3.3.5
integral carrier
structure which supports the contact strip, and is permanently attached to it, without any additional support between the contact strip and the base plate of the pantograph head or the mounting points of the pantograph

3.3.6
metal and carbon composite contact strip
contact strip formed by vertical layers of metal mixed with layers of carbon permanently attached to a carrier

3.3.7
self-supported
contact strip which does not need additional support between the mounting points used to interface the contact strip and the pantograph (see Figure 1)

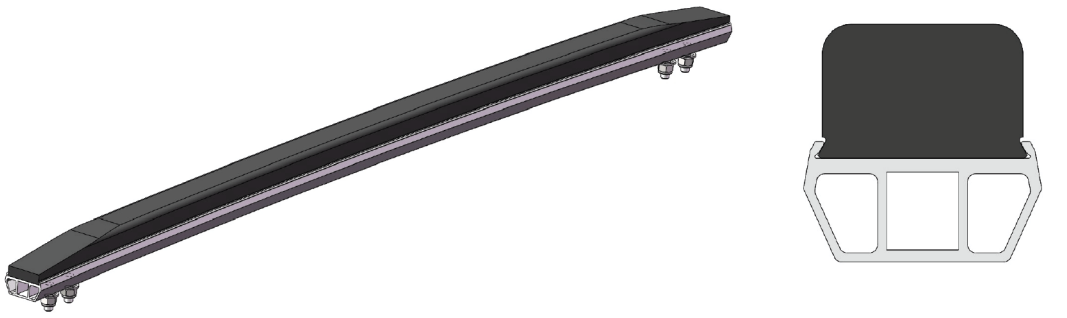
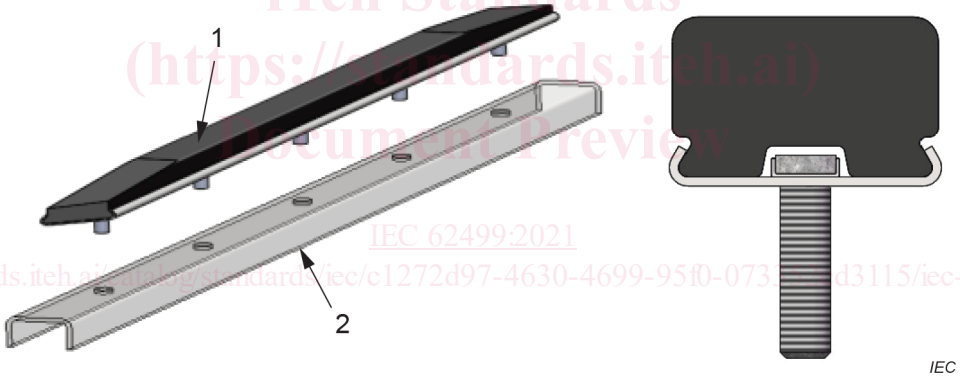


Figure 1 – Example of self-supported

3.3.8
soldered carbon contact strip
contact strip formed by a carbon contact strip permanently attached to an integral carrier by solder

3.3.9
un-supported
contact strip which requires mounting to an additional support structure (a carrier) before fitting to the pantograph (see Figure 2)



Key

1 contact strip

2 carrier (for example)

Figure 2 – Example of un-supported

3.3.10
bolted carbon contact strip
carbon contact strip which can be directly bolted to a carrier

4 Symbols and abbreviated terms

A	designed area of adhesion (mm^2)
F_s	shear force (N)
R	resistance (Ω)
T_s	shear strength (N/mm^2)
T_{cs}	maximum temperature of the contact strip at the interface between the carrier and the "wearing material" determined by test (see 7.1) (°C). The temperature is measured in the "wearing material" immediately adjacent to the interface.
T_{max}	the limit temperature at which the shear strength of the bond maintains a minimum value determined by test (see 7.4.3) (°C). (For bonded carbon contact trips). The temperature is measured in the carbon immediately adjacent to the interface.
W_{bi}	weight of the part before impregnation
W_{ai}	weight of the part after impregnation
AD_b	apparent density of the specimen before impregnation
AD_a	apparent density of the specimen after impregnation
Δh	vertical deflection in the middle of the contact strip (deflection upwards is positive)
Δl	change in length of the contact strip assembly (increase in length is positive)
F	test contact force (test 7.1.2)
A_1	initial cross-sectional area of the contact wire (mm^2)
A_2	cross-sectional area of contact wire after wear (mm^2)
h_1	initial height of the contact strip sample (mm)
h_2	height of the contact strip sample after wear (mm)
m_1	initial mass of the contact strip sample (g)
m_2	mass of contact strip sample after wear (g)
W_k	running distance (10^4 km)
n_{tpp}	the number of times pantograph passes through a contact wire (10^4 times)
W_h	height wear ratio ($mm/10^4$ km)
W_m	mass wear ratio ($g/10^4$ km)
W_a	area wear ratio ($mm^2/10^4$ times)
W_c	weight of the carbon powder
W_{me}	weight of the metal powder
μ	coefficient of friction

5 Requirements for data sheets

5.1 Data sheet and design drawing

The characteristics of the contact strip material should be provided in a data sheet and design drawing.

5.2 Contact strip material

The following information is an example:

a) manufacturer's grade designation;

b) hardness according to IEC 60413 or ISO 6508-1;

c) density according to IEC 60413;

d) flexural strength according to IEC 60413;

e) electric resistivity according to IEC 60413;

f) percentage of metal impregnation according to 7.8, with tolerance;

g) coefficient of friction according to 7.9;

h) material type e.g. plain carbon.

NOTE For metal contact strips information is provided according to alternative relevant standards.

5.3 Contact strip characteristics

The following information is an example:

a) contact strip construction as defined in 3.3 and Table 1;

b) data sheet and drawing reference numbers;

c) record of standard compliance and certification;

d) dimensions, tolerances and design drawings including specific requirements;

e) weight (new and fully worn) with tolerances;

NOTE 1 The worn weight, if provided, is an estimate based upon the service conditions.

f) designed rated current in operation;

NOTE 2 The designed rated current is defined by the manufacturer and customer, the manufacturer proves such currents.

g) wear limit;

NOTE 3 The method and the basis for deciding the wear limit is shown by the manufacturer.

h) value of T_{cs} determined by test 7.1;

i) value of T_{max} determined by test 7.4.3;

j) maximum and minimum operating pressure for use with a pantograph automatic dropping device;

k) air flow rate (in standard litres per minute) at minimum pressure for use with a pantograph automatic dropping device;

l) minimum air leakage flow rate (in standard litres per minute) at specified pressure corresponding to auto-drop operation;

NOTE 4 This parameter relates to IEC 60494-1:2013, 4.9. The value is given by the pantograph manufacturer to the carbon contact strip manufacturer to use in the test of the auto-drop detection shock impact function test set out in 7.5.5.

m) minimum air flow rate (in standard litres per minute) at specified pressure, for operation of auto-drop detection sensor.

NOTE 5 This parameter is defined to permit compliance with the time of 1 s mentioned in IEC 60494-1:2013, 6.2.5 for a specified pantograph. The value is given by the pantograph manufacturer to the carbon contact strip manufacturer to use in the air flow continuity test set out in 7.5.4.

6 Test categories and environmental conditions

6.1 General

There are two categories of tests:

- type tests;
- routine tests.

The above tests are described in 6.2 to 6.3.