
**Carbon fibre — Determination of
volume resistivity**

Fibres de carbone — Détermination de la résistivité transversale

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

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Carbon fibre — Determination of volume resistivity

1 Scope

This International Standard specifies two methods (i.e. method A and method B) for the determination of the volume resistivity of carbon fibre.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1889, *Reinforcement yarns — Determination of linear density*

ISO 10119, *Carbon fibre — Determination of density*

ISO 10548, *Carbon fibre — Determination of size content*

ISO 11567, *Carbon fibre — Determination of filament diameter and cross-sectional area*

3 Health and safety

This International Standard is limited to describing the determination of the volume resistivity of carbon fibre. The handling conditions of the test, specimens, apparatus and reagents used are intended to comply with the national regulations in force in each country, and the staff shall be informed of the hazards involved and appropriate precautions to be taken.

4 Principle

The volume resistivity is determined by the resistance of the material, and the length and a cross-section of the test specimen. The resistance and length of test specimen are measured. Method A specifies the determination of the volume resistivity for a single filament. The cross-section of single filament assumes that the cross-section of the test specimen is a true circle, and it is calculated from the diameter of the test specimen. Method B specifies the determination of the volume resistivity for a strand of fibres. The cross-section of the strand is calculated from the density and linear density of the test specimen.

5 Method A — Test method for single filament

5.1 Apparatus

5.1.1 **Length meter**, accurate to 0,1 mm.

5.1.2 **DC resistance meter**, with a precision of 0,5 % or higher.

5.2 Test specimen

5.2.1 Take a 40-mm to 50-mm length of filament yarn from the sample and open out the yarn structure. Pick out single filaments, one by one, for use as test specimens.

5.2.2 Stretch a single filament along the centreline of the mounting tab/template (see key item 1 of [Figure 1](#)) as shown in [Figure 1](#), and affix at the two end points of the window cut-out using conductive

adhesive (see key item 3 of [Figure 1](#)). Simultaneously, affix a copper wire together with the test specimen using the conductive adhesive to be used as a lead wire. Prepare at least three test specimens.

NOTE The mounting template is cardboard of approximately 0,3 mm in thickness. A hole of $(25 \pm 0,5)$ mm in length is punched or cut out.

Dry the adhesive completely, as the measured resistance can be unstable due to any remaining solvent in the conductive adhesive.

5.3 Procedure

5.3.1 Using a length meter (accurate to the nearest 0,1 mm) measure the distance of the stretched fibre between the two points of contact of the conductive adhesive on the test specimen, which is attached to the mounting tab. Make this length the gauge length for measuring the resistance.

5.3.2 Measure the resistance of the test specimen using the resistance meter.

5.3.3 Calculate the volume resistivity, S_f , according to Formula (1):

$$S_f = \frac{\pi D^2 R_f}{4L_f} \times 10^{-9} \quad (1)$$

where

S_f is the volume resistivity ($\Omega \cdot m$);

R_f is the resistance of the test specimen (Ω);

L_f is the gauge length of the test specimen (mm);

D is the diameter of the test specimen (mm) (specified in ISO 11567).

6 Method B — Test method for strand

6.1 Apparatus

6.1.1 Length meter, accurate to 0,1 mm.

6.1.2 DC resistance meter, with precision of 0,5 % or higher.

6.1.3 Electrode, copper plate with a clean and flat surface (see [Figure 2](#)).

6.2 Test specimen

6.2.1 Take the test specimen from the bundle of fibre. Prepare three test specimens, at least.

6.2.2 Where there is a large amount of water or sizing, which might influence the result, a pretreatment, such as drying the test specimen or size removal, in accordance with ISO 10548, is necessary.

6.3 Procedure

6.3.1 Set two electrodes 50 mm to 2 000 mm apart on an insulating board, and measure the distance between the electrodes to the nearest 1 mm (see [Figure 2](#)). An example of an electrode is shown in [Figure 2](#).

6.3.2 Fix one end of a test specimen to one electrode and the other end to the other electrode, taking care to avoid sagging of the test specimen.

6.3.3 Attach the resistance meter across the two electrodes, as shown in [Figure 2](#). Withn approximately 30 s of turning the meter on, read the resistance between the two electrodes.

6.3.4 Calculate the volume resistivity, S_s , according to Formula (2):

$$S_s = \frac{R_s}{L_s} \times \frac{T_s}{\rho} \times 10^{-6} \quad (2)$$

where

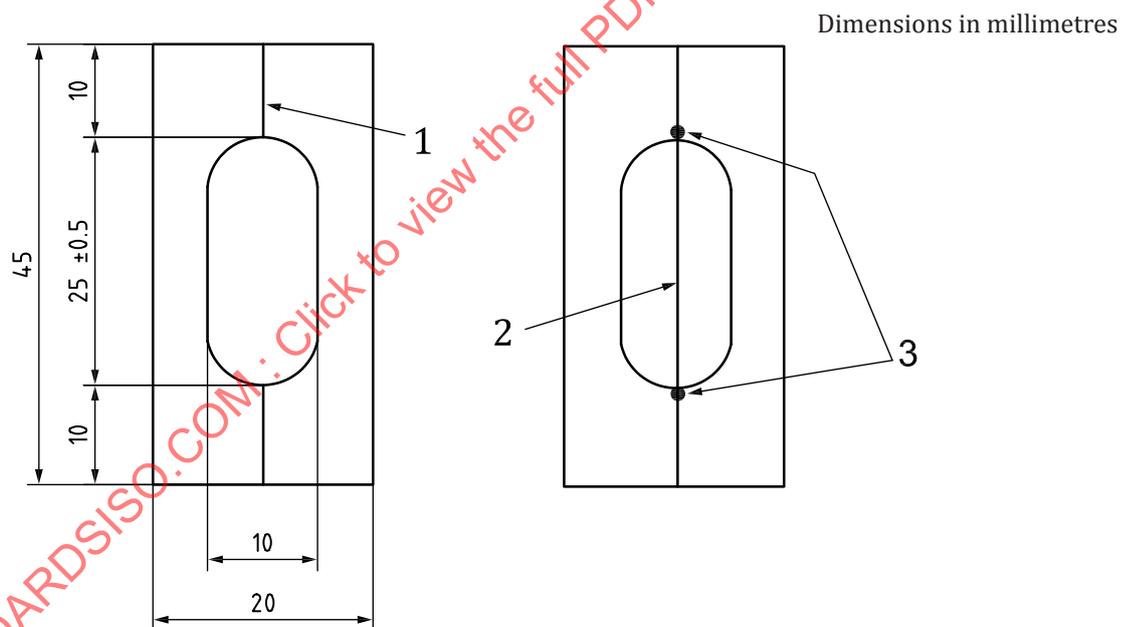
S_s is the volume resistivity ($\Omega \cdot \text{m}$);

R_s is the resistance of the test specimen (Ω);

L_s is the length of the test specimen (mm);

T_s is the linear density of strand (tex) (specified in ISO 1889);

ρ is the density of strand (g/cm^3) (specified in ISO 10119).

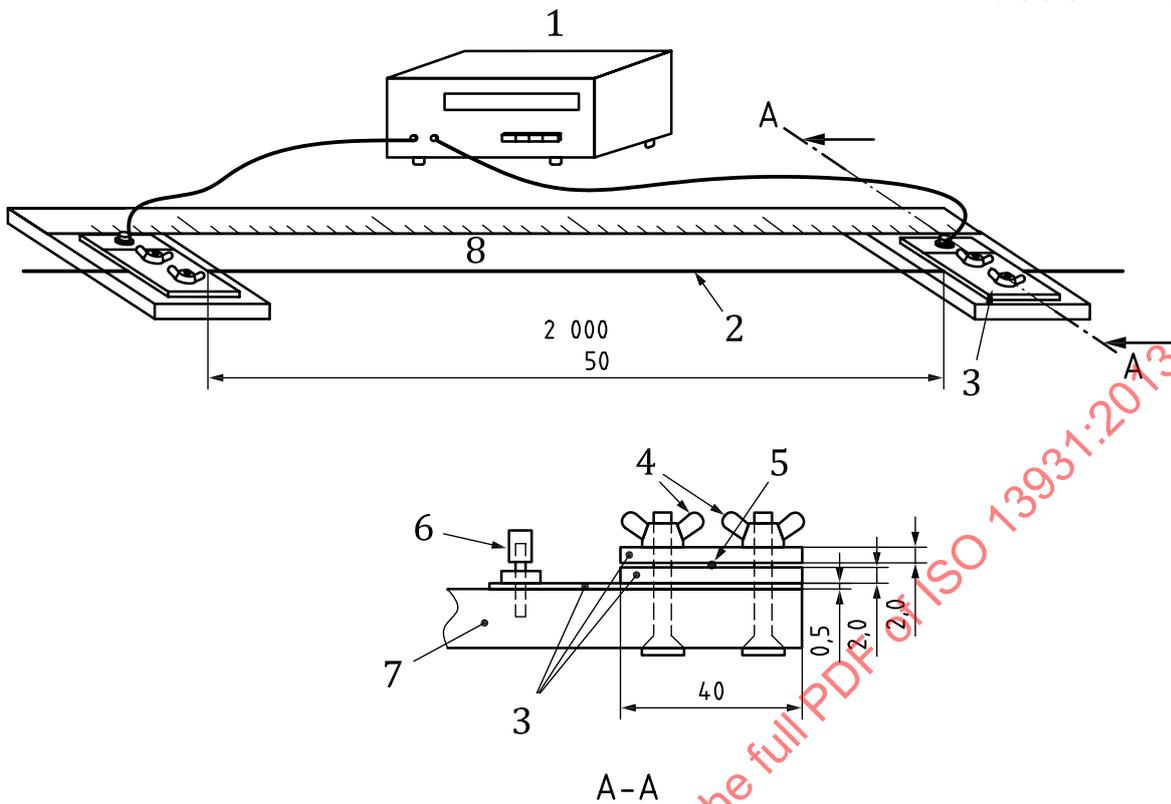


Key

- 1 centreline of the mounting template
- 2 test specimen (single fibre)
- 3 conductive adhesive

Figure 1 — Mounting tab for method A (for single filament)

Dimensions in millimetres



Key

- 1 resistance meter
- 2 test specimen
- 3 electrode (copper)
- 4 fastening nut
- 5 test sample
- 6 terminal
- 7 insulating board
- 8 length meter

Figure 2 — Apparatus for method B (for strand)

7 Test report

The test report shall include the following information;

- a) a reference to this International Standard, i.e. ISO 13931, indicating the method used (i.e. method A or B);
- b) complete identification of the material tested, including type, source, manufacturer's code number and previous history, where these are known;
- c) date of test;
- d) number of test specimens tested;
- e) dimension of the test specimens;
- f) temperature, humidity and time for conditioning of test specimens;