
**Road vehicles — Safety glazing
materials — Test methods for
properties of electrically heated
glazing**

*Véhicules routiers — Vitrages de sécurité — Méthodes d'essai pour les
propriétés des vitrages chauffés électriquement*

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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 (see 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 (see 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.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#).

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 35, *Lighting and visibility*.

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Road vehicles — Safety glazing materials — Test methods for properties of electrically heated glazing

1 Scope

This International Standard provides the test methods and acceptance criteria for circuit continuity and heating power, driving visibility, electrical attachment bond performance, electrical attachment bending performance, hot spot identification and heating uniformity, defrosting efficiency, high voltage durability, low temperature performance and long term humidity durability, for all electrically heated safety glazing materials in a road vehicle. This International Standard provides test protocols for the static performance of an electrically heated glazing material; it is not representative of in-vehicle performance.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for 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 3538, *Road vehicles — Safety glazing materials — Test methods for optical properties*

IEC 60051-2, *Direct acting indicating analogue electrical measuring instruments and their accessories, Part 2 — Special requirements for ammeters and voltmeters*

3 Terms and definitions

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

3.1

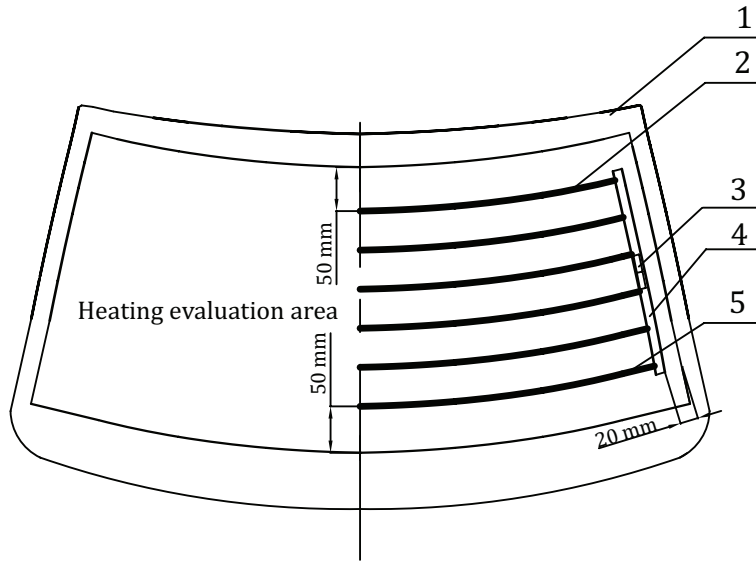
heating evaluation area

for *Type 1* (3.7), represented by an area formed by outermost conductors at an extended distance of 20 mm wider than the bus bars (along the edges) and extended to 50 mm on both the top and bottom, in the absence of specific requirements and for a glazing equipped with heating circuits formed by evenly distanced conductive lines and bus bars near to the glass edges

Note 1 to entry: If the extended distance is over the edge of the glass, then take the glass edge as the border of evaluation area. The size of this generated area is calculated using CAD, see [Figure 1](#). For other specifically designed heaters with e.g. circular shaped heater, product specification can be referenced for the heating evaluation area.

for *Type 2* (3.8) and *Type 3* (3.9), shall be the same as the area of the heating elements themselves, in the absence of special requirements

Note 2 to entry: No additional area shall be included.



Key

- 1 glass
- 2 heating circuits
- 3 electrical attachment
- 4 bus bar
- 5 outmost conductor

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Figure 1 — Heating evaluation area of Type 1

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3.2 electrical attachment

components used for connecting to the vehicle power supply

3.3 defrosting

elimination of frost from the exterior of the glazing by heating at specified voltage

3.4 melted area

area of the outer glazed surface of the sample having a dry surface or covered with melted frost

Note 1 to entry: Partially melted area is excluded. The melted area shall be determined visually.

3.5 defrosting efficiency

ratio of the melted area to the heating evaluation area after supplying specified voltage for the specified period of time at specified ambient condition

3.6 hot spot

any area on outer surface of the whole part that exceeds the maximum temperature defined in the product specification after the part is supplied with specified voltage for the specified heating time period at the specified ambient condition

3.7 Type 1

heater circuit consisting of conductors applied to the inside surface of a tempered or laminated safety glass or a plastic safety glazing parts by means of a screen print, ink jet, or other method

3.8**Type 2**

heater circuit consisting of discrete conductor lines applied to the inside of a laminated safety glazing by incorporation of metal wires or any other suitable method

3.9**Type 3**

heater circuit utilizing a transparent conductive film applied to one of the inner surfaces of a laminated safety glazing

4 Specimens

Test specimens can be production parts or test pieces which are upon the agreement between glass manufacturer and its customer.

5 Conditioning of test specimens

Unless otherwise specified, specimens to be tested shall be conditioned prior to testing under the following conditions for at least 4 h:

- ambient temperature: $23\text{ °C} \pm 2\text{ °C}$;
- atmospheric pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar);
- ambient relative humidity: $60\% \pm 20\%$.

6 Application of test

For certain types of safety glazing material, some of the tests specified in this International Standard are not appropriate to be applied. Test items and number of test specimens for a certain type of electrically heating glazing are suggested in [Table 1](#).

Table 1 — Test items and number of test specimens

No.	Test item	Subclause	Type			Number of specimens
			1	2	3	
1	Circuit continuity and heating power	7.1	X	X	X	3
2	Driving visibility	7.2	X	X	X	1
3	Electrical attachment bond performance	7.3	X	X	X	3
4	Electrical attachment bending performance	7.4	X	—	—	3
5	Hot spot identification and heating uniformity	7.5	X	X	X	1
6	Defrosting efficiency	7.6	X	X	X	1
7	High voltage durability	7.7	X	X	X	3
8	Low temperature performance	7.8	—	X	X	3
9	Long term humidity durability	7.9	X	X	X	3
X Test required. — Test needs not to be carried out.						

7 Requirements

7.1 Circuit continuity and heating power

7.1.1 Purpose of test

The purpose of this test is to determine whether the heating system circuit has the correct continuity between elements and heating power conforms to the product specification.

7.1.2 Apparatus

7.1.2.1 Variable direct current (DC) power supply, rated at a minimum of two times the voltage and two times the current specified for the parts to be tested.

7.1.2.2 Voltage meter, conforming to IEC 60051-2, with an Accuracy Class of 1.

7.1.2.3 Ampere meter, conforming to IEC 60051-2, with an Accuracy Class of 1.

7.1.2.4 Heat sensitive paper.

7.1.2.5 Projector, conforming to ISO 3538.

7.1.2.6 Thermal camera, with range of 0 °C to 100 °C, accuracy of $\pm 0,5$ °C, capable of measuring and recording surface of the tested area with a spatial resolution of 2 mm. The thermal camera emissivity can be adjusted to a level appropriate to glass substrate.

7.1.3 Procedure

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7.1.3.1 Circuit continuity

For Type 1 parts, supply the voltage defined in product specification to the electrical attachments of the part. Lay heat sensitive paper across the heating line/conductor. Optionally, use a thermal camera to check the part after power is supplied.

For Type 2 parts, supply the voltage defined in product specification to the electrical attachments of the part. Set the part vertically between the projector and a display screen. Light is projected through the part to the display screen. Wires with light shadow on the screen are broken wires.

For Type 3 parts, supply the voltage defined in product specification to the electrical attachments of the part, record value of ampere meter.

7.1.3.2 Heating power

In the absence of special requirements, heat the part for 30 min, and read the electrical current value shown on the ampere meter.

7.1.4 Expression of results

7.1.4.1 Circuit continuity

For Type 1 parts, check the colour change in the paper or in thermal camera due to heat. Make record of broken heating line/conductor.

For Type 2 parts, check the shadow of the part on the screen. Make record of broken wire position on the part.

For Type 3 parts, calculate the resistance according to the voltage measured at the attachments and the corresponding current as measured in [7.1.3.2](#), and determine the continuity.

7.1.4.2 Heating power

Calculate the heating power as the product of the voltage measured at the electrical attachments and the corresponding current measured in [7.1.3.2](#).

7.2 Driving visibility

7.2.1 Purpose of test

The purpose of this test is to determine whether driving visibility of the heated glass meets the requirements of the product specification.

This test is applicable only for parts whose transparent area is heated.

7.2.2 Apparatus

7.2.2.1 Steel ruler and reading microscope, with respective accuracy of 0,5 mm and 0,001 mm.

7.2.3 Procedure

For Type 1 parts, measure the width and length of heating lines/conductors, and the distance between two adjacent lines/conductors.

For Type 2 parts, measure the wire width or diameter, and calculate the number of wires per centimetre in cross direction.

For Type 3 parts, measure luminous light transmittance according to ISO 3538.

Regardless of the heating conductor type, all parts used as windscreen shall also have secondary image and optical distortion measured according to ISO 3538 while specified voltage being applied.

7.2.4 Expression of results

For Type 1 part, the driving visibility is expressed as the maximum width of conductors, minimum distance between two adjacent conductors, and the ratio of the total opaque wires area to heating evaluation area.

For Type 2 part, driving visibility is expressed as the width or diameter of wire and wire density (wires/cm).

For Type 3 part, driving visibility is expressed as the luminous light transmittance according to ISO 3538.

All windscreen parts shall have the levels of optical distortion and secondary image recorded while the specified voltage is applied.

7.3 Electrical attachment bond performance

7.3.1 Purpose of test

The purpose of this test is to determine whether the electrical attachments meet the requirements of the product specification after being subjected to mechanical forces.

7.3.2 Apparatus

7.3.2.1 Force meter with accuracy of 0,1 N.