BS ISO 16525-8:2014

BSI Standards Publication

# Adhesives — Test methods for isotropic electrically conductive adhesives

## Part 8: Electrochemical-migration test methods

**National foreword**

This British Standard is the UK implementation of ISO 16525-8:2014.

The UK participation in its preparation was entrusted to Technical Committee PRI/52, Adhesives.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.



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INTERNATIONAL STANDARD

**ISO 16525-8**

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# Adhesives — Test methods for isotropic electrically conductive adhesives —

## Part 8: Electrochemical-migration test methods

*Adhésifs — Méthodes d'essai pour adhésifs à conductivité électrique isotrope —*

*Partie 8: Méthodes d'essai de migration électrochimique*

Reference number
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# Contents

Page

# Foreword

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The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products.*

ISO 16525 consists of the following parts, under the general title *Adhesives — Test methods for isotropic electrically conductive adhesives*:

— *Part 1: General test methods*

— *Part 2: Determination of electrical characteristics*

— *Part 3: Determination of heat transfer properties*

— *Part 4: Determination of shear strength and electrical resistance using rigid-to-rigid bonded assemblies*

— *Part 5: Determination of shear fatigue*

— *Part 6: Determination of pendulum-type shear impact*

— *Part 7: Environmental test methods*

— *Part 8: Electrochemical-migration test methods*

— *Part 9: Determination of high-speed signal-transmission characteristics*

**INTERNATIONAL STANDARD** **ISO 16525-8:2014(E)**

# Adhesives — Test methods for isotropic electrically conductive adhesives —

## Part 8: Electrochemical-migration test methods

**SAFETY STATEMENT — Persons using this part of ISO 16525 should be familiar with normal laboratory practice. This part of ISO 16525 does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory conditions.**

**IMPORTANT — Certain procedures specified in this part of ISO 16525 might involve the use or generation of substances, or the generation of waste, that could constitute a local environmental hazard. Reference should be made to appropriate documentation on safe handling and disposal after use.**

## 1 Scope

This part of ISO 16525 specifies test methods for confirming the occurrence of electrochemical migration in electrically isotropic conductive adhesives at high-temperature and humidity. The electrical resistance is also determined.

## 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 472, *Plastics — Vocabulary*

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 9455-17, *Soft soldering fluxes — Test methods — Part 17: Surface insulation resistance comb test and electrochemical migration test of flux residues*

IEC 60068-2-67, *Environmental testing — Part 2: Tests — Test Cy: Damp heat, steady state, accelerated test primarily intended for components*

IEC 61249-2-7, *Materials for printed boards and other interconnecting structures — Part 2-7: Reinforced base materials clad and unclad — Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and ISO 9455-17 and the following apply.

**3.1**
**electrochemical migration**
electrochemical failure that occurs when voltage is applied between electrodes using electrically isotropic conductive adhesives where there is moisture and when, through migration and cathodic deposition, the electrodes dissolve, resulting in a short-circuit

Note 1 to entry: It is accelerated by temperature, humidity, and voltage.

**3.2**
**comb-pattern electrode**
comb-pattern test circuit formed on a printed circuit board

## 4 Principle

Comb-pattern electrodes that are formed on a printed circuit board using an electrically isotropic conductive adhesive are exposed to high humidity and voltage is applied between them to check the occurrence of electrochemical migration. To evaluate the occurrence of electrochemical migration, leak currents between the electrodes are measured and changes in insulation resistance recorded. The surface between the electrodes is observed using a microscope after the test to see whether or not electrochemical migration is present.

## 5 Apparatus and test circuit board

**5.1 High-resistance meter**, as specified in ISO 9455-17, able to measure high resistance in the range $10^6$ Ω–$10^{12}$ Ω with high precision. The range of voltage when measuring resistance is 10 V–100 V.

**5.2 DC power supply**, capable of generating DC voltage in the range 10 V–100 V with high precision.

**5.3 Humidity chamber**, capable of maintaining the specified temperature and humidity in an effective space. To maintain temperature and humidity uniformly, forced air circulation may be used.

**5.4 Microscope**, with magnification of from 50x to 250x and with a light that illuminates the specimen at a luminance of around 2 000 lx.

**5.5 Test coupon**, as follows.

a) **Material of substrate**

Glass fabric-based epoxy resin copper-clad laminate, specified as a general-purpose, single-sided substrate, in accordance with IEC 61249-2-7.

b) **Thickness of substrate**

1,6 ± 0,2 mm or the thickness specified in IEC 61249-2-7.

c) **Comb-pattern dimensions**

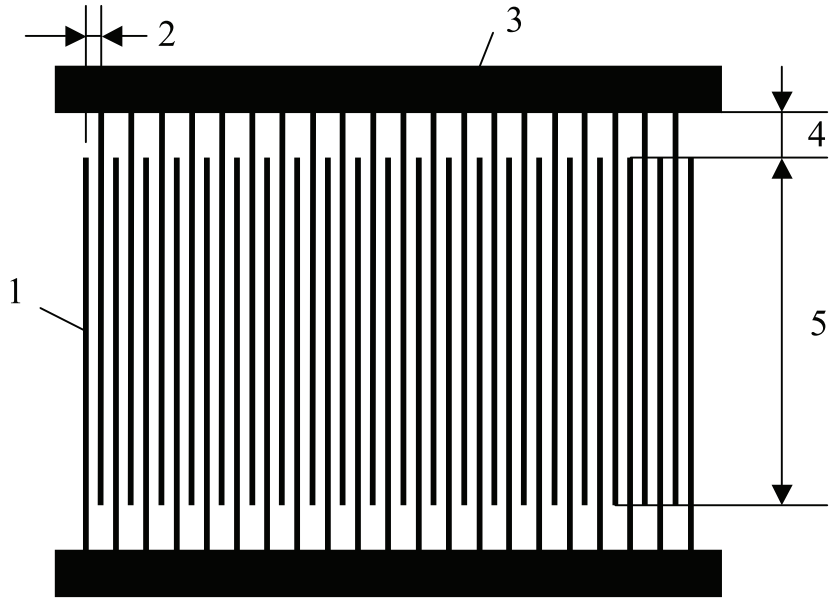
See Figure 1.

d) **Test coupon layout**

One or the other of the following (see Figure 2):

1) a copper pattern etched into the substrate surface in accordance with the specifications of conductor width;

2) a copper pattern etched into the terminal electrodes only.

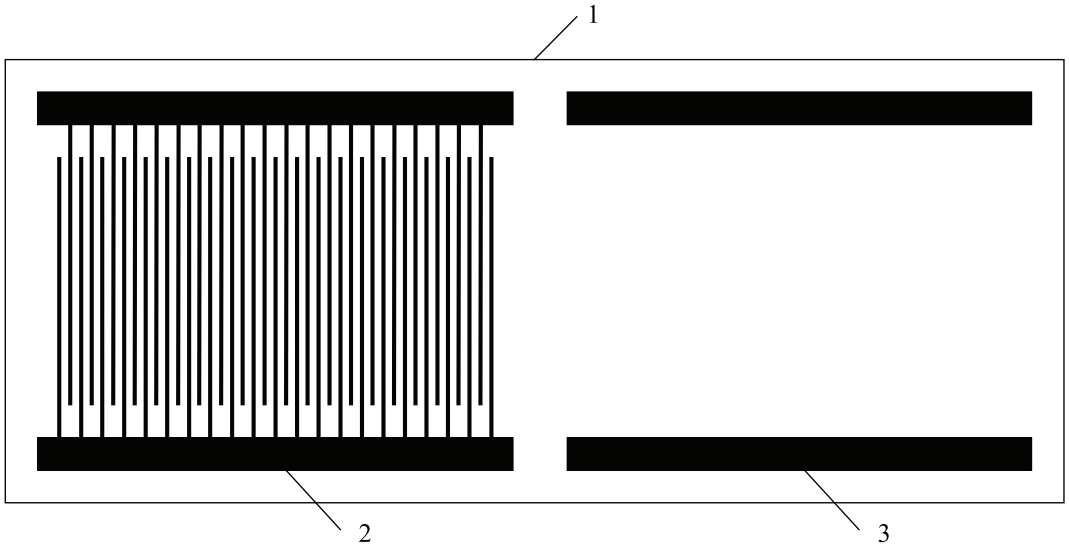



| Pattern | A | B |
|---|---|---|
| | mm | |
| CW (1) | 0,165 | 0,318 |
| CG (2) | 0,318 | |
| OC (5) | 15,75 | |
| *d* (4) | ≥5,0 | |

**Key**

| | | | |
|---|---|---|---|
| 1 | conductor width | 4 | distance between terminal electrodes |
| 2 | conductor gap | 5 | overlap of conductor |
| 3 | terminal electrodes | | |

**Figure 1 — Comb pattern of test coupon and stencil mask — Dimensions**




**Key**

1 test coupon (glass fabric-based epoxy resin)

2 etched copper pattern

3 etched only on the terminal electrodes

**Figure 2 — Test coupon layout**

## 5.1 Preparation of test coupon

The test coupon shall be prepared as follows.

a) Electrically isotropic conductive adhesive

In terms of general behaviour and processes, a paste-type electrically isotropic conductive adhesive containing an organic binder, in which metal particles or flakes disperse, shall be used. Generally, a heat-curing resin is used.

b) Printing and curing

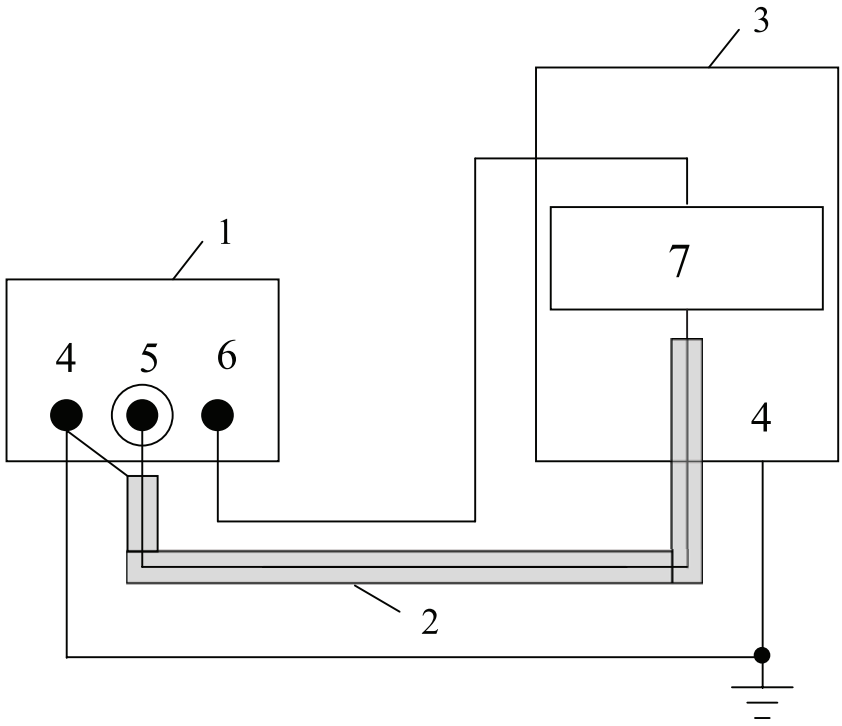
A comb pattern shall be formed by screen-printing the isotropic conductive adhesive onto the substrate. Curing conditions depend on specifications of the electrically isotropic conductive adhesive.

c) Visual inspection

Visual inspection or microscopic inspection using a microscope shall be performed to check the presence of foreign matter and interelectrode bridge.

## 5.2 Measurement wiring

Figure 3 shows a diagram of measurement wiring. For conductors used to connect the test coupon to the high resistance meter, shielded cables shall be used. When wiring the test bath, a PTFE cable, which is unlikely to emit gas, shall be used. To connect the shielded cables to the electrode on the test circuit board, solder should preferably be used.




**Key**

| | | | |
|---|---|---|---|
| 1 | insulation-resistance meter | 5 | signal input |
| 2 | shield-type cable | 6 | voltage supply |
| 3 | humidity chamber | 7 | test coupon |
| 4 | guard (earth) | | |

**Figure 3 — Diagram of measurement wiring**

# 6 Test

## 6.1 Test conditions

The test conditions shall be those given in Table 1, unless otherwise specified in the product specifications, and shall be in accordance with ISO 9455-17 and IEC 60068-2-67.

**Table 1 — Test conditions**

| Test temperature<br>°C | Test humidity<br>% | Bias voltage<br>V/DC | Measuring voltage<br>V/DC | Duration<br>h |
|---|---|---|---|---|
| 85 ± 2 | $85^{+2}_{-3}$ | 50 | 50 | 1 000 |

## 6.2 Test procedure

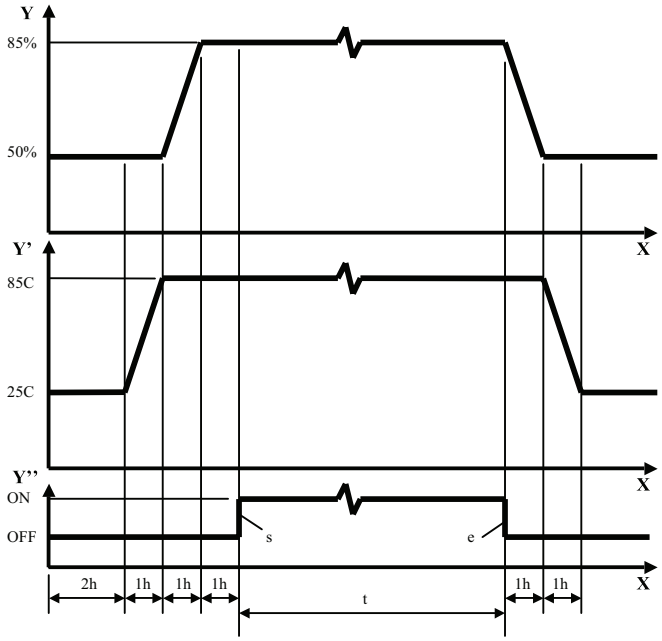
The test procedure is as follows:

a) **Initial measurement**

Visual inspection or microscopic inspection shall be used to check appearance; record the value of insulation resistance at a standard temperature of 25 ± 2 °C and standard humidity of 50 ± 5 % in accordance with ISO 291.

b) **Testing**

Place a test coupon in the test bath in accordance with 6.1 and apply bias voltage after temperature and humidity have reached the specified conditions from normal conditions, as shown in Figure 4.




**Key**

X time, h
Y relative humidity, % RH
Y′ temperature, °C
Y′′ bias voltage, V/DC
e end of test
s start of test
t duration (time)

**Figure 4 — Test profile**

c) **Intermediate measurement**

Measurement of insulation resistance may be performed during a test while the test coupon remains in the bath. In this instance, the method and interval of measurement shall be specified. The test coupon must not be taken out of the bath for measurement.

d) **Final measurement**

After measuring the insulation resistance in the bath, the temperature and humidity of the bath are allowed to return to normal conditions, and the test coupon is taken out of the bath. The visual inspection of the appearance coupon and/or microscopic inspection shall then be carried out, and the presence/absence of electrochemical migration recorded.

### 6.3 Judgment

The time at which insulation resistance of the test coupon was 10 MΩ or lower shall be judged, unless otherwise specified in the product specifications.

## 7 Test report

The test report shall include the following — some items may be selected from a) to h) upon agreement between the delivering and receiving parties:

a) brand name of the electrically isotropic conductive adhesive and its data, including the kinds of resin, filler material, manufacturer's code and lot number;

b) requirements of the test coupons, including material;

c) application and adhesive procedure of the electrically isotropic conductive adhesive, including curing time or setting time, temperature, and pressure of the adhesive procedure;

d) dimensions of the test coupons and comb-pattern electrode;

e) model number of the high resistance meter, DC power supply, and humidity chamber;

f) test conditions, including temperature, humidity, voltage, and duration time;

g) insulation resistance, down time, presence/absence of electrochemical migration after the test;

h) date, institution and atmospheric conditions of the test.

# Bibliography

[1] IEC 60068-2-1, *Environmental testing — Part 2-1: Tests — Test A: Cold*

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