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Soft soldering fluxes — Test methods —

Part 17: Surface insulation resistance comb test and electrochemical migration test of flux residues

Flux de brasage tendre — Méthodes d'essai —

Partie 17: Essai au peigne et essai de migration électrochimique de résistance d'isolement de surface des résidus de flux

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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).

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This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 12, *Soldering materials*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 9455-17:2002), which has been technically revised.

The main changes are as follows:

— in Clause 1 the applicability was clarified;

— in 6.5 the test coupon was aligned with IPC B53 from IEC 61189-5-501;

— in 9.5 the duration of the test was changed from 21 days to 1 000 h.

A list of all parts in the ISO 9455 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

Soft soldering fluxes — Test methods —

Part 17: Surface insulation resistance comb test and electrochemical migration test of flux residues

1 Scope

This document specifies a method of testing for deleterious effects that can arise from flux residues after soldering or tinning test coupons. The test is applicable to type 1 and type 2 fluxes, as specified in ISO 9454-1, in solid or liquid form, or in the form of flux-cored solder wire, solder preforms or solder paste constituted with eutectic or near-eutectic tin/lead (Sn/Pb) or Sn95,5Ag3Cu0,5 or other lead-free solders as agreed between user and supplier (see ISO 9453).

This test method is also applicable to fluxes for use with lead-containing and lead-free solders. However, the soldering temperatures can be adjusted with agreement between tester and customer.

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.

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 9454-1, *Soft soldering fluxes — Classification and requirements — Part 1: Classification, labelling and packaging*

IEC 61189-5-501, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies — Part 5-501: General test methods for materials and assemblies — Surface insulation resistance (SIR) testing of solder fluxes*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Principle

The objective of this test method is to characterize fluxes by determining the degradation of electrical resistance and the electrochemical migration of rigid printed wiring coupon specimens after exposure to the specified flux. This test is carried out at high humidity and heat conditions under bias voltage. For fluxes which can leave undesirable residues and hence require cleaning, the results obtained from the test will depend on the characteristics of the flux residue, substrate and metallization, and also on the effectiveness of the cleaning operation.

The measurement of surface insulation resistance (SIR) makes use of a printed wiring coupon substrate having one or more conductive interleaved test patterns. Prior to being subjected to conditioning, the interleaved test patterns are fluxed, soldered or tinned, and cleaned (when required). The patterns are then exposed to a controlled environment for a specified time with an applied voltage. The surface insulation resistance is measured using insulation test apparatus at a suitable test voltage while the test coupons are in the controlled environment. Annex A provides further information on SIR testing.

5 Reagents

Use only reagents of recognized analytical grade or higher and only distilled or deionized water with a conductivity of less than 0,05 µS/cm (resistivity ≥ 20 MΩ).

5.1 Propan-2-ol, (CH3)2CHOH or other suitable solvent.

5.2 Cleaning solvent (if required), recommended by the flux manufacturer as suitable for the removal of post-soldering flux residues or propan-2-ol.

6 Apparatus

Equipment shall be capable of demonstrating repeatability in accordance with the gauge r and R methodology specified in ISO 5725-2. The usual laboratory apparatus and, in particular, the following shall be used.

6.1 Low profile container, for example a Petri dish or a watch glass.

6.2 Drying oven, suitable for use at up to 120 °C ± 3 °C.

6.3 Insulated wire or cable, 1 000 V general-purpose wire, temperature rated to 150 °C; primary insulation of radiation-crosslinked; configuration suitable for equipment in use.

For consistent and repeatable results, it is important that all cabling carrying test signals be encased in an electromagnetic shield. Most often, this is a metallic foil or braid material. Since SIR measurement often deals with picoamperes of current or less, electromagnetic coupling (EMC) and other stray electrical fields can unduly affect the test signals. Encasing the signal lines with a grounded metal dramatically reduces currents due to EMC and other electrical noise. It is not necessary to individually shield each line, such as in coaxial cabling, but separating voltage supply lines and current-return lines is recommended. A single EMC shield can be used to encase all current-return lines.

6.4 Connector, 64-position, glass filled polyester body with the following properties:

- 1,27 mm × 10,67 mm (0,05 in × 0,42 in) on 2,54 mm (0,10 in) centres;
- 32 tabs, gold-plated over nickel plate over copper;
- 0,762 µm (0,000 03 in) gold plated post/pin mating end;
- bifurcated beam contacts;
- for coupon thickness of 1,40 mm to 1,78 mm (0,055 in to 0,070 in);
- capable of resisting temperatures up to 105 °C.

The IR (insulation resistance) of pin to pin at the connector shall have a resistance under climate and temperature conditions, with a minimum of 1 012 Ω under test conditions. The connector shall be suitable for use under different test conditions.

6.5 Test coupon. The test pattern IPC B53 according to IEC 61189-5-501, as shown in Figure 1, shall be used for the test specimen. Of the six comb patterns, A and B patterns have 0,4 mm line width and 0,2 mm spacing, comprising 5 207 squares (IEC 61189-5-501); C and D patterns have 0,4 mm line width and 0,5 mm spacing, comprising 1 038 squares (IPC B24); and E and F patterns have 0,318 mm line width and 0,318 mm spacing, comprising 1 981 squares (Bellcore).

NOTE The Bellcore/Telcordia standard assumes a serial model for electronic parts and it addresses failure rates at the infant mortality stage and at the steady-state stage with Methods I, II and III.[2,3] Method I is similar to the MIL-HDBK-217F parts count and part stress methods. [6]

The specimen is approximately 150 mm × 95 mm in size. The conductive patterns shall be either unpreserved bare copper or finished with electroless nickel gold (ENIG).

— 32 tabs, gold-plated over nickel plate over copper;

— 1,27 mm × 10,67 mm (0,05 in × 0,42 in) on 2,54 mm (0,10 in) centres.

The test pattern shall comply with Table 1 and the test coupon shall comply with Figure 1:

Table 1 — Test pattern

Type of SIR test patterns	A and B	C and D	E and F
Width of conductor	0,4 mm	0,4 mm	0,318 mm
Spacing of conductor	0,2 mm	0,5 mm	0,318 mm
Overlap length	25,4 mm	15,25 mm	15,75 mm
Overlapping spaces	41	34	40
Squares (nominal)	5 207	1 038	1 981

NOTE Spaces are determined by counting the number of overlapping areas per pattern. Squares are determined by:

$$\frac{l_o \times n_s}{w_s} = q$$

where

l_o length of overlap

n_s number of spaces

q squares

w_s spacing width

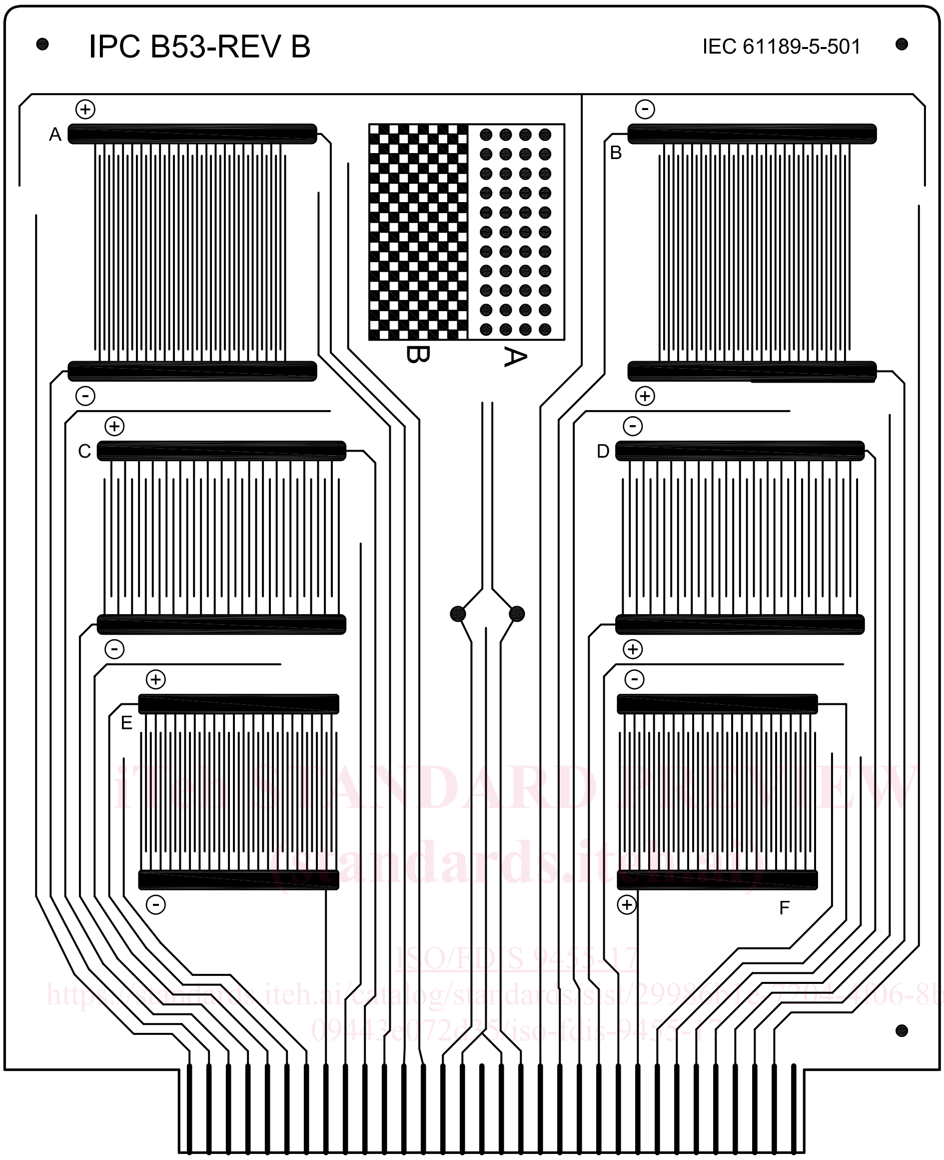

Figure 1 — Resistor verification coupon[1)]

6.6 Soldering equipment.

6.6.1 Flux-cored solder wire. If cabling is connected by soldering, non-activated flux of ISO 9454-1, classification 1111, shall be used, tin/lead or lead-free solder shall be agreed between user and supplier conforming to eutectic or near-eutectic tin/lead (S Sn60Pb40E or S Sn63Pb37) or lead-free solder (Sn95,5Ag3Cu0,5 or other lead-free solders as agreed between user and supplier, see ISO 9453).

NOTE This wire consists of 60/40 or 63/37 tin/lead solder wire or Sn96,5Ag3Cu0,5 or other lead-free solder wire agreed between user and supplier with a core of non-activated rosin (colophony) flux (ISO 9454-1, classification 1111).

6.6.2 Wave solder system, comprising a wave-soldering machine with the solder in a bath. Tin/lead or lead-free solder shall be agreed between user and supplier and conform to eutectic tin/lead

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(Sn63Pb37) or lead-free solder (Sn95,5Ag3Cu0,5 or other lead-free solders as agreed between user and supplier, see ISO 9453). The set point temperature shall be maintained to ±5 °C.

6.6.3 Static bath, containing solder to a depth of not less than 40 mm. Tin/lead or lead-free solder shall be agreed between user and supplier and conform to grade Sn63Pb37E or Sn96,5Ag3Cu0,5 or other lead-free solder agreed between user and supplier. The set point temperature shall be maintained to ±5 °C.

6.6.4 Reflow oven, with controllable temperature profiling.

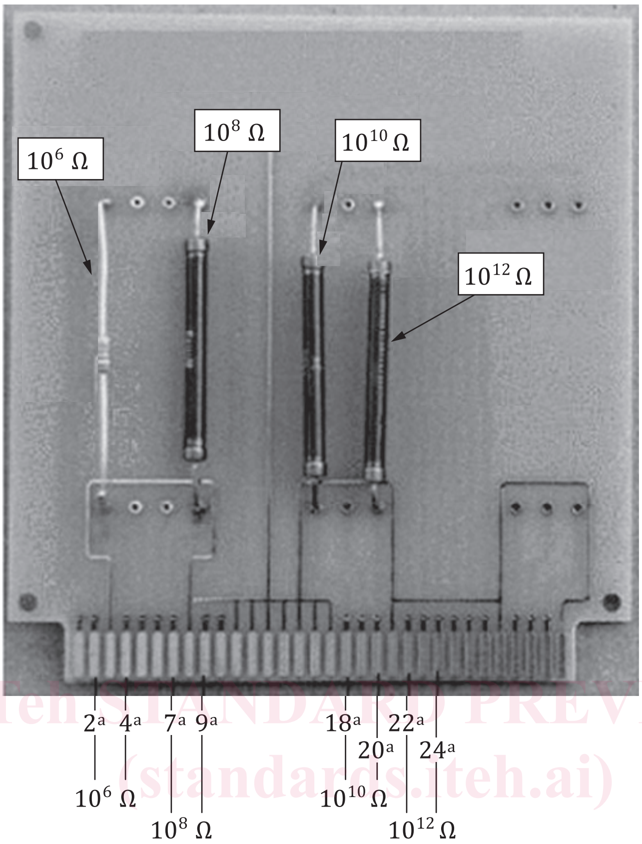
6.6.5 Soldering iron.

6.7 Humidity chamber, capable of maintaining environments up to 90 °C with temperature control of ±2 °C and relative humidity (RH) up to 95 % with control of ±3 % at a specific RH set point when loaded with test coupons. The chamber shall be constructed with stainless steel inner surfaces and be well insulated. Some solid-state sensors cannot tolerate high temperature and humidity. The temperature and humidity levels of the test chamber shall be recorded throughout the test, preferably with independent control sensors.

If used, independent temperature and humidity sensors should be located in close proximity to the test coupons. Conformance with these conditions will ensure that uniform test conditions can be maintained while the chamber is under test load.

6.8 High-resistance measurement system, capable of measuring surface insulation resistance (SIR) in the range of at least 10^6 Ω to 10^{12} Ω and with a test and bias voltage supply capable of providing a variable voltage from 5 V to 100 V direct current (d.c.) (±2 %) with a 1 MΩ load. The sample selection system shall be capable of individually selecting each test pattern under measurement. The system shall incorporate a 1 MΩ current limiting resistor in each current pathway. The tolerance of the total measurement system shall be ±5 % up to 10^{10} Ω, ±10 % between 10^{10} Ω to 10^{11} Ω, and ±20 % above 10^{11} Ω.

6.9 Resistor verification coupon, with the same dimensions as the test coupon, with four resistors with the values 10^6 Ω, 10^8 Ω, 10^{10} Ω and 10^{12} Ω in specific current pathways as shown on Figure 2. It shall have a protective metal (stainless steel) cover attached with stainless hardware to the grounded mounting holes on the coupon to protect the resistors from contamination or damage during handling (see Figure 3).



a Test coupon tab connectors.

Figure 2 — Resistor verification coupon

Figure 3 — Resistor verification board with protective cover

6.10 Soft bristle brush.

6.11 Scalpel, doctor blade or equivalent, cutting tool for solder wire.

6.12 Analytical balance, capable of measuring to an accuracy of 0,000 1 g, for solvent extract method.