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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 9455-17 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 12, *Soldering and brazing materials*.

ISO 9455 consists of the following parts, under the general title *Soft soldering fluxes — Test methods*:

— *Part 1: Determination of non-volatile matter, gravimetric method*

— *Part 2: Determination of non-volatile matter, ebulliometric method*

— *Part 3: Determination of acid value, potentiometric and visual titration methods*

— *Part 5: Copper mirror test*

— *Part 6: Determination and detection of halide (excluding fluoride) content*

— *Part 8: Determination of zinc content*

— *Part 9: Determination of ammonia content*

— *Part 10: Flux efficacy tests, solder spread method*

— *Part 11: Solubility of flux residues*

— *Part 12: Steel tube corrosion test*

— *Part 13: Determination of flux spattering*

— *Part 14: Assessment of tackiness of flux residues*

— *Part 15: Copper corrosion test*

— *Part 16: Flux efficacy tests, wetting balance method*

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

Soft soldering fluxes — Test methods —

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

1 Scope

This part of ISO 9455 specifies a method of testing for deleterious effects that may 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) solders (ISO 9453:1990, Class E).

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

2 Normative references

The following referenced documents are indispensable for the application 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 9453:1990, *Soft solder alloys — Chemical compositions and forms*

ISO 12224-1:1997, *Solder wire, solid and flux cored — Specification and test methods — Part 1: Classification and performance requirements*

IEC 61249-2-7:2002, *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*

IEC 60068-2-20, *Environmental testing — Part 2: Tests — Test T: Soldering*

IPC-TM-650[1)], *Test Methods Manual (TM 2.6.3.3 Surface Insulation Resistance, Fluxes) (Test pattern IPC-B-24)*

3 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 may leave undesirable residues and hence require cleaning, the results obtained from the test will depend on the characteristics of the flux residue, substrate, metallization, and also on the effectiveness of the cleaning operation.

1) Obtainable from: IPC, 2215 Sanders Road, Northbrook, IL, 60062-6135.

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.

4 Reagents

In the test use only reagents of recognized analytical grade or higher and only distilled, or deionized water, with a conductivity of less than 0,5 µS/cm (resistivity ⩾ 2 MΛ·cm).

4.1 Propan-2-ol, $(CH_3)_2CHOH$ or other suitable solvent.

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

5 Apparatus

Equipment shall be capable of demonstrating repeatability in accordance with the gauge r and R methodology specified in ISO 5725-2.

5.1 Low profile container, e.g. a Petri dish or a watch glass.

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

5.3 Insulated wire or cable, tin coated single copper conductor, 1 000 V general purpose wire, temperature rated to 150 °C; primary insulation of radiation-crosslinked, extruded polyalkene; primary jacket of radiation-crosslinked, extruded polyvinylidene fluoride; configuration suitable for equipment in use.

5.4 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 withstanding temperatures up to 105 °C.

5.5 Test coupon, conforming to IPC B-24, specified in IPC-TM-650 (see Figure 1). It shall be single sided copper clad epoxide woven glass fabric laminate conforming to IEC 61249-2-7 with nominal thickness of 1,5 mm, clad copper foil with a nominal thickness of 18 µm. The final finish of the circuit conductors shall be bare copper (without preservative). This test substrate is referred to as the "test coupon" comprising four (4) "test patterns". The dimensions of the test coupon shall be 101,6 mm × 114,4 mm (4,0 in × 4,5 in). The connections of the test coupon (connectors with gold-to-gold mechanical contacts) shall be:

— 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 be:

— 0,4 mm (0,016 in) width

— 0,5 mm (0,020 in) spacing

— 15,25 mm (0,6 in) overlap

— 34 overlapping spaces

— 1 040 squares (nominal)

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

$$\frac{\text{length of overlap} \times \text{number of spaces}}{\text{spacing width}} \approx 1040 \text{ squares}$$

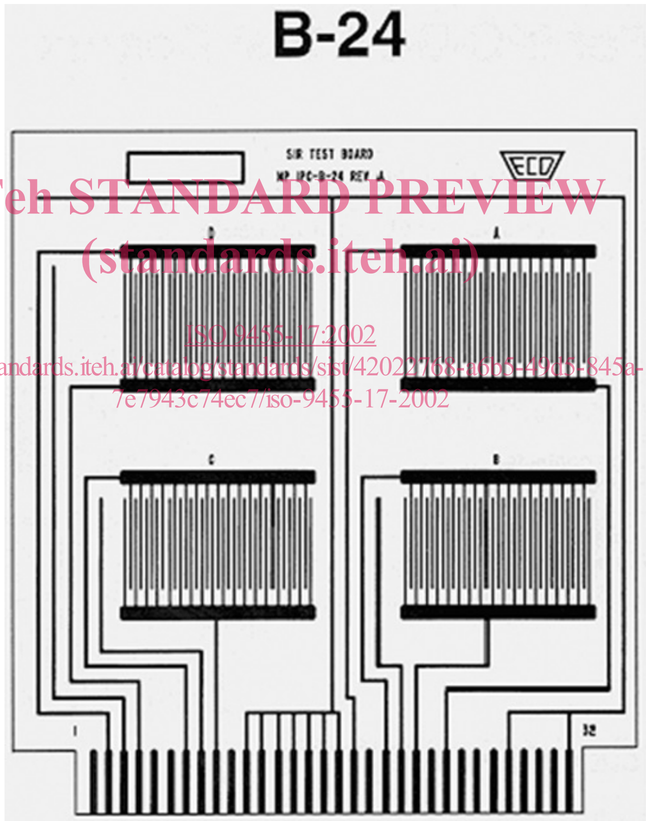


Figure 1 — Resistor verification coupon
(Reproduced with permission)

5.6 Soldering equipment.

5.6.1 Flux-cored solder wire, conforming to S-Sn60Pb40E/1.1.1 or S-Sn63Pb37E/1.1.1 of ISO 12224-1:1997.

NOTE This wire consists of 60/40 or 63/37 tin/lead solder wire with a core of non-activated rosin (colophony) flux (classification 1.1.1, non-activated of ISO 9454-1:1990).

5.6.2 Wave solder system, comprising a wave soldering machine where the solder in the bath shall conform to grade S-Sn63Pb37E of ISO 9453:1990. The set point temperature shall be maintained to ± 5 °C.

5.6.3 Static bath, containing solder to a depth of not less than 40 mm, conforming to grade S-Sn63Pb37E of ISO 9453:1990. The set point temperature shall be maintained to ± 5 °C.

5.6.4 Reflow oven, with controllable temperature profiling.

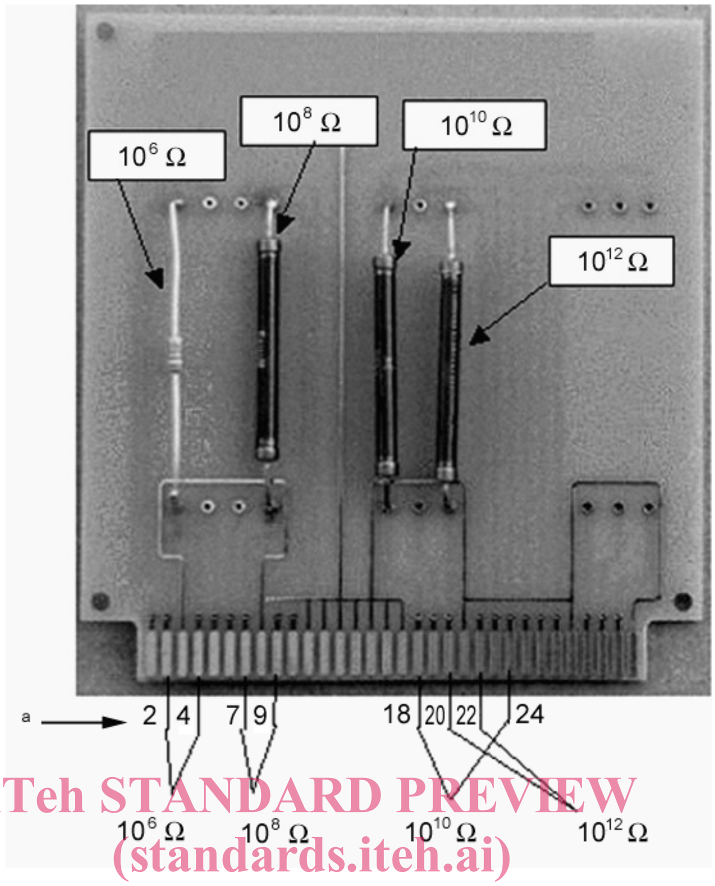
5.6.5 Soldering iron.

5.7 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.

NOTE 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.

5.8 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 10 V to 100 V dc (± 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.

5.9 Resistor verification coupon, with the same dimensions as the test coupon with one each 10^6, 10^8, 10^{10} and 10^{12} Ω resistors 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

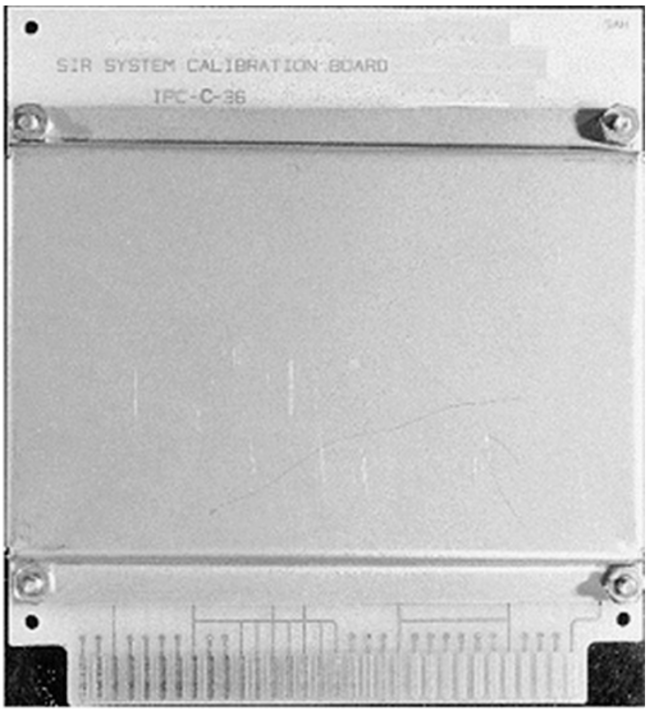


Figure 3 — Resistor verification board with protective cover

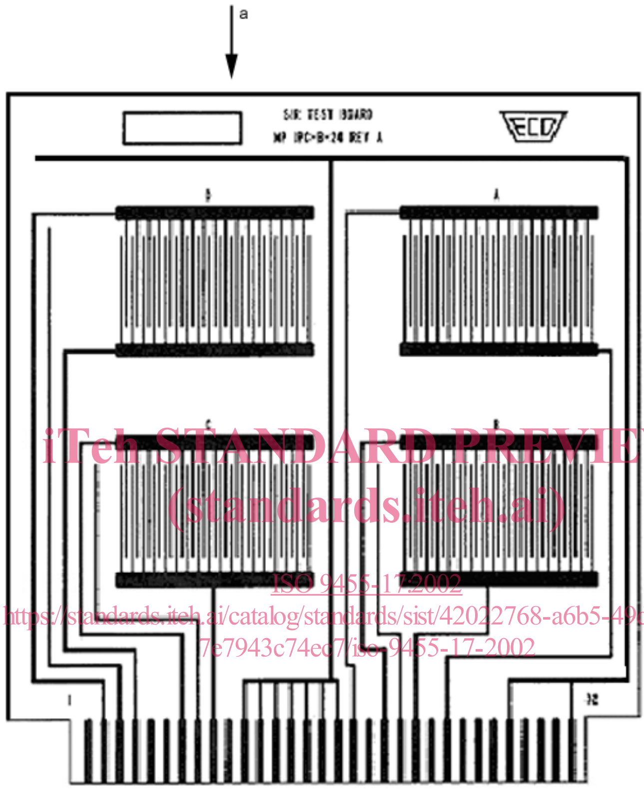
5.10 Soft bristle brush.

5.11 Scapel, doctor blade or equivalent.

5.12 Analytical balance, capable of measuring to an accuracy of 0,000 1 g.

5.13 Test coupon fixing device, capable of uniformly spacing coupons (minimum of 15 mm), parallel to air flow with the connector (if present), in accordance with Figure 4.

5.14 Soxhlet extraction apparatus.



[a] Air flow

Figure 4 — IPC-B-24 test coupon location with respect to chamber air flow

6 Inspection of test coupons

6.1 Surface plating

6.1.1 Slivering (thin metal overhang on etch runs)

There shall be no slivering on test coupons since the slivers are prone to breaking off with the associated possibility of creating electrical short circuits during SIR testing.

NOTE Slivering is a condition associated with surface plating or etching.

6.1.2 Plating nodules

Plating nodules on the edges of etch runs shall be kept to a minimum and in no case shall nodules violate minimum conductor design electrical spacing requirements. Nodules, if present, shall not be loose and flake on to the laminate substrate.

6.1.3 Plating pits

All conductors and plated-through lands shall be free of plating pits.

Gold plated card edge connector pads shall be free of plating pits that expose copper or nickel.

6.2 Surface laminate

Measles or crazing of the bare printed coupon, if present, shall not exceed 1 % of the coupon area. There shall be no more than 25 % reduction in space between electrically uncommon conductors due to measling or crazing. A separate determination shall be made for each side of the coupon.

NOTE 1 The area of measling or crazing is determined by combining the area of each measle or craze and dividing by the total area of the printed coupon.

NOTE 2 The referee test (destructive) to determine propagation of measling or crazing is to pre-condition the test coupon and then solder-float the specimen on a solder bath at a temperature of (260 ± 5) °C (500 ± 10) °F for a period of 5 s.

Total measling or crazing of the assembled test coupon shall not exceed 2 % of the test coupon area. There shall be no more than a 50 % reduction in the space between electrically uncommon conductors.

NOTE 3 The area of measling or crazing is determined by combining the area of each measle or craze and dividing by the total area of the printed coupon. A separate determination is made for each side of the coupon.

Conductor edges, if not smooth and even, shall be within design tolerances.

7 Sample preparation

7.1 Preparation of the flux test solution

7.1.1 Liquid flux samples

Use liquid flux samples, as received (i.e. unmodified), as the flux test solution.

7.1.2 Solid flux samples

Prepare a solution of the solid flux sample in accordance with the flux manufacturer's instructions.

7.1.3 Flux cored solder wire or preform samples

If a sample of the flux used in the cored solder wire or preform is not available from the flux manufacturer, then use the following method to prepare samples.

Cut a length of the flux cored solder wire or preform, weighing approximately 150 g and seal the ends by crimping. Wipe the surface clean with a cloth moistened with propan-2-ol (4.1). Place the sample in a beaker, add sufficient water to cover the sample, and boil for 5 min to 6 min. Remove the sample, rinse it with propan-2-ol and allow to dry.

Protecting the solder surface from contamination, cut the sample into 3 mm to 5 mm lengths, using a scalpel (5.11) and avoid crimping the cut ends. Weigh and place the cut segments into the extraction tube of a clean