7.6 Marking of live supply connections

Where it is necessary to mark and identify live supply connections, the following system shall be used unless otherwise specified in an individual Approval and test specification:

(a) For active connections, any marking or abbreviation which clearly indicates the intent.

(b) For neutral connections, N (or Neutral).

In any equipment, marking as above shall not be used other than to indicate live connections.

7.7 Additional marking of multi-rated equipment

Where an equipment is provided with facilities for supply by flexible cord and plug and is designed for conversion to a rating which exceeds that at which the equipment is initially intended to operate, the equipment shall be marked with the following information:

(a) Instructions which clearly indicate how the equipment is to be converted to any higher rating.

(b) Details for fitting the correct type of supply flexible cord and plug and the appropriate socket-outlet to be used for each rating which exceeds 10 A.

Such marking shall be legible and indelible, and shall be made either on the equipment itself or on a nameplate securely fixed thereto.

7.8 Equipment with type X, type Y and type Z attachments

The instructions shall contain the substance of the following:

(a) For equipment with Type X attachment having a specially prepared cord, if the supply cord is damaged, it shall be replaced by a special cord or assembly available from the manufacturer or its service agent.

(b) For equipment with Type Y attachment, if the supply cord is damaged, it shall be replaced by the manufacturer or its service agent or similarly qualified person in order to avoid a hazard.

(c) For equipment with Type Z attachment, the supply cord cannot be replaced. If the cord is damaged the equipment should be scrapped.

7.9 Legibility of marking

The marking required by Section 7 shall comply with Clause 8.13.

7.10 Instructions for installation and use

If it is necessary to take special precautions when installing or using equipment, details shall be given in an instruction sheet, which shall accompany the equipment.

SECTION 8: TESTS

8.1 General

In general, the tests specified in this Section shall be carried out on equipment as received.

A test of this Standard, or any individual Approval and test specification, that is not appropriate to any particular equipment because of the method of its construction or the technology of its design shall not be conducted. In such cases substitute tests may be considered to be appropriate.

In any equipment a component that is not depended upon for safety*, and the failure or malfunction of which would not introduce a hazard, need not be tested for compliance with any relevant Approval and test specification.

Where equipment is marked with a rated voltage of 230 V a.c. or a voltage range that includes 230 V a.c. for single phase equipment, the rated voltage is equal to 240 V a.c. in Australia and 230 V a.c. in New Zealand or the highest marked voltage which ever is greater.

Where equipment is marked with a rated voltage of 400 V a.c or a voltage range that includes 400 V a.c. for polyphase equipment, the rated voltage is equal to 415 V a.c. in Australia and 400 V a.c. in New Zealand or the highest marked voltage which ever is greater.

In all other cases, such tests shall be carried out at the highest marked voltage.

In Australia, for equipment other than class III equipment, that is intended for connection to the supply mains and that is not marked with an operating voltage of at least 240 V for single phase equipment and at least 415 V for three-phase equipment, for testing purposes the rating in amperes or loading in watts or volt-amperes is equal to:

a) the rated value, for accessories where the rating has been determined for operation at 240 V for single-phase equipment and 415 V for three-phase equipment, as appropriate.

b) the calculated value corresponding to 240 V for single-phase equipment and 415 V for three-phase equipment, as appropriate, in all other cases.

NOTE 1 Example of calculation for case b).

If the equipment is marked with an operating voltage of 230 V and a current rating in amperes "A" or a loading in watts "P" or a loading in volt-amperes "VA", it will be tested as if it is marked with an operating voltage of 240 V and a current rating in amperes of "A x (240/230)" or a loading in watts of "P x $(240/230)^2$ " or a loading in volt-amperes of "VA x $(240/230)^2$ "

The frequency of the test (supply) voltage shall be 50 Hz, unless the equipment is intended for operation at some other particular frequency.

If any equipment incorporates provision for adjustment of loading about any marked voltage, tests shall be conducted with the equipment adjusted so as to give maximum loading.

Where tests in this Standard or in any individual Approval and test specification are to be conducted with alternating current at a lagging power factor, the test circuit shall, unless otherwise specified, be a series circuit of an inductor and resistor.

NOTE 2 Where iron-cored inductors are used, the peak flux density under steady state conditions should not exceed half the value at the knee point of the magnetization curve of the iron. Where an air-cored inductor is used, it should be shunted with a resistor of a value that will pass 1% of the main circuit current.

The reference ambient temperature shall be 25 °C unless it is clear by virtue of the design, application or marking that the equipment will usually operate in an ambient temperature higher than 25°C, in which case it shall be 40 °C. Notwithstanding the foregoing, where an individual specification requires a test to be conducted under specified temperature conditions, or a particular reference ambient temperature is nominated, such temperatures shall apply in assessing the results of that test.

If a test failure occurs, and unless otherwise specified, a suitably modified sample shall be submitted to all tests which may be affected by the modification, and any other tests which may be affected by these repeat tests; all tests being carried out in the correct order. Where

———————

* For example, an air-break switch which is not intended as the principal means of opening the supply to the equipment or an independent portion thereof.

the submission of a suitably modified sample is not made, three additional samples shall be required to withstand all tests relevant to the failure.

If the test results are influenced by the temperature of the ambient air, the room temperature is, in general, maintained at 20 °C ± 5 °C. If, however, the temperature attained by any part is limited by a temperature-sensitive device, or is influenced by the temperature at which a change of state occurs, for example, the temperature of boiling water, the room temperature is, in case of doubt, maintained at 23 °C ± 2 °C.

NOTE 3 Any test to be conducted at 23 °C ± 2 °C, on small equipment, may be carried out in a controlled test chamber of adequate size.

8.2 Void

8.3 Insulation resistance and leakage current

8.3.1 Insulation resistance

Insulation resistance shall be measured with a d.c. voltage of approximately 500 V applied, the measurement being made 1 min after application of the voltage –

(a) between live parts and internal metal parts;

(b) between live parts and the case, frame, or exposed metal parts;

(c) between live parts and external metal parts;

(d) between live parts and a flexible electrode applied to non-conductive parts normally handled in service; and

(e) through supplementary insulation.

The insulation resistance so measured shall not be less than 1 MΩ between parts as detailed above in Items (a), (b) and (c) and not less than 10 MΩ in all other cases.

When performing the insulation resistance test on an accessory, any surge protection device, such as a varistor, may be disconnected during the test.

8.3.2 Leakage current test

The leakage current of equipment shall not be excessive when assessed according to the following test.

The leakage current is measured between any pole of the supply and accessible metal parts and metal foil having dimensions not exceeding 200 mm × 100 mm in contact with accessible surfaces of insulating material, connected together.

The connection diagram is shown in the following Figures.

(a) For single-phase equipment having a rated voltage not exceeding 250 V, for three-phase equipment to be tested as single-phase equipment and for heating equipment for d.c. only

  (i) if of Class II ..... Figure 8.3.2.1; or

  (ii) if other than Class II ..... Figure 8.3.2.2.

(b) For single-phase equipment having a rated voltage exceeding 250 V and for three-phase equipment not suitable for single-phase supply

  (i) if of Class II ..... Figure 8.3.2.3; or

  (ii) if other than Class II ..... Figure 8.3.2.4.

NOTE 1 See Figure 4 of AS/NZS 60990 for details of measuring circuits shown in the connection diagrams as C.

Single-phase equipment having a rated voltage exceeding 250 V are connected to two of the phase conductors.

The test is made with a.c. unless the equipment is for d.c. only, in which case the test is made with d.c. except that motor-operated equipment for d.c. only are not tested.

For single-phase equipment having a rated voltage not exceeding 250 V and for three-phase equipment to be tested as single-phase equipment, the leakage current is measured with the selector switch shown in Figures 8.3.2.1 and 8.3.2.2 in each of the positions 1 and 2.

For other equipment, the leakage current is measured with the switches 'a', 'b' and 'c', shown in Figures 8.3.2.3 and 8.3.2.4, closed; for three-phase equipment not suitable for single-phase supply the measurements are repeated with each of the switches 'a', 'b' and 'c' open in turn, the other two switches being closed; for single-phase equipment, the measurements are repeated with one of the switches open.

After the equipment has been operated until steady state conditions are established, the leakage current to accessible metal parts and metal foil shall not exceed the following values:

(a) For Class III equipment ..... 0.5 mA.

(b) For portable Class I equipment ..... 0.75 mA.

(c) For stationary Class I motor-operated equipment ..... 3.5 mA.

(d) For stationary Class I heating equipment with heating elements which are detachable or can be switched off separately ..... 0.75 mA or 0.75 mA per kW rated input for each element or group of elements, whichever is the greater, with a maximum of 5 mA for the equipment as a whole.

(e) For other stationary Class I heating equipment..... 0.75 mA or 0.75 mA per kW rated input of the equipment, whichever is the greater, with a maximum of 5 mA.

(f) For Class II equipment ..... 0.25 mA.

(g) For other Class I equipment ..... 5 mA.

If the equipment incorporates one or more capacitors and is provided with a single-pole switch, the measurements are repeated with the switch in the 'off' position.

NOTE 2 For equipment incorporating both heating elements and motors, the total leakage current may be within the limits specified for heating equipment or for motor-operated equipment, whichever is the greater, but the two limits should not be added.

NOTE 3 It is recommended that the equipment be supplied through an isolating transformer; otherwise, it should be insulated from earth.

NOTE 4 The metal foil has the largest area possible on the surface under test, without exceeding the dimensions specified. If its area is smaller than the surface under test, it is moved so as to test all parts of the surface; the heat dissipation of the appliance should, however, not be affected by the metal foil.

NOTE 5 The test with the switch in the 'off' position is made to verify that capacitors connected behind a single-pole switch do not cause an excessive leakage current.

NOTE 6 If the equipment incorporates a thermal control which operates during the test of Clause 8.12 or the appropriate test in the individual Approval and test specification, the leakage current is measured immediately before the control opens the circuit.

8.4 High voltage (electric strength) test

8.4.1 Between live parts

All accessories shall withstand the application between live parts of an a.c. voltage of the value indicated in Table 8.4, according to the working voltage between the parts to which the test is being applied.

8.4.2 Equipment with earthing facilities

All equipment with earthing facilities shall withstand the application between live parts and exposed metal or earth, of an a.c. voltage of the value indicated in Table 8.4, according to the working voltage between the live parts and exposed metal or earth.

Table 8.4 - Testing voltages

Working voltage between parts *	Testing voltage
≤ 50 V	500 V
> 50 V ≤ 250 V	1000 V
> 250 V ≤ 650 V	1000 V + 2 × working voltage with a maximum of 2000 V

* For example, an accessory that is to be connected to two phases of a system operating at 415 V between phases and 240 V to earth would receive a test of (1000 + 2 × 415) V between live parts, i.e. between the terminals to which the phases are to be connected, but a test of only 1250 V between live parts and frame.

8.4.3 Equipment with double insulation

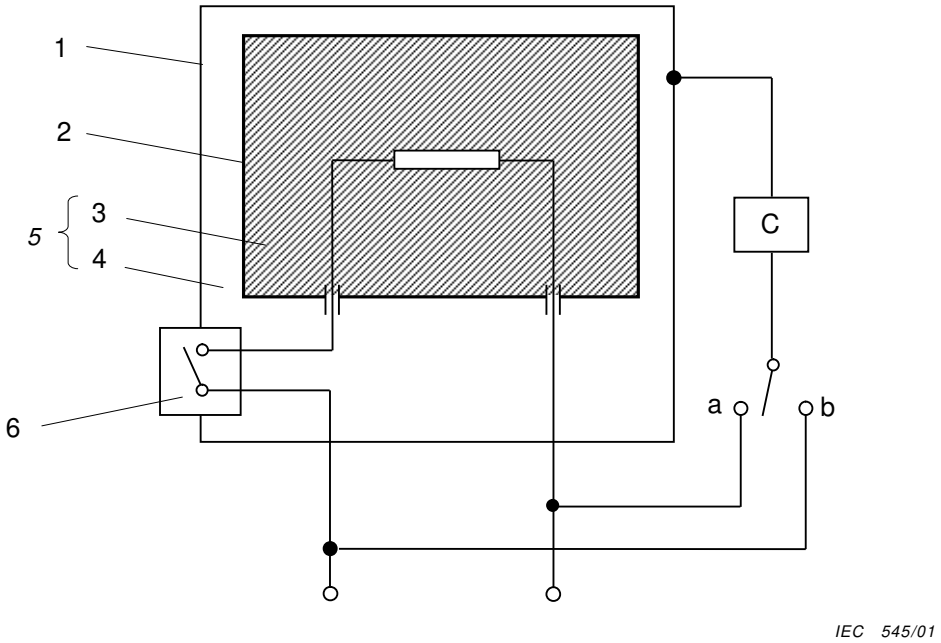
This test shall not apply to insulation that encloses only conductors or live parts operating at extra-low voltage supplied from a transformer complying with AS/NZS 61558.2.6.

The insulation between live parts and external metal, or live parts and a flexible electrode applied to the surface of the insulation, shall withstand high voltages applied as follows:

(a) Across basic insulation ..... 1250 V.

(b) Across supplementary insulation ..... 2500 V.

Where it is not possible to test the basic and supplementary insulation separately, or where a single layer of insulation is provided as the equivalent of separate layers of basic and supplementary insulation, a test voltage of 3750 V shall be applied between live parts and external metal or live parts and a flexible electrode applied to the outer surface of the insulation.



Key

C Circuit in Figure 4 of AS/NZS 60990

1 **Accessible part**

2 Inaccessible metal part

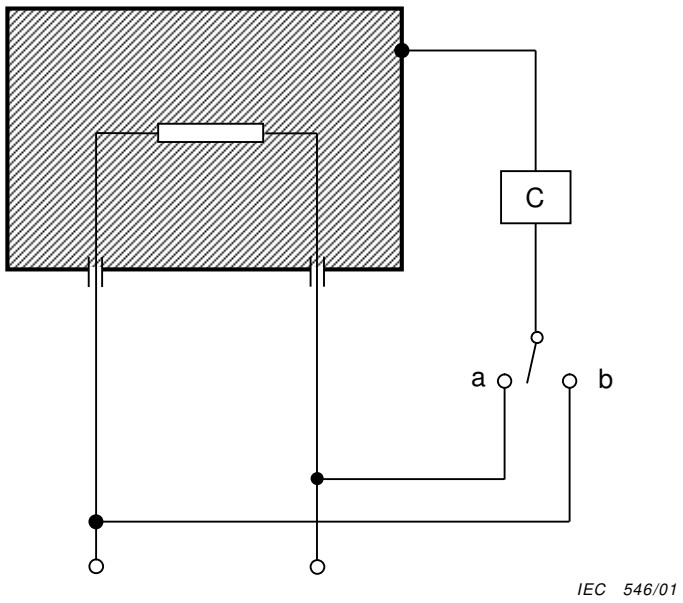
3 **Basic insulation**

4 **Supplementary insulation**

5 **Double insulation**

6 **Reinforced insulation**

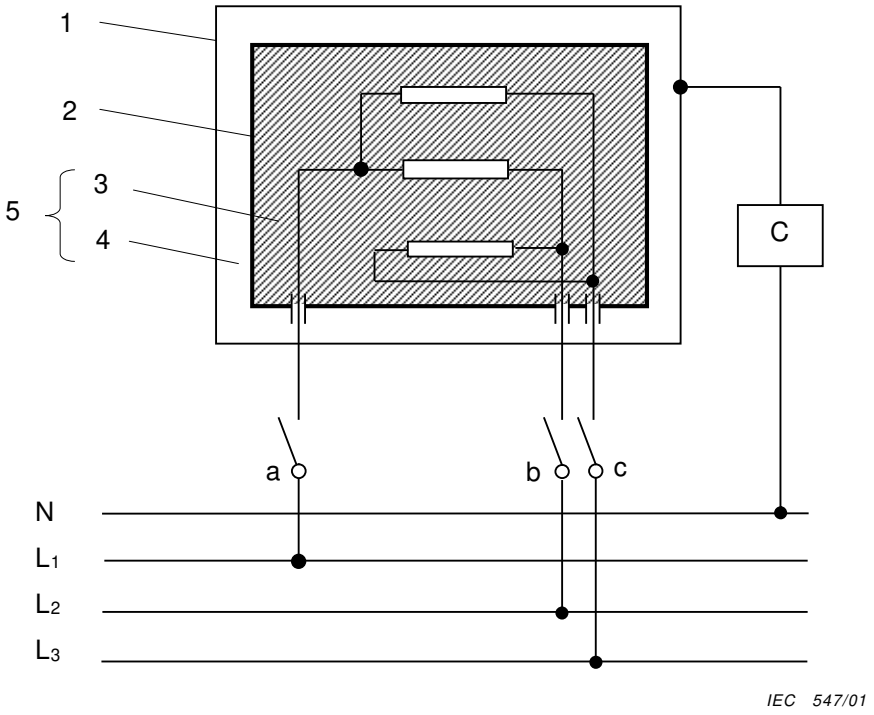
Figure 8.3.2.1 – Circuit diagram for leakage current measurement at operating temperature for single-phase connection of Class II equipment



Key

C Circuit in Figure 4 of AS/NZS 60990

Figure 8.3.2.2 – Circuit diagram for leakage current measurement at operating temperature for single-phase connection of equipment, other than those of Class II



Key

C Circuit in Figure 4 of AS/NZS 60990

1 **Accessible part**

2 Inaccessible metal part

3 **Basic insulation**

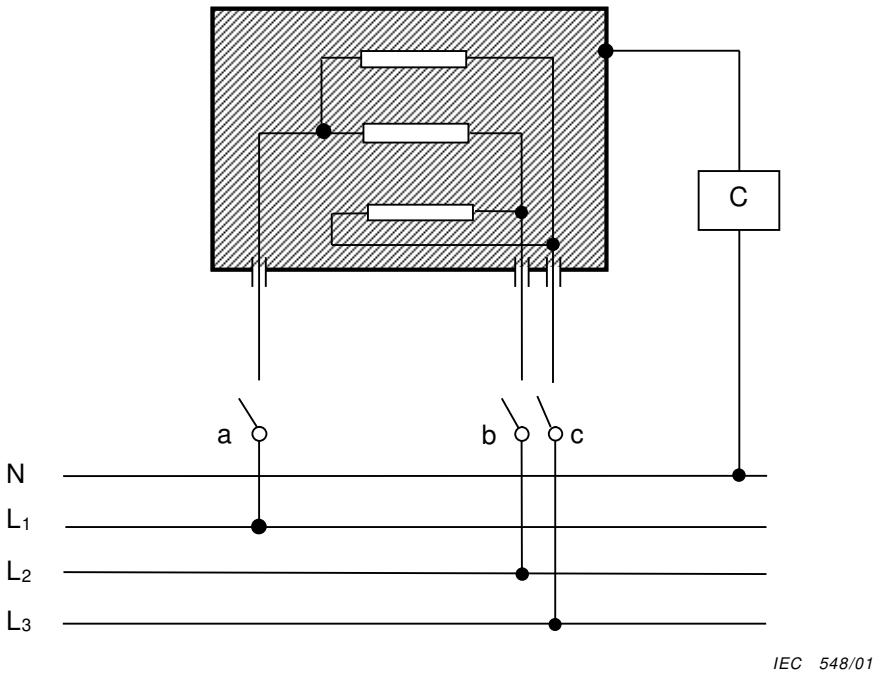
4 **Supplementary insulation**

5 **Double insulation**

Connections and supplies

L_1, L_2, L_3, N Supply voltage with neutral

Figure 8.3.2.3 – Circuit diagram for leakage current measurement at operating temperature for three-phase connection of Class II equipment



Key

C Circuit in Figure 4 of AS/NZS 60990

Connections and supplies

L_1, L_2, L_3, N Supply voltage with neutral

Figure 8.3.2.4 – Circuit diagram for leakage current measurement at operating temperature for three-phase connection of equipment other than those of Class II

8.4.4 Non-conducting external parts

An a.c. voltage of 3750 V shall be applied between live parts and a flexible electrode applied to non-conducting parts normally handled in service.

8.4.5 Method of applying test

When performing the high voltage test on an accessory, any surge protection device, such as a varistor, may be disconnected during the test.

Any radio interference suppression devices shall remain connected during the following high voltage test. The test equipment and the test method shall be generally in accordance with IEC 61180 as detailed below.

To prevent overvoltages due to switching surges, the initial voltage shall not exceed 30% of the full test voltage and shall be increased uniformly to the full voltage in a time of not more than 30 s. The full test voltage shall be maintained for 1 min after which the test voltage shall be diminished rapidly to 30% of its full value before switching off.

The specified test voltage shall be maintained for the 1 min duration of the test within ±3%.

The test voltage shall be alternating, of any frequency between 25 Hz and 100 Hz, and approximately of sine waveform.

There shall be no disruptive discharges, that is, flashovers or insulation punctures, during any high voltage tests.

NOTE Where an individual Approval and test specification specifies an insulation resistance test immediately after the high voltage test, the insulation resistance test of Clause 8.3.1 is not repeated.

The high voltage transformer used for the test shall be so designed that when the output terminals are short-circuited, after the output voltage has been adjusted to the appropriate test voltage, the output current shall be greater than 180 mA. The overcurrent relay shall not trip when the output current is less than 100 mA.

8.4.6 Number of samples

In cases where high voltage tests specified in any Specification would require the same insulation to be stressed more than once, the person submitting the equipment may submit, at the person's discretion, a sufficient number of samples to permit each such test to be made on a separate sample.

8.5 Test of earthing connection

The connection between the earthing terminal or earthing contact, and parts required to be connected thereto, shall be of low resistance.

Compliance is checked by an earthing connection test, whereby a current derived from an a.c. source having a no-load voltage not exceeding 12 V, and equal to 1.5 times rated current of the equipment or 25 A, whichever is the greater, is passed between the earthing terminal or earthing contact, and each of the accessible metal parts in turn.

The voltage drop between the earthing terminal of the equipment or the earthing contact of the appliance inlet and the accessible metal part is measured, and the resistance calculated from the current and this voltage drop.

The resistance shall not exceed

(a) for readily accessible exposed parts which rotate, reciprocate or oscillate continuously .....1 Ω.

(b) in all other cases .....0.1 Ω.

NOTE 1 In case of doubt, the test is carried out until steady conditions have been established.

NOTE 2 The resistance of the flexible cord is not included in the resistance measurement.

NOTE 3 Care is taken that the contact resistance between the tip of the measuring probe and the metal part under test does not influence the test results.

NOTE 4 For Item (a), a minimum current of 12 A is acceptable.

8.6 Cord anchorage

For the purpose of testing the cord anchorage, the equipment shall be wired in the normal manner with a flexible cord of the appropriate type. If the equipment is provided with an earthing terminal, the flexible cord shall include an earthing conductor.

For Type X attachment, the conductors are introduced into the terminals, the terminal screws, if any, being tightened just sufficiently to prevent the conductors from easily changing their position. The cord anchorage is used in the normal way, its clamping screws being tightened with a torque equal to two-thirds of that specified in Table 8.7.