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EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA - 129

INFORMATION TECHNOLOGY EQUIPMENT SAFETY

Volume 2

Annexes

Second edition - April 1994

Free copies of this document are available from ECMA,
European Computer Manufacturers Association,
114 Rue du Rhône - CH-1204 Geneva (Switzerland)

Phone: +41 22 735 36 34 Fax: +41 22 786 52 31
X.400: C=ch, A=arcom, P=ecma, O=genevanet,
OU1=ecma, S=helpdesk
Internet: helpdesk@ecma.ch

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Brief history

In 1976 ECMA/TC12 started to work on a new document "Safety Requirements for Data Processing Equipment" with two objectives in mind:

- to produce an ECMA Technical Report, incorporating the relevant requirements of IEC 435 and updates, enabling equipment designers to realise safety principles at an early stage, and
- to contribute this Technical Report to IEC TC74 as the basis for a complete second edition of IEC 435.

In December 1977 ECMA published this document as ECMA TR/9, which was superseded in January 1979 by Standard ECMA-57; each document embodied the latest technical thinking in IEC. In 1983 IEC published IEC 435 second edition, being substantially the same as Standard ECMA-57 first edition.

Since 1979 the combined work in IEC TC74 and ECMA/TC12 has advanced in many respects and eventually resulted in a combined IEC 435 and IEC 380 (Safety of Electrically energised office machines) Standard published in 1986 as IEC Publication 950 first edition. This was based on a year's intensive work by TC12, suitably enlarged by participation from the international community.

During the Berlin 1986 plenary meeting, IEC TC74 decided, based on the availability of IEC 950, to declare IEC 435 and IEC 380 as **obsolescent.**

This decision also affected ECMA-57 and during the December 1986 meeting the ECMA General Assembly chartered TC12 with the revision of ECMA-57 in line with IEC 950. Other relevant ECMA publications, such as Standard ECMA-83, "Safety Requirements for DTE-to-DCE Interfaces in Public Data Networks"; Standard ECMA-97, "Local Area Networks-Safety Requirements"; ECMA TR/35, "Particular Safety Requirements for Equipment to be connected to Telecommunication networks", were incorporated in order to provide equipment designers with all the standard requirements for the Safety of Information Technology Equipment in one document.

With the publication of the Second Edition of IEC 950 and related amendments, Standard ECMA 129 was superseded. It was therefore decided by TC12 to replace it with a new edition, taking into account the progress made within IEC/TC74 during the past years. The second edition of ECMA-129 has been prepared in such a way as to make it easier to use by equipment designers, grouping all the requirements related to a specific hazard in a single section. This has, in some cases, resulted in duplication of the text. A new annex, annex ZZ, list the proposals for changes that will, when approved, result in Amendment 3 of IEC 950 2nd Edition.

This ECMA standard reproduces numerous parts of the text of IEC 950, which has been possible thanks to the permission granted by IEC.

Adopted as second edition of Standard ECMA-129 by the General Assembly in March 1994.

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Annex A

(normative)

General tests for resistance to heat and fire

It should be noted that toxic fumes may be given off during the tests. Where appropriate the tests should be carried out either under a ventilated hood or in a well-ventilated room, but free from draughts which could invalidate the tests.

Where the tests use a gas flame, it is permitted to use technical grade methane with a suitable regulator and meter for gas flow, or natural gas having a calorific value of approximately 37 MJ/m^3, Technical grade methane has a minimum purity of 98,0 mole % and a typical analysis would be:

	mole %
methane	98,5
ethane	0,5
nitrogen	0,6
oxygen	0,1
carbon dioxide	0,1
propane	0,1
higher alkanes	0,1

A.1 Flammability test for fire enclosures of movable equipment having a total mass exceeding 18 kg and of stationary equipment (see 4.4.4)

A.1.1 Number of samples

Three samples, each consisting of either a complete FIRE ENCLOSURE or a section of the FIRE ENCLOSURE representing the least wall thickness and including any ventilation opening, are tested.

A.1.2 Preconditioning

Prior to being tested, the samples are conditioned in a circulating air oven for a period of 7 days (168 h), at a uniform temperature 10 K higher than the maximum temperature reached by the material measured during the test of 5.1, or 70°C, whichever is the higher, and then cooled to room temperature.

A.1.3 Setup

Samples are mounted as they would be in actual use. A layer of untreated surgical cotton is located 300 mm below the point of application of the test flame.

A.1.4 Test flame parameters

The test flame is obtained by means of a Bunsen burner whose barrel has an inside diameter of 9,5 mm ± 0,5 mm and a length of approximately 100 mm above the primary air inlet or inlets. A gas supply of calorific value ++approximately 37 MJ/m^3 is used and the flame is adjusted so that, while the burner is vertical, the overall height of the flame is approximately 130 mm and the height of the inner blue cone is approximately 40 mm.

A.1.5 Test flame application

The test flame is applied to an inside surface of the sample, at a location judged likely to become ignited because of its proximity to a source of ignition.

If a vertical part is involved, the flame is applied at an angle of approximately 20° from the vertical. If ventilation openings are involved, the flame is applied to an edge of an opening, otherwise to a solid surface. In all cases, the tip of the inner blue cone is to be in contact with the sample. The flame is applied for 5 s and removed for 5 s. This operation is repeated until the sample has been subjected to five applications of the test flame to the same location.

The test is repeated on the remaining two samples. If more than one part of the FIRE ENCLOSURE is near a source of ignition, each sample is tested with the flame applied to a different location.

A.1.6 Compliance

During the test, the sample shall not release either flaming drops or particles capable of igniting the surgical cotton. The sample shall not continue to burn for more than 1 min after the fifth application of the test flame, and shall not be consumed completely.

A.2 Flammability test for fire enclosures of movable equipment having a total mass not exceeding 18 kg, and for materials located within fire enclosures (see 4.4.3 and 4.4.4)

A.2.1 Number of samples

Three samples are tested. For FIRE ENCLOSURES, each sample consists of either a complete FIRE ENCLOSURE or a section of the FIRE ENCLOSURE representing the least wall thickness and including any ventilation opening.

A.2.2 Preconditionning

Prior to being tested, the samples are conditioned in a circulating air oven for a period of 7 days (168 h), at a uniform temperature 10 K higher than the maximum temperature of the part measured during the test of 5.1, or 70°C, whichever is the higher, and then cooled to room temperature.

A.2.3 Setup

Samples are mounted as they would be in actual use.

A.2.4 Test flame parameters

The test flame is obtained by means of a Bunsen burner whose barrel has an inside diameter of 9,5 mm ± 0,5 mm and a length of approximately 100 mm above the primary air inlet or inlets. A gas supply of calorific value approximately 37 MJ/m^3 is used and the flame adjusted so that, while the burner is vertical, the overall height as the flame is approximately 20 mm, with the air inlet ports closed.

A.2.5 Test flame application

The test flame is applied to an inside surface of the sample at a point judged to be likely to become ignited because of its proximity to a source of ignition. For the evaluation of materials located within the FIRE ENCLOSURE, it is permitted to apply the test flame to an external surface of the sample.

If a vertical part is involved, the flame is applied at an angle of approximately 20° from the vertical. If ventilation openings are involved, the flame is applied to an edge of an opening, otherwise to a solid surface. In all cases, the tip of the flame is to be in contact with the sample. The flame is applied for 30 s and removed for 60 s, then reapplied to the same location for 30 s.

The test is repeated on the remaining two samples. If any part being tested is near a source of ignition at more than one point, each sample is tested with the flame applied to a different point which is near to a source of ignition.

A.2.6 Compliance

During the test, the sample shall not continue to burn for more than 1 min after the second application of the test flame, and shall not be consumed completely.

A.2.7 Alternative test method

As an alternative to the apparatus and procedure specified in A.2.4 and A.2.5, it is permitted to use the apparatus and procedure specified in Clauses 4 and 8 of IEC 695-2-2 : 1980. The manner, duration and number of flame applications are as specified in A.2.5 and compliance is in accordance with A.2.6.

Compliance with the method of either A.2.6 or A.2.7 is acceptable; it is not required to comply with both methods.

A.3 High current arcing ignition test (see 4.4.4)

A.3.1 Number of samples

Five samples of each material are used. The samples are 130 mm long minimum by 13 mm wide and of uniform thickness representing the thinnest section of the part. Edges are to be free from burrs, fins, etc.

A.3.2 Test Power source

Each test is made with a pair of test electrodes and a variable inductive impedance load connected in series to a source of 220 V to 240 V a.c., 50 Hz or 60 Hz (see figure A.1).

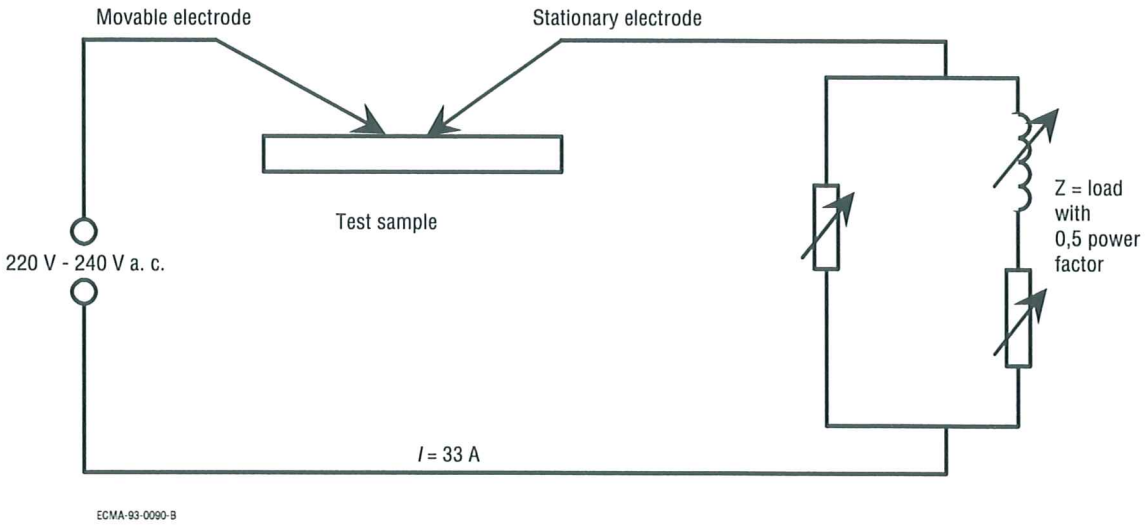


Figure A.1 - Circuit for high current arcing test

It is permitted to use an equivalent circuit

A.3.3 Test Electrodes

One electrode is stationary and the second movable. The stationary electrode consists of 3,5 mm diameter solid copper conductor having a 30° chisel point. The movable electrode is a 3 mm diameter stainless steel rod with a symmetrical conical point having a total angle of 60° and is capable of being moved along its own axis. The radius of curvature for the electrode tips does not exceed 0,1 mm at the start of a given test. The electrodes are located opposing each other, in the same plane, at an angle of 45° to the horizontal. With the electrodes short-circuited, the variable inductive impedance load is adjusted until the current is 33 A at a power factor of 0,5.

A.3.4 Test procedure

The sample under test is supported horizontally in air or on a non-conductive surface so that the electrodes, when touching each other, are in contact with the surface of the sample. The movable electrode is manually or otherwise controlled so that it can be withdrawn from contact with the stationary electrode to break the circuit and lowered to remake the circuit, so as to produce a series of arcs at a rate of approximately 40 arcs/min, with a separation speed of 254 mm/s ± 25 mm/s.

A.3.5 Test duration

The test is continued until ignition of the sample occurs, a hole is burned through the sample, or a total of 200 arcs has elapsed.

A.3.6 Compliance

The average number of arcs to ignition of the specimens tested shall not be less than 15 for V-0 CLASS MATERIALS and not less than 30 for other materials.

A.4 Hot wire ignition test (see 4.4.4)

A.4.1 Number of samples

Five samples of each material are tested. The samples are 130 mm long minimum by 13 mm wide and of a uniform thickness representing the thinnest section of the part. Edges are to be free from burrs, fins, etc.

A.4.2 Hot wire

A 250 mm ± 5 mm length of nichrome wire (nominal composition 80% nickel, 20% chromium, iron-free) approximately 0,5 mm diameter and having a cold resistance of approximately 5,28 Ω/m is used. The wire is

connected in a straight length to a variable source of power which is adjusted to cause a power dissipation of 0,26 W/mm ± 4% in the wire for a period of 8 s to 12 s. After cooling, the wire is wrapped around a sample to form five complete turns spaced 6 mm apart.

A.4.3 Test Set up

The wrapped sample is supported in a horizontal position and the ends of the wire connected to the variable power source, which is again adjusted to dissipate 0,26 W/mm ± 4% in the wire (see figure A.2).

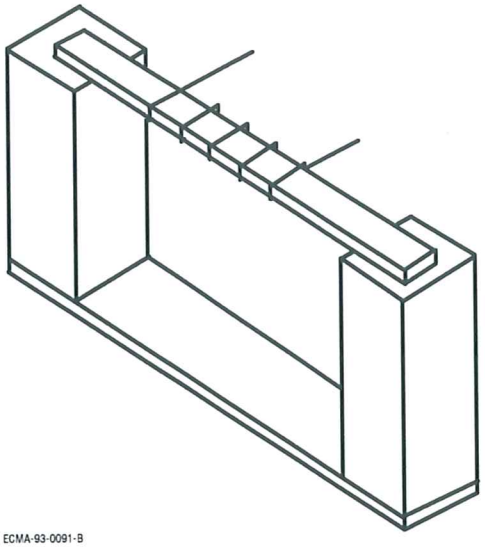


Figure A.2 - Test fixture for hot wire ignition test

A.4.4 Test procedure

At the start of the test, the circuit is energized so that a current is passed through the heater wire yielding a linear power density of 0,26 W/mm ± 4%. The test is continued until the test specimen ignites or until 120 s have passed. When ignition occurs or 120 s have passed, the test is discontinued and the test time recorded. For specimens that melt through the wire without ignition, the test is discontinued when the specimen is no longer in intimate contact with all five turns of the heater wire.

A.4.5 Test duration

The test is repeated on the remaining samples.

A.4.6 Compliance

The average ignition time of the specimens tested shall not be less than 15 s.

A.5 Hot flaming oil test (see 4.4.6)

A.5.1 Test setup

A sample of the complete finished bottom of the FIRE ENCLOSURE is securely supported in a horizontal position. Bleached cheesecloth of approximately 40 g/m^2 is placed in one layer over a shallow, flat-bottomed pan approximately 50 mm below the sample, and is of sufficient size to cover completely the pattern of openings in the sample, but not large enough to catch any of the oil that runs over the edge of the sample or otherwise does not pass through the openings.

NOTE
Use of a metal screen or a wired-glass ENCLOSURE surrounding the test area is recommended.

A.5.2 Test procedure

A small metal ladle (preferably no more than 65 mm in diameter) with a pouring lip and a long handle whose longitudinal axis remains horizontal during pouring, is partially filled with 10 ml of a distillate fuel oil which is a medium volatile distillate having a mass per unit volume between 0,845 g/ml and 0,865 g/ml, a flash point between 43,5°C and 93,5°C and an average calorific value of 38 MJ/l. The ladle containing the oil is heated and the oil

ignited and permitted to burn for 1 min, at which time all of the hot flaming oil is poured at the rate of approximately 1 ml/s in a steady stream onto the centre of the pattern of openings, from a position approximately 100 mm above the openings.

The test is repeated twice at 5 min intervals, using clean cheesecloth.

During these tests the cheesecloth shall not ignite.

A.6 Flammability tests for classifying materials V-0, V-1 or V-2 (see 1.5.4 and 4.4)

A.6.1 Number of samples

Ten samples of a material or assembly intended to be classified V-0, V-1 or V-2 are tested as indicated below.

A.6.2 Samples

Material test samples are approximately 130 mm long by 13 mm wide, and of the smallest thickness used. For sound-deadening material, other than foamed plastic, which is normally attached to a panel of another material, it is permitted to use samples consisting of the material attached to a panel of the smallest thickness used. For testing an assembly, it is permitted to use samples consisting of the assembly or a portion thereof not smaller than the dimensions specified for a material sample. It is permitted either to test gears, cams, belts, bearings, tubing, wiring harness, etc. as finished parts, or to test samples cut from finished parts.

A.6.3 Preconditioning

Prior to being tested, a set of five samples is conditioned in a circulating air oven for 7 days (168 h) at a uniform temperature of 70°C ± 1°C. Immediately afterwards, the samples are placed in a calcium chloride desiccator for at least 4 h to cool to room temperature. The other set of five samples is conditioned for 48 h at a uniform temperature of 23°C ± 2°C and a relative humidity between 45% and 55%.

A.6.4 Test setup

One sample is held with its longitudinal axis vertical by a clamp at its upper end so that its lower edge is 300 mm above a flat, horizontal layer of untreated surgical cotton 50 mm x 50 mm thinned out to a maximum free-standing thickness of 6 mm. An unlit Bunsen burner whose barrel has an inside diameter of 9,5 mm ± 0,5 mm and a length of approximately 100 mm above the primary air inlet or inlets, is supported under the sample with the longitudinal axis of the barrel vertical and coincident with the longitudinal axis of the sample. The tip of the barrel is 9,5 mm below the sample. The burner support is arranged to enable the burner to be quickly removed from and precisely returned to its position under the sample. A gas supply of calorific value approximately 37 MJ/m^3 is used. While not in proximity to the sample, the burner is ignited and adjusted to produce a steady blue flame with an overall height of approximately 20 mm.

A.6.5 Test procedure part 1

The burner flame is moved into position under the sample for 10 s, and then removed.

The duration of any flaming combustion of the sample after removal of the test flame shall not exceed 10 s for CLASS V-0 and 30 s for CLASSES V-1 or V-2.

A.6.6 Test procedure part 2

Immediately after flaming of the sample has ceased, the test of A.6.5 is repeated on the same sample.

The duration of any glowing combustion of the sample after the second removal of the test flame shall not exceed 30 s for CLASS V-0 and 60 s for CLASSES V-1 or V-2.

A.6.7 Test duration

The tests of A.6.5 and A.6.6 are repeated on the four remaining samples of each set.

A.6.8 V-2 Compliance

The material is of CLASS V-2 in the thickness tested if all of the following apply:

- *each sample passes the tests in A.6.5, A.6.6 and A.6.7;*
- *the average duration of flaming does not exceed 25 s for each set of five samples, and*
- *the material does not continue to burn up to the holding clamp.*

NOTE
For CLASS V-2, ignition of the surgical cotton is permitted to occur.

A.6.9 V-1 Compliance

The material is of CLASS V-1 in the thickness tested if all of the following apply:

- *each sample passes the tests in A.6.5, A.6.6 and A.6.7;*
- *the average duration of flaming does not exceed 25 s for each set of five samples;*
- *the material does not continue to burn up to the holding clamp, and*
- *the surgical cotton is not ignited by any particles or drops released during or after application of the test flame.*

A.6.10 V-0 Compliance

The material is of CLASS V-0 in the thickness tested if all of the following apply:

- *each sample passes the tests in A.6.5, A.6.6 and A.6.7;*
- *the average duration of flaming does not exceed 5 s for each set of five samples;*
- *the material does not continue to burn up to the holding clamp, and*
- *the surgical cotton is not ignited by any particles or drops released during or after application of the test flame.*

A.6.11 Re-test considerations

Only if one sample of a set of five samples fails to comply with the requirements of A.6.5, A.6.6, A.6.8, A.6.9 or A.6.10, another set of five samples, subjected to the same conditioning, is tested. All samples in this second set shall comply with the appropriate requirements in order for the material in that thickness to be classified V-0, V-1 or V-2.

A.7 Flammability test for classifying foamed materials HF-1, HF-2 or HBF (see 1.5.4, 4.4.1 and 4.4.3)

A.7.1 Number of samples

Ten samples of a foamed plastic material intended to be classified HF-1, HF-2 or HBF are tested as indicated below.

A.7.2 Samples

Material test samples are approximately 150 mm long by 50 mm wide, and of the smallest thickness used. For foam material which is normally attached to a panel of another material, it is permitted to use samples consisting of the foam material attached to a panel which is of the smallest thickness used.

A.7.3 Preconditioning

Prior to being tested, five samples, reference A, are conditioned in a circulating air oven for 7 days (168 h) at a uniform temperature of 70°C ± 1°C. Immediately afterwards, the samples are placed in a calcium chloride desiccator for at least 4 hrs to cool to room temperature. Five other samples, reference B, are conditioned for 48 h at a uniform temperature of 23°C ± 2°C and a relative humidity between 45% and 55%.

A.7.4 Test procedure

Samples are supported on a horizontal wire screen (approximately 0,8 mm steel wire in 6,5 mm square mesh), 200 mm long by 75 mm wide, with 13 mm at one end turned up vertically. The screen is supported approximately 300 mm above a layer of surgical cotton.

A Bunsen burner with a fish-tail flame is to be used. Its barrel shall heve internal dimensions of 9,5 mm ± 0,5 mm and a length of approximately 100 mm when measured from the air inlet or inlets; the flame spreader shall have a width of approximately 50 mm. It is supported 13 mm under the bend in the wire screen so that the flame is parallel to and central on the bend.

The burner support is arranged to enable the burner to be quickly removed from and precisely returned to its position under the sample. A gas supply of calorific value approximately 37 MJ/m^3 is used. While not in proximity to the sample, the burner is ignited and adjusted to produce a steady blue test flame with an overall height of approximately 38 mm.

One sample is placed flat on the screen, one end being in contact with the upturned end of the screen. Samples of combined materials are placed with the foamed plastic side facing up.

The burner flame is moved into position under the sample for 60 s, and then removed. The test is then repeated on the other nine samples.

A.7.5 General compliance

During and after the test the following conditions shall apply:

- *not more than one sample, reference A, and not more than one sample, reference B, shall flame longer than 2 s after removal of the test flame;*
- *no sample shall flame longer than 10 s after removal of the test flame;*
- *no sample shall glow longer than 30 s after removal of the test flame;*
- *no sample shall flame or glow for a distance greater than 60 mm from the end to which the test flame was applied.*

A.7.6 HF-2 compliance

The material is of CLASS HF-2 if it meets the conditions of A.7.5.

For CLASS HF-2 ignition of the surgical cotton is permitted to occur.

A.7.7 HF-1 compliance

The material is of CLASS HF-1 if it meets the conditions of A.7.5 and additionally, the cotton is not ignited by any particles or drops released during or after application of the test flame.

A.7.8 HBF compliance

The material is of CLASS HBF if despite failing to meet the conditions of A.7.5, all specimens either:

- *burn at a rate of under 40 mm/min over a 100 mm span, or*
- *cease to burn before reaching 120 mm from the end to which the test flame is applied.*

A.7.9 Re-test considerations for HBF classification

If only one sample from a set of five samples fails to comply with the requirements in A.7.8, a second set of five samples, subjected to the same conditioning, is tested. All samples from this second set of samples shall comply with the appropriate requirements in A.7.8 in order for the material of that thickness and density to be classified HBF.

A.7.10 Re-test considerations for HF-1 and HF-2 classification

A second set of five samples, subjected to the same conditioning, is tested if a set of five samples fails to comply with the requirements of A.7.6 or A.7.7 because of one of the following situations:

- one sample out of a set of five samples flames for more than 10 s; a second sample out of the same set flames for more than 2 s but less than 10 s as permitted by A.7.5, or
- two samples out of a set of five samples flame for more than 2 s but less than 10 s, or
- one sample out of a set of five samples flames or glows for a distance greater than 60 mm from the end to which the test flame was applied, or
- one sample out of a set of five samples glows for longer than 30 s after removal of the test flame, or
- for CLASS HF-1, the cotton is ignited by particles or drops released from one sample out of a set of five samples.

A.8 Flammability test for classifying materials HB (see 4.4.3 and 4.4.4)

A.8.1 Number of samples

Three samples of a material or assembly intended to be classified HB are tested as indicated below.

A.8.2 Samples

Material test samples are approximately 130 mm long by 13 mm wide, with smooth edges, and of the smallest thickness used or less. For materials used in a thickness greater than 3 mm, the samples are reduced to 3 mm thick. The samples are marked across their width with lines at 25 mm and 100 mm from one end.

A.8.3 Preconditioning

Prior to being tested the samples are conditioned for 48 h at a uniform temperature of 23°C ± 2°C and a relative humidity between 45% and 55%.

A.8.4 Test setup

A sample is held by a clamp at the end farthest from the 25 mm mark, with its longitudinal axis horizontal and its transverse axis at 45° to the horizontal. A flat sheet of steel wire gauze (approximately 130 mm square and having eight openings per centimetre) is supported horizontally 10 mm below the lowest edge of the sample, and with the free end of the sample immediately above the edge of the gauze (see figure A.3).

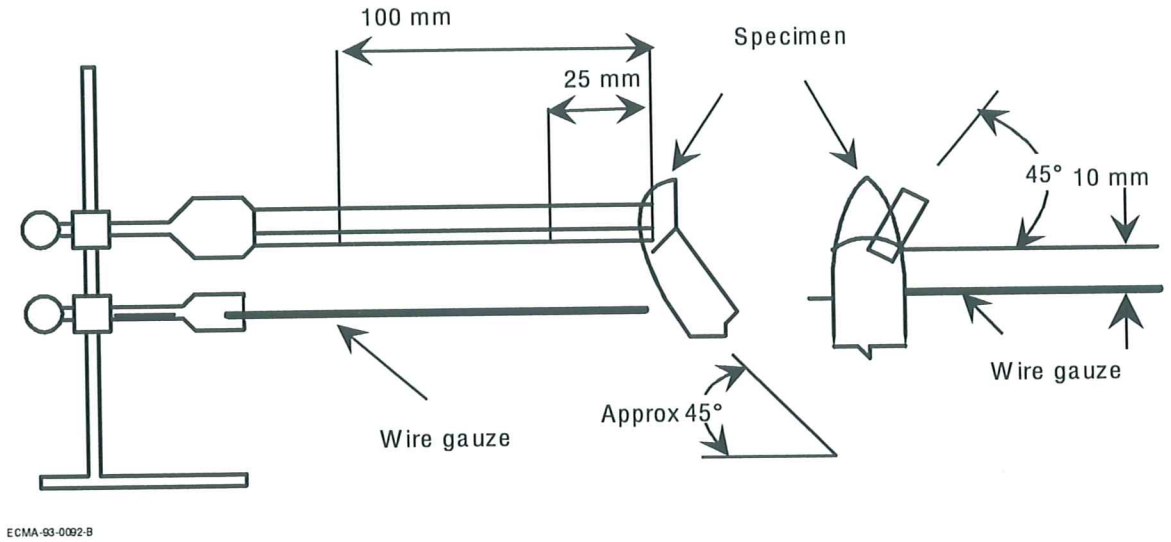


Figure A.3 - Test arrangement for flammability test for classifying materials HB

An unlit Bunsen burner whose barrel has an inside diameter of 9,5 mm ± 0,5 mm and a length of approximately 100 mm above the primary air inlet or inlets is supported with its longitudinal axis in the same vertical plane as the lowest edge of the sample, inclined at approximately 45° to the vertical, and with the lower edge of the barrel mouth 10 mm below the free end of the sample, so that the bottom edge of the sample is subjected to the test flame, when lit.

The burner support is arranged to enable the burner to be quickly removed from and precisely returned to its position under the sample. A gas supply of calorific value approximately 37 MJ/m^3 is used. When not in proximity to the sample, the burner is ignited and adjusted to produce a steady blue flame with an overall height of approximately 25 mm.

A.8.5 Test procedure

The burner flame is moved into position at the end of the sample for 30 s, or until burning reaches the 25 mm mark if this occurs earlier, and then removed. By timing the progress of flaming or glowing from the 25 mm mark to the 100 mm mark, at the lower edge of the sample, the rate of progress in millimetres per minute is calculated.
The test is repeated on the two remaining samples.

A.8.6 Compliance

The material is of CLASS HB provided that in the above test no sample has a calculated rate of flaming or glowing greater than:
- *40 mm/min for samples of a thickness of 3 mm;*
- *75 mm/min for samples of a thickness of less than 3 mm;*

or if the flaming or glowing does not reach the 100 mm reference mark.

A.8.7 Retest considerations

If only one sample of a set of three samples does not comply with the requirements in A.8.6, another set of three samples is tested. All samples of this second set shall comply with the requirements in order for the material in that thickness to be classified HB.

A.9 Flammability test for classifying materials 5V (see 4.4.1)

A.9.1 Number of samples

For each of the tests, samples of the material intended to be classified 5V are tested as indicated below.

The test is not applicable to samples of thickness greater than 13 mm and in such cases the tests of clause A.1 apply. If the classification is made as a result of testing samples of thickness less than 13 mm, it is applicable to any greater thickness up to a maximum of 13 mm.

A.9.2 Samples

At the option of the manufacturer, either ten samples of the material in the form of test bars (see A.9.5), or eight samples of the material in the form of test plaques (see A.9.6), are used. However, if bar specimens are observed to undergo shrinkage, elongation, or melting, additional tests are conducted on test plaques.

A.9.3 Preconditioning

For each test, prior to being tested, one set of five test bars or four test plaques is conditioned for at least 48 h at a uniform temperature of 23°C ± 2°C and a relative humidity of 45% to 55%. A further set of five test bars or four test plaques is conditioned in a circulating air oven for a duration of 7 days (168 h), at a uniform temperature 10 K greater than the maximum temperature of the material determined during the test of 5.1 or 70°C, whichever is the higher, and then cooled in a calcium chloride desiccator for at least 4 h at room temperature.

A.9.4 Test setup

The test flame is obtained by means of a Bunsen burner whose barrel has an inside diameter of 9,5 mm ± 0,5 mm and a length of approximately 100 mm above the primary air inlet or inlets. A gas supply of calorific value approximately 37 MJ/m^3 is used, and the test flame adjusted so that, while the burner is vertical, the overall height of the flame is approximately 130 mm and the height of the inner blue cone is approximately 40 mm.

A.9.5 Test procedure for bars

When test bars are used, the two sets are tested. Each test bar is 130 mm long and 13 mm wide, and is the same thickness as the smallest thickness used in the equipment, but not greater than 13 mm.

Each test bar is supported from the upper end of the bar with the longitudinal axis vertical, by a clamp on a ring stand. The burner is supported on an inclined plane of a mounting block so that the burner tube may be positioned at 20° from the vertical. The narrow edge of the bar faces the burner. A layer of untreated surgical cotton is located 300 mm below the point of application of the test flame.

The flame is applied to one of the lower corners of the bar at an angle of 20° from the vertical so that the tip of the blue cone touches the bar (see figure A.4).

The flame is applied for 5 s and removed for 5 s. The operation is repeated until each bar has been subjected to five applications of the test flame.

After the fifth removal of the test flame, the following are observed and recorded:

- duration of flaming plus glowing;
- the distance the bar burned or was affected;
- whether or not particles dripped from the bar during the test;
- any deformation and change in physical strength immediately after burning and when cooled.

For the material to be classified 5V, the test results shall comply with the criteria in A.9.7, and there shall be no shrinkage, elongation or melting of any test bar. When shrinkage, elongation or melting is observed, the test of A.9.6 shall be conducted on test plaques.

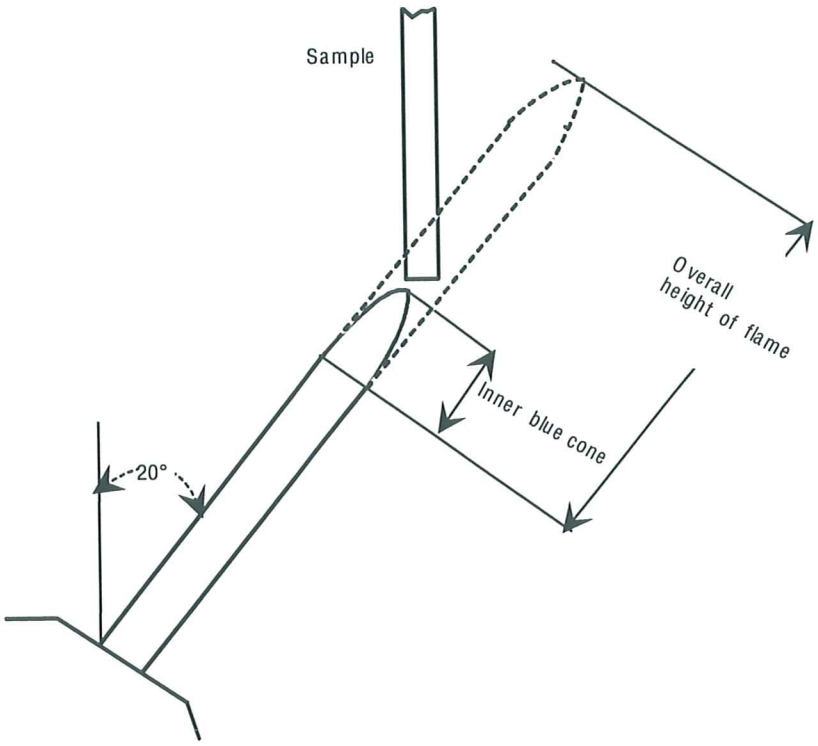


Figure A.4 - Vertical burning test for classifying materials 5V

A.9.6 Test procedure for plaques

When test plaques are used, the two sets are tested. Each test plaque is 150 mm by 150 mm, and is of the same thickness as the minimum thickness used in the design of the equipment, but not greater than 13 mm.

Each set of four plaques is mounted and tested in a different position so that the test flame is applied as follows:

A one plaque of each set vertical with the flame applied to the lower corner of the plaque;
B one plaque of each set vertical with the flame applied to the lower edge of the plaque;
C one plaque of each set vertical with the flame applied to the centre of one side of the plaque;
D one plaque of each set horizontal with the flame applied to the centre of the bottom surface of the plaque.

A layer of untreated surgical cotton is located 300 mm below the point of the application of the test flame.

If the vertical position for the test plaque is involved, the test flame is applied at an angle of approximately 20° from the vertical.

For all positions, the tip of the blue cone is to be in contact with the test plaque. The test flame is applied for 5 s and removed for 5 s. This operation is repeated until the test plaque has been subjected to five applications of the test flame to the same location.

After the fifth removal of the test flame, the following are observed and recorded:

- duration of flaming plus glowing;
- the distance the plaque burned or was affected;
- whether or not particles dripped from the plaque during the test;
- any deformation and change in physical strength immediately after burning and when cooled.

For the material to be classified 5V, the test results shall comply with the criteria in A.9.7, and the test results for positions C and D shall not show significant destruction in the area of the test flame application.

A.9.7 Compliance criteria

During the test, the material shall not:

- *release flaming drops or particles capable of igniting the surgical cotton;*
- *continue to burn with flaming or glowing combustion for more than 60 s after the fifth removal of the test flame;*
- *be consumed completely.*

After the test on each set of samples, the results are assessed as follows:

a) if all samples meet the requirements, the appropriate classification is made;

b) if only one sample in any set fails, the tests are repeated on a second set of samples subjected to the same conditioning. All of these samples shall meet the requirements in order to make the appropriate classification;

c) if two or more samples of any set fail to meet the requirements, the classification is not made.

Annex B

(normative)

Motor tests under abnormal conditions (see 4.4.5.2 and 5.4.2)

B.1 General requirements

Motors, other than d.c. motors in SECONDARY CIRCUITS, shall pass the tests of clauses B.4 and B.5 and, where applicable, clauses B.8, B.9 and B.10, except for the following motors which are not required to pass the test of clause B.4:

- motors which are used for air-handling only and where the air-propelling component is directly coupled to the motor shaft, and
- shaded pole motors whose values of locked-rotor current and no-load current do not differ by more than 1 A and have a ratio of not more than 2/1.

D.C. motors in SECONDARY CIRCUITS shall pass the tests of clauses B.6, B.7 and B.10 except for motors which by their intrinsic operation normally operate under locked-rotor conditions, such as stepper motors, are not tested.

B.2 Test conditions

Unless otherwise specified in this annex, during the test the equipment is operated at RATED VOLTAGE, or at the highest voltage of the RATED VOLTAGE RANGE.

The tests are carried out either in the equipment or under simulated conditions on the bench. It is permitted to use separate samples for bench tests. Simulated conditions include:

- any protection devices which would protect the motor in the complete equipment, and
- use of any mounting means which may serve as a heat sink to the motor frame.

Temperatures of windings are measured as specified in 1.4.8. Where thermocouples are used they are applied to the surface of the motor windings. Temperatures are determined at the end of the test period where specified, otherwise when the temperature has stabilized, or at the instant of operation of fuses, THERMAL CUT-OUTS, motor protection devices and the like.

For totally enclosed, impedance-protected motors, the temperatures are measured by thermocouples applied to the motor case.

When motors without inherent thermal protection are tested under simulated conditions on the bench, the measured winding temperature is adjusted to take into account the ambient temperature in which the motor is normally located within the equipment as measured during the tests of 5.1.

B.3 Maximum temperatures

For the tests in clauses B.5, B.7, B.8 and B.9 the temperature limits, as specified in table B.1, shall not be exceeded for each class of insulating material.

Table B.1 - Permitted temperature limits for motor windings
(except for running overload test)

Maximum temperature °C					
	Class A	*Class E*	*Class B*	*Class F*	*Class H*
Protection by inherent or external impedance	*150*	*165*	*175*	*190*	*210*
Protection by protective device which operates during the first hour	*200*	*215*	*225*	*240*	*260*
Protection by any protective device:					
– *maximum after first hour*	*175*	*190*	*200*	*215*	*235*
– *arithmetic average during the 2nd hour andduring the 72nd hour*	*150*	*165*	*175*	*190*	*210*

Arithmetic average temperature is determined as follows:

The graph of temperature against time, while the power to the motor is cycling on and off, is plotted for the period of test under consideration.

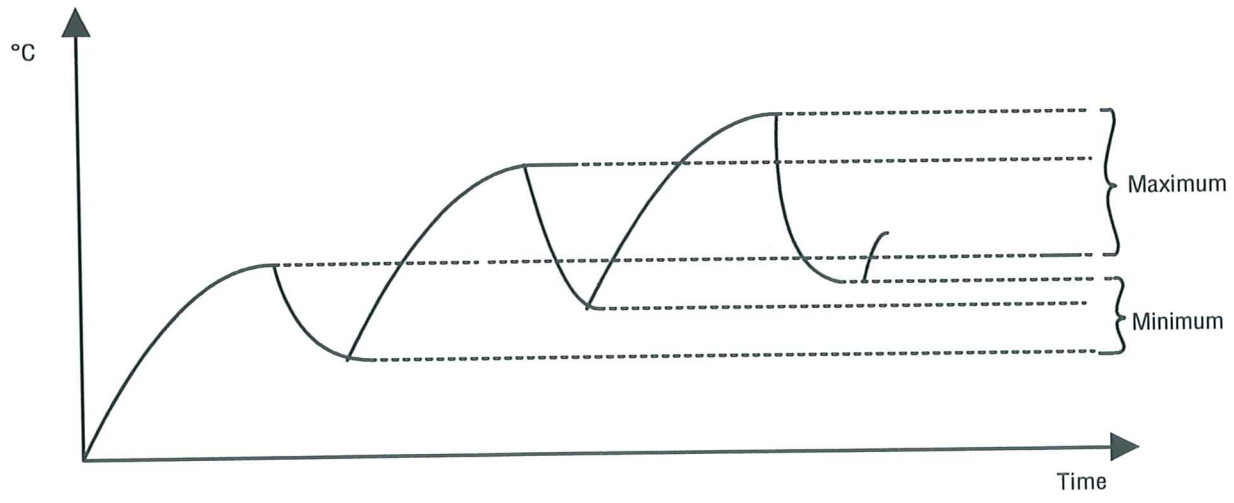
The arithmetic average temperature (t_A) is determined by the formula:

$$t_A = \frac{t_{max} + t_{min}}{2}$$

where:

t_{max} is the average of the maxima

t_{min} is the average of the minima



ECMA-93-0094-B

Figure B.1 - Determination of arithmetic average temperature

For the tests in clauses B.4 and B.6 the temperature limits, as specified in table B.2, shall not be exceeded for each class of insulating material.

Table B.2 - Permitted temperature limits for running overload tests

Maximum temperature °C				
Class A	*Class E*	*Class B*	*Class F*	*Class H*
140	*155*	*165*	*180*	*200*

B.4 Running overload test

A running overload protection test is carried out by operating the motor under NORMAL LOAD. The load is then increased so that the current is increased in appropriate gradual steps, the motor supply voltage being maintained at its original value. When steady conditions are established, the load is again increased. The load is thus progressively increased in appropriate steps but without reaching locked-rotor condition (see clause B.5) until the overload protection device operates.

The motor winding temperatures are determined during each steady period and the maximum temperature recorded shall not exceed the values specified in table B.2.

B.5 Locked-rotor overload test

A locked-rotor test is carried out starting at room temperature.

The duration of the test is as follows:

- a motor protected by inherent or external impedance is operated on locked-rotor for 15 days except that testing is discontinued when the windings of the motor, of either the open or totally enclosed type, reach a constant temperature, provided that the constant temperature is not more than that specified in 5.1 for the insulation system used;
- a motor with an automatic reset protection device is cycled on locked-rotor for 18 days;
- a motor with a manual reset protection device is cycled on locked-rotor for 60 cycles, the protection device being reset after each operation as soon as possible for it to remain closed, but after not less than 30 s;
- a motor with a non-resettable protection device is operated until the device operates.

Temperatures are recorded at regular intervals during the first three days for a motor with inherent or external impedance protection or with an automatic reset protection device, or during the first ten cycles for a motor with a manual reset protection device, or at the time of operation of a non-resettable protection device.

The temperatures shall not exceed the values specified in table B.1.

During the test, protection devices shall operate reliably without insulation fault to the motor frame or permanent damage to the motor, including excessive deterioration of the insulation.

Permanent damage to the motor includes:

- *severe or prolonged smoking or flaming;*
- *electrical or mechanical breakdown of any associated component part such as a capacitor or starting relay;*
- *flaking, embrittlement or charring of insulation.*

Discoloration of the insulation is permitted but charring or embrittlement to the extent that insulation flakes off or material is removed when the winding is rubbed with the thumb is not permitted.

After the period specified for temperature measurement, the motor shall withstand the electrical strength test in 5.3.2 after the insulation has cooled to room temperature and with test voltages reduced to 0,6 times the specified values. No further electric strength test is required.

NOTE
Continuation of the test of an automatic reset protection device beyond 72 h, and of a manual reset protection device beyond 10 cycles, is for the purpose of demonstrating the capability of the device to make and break locked-rotor current for an extended period of time.

B.6 Running overload test for d.c. motors in secondary circuits

The running overload test is carried out only if a possibility of an overload occurring is determined by inspection or by review of the design. The test need not be carried out, for example, where electronic drive circuits maintain a substantially constant drive current.

The test is carried out by operating the motor under NORMAL LOAD. The load is then increased so that the current is increased in appropriate gradual steps, the motor supply voltage being maintained at its original value. When steady conditions are established the load is again increased. The load is thus progressively increased in appropriate steps until either the overload protection device operates or the winding becomes an open circuit.

The motor winding temperatures are determined during each steady period and the maximum temperature recorded shall not exceed the value in table B.2, except that, where difficulty is experienced in obtaining accurate temperature measurements, due to the small size or unconventional design of the motor, it is permitted to use the following test instead of temperature measurement.

During the running overload test, the motor is covered with a single layer of bleached cotton cheesecloth of approximately 40 g/m^2. There shall be no ignition of the cheesecloth during the test or at its conclusion.

Compliance with either method is acceptable; it is not necessary to comply with both methods.

B.7 Locked-rotor overload test for d.c. motors in secondary circuits

B.7.1 General

Motors shall pass the test in B.7.2, except that, where difficulty is experienced in obtaining accurate temperature measurements, because of the small size or unconventional design of the motor, the method of B.7.3 can be used instead. Compliance may be established by either method.

Following the test of B.7.2 or B.7.3, as applicable, if the motor voltage exceeds 42,4 V peak, or 60 V d.c., and after the motor has cooled to room temperature, the motor shall withstand the electric strength test in 5.3.2 and with test voltages reduced to 0,6 times the specified values.

B.7.2 Test procedure and compliance

The motor is operated with its rotor locked for 7 h or until steady conditions are established, whichever is the longer. Temperatures shall not exceed the values specified in table B.1.

B.7.3 Alternative test procedure and compliance for B.7.2

The motor is placed on a wooden board which is covered with a single layer of wrapping tissue, and the motor in turn covered with a single layer of bleached cotton cheesecloth of approximately 40 g/m^2.

NOTE
Wrapping tissue is defined in ISO 4046: a soft and strong lightweight wrapping paper of grammage generally between 12 g/m^2 and 30 g/m^2, primarily intended for protective packaging of delicate articles and for gift wrapping.

The motor is then operated with the rotor locked for 7 h or until steady conditions are established, whichever is the longer.

At the conclusion of the test there shall be no ignition of the wrapping tissue or cheesecloth.

B.8 Test for motors with capacitors

Motors having phase-shifting capacitors are tested under locked-rotor conditions with the capacitor short-circuited or open-circuited (whichever is the more unfavourable).

The short-circuit test is not made if the capacitor is so designed that, upon failure, it will not remain short-circuited.

Temperatures shall not exceed the values specified in table B.1.

NOTE
Locked-rotor is specified because some motors may not start and variable results could be obtained.

B.9 Test for three-phase motors

Three-phase motors are tested under NORMAL LOAD, with one phase disconnected, unless circuit controls prevent the application of voltage to the motor when one or more supply phases are missing.

The effect of other loads and circuits within the equipment may necessitate that the motor be tested within the equipment and with the three supply phases disconnected one at a time.

Temperatures shall not exceed the values specified in table B.1.

B.10 Test for series motors

Series motors are operated at a voltage equal to 1,3 times its RATED VOLTAGE for 1 min with the lowest possible load.

After the test, windings and connections shall not have worked loose and no hazard shall be present within the meaning of this standard.

Annex C

(normative)

Transformers (see 1.5.3)

The tests in this annex are carried out either in the equipment or under simulated conditions on the bench.

Simulated conditions include any protection device which would protect the transformer in the complete equipment.

NOTE
For the relevant value of WORKING VOLTAGE see 2.2.7.

C.1 Overload test

A conventional or SAFETY ISOLATING TRANSFORMER has each secondary winding short-circuited in turn, with the other secondaries loaded to their specified maxima, taking into account the effect of any protection device provided.

A ferro-resonant transformer has each secondary in turn loaded so as to give maximum heating effect, and with the following parameters at the most adverse value:

- primary voltage;
- input frequency;
- loads on other secondaries between zero and their specified maxima.

Where a short-circuit or overload of a secondary winding cannot occur or is unlikely to cause a hazard, this test is not made.

Maximum temperatures of windings shall not exceed the values in table C.1 when measured as specified in 1.4.8, and determined as specified below:

- *with external overcurrent protection: at the moment of operation; for determination of the time until the overcurrent protection operates, it is permitted to refer to a datasheet of the overcurrent protection device showing the trip time versus the current characteristics;*
- *with an AUTOMATIC RESET THERMAL CUT-OUT: as shown in table C.1 and after 400 h;*
- *with a MANUAL RESET THERMAL CUT-OUT: at the moment of operation;*
- *for current-limiting transformers: after temperature has stabilized.*

Table C.1 - Permitted temperature limits for motor windings

	Maximum temperature °C				
	Class A	*Class E*	*Class B*	*Class F*	*Class H*
Protection by inherent or external impedance	*150*	*165*	*175*	*190*	*210*
Protection by protective device which operates during the first hour	*200*	*215*	*225*	*240*	*260*
Protection by any protective device:					
– *maximum after first hour*	*175*	*190*	*200*	*215*	*235*
– *arithmetic average during the 2nd hour andduring the 72nd hour*	*150*	*165*	*175*	*190*	*210*

Arithmetic average temperature is determined as follows:

The graph of temperature against time, while the power to the transformer is cycling on and off, is plotted for the period of test under consideration. The arithmetic average temperature (t_A) is determined by the formula:

$$t_A = \frac{t_{max} + t_{min}}{2}$$

where:

t_{max} is the average of the maxima

t_{min} is the average of the minima

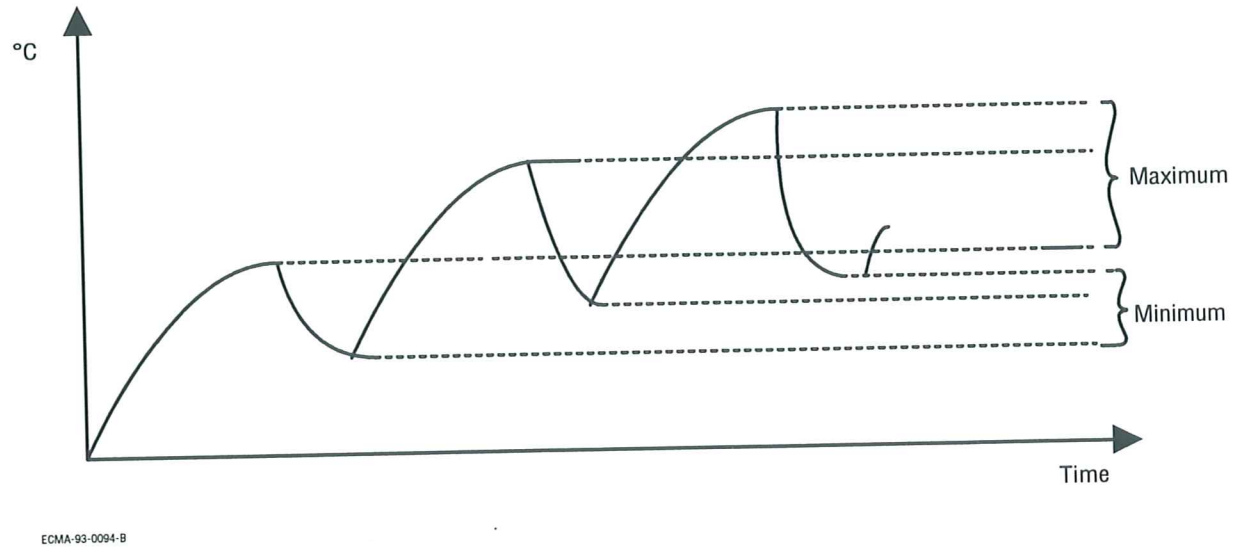


Figure C.1 - Determination of arithmetic average temperature

Secondary windings which exceed the temperature limits but which become open circuit or otherwise require replacement of the transformer do not constitute a failure of this test, provided that no hazard is created in the meaning of this standard.

C.2 Safety isolating transformers

SAFETY ISOLATING TRANSFORMERS shall comply with the following requirements.

Precautions shall be taken to prevent:

- displacement of windings, or their turns;
- displacement of internal wiring or wires for external connections, undue displacement of parts of windings or internal wiring, in the event of rupture of wires adjacent to connections or loosening of the connections;
- wires, screws, washers and the like from bridging any part of the required minimum insulation or CLEARANCES between the SELV windings and the other windings, including the connections of windings, should they loosen or become free.

NOTE
Examples of construction which comply with these requirements are the following (there are other forms of acceptable construction):

- Windings isolated from each other by placing them on separate limbs of the core, with or without spools;
- Windings on a single spool, with a partition wall, of adequate insulating material, whereby the spool and partition wall are pressed or moulded in one piece, or the pushed-on partition walls have an intermediate sheath or covering over the joint between the spool and the partition wall;
- Concentric windings on a spool of insulating material without flanges or on insulation applied in thin sheet form to the transformer iron core;
- Suitable insulation of adequate thickness is provided between the SELV windings and other windings, by sheet insulation extending beyond the end turns of each layer;

– Concentric windings, whereby SELV windings are separated from other windings by an earthed conductive screen with suitable insulation between each winding and the screen. The conductive screen may consist of metal foil extending the full width of the transformer winding. The conductive screen and its lead-out wire shall have a cross-section sufficient to ensure that on breakdown of the insulation an overload device will open the circuit before the screen is destroyed. The overload device can either be a part of the transformer or a part of the equipment.

All windings shall have the end turns retained by positive means.

It is not expected that two independent fixings will loosen at the same time.

If a SAFETY ISOLATING TRANSFORMER is fitted with an earthed screen for protective purposes, the transformer shall be subject to the test of 2.5.11 between the earthed screen and the earthing terminal of the transformer.

C.3 Electric strength requirements

Electric strength tests shall be applied in accordance with 5.3 and table C.2, taking into account figure C.2.

When carrying out a test between two points of application, it is permitted to connect other points together or to earth.

Table C.2 - Electric strength tests

Grade of insulation	*Insulation* [1), 2), 3), 7), 8)]		*Test voltage*	*Key to figure C.2*
	between	*and*		
1. OPERATIONAL	SELV *winding*	– *earthed* BODY,*core or screen* – DOUBLE-INSULATED BODY, *core or screen* – *any other SELV winding*	*See condition* [1)] *See condition* [4)]	*1a* *1b* *1c*
	ELV *winding*	– *earthed* BODY,*core or screen* – BASIC-INSULATED BODY, *core or screen* – *earthed* SELV *winding* – *another* ELV *winding*		*1d* *1e* *1f* *1g*
	Earthed HAZARDOUS VOLTAGE *secondary winding*	– *another earthed* HAZARDOUS VOLTAGE *secondary winding*		*1h*
	Series/parallel sections of a winding			
2. BASIC	*Mains winding*	– HAZARDOUS VOLTAGE *secondary winding* – ELV *winding* – *earthed* SELV *winding* – BASIC-INSULATED BODY, *core or screen* – *earthed* BODY, *core or screen*	*Table 18* *Primary* BASIC	*2a* *2b* *2c* *2d* *2e*
	Earthed or unearthed HAZARDOUS VOLTAGE *winding*	– *unearthed* HAZARDOUS VOLTAGE *secondary winding* – ELV *winding* – *earthed* SELV *winding* – BASIC-INSULATED BODY, *core or screen* – *earthed* BODY, *core or screen*	*Table 18* *Secondary* BASIC	*2f* *2g* *2h* *2j* *2k*
3. SUPPLEMENTARY	ELV *winding*	– DOUBLE-INSULATED BODY, *core or screen* – *unearthed* SELV *winding*	*Table18* SUPPLEMENTARY	*3a* *3b*
	BASIC-INSULATED BODY *or screen*	– DOUBLE-INSULATED BODY, *core or screen* – *unearthed* SELV *winding*	*See condition 6)*	*3c* *3d*
4. SUPPLEMENTARY *or* REINFORCED	*Unearthed* HAZARDOUS VOLTAGE *secondary winding*	– *unearthed* SELV *winding* – DOUBLE-INSULATED BODY, *core or screen*	*See condition 5)*	*4a* *4b*
5 REINFORCED	*Mains winding*	– *unearthed SELV winding* – DOUBLE-INSULATED BODY, *core or screen*	*Table 18* *primary* REINFORCED	*5a* *5b*
	Earthed HAZARDOUS VOLTAGE *secondary winding*	– *unearthed* SELV *winding* – DOUBLE-INSULATED BODY, *core or screen*	*Table 18* *Secondary* REINFORCED	*5c* *5d*

Conditions applicable to table C.2

1) The expression "SELV winding" is used as a simplification (for convenience) in table C.2 and should be read as "winding connected in, or to, an SELV CIRCUIT". Similarly, "ELV winding" should be read as "winding connected in, or to, an ELV CIRCUIT".

2) It is permitted for BODIES, cores and screens to have one or two levels of protection from parts at hazardous voltage. If they are protected by DOUBLE or REINFORCED INSULATION, they are termed "DOUBLE-INSULATED" in the table. If they are protected by BASIC INSULATION plus protective earthing, they are termed "earthed" in the table. If they have no second level of protection, they are termed "BASIC-INSULATED" and must not be accessible.

3) In the table, a part of a winding is termed "unearthed" unless it is connected to a protective earthing terminal or contact in such a way as to meet the requirements in 2.5.11 (although it will not necessarily be at earth potential). An ELV winding is therefore unearthed: an earthed ELV winding would be an SELV winding.

4) See 5.4.4 for requirements for OPERATIONAL INSULATION.

5) Insulation between an unearthed HAZARDOUS VOLTAGE secondary and an unearthed accessible part or SELV winding has to satisfy the more onerous of the following requirements:
   - REINFORCED INSULATION based on the WORKING VOLTAGE equal to the voltage of the HAZARDOUS VOLTAGE secondary, or
   - SUPPLEMENTARY INSULATION based on the WORKING VOLTAGE equal to the voltage between the HAZARDOUS VOLTAGE secondary and another HAZARDOUS VOLTAGE secondary or a mains winding.

   Which of these is more onerous will depend on the relative voltages of the windings.

6) Where unearthed parts of ELV windings are separated from HAZARDOUS VOLTAGES by BASIC INSULATION only, the WORKING VOLTAGE of the SUPPLEMENTARY INSULATION between such parts and unearthed accessible parts or SELV windings is the same as the most onerous WORKING VOLTAGE for the BASIC INSULATION. The most onerous WORKING VOLTAGE may be due to a mains primary winding or to a SECONDARY CIRCUIT and the test voltage is selected accordingly.

7) The term "body" means the BODY of the equipment together with any conductive parts of the transformer which are conductively connected to it as part of the protective earth system.

8) The electric strength tests do not apply to insulation between any winding and the core or screen, provided that the core or screen is totally enclosed or encapsulated and there is no electrical connection to the core or screen. However, the tests between windings which have terminations continue to apply.

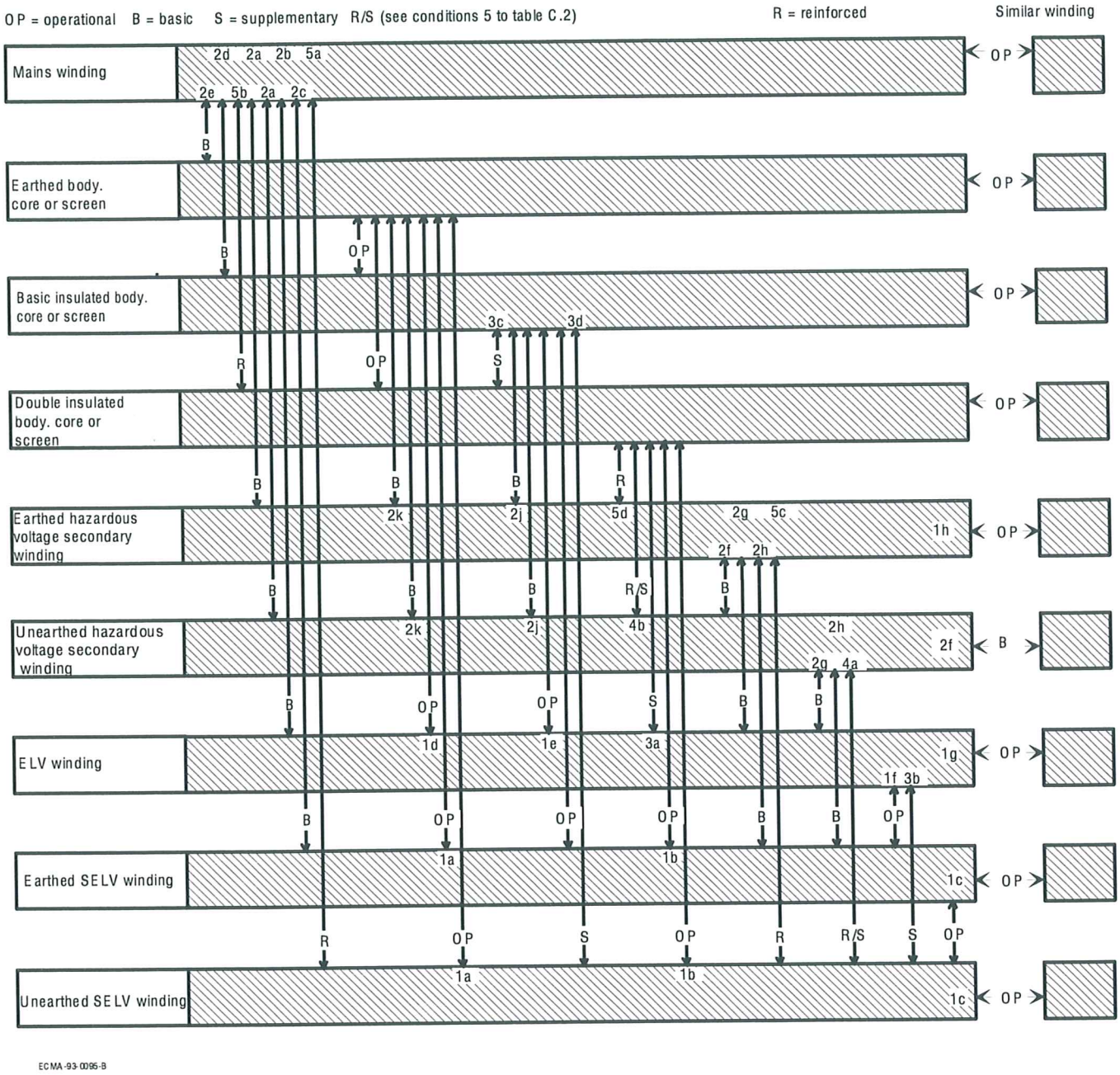
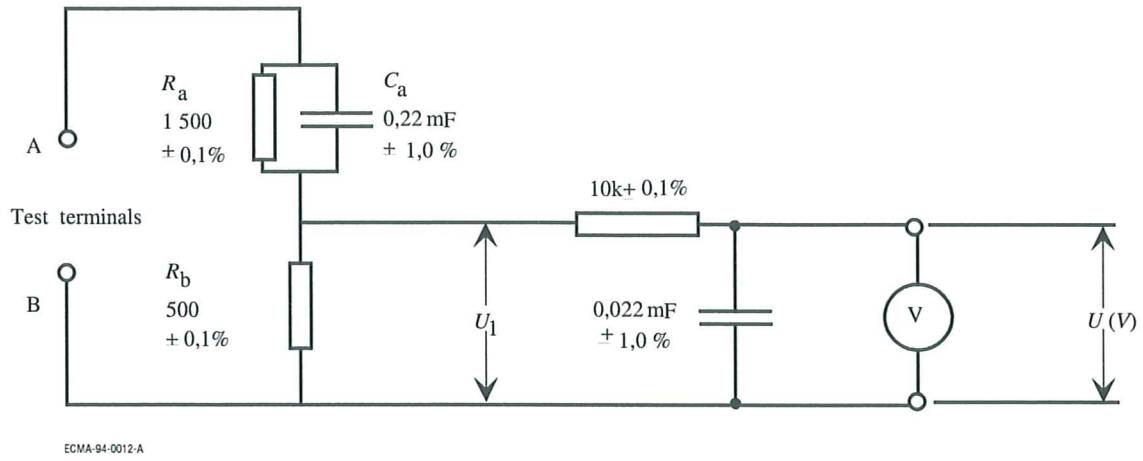


Figure C.2 - Grades of insulation in transformers

Annex D

(normative)

Measuring instrument for earth leakage current test (see 5.2.2 and Annex G.2)



V: Voltmeter — True r.m.s. reading
Uncertainty: ≤ 2%
Input resistance: ≥ 1 MΩ
Input capacitance: ≤ 200 pF
Frequency range: 15 Hz to 1 MHz

Weighted leakage current $\frac{U}{500}$ A

Figure D.1 - Measuring instrument for earth leakage current test

EN 60950 - European differences
Until annex D of amendment 1:1992 to IEC 950:1991 has been amended by IEC/TC74 in accordance with the decision taken at its meeting in May 1993, the measuring instrument for earth leakage testing as given in annex D of EN 60950:1992 (unamended) may be used instead of that in annex D of EN 60950:1992/A1:1993.

Annex E

(normative)

Temperature rise of a winding (see 1.4.8 and 5.1)

The value of the temperature rise of a winding is calculated from the formula:

$$\Delta t = \frac{R_2 - R_1}{R_1}(234{,}5 + t_1) - (t_2 - t_1)$$ for a copper winding

$$\Delta t = \frac{R_2 - R_1}{R_1}(225 + t_1) - (t_2 - t_1)$$ for an aluminium winding

Where

Δt is the temperature rise (K)
R_1 is the resistance of the winding at the beginning of the test (Ω)
R_2 is the resistance of the winding at the end of the test (Ω)
t_1 is the room temperature at the beginning of test (°C)
t_2 is the room temperature at the end of the test (°C)

At the beginning of the test, the windings are at room temperature.

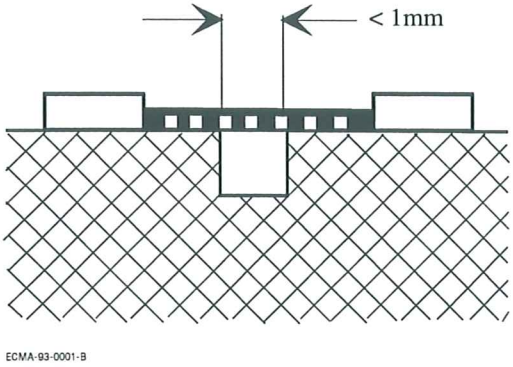
It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

Annex F

(normative)

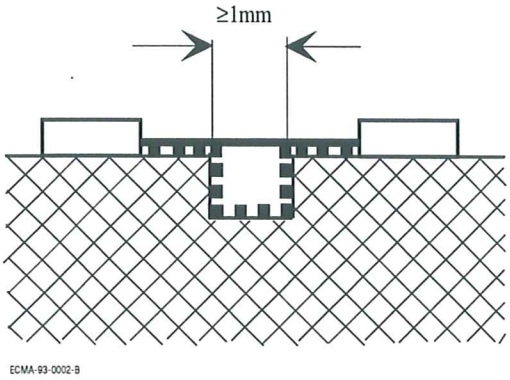
Measurement of creepage distances and clearances (see 2.9)

The methods of measuring CREEPAGE DISTANCES and CLEARANCES which are specified in the following figures are used in interpreting the requirements of this standard.



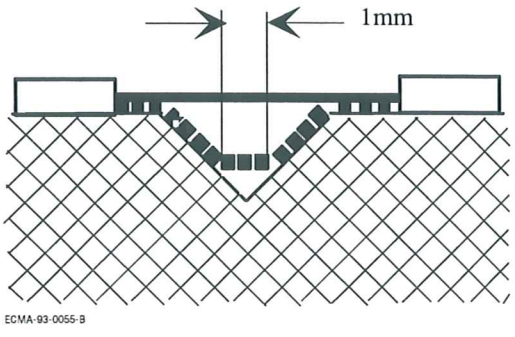
Condition: Path under consideration includes a parallel or converging-sided groove of any depth with width less than 1 mm.
Rule: CREEPAGE DISTANCE and CLEARANCE are measured directly across the groove.

Figure F.1 - Narrow groove



Condition: Path under consideration includes a parallel-sided groove of any depth, and equal to or more than 1 mm wide.
Rule: CLEARANCE is the "line of sight" distance. CREEPAGE DISTANCE path follows the contour of the groove.

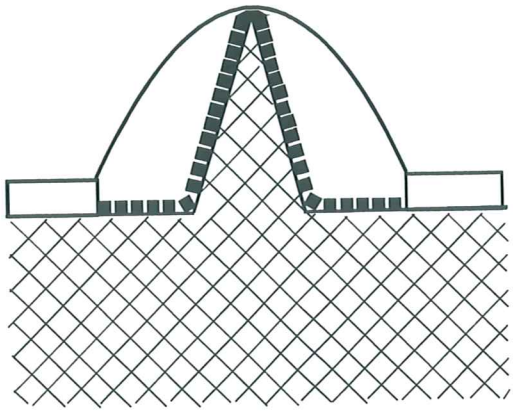
Figure F.2 - Wide groove



Condition: Path under consideration includes a V-shaped groove with internal angle of less than 80° and a width greater than 1 mm.
Rule: CLEARANCE is the "line of sight" distance. CREEPAGE DISTANCE path follows the contour of the groove but "short-circuits" the bottom of the groove by 1 mm (0,25 mm for dirt-free situations) link.

Figure F.3 - V-shaped groove

■ ■ ■ ■ ■ ■ Creepage distance
——————— Clearance



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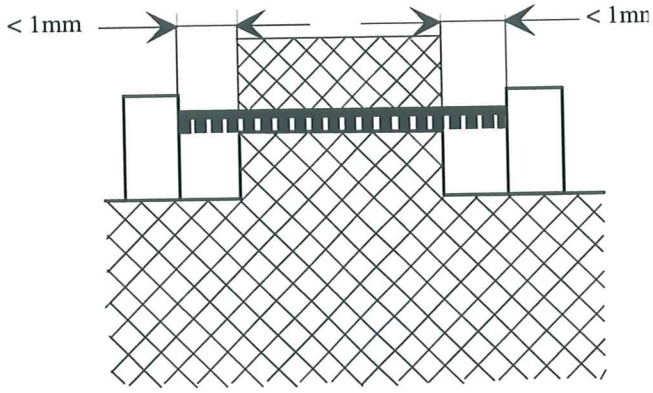
Condition: Path under consideration includes a rib.
Rule: CLEARANCE is the shortest direct air path over the top of the rib. CREEPAGE DISTANCE path follows the contour of the rib.

Figure F.4 - Rib



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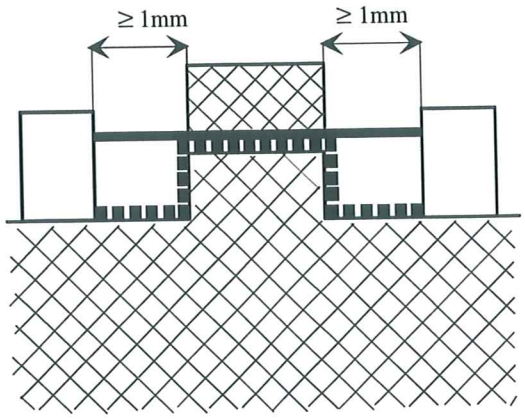
Condition: Path under consideration includes an uncemented joint with grooves less than 1 mm (0,25 mm for dirt-free situations) wide on either side.
Rule: CREEPAGE DISTANCE and CLEARANCE path is the "line of sight" distance shown.

Figure F.5 - Uncemented joint with narrow groove

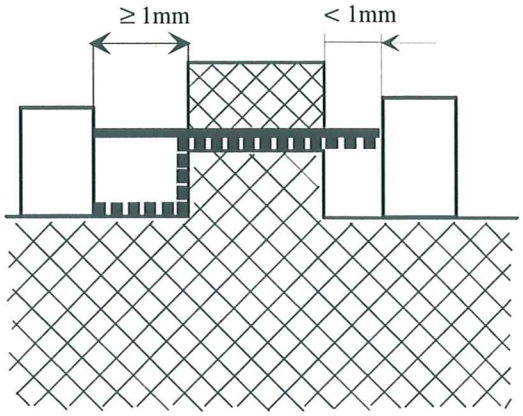


ECMA-93-0058-B

Condition: Path under consideration includes an uncemented joint with a groove equal to or more than 1 mm wide each side.
Rule: CLEARANCE is the "line of sight" distance. Creepage path follows the contour of the groove.

Figure F.6 - Uncemented joint with wide groove

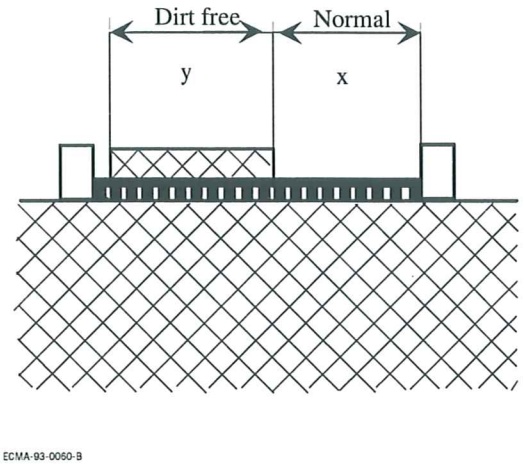
■ ■ ■ ■ ■ ■ Creepage distance
——————— Clearance



Condition: Path under consideration includes an uncemented joint with grooves on one side less than 1 mm wide, and a groove on the other equal to or more than 1 mm wide.

Rule: CLEARANCE and creepage path are as shown.

Figure F.7 - Uncemented joint with narrow and wide grooves



To apply the CREEPAGE requirements given for dirt-free, normal or dirty situations, to a case where more than one situation exists, the limits are computed on a volt per millimetre basis according to the distance measured under each situation.

For the requirements of 2.9.3, for a WORKING VOLTAGE of 250 V for OPERATIONAL, BASIC and SUPPLEMENTARY INSULATION, material group II, the corresponding limiting volts/millimetre are given in table F1.

Table F.1 - Pollution degrees

Situation	V/mm
Pollution degree 1 Pollution degree 2 Pollution degree 3	150 138 69

The CREEPAGE DISTANCE in each situation shall be measured and the corresponding voltage computed from table F.1. The sum of these computed voltages shall be not less than the WORKING VOLTAGE between the parts concerned.

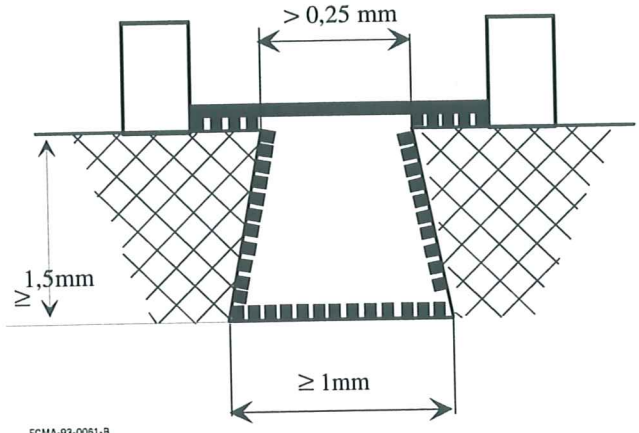
For example:

Suppose x = 2 mm, then computed voltage = 2 X 69 = 138.
Suppose y = 1 mm, then computed voltage = 1 X 138 = 138.

The sum of these voltages is 276 and thus the example complies with the requirements for a WORKING VOLTAGE of 250 V.

Figure F.8 - Creepage distance under mixed conditions

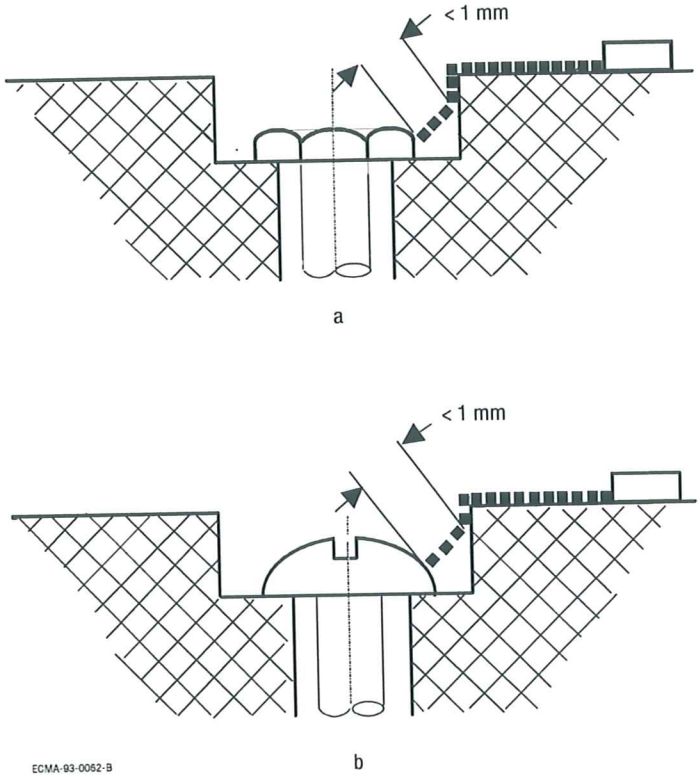
■ ■ ■ ■ ■ ■ Creepage distance
——————— Clearance



Condition: Path under consideration includes a diverging-sided groove equal to or greater than 1,5 mm deep, and greater than 0,25 mm wide at the narrowest part and equal to or greater than 1 mm at the bottom.

Rule: CLEARANCE is the "line of sight" distance. CREEPAGE path follows the contour of the groove. F3 also applies to the internal corners if they are less than 80°.

Figure F.9 - Divergent groove

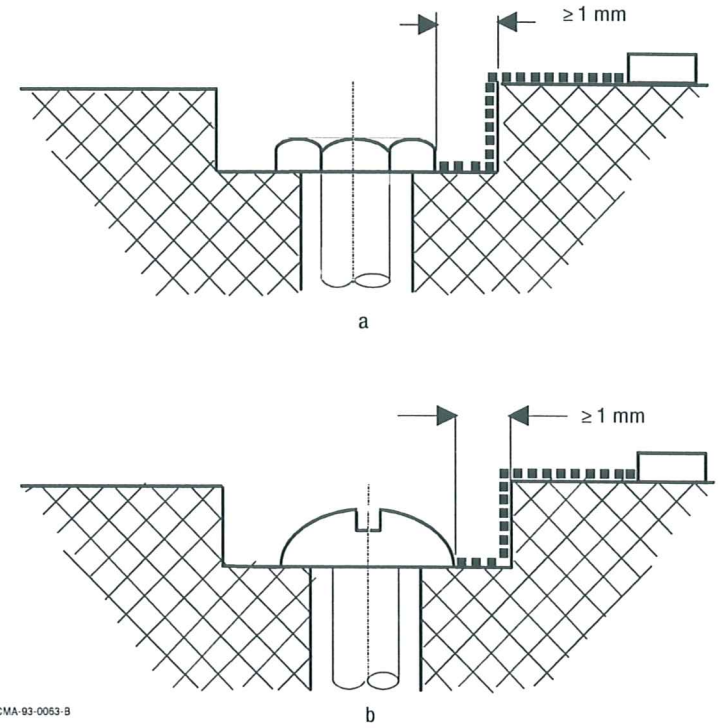


Gap between head of screw and wall of recess too narrow to be taken into account.

Figure F.10 - Narrow recess

■ ■ ■ ■ ■ ■ Creepage distance

——————— Clearance



Gap between head of screw and wall of recess wide enough to be taken into account.

Figure F.11 - Wide recess

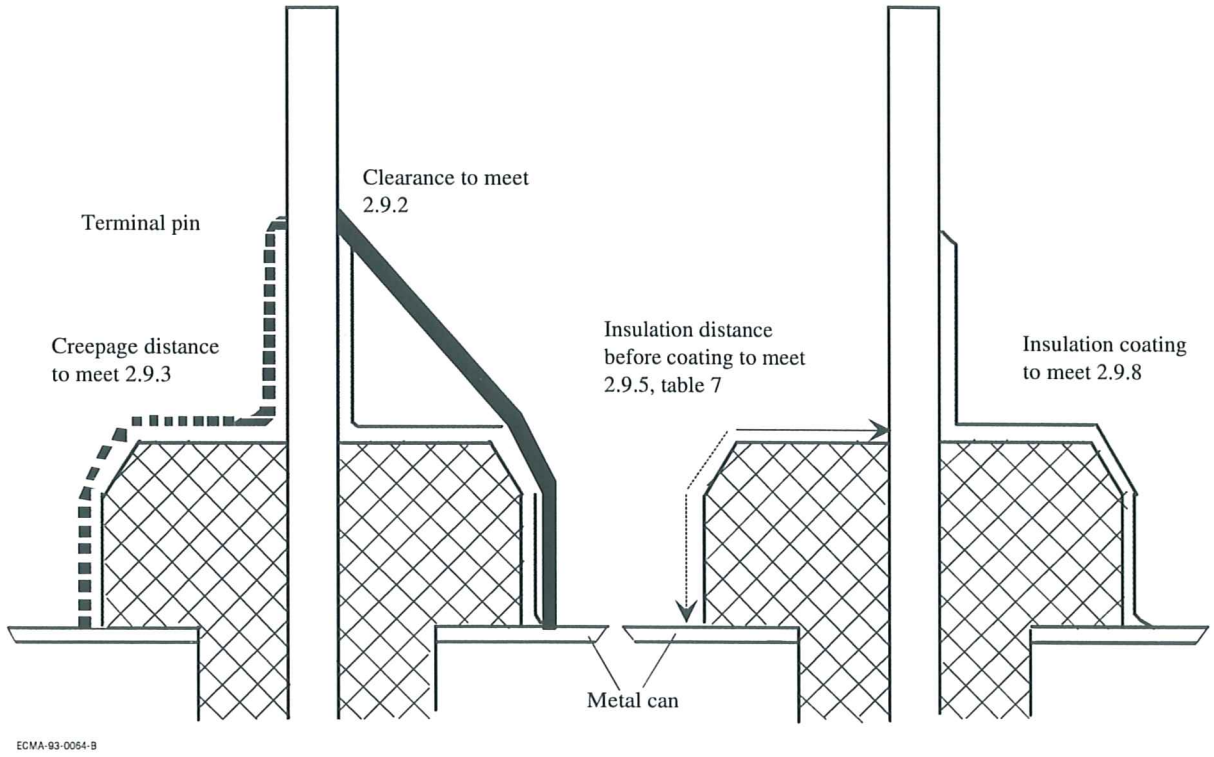


Figure F.12 - Coating around terminals

■ ■ ■ ■ ■ ■ Creepage distance

——————— Clearance

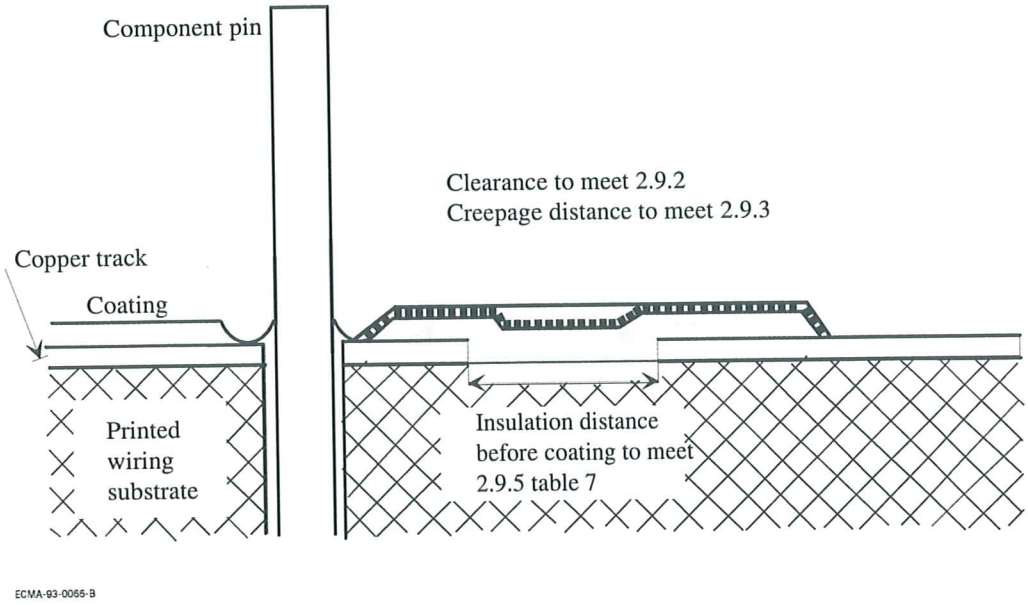
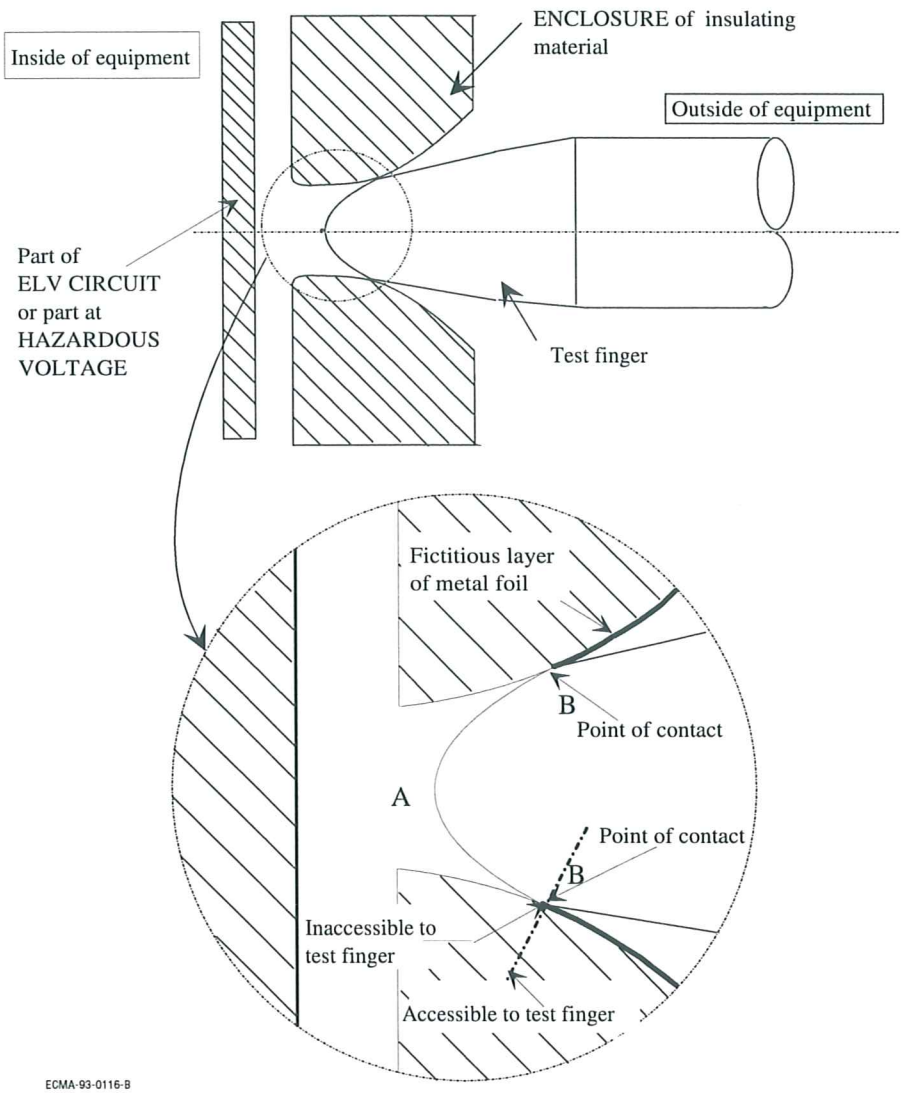


Figure F.13 - Coating over printed wiring

■ ■ ■ ■ ■ ■ Creepage distance
——————— Clearance



Point A is used for determining accessibility (see 2.1.,2)

Point B is used for measurement of CLEARANCE and CREEPAGE distances

Figure F.14 - Example of measurements in an enclosure of insulating material

Annex G

(normative)

Earth leakage current for equipment intended to be connected directly to IT power systems (see 5.2)

G.1 General

This annex provisionally covers the requirements for equipment to be connected directly to IT POWER SYSTEMS. Equipment which meets these requirements will also meet the requirements, specified in 5.2, for connection to TT or TN POWER SYSTEMS. Equipment which is not intended to be connected to IT POWER SYSTEMS should be tested according to 5.2, not this annex.

NOTE
On an IT POWER SYSTEM, the current which flows through the equipment safety earth conductor when it is correctly connected may be higher than for TT or TN POWER SYSTEMS. The test procedures in this annex will, under the adopted conditions, determine the leakage current which could flow through a person in the event of accidental breakage of the equipment safety earth conductor.

G.2 Requirements

Equipment shall not have earth leakage current in excess of the values in table G.1 when measured as defined in clauses G.3 or G.4.

Table G.1 - Maximum earth leakage current for equipment connected to IT power systems

Class	Type of equipment	Maximum leakage current mA
II	All	0,25
I	HAND-HELD	0,75
I	MOVABLE (other than hand-held)	3,5
I	STATIONARY, PLUGGABLE TYPE A	3,5
I	STATIONARY, PERMANENTLY CONNECTED or PLUGGABLE TYPE B: – not subject to the conditions in clause G.5 – subject to the conditions in clause G.5	 3,5 5% of input current

Systems of interconnected equipment with individual connections to primary power shall have each piece of equipment tested separately. Systems of interconnected equipment with one common connection to primary power shall be treated as a single piece of equipment.

Equipment designed for multiple (redundant) supplies shall be tested with only one supply connected.

If it is clear from a study of the circuit diagrams of CLASS I PERMANENTLY CONNECTED EQUIPMENT or PLUGGABLE EQUIPMENT TYPE B that the earth leakage current will exceed 3,5 mA, but will not exceed 5% of input current, the tests need not be made.

Compliance is checked by the following tests which are carried out using the measuring instrument described in annex D, or any other circuit giving the same results, and preferably using an isolating supply transformer as shown. If the use of an isolating transformer is not practicable, the equipment is mounted on an insulating stand, not earthed, and due safety precautions are taken in view of the possibility of the BODY of the equipment being at a HAZARDOUS VOLTAGE.

For CLASS II EQUIPMENT the test is made to accessible conductive parts, and to metal foil having dimensions of 10 cm x 20 cm in contact with accessible non-conductive parts. If the area of the foil is smaller than the surface under test, the foil is moved so as to test all parts of the surface where adhesive metal foil is used, the adhesive shall be conductive. Precautions are taken to avoid the metal foil affecting the heat dissipation of the equipment.

Note
The test simulates hand contact.

If it is inconvenient to test equipment at the most unfavourable supply voltage (see 1.4.5), it is permitted to test at any available voltage within the RATED VOLTAGE RANGE or within the tolerance of RATED VOLTAGE and then calculate the results.

G.3 Single-phase equipment

G.3.1 Test Set up

Single-phase equipment intended for operation between one phase conductor and neutral is tested using the circuit of figure G.1, with the selector switch in each of the positions 1, 2 and 3.

G.3.2 Test procedure

For each position of the selector switch, any switches within the equipment controlling primary power and likely to be operated in normal use are opened and closed in all possible combinations.

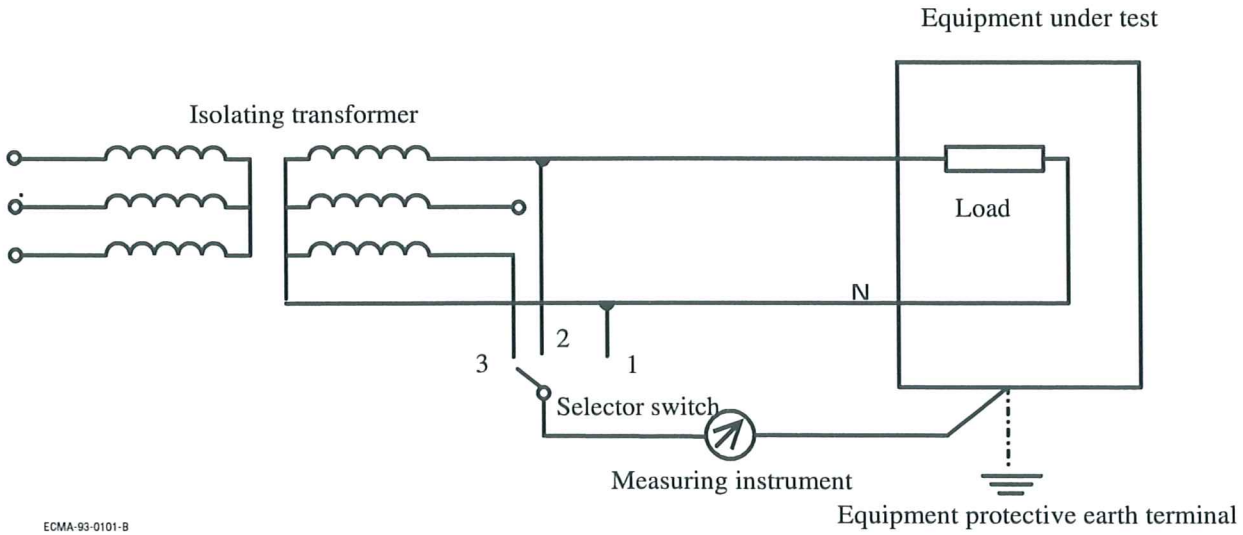


Figure G.1 - Test circuit for earth leakage current on single-phase equipment for connection to IT power systems

None of the current values shall exceed the relevant limit specified in table G.1.

G.4 Three-phase equipment

G.4.1 Test setup

Three-phase equipment and equipment intended for operation between two phase conductors is tested under the following conditions, using the circuit of figure G.2, with the selector switch in each of the positions 1, 2, 3 and 4.

G.4.2 Test procedure - (opening of switches)

For each position of the selector switch, any switches within the equipment controlling primary power and likely to be operated in normal use are opened and closed in all possible combinations.

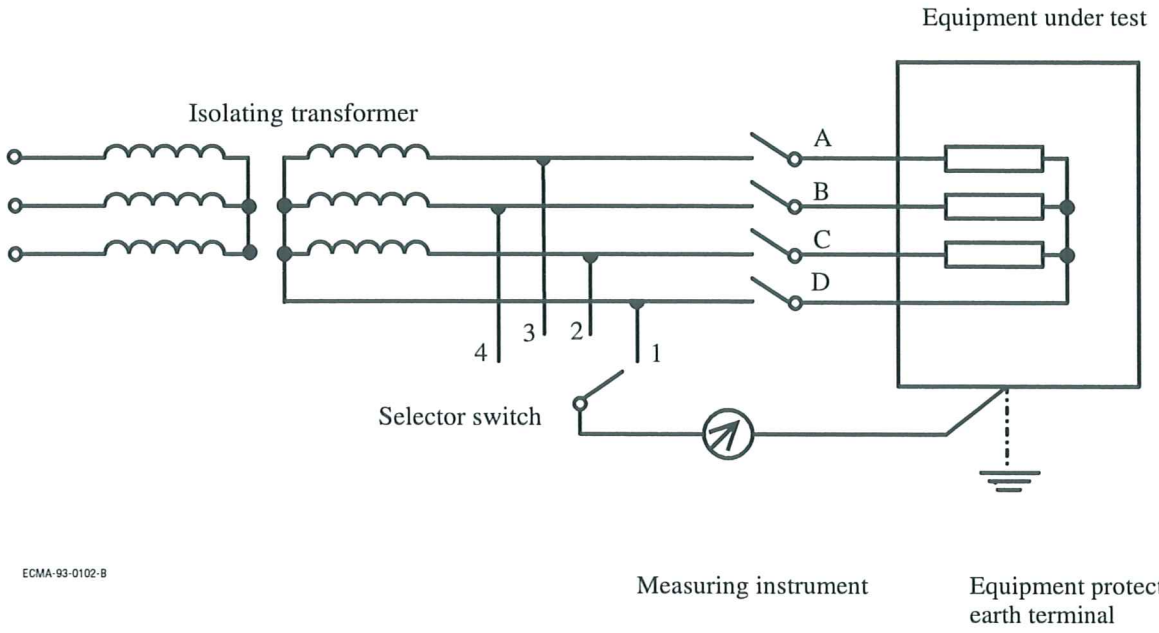


Figure G.2 - Test circuit for earth leakage current on three-phase equipment for connection to IT power systems

G.4.3 Test procedure - disconnection of EMI components

Test as in G.4.2 and in addition disconnect one at a time any components used for EMI suppression connected between phase and earth; for this purpose groups of components in parallel connected through a single connection are treated as single components.

Each time a line to earth component is disconnected the full sequence of G.4.2 is repeated.

NOTE
Where filters are normally encapsulated it may be necessary either to provide an unencapsulated unit for this test or to simulate the filter network.

None of the current values shall exceed the relevant limit specified in table G.1.

G.5 Equipment with earth leakage current exceeding 3,5 mA

CLASS I STATIONARY EQUIPMENT that is PERMANENTLY CONNECTED EQUIPMENT or that is PLUGGABLE EQUIPMENT TYPE B, with an earth leakage current exceeding 3,5 mA is subjected to the following conditions:

- leakage current shall not exceed 5% of the input current per phase. Where the load is unbalanced the largest of the three-phase currents is used for this calculation. Where necessary, the tests in 5.2.3 and 5.2.4 are used but with a measuring instrument of negligible impedance;
- the cross-sectional area of the internal protective earthing conductor shall be not less than that of the conductor in table 11, with minimum of 1,0 mm^2, in the path of high leakage current;
- a label bearing the following warning, or similar wording, shall be affixed adjacent to the equipment primary power connection:

HIGH LEAKAGE CURRENT

Earth connection essential

before connecting supply

Annex H

(normative)

Ionizing radiation (see 4.3.12)

Equipment which might produce ionizing radiation is checked by measuring the amount of radiation.

The amount of radiation is determined by means of a radiation monitor of the ionizing chamber type with an effective area of 10 cm^2, or by measuring equipment of other types giving equivalent results.

Measurements are made with the equipment on test operating at the most unfavourable supply voltage (see 1.4.5) and with OPERATOR controls and service controls adjusted so as to give maximum radiation whilst maintaining the equipment operative for normal use. Internal preset controls not intended to be adjusted during the lifetime of the equipment are not considered to be service controls.

At any point 5 cm from the surface of the OPERATOR ACCESS AREA the dose-rate shall not exceed 36 pA/kg (0,5 mR/h). Account is taken of the background level.

NOTE
This value appears in ICRP 26.

EN 60950 - European differences

Germany
(Regulation on protection against hazards by X-rays, of 8th January 1987, Article 5 (Operation of X-rays emission source), Clauses 1 to 4)

a) A licence is required by those who operate an X-rays emission source

b) A licence in accordance with clause 1 is not required by those who operate an X-rays emission source on which the electron acceleration voltage does not exceed 20 kV if
   1) the local dose rate at a distance of 0,1 m from the surface does not exceed 1 µSv/h and
   2) it is adequately indicated on the X-rays emission source that
      i) X-rays are generated and
      ii) the electron acceleration voltage must not exceed the maximum value stipulated by the manufacturer or importer.

c) A licence in accordance with clause 1 is also not required by persons who operate an X-ray emission source on which the electron acceleration voltage exceeds 20 kV if
   1) the X-rays emission source has been granted a type approval and
   2) it is adequately indicated on the X-ray emission source that
      i) X-rays are generated,
      ii) the device stipulated by the manufacturer or importer guarantees that the maximum permissible locale dose rate in accordance with the type approval is not exceeded and
      iii) the electron acceleration voltage must not exceed the maximum value stipulated by the manufacturer or importer

d) Furthermore, a licence in accordance with clause 1 is also not required by persons who operate X-ray emission sources on which the electron acceleration voltage does not exceed 30 kV if
   1) the X-rays are generated only by intrinsically safe CRTs complying with Enclosure III, No. 6,
   2) the values stipulated in accordance with Enclosures III, No. 6.2 are limited by technical measures and specified in the device and
   3) it is adequately indicated on the X-ray emission source that the X-rays generated are adequately screened by the intrinsically safe CRT.

Annex J

(normative)

Table of electrochemical potentials (see 2.5.10)

Table J.1 - Electrochemical potentials

Magnesium, magnesium alloys	Zinc, zinc alloys	80 tin/20 Zn on steel, Zn on iron or steel	Aluminium	Cd on steel	Al/Mg alloy	Mild steel	Duralumin	Lead	Cr on steel, soft solder	Cr on Ni on steel, tin on steel 12% Cr stainless steel	High Cr stainless steel	Copper, copper alloys	Silver solder, Austenitic stainless steel	Ni on steel	Silver	Rh on Ag on Cu, silver/gold alloy	Carbon	Gold, platinum	
0	0,05	0,55	0,7	0,8	0,85	0,9	1,0	1,05	1,1	1,15	1,25	1,35	1,4	1,45	1,6	1,65	1,7	1,75	Magnesium, magnesium alloys
	0	0,05	0,2	0,3	0,35	0,4	0,5	0,55	0,6	0,65	0,75	0,85	0,9	0,95	1,1	1,15	1,2	1,25	Zinc, zinc alloys
		0	0,15	0,25	0,3	0,35	0,45	0,5	0,55	0,6	0,7	0,8	0,85	0,9	1,05	1,1	1,15	1,2	80 tin/20Zn on steel, Zn on iron or steel
			0	0,1	0,15	0,2	0,3	0,35	0,4	0,45	0,55	0,65	0,7	0,75	0,9	0,95	1,0	1,05	Aluminium
				0	0,05	0,1	0,2	0,25	0,3	0,35	0,45	0,55	0,6	0,65	0,8	0,85	0,9	0,95	Cd on steel
					0	0,05	0,15	0,2	0,25	0,3	0,4	0,5	0,55	0,6	0,75	0,8	0,85	0,9	Al/Mg alloy
						0	0,1	0,15	0,2	0,25	0,35	0,45	0,5	0,55	0,7	0,75	0,8	0,85	Mild steel
							0	0,05	0,1	0,15	0,25	0,35	0,4	0,45	0,6	0,65	0,7	0,75	Duralumin
								0	0,05	0,1	0,2	0,3	0,35	0,4	0,55	0,6	0,66	0,7	Lead
									0	0,5	0,15	0,25	0,3	0,35	0,5	0,55	0,6	0,65	Cr on steel, soft solder
										0	0,1	0,2	0,25	0,3	0,45	0,5	0,55	0,6	Cr on Ni on steel, tin on steel, 12% Cr stainless steel
											0	0,1	0,15	0,2	0,35	0,4	0,45	0,5	High Cr stainless steel
												0	0,05	0,1	0,25	0,3	0,35	0,4	Copper, copper alloys
													0	0,05	0,2	0,25	0,3	0,35	Silver solder, Austenitic stainless steel
														0	0,15	0,2	0,25	0,3	Ni on steel
															0	0,05	0,1	0,15	Silver
																0	0,05	0,1	Rh on Ag on Cu, silver/gold alloy
																	0	0,05	Carbon
																		0	Gold, platinum

Ag = Silver
Al = Aluminium
Cr = Chromium
Cd = Cadmium
Cu = Copper
Mg = Magnesium
Ni = Nickel
Rh = Rhodium
Zn = Zinc

ECMA-93-0103-B

NOTE
Corrosion due to the electrochemical action between dissimilar metals which are in contact is minimized if the combined electrochemical potential is below about 0,6 V. In the table above the combined electrochemical potentials are listed for a number of pairs of metals in common use; combinations above the dividing line should be avoided.

Annex K

(normative)

Thermal controls (see 1.5.2 and 5.4.8)

K.1 General requirements

THERMOSTATS and TEMPERATURE LIMITERS shall have adequate making and breaking capacity.

Compliance is checked by subjecting three samples either to the tests of clauses K.2 and K.3, or to the tests of clause K.4, as appropriate. If the component is T-marked, one sample is tested with the switch part at room temperature, and two samples with the switch part at a temperature in accordance with the marking.

Components not marked with individual ratings are tested either in the equipment or separately, whichever is more convenient, but, if tested separately, the test conditions are to be similar to those occurring in the equipment.

During the tests, no sustained arcing shall occur.

After the tests, the samples shall show no damage impairing their further use. Electrical connections shall not have worked loose. The component shall withstand an electric strength test as specified in 5.3.2, except that the test voltage for the insulation between the contacts is twice the voltage applied when the equipment is operated at RATED VOLTAGE or at the upper voltage of the rated VOLTAGE RANGE.

For test purposes the switching frequency can be increased above the normal switching frequency inherent to the equipment, provided that no greater risk of failure is induced.

If it is not possible to test the component separately, three samples of the equipment in which it is used are tested.

K.2 Thermostats for equipment operating at 110% of the rated voltage

THERMOSTATS are caused, thermally, to perform 200 cycles of operation (200 makes and 200 breaks) when the equipment is operated at a voltage equal to 1,1 times RATED VOLTAGE or to 1,1 times the upper voltage of the RATED VOLTAGE RANGE, and under the most unfavourable load occurring in normal use.

K.3 Thermostats for equipment operating at the rated voltage

THERMOSTATS are caused, thermally, to perform 10 000 cycles of operation (10 000 makes and 10 000 breaks) when the equipment is operated at RATED VOLTAGE or at the upper voltage of the RATED VOLTAGE RANGE, and under NORMAL LOAD.

K.4 Temperature limiters

TEMPERATURE LIMITERS are caused, thermally, to perform 1 000 cycles of operation (1 000 makes and 1 000 breaks) when the equipment is operated at RATED VOLTAGE or at the upper voltage of the voltage range and under NORMAL LOAD.

K.5 Thermal cut-outs

THERMAL CUT-OUTS shall operate reliably.

Compliance is checked while the equipment is operating under the conditions specified in 5.1.

AUTOMATIC RESET THERMAL CUT-OUTS are caused to operate 200 times; MANUAL RESET THERMAL CUT-OUTS are reset after each operation and thus caused to operate ten times.

After the tests, the samples shall show no damage impairing their further use.

Forced cooling and resting periods are permitted to prevent damage to the equipment.

K.6 Construction

THERMOSTATS, TEMPERATURE LIMITERS and THERMAL CUT-OUTS shall be so constructed that their setting is not changed appreciably by heating, vibration, etc., occurring in normal use.

Compliance is checked by inspection during the abnormal operation tests of 5.4.9.

Annex L

(normative)

Normal load conditions for some types of electrical business equipment (see 1.2.2.1 and 5.1)

NORMAL LOAD conditions are as follows:

- *Typewriters are energized with no load applied until steady conditions are established. Manually keyed machines are then operated at a rate of 200 characters per minute, with a line transport operation after each 60 characters including spaces, until steady conditions are established. Automatically operated machines are operated at the maximum typing speed recommended in the manufacturer's instruction sheet.*
- *For adding machines and cash registers, four digit numbers are entered or set and the repeat key or operating bar activated 24 times per minute, until steady conditions are established.The four digit number to be employed shall be that which loads the machine most heavily. If the cash register has a drawer which opens every time an item is rung up, the cash register is operated at a rate of 15 operation cycles per minute, the drawer being shut after each operation, until steady conditions are established. For an adding machine or cash register, an operation consists in the OPERATOR setting or inserting the figures with which the machine is to operate and then pressing the operating bar, repeat key or the like for each operation.*
- *Erasers are operated continuously at no load for 1 h.*
- *For a pencil sharpener five new pencils are each sharpened eight times according to the following timetable. Except for new pencils, the point is broken off before each sharpening*

sharpening period	*4s for a new pencil*
	2s for subsequent sharpenings
interval between sharpenings	*6s*
interval between pencils	*60s*

  All times are approximate
- *Duplicators and copying machines are operated continuously at maximum speed until steady conditions are established. It is permitted to introduce a rest period of 3 min after each 500 copies if this would be compatible with the design of the machine.*
- *Motor-operated files are loaded to simulate a condition of unbalance caused by uneven distribution of the contents. During operation, the unbalanced load is moved approximately one-third of the total carrier travel of the path that will impose maximum loading during each operation. The operation is repeated each 15 s until steady conditions are established.*

  A load caused by the non-uniform distribution of the content is permitted to be simulated as follows. In the case of vertical transport, three-eighths of the filing area are to be loaded, without leaving clearances, with three-eighths of the admissible load. The entire transport way is to be travelled with this load. The transport cycle is to be repeated, at intervals of 10 s, until the temperature has stabilized. In the case of a different transport, for example horizontal or circular mode of transport, the total load is moved over the whole transport way. The transport cycle is to be repeated, at intervals of 15 s, until the temperature has stabilized.
- *Other business equipment is operated according to the most unfavourable way of operation given in the manufacturer's instruction sheet.*

Annex M

(normative)

Criteria for telephone ringing signals (see 6.2.1.1)

M.1 Introduction

The two alternative methods described in this annex reflect satisfactory experience in different parts of the world. Method A is typical of TELECOMMUNICATION NETWORKS in Europe, and Method B of those in North America. The two methods result in standards of electrical safety which are broadly equivalent.

M.2 Method A

This method is based on annex D of CENELEC EN 41003.

This method requires that the currents I_{TS1} and I_{TS2} flowing through a 5 kΩ resistor, between any two conductors or between one conductor and earth do not exceed the limits specified, as follows:

a) I_{TS1}, the effective current calculated from the calculated or measured current for any single active ringing period t_1 (as defined in figure M.1), does not exceed:

- for cadenced ringing ($t_1 < \infty$), the current given by the curve of figure M.2 at t_1, or
- for continuous ringing ($t_1 = \infty$), 16 mA, or 20 mA where cadenced ringing becomes continuous as a consequence of a single fault;

where I_{TS1}, in mA, is as given by:

$$I_{TS1} = \frac{I_p}{\sqrt{2}} \qquad (t1 \leq 600 \text{ ms})$$

$$I_{TS\,1} = \frac{T - 600}{600} \times \frac{I_{pp}}{2\sqrt{2}} + \frac{1200 - t_1}{600} \times \frac{I_p}{\sqrt{2}} \qquad (600 \text{ ms} < t1 < 1200 \text{ ms})$$

$$I_{TS1} = \frac{I_{pp}}{2\sqrt{2}} \qquad (t1 \geq 1200 \text{ ms})$$

where:

I_p is the peak current, in mA, of the relevant waveform given in figure M.3;

I_{pp} is the peak-to-peak current, in mA, of the relevant waveform given in figure M.3;

t_1 is expressed in ms.

b) I_{TS2}, the average current for repeated bursts of a cadenced ringing signal calculated for one ringing cadence cycle t_2 (as defined in figure M.1), does not exceed 16 mA r.m.s;

where I_{TS2}, in mA, is as given by:

$$I_{TS2} = \left[\frac{t_1}{t_2} \times I_{TS1}^2 + \frac{t_2 - t_1}{T_2} \times \frac{I_{dc}^2}{3{,}75^2} \right]^{1/2}$$

where:

I_{TS1}, in mA, is as given by (a);

I_{dc} is the d.c. current in mA flowing through the 5 kΩ resistor during the non-active period of the cadence cycle;

t_1 and t_2 are expressed in ms.

NOTE
The frequencies of telephone ringing voltages are normally within the range of 14 Hz to 50 Hz.

t_1 is:

- the duration of a single ringing period, where the ringing is active for the whole of the single ringing period;
- the sum of the active periods of ringing within the single ringing period, where the single ringing period contains two or more discrete active periods of ringing, as in the example shown, for which $t_1 = t_{1a} + t_{1b}$.

t_2 is

- the duration of one complete cadence cycle.

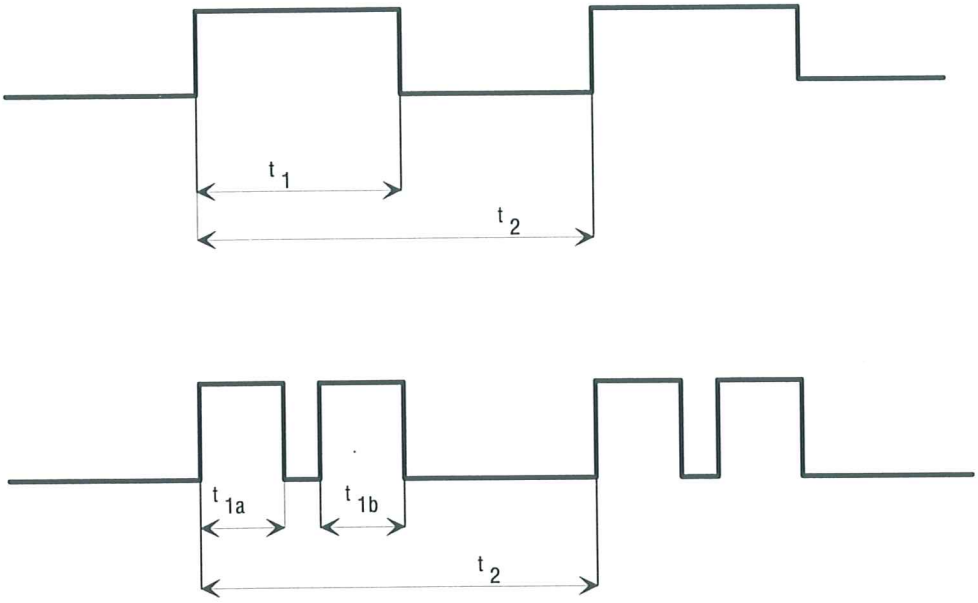
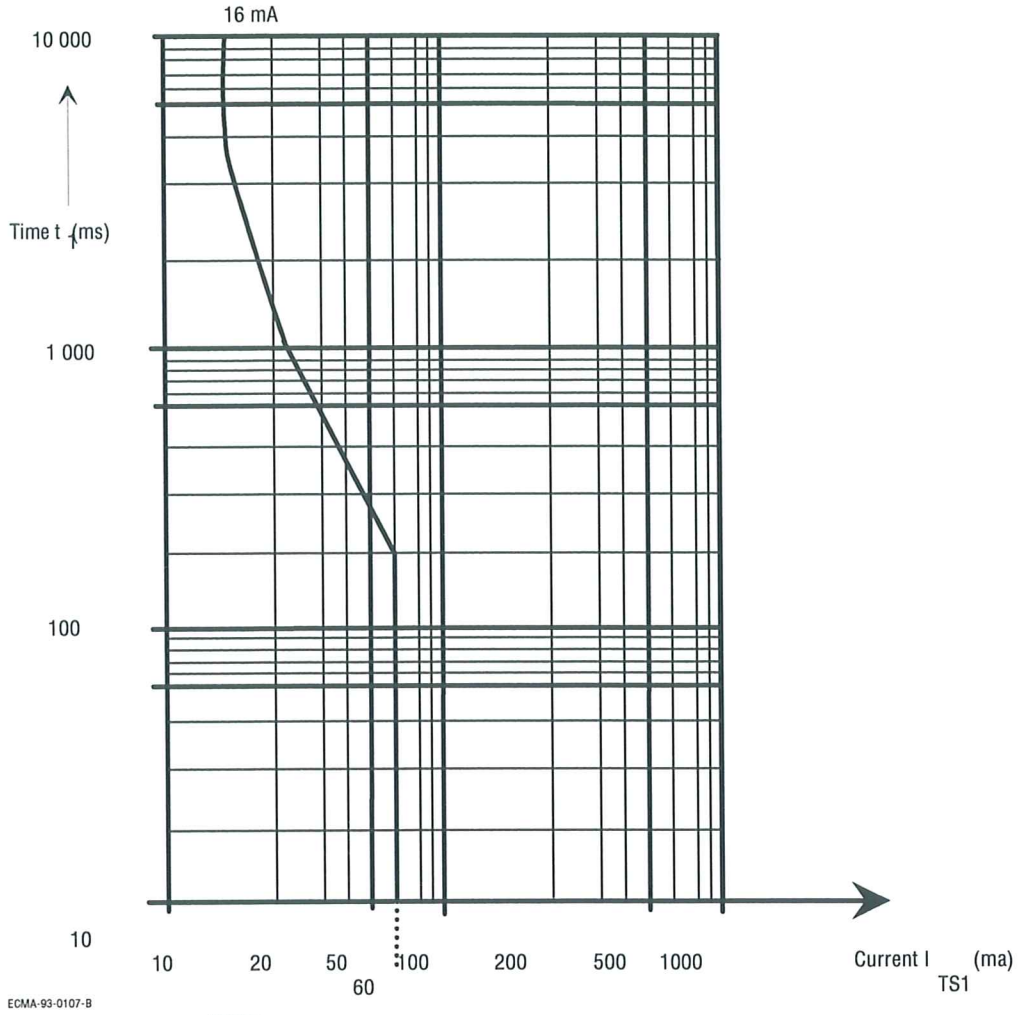


Figure M.1 - Definition of ringing period and cadence cycle



NOTE
The curve is based on curve b of figure 5 of IEC 479-1.

Figure M.2 - I_{ts1} limit curve for cadenced ringing signal

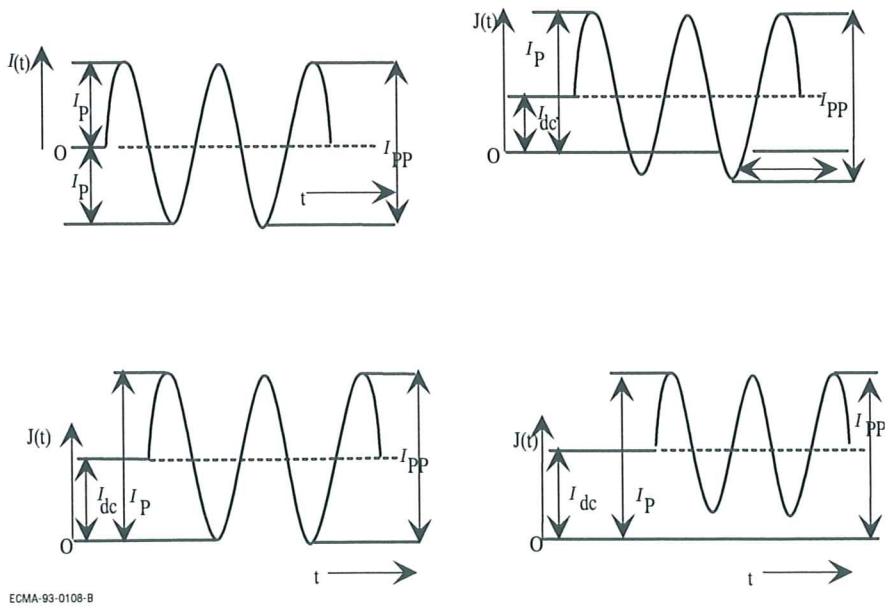


Figure M.3 - Peak and peak-to-peak currents

M.3 Method B

This method is based on U.S.A. CFR 47 ("FCC Rules") Part 68, Sub-part D, with additional requirements that apply under fault conditions. It requires that a ringing source shall meet the requirements of M.3.1, M.3.2 and M.3.3.

M.3.1 Ringing signal

M.3.1.1 Frequency.

The ringing shall use only frequencies whose fundamental component is equal to or less than 70 Hz.

M.3.1.2 Voltage

The ringing voltage shall be less than 300 V peak-to-peak and less than 200 V peak-to-earth, measured across a resistance of at least 1 MΩ.

M.3.1.3 Interval

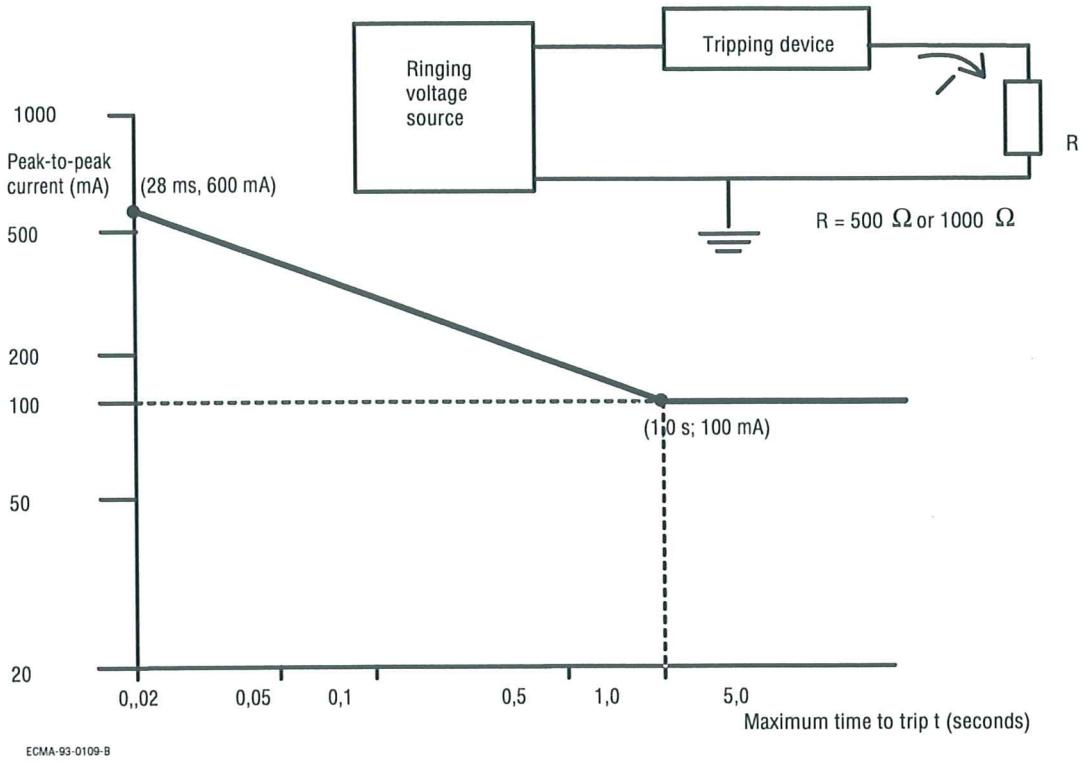
The ringing voltage shall be interrupted to create quiet intervals of at least 1 s duration separated by no more than 5 s. During the quiet intervals, the voltage to earth shall not exceed 56,5 V d.c.

M.3.2 Tripping device and monitoring voltage

M.3.2.1 Conditions for use of tripping device or monitoring voltage

A ringing signal circuit shall include a tripping device as specified in M.3.2.2, or provide a monitoring voltage as specified in M.3.2.3, or both, depending on the current through a specified resistance connected between the ringing source and earth, as follows:

- if the current through a 500 Ω resistor does not exceed 100 mA peak-to-peak, neither a tripping device nor a monitoring voltage is required;
- if the current through a 1500 Ω resistor exceeds 100 mA peak-to-peak, a tripping device shall be included If the tripping device meets the trip criteria specified in figure M.4 with R = 500 Ω, no monitoring voltage is required. If, however, the tripping device only meets the trip criteria with R = 1500 Ω, a monitoring voltage shall also be provided;
- if the current through a 500 Ω resistor exceeds 100 mA peak-to-peak, but the current through a 1500 Ω resistor does not exceed this value, either:
  - a tripping device shall be provided, meeting the trip criteria specified in figure M.4 with R = 500 Ω, or
  - a monitoring voltage shall be provided.



NOTE 1
t is measured from the time of connection of the resistor R to the circuit.

NOTE 2
The sloping part of the curve is defined as $I = \frac{100}{\sqrt{t}}$

Figure M.4 - Ringing voltage trip criteria

M.3.2.2 Tripping device

A series current-sensitive tripping device in the ring lead which will trip ringing as specified in figure M.4.

M.3.2.3 Monitoring voltage

A voltage to earth on the tip or ring conductor with a magnitude of at least 19 V peak, but not exceeding 56,5 V d.c., whenever the ringing voltage is not present (idle state).

M.3.3 Fault conditions

The ringing source shall meet the requirements of M.3.3.1 and M.3.3.2.

M.3.3.1 Overload

The current through a 5 Ω resistor shall not exceed 20 mA r.m.s. when it is connected between:

- any two conductors;
- any one conductor and earth.

M.3.3.2 Short circuit

The current that flows shall not exceed 500 mA r.m.s. when connections are made as follows:

- the output conductors are connected together, or
- any conductor is connected to earth

Annex N

(normative)

Impulse test generator (see 6.4.2.1)

The circuit in figure N.1 is used to generate 10/700 µs impulses (10 µs virtual front time, 700 µs virtual time to half value), the 20 µF capacitor being charged initially to a voltage Uc.

NOTES

1 Extreme care is necessary when using this test generator due to the high electric charge stored in the capacitor.

2 The impulse test circuit is that specified in CCITT Recommendation K.17 to simulate lightning interference in the TELECOMMUNICATION NETWORK.

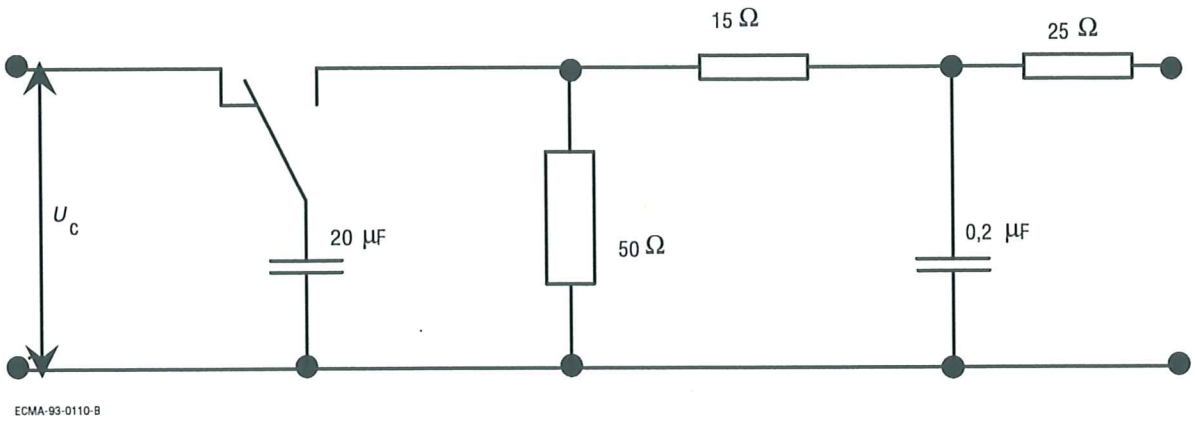


Figure N.1 - Impulse generating circuit

Annex P

(normative)

Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC Standards

IEC 65:(1985),	*Safety requirements for mains operated electronic and related apparatus for household and similar general use.*
IEC 73:(1984),	*Colours of indicator lights and push-buttons.*
IEC 83:(1975),	*Plugs and socket-outlets for domestic and similar general use.*
IEC 85:(1984),	*Thermal evaluation and classification of electrical insulation.*
IEC 112:(1979),	*Method for determining the comparative and the proof tracking indices of solid insulating material under moist conditions.*
IEC 227:(1979),	*Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V.*
IEC 245:(1980; 1985),	*Rubber insulated cables of rated voltages up to and including 450/750 V.*
IEC 309:(1988; 1989),	*Plugs, socket-outlets and couplers for industrial purposes.*
IEC 320:(1981),	*Appliance couplers for household and similar general purposes.*
IEC 364:(19xx),	*Electrical installations of buildings.*
IEC 384-14:(1981),	*Fixed capacitors for radio interference suppression. Fixed capacitors for use in electronic equipment. Part 14 :sectional specification:Fixed capacitors for radio interference suppression. Selection of methods of test and general requirements.*
IEC 417:(1973),	*Graphical symbols for use on equipment. Index, survey and compilation of the single sheets.*
IEC 664:(1980),	*Insulation co-ordination within low-voltage systems including clearances and creepage distances for equipment.*
IEC 695-2-2:(1980),	*Fire hazard testing, Needle-flame test.*
IEC 825:(1984),	*Radiation safety of laser products, equipment classification, requirements and user's guide.*
IEC 885-1:(1987),	*Electrical tests for electric cables. Text missing cords and wires for voltages up to and including 450/750 V.*

ISO Standards

ISO 216:(1975),	*Writing paper and certain classes of printed matter - Trimmed sizes - A and B series.*
ISO 261:(1973),	*ISO General purpose metric screw threads - General plan.*
ISO 262:(1973),	*ISO General purpose metric screw threads - Selected sizes for screws, bolts and nuts.*
ISO 3864:(1984),	*Safety colours and safety signs.*
ISO 4046:(1978),	*Paper, board, pulp and related terms - Vocabulary.*
ISO 7000:(1984),	*Graphical symbols for use on equipment - Index and synopsis.*

Other publications

- CENELEC EN 41003 (1991): Particular electrical safety requirements for equipment to be connected to telecommunication networks.
- CFR 47, Part 68 : Code of Federal Regulations (USA). Part 68: Connection of terminal equipment to the telephone network (commonly referred to as "FCC Rules, part 68").

EN 60950 - European differences
Replace the text of this annex by: See annex ZA

Annex Q

(informative)

Bibliography

IEC Standards

IEC 364-7.707.(1984), *Electrical installations of buildings. Part 7: Requirements for special installations or locations. Section 707: Earthing requirements for the installation of data processing equipment.*

IEC 410:(1973), *Sampling plans and procedures for inspection by attributes.*

IEC 479-1:(1984), *Effects of current passing through the human body, General aspects.*

IEC 529:(1989), *Classification of degrees of protection provided by enclosures. (IP Code)*

EN 60950 - European differences
NOTE
Endorsed by EN 60529:1991 (not modified)

IEC 664A:(1981), *First supplement to IEC 664 (1980): Insulation co-ordination within low-voltage systems including clearances and creepage distances for equipment*

IEC 707-1:(1981), *Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source.*

EN 60950 - European differences
NOTE
Endorsed by HD 441:1993 (not modified)

IEC 1032:(1990), *Test probes to verify protection by enclosures.*

IEC 1058-1:(1990), *Switches for appliances - Part 1: General requirements.*

EN 60950 - European differences
NOTE
Endorsed by EN 61-058-1:1992 (not modified)

ISO Standards

ISO 2859:(1974), *Sampling procedures and tables for inspection by attributes.*

Other publications

ICRP 26:(1977), Protection against ionizing radiation from external sources, published by the International Commission on Radiological Protection.

CCITT Rec.K.11:(1988), Principles of protection against overvoltages and overcurrents.

CCITT Rec.K.17:(1988): Tests on power-fed repeaters using solid-state devices in order to check the arrangements for protection from external interference.

EN 60950 - European differences
Replace this annex by annex ZA

Annex R

(informative)

Example of requirements for a quality control programme for unpopulated coated printed boards

NOTE
This annex gives an example of requirements for a quality control programme as specified in 2.9.5 for minimum separation distances for coated printed boards. Under consideration are examples of similar quality control programmes as specified in 2.9.2 for CLEARANCES and in 2.9.8 for spacings for component external terminations.

Minimum separation distances for coated printed boards (see 2.9.5)

A manufacturer wishing to use the reduced spacings permitted by 2.9.5 table 7 shall implement a quality control program for those features of the boards which are listed in table R.1. This program shall include specific quality controls for the tools and materials which affect conductor spacing, adequate inspection of pattern and spacing, cleanliness, coating thickness, electrical tests for short circuits, insulation resistance and electric withstand voltage.

The manufacturer shall also identify and plan the protection and, where applicable, installation processes which directly affect quality and shall ensure that these processes are carried out under controlled conditions. Controlled conditions shall include the following:

- documented work instructions defining Process, Equipment, Environment and Manner of Production where the absence of such instructions would adversely affect quality, use of suitable production and installation equipment, suitable working environment, compliance with reference standards, specifications and quality plans;
- monitoring and control of suitable processes and product characteristics during production and installation in the equipment;
- criteria for workmanship stipulated to the extent necessary in written specifications or by means of representative samples;
- records maintained for qualified processes, equipment and personnel as appropriate.

Table R.1 provides the sampling plan for attributes and tests necessary to conform with the requirements of 2.9.5. The number of samples of production boards shall be based on IEC 410 or ISO 2859 or equivalent National Standards.

Table R.1 - Rules for sampling and inspection

INSULATION	BASIC	SUPPLEMENTARY	REINFORCED
Spacing mm 1)	Sampling S2 AQL 1,0	Sampling S2 AQL 1,0	Sampling S2 AQL 1,0
Electric strength test 4)	Sampling S2 AQL 2,5	Sampling S2 AQL 2,5	Routine 100%: one failure requires evaluation for cause
Abrasion resistance	Sampling S1 AQL 2,5	Sampling S1 AQL 2,5	Sampling S1 AQL 2,5
Thermal ageing 2)	Sampling S3 AQL 4	Sampling S3 AQL 4	Sampling S3 AQL 4
Thermal cycling 2)	Sampling S1 AQL 1,5	Sampling S1 AQL 1,5	Sampling S1 AQL 1,5
Insulation resistance 3)	Sampling S2 AQL 2,5	Sampling S2 AQL 2,5	Sampling S2 AQL 2,5
Visual inspection of coating 5)	100%	100%	100%

Conditions applicable to table R.1

1) To minimize test and inspection time, it is permitted to replace measurement of spacings by measurement of breakdown voltage. Initially the breakdown voltage is established for ten uncoated boards for which the correct spacing measurements have been confirmed. The breakdown voltage of subsequent uncoated production boards is then checked against a lower limit equal to the minimum breakdown voltage of the initial ten boards minus 100 V. If breakdown occurs at this lower limit, a board is considered a failure unless direct measurement of the spacing conforms with the requirement.

2) The thermal ageing and thermal cycling tests shall be done whenever the type of coating material, printed board material, or process is changed. It is recommended that it should be done at least once a year.

3) The insulation resistance shall not be less than 1 000 MΩ.

4) The electric strength test shall consist of one of the following options:
   - a 1,2/50 µs impulse test using a positive and a negative impulse whose magnitude equals the peak of the test voltage from table 18 and repeated three times for each polarity;
   - a three cycle pulse of a.c. power frequency meeting the requirements of table 18;
   - a 10 ms d.c. pulse with magnitude equal to the peak voltage requirement of table 18. There shall be three positive and three negative pulses.

5) Visual inspection without optical magnification or automated optical inspection with equivalent resolution shall show no cracks, no bubbles, no pinholes, or detachment of the coating in the area of reduced spacings. Any such defects shall be reason for rejection of the printed board.

Annex S

(informative)

Procedure for impulse testing (see 6.4.2.3)

S.1 Test equipment

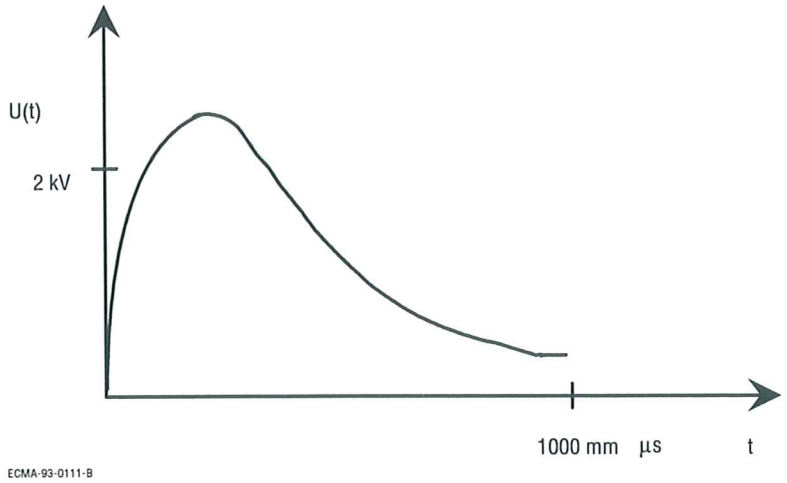
- Impulse generator according to annex N.
- Storage oscilloscope with a bandwidth of a few MHz.
- High voltage probe with compensating elements.

S.2 Test procedure

Apply the required number of impulses to the equipment under test and record the waveform patterns.

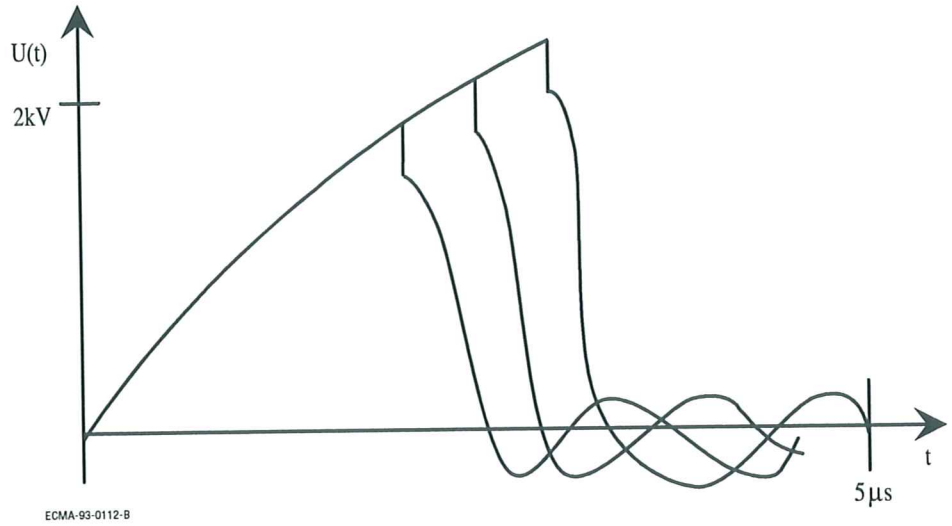
Examples are given in S.3 to assist in judging whether or not a surge suppressor has operated or insulation has broken down.

S.3 Examples of waveforms during impulse testing



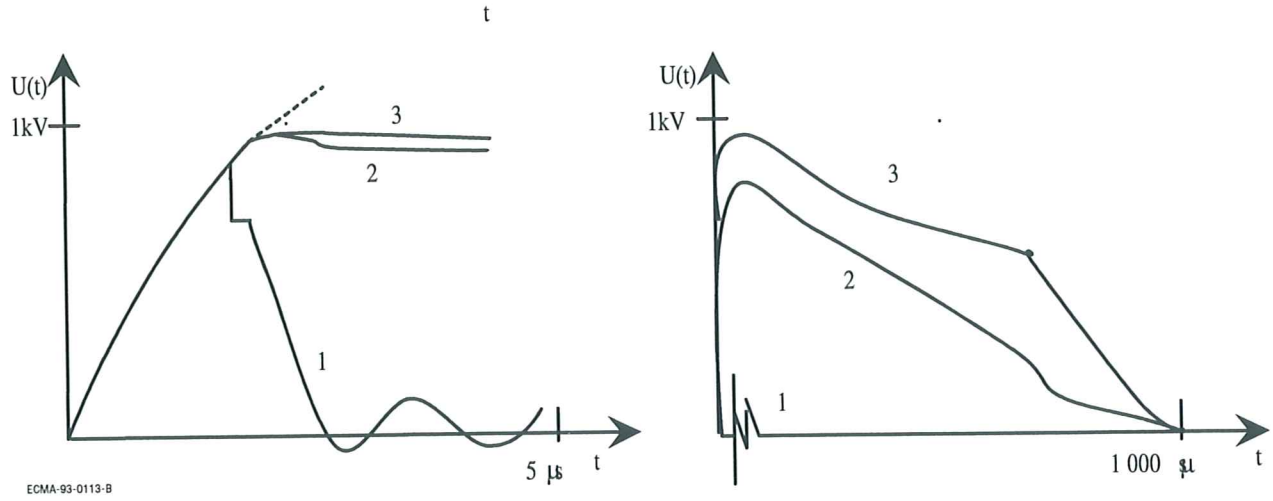
Consecutive impulses are identical in their waveforms.

Figure S.1 - Waveform on insulation without surge suppressors and no breakdown



Consecutive impulses are not identical in their waveforms. The pulse shape changes from pulse to pulse until a stable resistance path through the insulation is established. Breakdown can be seen clearly on the shape of the pulse voltage oscillogram.

Figure S.2 - Waveforms on insulation during breakdown without surge suppressors



1 gas discharge type
2 semiconductor type
3 metal oxide type
Consecutive impulses are identical in their waveforms

Figure S.3 - Waveforms on insulation with surge suppressors in operation

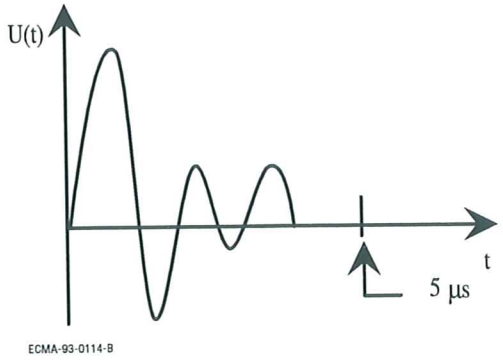


Figure S.4 - Waveform on short-circuited surge suppressor and insulation

Annex T

(informative)

Guidance on protection against ingress of water (see 1.1.2)

When the intended application is such that ingress of water is possible, an appropriate degree of protection other than IPX0 should be selected by the manufacturer from IEC 529, an extract from which is included in this annex.

Additional design features should then be included to ensure that ingress of water does not affect insulation.

IEC 529 gives test conditions for each degree of protection other than IPX0. The conditions appropriate to the selected degree of protection should be applied to the equipment, immediately followed by an electric strength test as specified in 5.3.2 on any insulation which may have become wet, and inspection should show that water has not created a risk of personal injury or fire. In particular, there should be no trace of water on insulation that is not designed to operate when wet.

If the equipment is provided with drain holes, inspection should show that any water which enters does not accumulate and that it drains away without affecting compliance.

If the equipment is not provided with drain holes, account should be taken of the possibility of build-up of water.

Where equipment is only partly exposed to water, for example when it is to be installed through an opening in an outside wall, only the exposed parts should be subjected to the IEC 529 test conditions. For these tests, such equipment should be installed in an appropriate test assembly, simulating actual conditions of installation according to the manufacturer's installation instructions, including the use of a kit of sealing parts where required.

It should not be possible to remove without the aid of a TOOL parts which ensure the required degree of protection against ingress of water.

The information in table T.1 (overleaf) is extracted from IEC 529.

Table T.1 - Extract from IEC 529

Second characteristic numeral	Degree of protection	
	Brief description	**Definition**
0	Non-protected	
1	Protected against vertically falling water drops	Vertically falling drops shall have no harmful effects
2	Protected against vertically falling water drops when enclosure tilted up to 15°	Vertically falling drops shall have no harmful effects when the enclosure is tilted at any angle up to 15° on either side of the vertical
3	Protected against spraying water	Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects
4	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effects
5	Protected against water jets	Water projected in jets against the enclosure from any direction shall have no harmful effects
6	Protected against powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects
7	Protected against the effects of temporary immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time
8	Protected against the effects of continuous immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is continuously immersed in water under conditions which shall be agreed between manufacturer and user but which are more severe than for numeral 7

EN 60950 - European differences

Annex ZA

(normative)

Normative references to international publications with their relevant European publications

This European Standard incorporates by dated or undated reference, provision from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For date references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE:
When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

IEC Publication	Date	Title	EN/HD	Date
65 (mod)	1985	Safety requirements for mains operated electronic and related apparatus for household and similar general use	HD 195 S6	1989
73	1984	Colours of indicator lights and push-buttons	HD 354 S2	1987
NOTE HD 354 S2 is superseded by EN 60073:1993 which is based on IEC 73:1991 - Coding of indicating devices and actuators by colours and supplementary means.				
83	1975	Plugs and socket-outlets for domestic and similar general use	--	--
85	1984	Thermal evaluation and classification of electrical insulation	HD 566 S1	1990
112	1979	Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions	HD 214 S2	1980
227 (mod)	series	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V	HD 21	series
245 (mod)	series	Rubber insulated cables of rates voltages up to and including 450/750 V	HD 22	series
309 (mod)	1988	Plugs, socket-outlets and couplers for industrial purposes	EN 60309	1992
320 (mod)	1981	Appliance couplers for household and similar general purposes	EN 60320-1	1987
NOTE EN 60320-1 includes A1: 1984 + A2: 1985 to IEC 320; A3: 1987 was endorsed by EN 60320-1: 1987/A3: 1989.				
364	series	Electrical installation of buildings	HD 384	series
384-14	1981	Fixed capacitors for use in electronic equipment - Part 14: Sectional specification: Fixed capacitors for radio interference suppression - Selection of methods of test and general requirements	--	--

IEC Publication	Date	Title	EN/HD	Date
417	1973	Graphical symbols for use on equipment Index, survey and compilation of the single sheets	HD 243 S1	1975
NOTE HD 243 S1 is superseded by HD 243 S9: 1991 which is based on IEC 417: 1973 + supplements A: 1974 to J: 1990				
664	1980	Insulation co-ordination within low-voltage systems including clearances and creepage distances for equipment	--	--
695-2-2	1980	Fire hazard testing - Section 2: Needle-flame test	HD 444.2.2 S1	1983
825 (mod)	1984	Radiation safety of laser products, equipment classification, requirements and user's guide	HD 482 S1*	1988
NOTE HD 482 S1 is superseded by EN 60825:1991 which includes A1: 1990 to IEC 825				
885-1	1987	Electrical test methods for electric cables Part 1: Electrical tests for cables, cords and wires for voltages up to and including 450/750 V	--	--
1032	1990	Test probes to verify protection by enclosures	HD 601 S1	1991

ISO Publication	Date	Title	EN/HD	Date
216	1975	Writing paper and certain classes of printed matter - Trimmer sizes - A and B series	EN 20216	1990
261	1973	ISO General purpose metric screw threads General plan	--	--
262	1973	ISO General purpose metric screw threads Selected sizes for screws, bolts and nuts	--	--
3864	1984	Safety colours and safety signs	--	--
4046	1978	Paper, board, pulp and related terms - Vocabulary	--	--
7000	1984	Graphical symbols for use on equipment Index and synopsis	--	--

Other publications

EN 41003	1991	Particular electrical safety requirements for equipment to be connected to telecommunication networks	--	--

FR 47, Part 68 - Code of Federal Regulations (USA) Part 68: Connection of terminal equipment to the telephone network (commonly referred to as "FFC Rules, part 68")

73/23/EEC - Council Directive of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (Low Voltage Directive)

EN 60950 - European differences

Annex ZB

(normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions. If it affects harmonization, it forms part of the European Standard.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

Clause	Special national condition
1.2.4.1	In **Denmark**, certain types of Class I appliances (see 3.2.1) may be provided with a plug not establishing earthing continuity when inserted into Danish socket-outlets.
1.7.1	In **United Kingdom**, marking shall refer to 240 V or 415 V, these being the voltages of the public supplysystem.
1.7.2	In **Norway**, if separation between the mains and a communication system/network other than the public telecommunications networks, relies upon the connection to safety earth, the equipment shall have a marking stating that it must be connected to an earthed mains socket-outlet. NOTE For requirements for equipment to be connected to a public TELECOMMUNICATION NETWORK see 6.2.1.4 In **Sweden**, if the separation between the mains and a SELV terminal relies upon connection to the safety earth, the apparatus shall have a marking stating that it must be connected to an earthed mains socket-outlet when a SELV circuit is connected to a network passing both unearthed and earthed electrical environment. The marking text shall be in Swedish and as follows: "Apparaten skall anslutas till jordat uttag när den ansluts till ett nätverk."
1.7.5	In **Denmark** socket-outlets for providing power to other appliances shall be in accordance with the Heavy Current Regulations, Section 107-2-DY, Standard Sheet DK 1-3a, DK 1-5a or DK 1-7a, when used on appliances of Class I.
2.3.6	In **Denmark, Finland** and **France** method 3 is not acceptable
2.3.9	In **Norway**, marking and insulation requirements according to this annex, 1.7.2 and 6.2.1.4.b) apply.
2.5.2	In **Denmark,** the first sentence is replaced by the following: Class II equipment shall have no provision for protective earthing, except that permanently connectedequipment may be provided with a means for maintaining the continuity of protective earthing circuits to other equipment in a system, if the earth connection is separated from parts at hazardous voltages by double or reinforced insulation.
2.9.1	In **Norway**, due to the IT power system used, the mains supply voltage is considered to be equal to phase-to-phase voltage.
3.2.1	In **Denmark** supply cords of single-phase appliances having a rated current not exceeding 10 A shall beprovided with a plug according to the following table:

Class		Plug
		Section 107-2-D1 Standard Sheet
1	Protection against indirect contact required *)	DK 2-1a or DK 2-5a
	Earthing connection not required	DK 2-1a, DK 2-5a DKA 2-1a, DKA 2-1b, C 1b, C 2b, C 3b, C 4
II		DK 2-5a**), DKA 2-1a, DKA 2-1b, C 1b, C5, C6

*) Appliances fitted with a socket-outlet for providing power to other appliances.
Appliances covered by the general requirement for protection against indirect contact in Section 10, clause 18.1
Appliances which are mainly used in locations where protection against indirect contact is required, cf. Section 10, clause 17.

**) The earthing contact not connected.

If poly-phase appliances and single-phase appliances having a rated current exceeding 10 A are provided with a supply cord with a plug, this plug shall be in accordance with the following table:

Class of equipment	Plug	
	The heavy Current Regulations Section 107-1-D1, Standard Sheet	The heavy Current Regulations Section 117 Standard Sheet
I	DK 6-1a	II
II	DK 6-1a *)	II*)
III	-	IX

*) The earthing contact not connected.

3.2.1 In **Switzerland,** plugs for connection of the power supply cord to primary power have to comply with SEV/ASE 1011.

3.2.4 In **United Kingdom**, a power supply cord with conductor of 1,25 mm^2 is allowed for equipment with a rated current over 10 A and up to and including 13 A.

3.3.5 In **United Kingdom,** the range of conductor sizes of flexible cords to be accepted by terminals for equipment with a rated current of over 10 A up to and including 13 A is 1,24 mm^2 to 1,5 mm^2 nominal cross-sectional area.

5.1 In **Norway,** to prevent fire risk, temperature rise limits for wooden supports shall be taken into account. The temperature rise limit is 65K in general and 60K for equipment for continuous operation.

5.4.9 In **Norway**, the electric strength test after the test of 5.4.4, 5.4.5, 5.4.6, 5.4.7 and 5.4.8 includes testing off basic insulation in Class 1 equipment.

6.1 In **Switzerland**, protective means in the equipment shall not prevent transient surge protection in the telecommunication network from operating properly (d.c. spark-over voltage of the surge suppressor installed in the telecommunication network: approximately 245 V).

6.2.1.4b) In **Finland,** this method is only permitted for permanently connected equipment or for pluggable equipment type B.
In Norway, insulation between part conductively connected to the supply mains and parts connected to a public telecommunication network shall comply with the requirements for double or reinforced insulation.

6.4.1 In **Finland,** for pluggable equipment it is forbidden to use surge suppressors between the telecommunication network and conductive metallic parts which are permitted to be accessible.

EN 60950 - European differences

Annex ZC

(informative)

A-Deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC member.

This European Standard falls under Directive 73/23/EEC.

Note
(from CEN/CENELEC IR Part 2, 3.1.9):Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ No g 59, 9.3.1982) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovitch (European Court Reports 1980, P. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

Clause	Deviation
1.1.3	**Switzerland** (Swiss Telecommunications law SR 784.10) This standard applies also to all equipment designed and intended to be connected to a telecommunication network terminal
1.5.1	**Sweden** (Ordinance SFS 1991: 1290) Add the following: NOTE Switches containing mercury such as thermostats, relays and level controllers are not allowed
1.7.2	**Denmark** (Heavy Current Regulations) Supply cords of Class I appliances, which are delivered without a plug, must be provided with a visible tag with the following text: 'Vigtigt! Lederen med grøn/gul isolation må kun tilsluttes en klemme mærket  eller  ' If essential for the safety of the appliance, the tag must in addition be provided with a diagram, which shows the connection of the other conductors, or be provided with the following text: "For tilslutning af de øvrige ledere, se medfølgende installationsvejledning". **United Kingdom** (Statutory Instrument 931: 1977) Power supply cords of Class 1 equipment must be provided with a label with the following text in legible characters: **IMPORTANT** The cores in this mains lead are coloured in accordance with the following code: - green and yellow: earth - blue: neutral - brown: live
1.7.5	**Denmark** (Heavy Current Regulations) Class II appliance shall not be fitted with socket-outlets for providing power to other appliances.
1.7.14	**Germany** (Gesetz über technische Arbeitsmittel (Gerätesicherheitsgesetz) [Law on technical labour equipment (Equipment safety law)], of 24th June 1968 in the version of 18th February 1986, Article 3,

3rd paragraph, 2nd sentence, together with the "Allgemeine Verwaltungsvorschrift zum Gesetz über technische Arbeitsmittel" [General administrative regulation on the law on technical labour equipment], Article 2, 2nd paragraph, item 2).

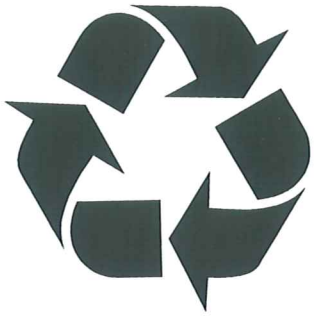
Directions for use with rules to prevent certain hazards for (among others) maintenance of the technical labour equipment, also for imported technical labour equipment shall be written in the German language.

NOTE
Of this requirement, rules for use even only by service personnel are not exempted.

1.7.17 **Switzerland** (Ordinance on environmentally hazardous substances SR 814.013)
Annex 4.10 of SR 814.013 applies for batteries.

1.7.18 **Sweden** (Ordinance SFS 1989: 974)

Equipment provided with built-in batteries, not replaceable by the user, shall be marked with the following symbol if the batteries have a content of mercury or cadmium exceeding 0,025% by weight.



2.11 **Denmark** (Heavy Current Regulations)
Finland (Decree No 205/74)
A limited power source shall incorporate an isolating transformer and shall comply with the following:

- the open-circuit voltage shall not exceed 42,4 V peak d.c. and shall not generate voltages above that value;
- the current which may be drawn for more than two minutes at any load, including short circuits, shall not exceed 0,2 A.

Norway (National Building Installation Specification - Feb. 1991)
Table 8 - Limits for inherently limited power sources
In Norway, the maximum value of VA for values of U_{oc} exceeding 10 V is 50
Table 9 - Limits for power sources not inherently limited (overcurrent protective device required).
In Norway, the maximum value of VA is 50.

6.4.2.1 **Austria** (Femmeldebauvorschrift Teil 11)
Equipment shall comply with U_c = 2,0 kV in cases b) and c).

Annex H **Germany** (Regulation on protection against hazards by X-ray, of 8th January 1987, Article 5 (Operation of X-ray emission source), Clauses 1 to 4)

a) A licence is required by those who operate an X-ray emission source.

b) A licence in accordance with clause I is not required by those who operate an X-ray emission source on which the electron acceleration voltage does not exceed 20 kV if

1) the local dose rate at a distance of 0,1 m from the surface does not exceed 1 µSv/h and

2) it is adequately indicated on the X-ray emission source that

i) X- rays are generated and

ii) the electron acceleration voltage must not exceed the maximum value stipulated by the manufacturer or importer.

c) A licence in accordance with clause 1 is also not required by persons who operate an X-ray emission source on which the electron acceleration voltage exceed 20 kV if

1) the X-ray emission source has been granted a type approval and

2) it is adequately indicated on the X-ray emission source that

i) X- rays are generated,

ii) the device stipulated by the manufacturer or importer guarantees that the maximum permissible local dose rate in accordance with the type approval is not exceeded and

iii) the electron acceleration voltage must not exceed the maximum value stipulated by the manufacturer or importer.

d) Furthermore, a licence in accordance with clause I is also not required by persons who operate X-ray emission sources on which the electron acceleration voltage does not exceed 30 kV if

1) the X-ray are generated only by intrinsically safe CRTs complying with Enclosure III, no 6,

2) the values stipulated in accordance with Enclosure III, No. 6.2 are limited by technical measures and specified in the device and

3) it is adequately indicated on the X-ray emission source that the X-rays generated are adequately screened by the intrinsically safe CRT.

Annex ZZ

(Informative)

Future Requirements

This annex includes the information of IEC TC74 Committee Drafts which have been agreed to go out for voting. This conclusion was arrived at during the Plenary Assembly of IEC TC74 held in Omyia (Japan) in May 1993.

It is expected that the modifications collected in this Annex will form the 3rd Amendment of IEC 950, 2nd Editon (1991).

This 3rd Amendment is due to be printed by IEC in the course of 1995. The actual text might differ from the present annex.

The content of this annex is still under vote and subject to changes, and therefore should not be used other than for reference purposes.

In this annex, deleted text is struck out, added text is underlined when in the middle of a clause. Added full clauses are not underlined.

IEC/TC74(Secretariat)324 - Results of the vote on IEC/TC74(Secretariat)289

Title **Modify** - the title of the standard as follows:

Safety of information technology equipment,

~~including electrical business equipment~~

so that is reads:

SAFETY OF INFORMATION TECHNOLOGY EQUIPMENT

IEC/TC74(Secretariat)325 - Results of the vote on IEC/TC74(Secretariat)290

1.1 Scope

1.1.1 **Modify** - the second paragraph as follows

This standard is also applicable to such equipment designed and intented to be connected directly to a TELECOMMUNICATION NETWORK and forming a part of a subscriber's installation, regardless of ownership and of responsibility for installation and maintenance, and regardless of the source of power.

Modify - the list of examples (3rd line) as follows

(e.g. modems), PABXs, key telephone systems, telephone answering machines, telephone sets, facsimile equipment...

1.1.3 **Modify** - the third dashed paragraph as follows

~~equipment which depends on TELECOMMUNICATION NETWORK as its only source of electrical power for its operation, and passive~~ devices requiring no ~~source of~~ electrical power.

IEC/TC74(Secretariat)315 - Results of the vote on IEC/TC74(Secretariat)275

1.2.5 Connection to the supply

1.2.5.2 Modify - as follows

PLUGGABLE EQUIPMENT TYPE B: Equipment which is intended for connection to the building power supply wiring via **an** industrial plugs and socket-outlets or an appliance coupler, or both, complying with IEC 309, or with national standards for similar applications.

IEC/TC74(Secretariat)334 - Results of the vote on IEC/TC74(Secretariat)297

1.2.8 Circuits characteristics

1.2.8.2 Modify - as follows

SECONDARY CIRCUIT: A circuit which has no direct connection to primary power and derives its power from a transformer, converter or equivalent isolation device, ~~situated within the equipment~~ or from a battery.

IEC/TC74(Secretariat)343 - Results of the vote on IEC/TC74(Secretariat)308

1.2.11 Components

1.2.11.1 Delete - the following from 1.2 " Definitions".

~~SAFETY ISOLATING TRANSFORMER: A transformer in which windings supplying SELV CIRCUITS are isolated from other windings in such a way that an insulation breakdown either is unlikely or does not cause a hazardous condition on SELV windings.~~

Secretary's Note
This definition will also be removed from the list in 1.2, page 29.

IEC/TC74(Secretariat)335 - Results of the vote on IEC/TC74(Secretariat)298

1.2.12 Power distribution

1.2.12.1 Add - new paragraph after the third dashed item (no changes to figures 1, 2, and 3 are required).

Some TN POWER SYSTEMS are supplied from a secondary winding of a transformer that has an earthed centre tap (neutral). Where the two phase conductors and the neutral conductor are available, these systems are commonly known as a "single-phase, 3-wire power systems".

IEC/TC74(Secretariat)347 - Results of the vote on IEC/TC74(United Kingdom)138

1.2.14 Miscellaneous

1.2.14.3 Modify - by deleting the first dashed paragraph and combining the second dashed paragraph so that it reads:

SERVICE PERSONNEL: Persons having appropriate technical training and experience necessary to be aware of hazards to which they are exposed in performing a task and of measures to minimise the danger to themselves or other persons.

IEC/TC74(Secretariat)316 - Results of the vote on IEC/TC74(Secretariat)276

1.2.14 Miscellaneous

1.2.14.4 **Modify** - the NOTE, modified with the following normative text, will become the second paragraph of this subclause.

The term OPERATOR in this standard ~~is~~ has the same meaning as the term USER and the two can be interchanged ~~used interchangeably~~.

IEC/TC74(Secretariat)316 - Results of the vote on IEC/TC74(Secretariat)276

1.2.14 Miscellaneous

1.2.14.5 **Add** - the following new definition

User: See OPERATOR (1.2.14.4)

Secretary's Note
Present 1.2.14.5 and 1.2.14.6 will be renumbered to 1.2.14.6 and 1.2.14.7 respectively. 1.2, page 29, will be modified accordingly.

1.4 General conditions for tests

1.4.1 **Modify** - the second paragraph as follows:

In order to establish whether or not safety is involved, the circuits and construction shall be carefully investigated to take into account the consequences of possible failures ~~of components.~~

IEC/TC74(Secretariat)334 - Results of the vote on IEC/TC74(Secretariat)297

1.4 General conditions for tests

1.4.3 **Delete** - the first paragraph

~~Unless otherwise specified in this standard, the tests shall be made on a single sample which shall pass all the relevant tests.~~

Modify - the second paragraph as follows

The sample or samples under test shall be representative of the equipment the user would receive, or shall be the actual equipment ready for shipment to the user.

IEC/TC74(Secretariat)314 - Secretary's Inquiry

1.5 Components

1.5.2 **Modify** - the first two dashed paragraphs as follows

Evaluation and testing of components shall be carried out as follows:

- A component that has been shown to comply ~~certified by a recognized testing authority for compliance~~ with a standard harmonized with the relevant IEC component standard shall be checked for correct application and use in accordance with its rating. It shall be subjected to the applicable tests of this standard as part of the equipment with the exception of those tests which are part of the relevant IEC component standard;
- A component that has not been shown to comply ~~which is not certified for compliance~~ with a relevant standard as above shall be checked for correct application and use in accordance with its specified rating. It shall be subjected to the applicable tests of this standard, as part of the equipment, and to the applicable tests of the component standard, under the conditions occuring in the equipment;

NOTE
The applicable test for compliance with a component standard is, in general, carried out separately. The number of test samples is, in general, the same as that required in the component standard.

IEC/TC74(Secretariat)343 - Results of the vote on IEC/TC74(Secretariat)308

1.5 Components

1.5.3 Modify - as follows

Transformers~~, including SAFETY ISOLATING TRANSFORMERS,~~ shall be of a type suitable for their intended application and shall comply with the relevant requirements of this standard, particularly those of Annex C.

Delete - the second paragraph

~~A SAFETY ISOLATING TRANSFORMER shall be so constructed that a single insulation fault and its consequences will not cause a HAZARDOUS VOLTAGE to appear on SELV windings.~~

IEC/TC74(Secretariat)346 - Results of the vote on IEC/TC74(United Kingdom) 137

1.5 Components

1.5.6 Add - the following as a fourth dashed paragraph

– a capacitor which passes the tests of IEC 65, subclause 14.2.

IEC/TC74(Secretariat)335 - Results of the vote on IEC/TC74(Secretariat)298

1.7.1 Power rating

Add - the following as a second paragraph of the first dashed paragraph following Note 1

If equipment is to be connected to both phase conductors and the neutral conductor of a single-phase, 3-wire power system, the marking shall give the line-to-neutral voltage and the line-to-line voltage, separated by a solidus, with the added notation "Three wires plus protective earth" or "3W + PE" or equivalent.

Note 2 - Some examples of the above system rating markings are:

120/240 V; 3 wire + PE
120/240 V; 3W +  (IEC 417, No. 5019)
100/200 V; 2W + N + PE

Secretary's Note
Present Note 2 become Note 3.

IEC/TC74(Secretariat)316 - Results of the vote on IEC/TC74(Secretariat)276

1.7.1 Wiring terminals

Add - the following subclause number and title, and retain existing paragraphs 1, 2, 3, 4 and 7

1.7.7.1 Protective earthing terminals

Delete - the fifth and sixth paragraphs

~~Terminals intended exclusively for connection of the primary power neutral conductor, if any, shall be indicated by the capital letter N.~~

~~On three-phase equipment, if incorrect phase rotation could cause overheating or other hazard, terminals intended for connection of the primary power phase conductors shall be marked in such a way that, in conjunction with any installation instructions, the sequence of phase rotation is unambiguous.~~

Add - the following new subclause

1.7.7.2 Terminals for externals primary power supply conductors

For PERMANENTLY CONNECTED EQUIPMENT and equipment with ordinary NON-DETACHABLE POWER SUPPLY CORDS:

- Terminals intended exclusively for connection of the primary power neutral conductor, if any, shall be indicated by the capital letter N; and (previously paragraph 5 in 1.7.7)
- On three-phase equipment, if incorrect phase rotation could cause overheating or other hazard, terminals intended for connection of the primary power phase conductors shall be marked in such a way that, in conjunction with any installation instructions, the sequence of phase rotation is unambiguous. (previously paragraph 6 in 1.7.7)

These indications shall not be placed on screws, or other parts which might be removed when conductors are being connected. (previous paragraph 7 in 1.7.7 repeated)

2.1 Protection against electric shock and energy hazards

2.1.2 **Add** - the following identification

Compliance is checked:

a) by inspection;

b) by a test with the test finger, ...

c) by a test with the test pin, ...

Modify - the fourth compliance paragraph as follows

Apertures preventing the entry of the test finger~~, figure 19 (page 239)~~, (test b) above) are further tested by means of a straight unjointed version of the test finger applied with a force of 30 N. If ~~this~~ the unjointed finger enters, ~~the test with the finger, figure 19 (page 239), is repeated, the finger being pushed through the aperture if necessary,~~ test b) is repeated except that the finger is pushed through the aperture using any necessary force up to 30 N.

IEC/TC74(Secretariat)331 - Results of the vote on IEC/TC74(Secretariat)296

2.1 Protection against electric shock and energy hazards

2.1.3 **Add** - following title

Access to internal wiring

Secretary's Note
Titles will be added to the other subclauses in 2.1.

Modify - former 2.1.3 as follows

2.1.3.1 ELV circuits

~~Where the insulation of external~~ It is permitted that the insulation of internal wiring in an ELV CIRCUIT is accessible to an OPERATOR, ~~this~~ provided that the wiring ~~shall~~:

- ~~not be subject to damage or to stress;~~

a) **does** not need to be handled by the OPERATOR; and

b) ~~be~~ **is** routed and fixed so as not to touch unearthed accessible metal parts; and

c) ~~have~~ **has** distance through insulation not less than that given in Table 0; and

Table 0 - Distance through insulation of internal wiring

WORKING VOLTAGE (in case of failure of basic insulation)		Minimum distance through insulation
V peak or d.c.	V r.m.s. (sinusoidal)	mm
over 71, up to 350	over 50, up to 250	0,17
over 350	over 250	0,31

Secretary's Note
Table 0 will be added in the Contents, page 9.

Delete - the following dashed paragraph

~~Withstand on its insulation an electric strength test with a voltage specified for SUPPLEMENTARY INSULATION (see 5.3). The test voltage shall be related to the voltage which occurs across the insulation in case of failure of BASIC INSULATION.~~

Add - the following test

d) meets the requirements of 3.1.5 for SUPPLEMENTARY INSULATION.

Where wiring in an ELV CIRCUIT does not meet both conditions a) and b), the insulation shall meet the full requirements for supplementary insulation detailed in 2.9.4 and 3.1.5.

Modify - the compliance clause as follows

Compliance is checked by inspection and measurement and, if necessary, by test.

Add - the following as new 2.1.3.2

2.1.3.2 Hazardous voltage circuits

The insulation of internal wiring at HAZARDOUS VOLTAGE that is OPERATOR-accessible, or that is not routed and fixed to prevent it from touching unearthed accessible conductive-parts, shall meet the requirements of 2.9.4 and 3.1.5 for DOUBLE or REINFORCED INSULATION.

Compliance is checked by inspection and measurement and, if necessary, by test.

IEC/TC74(Secretariat)345 - Results of the vote on IEC/TC74(Secretariat)310

2.2 Insulation

2.2.2 **Modify** - the first compliance clause of 2.2.2 as follows

Compliance is checked by inspection and by evaluation of the data for the material. If ~~such data is not available~~ this data does not confirm that the material is non-hygroscopic, the hygroscopic nature of an insulating material is determined by subjecting the component or sub-assembly employing the insulation in question to the humidity treatment of 2.2.3.

IEC/TC74(Secretariat)331 - Compilation of Comments IEC/TC74(Secretariat)296

2.2 Insulation

2.2.4 Replace - with the following rearrangement and modification

Insulation in equipment shall comply with the heating requirements of 5.1, and, except where 2.1.3 applies, with

- The applicable electric strength requirements of 5.3, and
- the CREEPAGE DISTANCE, CLEARANCE and distance through insulation requirements of 2.9.

IEC/TC74(Secretariat)343 - Results of the vote on IEC/TC74(Secretariat)308

2.2 Insulation

2.2.6 Replace - existing 2.2.6 with the following

Application of insulation shall be considered to be OPERATIONAL, BASIC, SUPPLEMENTARY, REINFORCED OR DOUBLE INSULATION.

Rules for the application of insulation in many common situations are given in table 0.1 and illustrated in figure 5A, but other situations may exist. In certain specific cases, insulation may be bridged by a conductive path, e.g., where 2.3.9, 2.4.3 or 6.2.1.5 applies, provided that the level of safety is maintained.

In table 0.1 and figure 5A, the term "conductive part" refers to a part that is

- not normally energised and
- not connected to any active circuit, i.e., to a HAZARDOUS VOLTAGE circuit, an ELV CIRCUIT, a TNV CIRCUIT or an SELV CIRCUIT,

such as the BODY, a transformer core, or in some cases a conductive screen in a transformer.

A circuit or conductive part is termed "earthed" if it is connected to a protective earthing terminal or contact in such a way as to meet the requirements in 2.5 (although it will not necessarily be at earth potential). Otherwise it is termed "unearthed".

For DOUBLE INSULATION it is permitted to interchange the basic and supplementary layers. Where DOUBLE INSULATION is used, ELV CIRCUITS or unearthed parts are permitted between the BASIC INSULATION and the SUPPLEMENTARY INSULATION provided that the overall level of insulation is maintained.

It is permitted for a conductive part to have one or two levels of protection from a part at HAZARDOUS VOLTAGE. If it is protected by

- DOUBLE or REINFORCED INSULATION, it is termed a "double-insulated part";
- BASIC INSULATION plus protective earthing, it is termed an "earthed part";
- BASIC INSULATION but is not earthed (i.e., it has no second level of protection) it is termed a "basic-insulated part" and shall not be accessible.

Secretary's Note

The existing Note in 2.2.6 is deleted, as its content is either covered by table 0.1 or by the definitions of insulation.

Table 0.1 - Grades of insulation

Grade of INSULATION	INSULATION between:	and:	Key to figure 5A
1. OPERATIONAL See condition [1]	SELV CIRCUIT	– earthed part	OP1
		– double insulated part	OP2
		– another SELV CIRCUIT	OP1
	ELV CIRCUIT	– earthed part	OP3
		– earthed SELV CIRCUIT	OP3
		– basic-insulated part	OP4
		– another ELV CIRCUIT	OP4
	Earthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	– another earthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	OP5
	TNV CIRCUIT	– earthed part	[5]
		– EARTHED SELV CIRCUIT	[5]
		– another TNV CIRCUIT	OP6
	Series/parallel sections of a transformer winding		
2. BASIC	PRIMARY CIRCUIT	– earthed or unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	B1
		– earthed part	B2
		– earthed SELV CIRCUIT	B2
		– basic-insulated part	B3
		– ELV CIRCUIT	B3
	Earthed or unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	– unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	B4
		– earthed part	B5
		– earthed SELV CIRCUIT	B5
		– basic -insulated part	B6
		– ELV CIRCUIT	B6
	TNV CIRCUIT	– basic-insulated part	B7 [4]
		– ELV CIRCUIT	B7 [4]
		– double-insulated part	B8 [4]
		– unearthed SELV CIRCUIT	B8 [4]
		– earthed SELV CIRCUIT	B9 [5]
3. SUPPLEMENTARY	Basic-insulated part or ELV CIRCUIT	– double-insulated part	S1 [2]
		– unearthed SELV CIRCUIT	S1 [2]
	TNV CIRCUIT	– earthed SELV CIRCUIT	S2 [5]
4. SUPPLEMENTARY or REINFORCED	Unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	– double-insulated part	S/R [3]
		– unearthed SELV CIRCUIT	S/R [3]
		– TNV CIRCUIT	S/R [3][4]
5. REINFORCED	PRIMARY CIRCUIT	– double-insulated part	R1
		– unearthed SELV CIRCUIT	R1
		– TNV CIRCUIT	R2
	Earthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	– double-insulated part	R3
		– unearthed SELV CIRCUIT	R3
		– TNV CIRCUIT	R4

Secretary's Note
Table 0.1 will be added in the Contents.

Conditions applicable to table 0.1.

1 See 5.4.4 for requirements for OPERATIONAL INSULATION.

2 The WORKING VOLTAGE of the SUPPLEMENTARY INSULATION between an ELV CIRCUIT or a basic-insulated part and an unearthed accessible part is equal to the most onerous WORKING VOLTAGE for the BASIC INSULATION. The most onerous WORKING VOLTAGE may be due to a PRIMARY or SECONDARY CIRCUIT and the insulation is specified accordingly.

3 Insulation between an unearthed SECONDARY CIRCUIT at HAZARDOUS VOLTAGE and an unearthed accessible part or circuit (ref S/R in figure 5A) shall satisfy the more onerous of the following requirements:

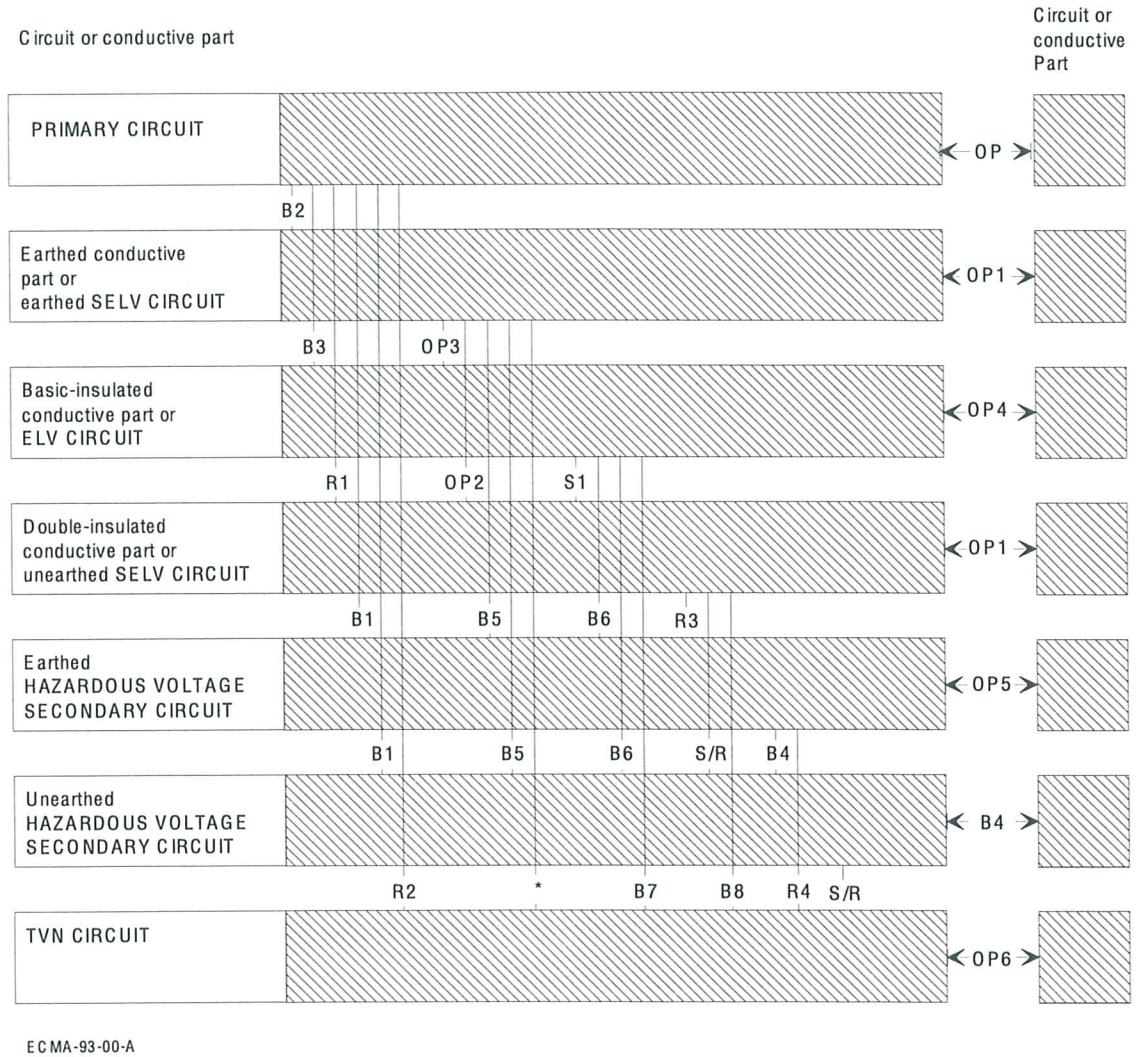
– REINFORCED INSULATION whose WORKING VOLTAGE is equal to the HAZARDOUS VOLTAGE,

– SUPPLEMENTARY INSULATION whose WORKING VOLTAGE is equal to the voltage between
  . the SECONDARY CIRCUIT at HAZARDOUS VOLTAGE and
  . another SECONDARY CIRCUIT at HAZARDOUS VOLTAGE or a PRIMARY CIRCUIT.

Which of these is more onerous will depend on the relative voltages of the windings.

4 Applies only if the normal operation voltage of the TNV CIRCUIT exceeds the limits for an SELV CIRCUIT. Otherwise the TNV CIRCUIT is treated for the purpose of 2.2.6 as an earthed or unearthed SELV CIRCUIT as appropriate.

5 See Note 2 to 6.1
See 6.2.1.3 for additional requirements if BASIC INSULATION (B9) is not provided.
If 6.3.3 applies, SUPPLEMENTARY INSULATION is required (S2).



OP = operational
S = supplementary
R = reinforced

B = Basic
S/R, see condition 3) to table 0
***see condition 4) to table 0**

Figure 5A - Grades of insulation

Secretary's Note
figure 5a will be added in the Contents.

Secretary's Note
The following is an alternative presentation of figure 5A. National Committees are requested to express a preference for one presentation - either the original or the alternative.

Circuit or conductive part

PRIMARY CIRCUIT	OP	B2	B3	R1	B1	B1	R2
Earthed conductive part or earthed SELV CIRCUIT	B2	OP1	OP3	OP2	B5	B5	*
Basic-insulated conductive part or ELV CIRCUIT	B3	OP3	OP4	S1	B6	B6	B7
Double-Insulated conductive part or unearthed SELV CIRCUIT	R1	OP1	S1	OP1	R3	S/R	B8
Earthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	B1	B5	B6	R3	OP5	B4	R4
Unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	B1	B5	B6	S/R	B4	B4	S/R
TNV CIRCUIT	R2	*	B7	B8	R4	S/R	OP6

between / and

PRIMARY CIRCUIT	Earthed conductive part or earthed SELV CIRCUIT	Basic-insulated conductive part or ELV CIRCUIT	Double-Insulated conductive part or unearthed SELV CIRCUIT	Earthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	Unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	TNV CIRCUIT

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OP = operational **B = Basic**
S = supplementary **S/R, see condition 3) to table 0**
R = reinforced ***see condition 4) to table 0**

Figure 5A - Grades of insulation - Alternative presentation

IEC/TC74(Secretariat)317 - Results of the vote on IEC/TCecretariat)277

2.2 Insulation

Replace - as follows

2.2.7 For the purpose of determining WORKING VOLTAGE the rules of 2.2.7.1 and, where relevant, those of 2.2.7.2, 2.2.7.3, 2.2.7.4, and 2.2.7.5, shall be applied (see also 1.4.11):

Note : WORKING VOLTAGE in switch mode power supplies are best determined by measurement.

2.2.7.1 Where the voltage of a PRIMARY CIRCUIT is involved, the value of the RATED VOLTAGE or the maximum value of the RATED VOLTAGE RANGE shall be used. (Formerly dashed paragraph 9 of 2.2.7)

Unearthed accessible conductive parts shall be assumed to be earthed. (Formerly dashed paragraph 4 of 2.2.7)

Where a transformer winding or other part is floating, i.e., not connected to a circuit which establishes its potential relative to earth, it shall be assumed to be earthed at the point by which the highest WORKING VOLTAGE is obtained. (Formerly dashed paragraph 5 of 2.2.7)

Where DOUBLE INSULATION is used, the WORKING VOLTAGE accross the BASIC INSULATION shall be determined by imagining a short-circuit accross the SUPPLEMENTARY INSULATION, and vice-versa. For insulation between transformer windings, the short-circuit shall be assumed to take place at the point by which the highest WORKING VOLTAGE is produced in the other insulation. (Formerly dashed paragraph 6 of 2.2.7)

For insulation between two transformer windings, the highest voltage between any two points in the two windings shall be used, taking into account external voltages to which the windings may be connected. (Formerly paragraph 7 or 2.7.7).

For insulation between a transformer winding and another part, the highest voltage between any point on the winding and the other part shall be used. (Formerly dashed paragraph 8 of 2.2.7).

2.2.7.2 For a WORKING VOLTAGE to be used in determining CLEARANCES for PRIMARY CIRCUITS in accordance with table 3:

- for d.c. voltages, the peak value of any superimposed ripple shall be included; (Formerly dashed paragraph 1 of 2.2.7)
- non-repetitive transients (due, for example, to atmospheric disturbances) shall be disregarded; (Formerly dashed paragraph 2 of 2.2.7)

NOTE
It is assumed that any such transient in a *SECONDARY CIRCUIT* will not exceed the transient rating of the PRIMARY CIRCUIT.

- the voltage of any

  ELV CIRCUIT,
  SELV CIRCUIT, or
  TNV CIRCUIT
  shall be regarded as zero;
  (Formerly dashed paragraph 3 of 2.2.7 modified)

and in accordance with table 4 where appropriate:

- for repetitive peak voltages exceeding the peak values of the mains supply voltage, the maximum repetitive peak value shall be used.

2.2.7.3 For a WORKING VOLTAGE to be used in determining CLEARANCES for SECONDARY CIRCUITS in accordance with table 5:

- for d.c. voltages, the peak value of any superimposed ripple shall be included;
- for non-sinusoidal wave forms, the r.m.s. value multiplied by $\sqrt{2}$ shall be used as the peak value.

2.2.7.4 For a WORKING VOLTAGE to be used in determining CREEPAGE DISTANCES:

- the actual r.m.s. or d.c. value shall be used;
- if the d.c. value is used, any superimposed ripple shall be ignored.

2.2.7.5 For a WORKING VOLTAGE to be used in determining the electric strength test voltages of 5.3, d.c. values shall be used for d.c. VOLTAGES and peak values for other voltages.

IEC/TC74(Secretariat)328 - Results of the vote on IEC/TC74(Secretariat)293

Add - the following new subclause

2.2.8 Components bridging double or reinforced insulation

2.2.8.1 Bridging Capacitors

It is permitted to bridge DOUBLE or REINFORCED INSULATION by a single capacitor complying with IEC 384-14 for Y1 capacitors, or by two capacitors in series each complying with the requirements of IEC 384-14 for Y2 or Y4 capacitors. Where two capacitors are used in series, they shall each be rated for the total WORKING VOLTAGE accross the pair and shall have the same nominal capacitance value.

2.2.8.2 Bridging resistors

It is permitted to bridge DOUBLE or REINFORCED INSULATION by two resistors in series. They shall each comply with the requirements of 2.9.2 and 2.9.3 between their terminations for the total WORKING VOLTAGE across the pair and shall have the same nominal resistance value.

2.2.8.3 Accessible parts

Where accessible conductive parts or circuits are separated from other parts by DOUBLE or REINFORCED INSULATION that is bridged by components in accordance with 2.2.8.1 or 2.2.8.2, the accessible parts shall comply with the requirements in 2.4 LIMITED CURRENT CIRCUITS. These requirements shall apply after electric strength testing of the insulation has been carried out.

IEC/TC74(Secretariat)343 - Results of the vote on IEC/TC74(Secretariat)308

2.3 Safety extra-low voltage (SELV) circuits

2.3.3 **Modify** - the third paragraph (after method 4) as follows

It si permitted to provide method 1 by two separate transformers in tandem, where one transformer provides BASIC INSULATION and the other transformer provides SUPPLEMENTARY INSULATION. ~~The two transformers shall follow, as a pair, the principles of construction for a single SAFETY ISOLATING TRANSFORMER in clause C.2, taking into account the voltage in the intermediate circuit~~.

IEC/TC74(Secretariat)334 - Results of the vote on IEC/TC74(Secretariat)297

2.5 Provision for protective earthing

Modify - as follows

CLASS II EQUIPMENT shall have no provision for protective earthing except that it may be provided with a means for maintaining the continuity of protective earthing circuits to other equipment in a system. Such a means shall be separated from parts at HAZARDOUS VOLTAGES by DOUBLE or REINFORCED INSULATION.

Add - the following new paragraph (formerly the second sentence of 2.5.2).

If CLASS II EQUIPMENT has an earth connection for functional purposes, the functional earth circuit shall be separated from parts at HAZARDOUS VOLTAGES by DOUBLE or REINFORCED INSULATION.

IEC/TC74(Secretariat)348 - Results of the vote on IEC/TC74(United kingdom)139

2.5 Provision for protective earthing

2.5.7 **Replace** - as follows

Protective earth connections shall make earlier and break later than the supply connections in each of the following:

- the connector of an OPERATOR removable part that has a protective earthing connection;
- a plug on a power supply cord;
- an appliance coupler.

2.6 Primary power isolation

2.6.10 Delete - this subclause

~~For CLASS I EQUIPMENT, the supply plug or appliance coupler, if used as the disconnected device, shall make the protective earthing connection earlier than the supply connections and shall break it later than the supply connections.~~

IEC/TC74(Secretariat)334 - Results of the vote on IEC/TC74(Secretariat)297

2.7.3 Short- circuit protection

Add - the following Note 1 after the third paragraph

NOTES

1 If fuses complying with IEC 127 are used in PRIMARY CIRCUITS, they should have high breaking capacity (1 500A) if the prospective short-circuit current exceeds 35A or, for fuses with a rating of 3,5A or more, 10 times the rated current of the fuse.

Modify - the existing Note by renumbering it as "2"

2 Appropriate conditions for short-circuit testing are under consideration.

2.7.4 Number and location of protective devices

Modify - the Note and tables as follows

NOTE

For protective devices that are an integral part of the equipment, examples of the minimum number and location of fuses or circuit-breaker poles are given in informative example table 1 for single-phase equipment or sub-assemblies and in informative example table 2 for three-phase equipment. The informative examples are not necessarily valid for protective devices in the building installation.

Table 1 - Informative example of protective devices in single-phase equipment or sub-assemblies

	Protection against	Minimum number of fuses or circuit-breaker poles	Location
Equipment to be connnected to POWER SYSTEMS with earthed neutral reliably identified	Earth faults	1	Phase conductor
	Overcurrent	1	Either of the two conductors
Equipment to be connected to any supply, including IT POWER SYSTEMS and supplies with reversible plugs	Earth faults	2	Both conductors
	Overcurrent	1	Either of the two conductors

Table 2 - Informative example of protective devices in three-phase equipment

Power system	Number of supply conductors	Protection against	Minimum number of fuses or circuit-breaker poles	Location
Three-phase without neutral	3	Earth faults	3	All three conductors
		Overcurrent	2	Any two conductors
With earthed neutral (TN orTT)	4	Earth faults	3	Each phase conductor
		Overcurrent	3	Each phase conductor
With unearthed neutral	4	Earth faults	4	All four conductors
		Overcurrent	3	Each phase conductor

IEC/TC74(Secretariat)335 - Results of the vote on IEC/TC74(Secretariat)298

2.7.4 Number and location of protective devices

Modify - the second paragraph as follows

In a supply to a ~~three-phase~~ load using more than one phase conductor, if a protective device interrupts the neutral conductor, it shall also interrupt all other supply conductors. Single pole protective devices, therefore, shall not be used in such cases.

Modify - the informative example table 1 of the NOTE as follows:

Table 1 - informative example of protective devices in single-phase equipment or sub-assemblies

	protection against	Minimum number of fuses or circuit-breaker poles	Location
Case A: Equipment to be connected to POWER SYSTEMS with earthed neutral reliably identified, except for Case C below	earth faults	1	Phase conductors
	Overcurrent	1	Either of the two conductors
Case B: Equipment to be connected to any supply, including IT POWER SYSTEMS and supplies with reversible plugs, except for Case C below	Earth faults	2	Both conductors
	Overcurrent	1	Either of the two conductors
Case C: Equipment to be connected to 3-wire power systems with earthed neutral reliably identified	Earth faults	2	Each phase conductor
	Overcurrent	2	Each phase conductor

IEC/TC74(Secretariat)349 - Results of the vote on IEC/TC74(United Kingdom) 140

2.8 Safety interlocks

2.8.6 **Add** - the underlined words to 2.8.6 and rearrange

A mechanical interlock switch shall

- comply with 2.8.6.1, or
- pass the tests of 2.8.6.2 and 2.8.6.3, or
- conform with IEC 1058-1

IEC/TC74(Secretariat)319 - Results of the vote on IEC/TC74(Secretariat)279

2.9.1 General

Add - new paragraph after the seventh paragraph which ends with "... as the minimum CREEPAGE DISTANCES".

It is permitted for CLEARANCES and CREEPAGE DISTANCES to be divided by intervening, unconnected (floating) conductive parts, such as unused contacts of a connector, provided that the sum of the individual distances meets the specified minimum requirements. See figure F.15.

Add - new paragraph after first compliance paragraph

Compliance is chekced by measurement, taking into account Annex F.

2.9.2 Clearance

Delete - the first compliance paragraph

~~Compliance is checked by measurement, taking into account the figures in Annex F, subject to conditions detailed in 2.9.1.~~

IEC/TC74(Secretariat)320 - Results of the vote on IEC/TC74(Secretariat)280

2.9.2 Clearances

Modify - and combine the first and second paragraphs

CLEARANCES in PRIMARY CIRCUITS shall comply with the minimum dimensions in ~~be dimensioned in accordance with~~ table 3 and, where appropriate table 4. Clearances in SECONDARY CIRCUITS shall **comply with the minimum dimensions in** ~~be dimensioned in accordance with~~ table 5. Manufacturing tolerances and deformation which can occur due to handling, shock and vibration likely to be encountered during manufacture, transport and normal use shall not result in CLEARANCES below the minimum dimensions**.** The relevant conditions under the tables shall be taken into account.

Delete - the penultimate paragraph and the Note

~~If the transient overvoltages exceed the test voltages in 5.3.2, the determination of transient limits shall be made using IEC 664.~~

~~Note: The above paragraph is under consideration.~~

IEC/TC74(Secretariat)345 - Results of the vote on IEC/TC74(Secretariat)310

2.9.2 Clearance

Modify - tables 3, 4 and 5 as attached

Modify - conditions 3) to table 3 as follows.

The values in parentheses are applicable to BASIC, SUPPLEMENTARY or REINFORCED INSULATION only if manufacturing is subject to a quality control programme, ~~an example of which is given in Annex R~~ that provides at least the same level of assurance as the example given in Annex R.2. In particular, DOUBLE and REINFORCED INSULATION shall be subject to 100% electric strength testing.

Add - an informative Note under table 4

Note: Use of *CLEARANCE* - Tables 3 and 4
Select the appropriate column in table 3 for the mains supply voltage and pollution degree.
Select the row appropriate to a *WORKING VOLTAGE* equal to the mains voltage. Note the *CLEARANCE* requirement.

Move to table 4. Select the appropriate column for the mains voltage and pollution degree and choose the row in that column which covers the actual repetitive peak insulation *WORKING VOLTAGE*. Read the additional *CLEARANCE* required from one of the two right hand columns and add this to the *CLEARANCE* from table 3 to give the required *CLEARANCE*.

Modify - condition 2) to table 5 as follows.

The values in parentheses are applicable to BASIC, SUPPLEMENTARY or REINFORCED INSULATION only if manufacturing is subject to a quality control programme, ~~an example of which is given in Annex R~~ that provides at least the same level of assurance as the example given in Annex R.2. In particular, DOUBLE and REINFORCED INSULATION shall be subject to 100% electric strength testing.

Table 3 - Minimum clearances for insulation in primary circuits and between primary and secondary circuits (mm)

Insulation working voltage (see 2.2.7) up to an including		Circuits subject to installation Category II														
		Nominal mains supply voltage ≤ 150 V (Transient rating 1 500V)						Nominal mains supply voltage > 150 V ≤ 300 V (Transient rating 2 500 V)						Nominal mains supply voltage > 300 V ≤ 600 V (Transient rating 4 000 V)		
V peak or d.c.	V r.m.s. (sinusoidal)	Pollution degrees 1 and 2			Pollution degree 3			Pollution degrees 1 and 2			Pollution degree 3			Pollution degrees 1, 2 and 3		
V	V	Op	B/S	R	Op	B/S	R	Op	B/S	R	Op	B/S	R	Op	B/S	R
71	50	0,4	1,0 (0,5)	2,0 (1,0)	0,8	1,3 (0,8)	2,6 (1,6)	1,0	2,0 (1,5)	4,0 (3,0)	1,3	2,0 (1,5)	4,0 (3,0)	2,0	3,2 (3,0)	6,4 (6,0)
210	150	0,5	1,0 (0,5)	2,0 (1,0)	0,8	1,3 (0,8)	2,6 (1,6)	1,4	2,0 (1,5)	4,0 (3,0)	1,5	2,0 (1,5)	4,0 (3,0)	2,0	3,2 (3,0)	6,4 (6,0)
420	300	Op 1,5 B/S 2,0(1,5) R 4,0(3,0)												2,5	3,2 (3,0)	6,4 (6,0)
840	600	Op 3,0 B/S3,2(3,0) R 6,4(6,0)														
1 400	1 000	Op/B/S 4,2 R 6,4														
2 800	2 000	Op/B/S/R 8,4														
7 000	5 000	Op/B/S/R 17,5														
9 800	7 000	Op/B/S/R 25														
14 000	10 000	Op/B/S/R 37														
28 000	20 000	Op/B/S/R 80														
42 000	30 000	Op/B/S/R 130														

Table 4 - Additional clearances for insulation in primary circuits with repetitive peak voltages exceeding the peak value of the mains supply voltage

Nominal mains supply voltage ≤ 150 V		Nominal mains supply voltage > 150 V ≤ 300 V	Additional clearance mm	
Pollution degrees 1 and 2	Pollution degree 3	Pollution degrees 1, 2 and 3	Operational, basic or supplementary insulation	Reinforced insulation
Maximum repetitive peak voltage V	Maximum repetitive peak voltage V	Maximum repetitive peak voltage V		
210 (210)	210 (210)	420 (420)	0	0
298 (288)	294 (293)	493 (497)	0,1	0,2
386 (366)	379 (376)	567 (575)	0,2	0,4
474 (444)	463 (459)	640 (654)	0,3	0,6
562 (525)	547 (541)	713 (729)	0,4	0,8
650 (600)	632 (624)	787 (807)	0,5	1,0
738 (678)	716 (707)	860 (884)	0,6	1,2
826 (756)	800 (730)	933 (961)	0,7	1,4
914 (839)	– –	1006 (1039)	0.8	1,6
1002 (9112	– –	1080 (1116)	0,9	1,8
1090 (990)	– –	1153 (1183)	1,0	2,0
– –	– –	1226 (1271)	1,1	2,2
– –	– –	1300 (1348)	1,2	2,4
– –	– –	– (1425)	1,3	2,6

Table 5 - Minimum clearances in secondary circuits (mm)

Insulation working voltage up to and including		Circuits subject to installation Category I (see condition 5)																	
		Nominal mains supply voltage ≤ 150 V (Transient rating of secondary circuit 800 V)						Nominal mains supply voltage > 150 V ≤ 300 V (Transient rating of secondary circuit 1500 V)						Nominal mains supply voltage > 300 V ≤ 600 V (Transient rating of secondary circuit 2 500 V)			Circuits not subjected to transient overvoltage (see condition 4)		
V peak or d.c.	V r.m.s. (sinusoidal)	Pollution degrees 1 and 2			Pollution degree 3			Pollution degrees 1 and 2			Pollution degree 3			Pollution degrees 1, 2 and 3			Pollution degrees 1 and 2 only		
V	V	Op	B/S	R	Op	B/S	R	Op	B/S	R	Op	B/S	R	Op	B/S	R	Op	B/S	R
71	50	0,4 (0,2)	0,7 (0,2)	1,4 (0,4)	1,0 (0,8)	1,3 (1,0)	2,6 (1,6)	0,7 (0,5)	1,0 (0,5)	2,0 (1,0)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	0,4 (0,2)	0,4 (0,2)	0,8 (0,4)
140	100	0,6 (0,2)	0,7 (0,2)	1,4 (0,4)	1,0 (0,8)	1,3 (1,0)	2,6 (1,6)	0,7 (0,5)	1,0 (0,5)	2,0 (1,0)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	0,6 (0,2)	0,7 (0,2)	1,4 (0,4)
210	150	0,6 (0,2)	0,9 (0,2)	1,8 (0,4)	1,0 (0,8)	1,3 (1,0)	2,6 (1,6)	0,7 (0,5)	1,0 (0,5)	2,0 (1,0)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	0,6 (0,2)	0,7 (0,2)	1,4 (0,4)
280	200	Op 1,1 (0,8) B/S 1,4(0,8) R 2,8(1,6)												1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	1,1 (0,2)	1,1 (0,2)	2,2 (0,4)
420	300	Op 1,6 (1,0) B/S 1,9(1,0) R 3,8(2,0)												1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	1,4 (0,2)	1,4 (0,2)	2,8 (0,4)
700	500	Op/B/S 2,5 R 5,0																	
840	600	Op/B/S 3,2 R 5,0																	
1 400	1 000	Op/B/S 4,2 R 5,0																	
2 800	2 000	Op/B/S/R 8,4																	
7 000	5 000	Op/B/S/R 17,5																	
9 800	7 000	Op/B/S/R 25																	
14 000	10 000	Op/B/S/R 37																	
28 000	20 000	Op/B/S/R 80																	
42 000	30 000	Op/B/S/R 130																	

IEC/TC74(Secretariat)317 - Results of the vote on IEC/TC74(Secretariat)277

2.9.2 Clearance

Replace - the headers of table 5 as follows where the transient rating is contained to read:

Nominal mains supply voltage ≤ 150 V (Maximum transient in secondary circuit 800 V see condition 6)	Nominal mains supply voltage >150 V ≤ 300 V (Maximum transient in secondary circuit 1500 V see condition 6)	Nominal mains supply voltage > 300 V ≤ 600 V (Maximum transient in secondary circuit 2500 V see condition 6)

Replace - conditions 6 to table 5

6 Where transients in the equipment exceed this value, the appropriate higher CLEARANCE shall be used.

IEC/TC74(Secretariat)319 - Results of the vote on IEC/TC74(Secretariat)279

2.9.3 Creepage distances

Delete - the compliance paragraph

~~Compliance is checked by measurement, taking account of the figures in Annex F and subject to conditions in 2.9.1.~~

IEC/TC74(Secretariat)345 - Results of the vote on IEC/TC74(Secretariat)310

2.9.3 Creepage distances

Delete - condition 5 to table 6

~~For WORKING VOLTAGES of 127 V, 208 V and 415 V, it is permitted to use CREEPAGE DISTANCES corresponding to 125 V, 200 V and 400 V.~~

IEC/TC74(Secretariat)330 - Results of the vote on IEC/TC74(Secretariat)295

2.9.4 Distance through insulation

Modify - the third paragraph as follows

Enamel ~~or other insulating coating~~ on winding wire such as is normally used in transformer construction is not considered to be insulation in thin sheet material.

Add - the following two paragraphs at the end of 2.9.4 before the compliance paragraph

Where the insulation on winding wire is used to provide BASIC, SUPPLEMENTARY or DOUBLE INSULATION in a wound component without additional interleaved insulation, polyimide-insulated wire complying with Annex U shall be used. The insulation is considered to be BASIC or SUPPLEMENTARY INSULATION; two wires that are adjacent to each other are considered to be separated by DOUBLE INSULATION. Wire with other insulating materials shall not be used without interleaved insulation.

The construction of the wound component shall be as follows:

- where REINFORCED INSULATION is required for wire whose insulation would be accessible, it shall pass the electric strength test for REINFORCED INSULATION, and additionally it shall be covered by thin film or other insulation meeting the requirements for SUPPLEMENTARY INSULATION;
- where two wires are in contact inside the component and cross each other at an acute angle that exceeds 45°, intervening insulation shall be provided in the form of sleeving or sheet materia;
- the finished component shall be subjected to 100% routine electric strength testing according to 5.3.

NOTE
Any material used to impregnate or encapsulate the winding wire in the finished component should be compatible with the insulation on the winding wire.

IEC/TC74(Secretariat)331 - Results of Comments IEC/TC74(Secretariat)296

2.9.4 Distance through insulation

Modify - the first paragraph after Note 1

Except where 2.1.3 applies. ~~Unless otherwise specified (see 2.1.3, 2.9.5 and 3.1.5),~~ distance through insulation shall be dimensioned according to WORKING VOLTAGE and to application of the insulation (see 2.2.6 and 2.2.7), and as follows:

Add - a new dashed item between the existing first and second dashed items

– for OPERATIONAL INSULATION and BASIC INSULATION there is no requirement at any WORKING VOLTAGE for distance through insulation.

IEC/TC74(Secretariat)345 - Results of the vote on IEC/TC74(Secretariat)310

2.9.5 Coated printed boards

Modify - the third paragraph as follows

The values in table 7 shall be used only if manufacturing is subject to a quality control programme, ~~an example of which is given in Annex R~~ that provides at least the same level of assurance as the example given in Annex R.1. In particular, DOUBLE and REINFORCED INSULATION shall be subject to 100% electric strength testing.

IEC/TC74(Secretariat)294 - Results of the vote on IEC/TC74(Secretariat)329

2.9.6 Enclosed and sealed parts

Replace - existing 2.9.6 with the following:

For components or sub-assemblies which are adequately enclosed by enveloping or hermetic sealing to prevent ingress of dirt and moisture, the values for Pollution Degree 1 apply to the internal CLEARANCES and CREEPAGE DISTANCES.

NOTE
Some examples of such constructions include parts in boxes that are hermetically sealed by adhesive or otherwise, and parts enveloped in a dip coat.

Compliance is checked by inspection, measurement and test. A component or sub-assembly is considered to be adequately enclosed if a sample passes the following sequence of tests.

The sample is subjected ten times to the following sequence of temperature cycles:

68 h at	T°C ± 2°C
1 h at	25°C ± 2°C
2 h at	0°C ± 2°C
1 h at	25°C ± 2°C

For wound components, T is

– the highest temperature of the winding measured under normal conditions in accordance with 1.4.5, 1.4.7 and 1.4.8, plus 10 K, or

– 85°C,

whichever is higher.

For other parts T is

– the highest temperature of the component or sub-assembly, measured under normal conditions in accordance with 1.4.5 and 1.4.7, plus 10 K, or

– 85°C,

whichever is higher.

The sample is allowed to cool to room temperature and is subjected to the humidity treatment of 2.2.3, followed immediately by the electric strength tests of 5.3.2.

IEC/TC74(Secretariat)329 - Results of the vote on IEC/TC74(Secretariat)294

Replace - existing 2.9.7 with the following:

2.9.7 Spacing filled by insulating compound

Where distances between conductive parts are effectively filled with insulating compound so that CLEARANCES and CREEPAGE DISTANCES do not exist, only the requirements for distance through insulation of 2.9.4 apply.

NOTES

1 Some examples of such treatment are variously known as potting, encapsulation and vacuum impregnation.

2 Acceptable forms of construction include

- components or sub-assemblies which are treated with an insulating compound that fills voids;
- internal insulation of multi-layer printed boards.

3 For cemented joints, see 2.9.8.

Compliance is checked as follows: the finished component with its insulating compound is subjected to the thermal cycling, humidity and electric strength tests of 2.9.6. These tests are followed by inspection, including sectioning, and measurement. There shall be neither cracks nor voids in the insulating compound such as would affect compliance with 2.9.4

Add - the following new subclause

2.9.8 Cemented joints

Where insulation is reliably cemented together, no CREEPAGE DISTANCE or CLEARANCE path exists along the joint and the requirements for distance through insulation of 2.9.4 apply. See Annex F.

Compliance is checked by inspection, measurement and test.

For this test uninsulated conductors are used (e.g. enamelled wires are replaced by uninsulated wires).

The materials are considered to be cemented together, if they withstand the following test:

Three samples of the component of sub-assembly are subjected to the thermal cycling test of 2.9.5. The 100°C temperature is replaced by the highest temperature measured under normal conditions plus 10 K on the component or sub-assembly under consideration with a minimum of 85°C.

One of the samples is subjected to the relevant electric strength test of 5.3.2, immediately after the last period at highest temperature during the thermal cycling test, except that the test voltage is multiplied by 1,6.

The other samples are subjected to the humidity treatment of 2.2.3 (48 h treatment) followed by the relevant electric strength test of 5.3.2, except that the test voltages are multiplied by 1,6.

Secretary's Note
Present 2.9.8 will become 2.9.9 and existing references to 2.9.8 will be revised accordingly.

IEC/TC74(Secretariat)331 - Results of the vote on IEC/TC74(Secretariat)296

3.1 General

3.1.5 **Replace** - the first two paragraphs with the following combined text

Insulation of individual conductors of internal wiring shall be capable of withstanding the appropriate electric strength test specified in 5.3.2.

Delete - the Note

~~Note: If the suitability of conductor insulation is assessed by reference to a relevant component standard, that standard may contain requirements for distance through insulation~~.

Add - a new first compliance paragraph

Compliance is checked by inspection of applicable test results

Secretary's Note
Modification to 3.1.5 was proposed in IEC/TC74(Secretariat)240, but was inadvertently omitted in IEC/TC74(Secretariat)296.

IEC/TC74(Secretariat)315 - Results of the vote on IEC/TC74(Secretariat)275

3.2 Connection to primary power

3.2.3 **Modify** - the first dashed paragraph as follows

– so located or enclosed that parts at HAZARDOUS VOLTAGE are not accessible during insertion or removal of the connector (appliance inlets complying with IEC 309 or with IEC 320 are considered to comply with this requirement);

IEC/TC74(Secretariat)316 - Results of the vote on IEC/TC74(Secretariat)276

4.1 Stability and mechanical hazards

4.1.2 **Modify** - the third compliance paragraph

Apertures preventing the entry of the test finger, figure 19 (page 239), are further tested by means of a straight unjointed version of the test finger applied with a force of 30 N. If the unjointed finger enters, the test with the test finger, figure 19, is repeated, ~~the finger being pushed through the aperture if necessary~~ except that the finger is pushed through the aperture using any necessary force up to 30 N.

IEC/TC74(Secretariat)338 - Results of the vote on IEC/TC74(Secretariat)301

4.2.1 General

Modify - the first sentence of the compliance paragraph as follows:

Compliance is checked for all equipemnt by the relevant ~~steady force and impact~~ tests of 4.2.2 to ~~4.2.4~~, **4.2.5 as specified**. ~~HAND HELD EQUIPMENT is also subjected to the drop test of 4.2.5~~. Alternatively, compliance with this subclause is checked by examination of the construction and available data.

4.2.4 Steel ball test

Modify - the first sentence of the first paragraph as follows:

Except for **equipment identified in 4.2.5**, ~~HAND HELD EQUIPMENT and direct PLUG-IN EQUIPMENT (see 4.2.5)~~, external surfaces of ENCLOSURES, the failure of which would give access to hazardous parts, are tested as follows:

4.2.5 Drop test

Modify - the first paragraph as follows:

HAND HELD EQUIPMENT, ~~and~~ desk-top equipment having a mass of 5 kg or less that is intented for use with a cord-connected telephone handset or other hand-held accessory with an acoustic function or a headset and DIRECT PLUG-IN EQUIPMENT are subject to a drop test. A sample of the complete equipment is subjected to three impacts that result from being dropped ~~1 m~~ onto a hardwood surface in positions likely to produce the most adverse results.

The height of the drop shall be

– 1 m for HAND-HELD EQUIPMENT and DIRECT PLUG-IN EQUIPMENT;

– 750 mm for desk-top equipment.

IEC/TC74(Secretariat)334 - Results of the vote on IEC/TC74(Secretariat)297

4.2.5 Drop test

Modify - the second paragraph as follows

The hardwood surface consists of a layer of tongued and grooved oak flooring ~~approximatibely 18 mm thick by 75 mm wide~~ <u>at least 13 mm thick</u>, mounted on two layers of plywood each 19 mm to 20 mm thick, all supported on a concrete or equivalent non-resilient floor.

IEC/TC74(Secretariat)338 - Results of the vote on IEC/TC74(Secretariat)301

4.2.7 Compliance criteria

Modify - the first sentence of the first paragraph as follows:

After the tests 4.2.2 to 4.2.6, the sample shall comply with the requirements of 2.1.2, 2.1.5, 2.5.1, 2.5.2, 2.9, 3.2.5, ~~and~~ 4.1.2, <u>and 6.2.2</u> and shall show no signs of interference with the operation of the safety features such as THERMAL CUT-OUTS, overcurrent protection devices or interlocks. In case of doubt, SUPPLEMENTARY or REINFORCED INSULATION is subject to an electric strength test as specified in 5.3.2.

IEC/TC74(Secretariat)329 - Results of the vote on IEC/TC74(Secretariat)294

4.3 Construction details

4.3.8 Delete - this subclause

~~Any gap with a width greater than 0,3 mm in SUPPLEMENTARY INSULATION shall not coincide with any such gap in BASIC INSULATION, nor shall any such gap in REINFORCED INSULATION give straight access to parts at HAZARDOUS VOLTAGE.~~

IEC/TC74(Secretariat)345 - Results of the vote on IEC/TC74(Secretariat)310

4.3 Construction details

4.3.10 Delete - this subclause

~~SUPPLEMENTARY INSULATION and REINFORCED INSULATION shall be so designed or protected that they are not likely to be impaired by deposition of dirt, or by dust resulting from wear of parts within the equipment, to such an extent that CREEPAGE DISTANCES and CLEARANCES are reduced below the values specified in 2.9.~~

~~Part of synthetic rubber used as SUPPLEMENTARY or REINFORCED INSULATION shall be resistant to ageing, and be so arranged and dimensioned that the CREEPAGE DISTANCES are not reduced below the values specified in 2.9 if any cracks occur.~~

~~Compliance is checked by inspection and by measurement.~~

4.3.11 Modify - the compliance clause in 4.3.11 as follows.

Compliance is checked by inspection, and by evaluation of the data for the insulating material.

IEC/TC74(Secretariat)321 - Results of the vote on IEC/TC74(Secretariat)281

4.3 Construction details

4.3.18 Replace - as follows

DIRECT PLUG-IN EQUIPMENT shall not impose undue strain on the socket-outlet. The mains plug part shall comply with the standard for the relevant mains plug.

Compliance is checked by inspection and, if necessary, by the following test:

The equipment is inserted, as in normal use, into a fixed socket-outlet without earthing contact, which can be pivoted about a horizontal axis intersecting the centre lines of contacts at a distance of 8 mm behind the engagement face of the socket-outlet. The additional torque which has to be applied to the socket-outlet to maintain the engagement face in the vertical plane shall not exceed 0,25 N·m.

NOTE
In the United Kingdom the use of plugs or socket-outlets without earthing contact is not permitted and this test cannot be applied.

IEC/TC74(Secretariat)339 - Results of the vote on IEC/TC74(Secretariat)302

4.3 Construction details

Add - the following new subclause

4.3.22 If a barrier or screen provided to comply with 4.3.14,

4.3.15, 4.3.16 or 4.4.6 is secured with adhesive to the inside of the enclosure or to other parts inside the enclosure, the adhesive shall have adequate ageing properties.

Compliance is checked by the following tests.

A sample of the equipment or a part of the enclosure with the barrier of screen attached is conditioned as follows. The sample is placed with the barrier or screen on the underside during conditioning.

Day 1: At the manufacturer's option, place in the oven at

a) 100°C ± 2°C for one week; or
b) 90°C ± 2°C for three week; or
c) 82°C ± 2°C for eight week.

Day 8, Day 22, or Day 57:

a) Remove from oven and leave at any convenient temperature between 20°C and 30°C for 1 h;
b) Place in freezer at -40°C ± 2°C for 4 h;
c) Remove from freezer and allow to come to any convenient temperature between 20°C and 30°C over 8 h.

Day 9, Day 23, or Day 58:

a) Place in a compartment at 95% ± 5% relative humidity for 72 h;
b) Remove and leave at any convenient temperature between 20°C and 30°C for 1 h;
c) Place in oven at the temperature selected in the first cycle for 4h;
d) Remove and allow sample to reach any convenient temperature between 20°C and 30°C over 8 h.

Immediately after conditioning, the sample is subjected to the tests of 4.2 as applicable. The barrier or screen shall not fall off or partly dislodge as a result of these tests.

IEC/TC74(Secretariat)316 - Results of the vote on IEC/TC74(Secretariat)276

4.4.3 Flammability of materials and components

4.4.3.2 Modify - as follows

Except as specified in 1.5.4, elsewhere in 4.4.3, and in 4.4.4, all materials and components shall comply with one of the following:

4.4.4 Materials for enclosures and for decorative parts

Modify - the sixth paragraph as follows

ENCLOSURES or parts of ENCLOSURES that are located within 13 mm of arcing parts, such as unenclosed commutators and unenclosed switch contacts, shall also comply with the test of clause A.3. This requirement applies to ENCLOSURES of equipment and not to covers of components.

4.4.5 Conditions for fire enclosures

4.4.5.2 Add - the following new fourth dashed paragraph

– components in a TNV CIRCUIT supplied by an internal or external power souce which is limited to a maximum of 15 VA under normal operating conditions and after a single fault. For the purpose of this subclause, the power available from a TELECOMMUNCIATION NETWORK is considered to be limited to 15 VA

IEC/TC74(Secretariat)345 - Results of the vote on IEC/TC74(Secretariat)310

5.1 Heating

Modify - condition 7) to table 16 as follows.

Consideration should be given to the fact that, on a long-term basis, the electrical and mechanical properties of certain insulating materials may be adversely affected, e.g., by softeners evaporating at temperatures below their normal softening temperatures, see 2.2.2

IEC/TC74(Secretariat)343 - Results of the vote on IEC/TC74(Secretariat)308

5.3 Electric strength

5.3.1 Modify - the 1st compliance clause as follows

Compliance is checked by testing the equipment in accordance with 5.3.2 ~~or, for SAFETY ISOLATING TRANSFORMERS, in accordance with clause C.3,~~ while the equipment is still in a well-heated condition immediately following the heating test as specified in 5.1.

IEC/TC74(Secretariat)317 - Results of the vote on IEC/TC74(Secretariat)277

5.3 Electric strength

5.3.2 Delete - the second paragraph

~~For d.c. WORKING VOLTAGES which are derived inside the equipment from an a.c. mains supply or from batteries, the WORKING VOLTAGE (r.m.s.) used in table 18 is the D.C. component e the voltage plus the peak value of any ripple, all divided by $\sqrt{2}$.~~

Secretary's Note

Former 5.3.2 has been revised and moved to 2.2.7.5

Table 18

Modify - condition 3 to read

For WORKING VOLTAGES exceeding **10** kV peak or d.c. in SECONDARY CIRCUITS, the same values as for PRIMARY CIRCUITS apply.

Modify - condition 4 as follows

At these voltages , the values of V_b are determined by the general curve $V_b = 155{,}86\ U^{0{,}4638}$ and are not 1,6 V_a

Add - the following new conditions

6 Use this column for d.c. mains supplies under and including 130 V

7 Use this column for d.c. mains supplies over 130 V , up to and including 250 V

8 Use this column for d.c. mains supplies over 250 V.

NOTE
Conditions 6,7 and 8 apply to d.c. mains supply. They are not applicable to d.c. derived within the equipment from a.c. supplies.

Modify - Table 18, parts 1 and 2

Part 1 Working voltages and grade of insulation have been revised as follows

Working Voltages	U ≤ 184 V peak or d.c	184 V < U ≤ 354 V peak or d.c.	354 V < U ≤ 1,41 kV peak or d.c.	1,41 kV < U ≤ 10 kV peak or d.c.	10 kV < U ≤ 50 kV peak or d.c.	U ≤ 42,4 V peak or d.c 60 V d.c. .	42,4 V peak or 60 V d.c < U ≤ 10 kV peak or d.c.
Grade of Insulation	6)	7)	8)				

Replace

Part 1 - the values listed under the fifth column from 1,5 U to 1,06 U.

Replace

Part 2 - As follows

Table 18 - Test voltages [2) 5)] for electric strength tests - Part 2
Volts

U peak or d.c	Va r.m.s	Vb r.m.s	U peak or d.c	Va r.m.s	Vb r.m.s	U peak or d.c	Va r.m.s	Vb r.m.s
34	500	800	250	1 261	2 018	1 750	3 257	3 257
35	507	811	260	1 285	2 055	1 800	3 320	3 320
36	513	821	270	1 307	2 092	1 900	3 444	3 444
38	526	842	280	1 330	2 127	2 000	3 566	3 566
40	539	863	290	1 351	2 162	2 100	3 685	3 685
42	551	882	300	1 373	2 196	2 200	3 803	3 803
44	564	902	310	1 394	2 230	2 300	3 920	3 920
46	575	920	320	1 414	2 263	2 400	4 034	4 034
48	587	939	330	1 435	2 296	2 500	4 147	4 147
50	598	957	340	1 455	2 328	2 600	4 259	4 259
52	609	974	350	1 474	2 359	2 700	4 369	4 369
54	620	991	360	1 494	2 390	2 800	4 478	4 478
56	630	1 008	380	1 532	2 451	2 900	4 586	4 586
58	641	1 025	400	1 569	2 510	3 000	4 693	4 693
60	651	1 041	420	1 605	2 567	3 100	4 798	4 798
62	661	1 057	440	1 640	2 623	3 200	4 902	4 902
64	670	1 073	460	1 674	2 678	3 300	5 006	5 006
66	680	1 088	480	1 707	2 731	3 400	5 108	5 108
68	690	1 103	500	1 740	2 784	3 500	5 209	5 209
70	699	1 118	520	1 772	2 835	3 600	5 309	5 309
72	708	1 133	540	1 803	2 885	3 800	5 507	5 507
74	717	1 147	560	1 834	2 934	4 000	5 702	5 702
76	726	1 162	580	1 864	2 982	4 200	5 894	5 894
78	735	1 176	588	1 875	3 000	4 400	6 082	6 082
80	744	1 190	600	1 893	3 000	4 600	6 268	6 268
85	765	1 224	620	1 922	3 000	4 800	6 452	6 452
90	785	1 257	640	1 951	3 000	5 000	6 633	6 633
95	805	1 288	660	1 979	3 000	5 200	6 811	6 811
100	825	1 319	680	2 006	3 000	5 400	6 987	6 987
105	844	1 350	700	2 034	3 000	5 600	7 162	7 162
110	862	1 379	720	2 060	3 000	5 800	7 334	7 334
115	880	1 408	740	2 087	3 000	6 000	7 504	7 504
120	897	1 436	760	2 113	3 000	6 200	7 673	7 673
125	915	1 463	780	2 138	3 000	6 400	7 840	7 840
130	931	1 490	800	2 164	3 000	6 600	8 005	8 005
135	948	1 517	850	2 225	3 000	6 800	8 168	8 168
140	964	1 542	900	2 285	3 000	7 000	8 330	8 330
145	980	1 568	950	2 343	3 000	7 200	8 491	8 491
150	995	1 593	1 000	2 399	3 000	7 400	8 650	8 650
152	1 000	1 602	1 050	2 454	3 000	7 600	8 807	8 807
4) 155	1 000	1 617	1 100	2 508	3 000	7 800	8 964	8 964
4) 160	1 000	1 641	1 150	2 560	3 000	8 000	9 119	9 119
4) 165	1 000	1 664	1 200	2 611	3 000	8 200	9 273	9 273
4) 170	1 000	1 688	1 250	2 661	3 000	8 400	9 425	9 425
4) 175	1 000	1 711	1 300	2 710	3 000	8 600	9 577	9 577
4) 180	1 000	1 733	1 350	2 758	3 000	8 800	9 727	9 727
4) 184	1 000	1 751	1 400	2 805	3 000	9 000	9 876	9 876
185	1 097	1 755	1 410	2 814	3 000	9 200	10 024	10 024
190	1 111	1 777	1 450	2 868	3 000	9 400	10 171	10 171
200	1 137	1 820	1 500	2 934	3 000	9 600	10 317	10 317
210	1 163	1 861	1 550	3 000	3 000	9 800	10 463	10 463
220	1 189	1 902	1 600	3 065	3 065	10 000	10 607	10 607
230	1 214	1 942	1 650	3 130	3 130			
240	1 238	1 980	1 700	3 194	3 194			

IEC/TC74(Secretariat)334 - Results of the vote on IEC/TC74(Secretariat)297

5.4 Abnormal operating and fault conditions

5.4.9 **Modify** - the third paragraph as follows

If the failure of the insulation would not result in exposure to HAZARDOUS VOLTAGES or HAZARDOUS ENERGY LEVELS, a maximum temperature of 300°C is permitted. Higher temperatures are permitted for insulation made of glass or ceramic material.

Modify - the last paragraph as follows

~~This~~ The test is made as specified in 5.3.2. ~~after the insulation has cooled to room tempeature.~~

IEC/TC74(Secretariat)340 - Results of the vote on IEC/TC74(Secretariat)305

6.2.1 TNV circuit characteristics and requirements

6.2.1.1 **Modify** - 6.2.1.1 as follows:

Under normal operating conditions, TNV CIRCUITS shall ~~not exceed the following limits~~ comply with the following:

a) For continuous voltages, the combination of a.c. and d.c. values is such that

$$\frac{U_{ac}}{70,7} + \frac{U_{dc}}{120} \leq 1$$

Where:

U_{ac} is the peak value of the a.c. voltage (V) at any frequency,

U_{dc} is the value of the d.c. voltage (V).

NOTES

1. When U_{dc} is zero, U_{ac} can be up to 70,7 V peak
2. When U_{ac} is zero, U_{dc} can be up to 120 V.

In the event of a single insulation fault or component failure within the equipment a TNV CIRCUIT shall not exceed the limits of figure 15.

b) For telephone ringing signals that exceeds a), the signal complies with the criteria of either clause M.2 or clause M.3.

Compliance is checked by inspection and measurement.

IEC/TC74(Secretariat)286 - Results of the vote on IEC/TC74(Secretariat)267

6.2.1 TNV circuit characteristics and requirements

6.2.1.1 **Delete** - paragraph c)

~~c) For telegraph or teletypewriters signals of any frequency, the signal has a value not exceeding 135 V peak with respect to earth~~

Add - the following note

NOTE
Telegraph and teletypewriter signals may be present on the existing telecommunication network, however, since the use of those signals is considered obsolescent, their TNV CIRCUIT characteristics are not considered in this standard.

6.2.1.2 **Modify** - the last paragraph as follows

In the event of a single insulation fault or component failure, the limits of 6.2.1.1 ~~a) or b)~~ shall not be exceed on accessible **conductive** parts.

Delete - the note

~~Note. Requirements for TNV CIRCUITs complying with 6.2.1.1 a) are under consideration.~~

6.2.1.3 **Modify** - as follows

If a TNV CIRCUIT ~~complying with 6.2.1.1 a) or b)~~ is connected to an SELV CIRCUIT that has one pole connected to earth, 2.3.9 applies except that the limits of 2.3.3 are replaced by the limits of 6.2.1.1 ~~a) or b)~~.

Delete - the note

~~Note: Requirements for TNV circuits complying with 6.2.1.1 a) are under consideration.~~

IEC/TC74(Secretariat)312 - Compilation of Comments on IEC/TC74(Secretariat)355

6.2.1 TNV circuit characteristics and requirements

6.2.1.4 **Modify** - as follows

Except as permitted in 6.2.1.5, TNV CIRCUITS shall be separated from circuits at HAZARDOUS VOLTAGES by one or more of the following methods:

a) by DOUBLE or REINFORCED INSULATION as detailed in 2.3.4;

b) by BASIC INSULATION, together with protective screening connected to the protective ear**thing** terminal, as detailed in 2.3.5;

NOTES

1 In Finland method (b) is permitted only for PERMANENTLY CONNECTED EQUIPMENT or for PLUGGABLE EQUIPMENT TYPE B.

2 In Norway method (b) is not permitted.

Delete - paragraph c)

~~c) by a design complying with 6.2.1.5~~

Secretary's Note
The following text for 6.2.1.5 has been combined with IEC/TC74(Secretariat)292

6.2.1.5 **Replace** - as follows

A TNV CIRCUIT is pemitted to be connected to other circuits provided that all of the following conditions are met:

– the TNV CIRCUIT is not conductively connected to any PRIMARY CIRCUIT (including the neutral) within the equipment;

– the TNV CIRCUIT meets the limits of 6.2.1.1 under normal operating conditions;

– the TNV CIRCUIT meets the limits of figure 15 in the event of a single failure of any component or insulation of the TNV CIRCUIT, or of any component or insulation of the SECONDARY CIRCUIT to which it is connected.

If a TNV CIRCUIT is connected to one or more other circuits, the TNV CIRCUIT is that part which complies with the limits of 6.2.1.1 and figure 15.

Where a TNV CIRCUIT obtains its supply conductively from a SECONDARY CIRCUIT which is separated from the PRIMARY CIRCUIT or another HAZARDOUS VOLTAGE circuit by

– DOUBLE or REINFORCED INSULATION, or by

– the use of an earthed conductive screen that is separated from the PRIMARY CIRCUIT by BASIC INSULATION,

the TNV CIRCUIT shall be considered as being separated from the PRIMARY CIRCUIT or other HAZARDOUS VOLTAGE circuit by the same method.

Replace - the existing compliance clause under figure 15 and the last paragraph

Compliance is checked by inspection, and by simulation of failures of components and insulation such as are likely to occur in the equipment. No such simulated failures shall cause the voltage acccross a 5 kΩ resistor, connected between any two conductors of the TNV CIRCUIT or between any one such conductor and earth, to fall outside the shaded area of figure 15. Observation is continued until stable conditions have existed for at least 5 s.

Delete - the note

~~Note: The 500 Ω resistor approximate the resistance of the telecommunication line and the human body parallel~~

Add - the following note

NOTE
In Norway, it is a requirement that there shall be DOUBLE or REINFORCED INSULATION between parts conductively connected to the supply mains and parts connected to the public TELECOMMUNICATION NETWORK.

IEC/TC74(Secretariat)341 - Results of the vote on IEC/TC74(Secretariat)306

6.2.2 Protection against contact with TNV circuits

Modify - first and second paragraphs as follows and renumber to 6.2.2.1

6.2.2.1 Accessibility

Equipment shall be provided with adequate protection against contact with bare conductive TNV CIRCUIT parts that carry voltages which exceed 42,4 V peak, or 60 V d.c., under normal operating conditions.

Exempt from this requirement are:

– contacts of connectors which cannot be touched by the test probe (figure 16);

– equipment intended for installation in a RESTRICTED ACCESS LOCATION;

– bare conductive parts in the interior of a battery compartment that complies with 6.2.2.2

Add - the following new subclause

6.2.2.2 Battery compartments

Access to a TNV CIRCUIT within a dedicated battery compartment in the equipment is permitted if all of the following conditions are met:

– the compartment has a door that requires a deliberate technique to open, such as use of a tool or latching device;

– the TNV CIRCUIT is not accessible when the door is closed;

– there is a marking next the door, or on the door if the door is secured to the equipment, with instructions for protection of the operator once the door is opened.

NOTE
Information stating that the telephone cord is to be disconnecteed from the equipment prior to opening the door is an example of an acceptable instruction.

Compliance is checked by inspection.

IEC/TC74(Secretariat)342 - Results of the vote on IEC/TC74(Secretariat)307

6.3.3 Particular requirements for pluggable equipment type A

Modify - the second paragraphs as follows

The requirements of 6.3.3 do not apply to equipment that fulfills both of the following:

- it needs a connection to earth ~~for functional reasons~~ to enable the equipment to function, and
- ~~provided the equipment~~ **it** has a marking stating that safety requirements are not fulfilled unless the equipment is connected to a ~~wall~~ socket-outlet with protective earth**ing** contact.

IEC/TC74(Secretariat)323 - Results of the vote on IEC/TC74(Secretariat)283

6.4.2.2 Electric strength test

Add - the following new paragraph after the Note at the end of this subclause

In cases b) and c) it is permitted to remove surge suppressors provided that such devices pass the impulse test of 6.4.2.1 for cases b) and c) when tested as components outside the equipment.

6.4.2.3 Compliance criteria

Modify - as follows

During the tests of 6.4.2.1 and 6.4.2.2 there shall be no breakdown of insulation.

Insulation breakdown is considered to have occured when the current which flows as a result of the application of the test voltage rapidly increases in an uncontrolled manner, i.e., the insulation does not restrict the flow of current.

If a surge suppressor operates (or sparkover occurs within a gas discharge tube) during the test:

- in case a) of 6.4.1 such operation represents a failure;
- in cases b) and c) such operation is permitted during the impulse test;
- in cases b) and c) such operation during the electric strength test (by any surge suppresor left in place) represents a failure.

IEC/TC74(Secretariat)343 - Results of the vote on IEC/TC74(Secretariat)308

Annex C Transformers

C.1 Overload test

Modify - the first paragraph as follows

A conventional ~~or SAFETY ISOLATING TRANSFORMER~~ transformer has each secondary winding short-circuited in turn, with the other secondaries loaded to their specified maxima, taking into account the effect of any protection device provided.

C.2 Safety isolating transformers

Replace - existing C.2 with the following

C.2 Insulation

Insulation in transformers shall comply with the following requirements;

Windings and conductive parts of transformers shall be treated as parts of the circuits to which they are connected, if any. The insulation between them shall comply with the relevant requirements of 2.9 and pass the relevant tests of 5.3.2, according to the application of the insulation in the equipment (see 2.2.6).

Precautions shall be taken to prevent the reduction below the required minimum values of CLEARANCES and CREEPAGE DISTANCE that provide BASIC, SUPPLEMENTARY or REINFORCED INSULATION by:

- displacement of windings, or their turns;
- displacement of internal wiring or wires for external connections, undue displacement of parts of windings or internal wiring, in the event of rupture of wires adjacent to connections or loosening of the connections;
- bridging of insulation by wires, screws, washers and the like should they loosen or become free.

It is not excepted that two independent fixings will loosen at the same time.

All windings shall have the end turns retained by positive means.

NOTE
Examples of acceptable forms of construction are the following (there are other acceptable forms of construction)

- windings isolated from each other by placing them on separate limbs of the core, with or without spools;
- windings on a single spool with a partition wall, where either the spool and partition wall are pressed or moulded in one piece, or a pushed-on partition wall has an intermediate sheath or covering over the joint between the spool and the partition wall;
- concentric windings on a spool of insulation material without flanges, or on insulation applied in thin sheet form to the transformer core;
- insulation is provided between windings consisting of sheet insulation extending beyond the end turns of each layer;
- concentric windings, separated by an earthed conductive screen which consists of metal foil extending the full width of the windings, with suitable insulation between each winding and the screen. The conductive screen and its lead-out wire have a cross section sufficient to ensure that on breakdown of the insulation and overload device will open the circuit before the screen is destroyed. The overload device may be a part of the transformer.

Compliance is checked by inspection and measurement.

If a transformer is fitted with and earthed screen for protective purposes, the transformer shall pass the test of 2.5.11 between the earthed screen and the earthing terminal of the transformer.

No electric strength test applies to insulation between any winding and the core or screen, provided that the core or screen is totally enclosed or encapsulated and there is no electrical connection to the core or screen. However, the tests between windings which have terminations continue to apply.

Delete - existing C.3 including table C.2, C.2 conditions, and figure C.2

~~C.3 Electric strength requirements~~

~~Electric strength tests shall be applied in accordance with 5.3 and table C.2, taking into account figure C.2.~~

~~When carrying out a test between two points of application, it is permitted to connect other points together or to earth.~~

IEC/TC74(Secretariat)319 - Results of the vote on IEC/TC74(Secretariat)279

Annex F Measurement of creepage distances and clearances

Modify - the first paragraph as follows

The methods of measuring CREEPAGE DISTANCES and CLEARANCES which are specified in the following figures ~~F.1 to F.13~~ are used in interpreting the requirements of this standard.

Add - the following as the second paragraph

In the following figures, the value of X is given in table F.1. Where the distance shown is less than X, the depth of the gap or groove is ignored when measuring a CREEPAGE DISTANCE.

Table F.1 - Value of X

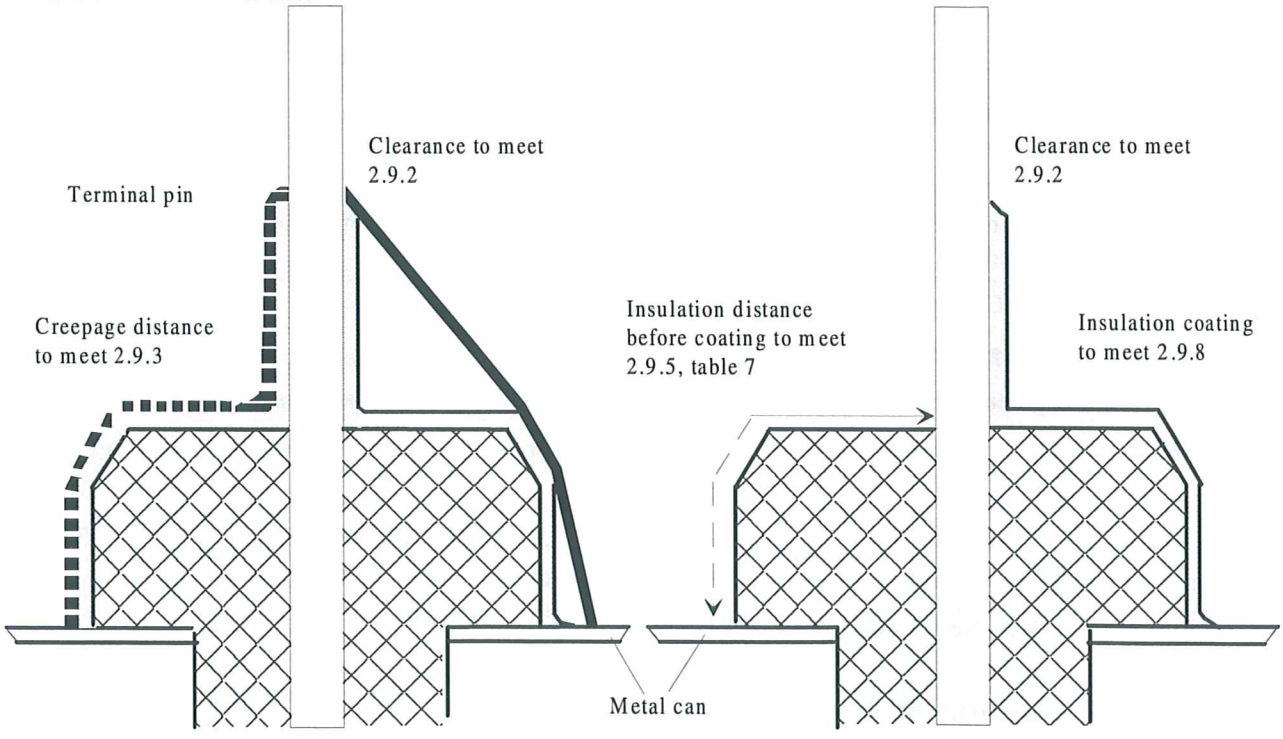
Pollution degree (see 2.9.1)	X mm
1	0,25
2	1,0
3	1,5

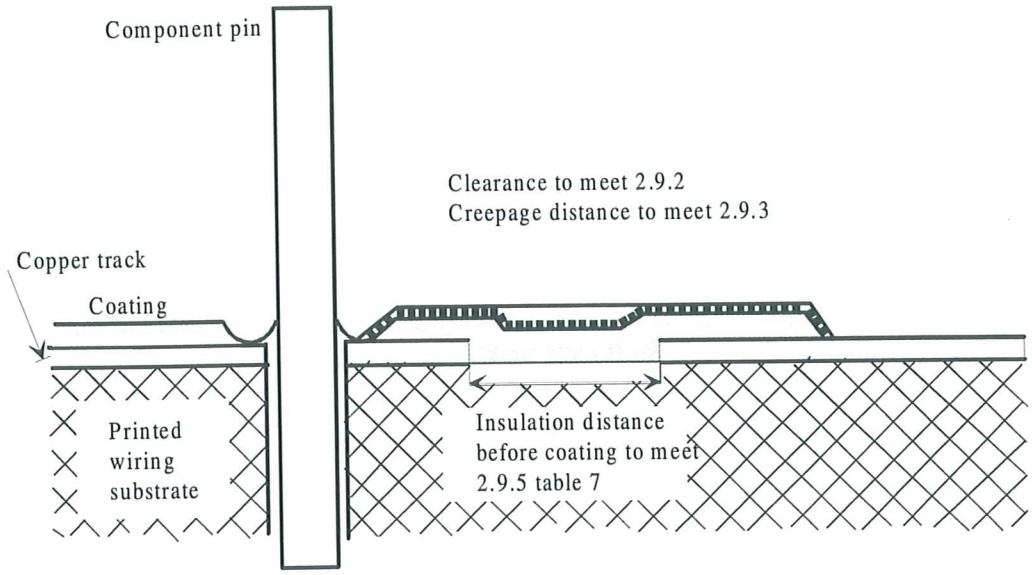
Table F.1 is valid only if the required minimum CLEARANCE is 3 mm or more. If the required minimum CLEARANCE is less than 3 mm, the value of X is

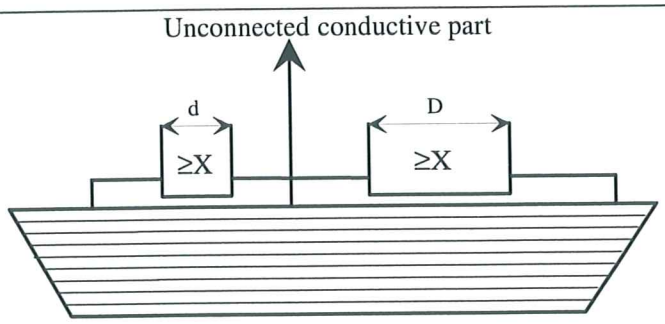
- the relevant value in Table F.1, or
- one-third of the required minimum CLEARANCE, whichever is less.

Figure 1 through 7, and figures 10 and 11 — Replace - "1" is replaced by "X"

Figures 8 and 9 — Delete







Condition: Insulation distance with intervening, unconnected conductive part.

Rule: CLEARANCE is the distance d + D
CREEPAGE DISTANCE is also d + D
Where the value of d or D is smaller than X it shall be considered as zero

IEC/TC74(Secretariat)344 - Results of the vote on IEC/TC74(Secretariat)309

Annex M Criteria for telephone ringing signals

M.2 Method A

Delete - the first paragraph

~~This method is based on Annex D of CENELEC EN 41003~~

Modify the first paragraph of item a) as follows

$I/_{TS1}$, the ~~effective~~ current calculated determined from the calculated or measured current for any single active ringing period t_1 (as defined in figure M.1), does not exceed:

IEC/TC74(Secretariat)330 - Results of the vote on IEC/TC74(Secretariat)295

Annex P Normative references

Add - the following under the IEC standards heading

851: Methods of test for winding wires

851-3: 1985, Part 3: Mechanical properties Amendment No. 1: 1988

851-5: 1985, Part 5: Electrical properties Amendment No. 1: 1990

851-6: 1985, Part 6: Thermal properties

IEC/TC74(Secretariat)349 - Results of the vote on IEC/TC74(United Kingdom)140

Annex P Normative references

Add - the following under the IEC standards heading

1058: Switches for appliances

1058-1: 1990, Part 1: General requirements

Annex Q Bibliography

Delete - the following under the IEC standards heading

~~1058-1: 1990, Switches for appliances Part 1: General requirements~~

IEC/TC74(Secretariat)345 - Results of the vote on IEC/TC74(Secretariat)310

Annex R Examples of requirements for a quality control programme for unpopulated coated printed boards

Modify - the title and Note of Annex R as follows

Examples of requirements for a quality control programm<u>e</u>s ~~for unpopulated coated printed boards~~

NOTE
This annex gives examples of requirements for a quality control programme as specified in 2.9.5 for minimum separation distances for coated printed boards <u>and in 2.9.2 for reduced CLEARANCES</u>. Under consideration ~~are~~ <u>is an</u> example of a similar quality control programme as specified ~~in 2.9.2 for CLEARANCES and~~ in 2.9.8 for spacing for component external terminations.

Add - the following identification

R.1 Minimum separation distances for coated printed boards (see 2.9.5)

Add - the following

R.2 Reduced clearances (see 2.9.2)

A manufacturer wishing to use reduced CLEARANCES permitted by 2.9.2, tables 3, 4, and 5, shall implement a quality control programme for those features of the construction listed in table R.2. This programme shall include specific quality controls for the tools and materials which affect the CLEARANCE.

The suppliers shall also identify and plan the protection and, where applicable, installation processes which directly affect quality and shall ensure that these processes are carried out under controlled conditions. Controlled conditions shall include the following:

- documented work instructions defining process, Equipment, Environment, and Manner or Production where the absence of such instructions would adversely affect quality, suitable working environment, compliance with reference standards or specifications and quality plans;
- monitoring and control of suitable processes and product characteristics during production and installation in the equipment;
- criteria for workmanship stipulated to the extent necessary in written specifications or by means of representative samples;
- records maintained for qualified processes, equipment and personnel as appropriate.

Table R.2 provides the sampling plan for attributes and tests necessary to conform with the requirements of 2.9.2. The number of samples of production parts or assemblies shall be based on IEC 410 or ISO 2859 or equivalent national standards.

Table R.2 - Rules for sampling and inspection

INSULATION	BASIC	SUPPLEMENTARY	REINFORCED
CLEARANCE 1)	SAMPLING S2 AQL 4	SAMPLING S2 AQL 4	SAMPLING S2 AQL 4
Electric Strength Test 2)	NA	NA	Routine 100%; one failure requires evaluation for cause

Conditions applicable to table R.2

1) To minimize test and inspection time, it is permitted to replace measurement of CLEARANCES by measurement of breakdown voltage. Initially the breakdown voltage is established for ten samples for which the correct CLEARANCE measurements have been confirmed. The breakdown voltage of subsequent parts or assemblies is then checked against a lower limit equal to the minimum breakdown voltage of the initial ten samples minus 100 V. If breakdown occurs at this lower limit, a part or assembly is considered a failure unless direct measurement of the CLEARANCE conforms with the requirement.

2) The electric strength test shall consist of one of the following alternatives:
   - a 1,2/50 µs impulse test using a positive and a negative impulse whose magnitude equals the peak of the test voltage from table 18 and repeated three times for each polarity;
   - a three cycle pulse of a.c. power frequency meeting the requirements of table 18;
   - a ten ms d.c. pulse with magnitude equal to the peak voltage requirements of table 18. There shall be three positive and three negative pulses.

3) Any failure to meet conditions 1) or 2) is a reason for rejection of the part or assembly.

IEC/TC74(Secretariat)330 - Results of the vote on IEC/TC74(Secretariat)295

Add - the following new Annex U

Annex U
(normative)

Insulated winding wires for use as multiple layer insulation
(see 2.9.4)

This annex specifies winding wire insulated with polyimide film that may be used to provide BASIC, SUPPLEMENTARY or REINFORCED INSULATION in wound components without additional interleaved insulation.

NOTE
Typical values of same properties of polyimide are given below for information. Adherence to these values is not part of this specification.

- electric strength 180 kV/mm
- dielectric constant 3,5
- dissipation factor 0,003 at 1 kHz
- insulation resistance 10^5 M Ω μF
- surface resistivity 10^{16} Ω at 50% r.h.
- folding endurance 10^4 cycles

U.1 Wire construction

Winding wire shall be insulated with two or more spirally-wrapped layers of polyimide tape. Overlap of layers shall be adequate to ensure continued overlap during manufacture of the wound component. Layers of tape shall be sealed to eliminate creepage paths between layers.

U.2 Conformance tests

The wire shall pass the following five type tests U.2.1 to U.2.5, carried out at a temperature between 15°C and 35°C and a relative humidity between 45% and 75%.

U.2.1 Electric strength

Test 13 of IEC 851-5, with a test voltage not less than the appropriate voltage in table 18 of this standard or 3 kV r.m.s., whichever is the greater.

U.2.2 Adherence and flexibility

Test 8 of IEC 851-3, 5.1.4, followed by the electric strength test U.2.1, carried out at rated temperature.

U.2.3 Heat shock

Test 9 of IEC 851-6, 3.1 or 3.2, followed by the electric strength test U.2.1.

U.2.4 Retention of electric strength after bending

Test 13 of IEC 851-5, 4.6.1C, followed by the electric strength test U.2.1.

U.2.5 Resistance to abrasion

Test 11 of IEC 851-3.

U.3 Production line test

The wire shall be subjected by the wire manufacturer to 100% electric strength testing in accordance with IEC 851-5, with a test voltage not less than the appropriate voltage in table 18 of this standard, or 3 kV r.m.s., whichever is the greater.

Index to Standard ECMA-129

Index to Standard ECMA-129

This index is derived from ECMA TR/63, Index to Publication IEC 950 - Safety of Information Technology Equipment, which has been adapted for use with this second edition of Standard ECMA-129. This index is for information only and the selection of indexed items does not imply any particular importance.

Location references are clause or sub-clause numbers or annex letters. If the location reference is purely numeric (e.g. 4.3.20) the sub-clause referred to is in Volume 1. The number of the Part or Parts where the subclause is located in Volume 1 is given in Roman numerals between parentheses after the subclause number, e.g. 1.2.3 (I, IV).

If the location reference starts with a letter of the alphabet (e.g. C.3) or if the reference is to an annex, the sub-clause referred to is in volume 2. All the annexes are in volume 2.

Principal references are printed **Bold**. When a reference to more than one Part appears, and one of these references is printed in bold, the full text of the subclause is reproduced in full only in the subclause whose number is printed in bold. For example, 4.2 (I, II, **IV**, V) means that sub-clause 4.2 is printed in full in part IV and is referred to in Parts I, II and 5). Otherwise, the full text appears in all referenced Parts.

Terms that are defined in ECMA-129 are printed in SMALL CAPITALS, both in the standard and in this index. Where such a term appears in the index, its definition is indicated by an asterisk, e.g. 1.2.13.1*

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