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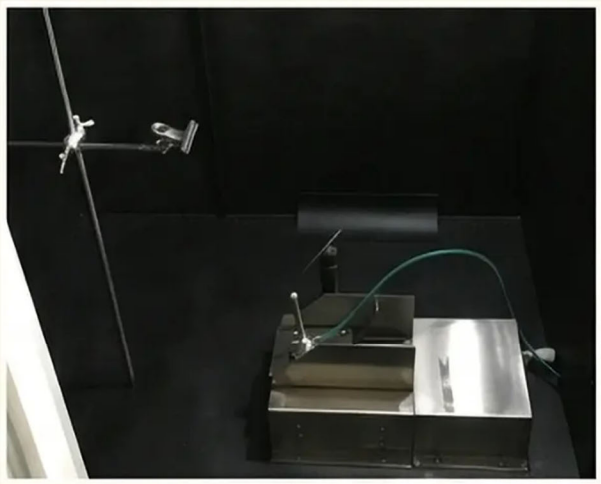

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Appendix B
Needle-Flame Test
(See Clauses 4.3.5.2, 9.2.1, and 9.2.2.)

Note: *This Appendix is not a mandatory part of this Standard but is written in mandatory language to accommodate its adoption by anyone wishing to do so.*

B1. Introduction and Scope

The needle-flame test described in this Appendix is applicable to electro-technical equipment subassemblies and components.

B2. Object of the Test

The needle-flame test is a test to simulate the effect of small flames, which may result from fault conditions within the equipment.

B3. General Description of the Test

The specimen shall be the complete equipment, subassembly, or component. It may be necessary to take away parts of an enclosure or to cut off a suitable part to perform the test. The test shall approximate those conditions occurring in normal use with regard to shape, ventilation, effect of thermal stresses, and the possibility of flames occurring, or burning or glowing particles falling in the vicinity of the specimen.

If the specimen is a suitable part cut from a larger unit, care shall be taken to ensure that the test flame is not applied incorrectly, for example, to an edge created by cutting.

The test is performed to ensure that

(a) the test flame does not cause ignition of parts; or

(b) a combustible part, which might be ignited by the test flame under defined conditions, has a limited duration of burning or a limited extent of burning, without spreading fire by flames or burning or glowing particles falling from the specimen. An indicator layer shall be used if required by the end-product Standard.

B4. Description of Test Apparatus

The burner to produce the test flame shall consist of a tube that is at least 35 mm long and has a bore of 0.5 ±±0.1 mm and an outer diameter not exceeding 0.9 mm. A hypodermic needle, the tapered end of which is cut off, may be used for the test.

The burner shall be supplied with butane or propane gas having a purity of at least 95%, with no air admitted to the burner tube*.

With the axis of the burner in the vertical position, the gas supply shall be adjusted so that without artificial air supply the length of the flame is 12 ± 1 mm (see Figure 12).

Means to fix the specimen and the burner in position may be necessary.

**Propane gas may be used to supply the burner; however, butane gas is the standard reference.*

B5. Preconditioning

Test specimens shall be conditioned for 24 h at a temperature of 23 ±±2 °C and 50 ± 10% rh.

B6. Test Procedure

B6.1

The test chamber (with minimum volume of 0.5 m^3) in which the test is made shall have dimensions adequate to ensure that the test is carried out in a draft-free atmosphere and with an adequate supply of air.

B6.2

The specimen shall be arranged in its most unfavourable position of normal use. The means to fix the specimen shall not influence the effect of the test flame or the propagation of flames in a way other than that occurring under normal conditions of use.

B6.3

The test flame shall be kept at least 150 mm away from the specimen to avoid the influence of heat or radiation on the specimen except when the flame is being applied.

B6.4

The test flame shall be applied to that part of the surface of the specimen which is likely to be affected by flames resulting from normal use or from fault conditions, or from any source of ignition accidentally applied.

The flame shall be positioned so that its tip is in contact with the surface of the specimen. The position of the burner shall remain unchanged during each application of the test flame.

The flame shall be positioned so that its tip is in contact with the surface of the specimen — the burner shall not be moved. The test flame shall be applied as specified in Clause 9.2.1 (see Figure 12 for positioning of the flame).

B6.5

The flame may be applied to the outside surface of the enclosure if the equipment is of the encapsulated type or of such a size that the flame cannot be applied inside. The test shall be performed on three specimens or three separate areas of the same specimen.

B6.6

The test flame may be applied to more than one point on the same specimen, as long as the previous tests do not affect the result of the test.

Note: *The needle may be angled at 45° (upward or downward) to the sample during the test.*

B7. Observations and Measurements

During the test, the specimen and the parts surrounding the specimen shall be observed.

In the case of ignition of the specimen or of the parts surrounding it, the duration of burning shall be measured.

Duration of burning denotes the time interval from the moment the test flame is removed until the flames have extinguished or the glowing of the specimen is no longer visible.

Ignition of the indicating layer shall be noted if applicable.

Appendix C
Flame Tests Equivalency Table

Note: *This Appendix is not a mandatory part of this Standard.*

C22.2 No. 0.17	UL 94	IEC	ISO
5VA	5VA	5VA*	5VA
5VB	5VB	5VB*	5VB
V-0	V-0	V-0††	V-0
V-1	V-1	V-1††	V-1
V-2	V-2	V-2††	V-2
HB	HB	HB-40††	HB-40
		HB-75††	HB-75
VTM-0	VTM-0		VTM-0‡‡
VTM-1	VTM-1		VTM-1‡‡
VTM-2	VTM-2		VTM-2‡‡
HF-1	HF-1		HF-1§§
HF-2	HF-2		HF-2§§
HBF	HBF		HBF§§
Needle flame	12 mm flame UL 746C	Needle flame IEC 60695-2-2	Needle flame

**IEC 60695-11-20.*
†*IEC 60695-11-10.*
‡*ISO 9773.*
§*ISO 9772.*

Appendix D
Flame Tests

Notes:
(1) *The flame tests in this Appendix are to support present flame tests in* CEC, Part II *Standards that are not scheduled for new editions or revisions at present.*
(2) *This Appendix is not a mandatory part of this Standard but is written in mandatory language to accommodate its adoption by anyone wishing to do so.*

D1. Flame Test A — 125 mm Flame Test

D1.1 Apparatus

The apparatus for this test shall consist of the following:
(a) a test shield of sheet metal approximately 300 mm wide, 350 mm deep, and 600 mm high, open at the top and front, and two rigid support clamps for supporting the test specimen in a vertical position;
(b) a burner equipped with a flame stabilizer and having a bore of 10 + 1.6, –0.0 mm and a length of 100 + 5, –0 mm above the primary-air inlets;
(c) a 20° angle block for supporting the burner;
(d) a supply of bottled, technical-grade methane gas of approximately 37 MJ/m ^{3} at normal pressure with a suitable regulator and meter for uniform gas flow;
Note: *Natural gas having a heat content of approximately* 37 MJ/m^3 *has been found to provide similar results.*
(e) a stop-watch or other suitable timing device; and
(f) surgical cotton.

D1.2 Test Specimens

D1.2.1

Test specimens shall be the actual enclosure, a support for live parts, or a plaque having a minimum size of 100 mm by 150 mm and a thickness not greater than the minimum thickness of the enclosure or support.

D1.2.2

If the material is furnished in a range of colours, melt flows, or reinforcements, specimens representing these ranges shall also be provided. If the burning characteristics are not essentially the same for all specimens representing the range, evaluation shall be limited only to the material in the colours, melt flows, and reinforcement contents tested, or additional specimens in intermediate colours, melt flows, and reinforcement contents shall be provided for testing.

D1.2.3

Three specimens of each type shall be made available for testing.

D1.3 Test Procedure (See Figure D1)

D1.3.1

The test shall be made in a still-air test chamber from which all drafts of air are excluded.

D1.3.2

A specimen of the material shall be supported in a vertical position in the test chamber by two rigid support clamps at both vertical edges of the specimen. A layer of surgical cotton shall be located 300 mm below the point of application of the test flame. To form the horizontal layer, a small portion

(approximately 13 mm by 25 mm) of cotton shall be pulled from the supply and then thinned and spread into a 50 mm square having a free-standing thickness of 6 mm.

D1.3.3

The height of the flame, with the burner vertical, shall be adjusted to approximately 125 mm with an inner blue cone approximately 40 mm high at a gas pressure equivalent to the one exerted by a 75 mm water column.

D1.3.4

The burner shall be tilted to an angle of 20 ° from the vertical and the flame applied to the sample of material under test so that the tip of the inner blue cone of the flame touches the specimen at a point approximately 50 mm above its lower end. A stop shall be fixed in position as shown in Figure D1 to permit the burner to be returned to the same position, thereby maintaining the initial fixed distance between the forward edge of the barrel of the burner and the initial position of the test specimen.

D1.3.5

The flame shall be brought up to the material so that the vertical plane containing the major axis of the burner barrel is at right angles to the line of approach.

D1.3.6

The flame shall be applied for 15 s and then removed for 15 s, until five such applications have been made. The flame shall not be reapplied while the material is still burning. If the material burns for more than 30 s after any of the first four applications, the test shall be discontinued. If the material burns for more than 15 s but less than 30 s, the flame shall be immediately reapplied upon cessation of flaming.

D1.3.7

The material shall not support combustion for more than 60 s after the fifth application of the test flame.

D1.3.8

The following shall be observed and recorded for each specimen:
(a) the duration of flaming after the first, second, third, fourth, and fifth flame applications;
(b) the duration of flaming plus glowing after the fifth flame application;
(c) whether or not specimens burn up to the holding clamps;
(d) whether or not specimens drip flaming particles that ignite the surgical cotton; and
(e) whether or not any openings or other destruction of the test specimen has occurred, and the maximum diameter probe that will pass through any such openings.

D2. Flame Test B — Flame Test for Combustion-Resistant Materials

D2.1 Apparatus

The apparatus for this test shall consist of the following:
(a) a test shield of sheet metal approximately 300 mm wide, 350 mm deep, and 600 mm high, open at the top and front, and two rigid support clamps for supporting the test specimen in a vertical position;
(b) a burner with a flame stabilizer and having a bore of 10 + 1.6, –0.0 mm and a length of 100 + 5, –0 mm above the primary-air inlets;
(c) a 20° angle block for supporting the burner;
(d) a supply of bottled, technical-grade methane gas of approximately 37 MJ/m ^{3} at normal pressure with a suitable regulator and meter for uniform gas flow;
Note: *Natural gas having a heat content of approximately* 37 MJ/m^3 *has been found to provide similar results.*

(e) a stopwatch or other suitable timing device; and
(f) surgical cotton.

D2.2 Test Specimens

D2.2.1
Test specimens shall be the actual enclosure, the support for live parts, or a plaque having a minimum size of 100 mm by 150 mm and a thickness not greater than the minimum thickness of the enclosure or support.

D2.2.2
If the material is furnished in a range of colours, melt flows, or reinforcements, specimens representing these ranges shall also be provided. If the burning characteristics are not essentially the same for all specimens representing the range, evaluation shall be limited only to the material in the colours, melt flows, and reinforcement contents tested, or additional specimens in intermediate colours, melt flows, and reinforcement contents shall be provided for testing.

D2.2.3
Three specimens of each type shall be available for testing.

D2.3 Test Procedure (See Figure D1)

D2.3.1
The test shall be made in a still-air test chamber from which all drafts of air are excluded.

D2.3.2
A specimen of the material shall be supported in a vertical position in the test chamber by two rigid support clamps at both vertical edges of the specimen. A layer of surgical cotton shall be located 300 mm below the point of application of the test flame. To form the horizontal layer, a small portion (approximately 13 mm by 25 mm) of cotton shall be pulled from the supply and then thinned and spread into a 50 mm square having a free-standing thickness of 6 mm.

D2.3.3
The height of the flame, with the burner vertical, shall be adjusted to approximately 125 mm with an inner blue cone approximately 40 mm high at a gas pressure equivalent to the one exerted by a 75 mm water column.

D2.3.4
The burner shall be tilted to an angle of 20 ° from the vertical and the flame applied to the sample of material under test so that the tip of the inner blue cone of the flame touches the lower edge of the specimen. A stop shall be fixed in position as shown in Figure D1 to permit the burner to be returned to the same position, thereby maintaining the initial fixed distance between the forward edge of the barrel of the burner and the initial position of the test specimen.

D2.3.5
The flame shall be brought up to the material so that the vertical plane containing the major axis of the burner barrel is at right angles to the line of approach.

D2.3.6
The flame shall be applied for 5 s and then removed for 5 s, until five such applications have been made. The flame shall not be reapplied while the material is still burning. If the material burns for more than 30 s after any of the first four applications, the test shall be discontinued. If the material burns for more than 5 s but less than 30 s, the flame shall be immediately reapplied upon cessation of flaming.

D2.3.7
The material shall not support combustion for more than 60 s after the fifth application of the test flame.

D2.3.8
The following shall be observed and recorded for each specimen:
(a) the duration of flaming after the first, second, third, fourth, and fifth flame applications;
(b) the duration of flaming plus glowing after the fifth flame application;
(c) whether or not specimens burn up to the holding clamps;
(d) whether or not specimens drip flaming particles that ignite the surgical cotton; and
(e) whether or not any openings or other destruction of the test specimen has occurred, and the maximum diameter probe that will pass through any such openings.

D3. Flame Test D — Horizontal Burning Flame Test

D3.1 Apparatus
The apparatus for this test shall consist of the following:
(a) a test shield of sheet metal approximately 300 mm wide, 350 mm deep, and 600 mm high, open at the top and front, and a means of supporting the test specimen in a horizontal position;
(b) a burner having a bore of 10 + 1.6, –0.0 mm and a length of 100 + 5, –0 mm above the primary-air inlets without stabilizer;
(c) a supply of bottled, technical-grade methane gas of approximately 37 MJ/m ^{3} at normal pressure with a suitable regulator and meter for uniform gas flow;
Note: *Natural gas having a heat content of approximately* 37 MJ/m^3 *has been found to provide similar results.*
(d) a stop-watch or other suitable timing device; and
(e) surgical cotton.

D3.2 Test Specimens

D3.2.1
Test specimens shall be the actual enclosure, a support for live parts, or a plaque having a minimum size of 100 mm by 150 mm and a thickness not greater than the minimum thickness of the enclosure or support.

D3.2.2
If the material is furnished in a range of colours, melt flows, or reinforcements, specimens representing these ranges shall also be provided. If the burning characteristics are not essentially the same for all specimens representing the range, evaluation shall be limited only to the material in the colours, melt flows, and reinforcement contents tested, or additional specimens in intermediate colours, melt flows, and reinforcement contents shall be provided for testing.

D3.2.3
Three specimens of each type shall be available for testing.

D3.3 Test Procedure

D3.3.1
The test shall be made in a still-air test chamber from which all drafts of air are excluded.

D3.3.2
A specimen of the material shall be supported in a horizontal position in the test chamber. A layer of surgical cotton shall be located 300 mm below the point of application of the test flame. To form the

horizontal layer, a small portion (approximately 13 mm by 25 mm) of cotton shall be pulled from the supply and then thinned and spread into a 50 mm square having a free-standing thickness of 6 mm.

D3.3.3

The height of the flame, with the burner vertical, shall be adjusted to approximately 20 mm with a yellow tip flame at a gas pressure equivalent to the one exerted by a 75 mm water column.

D3.3.4

The barrel of the burner shall be positioned in a vertical plane and the flame applied to the sample of material under test so that the tip of the flame touches the specimen. A stop shall be positioned on the surface supporting the burner to permit the burner to be returned to the same position, thereby maintaining the initial fixed distance between the barrel of the burner and the initial position of the test specimen.

D3.3.5

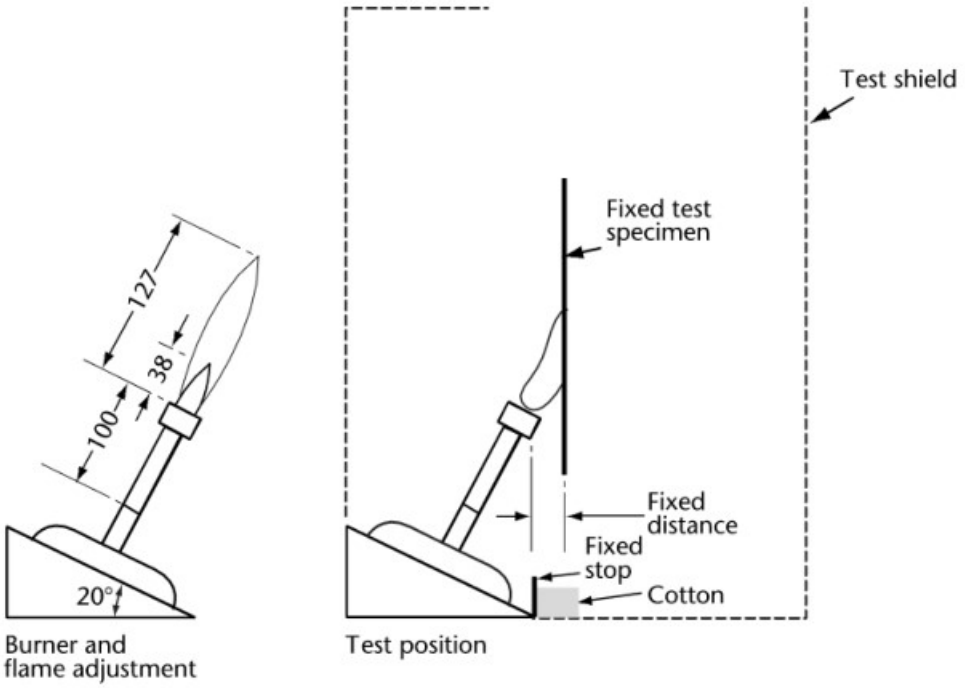
The flame shall be brought into position approximately centred under the specimen so that the vertical plane containing the major axis of the burner barrel is at right angles to the line of approach.

D3.3.6

The flame shall be applied for two 30 s applications, with a 60 s interval between the end of the first application and the start of the second application. The flame shall not be reapplied while the material is still burning. If the material burns for more than 30 s after the removal of either application, the test shall be discontinued.

D3.3.7

The following shall be observed and recorded:
(a) the duration of flaming after the first flame application;
(b) the duration of flaming plus glowing after the second flame application;
(c) whether or not specimens burn up to the holding clamp;
(d) whether or not specimens drip flaming particles that ignite the surgical cotton; and
(e) whether or not any openings or other destruction of the test specimen has occurred, and the maximum diameter probe that will pass through any such openings.



Notes:
(1) *The tip of the inner blue cone impinges on the specimen.*
(2) *Dimensions are in millimetres.*

Figure D1
Flame Test
(See Clauses D1.3, D1.3.4, D2.3, and D2.3.4.)