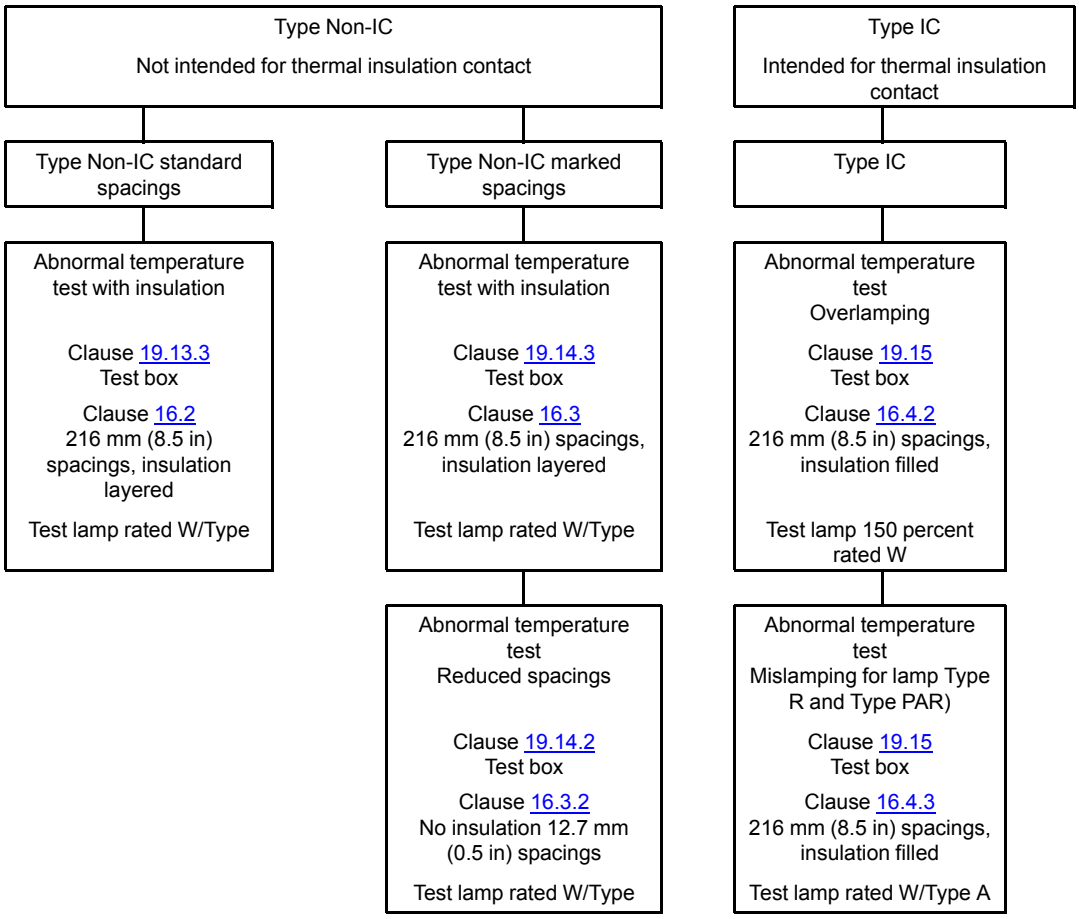
**Table 16.1.1**
**Recessed luminaire abnormal temperature tests**

(See Clause 16.1.2.)




## 16.2 Type Non-IC recessed luminaires (not intended for thermal insulation contact)

16.2.1 A test box shall be constructed as specified in Clause 19.13.3.

16.2.2 A luminaire shall be installed in the test box in the normal temperature test configuration of Clause 15.5 that results in the lowest operating temperatures on luminaire surfaces that contact the test box or that can contact thermal insulation.

16.2.3 For ceiling-mounted luminaires, the thermal insulation specified in Clause 19.16 shall be placed around the luminaire in the test box as follows:

a) the initial depth of the thermal insulation shall be 100 mm (4 in) above the bottom of the test box or 50 mm (2 in) above the lowest glass portion of the test lamp, whichever is higher;

b) the initial depth of the insulation shall not exceed the height of the lamp compartment; and

c) if more than one test iteration is required to achieve the results specified in Clause 16.2.7, an additional 50 mm (2 in) of thermal insulation shall be added for each successive iteration. The last increase in thermal insulation may be less than a 50 mm (2 in) increment, to ensure that the

maximum 216 mm (8.5 in) height requirement is not exceeded. For each additional thermal insulation level, the test shall be restarted with all temperatures at room ambient.

16.2.4 For recessed wall-mounted luminaires, the thermal insulation specified in Clause 19.16 shall be placed over a recessed luminaire mounted in the test wall so the topmost portion of the luminaire is under 216 mm (8.5 in) of thermal insulation.

16.2.5 The test lamp type and wattage for:

a) an incandescent luminaire shall be as marked on the luminaire and as specified in Clause 19.8 and Table 19.8.2; and

b) an HID luminaire shall be as marked on the luminaire and ballast, and as specified in Clause 19.8.

16.2.6 A luminaire shall be operated until the thermal protector trips or for a maximum of 7.5 h. If the protector does not trip within 3 h, the test shall be repeated with an additional 50 mm (2 in) of thermal insulation, until:

a) the thermal protector trips within 3 h; or

b) the temperature limits in Table 15.1.2 are exceeded; or

c) the thermal insulation height is 216 mm (8.5 in) above the highest projection of the luminaire, the thermal protector does not operate, and the temperature limits are not exceeded, in which case the test shall be repeated with the next hotter trim installed.

16.2.7 Test results shall be acceptable if the thermal protector:

a) operates within 3 h and no part of the luminaire in contact with thermal insulation or the test box exceeds 160 °C; or

b) does not operate within 3 h and the temperature limits specified in Table 15.1.2 are not exceeded during the test. Any part of the luminaire in contact with thermal insulation or the test box shall not exceed 90 °C. The test shall be terminated after 7.5 h.

### 16.3 Type Non-IC marked spacings incandescent and HID recessed luminaires (not intended for thermal insulation contact)

#### 16.3.1 Abnormal insulation temperature

16.3.1.1 A test box shall be constructed as specified in Clause 19.14.3.

16.3.1.2 A luminaire shall be installed in the test box in the normal temperature test configuration of Clause 15.5 that results in the lowest operating temperatures on luminaire surfaces that contact the test box or that can contact thermal insulation.

16.3.1.3 For ceiling-mounted luminaires, the thermal insulation specified in Clause 19.16 shall be placed around the luminaire in the test box as follows:

a) the initial depth of the thermal insulation shall be 100 mm (4 in) above the bottom of the test box or 50 mm (2 in) above the lowest glass portion of the test lamp, whichever is higher;

b) no thermal insulation shall be initially placed on top of the lamp compartment; and

c) if more than one test iteration is required to achieve the results specified in Clause 16.2.7, an additional 50 mm (2 in) of thermal insulation shall be added for each successive iteration. The last increase in thermal insulation may be less than a 50 mm (2 in) increment, to ensure that the maximum 216 mm (8.5 in) height requirement is not exceeded. For each additional thermal insulation level, the test shall be restarted with all temperatures at room ambient.

16.3.1.4 For wall-mounted luminaires, the thermal insulation specified in Clause 19.16 shall be placed over a wall mounted luminaire so the topmost portion of a luminaire recessed in the test wall is under 216 mm (8.5 in) of thermal insulation.

16.3.1.5 The test lamp type and wattage for:

a) an incandescent luminaire shall be as marked on the luminaire and as specified in Clause 19.8 and Table 19.8.1 and Table 19.8.2; and

b) an HID luminaire shall be as marked on the luminaire and ballast, and as specified in Clause 19.8.

16.3.1.6 A luminaire shall be operated until the thermal protector trips or for a maximum of 7.5 h. If the protector does not trip within 3 h, the test shall be repeated with an additional 50 mm (2 in) of thermal insulation, until:

a) the thermal protector trips within 3 h;

b) the temperature limits in Table 15.1.2 are exceeded; or

c) the thermal insulation height is 216 mm (8.5 in) above the highest projection of the luminaire.

16.3.1.7 Test results shall be acceptable if the thermal protector:

a) operates within 3 h and no part of the luminaire in contact with thermal insulation or the test box exceeds 160 °C; or

b) does not operate within 3 h and the temperature limits specified in Table 15.1.2 are not exceeded during the test. Any part of the luminaire in contact with thermal insulation or the test box shall not exceed 90 °C. The test shall be terminated after 7.5 h.

### 16.3.2 Reduced spacings abnormal temperature

16.3.2.1 The test shall be conducted as specified in Clause 15.5.

16.3.2.2 Test results shall be acceptable if the thermal protector:

a) operates within 3 h and no part of the luminaire in contact with the test box exceeds 160 °C; or

b) does not operate within 3 h and the temperature of any part of the luminaire in contact with the test box is 90 °C or less. The test shall be terminated after 7.5 h.

## 16.4 Type IC incandescent recessed luminaires (intended for thermal insulation contact)

### 16.4.1 General

16.4.1.1 A Type IC recessed incandescent luminaire shall comply with the abnormal overlamping and mislamping temperature tests described in Clauses 16.4.2 and 16.4.3, unless constructed as described in Clause 16.4.1.2.

16.4.1.2 A Type IC incandescent luminaire with a thermal protector rated 110 ±5 °C or less and located within 38 mm (1.5 in) of the geometric center of the top shall be exempted from the tests specified in Clause 16.4.1.1.

### 16.4.2 Overlamping

16.4.2.1 A test box shall be constructed as specified in Clause 19.15.

16.4.2.2 A luminaire shall be installed in the test box in the configuration that resulted in the lowest operating temperatures on luminaire surfaces in contact with the test box or thermal insulation during the normal temperature test described in Clause 15.7.

16.4.2.3 The abnormal test box shall be filled with the thermal insulation specified in Clause 19.16.

16.4.2.4 A luminaire shall be tested with a lamp in accordance with Table 19.8.3 and shall have the voltage adjusted to operate the lamp at rated wattage.

16.4.2.5 A luminaire rated for lamps that are not included in Table 19.8.3 shall be tested with a lamp of the same type used in the normal temperature test that is either:

a) 150 percent of the specified lamp wattage; or

b) the next higher common lamp rating more than 150 percent of specified wattage.

16.4.2.6 The test shall not be required to be conducted under the following conditions:

a) the test lamp cannot fit into the luminaire with the trim installed; or

b) no higher lamp wattage exists.

16.4.2.7 For a luminaire that has more than one lamp type, the abnormal test shall be conducted separately for each lamp type and for each lamp of a multi-lamp luminaire.

16.4.2.8 A luminaire shall be operated until the thermal protector trips or for a maximum of 7.5 h. If the thermal protector does not open within 3 h and the temperatures on the luminaire surfaces in contact with thermal insulation and points of support are less than 90 °C, the test shall be repeated with the next higher wattage lamp. If there is no higher wattage lamp or if the lamp will not fit, the test shall be repeated with the lamp and the trim that resulted in the next higher recessed housing temperature or point-of support temperature, or both, during the normal temperature test. Each iteration shall start with the luminaire at room ambient temperature. This process shall be repeated until

a) the thermal protector trips within 3 h;

b) there is no higher wattage lamp;

c) the next higher wattage lamp does not fit in the luminaire; or

d) there are no trims that result in the luminaire operating at a higher temperature.

16.4.2.9 If the thermal protector does not open in 3 h, and the temperatures on the luminaire surfaces in contact with thermal insulation and points of support are greater than 90 °C, but less than 20 °C above the temperatures measured on these same points during the normal temperature test, the test procedure in Clause 16.4.2.10 shall be performed.

16.4.2.10 The following test procedure shall be performed on a luminaire that complies with Clause 16.4.2.9 after the luminaire has reached thermal stabilization:

a) defeat (short) the thermal protector;

b) increase the supply voltage to 5 V above that required to make the lamp operate at rated wattage;

c) operate the luminaire and measure the temperature of points of the luminaire in contact with thermal insulation and points of support after 15 min;

d) if the temperatures measured are less than 20 °C above the temperature measured at that point during the normal temperature test, return to the point in the procedure described in Item (b) and raise the supply voltage another 5 V; and

e) when any of the temperatures measured in Item (c) exceed the temperature measured at that point during the normal temperature test by 20 °C:

1) record the supply voltage;

2) de-energize the luminaire and let it cool to room ambient temperature;

3) reconnect the thermal protector;

4) connect the luminaire to a supply adjusted to the voltage recorded in Item (1) and let it operate; and

5) apply Clauses 16.4.2.8 and 16.4.2.11.

16.4.2.11 Test results shall be acceptable if the thermal protector:

a) operates within 3 h and the temperature of any part of the luminaire in contact with thermal insulation or the test box does not exceed 160 °C; or

b) does not operate within 3 h, the test is continued for 7.5 h, and the temperature of any part of the luminaire in contact with thermal insulation or the test box does not exceed 90 °C.

### 16.4.3 Mislamping

16.4.3.1 The test box shall be constructed as described in Clause 19.15.

16.4.3.2 A luminaire shall be installed in the test box in the configuration that resulted in the lowest operating temperatures on luminaire surfaces in contact with the test box or thermal insulation during the normal temperature test, in Clause 15.7.

16.4.3.3 The test box shall be filled with the thermal insulation specified in Clause 19.16.

16.4.3.4 A luminaire marked for use with a reflector-type lamp shall be tested with a Type A lamp of the same wattage or the next higher wattage. Whenever possible, standard incandescent test lamps specified in Table 19.8.2 shall be used.

16.4.3.5 For a luminaire that has more than one lamp, the mislamping test shall be conducted separately for each lamp.

16.4.3.6 The test shall be continued until:

a) the thermal protector trips;

b) the temperature limits are exceeded; or

c) 7.5 h has elapsed, and there are no trims that result in the luminaire operating at a higher temperature.

16.4.3.7 If the thermal protector does not open within 3 h, and the temperatures on the luminaire surfaces in contact with thermal insulation and the points of support are less than 90 °C, the test shall be repeated with the trim that resulted in the next higher recessed housing temperature or point-of support temperature, or both, during the normal temperature test. Each iteration shall start with the luminaire at room ambient temperature.

16.4.3.8 If the thermal protector does not open in 3 h and the temperatures on the luminaire surfaces in contact with thermal insulation and the points of support are more than 90 °C, but less than 20 °C above the temperatures measured on these same points during the normal temperature test, the test procedure in Clause 16.4.3.9 shall be performed.

16.4.3.9 Perform the following test procedure on a luminaire that complies with Clause 16.4.3.8 after the luminaire has reached thermal stabilization:

a) defeat the thermal protector;

b) increase the supply voltage to 5 V above that required to make the lamp operate at rated wattage;

c) operate the luminaire and measure the temperature of points of the luminaire in contact with thermal insulation and points of support after 15 min;

d) if the temperatures measured are less than 20 °C above the temperature measured at that point during the normal temperature test, return to the point in the procedure described in Item (b) and raise the supply voltage another 5 V; and

e) when any of the temperatures measured in Item (c) exceed the temperature measured at that point during the normal temperature test by 20 °C:

1) record the supply voltage;

2) de-energize the luminaire and let it cool to room ambient temperature;

3) reconnect the thermal protector;

4) connect the luminaire to a supply adjusted to the voltage recorded in Item (1) and let it operate; and

5) apply Clauses 16.4.3.6 and 16.4.3.10.

16.4.3.10 Test results shall be acceptable if the thermal protector:

a) operates within 3 h and the temperature of any part of the luminaire in contact with thermal insulation or the test box does not exceed 160 °C; or

b) does not operate within 3 h, the test is continued for 7.5 h, and the temperature of any part of the luminaire in contact with thermal insulation or the test box does not exceed 90 °C.

### 16.5 Abnormal overlamping operation test for incandescent luminaires with polymeric housings or enclosures

16.5.1 A luminaire shall be operated as specified in the normal temperature test, with the largest possible wattage lamp the luminaire accommodates, for 7.5 h.

16.5.2 There shall be no ignition of the polymeric material or exposure of live parts. Shrinkage, warpage, expansion, or cracking shall be acceptable.

## 17 Mechanical tests

### 17.1 Barrier strength

17.1.1 A sample luminaire with the barrier mounted as intended shall be tested.

17.1.2 A force of 44.5 N (10 lb) over an area of 6.45 $cm^2$ (1 $in^2$) shall be applied to the barrier for 1 min.

17.1.3 The application of the force shall not result in

a) permanent distortion of a metal barrier;

b) temporary or permanent reduction of electrical spacings; or

c) breaking or cracking of a nonmetallic barrier.

### 17.2 Metal thickness equivalency

#### 17.2.1 General

17.2.1.1 A luminaire having reduced metal thickness shall comply with the compression and impact tests described in Clauses 17.2.2 and 17.2.3. Pendant-mounted luminaires having reduced metal thickness shall additionally comply with the flexing test described in Clause 17.2.4 and the torque and cantilever tests in Clauses 17.2.4 and 17.2.5.

#### 17.2.2 Compression

17.2.2.1 The luminaire shall be tested as follows:

a) the luminaire shall be placed on a flat horizontal surface; and

b) a 111 N (25 lb) force shall be applied, using a rod with a 25.4 mm (1 in) diameter face, to the center of the surface being tested for 1 min.

17.2.2.2 Test results shall be acceptable if:

a) the electrical spacings comply with Clause 6.12; and

b) the accessibility of uninsulated live parts complies with Clause 6.14.2.

#### 17.2.3 Impact

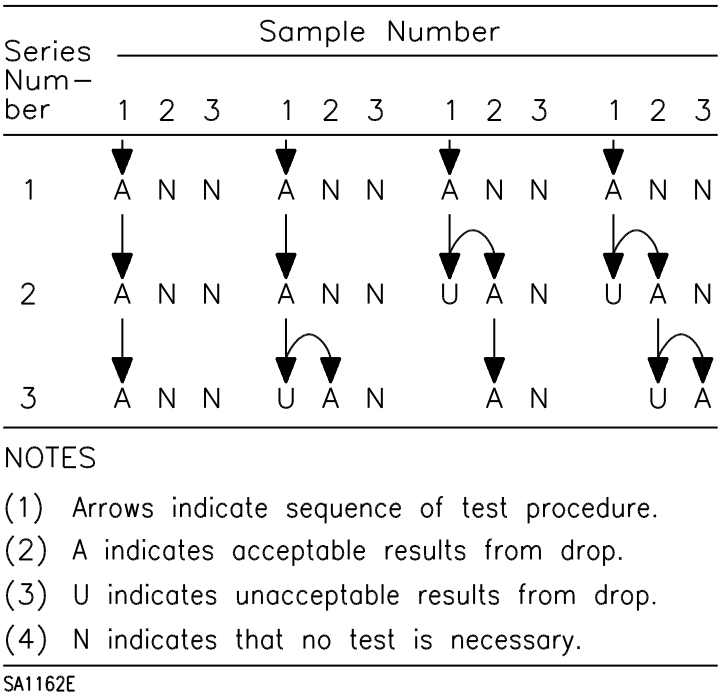
17.2.3.1 The sample luminaires shall be held in place and subjected to a single 7 J (5 ft·lb) impact, using the impact test apparatus described in Clause 19.21, falling through a vertical height of 1.29 m (4.24 ft), on surfaces being tested.

17.2.3.2 The number of samples and the sequence of the procedure shall be in accordance with Figure 17.2.3.1.

**Figure 17.2.3.1**

**Procedure for impact test**

(See Clause 17.2.3.2 and 17.41.2.)




17.2.3.3 Test results shall be acceptable if the enclosure is capable of complying with all the applicable requirements of this Standard.

### 17.2.4 Flexing

17.2.4.1 The luminaire shall be supported directly below the pendant support connection points on maximum 25 mm (1 in) wide wooden blocks of sufficient length.

17.2.4.2 A 89 N (20 lb) force shall be applied to a 39 $cm^2$ (6 $in^2$) piece of 19 mm (0.75 in) thick plywood centered on the top of the luminaire midway between the two supports closest to the end.

17.2.4.3 The maximum deflection under load shall be 6.4 mm (0.25 in).

### 17.2.5 Torque and cantilever

#### 17.2.5.1 General

17.2.5.1.1 During the torque and cantilever tests, a comparison shall be made between a control sample luminaire having the minimum metal thickness specified in Table 5.5.1 and a test sample luminaire having reduced metal thickness.

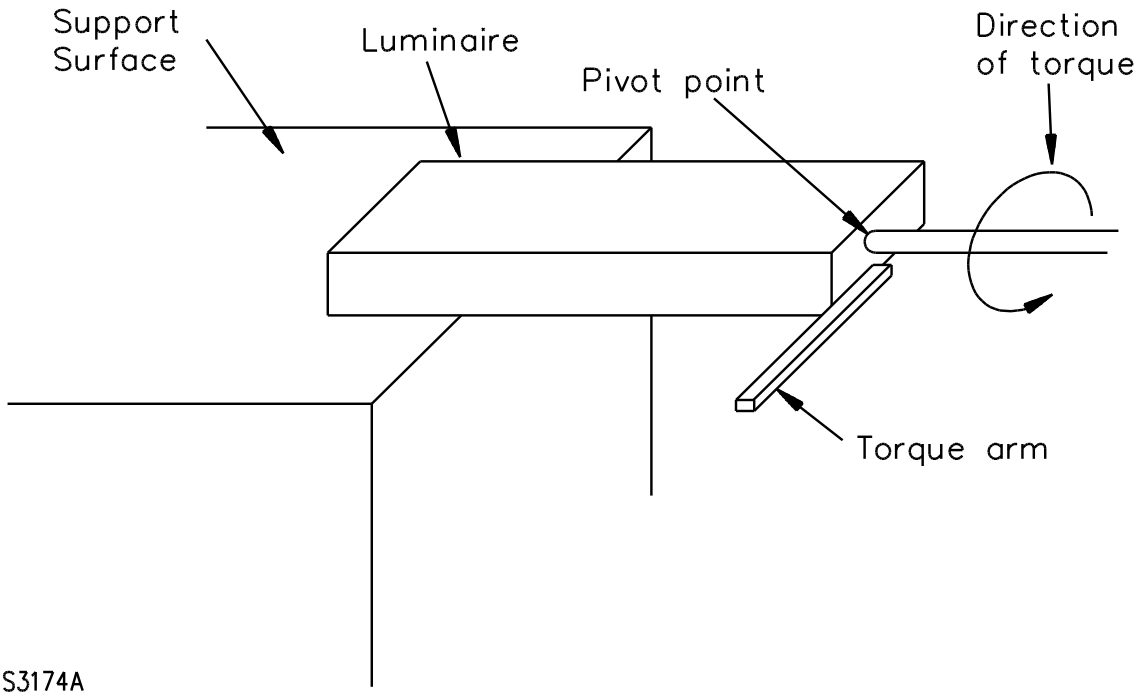
### 17.2.5.2 Torque

17.2.5.2.1 The control and test sample luminaires shall be secured to a solid horizontal surface so that the sample overlaps the surface by a length equal to 10 percent of the sample's overall length. The opposite end of each luminaire shall be supported at the same height as the fixed end by a pivot arm that is attached to the luminaire but allows free rotation of the luminaire around its major axis. A 610 mm (24 in) long torque arm shall be connected to the pivot end of each luminaire at a right angle to its major axis as shown in Figure 17.2.5.2.1.

**Figure 17.2.5.2.1**

**Torque test**

(See Clause 17.2.5.2.1.)




17.2.5.2.2 A 4.4 N (1 lb) force shall be applied to one end of the arm in a direction that results in luminaire rotation deflection around the major axis.

17.2.5.2.3 During or after the test, the deflection of the test sample luminaire shall be equal to or less than the deflection of the control sample luminaire.

### 17.2.5.3 Cantilever

17.2.5.3.1 The control and test sample luminaires shall be secured at one end to a solid horizontal surface. The opposite end of each luminaire shall be suspended by the support provided with the luminaire.

17.2.5.3.2 A 11.3 kg (25 lb) weight shall be applied to the suspended end of each luminaire. The weight shall be applied for 1 min.

17.2.5.3.3 During or after the test, the deflection of the test sample luminaire shall be equal to or less than the deflection of the control sample luminaire.

### 17.3 Five-inch flame

17.3.1 Three samples of complete luminaires or enclosure specimens shall be subjected to this test, using the test apparatus of Clause 19.24.

17.3.1 (MEX) In Mexico, Clause 17.3 does not apply.

17.3.2 The conditioning described in Clause 17.3.3 shall be conducted only if:

a) the enclosure material exhibits a reduction in flame-resistance properties as a result of long-term thermal aging; or

b) the enclosure material thickness is less than the minimum thickness subjected to the long-term thermal aging.

17.3.3 After conditioning for 40 h at 23 ±2 °C and 50 ±5 percent relative humidity, the test samples shall be placed in a full-draft air-circulating oven for 7 d at a temperature at least 10 °C above the temperatures measured during the normal temperature test and, in no case, less than 70 °C.

17.3.4 The sample shall be positioned to simulate intended usage, with a layer of surgical cotton located 300 mm (12 in) below the point of test flame application.

17.3.5 The burner shall be placed in a location remote from the sample, in a vertical position, and ignited. The burner shall be adjusted to provide a 125 ±10 mm (5 in) overall height flame with a 40 ±2 mm (1.5 in) high inner blue cone.

17.3.6 The flame shall be applied at an angle of approximately 20 degrees from the vertical to 3 different locations on each of the 3 samples, in the following areas, as appropriate:

a) any interior portion of the enclosure judged as likely to be ignited (by proximity to live arcing parts, coils, and conductors);

b) the outside enclosure of encapsulated portions; and

c) the outside enclosure, if the flame cannot be applied to the interior.

17.3.7 The flame shall be applied for 5 s and removed for 5 s. This cycle shall be repeated 5 times at each location.

17.3.8 Test results shall be acceptable when the following conditions are met:

a) the material does not continue to burn more than 1 min after the fifth flame application at any of the locations;

b) there are no flaming drops or glowing particles that ignite the surgical cotton below the sample; and

c) no visible flame shall be observed on the surface of the enclosure opposite to the surface on which the test flame is applied during the test. In addition, unless otherwise specified in the relevant end-product standard, no opening greater than 3 mm appears after the test has been performed and the sample has cooled for 30 s.