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Standard Specification for Fire Safety for Candle Accessories[1]

This standard is issued under the fixed designation F2601; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification prescribes minimum safety requirements for candle accessories to help ensure a reasonable degree of safety for normal use with candles, thereby improving personal safety and reducing fires, deaths, and injuries.

1.2 This specification is not intended to replace other safety practices such as adult supervision, close monitoring of product when in use, and fire detection, alarm, or suppression systems.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.*

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester

E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

E176 Terminology of Fire Standards

F1972 Guide for Terminology Relating to Candles and Associated Accessory Items

F2417 Specification for Fire Safety for Candles

3. Terminology

3.1 *Definitions*—Certain candle-related terminology has already been addressed in Guide F1972. Certain additional fire-related terminology is found in Terminology E176. The reader is directed to those standards for definitions not found in 3.2.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *burn time, n*—time interval a test specimen supports sustained flaming combustion after removal of the ignition source until all flaming ceases.

3.2.2 *candle accessory, n*—object designed, intended, or marketed for use with a candle.

3.2.3 *candle burner, n*—a candle holder that restricts the free flow of exiting combustion gases.

3.2.3.1 *Discussion*—Does not include the item known as a candle follower also referred to by the term candle burner in the liturgical industry. Candle burners also include, but are not limited to, lanterns, potpourri burners, and food warmers.

3.2.4 *candle holder, n*—candle accessory onto which a candle is placed. It may support, hold or contain a candle when in use.

3.2.4.1 *Discussion*—Filled candles are not candle holders.

3.2.5 *candle ring, n*—candle accessory intended to surround the candle with decorative materials in proximity to a candle, including, but not limited to, a continuous ring or loose fill material.

3.2.6 *consumption rate, n*—rate at which a candle is consumed measured in grams of fuel consumed per hour.

3.2.6.1 *Discussion*—Consumption rate is determined by weighing a candle prior to burning and then again at the end of the life or burn cycle of the candle. The weight consumed in grams is then divided by the burn time in hours to arrive at a consumption rate in grams per hour.

3.2.7 *ignition, n*—initiation of combustion.

3.2.7.1 *Discussion*—The combustion is typically evidenced by glow or flame. The combustion may be sustained or transient.

3.2.8 *noncombustible, adj*—not capable of igniting and burning when subjected to a fire under specified conditions.

[1] This specification is under the jurisdiction of ASTM Committee F15 on Consumer Products and is the direct responsibility of Subcommittee F15.45 on Candle Products.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.8.1 *Discussion*—Materials that pass Test Method E136 are considered noncombustible.

3.2.9 *potpourri burner, n*—candle burner designed to provide a source of heat to warm a reservoir of extraneous material.

3.2.10 *shade, n*—a candle accessory placed above the candle, whose function is to modify light from the flame and change the appearance of the candle.

3.2.11 *sustained flaming, n*—existence of flame on or over the surface of the specimen for periods of 4 s or more.

3.2.11.1 *Discussion*—Sustained flaming starts at the beginning of the period when a flame is found on or over the surface.

3.2.12 *topper, n*—vented candle accessory, which is placed directly on top of a container candle, to modify airflow.

4. Safety Requirements

4.1 *Safety Requirements for Candle Rings*—This safety requirement applies to all candle rings with the following exceptions: rings constructed exclusively of noncombustible materials, rings constructed exclusively of live plants or fresh cut flowers, or both, that remain hydrated during their intended life, or items which include rings that incorporate barrier technology (see 5.2.4.14 – 5.2.4.16).

4.1.1 *Rationale:*

4.1.1.1 Candle rings are used in proximity to a known source of ignition (candle flame).

4.1.1.2 Flammable components of candle rings increase the risk of fires when using candle products.

4.1.2 *Performance Requirement:*

4.1.2.1 A candle ring shall pass the flammability requirements for candle rings if, when tested according to 5.2, it does not ignite or has a burn time less than or equal to an average of 30 s for three tests per component and the burn time for any one test shall not exceed 60 s. During any test, flaming shall not spread over the entire candle ring. The test shall be conducted on all applicable components of the ring.

4.2 *Safety Requirements for Candle Holders, Shades, and Toppers*—This safety requirement applies to all candle holders, including candle burners and potpourri burners, and candle shades and toppers, with the following exceptions: items constructed exclusively of noncombustible materials (see Note 1) or which incorporate barrier technology. (See 5.2.4.15.)

NOTE 1—Observations indicate that some porous materials which are otherwise considered to be noncombustible, for example, unglazed ceramics and terra cotta, absorb molten wax or other combustible liquids and can support sustained flaming combustion. This note has been provided for informational purposes only.

4.2.1 *Rationale:*

4.2.1.1 Candle holders, shades, and toppers are used with burning candles placed directly under, on, or in them.

4.2.1.2 A buildup of heat or direct flame impingement from the candle flame onto candle holders, shades, or toppers is possible during use, resulting in the candle holder, shade, or topper igniting.

4.2.2 *Performance Requirement*—A candle holder, shade, or topper shall pass the flammability requirements for candle holders, shades, or toppers if, when tested according to 5.2, it does not ignite or has a burn time less than or equal to an average of 30 s for three tests per component and the burn time for any one test shall not exceed 60 s. During any test, flaming shall not spread over the entire candle holder, shade, or topper. The test shall be conducted on all applicable components of the holder, shade, or topper.

4.3 *Safety Requirements for Candle Burners and Potpourri Burners*—This safety requirement applies to all types of burners designed to use a candle as a source of heat or light, or both. Candle accessories marketed as food warmers must be assessed to determine whether the item qualifies as a candle burner, a candle holder, or other type of accessory and evaluated accordingly. Candle burners and potpourri burners are also subject to the requirements of 4.2.

4.3.1 *Rationale:*

4.3.1.1 Candle burners and potpourri burners can contribute to secondary ignition, excessive flame heights, or end of useful life problems, or a combination thereof. These are often associated with the buildup of heat or soot or both from candles placed in these types of products.

4.3.1.2 Candle burners and potpourri burners meeting the performance requirement listed in 4.3.2 will reduce the risk of fires initiated by candles used with these types of products.

4.3.2 *Performance Requirement:*

4.3.2.1 All candle burners which have the capability of accepting multiple types of candles shall be labeled for use with, quantities of candles, maximum candle size and the candle type(s), (including number of wicks if pertinent). The label must have the following warning message or its practical equivalent, "⚠WARNING: For use with *quantity, size, # wicks, type candle(s)*" Example: "⚠WARNING: For use with one, single wick container candle up to 22 ounces." The minimum height of the safety alert symbol (⚠) and the warning message shall be 1.8 mm (0.07 in.) based on the height of an upper case letter. This warning shall be directly affixed, engraved or attached to the accessory in such a way that it is likely to remain on the item throughout its useful life (for example an adhesive label placed on the bottom or other surface of the item). If sold with external packaging, this warning shall also appear on the external packaging.

4.3.2.2 A candle burner shall pass the performance requirements if there is no secondary ignition, excessive flame height, or end-of-useful life problems as detailed in Sections 4.1 through 4.3 in Specification F2417 and the burner does not ignite, crack, or break when the candle burner is tested with an appropriate candle(s) according to the candle burning performance test method found in Section 5.2.4 of Specification F2417. If the appropriate candle is a tealight, it must meet the requirements found in 5.3.1. If the unit can be used with multiple candles, the unit is to be tested with the largest candle and the maximum number of candles specified on the label of the burner as found in 4.3.2.1.

4.3.2.3 All candle burners shall be tested using the prescribed candles in 4.3.2.1 and 4.3.2.2. Three identical samples (burners) shall be tested using at least 8 candle burn cycles each. If the candle reaches end of life prior to the 8th burn cycle, continue the test with a new candle until 8 cycles are completed. For burners requiring tealight candles, or candles

that reach end of life in less than 4 hours, each candle is burned to end of life which constitutes a complete cycle. Thus, each burner shall be tested 8 times.

NOTE 2—Research[3] indicates that candle burners with a small internal volume, low ceiling height, and limited ventilation are especially at risk to fail the flame height, end-of-useful life, and secondary ignition requirements of Specification F2417.

4.4 *Safety Requirements for Stability*—This safety requirement applies to all accessories intended to be used in direct contact with burning candles.

4.4.1 *Rationale*—This requirement minimizes the hazards of candle accessory/ensemble tip over.

4.4.2 *Performance Requirement*—The candle accessory must not tip over when placed at a minimum 10.0° incline when tested with the candle specified in 5.4.1.

5. Test Methods

5.1 Candle fire safety issues addressed by these test methods include candle ring, shade, topper, and holder flammability, candle burner and potpourri burner accessories burn performance and stability.

5.2 *Flammability of Candle Rings, Shades, Toppers, or Holders:*

5.2.1 *Summary of Test Method*—Components of candle rings, shades, toppers, or holders are tested on a flat noncombustible surface for sustained flaming combustion. Components of the ring, shade, topper, or holder are tested for flammability through contact with the flame source for up to 60 s. Each test is monitored for sustained flaming combustion of the component. Three separate tests are performed on each type of component of the candle ring, shade, topper, or the candle holder. The burn time is measured.

5.2.2 *Apparatus:*

5.2.2.1 Large, flat, noncombustible surface.

5.2.2.2 *Flame Source*—A butane diffusion flame intended to represent a candle flame. The burner tube consists of a stainless steel tube with an outside diameter of nominally 8 mm and a wall thickness of 1 mm. The gas supply system consists of a pressure gauge, flow meter, fine-control valve, and cylinder regulator providing an outlet pressure of 28.5 mbar (0.4 psi). The flow meter supplies butane gas at a constant rate of 45 mL/min at 25°C. Under the specified conditions, the flame height is approximately 35 mm.

NOTE 3—An alternative flame source is permissible provided that it can be demonstrated by testing identical specimens with both the alternative flame source and the flame source specified in this test method that the tests using the alternative flame source yields failing results as often as, or more often than tests using the specified flame source.

5.2.2.3 Ring stand/clamp assembly.

5.2.2.4 Stopwatch.

5.2.2.5 Ruler.

5.2.2.6 Thermometer.

5.2.2.7 Hygrometer.

5.2.3 *Safety Hazards*—(**Warning—**There is an inherent risk of working with and around open flames. Appropriate personal protective equipment shall be used and safe work practices shall be followed. Fire suppression equipment capable of mitigating fires associated with candle accessory fire safety testing shall be readily available during testing.)

5.2.4 *Procedure:*

5.2.4.1 The candle ring, shade, topper, or holder under test shall be conditioned before testing for at least 4 h at a temperature between 20 to 30°C (68 to 86°F) and a relative humidity of less than or equal to 55 %. All candle rings, shades, toppers, or holders shall be tested in a burn test area that will be environmentally controlled to between 20 to 30°C (68 to 86°F) and less than or equal to 70 % relative humidity. Once removed from the conditioning atmosphere, the candle rings, shades, toppers, or holders shall be tested within 1 h.

5.2.4.2 The test shall be carried out with minimal disturbance of the flame source in a test area of sufficient size to accommodate the candle ring, shade, topper, or holder and prevent oxygen starvation of the flame source. The test surface shall be constructed of a noncombustible material and shall be cleaned before conducting each test, removing charred and molten materials or other debris from previous tests.

5.2.4.3 The finished product is to be tested in an orientation typical of the product's intended use. The candle ring or holder shall be placed on the test surface such that it lays flat to simulate normal use with no free-flowing air space under the candle ring unless that is how the candle ring is designed.

5.2.4.4 The candle shades and toppers are positioned like they would be used on a candle. If a candle ring, shade, topper, or holder is designed or advertised to be used in several orientations or configurations, it shall be tested in every orientation/configuration for which it was designed or advertised. If the candle ring, shade, topper, or holder fails the performance requirement in any of the orientations tested, it will be considered a failure.

5.2.4.5 The flame source is to be applied to each unique component on the candle ring, shade, topper, or holder for a period of up to 60 s. The flame source shall remain stationary during the ignition period. The flame source shall be positioned at an angle between 15 and 45° (nonburning end of flame source higher than the flame end) from horizontal. See Fig. 1.

5.2.4.6 Position the flame source such that its tip is stationary. The tip of the flame source shall be positioned approximately one half of the normal flame height away from the ring, shade, topper, or holder component to be tested. See Fig. 1.

NOTE 4—For example, if the flame source produces a flame approximately 35 mm (1.4 in.) in height, the tip of the flame source would be positioned approximately 17.5 mm (0.7 in.) away from the test component. This will put the midpoint of the flame in contact with the edge of the component to be tested.

5.2.4.7 Ignite the flame source allowing the flame to make contact with the candle ring, shade, topper, or holder component. Remove the flame source from the test component as soon as the test component exhibits sustained flaming combustion.

5.2.4.8 Record the time from when the test component first ignites with sustained flaming combustion until flaming ceases.

[3] "Consumer Safety Research—Fires Associated With the Use of Night Lights and Ceramic Burners," July 1996, Fire Research Station, Building Research Establishment. (Research conducted on behalf of the Consumer Safety Unit of the Department of Trade and Industry.) Consumer Safety Unit, 1 Victoria Street, London SW1H 0ET.

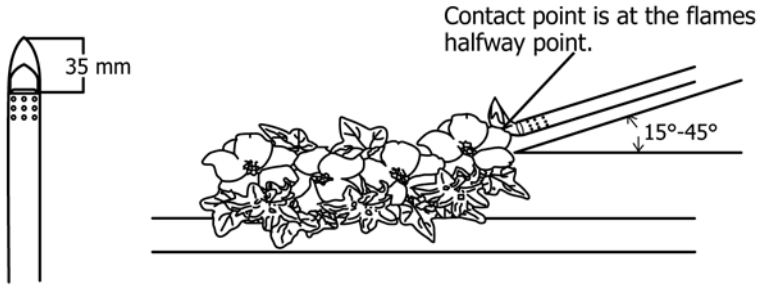

FIG. 1 Flame Source Positioning

If the test component fails to ignite after 60 s, remove the flame source and record the burn time as 0 s.

5.2.4.9 Each candle ring, shade, topper, or holder shall be exposed to the flame at each unique component, piece, and material.

NOTE 5—For example, a simple circular candle ring or holder made of a single material with a uniform thickness would only have to be tested three times. A candle ring, shade, topper, or holder that has several different components (such as a candle ring that contains pinecones, berries, leaves, flowers, or a candle holder that has multiple types of materials) would be tested three times at each component. In addition, if there is a single flower and a grouping of flowers, the candle ring would be tested both at the single flower and the flower cluster since they have the potential to exhibit different flammability characteristics. A large flower and a small flower would each need to be tested even if they are made of the same material since it is possible for size and thickness of the item to affect test results.

5.2.4.10 This procedure shall be repeated until a minimum of three tests per component have been conducted. If there are multiple components on the candle ring, shade, topper, or holder, all components shall be tested.

NOTE 6—For example, if the candle ring is composed of flowers, pinecones, and greenery, each component would be tested for each sample; thus, a total of nine ignition tests are necessary for this item.

5.2.4.11 When conducting multiple ignition tests on a single candle ring, shade, topper, or holder, if the area tested by an earlier ignition test affects the results of a subsequent test such that the testing of the first component impedes the flame spread of the second component tested, additional candle rings, shades, toppers, or holders are required to have three independent tests on each unique component.

NOTE 7—For example, if a flower and a pinecone are in close proximity on a candle ring, and the flower is tested first and passes but consumes a major portion of the flower before extinguishing, this could affect the burn time of a test made subsequently on another component on the same ring such as the pinecone. Had the pinecone been tested first, it is possible that the resulting fire would have consumed both the pinecone and flower resulting in a burn time of more than the maximum allowable 60 s or an average of greater than 30 s for the three component tests. In this case, an additional candle ring would be required to test the pinecone. This means that six candle rings would potentially need to be tested; three to test the flower first and three to test the pinecone first to have at least three independent tests of each unique component.

5.2.4.12 If the candle ring, shade, topper, or holder component does not extinguish within 60 s, it shall be manually extinguished as it has failed the requirement for extinguishing within the acceptable burn time.

5.2.4.13 Candle ring, shade, topper, or candle holder components that do not ignite are acceptable and shall be assigned a burn time of 0 s.

5.2.4.14 Ceramic, metallic, glass, and other noncombustible materials are acceptable without testing those components. If, however, there is something combustible associated with the noncombustible component (for example, flammable paint, wrapping on a wire, or a decorative component), the potentially combustible component shall be tested.

5.2.4.15 Candle holders, shades, toppers, rings, or ensembles of either that incorporate a flame barrier or other technology that completely prevents the candle flame(s) or the heat from the candle flame from coming into contact with all potentially combustible components of these accessories are exempt from these requirements.

5.2.4.16 Candle rings constructed exclusively of live plants or fresh cut flowers, or both, that remain hydrated during their intended life are exempt from these requirements.

5.2.5 *Calculation of Results:*

5.2.5.1 For candle rings, shades, toppers, or candle holders, at least three independent tests shall be conducted on each unique component.

5.2.5.2 If there is no self-sustained flame for a particular test, the recorded burn time is 0 s.

5.2.5.3 For candle rings, shades, toppers, or candle holders, the three burn times of each unique component are averaged together.

5.2.5.4 Any average burn time greater than 30 s of any candle ring, shade, topper, or candle holder component is a failure.

5.2.5.5 Any individual burn time of any candle ring, shade, topper, or candle holder component greater than 60 s is a failure.

5.2.5.6 Any test in which the flame spreads over the entire candle ring, shade, topper, or holder is a failure.

5.2.5.7 Accept the candle ring, shade, topper, or candle holder as passing if the average of the three burn times of each unique component is less than or equal to 30 s, with no one burn time of any component exceeding 60 s, and the flame does not spread over the entire candle ring, shade, topper, or candle holder.

5.2.5.8 Retesting of the non-compliant component(s) is allowed if one of the three tests per component has a burn time of greater than 60 s and the average burn time is less than or

equal to 30 s. Test additional candle rings, shades, toppers, or holders, testing each non-compliant component 10 times. If the component(s) fail any requirement of 4.1 and 4.2 on retest, the candle ring, shade, topper, or holder shall be rejected.

5.3 *Fire Safety of Candle Burners and Potpourri Burners:*

5.3.1 *Summary of Test Method*—The candle burner or potpourri burner with the appropriate test candle is tested using the candle-burning performance test method found in 5.2 of Specification F2417. According to this section of Specification F2417, tealight candles are burned to completion, gel-containing candles are burned for 8-h intervals, and all other candles are burned for 4-h intervals. When the appropriate candle is a tealight candle, an unscented tealight shall be used in this evaluation with a demonstrated average consumption rate of 3.2 to 3.6 g per hour outside a holder or burner and have an open cup flashpoint, as determined in Test Method D92, of no greater than 450°F.

NOTE 8—Testing of various tealight candles currently available in the market place has shown wide variability of consumption rates and flash points.

5.3.2 *Apparatus*—Same as specified in 5.2.2 of Specification F2417.

5.3.3 *Procedure*—Place the appropriate test candle in the candle burner or potpourri burner. If the unit under test has a reservoir in which to hold fragrance or other scented material, fill with the appropriate quantity of specified material or, if not specified in the instructions, use scented wax. If the unit is meant to warm food, fill with enough water to cover the bottom (ensure that the bottom is covered for all subsequent burn cycles). Test the unit as an ensemble using the candle-burning performance test method specified in 5.2.4 of Specification F2417. A minimum of three identical burners shall be tested eight burn cycles each with no failures allowed.

5.3.3.1 Any candle burner shall be tested to the manufacturers specified instructions for use.

5.3.4 *Calculation of Results:*

5.3.4.1 Record as a failure any candle burner that fails the test as specified in 4.3.2.2.

5.3.4.2 Failure of any single unit tested results in a failure of the whole lot of product.

5.4 *Stability of Candle Accessories:*

5.4.1 *Summary of Test Method*—Candle accessories with the intended candle(s) installed shall be placed on a minimum 10.0° incline to determine if they remain in a stable, upright position without tipping over.

5.4.2 *Apparatus*—An incline plane, either fixed or adjustable, that is capable of achieving a 10.0° incline from level. The plane needs a stop to prevent the candle accessory from slipping during this test. The maximum height of the stop shall not exceed 6.4 mm (0.25 in.) so as not to affect the test result.

5.4.3 *Procedure:*

5.4.3.1 *Preparation of Samples*—Remove any outer wrapping. Make the candle accessory ready for use and insert the appropriate unlit candles into the accessory as follows:

(1) For accessories designed to hold taper candles (or other types of candles needing support to remain upright), the accessory shall be tested with a 30.5 cm (12 in.) taper candle.

(2) For accessories designed to hold freestanding candles, the accessory shall be tested using a nominal 7.6 by 22.9 cm (3.0 by 9.0 in.) pillar candle. If the accessory is not wide enough to accommodate a 7.6 cm (3.0 in.) diameter pillar candle, the accessory shall be tested with the widest diameter pillar candle that fits the accessory with a height of 22.9 cm (9.0 in.).

(3) Accessories that have a warning not to use candles exceeding specified dimensions shall be tested with candles at the specified size limits. For example, a taper holder with a warning label stating not to use a candle over 15.2 cm (6.0 in.) shall be tested with a 15.2 cm (6.0 in.) candle not a 30.5 cm (12.0 in.) candle. The label must have the following warning message or its practical equivalent: "⚠ WARNING: Do not use a candle greater than X inches tall" (where X is the maximum allowable height of the candle). The minimum height of the safety alert symbol (⚠) and the warning message shall be 1.8 mm (0.07 in.) based on the height of an upper case letter. This warning shall be directly affixed, engraved, or attached to the accessory in such a way that it is likely to remain on the item throughout its useful life (for example an adhesive label placed on the bottom or other surface of the item). If sold with external packaging, this warning shall also appear on the external packaging. If the accessory fails to bear these labeling requirements, it shall be tested with the candles specified in 5.4.3.1 (*1*) and (*2*).

(4) For accessories designed to hold votives or tealights, or both, the accessory shall be tested using a nominal 3.8 by 5.1 cm (1.5 by 2.0 in.) votive or a 3.8 by 1.9 cm (1.5 by 0.75 in.) tealight candle, or both.

5.4.3.2 Place the prepared candle accessory with the appropriate unlit candle in the orientation most likely to cause tipping on the incline apparatus at a minimum of 10.0° from level. Rotation of the accessory/candle around the candle's vertical axis will be necessary to determine the stability of an asymmetrical accessory. The tested accessory/candle shall remain stable and not fall over.

5.4.4 *Calculation of Results*—Record as a failure any accessory that tips over when tilted at 10.0° from level.

6. Keywords

6.1 candle; candle accessories; candle burner; candle holder; candle ring; flammability; potpourri burner; stability