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Standard Specification for Fire Safety for Candles[1]

This standard is issued under the fixed designation F2417; 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 is intended to prescribe minimum safety requirements for candles and candle ensembles to provide 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 important safety practices that should be in place, such as adult supervision, close monitoring, fire detection, alarm or suppression systems, and use of candles away from combustible materials.

~~1.3 Flame-producing devices, such as candles, present a potential hazard to the user. This specification cannot eliminate all hazards, but will minimize the potential hazards of candles to the user.~~

1.3 *This specification 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.*

1.4 *This standard is used to predict or provide a quantitative measure of the fire hazard from a specified set of fire conditions involving specific materials, products, or assemblies. This assessment does not necessarily predict the hazard of actual fires which involve conditions other than those assumed in the analysis.*

1.5 *Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

1.6 This specification states values in ~~SI~~inch-pound units which are to be regarded as the standard. The values given in parenthesis are for information only.

1.7 *This specification 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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory requirements prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

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

E176 Terminology of Fire Standards

~~F400 Consumer Safety Specification for Lighters~~

F1972 Guide for Terminology Relating to Candles and Associated Accessory Items

2.2 *NFPA Standard:*[3]

NFPA 909 Code for the Protection of Cultural Resources

[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] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101.

3. Terminology

3.1 Certain candle-related terminology is addressed in Guide F1972, and the reader is directed to that guide for definitions not found in 3.2. For definitions of terms associated with fire issues, see Terminology E176.

3.2 *Definitions: Candle Classification Terms*:

3.2.1 *candle, n*—one or more combustible wicks supported by a material that constitutes a fuel which is solid, semi-solid, or quasi-rigid at room temperature, 68 to 80°F (20 to 27°C); it can also contain additives that are used for color, scent, stability, or to modify the burning characteristics; the combined function of which is to sustain a light-producing flame.

3.2.2 *extended use candle, n*—a candle that is intended for home use to be burned continuously for longer than 4 hours, excluding tealight candles.

3.2.2.1 *Discussion—*

Examples of extended use candles include religious candles, available to consumers, intended to be burned continuously for 24 hours or multiple days.

3.2.3 *filled candle, n*—a candle produced and used within the same container or vessel.

3.2.4 *freestanding candle, n*—a rigid candle that is intended to be burned outside a container and does not require a holder to keep it upright, excluding votive candles.

3.2.4.1 *Discussion—*

Examples of freestanding candles include pillar-shaped, column-shaped, and figurine candles.

3.2.5 *gel-containing candle, n*—a candle where the primary fuel is a liquid, such as mineral oil, terpene type chemicals, or modified hydrocarbons that are not mineral oil based, which may or may not contain organic functional groups; it also contains a chemical agent to increase the viscosity (thicken) to a point where the candle has a quasi-rigid property.

3.2.6 *non-freestanding birthday candle, n*—any candle or candle ensemble that does not include pyrotechnics and is designed and marketed for use with birthday cakes and does not comply with the applicable stability requirements.

3.2.6.1 *Discussion—*

4.5 contains safety requirements for stability.

3.2.7 *outdoor candle, n*—a candle intended to be burned outdoors.

3.2.8 *religious/ceremonial candle, n*—a candle that is predominantly intended, constructed, packaged, and labeled for use in a public venue during a religious or similar ceremony.

3.2.8.1 *Discussion—*

Candles such as an Easter, Paschal, sacramental, or altar (or some combination, for example Easter/Paschal), generally 17 in. (43 cm) or more in length are considered religious/ceremonial candles. These candles are generally displayed and burned in the place of worship as the focal candle during a ceremony, service, or event. These candles may be adorned with symbols and ornamentation as required and deemed appropriate.

3.2.9 *tealight candle, n*—a cylindrical filled candle produced with a diameter and height of approximately 1.5 in. (38 mm) and 0.75 in. (19 mm) respectively.

3.2.10 *votive candle, n*—a candle produced for use fully within a candle accessory, specifically, a votive holder.

3.3 *Definitions: General Terms*:

3.3.1 ~~*altar candle,*~~*barrier technology, n*—~~candle that is constructed, packaged, and labeled as an altar candle.~~ a functional design element of a candle accessory that minimizes the risk of the flame spreading to combustible components of the candle accessory as a result of foreseeable misuse or failure of the candle.

~~3.2.1.1 *Discussion—*~~

~~The candle is used in a place of worship in close proximity to the altar during the religious service or ceremony.~~

3.3.1.1 *Discussion—*

Examples include a durable, noncombustible wall, or space absent of combustible objects.

3.3.2 *base material, n*—the intended fuel source for ~~candle flame.~~the candle.

3.3.3 *burn cycle, n*—the length of time a candle burns from when it is lit to when it is manually extinguished or from when it is lit until it extinguishes on its own at end of useful life.

3.3.3.1 *Discussion*—

Burn cycles for tealight candles are until end of useful life; burn cycles for gel-containing candles are 8 h; burn cycles for extended use candles are as labeled or intended; and burn cycles for all other candles are 4 h.

3.3.4 ~~*birthday candle,*~~*burn time, n*—~~candle or candle ensemble whose sole purpose is to be used on a birthday cake.~~the time a material supports sustained flaming combustion after removal of the ignition source until all flaming ceases.

3.3.5 *candle flashover, n*—the condition where the base ~~material's~~material's vapors ignite over the entire fuel ~~pool.~~pool

3.3.6 ~~*coating,*~~ *coating*—*n*—any material, other than wax based, which is used to cover at least a portion of the candle.

~~3.2.5.1 *Discussion*—~~

~~This material includes, but is not limited to, paint, glue, glitter, wood, plastic, or any other material that is not wax-based (which is generally considered an overdip).~~

~~3.2.5.2 *Discussion*—~~

~~Excludes product labeling on bottom and any packaging meant to be removed prior to use.~~

3.3.6.1 *Discussion*—

This material includes, but is not limited to, paint, glue, glitter, wood, plastic, or any other material that is not wax-based (which is generally considered an overdip).

3.3.6.2 *Discussion*—

Excludes product labeling on bottom and any packaging meant to be removed prior to use.

3.3.7 ~~*Easter, Paschal, sacramental candle,*~~ *diffusion flame, n*—~~candle that is constructed, packaged, and labeled as an Easter, Paschal, or sacramental candle (or some combination of these names, for example, Easter/Paschal), generally 43.2 cm (17.0 in.) or more in length.~~ a type of flame where the fuel is not premixed with air or other oxygen source.

~~3.2.6.1 *Discussion*—~~

~~The candle shall be displayed and burned in the place of worship as the focal candle during Easter or with the celebration of various sacraments. The candle is adorned with symbols and ornamentation as required and deemed appropriate.~~

3.3.7.1 *Discussion*—

Diffusion flames are typically red, yellow, or orange in color.

3.3.8 *end of useful life, n*—when the candle ceases to support combustion and the candle flame(s) goes(go) out on its own, as designed, and cannot be re-lit.

3.3.9 *ensemble, n*—a candle and items physically packaged together and intended for use with the candle for sale as one unit at the retail level.

3.3.10 *flame height, n*—the length of the candle flame from the base to the tip.

3.3.11 *flame impingement, n*—the situation where the flame makes contact with a surface.

3.3.11.1 *Discussion*—

Within this standard, the concern is when a freestanding candle flame impinges on the supporting surface at the end of useful life.

3.3.12 *fuel pool, n*—pool of molten base material.

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

~~3.2.10.1 *Discussion*—~~

~~Materials that are reported as passing Test Method E136 are considered noncombustible.~~

3.3.13.1 *Discussion*—

Materials that are reported as passing Test Method E136 are considered noncombustible.

~~3.2.11 *non-freestanding birthday candle, n*—any candle or candle ensemble that does not include pyrotechnics and is designed and marketed for use with birthday cakes and does not comply with the applicable stability requirements.~~

~~3.2.11.1 *Discussion*—~~

~~Section 4.4 of Specification F2417 contains safety requirements for stability.~~

~~3.2.12 *paint, n*—a pigmented material which is generally applied to the outside surface of the candle, primarily used to decorate the candle.~~

3.3.14 *place of worship, n*—any building that functions primarily as a group meeting place for the practice of religion (see NFPA 909).

~~3.2.13.1 *Discussion*—~~

~~This includes, but is not limited to, churches, synagogues, cathedrals, temples, and meeting halls.~~

3.3.14.1 *Discussion*—

This includes, but is not limited to, churches, synagogues, cathedrals, temples, mosques, and meeting halls.

3.3.15 *secondary ignition, n*—a self-sustained flame other than that on the intended wick(s) that occurs during candle use, including candle flashover.

~~3.2.14.1 *Discussion*—~~

~~If a wick curls over during the burning of the candle such that the wick and the tip are both touching the melt pool but the wick only has one flame it is not to be interpreted as secondary ignition unless two or more separate flames can be distinguished on the same wick.~~

3.3.15.1 *Discussion*—

If a wick curls over during the burning of the candle such that the wick and the tip are both touching the melt pool but the wick only has one flame it is not to be interpreted as secondary ignition unless two or more separate flames can be distinguished on the same wick.

3.3.16 *self-sustained flame, n*—a flame that continues to burn until the fuel source is removed or depleted or requires manual extinguishing.

3.3.17 *useful life*—total length of time a candle burns.

3.3.18 *wick, n*—an object that delivers fuel to a flame through the process of capillary action.

4. Safety Requirements

4.1 *Safety Requirements for Flame ~~Height~~—Height:* ~~This safety requirement applies to all candles except candles intended to be burned outdoors.~~

4.1.1 ~~*Rationale:*~~ This safety requirement applies to all candles except outdoor candles. See X1.1.

~~4.1.1.1 Candle flame heights are burn characteristics that shall be monitored closely by manufacturers, consumers, retailers, and anyone associated with the distribution and use of candles.~~

~~4.1.1.2 Excessive candle flame heights can increase the risk of fires when using candle products.~~

~~4.1.1.3 The 76.2-mm (3.0-in.) maximum allowable flame height requirement for all candles excluding Easter, Paschal, sacramental, altar, and outdoor candles is, in part, based on the established requirement for nonadjustable, non-windproof lighters~~

~~contained in Consumer Safety Specification F400, taking into account certain differences in measurement methods and other candle performance considerations not relevant to fire safety. In addition, candle flame heights are not static. The natural tendency of a candle is for the flame height to vary during the burn life. The maximum allowable flame height requirement in this specification takes into account such variation and anticipates that manufacturers will design candles to ensure that they remain below the maximum flame height requirement throughout the burning period. Furthermore, the manufacturer shall determine the appropriate lower flame height for optimum performance for individual candle types.~~

~~4.1.1.4 The 95.3-mm (3.75-in.) maximum allowable flame height requirement for Easter, Paschal, sacramental, and altar candles is larger than other candles because visibility of the flame during services at the place of worship warrants slightly larger flame heights.~~

4.1.2 *Performance ~~Requirement:~~ Requirement*—When tested in accordance with test method in 5.2:

4.1.2.1 ~~Candle flame heights (other than those of Easter, Paschal, sacramental, altar, and outdoor candles), when tested~~ Except as listed in 4.1.2.2~~accordance with the test method in~~ , candle flame heights ~~5.2,~~ shall not exceed ~~76.2 mm (3.0 in.). If at any time during the testing period the flame height exceeds 76.2 mm (3.0 in.), extinguish that candle and record it as a failure.~~3.0 in. (76 mm).

~~4.1.2.2 Easter, Paschal, sacramental, and altar candle flame heights, when tested in accordance with the test method in 5.2, shall not exceed 95.3 mm (3.75 in.). If at any time during the testing period the flame height exceeds 95.3 mm (3.75 in.), extinguish that candle and record it as a failure.~~

4.1.2.2 ~~For filled candles, if at any time during the testing period, regardless of flame height, the container cracks or breaks, it shall be recorded as~~Religious/ceremonial candle flame heights shall not exceed 3¾ ~~a failure.~~in. (95 mm).

~~4.2 *Safety Requirements for Secondary Ignition*—This safety requirement applies to all candles and ensembles with the exception of all Easter, Paschal, and sacramental candles predominantly intended to be used at the place of worship during the service (for less than 60 min). Non-freestanding birthday candles are also exempt.~~

~~4.2.1 *Rationale:*~~

~~4.2.1.1 Potential hazards associated with secondary ignition sources in and on candles exist, especially if the candle is not designed properly. The ignition of material other than the intended wick(s) may result in damaged candles, elevated fuel pool temperatures, excessively rapid base material consumption, and unintended flames. All of these conditions could lead to potential fire hazards.~~

~~4.2.1.2 This requirement describes the method to determine the tendency of candles to support ignition at points other than the intended wick(s) that are integrated into the candles to enable them to burn.~~

~~4.2.2 *Performance Requirement:*~~

~~4.2.2.1 When the candle is tested in accordance with 5.2 of this specification, no secondary ignition shall occur.~~

~~4.2.2.2 Record the candle as passing the secondary ignition specification if no secondary ignition is observed during the testing.~~

4.2 *Safety ~~Requirements for End of Useful Life—~~Requirement for Candle Container Integrity:* ~~This safety requirement applies to all votive, freestanding, and filled (including tealights) candles and to all ensembles containing tealights. This safety requirement does not apply to candles requiring a holder to keep them upright, birthday candles, and candles intended to float on water.~~

4.2.1 *~~Rationale~~*—~~When the candle meets the safety requirements for the end of useful life, this~~This safety requirement applies to filled candles, including tealights. See X1.2~~will reduce the risk of fires.~~.

4.2.2 *Performance ~~Requirement:~~ Requirement—*

~~4.3.2.1 Record votive and filled (including tealights) candle or tealight ensembles as passing the end of useful life requirement when tested in accordance with the test method in 5.2 if the candle or tealight ensemble meets the definition in 3.2.7 and does not break or crack the container, does not exhibit excessive flame height, and does not exhibit secondary ignition as detailed in this specification.~~When tested in accordance with the test method in 5.2:

4.2.2.1 ~~Record the freestanding candle as passing the end of useful life requirement when tested in accordance with the test method in~~ The container shall ~~5.2 if the candle meets the definition in 3.2.7 and the flame does not impinge on the supporting surface, does not exhibit excessive flame height, does not exhibit secondary ignition as detailed in this specification, and does not tip over on its own accord when tested on a level surface in accordance with~~ not crack or break.~~5.2.~~

~~NOTE 1—The use of current processes or devices that limit the candle's ability to consume all of the available fuel is offered as a way to reduce candle fires that occur at the end of the candle's life. This does not preclude the development of other suitable means to meet the requirements set forth in 4.3 – 4.3.2.2. This reduces heat buildup at the end of life and the possibility of secondary ignition, candle flashover, and container failure. While it is understood that current processes and devices will not guarantee that all fuel will not be consumed, the anticipated benefit in reducing candle fires warrants their consideration for use.~~

4.3 *Safety Requirements for Secondary Ignition:*

4.3.1 This safety requirement applies to all candles and ensembles except religious/ceremonial candles and non-freestanding birthday candles. See X1.3.

4.3.2 *Performance Requirement*—When tested in accordance with the test method in 5.2.

4.3.2.1 Secondary ignition shall not occur.

4.4 *Safety Requirements for Flame Impingement:*

4.4.1 This safety requirement applies to freestanding candles. See X1.4.

4.4.2 *Performance Requirement*—When tested in accordance with the test method in 5.2:

4.4.2.1 Candle flames shall not impinge on the supporting surface.

4.5 *Safety Requirements for ~~Stability~~—Stability:* ~~This safety requirement is intended to cover freestanding candles that are normally used without the aid of a holding device to keep them upright, filled candles (including tealights), and ensembles. Candles requiring a holder to keep them upright and votive candles are excluded unless they are incorporated in an ensemble. Easter, Paschal, sacramental, and altar candles specifically designed for use during the service at the place of worship are also excluded from the requirements of this section.~~

4.5.1 ~~*Rationale*—~~This safety requirement ~~is intended to minimize the hazards of candle tip over.~~applies to freestanding candles and filled candles, including tealight candles and ensembles. See X1.5.

4.5.2 *Performance ~~Requirement:~~ Requirement Before Burning*—When tested in accordance with the test method in 5.3:

4.5.2.1 ~~Candles specified in~~Freestanding and filled ~~4.4 must~~ including tealight candles and ensembles shall not tip over when placed ~~on~~at a ~~minimum 10.0° incline when tested in accordance with~~ 10.0° (–0.0° / +0.5°) incline from horizontal.~~5.3 in this specification.~~

4.5.2.2 Asymmetrical candles ~~must pass this requirement if they do~~ and ensembles shall not tip over when ~~rotated around the candle's vertical axis and tested on the incline apparatus in all orientations in accordance with~~placed at a 10.0° (–0.0° / +0.5°) incline from horizontal at any position when rotated around the vertical ~~5.3.~~axis.

~~4.4.2.3 Candles must remain stable when tested on a level surface in accordance with 5.2 and not tip over at any time during the candle burning performance test.~~

4.5.3 *Performance Requirement While Burning*—When tested in accordance with the test method in 5.2.

4.5.3.1 Freestanding candles shall not tip over on a level surface.

4.6 *Safety Requirements for Plastic ~~Containers (Including Tea Light Cups)—~~Containers:* ~~This requirement applies to all plastic containers used for candles. Containers constructed of noncombustible materials are exempt from this test.~~

4.6.1 ~~*Rationale*—Plastic~~ This requirement applies to all plastic containers used for ~~candle applications~~candles. See X1.6~~are intended to be used in close proximity to an open flame. A wide variety of materials are used to manufacture plastic containers, some of which are inappropriate and can catch fire resulting in a potential candle fire hazard. When plastic containers meet this requirement for flammability the risk will be reduced of the container igniting while in use and contributing to a candle fire.~~.

4.6.2 *Performance Requirement*—~~The plastic containers specified in~~ When ~~4.5 must have a total burn time less than or equal to 300 s with no single burn time event exceeding 30 s when the containers are tested~~ in accordance with the test method in 5.4 ~~of this standard.~~:

4.6.2.1 The total burn time for the ten plastic containers shall be less than or equal to 300 s.

4.6.2.2 No single burn time of a plastic container shall exceed 30 s.

4.6.2.3 No single plastic container shall be completely consumed during testing.

4.7 *Safety Requirements for ~~Paints/Coatings~~Coatings on ~~Candles—~~Candles:* ~~This safety requirement is intended to cover all candles which contain a coating or a painted surface. This requirement excludes filled containers where there is a noncombustible material, such as glass, between the flame and the painted/coated surface.~~

4.7.1 This safety requirement applies to all candles which contain a coating (such as a painted surface) except non-freestanding birthday candles, religious/ceremonial candles, and filled candles where there is a noncombustible material, such as glass, between the flame and the coated surface. See X1.7.

4.7.2 ~~*Rationale—*~~*Performance Requirement*—~~Candles with coating or paint applied to the outside of the product are susceptible to the secondary ignition of~~When a minimum of 24 identical candles are tested in accordance with the test method in 5.2~~this coating or paint, thereby leading to the possibility of candle fires if this occurs. This requirement will reduce the possibility of this happening. There is no data to indicate that coatings on the exterior of filled containers are a concern, therefore they are excluded from the requirement.~~:

4.7.2.1 Candle flame heights shall not exceed 3.0 in. (76 mm), 4.1.2.1.

4.7.2.2 Secondary ignition shall not occur, 4.3.

4.7.2.3 Freestanding candle flames shall not impinge on the supporting surface, 4.4.

4.7.2.4 Freestanding candles shall not tip over on a level surface, 4.5.3.

NOTE 1—There is no data to indicate that coatings on the exterior or filled containers are a concern; therefore they are excluded from the coatings on candles requirements.

~~4.6.2 *Performance Requirement:*~~

~~4.6.2.1 When the candle is tested in accordance with 5.2 of the specification, no secondary ignition shall occur. A minimum of 24 identical candles shall be tested.~~

~~4.6.2.2 Record the candle as passing the secondary ignition specification if no secondary ignition is observed during the testing in 4.3.2.~~