



## NATIONAL ASSOCIATION OF STATE FIRE MARSHALS

### **Government Relations**

February 10, 2004

Office of the Secretary  
United States Consumer Product Safety Commission  
Washington, DC 20207

RE: Petition for improved candle products fire safety

The National Association of State Fire Marshals (NASFM) is a membership organization whose members include the senior fire safety officials in the United States. NASFM is committed to the protection of life, property and the environment from fire and other hazards.

For the reasons stated below, NASFM petitions<sup>1</sup> the United States Consumer Product Safety Commission (CPSC) to adopt and enforce a standard addressing candle products fire safety. This standard should be substantially based, as a minimum, upon the requirements contained within ASTM International (ASTM) Provisional Specifications for Fire Safety for Candles (Designation PS59-02) for all candles sold for consumer use in the United States. Details of this ASTM standard are included in Appendix 1 of this correspondence. The CPSC mandatory standard should also incorporate, at a minimum, the following additional provisions:

1. Flammability performance requirements for candle accessories, including candleholders;
2. End of useful life requirements for freestanding, tealight, taper, and votive candles;
3. Stability requirements for votive candles and taper candles mounted in appropriate candleholders; and
4. Miscibility and flash point requirements for gel candles.

The CPSC should consider the recent efforts of the ASTM Candle Products Subcommittee, F15.45, in developing these additional provisions. This Subcommittee is pursuing similar additional requirements to upgrade the provisional standard during the process to convert the provisional standard into a final consumer product safety standard. CPSC has been represented on the task group working in these areas.

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<sup>1</sup> This petition on candle fire safety is filed in accordance with the Consumer Product Safety Act (15 U.S.C. 2051 *et seq.*), and in conformity with the requirements set forth under 16 CFR 1051.2-6.

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### Fire losses related to candle fires are unacceptably high and increasing with time.

In 1999, the most recent year for which data are available, there were an estimated 14,500 home candle fires, resulting in 100 civilian deaths, over 1,500 injuries, and \$265.0 million in direct property loss.<sup>2</sup>

While other causes of home fires have decreased, the percentage caused by candles has increased. According to the National Fire Protection Association (NFPA), in 1999 candle fires accounted for 4.1% of all reported fires, more than triple the 1980 share of 1.1%. Home candle fires jumped 20% from 1998 to 1999 to hit their 20-year peak in 1999.<sup>3</sup> Recent charts of the data compiled by NFPA's Fire Analysis and Research Division can be found in Table 1 and Figure 1 in Appendix 2.

According to data collected by the NFPA and the National Fire Incident Reporting System, and detailed in Table 2 in Appendix 3, nearly one-third of home candle fires reported were due to unattended candles or inattention to candles, and a quarter were due to the placement of candles too close to combustible material.<sup>4</sup> These fire loss trends are consistent with increased consumer use of candles, much as reductions in cigarette smoking often are linked to some decrease in cigarette-related fires. According to industry sources, candle sales are increasing 10% to 15% annually. The National Candle Association's (NCA) website<sup>5</sup> reports that each of the more than 350 manufacturers of candles in the United States produce, on average, 1,000 to 2,000 varieties of candles. These candles are produced for commercial, religious and institutional use, and produce sales of approximately \$2 billion annually. It is estimated that 7 out of 10 US households use candles on a regular basis. The inherent danger posed by candles with their open flame, coupled with the increase in residential fires caused by candles over the past decade, make fire safety issues paramount in regulation of the candle manufacturing process.

### Very few candle fires are intentional.

Consumers are warned repeatedly not to leave candles unattended. Yet, even the most cautious consumer realistically cannot maintain continuous direct visual supervision of candles without some interruption. To place the burden of safety entirely on the consumer makes no sense and has no legal standing.

According to the NFPA, 93% of home candle fires are unintentional. In the most recent NFPA report on the issue, 38% of home candle fires in 1999 "occurred when candles were left

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<sup>2</sup> Miller, D., Smith, L., and Greene, M. 1999 Residential Fire Loss Estimates. Washington, DC: U.S. Consumer Product Safety Commission, November, 2003.

<sup>3</sup> <http://www.nfpa.org/Research/NFPAFactSheets/CandleSafety/CandleSafety.asp>

<sup>4</sup> Ahrens, Marty. *Candle Fires in US Homes and Other Occupancies: A Statistical Analysis*. Quincy, MA: NFPA, Fire Analysis and Research Division, Dec. 2002.

<sup>5</sup> <http://www.candles.org/CandleIndustry/index.htm>

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unattended, abandoned or inadequately controlled.”<sup>6</sup> Twenty-three percent started when a candle was left too close to different types of combustible material. People playing with candles caused eight percent of the incidents. A more comprehensive listing of ignition factors published by NFPA’s Fire Analysis and Research Division can be found in Table 3 in Appendix 4.<sup>7</sup> The materials cited in this report as items first ignited range from clothing, mattresses, and upholstered furniture to small electronics and other common combustible goods.

Another NFPA publication, the *U.S. Home Product Report, 1994-1998: Forms and Types of Material First Ignited in Fires*,<sup>8</sup> reports that 45% of decoration fires, 20% of curtain and drape fires, and 5% of mattress and bedding fires were ignited by candles.

According to the NFPA, approximately 40% of home candle fires begin in bedrooms, and 19% originate in living rooms/common rooms. Smaller percentages begin in bathrooms, kitchens, or dining rooms. More than half of the deaths caused by candle fires come from fires that began in the living room, family room, common room, or den.

Candles can be designed and produced to reduce fire loss.

The CPSC has issued approximately 58 candle or candle product recalls since 1994. These recalls involved excessive candle flame heights, candleholders or containers that overheated, shattered or caught fire, the presence of flammable material within the candle, and flammable paint on candleholders or containers.

In 1997, the CPSC approached ASTM to request that ASTM organize a subcommittee to consider the development of a new voluntary standard addressing the safety problems of candles in residences, primarily fires. ASTM contacted all known stakeholders, including the National Candle Association, which represented a significant proportion of the candle manufacturing industry. A new Subcommittee, F15.45, Candle Products, was formed, and the process initiated to develop a standard. Representatives of the National Candle Association and their suppliers provided the leadership and officers to the Subcommittee. To date, three final standards have been adopted, and the Subcommittee remains very active in pursuing additional standards and provisions:

F1972-99, *Standard Guide for Terminology Relating to Candles and Associated Accessory Items*, establishes standard terms and definitions for common types of candles and associated products.

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<sup>6</sup> Ahrens, Marty. *Candle Fires In U.S. Homes and Other Occupancies: A Statistical Analysis*. Quincy, MA: NFPA, Fire Analysis and Research Division, Dec. 2002.

<sup>7</sup> Ahrens, Marty. *Candle Fires In U.S. Homes and Other Occupancies: A Statistical Analysis*. Quincy, MA: NFPA, Fire Analysis and Research Division, Dec. 2002.

<sup>8</sup> Rohr, Kimberly D. *U.S. Home Product Report, 1994-1998: Forms and Types of Materials First Ignited in Fires*. Quincy, MA: NFPA, Fire Analysis and Research Division, Dec. 2001.

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F2058-00, *Standard Specification for Cautionary Labeling for Candles Burned in a Home*, describes labeling requirements, including minimum size, formatting specifications, and the minimum words of “Warning: To Prevent Fire, Burn candle within sight. Out of the reach of children and pets. Never on anything that can catch fire.”

F2179-02, *Standard Specification for Annealed Soda-Lime Silicate Glass Containers That are Produced for Use as Candle Containers*, provides for minimum requirements and testing options for containers of this type when they are expected to be used for candles. Containers should be able to withstand a change in temperature without cracking or breaking.

The Provisional Specifications for Fire Safety for Candles (Designation PS59-02), also developed by the technical committee, addresses some of the more common reasons that candles contribute to fires and is also the basis for most of the requested requirements in this petition. This document:

- Establishes a maximum allowable flame height of three inches. The maximum flame height of certain religious candles may be 3¾ inches. Candles intended for use outdoors are exempt from this requirement.
- Prohibits ignition of material other than on the intended wick(s), including flashover.
- Requires candles to terminate burning safely. Candles must go out on their own as intended, cannot be relit, and must not break the container. This requirement applies to all filled container candles, but not to tealight, taper, votive, birthday, freestanding, or floating candles.
- Sets stability requirements for candles that are freestanding, filled candles, and ensembles. Taper and votive candles are excluded. Candles may not tip over when placed on a 10-degree incline. Certain religious candles are excluded from this requirement.

NASFM assumes that since experts from the candle industry provided leadership and participated in the development of these standards, the standards are commercially feasible.

Without some means of ensuring candle manufacturers’ compliance with the Provisional ASTM Specifications, consumers are no safer than before the Provisional ASTM Standard was written.

While these voluntary standards have been issued, they are not mandated by ASTM, and to NASFM’s knowledge have not been referenced or incorporated into contracts, regulations, laws, codes or procedures. The value of these ASTM documents is that they provide standard definitions, tests and minimum warning wording – in effect, an agreed-upon starting place from which to build. NASFM has been unable to determine what percentage of the hundreds of thousands of candle products in commerce, if any, are or intend to be in compliance with the

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Provisional ASTM standard. Neither trade association representing the candle industry makes mention of any effort to encourage compliance with the ASTM Provisional standard,<sup>9</sup> and conversations with representatives of these two groups suggest that no compliance program is planned or under way.

The Consumer Product Safety Act requires the CPSC to defer to an existing voluntary standard if two basic criteria are met. In other words, the CPSC is prohibited from developing, issuing, or enforcing a mandatory consumer product safety rule, regulation, or standard if there exists a voluntary standard that meets these criteria.

These criteria are “whenever compliance with such voluntary standards would eliminate or adequately reduce the risk of injury addressed and it is likely that there will be substantial compliance with such voluntary standards.”<sup>10</sup>

NASFM believes that the current ASTM provisional standard – with the additional provisions specified on the first page of this petition and when upgraded through the current efforts to address flammable accessories and to include certain types of candles now excluded – addresses the specific design and manufacturing concerns identified by the CPSC and should be effective in reducing accidental fire losses, thus meeting the first criterion. However, NASFM has seen no evidence of any program to encourage or track compliance with the standard. Without such a coordinated industry-supported compliance program, insufficient compliance is virtually certain. Therefore, mandatory national candle product fire safety requirements must be adopted and enforced by the CPSC.

Most consumers do their part; other industries are doing their part and so must candle producers.

We urge homeowners to install and maintain smoke detectors and most do. We ask all consumers to be careful with candles and most are. After all, 15,000 residential fires were reported from hundreds of millions of candles sold and ostensibly used in 1999.

Safety is the responsibility of everyone, not just of consumers. The CPSC is now working on open flame ignition standards for upholstered furniture and mattresses, and has reported that it expects to begin work on similar requirements for bedclothes. Manufacturers have worked hard to make these products safer. The State of New York, and hopefully the U.S., soon will benefit from cigarettes with reduced ignition power. The International Electrotechnical Commission, Underwriters Laboratories and electronics manufacturers have just defined “candle-ignition” standards for information technology, consumer electronics and telecommunications equipment sold for use in the home. But as effective as these new fire safety standards may be, none is perfect.

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<sup>9</sup> Consumer Specialty Products Association at [http://www.cspa.org/index\\_public.html](http://www.cspa.org/index_public.html) and National Candle Association at <http://www.candles.org/>

<sup>10</sup> 15 U.S.C. 2056(b)(1)

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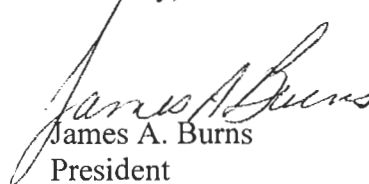
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Candles can and must be made safer because lives can be saved. The candle industry has had every opportunity to organize and operate a complete and effective voluntary fire safety program, but has not moved forward with such a program. The CPSC's authorizing statutes are clear in the case of any product within its jurisdiction that results in multiple deaths year after year and for which there is no existing voluntary safety program that meets the statutory criteria. As a matter of public safety and fairness, NASFM believes that the manufacturers of candles should share equally with consumers, fire safety officials and the producers of cigarettes, upholstered furniture, mattresses, bedding, cigarette lighters and electronics the responsibility of preventing loss of life and property from fires in the home.

We thank the CPSC for its consideration of this petition and stand ready to assist you as this matter moves forward.

Sincerely,



James A. Burns  
President

Attachments

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## Provisional Specification for Fire Safety for Candles<sup>1</sup>

This provisional standard is issued under the fixed designation PS 59; the number immediately following the designation indicates the year of original adoption.

### 1. Scope

1.1 This provisional standard is intended to prescribe requirements for certain candles to help ensure a reasonable degree of safety for normal use, thereby improving personal safety and reducing fires, deaths, and injuries.

1.2 This provisional standard is not intended to replace other safety practices that should be in place, such as, adult supervision, close monitoring, fire detection, alarm or suppression systems, and practical use of candles away from combustible materials.

1.3 *This provisional 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 requirements prior to use.*

1.4 **Warning**—Flame-producing devices, such as candles, present a potential hazard to the user. This provisional standard cannot eliminate all hazards, but it is intended to minimize the potential hazards of candles to the user.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

E 122 Practice for Calculating Sample Size to Estimate, With a Specified Tolerable Error, the Average for Characteristic of a Lot or Process<sup>2</sup>

F 400 Consumer Safety Specification for Lighters<sup>2</sup>

F 1972 Guide for Terminology Relating to Candles and Associated Accessory Items<sup>3</sup>

F 2058 Specification For Cautionary Labeling For Candles Burned In A Home<sup>3</sup>

#### 2.2 Military Standards:<sup>4</sup>

MIL-STD-105D (ISO 2859) Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-414 (ISO 3951) Sampling Procedures and Tables

<sup>1</sup> This provisional specification is under the jurisdiction of ASTM Committee F15 on Consumer Products and is the direct responsibility of Subcommittee F15.45 on Candle Products.

Current edition approved Dec. 4, 2002. Published January 2003.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.07.

<sup>4</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

for Inspection by Variables for Percent Defective

### 3. Terminology

3.1 Certain candle-related terminology has already been addressed in Guide F 1972 and Specification F 2058, and the reader is directed to those standards for definitions not found in 3.2.

#### 3.2 Definitions:

3.2.1 *Altar candle*—a candle that is constructed, packaged, and labeled as an “Altar” candle. The candle is used in the institutional house of worship in close proximity to the altar during the religious service or ceremony.

3.2.2 *base material*—intended fuel source for candle flame.

3.2.3 *birthday candle*—candle whose sole purpose is to be used on a birthday cake.

3.2.4 *candle flashover*—condition where the base material’s vapors ignite over the entire fuel pool.

3.2.5 *Easter, Paschal, Sacramental candle*—a 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. The candle is to be displayed and burned in the institutional house 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 by the institutional house of worship.

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

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

3.2.8 *filled container candle*—a candle produced and used within the same vessel.

3.2.9 *freestanding candle*—a rigid candle (for example, pillar-shaped, column-shaped, or figurine) recommended to be used on a heat-resistant, nonflammable surface or on a candle accessory.

3.2.10 *fuel pool*—pool of molten base material.

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

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

#### 4. Safety Requirements

4.1 *Safety Requirements for Flame Height*—This safety requirement does not pertain to candles intended to be burned outdoors.

##### 4.1.1 *Rationale:*

4.1.1.1 Candle flame heights are an important burn characteristic that should 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 potential for 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 F 400, 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 recommended in this provisional specification incorporates all possible variations with respect to the candle’s fire safety. While 76.2 mm (3.0 in.) is the maximum flame height for fire safety for all candle types, the manufacturer must determine the flame height, not to exceed 76.2 mm (3.0 in.), 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 religious services warrants slightly larger flame heights.

##### 4.1.2 *Performance Requirement:*

4.1.2.1 Candle flame heights (other than those of “Easter,” “Paschal,” “Sacramental,” “Altar,” and outdoor candles), when tested in accordance with the test method in 5.1, 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.

4.1.2.2 “Easter,” “Paschal,” “Sacramental,” and “Altar” candle flame heights, when tested in accordance with the test method in 5.1, 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.

4.1.2.3 For filled container candles, if at any time during the testing period, regardless of flame height, the container fails, it shall be recorded as a failure.

4.2 *Safety Requirements for Secondary Ignition*—This safety requirement applies to all candles and ensembles with the exception of “Easter,” “Paschal,” and “Sacramental” candles specifically designed to be used during the institutional house of worship service.

##### 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 or candle flashover, or both.

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 5.1 of this provisional 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.

4.3 *Safety Requirements for End of Useful Life*—This requirement applies to all filled container candles. This requirement does not apply to tealights, tapers, votives, birthday, and freestanding candles or to candles that are intended to float on water when they are burned.

4.3.1 *Rationale*—It is believed that if the candle meets the safety requirements for the end of useful life, this will substantially reduce the risk of fires caused by candles. Otherwise, the candle may overheat, increasing the risk of fires.

##### 4.3.2 *Performance Requirement:*

4.3.2.1 Record candle as passing the end of useful life requirement when tested in accordance with the test method in 5.1 if the candle meets the definition in 3.2.6 and does not break the container, does not exhibit excessive flame height, and does not exhibit secondary ignition as detailed in this provisional specification.

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 possible 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 4.3.2.1. 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.

4.4 *Safety Requirements for 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, and ensembles. Tapers and votive candles are excluded unless they are incorporated in an ensemble. “Easter,” “Paschal,” “Sacramental,” and “Altar” candles, specifically designed for use during the institutional house of worship service, are also excluded from the requirements of this section.

4.4.1 *Rationale*—This requirement is intended to minimize the hazards of candle tip over.

##### 4.4.2 *Performance Requirement:*

4.4.2.1 Candles specified in 4.4 must not tip over when placed on a minimum 10° incline when tested in accordance with 5.2 in this provisional specification.

4.4.2.2 Asymmetrical candles must pass this requirement when rotated around the candle's vertical axis and tested on the incline apparatus in all orientations.

## 5. Test Methods

5.1 Candle fire safety issues intended to be monitored by these test methods include flame height, secondary ignition, safety requirements for end of useful life and stability.

### 5.2 Candle Burning Performance Test:

5.2.1 *Summary of Test Method*—Candle wicks are trimmed in accordance with the manufacturer's instructions. If no information is provided from the manufacturer, the wicks are not trimmed for this test. The candles are lit and allowed to burn for 4 h with periodic observation. This procedure is repeated until the candle burns out completely on its own. Flame heights are observed at specified intervals and recorded at the end of each burn cycle. Flame heights shall be measured and recorded in millimetres.

#### 5.2.2 Apparatus:

5.2.2.1 Nonflammable measuring device graduated in millimetres;

5.2.2.2 Votive holder/glass (if applicable);

5.2.2.3 Taper holder (if applicable);

5.2.2.4 Lighter, matches, or other source of ignition;

5.2.2.5 Test surface-level, noncombustible; and

5.2.2.6 Wick-trimming device.

#### 5.2.3 Hazards:

5.2.3.1 Safety glasses should be worn at all times.

5.2.3.2 Avoid contact with flame, fuel pool, or other surfaces that may be hot.

5.2.3.3 Keep clothing, hair, etc. from coming in contact with flame.

5.2.3.4 Testing should be conducted under careful observation in an area away from combustible materials.

5.2.3.5 Class B or Class ABC fire extinguisher should be available.

#### 5.2.4 Procedure:

5.2.4.1 Remove all outer wrapping. Remove label material (according to manufacturer's instructions) before initiating the burn test.

5.2.4.2 The burn test area will be environmentally controlled to 20 to 30°C (68 to 86°F) with 20 to 70 % relative humidity and an environment that minimizes the disturbance of the flame of the candles under test. Drafts can affect flame heights and should be minimized.

5.2.4.3 Place candles with the wicks in a straight/upright position. When appropriate, place candles in a holder and trim wicks in accordance with the manufacturer's instructions.

5.2.4.4 Place candles at least 20 cm (7.87 in.) apart, measured sidewall to sidewall, on test surface.

5.2.4.5 Light candles, taking care not to contaminate them with carbon or debris from the ignition source. Burn continuously for 4 h.

5.2.4.6 Make visual observations after initial lighting and at least hourly intervals throughout the entire burn duration. If a flame height appears to approach the maximum allowable flame height, measure and record the flame height and the time of occurrence.

5.2.4.7 Measure and record flame height at the end of the specified 4-h burn cycle. For candles whose intended product life is less than 8 hours, measure and record the flame height a minimum of two times before the end of useful life. Measure flame with a nonflammable measuring device. Carefully place the measuring device as close as possible behind the flame without disturbing the flame. Allow flame to stabilize. Hold the measuring device in place for 5 s and record a maximum value (undisturbed flame). Measure the flame height from bottom of flame arc to the flame tip (see Fig. 1).

5.2.4.8 At the end of burn cycle, extinguish the candle and allow to cool.

5.2.4.9 Repeat 5.2.4.2-5.2.4.8 until the end of candle life.

#### 5.2.5 Calculation of Results:

5.2.5.1 Record any failure for maximum flame height.

5.2.5.2 Record any occurrence of secondary ignition.

5.2.5.3 Record if the candle does not pass the safety requirements at end of useful life in accordance with 4.3.2.1 of this provisional specification.

5.2.6 *Precision and Bias*—No information is presented about either the precision or bias for measuring the flame height, secondary ignition, or safety requirements for end of useful life since the test results are nonquantitative.

#### 5.3 Stability Test Method:

5.3.1 *Summary of Test Method*—Candles are placed on a minimum 10° incline to determine if they remain in a stable, upright position without tipping over.

5.3.2 *Apparatus*—An incline plane, either fixed or adjustable, that is capable of achieving a minimum of 10.0° from level. The plane may need a stop to help prevent the candle from slipping during this test. If a stop is used, its maximum height shall not exceed 6.4 mm (0.25 in.) so as not to affect the test results.

#### 5.3.3 Procedure:

5.3.3.1 *Preparation of Samples*—Remove any outer wrapping. Remove label material (according to manufacturer's instructions) and make the candle or ensemble, or both, ready for use.

5.3.3.2 Place the prepared, unlit candle or assembled ensemble on an incline apparatus in the orientation most likely to cause tipping at a minimum of 10.0° from level. The tested candle or assembled ensemble or both must remain stable and not fall over. Rotation around the candle's vertical axis may be necessary to determine the stability of an asymmetrical candle.

5.3.4 *Calculation of Results*—Record any stability failures.

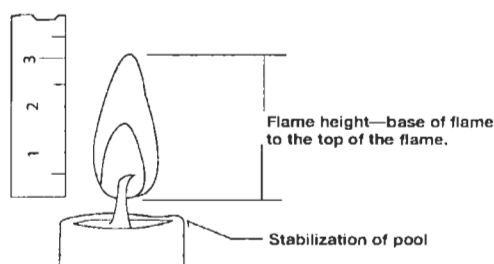


FIG. 1 Flame Measurement Diagram

5.3.5 *Precision and Bias*—No information is presented about either the precision or bias of the measurement of stability since the test results are nonquantitative.

## 6. Keywords

6.1 candles; “Easter,” “Paschal,” and “Sacramental” candles; end of useful life; fire safety; flame height; secondary ignition; stability

## APPENDIX

### (Nonmandatory Information)

#### X1. MANUFACTURER’S SAMPLING SCHEME REFERENCES

X1.1 The following published documents may be used to help establish a sampling plan and sample sizes when testing candles for fire safety characteristics included in this provisional specification. Other custom-designed plans and statistical methods may be used at the manufacturer’s discretion.

X1.1.1 Practice E 122

X1.1.2 MIL-STD-105D (ISO 2859)

X1.1.3 MIL-STD-414 (ISO 3951)

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**Table 1****Candle Fires in the Home as a Share of All Home Fires  
1980-1999**

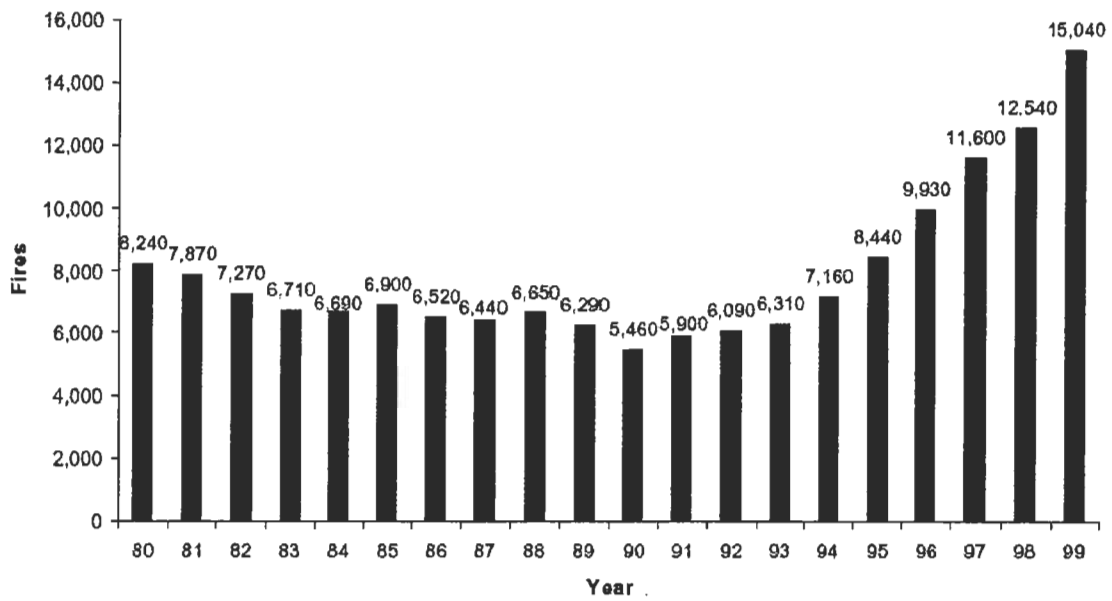
<b>Year</b>	<b>Home Fires</b>	<b>Home Candle Fires</b>	<b>Percent of Home Fires Started by Candles</b>
1980	733,370	8,240	(1.1%)
1981	711,080	7,870	(1.1%)
1982	659,000	7,270	(1.1%)
1983	626,590	6,710	(1.1%)
1984	606,450	6,690	(1.1%)
1985	607,100	6,900	(1.1%)
1986	566,710	6,520	(1.2%)
1987	537,200	6,440	(1.2%)
1988	537,960	6,650	(1.2%)
1989	499,840	6,290	(1.3%)
1990	454,890	5,460	(1.2%)
1991	465,530	5,900	(1.3%)
1992	459,280	6,090	(1.3%)
1993	457,720	6,310	(1.4%)
1994	439,280	7,160	(1.6%)
1995	414,350	8,440	(2.0%)
1996	417,020	9,930	(2.4%)
1997	395,490	11,600	(2.9%)
1998	370,180	12,540	(3.4%)
1999	370,410	15,040	(4.1%)
1980-1999			
Annual average	516,470	7,900	(1.5%)

Note: These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in the candle fires.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

### Home Candle Fires by Year: 1980-1999



Source: National estimates based on NFIRS and NFPA survey.

Figure 1

**Table 2**

**Factors Contributing to Ignition in Home Candle Fires during 1999**

<b>Factor Contributing</b>	<b>Fires</b>		<b>Civilian Deaths</b>		<b>Civilian Injuries</b>		<b>Direct Property Damage (in Millions)</b>	
Heat source too close to combustibles	3,460	(23.0%)	5	(5.2%)	349	(23.7%)	\$59.5	(21.4%)
Unattended	3,410	(22.7%)	45	(44.3%)	359	(24.4%)	\$63.9	(23.0%)
Inadequate control of open fire*	1,350	(8.9%)	12	(11.3%)	159	(10.8%)	\$27.5	(9.9%)
Playing with heat source	1,130	(7.5%)	0	(0.0%)	133	(9.0%)	\$24.4	(8.8%)
Abandoned or discarded materials or products	920	(6.1%)	0	(0.0%)	56	(3.8%)	\$13.7	(4.9%)
Unclassified misuse of product	720	(4.8%)	0	(0.0%)	60	(4.1%)	\$13.4	(4.8%)
Unclassified factor	440	(2.9%)	5	(5.2%)	15	(1.0%)	\$10.8	(3.9%)
Collision, knockdown or turn over	220	(1.5%)	12	(11.3%)	52	(3.6%)	\$4.8	(1.7%)
Improper container or storage	170	(1.2%)	0	(0.0%)	37	(2.5%)	\$1.9	(0.7%)
Animal	110	(0.7%)	0	(0.0%)	4	(0.3%)	\$2.3	(0.8%)
Property too close to or exposure fire	100	(0.7%)	0	(0.0%)	4	(0.3%)	\$0.7	(0.3%)
Cutting, welding too close to combustible	90	(0.6%)	0	(0.0%)	0	(0.0%)	\$1.0	(0.4%)
Other known factor	360	(2.4%)	0	(0.0%)	38	(2.6%)	\$6.6	(2.4%)
None	190	(1.3%)	0	(0.0%)	7	(0.5%)	\$3.0	(1.1%)
Not Reported	2,410	(16.0%)	23	(22.7%)	200	(13.6%)	\$44.7	(16.1%)
<b>Total</b>	<b>15,040</b>	<b>(100.0%)</b>	<b>102</b>	<b>(100.0%)</b>	<b>1,473</b>	<b>(100.0%)</b>	<b>\$278.0</b>	<b>(100.0%)</b>

\* "Inadequate control of open fire" was an ignition factor code in NFIRS Version 4.1 that converts to factor contributing to ignition "Outside or open fire for debris or waste disposal." Since most of these incidents were collected in Version 4.1 and converted, the older code definition seems more appropriate.

Note: These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals. In NFIRS 5.0, multiple entries may be recorded for factors contributing to ignition. "None" is also a valid choice. Candle fires in which the contributing factor was described as undetermined were allocated proportionally among fires with known, no or "not reported" contributing factors. In some cases, the "not reported" fires were a result of the conversion process. Percentages were calculated on the total number of fires, not number of mentions. Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Table 3****Causes of Home Candle Fires during 1999**

Cause	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Unintentional	14,010	(93.1%)	90	(88.0%)	1,428	(96.9%)	\$256.3	(92.2%)
Unclassified	370	(2.4%)	0	(0.0%)	7	(0.5%)	\$9.1	(3.3%)
Intentional	340	(2.3%)	12	(12.0%)	26	(1.8%)	\$7.0	(2.5%)
Failure of equipment or heat source	230	(1.5%)	0	(0.0%)	7	(0.5%)	\$3.4	(1.2%)
Act of nature	100	(0.7%)	0	(0.0%)	4	(0.3%)	\$2.2	(0.8%)
<b>Total</b>	<b>15,040</b>	<b>(100.0%)</b>	<b>102</b>	<b>(100.0%)</b>	<b>1,473</b>	<b>(100.0%)</b>	<b>\$278.0</b>	<b>(100.0%)</b>

Note: These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals. Candle fires in which the cause was unknown or not reported have been allocated proportionally among fires with known cause. Totals may not equal sums due to rounding.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.