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Standard Specification for Performance of Flame Mitigation Devices Installed in Disposable and Pre-Filled Flammable Liquid Containers[1]

This standard is issued under the fixed designation F3429/F3429M; 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 establishes performance requirements for the performance of flame mitigation devices (FMDs) installed in disposable and pre-filled liquid containers, intended for consumer use where the liquid flashpoint is below 60 °C [140 °F]. (See Appendix X1.)

1.1.1 Uses of disposable and pre-filled flammable liquid containers include but are not limited to fuels, fire starters, and additives for internal combustion engines.

1.1.2 An FMD that complies with this specification minimizes the potential of flame jetting or container rupture from occurring.

1.1.3 Containers without a significant area reduction at the container opening are not covered because there is no hazard of a flame jet or container rupture because an internal pressure rise does not result from an internal ignition. (See X1.5.)

1.2 This specification does not apply to the following containers:

1.2.1 Containers greater than 20 L [5.3 gal] or smaller than 100 mL [3.4 oz] in volume.

1.2.2 Containers intended for beverages.

1.2.3 Portable fuel containers as defined in Specification F852/F852M.

1.2.4 One-time use portable emergency fuel containers for use by consumers as defined in Specification F2874.

1.2.5 Containers not intended to be open to ambient conditions such as those for liquefied petroleum gas.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Information on specific hazards associated with the test methods in this specification is shown in Section 4.4.

1.5 This specification does not address hazards caused by fire and explosion nor hazards from vapors external to the container when the fuel in the container does not ignite. Further, this specification does not consider scenarios where confinement, obstructions, or preheating cause flame acceleration prior to the flame front reaching the interior of the container.

1.6 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.

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

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]

D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester

D4359 Test Method for Determining Whether a Material Is a Liquid or a Solid

F852/F852M Specification for Portable Gasoline, Kerosene, and Diesel Containers for Consumer Use

F2874 Specification for One Time Use Portable Emergency Fuel Containers (PEFC) for Use by Consumers

[1] This specification is under the jurisdiction of ASTM Committee F15 on Consumer Products and is the direct responsibility of Subcommittee F15.72 on Pre-Filled Containers of Flammable and Combustible Liquids.

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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.

2.2 *NFPA Standards:*[3]

NFPA 68 Standard on Explosion Protection by Deflagration Venting

NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gasses, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

3. Terminology

3.1 *Definitions:*

3.1.1 *disposable and pre-filled flammable liquid container, n*—a vessel, which includes a closure for storage or dispensing pre-filled with flammable liquids, that is intended and designed to be poured and discarded or recycled (and not re-filled) after the flammable liquids are fully consumed in one or multiple uses.

3.1.1.1 *Discussion*—In this specification, "container" means "disposable and pre-filled flammable liquid fuel container."

3.1.2 *equivalence ratio, n*—the ratio of fuel concentration in the actual fuel-air mixture divided by the fuel concentration in a stoichiometric mixture.

3.1.3 *flame jetting, n*—phenomenon where an external ignition source causes a sudden ignition within a liquid container that directionally propels burning vapor and liquid from the mouth of the container.

3.1.3.1 *Discussion*—Flame jetting requires the burning vapor and liquid to travel a lengthy distance from the container, relative to the intended use and application. Often, flame jetting will occur when pouring from the container; in these situations flame jetting occurs only when the burning liquid and vapor are propelled reasonably beyond the pouring target. The presence of a small flame in the immediate vicinity of the mouth of the container is not considered flame jetting.

3.1.4 *flame mitigation device (FMD), n*—a device or feature attached to, installed in, or otherwise integral to, a container that is expected to inhibit the propagation of an external flame into the container.

3.1.4.1 *Discussion*—A flame arrester is a type of FMD that prevents the propagation of flame through quenching, or removal of heat from the flame. A flame arrester may be an assembly with multiple components used to both inhibit the propagation of the flame and to attach it to the container. Other examples of FMDs include, but are not limited to, expanded metal mesh, screens, bladders, pinhole restrictors, cap assemblies with small orifice spouts, and pumps.

3.1.5 *fundamental burning velocity, n*—the velocity of a laminar flame under stated conditions of composition, temperature, and pressure through a mixture of unburnt fuel and oxidizer gases.

3.1.6 *maximum experimental safe gap (MESG), n*—a standardized measurement of how easily a gas flame will pass through a narrow gap bordered by heat absorbing metal.

3.1.6.1 *Discussion*—Industry practice is to report MESG in millimeters (mm), therefore MESG is only reported in millimeters (mm) in this specification.

3.1.7 *removable spout, n*—a device included with the container that is intended and allows for the consumer can easily attach, remove, and reattach without the use of tools.

3.1.7.1 *Discussion*—While a removable spout is not required in order to pour liquid from a container, the spout will allow, when attached, flammable liquid to pass through it.

4. Significance and Use and Limitations

4.1 These test methods are intended to provide a challenge as severe as possible to FMDs made of polymers or other materials that have the potential to swell, melt, or self-close in some other fashion when exposed to direct flame impingement.

4.2 The endurance flame test required by 5.2 and described in Section 8 is intended to challenge the performance of such FMDs when exposed to sustained thermal exposures.

4.3 The flashback flame test required by 5.3 and described in Section 9 does not necessarily provide the most severe test to such FMDs. It is intended to challenge the performance of such FMDs.

4.4 *Hazards:*

4.4.1 The test methods in Sections 8 and 9 require exposure to open flames and pre-mixed flammable gases. Consider and address the inherent dangers of testing with open flames and the storage, handling, and transport of flammable gases.

4.4.2 Utilize appropriate personal protective equipment (PPE) as necessary. Appropriate PPE will potentially include gloves, glasses, safety shields, and respiratory equipment, as necessary to protect from exposure to flames, heat, smoke, and combustion products.

4.4.3 The test methods require controlled pre-mixing of flammable gas and air.

4.4.3.1 Control and port the gases separately from the supply to the container under test. Mix the flammable gas and air as close as possible to the inlet to the container to limit the potential for supply line flashback.

4.4.3.2 Use an inline flame arrester placed in the pre-mixed flow path to protect from potential flashback.

(1) Use caution when selecting an inline flame arrester to be certain that it provides sufficient protection for this application. Inline flame arresters intended for protection of gases with lower maximum experimental safe gap (MESG) than the test gas are sufficient for this purpose.

4.4.4 Separate the operator from the test apparatus by a rigid wall, window, or other separation.

4.4.5 The pre-mixed flammable gases will flow for an extended duration prior to ignition. Conduct the test in an area with sufficient ventilation to remove all flammable gases from the area while limiting direct air movement around the opening to the container. Compare the calculations of total gas flow rate made in accordance with Section 7 to the volume of the test area and the volumetric flow rate of the exhaust system to prevent hazardous buildup of flammable gases.

4.4.6 Internal ignition of the pre-mixed gases occurs if a flame penetrates a container. A means to vent the internal ignition is required in 6.1.1.4 with the intention of preventing

[3] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.