Designation: F3326 – 21

Standard Specification for Flame Mitigation Devices on Portable Fuel Containers[1]

This standard is issued under the fixed designation F3326; 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 flame mitigation devices (FMDs) in portable fuel containers (PFCs) for gasoline, kerosene, and diesel fuels intended for reuse by the consumer.

1.2 A flame mitigation device in gasoline (red), diesel (yellow), and kerosene (blue) PFCs protects the container openings from possible propagation of a flame into a flammable fuel-air mixture within the container. Formation of a flammable fuel-air mixture in the container can occur in special circumstances associated with cold ambient conditions and low liquid levels in the container. Delineations of those circumstances and conditions have been described in published reports, for example, Gardiner et al, 2010 (**1**),[2] and papers, for example, Elias et al, 2013 (**2**), including research sponsored and overseen by the ASTM F15.10 Technical Committee.

1.3 This specification does not address the hazard of injury or death caused by ignition of vapors external to the PFC when the fuel in the PFC is poured onto or near to a fire or other ignition source causing these external vapors to ignite or explode. An FMD does not prevent hazards associated with misuse of the PFC resulting in external vapor ignition.

1.4 The flame mitigation device is chemically conditioned by exposure to representative fuel surrogates CE25a and CE85a fuel and other expected conditions prior to the tests.

1.5 The flame mitigation device is mechanically conditioned by repeated insertions and removal of a fuel refueling spout prior to the tests.

1.6 The first test method establishes that the flame mitigation device can effectively prevent flame propagation into a flammable butane-air mixture inside the portable fuel container. The butane-air mixture is a controlled and repeatable proxy for the more variable fuel vapor-air mixture in the container.

1.7 The second test method establishes that the flame mitigation device is permitting adequate flow rates of fuel.

1.8 This specification states values in SI units which are to be regarded as the standard. The values given in parentheses are for information only.

1.9 *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.*

1.10 *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:*[3]

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

2.2 *Other Standards:*

NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas[4]

IEC 60079-20-1 Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data[5]

3. Terminology

3.1 Specification F852 is the reference for all portable fuel container specific terminology in this specification. Definitions may be presented in this section for convenience.

[1] This specification is under the jurisdiction of ASTM Committee F15 on Consumer Products and is the direct responsibility of Subcommittee F15.10 on Standards for Flammable Liquid Containers.

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[2] The boldface numbers in parentheses refer to a list of references at the end of this standard.

[3] 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.

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

[5] Available from International Electrotechnical Commission (IEC), 3, rue de Varembé, 1st Floor, P.O. Box 131, CH-1211, Geneva 20, Switzerland, http://www.iec.ch.

3.2 *Definitions:*

3.2.1 *flame mitigation device (FMD), n*—a device permanently installed in a PFC to prevent the propagation of an external ignition into the PFC.

3.2.2 *flame speed, n*—the average frame to frame measured speed of the flame in the first ¾ of the tube length.

3.2.3 *fuel, n*—a volatile mixture of liquid petroleum hydrocarbons distillates, and small amounts of additives, sometimes blended with ethanol or similar oxygenates, suitable for use as a fuel in spark-ignition, internal combustion gasoline engines), or bio diesel (for compression ignition in diesel engines).

3.2.4 *Maximum Experimental Safe Gap (MESG), n*—the maximum clearance between two parallel metal surfaces that has been found, under specified test conditions, to prevent a deflagration in a test chamber from being propagated to a secondary chamber containing the same gas or vapor at the same concentration (see IEC 60079-20-1).

3.2.5 *portable fuel container (PFC), n*—a single- or multi-compartment vessel intended for use by consumers to transport gasoline, gas/oil mixtures (or separate compartments of gas and oil), diesel, or kerosene from their distribution points to the consumer's storage and use points, including all of the components intended for use on or with the container including those supplied by manufacturers other than the PFC manufacturer.

4. FMD Requirements

4.1 *General Requirements:*

4.1.1 A flame mitigation device shall be provided in each PFC opening to protect the container opening(s) from possible propagation of a flame into a flammable fuel-air mixture within the container.

4.1.2 Due to the increased risk of static discharge with more conductive materials, a plastic PFC shall only contain FMDs composed of nonmetallic materials.

4.1.3 The PFC with the highest rated capacity up to 5 gal or 20 L of a family of similar design and construction shall be representative of all of the PFCs within that family with respect to this specification.

NOTE 1—The PFC with the highest rated capacity in the family may be used to certify all of the PFCs in the family.

NOTE 2—This FMD standard may be referenced for other container capacities and applications.

4.2 *FMD Effectiveness:*

4.2.1 When tested in accordance with 6.1, a PFC which has undergone test method 8.3 of Specification F852, Drop Strength Test using water only:

4.2.1.1 Shall not allow a flame to propagate into and ignite the headspace within the PFC with the pouring spout installed according to the manufacturer's instructions.

4.2.1.2 If the pouring spout is removable, shall not allow a flame to propagate into and ignite the headspace within the PFC with the pouring spout removed.

4.2.1.3 If there are separate openings for filling and pouring, shall not allow a flame to propagate into and ignite the headspace within the PFC through the filling opening.

4.2.2 When tested in accordance with 6.1, a PFC which has undergone test method 8.4 of Specification F852, Hydrostatic Pressure Test:

4.2.2.1 Shall not allow a flame to propagate into and ignite the headspace within the PFC with the pouring spout installed according to the manufacturer's instructions.

4.2.2.2 If the pouring spout is removable, shall not allow a flame to propagate into and ignite the headspace within the PFC with the pouring spout removed.

4.2.2.3 If there are separate openings for filling and pouring, shall not allow a flame to propagate into and ignite the headspace within the PFC through the filling opening.

4.2.3 When tested in accordance with 6.1, a new, unused PFC chemically conditioned in accordance to 5.1 using Standard Fuel CE25a, then mechanically conditioned in accordance to 5.2 and tested within 48 h of the chemical conditioning:

4.2.3.1 Shall not allow a flame to propagate into and ignite the headspace within the PFC over the course of five (5) successive tests within 8 h with the pouring spout installed according to the manufacturer's instructions.

4.2.3.2 If the pouring spout is removable, shall not allow a flame to propagate into and ignite the headspace within the PFC over the course of five (5) successive tests within 8 h with the pouring spout removed.

4.2.3.3 If there are separate openings for filling and pouring, shall not allow a flame to propagate into and ignite the headspace within the PFC through the filling opening over the course of five (5) successive tests within 8 h.

NOTE 3—It is permissible to use the same conditioned PFC as used in 4.3.1.

4.2.4 When tested in accordance with 6.1, a new, unused PFC chemically conditioned in accordance to 5.1 using Standard Fuel CE85a, then mechanically conditioned in accordance to 5.2 and tested within 48 h of the chemical conditioning:

4.2.4.1 Shall not allow a flame to propagate into and ignite the headspace within the PFC over the course of five (5) successive tests within 8 h with the pouring spout installed according to the manufacturer's instructions.

4.2.4.2 If the pouring spout is removable, shall not allow a flame to propagate into and ignite the headspace within the PFC over the course of five (5) successive tests within 8 h with the pouring spout removed.

4.2.4.3 If there are separate openings for filling and pouring, shall not allow a flame to propagate into and ignite the headspace within the PFC through the filling opening over the course of five (5) successive tests within 8 h.

NOTE 4—It is permissible to use the same conditioned PFC as used in 4.3.2.

4.3 *FMD Flow Resistance:*

4.3.1 A new, unused PFC chemically conditioned in accordance to 5.1 using Standard Fuel CE25a, then mechanically conditioned in accordance to 5.2:

4.3.1.1 When tested in accordance with 6.2.3 shall have a pour-in rate not less than 34 L/min (9 gal/min).

NOTE 5—It is permissible to use this conditioned PFC for 4.2.3.