United States
Consumer Product Safety Commission
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Memorandum

TO: The Commission
Alberta E. Mills, Secretary

DATE: May 11, 2022

THROUGH: Austin C. Schlick, General Counsel
Mary T. Boyle, Executive Director
DeWane Ray, Deputy Executive Director for Operations

FROM: Duane E. Boniface, Assistant Executive Director
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SUBJECT: Voluntary Standards Evaluation Under the Portable Fuel Container Safety Act of 2020

Executive Summary

The Portable Fuel Container Safety Act of 2020 (the Act), codified at 15 U.S.C. § 2056d, requires the U.S. Consumer Product Safety Commission (Commission or CPSC) to promulgate a final rule requiring flame mitigation devices (FMDs) on portable fuel containers by June 27, 2023, unless the Commission determines that the existing voluntary standards have requirements for FMDs for certain classes of portable fuel containers that impede the propagation of flames into the container.

This memorandum provides background regarding the product hazard and the existing voluntary standards for portable fuel containers. It also provides the staff assessment and recommendation that the Commission determine the existing voluntary standards for portable fuel containers meet the requirements of the Act for an exception to the rulemaking requirement. Staff also recommends publication in the *Federal Register* of the Commission's determination that the voluntary standards meet the requirements of the Act for an exception to the rulemaking requirement.

Background

The Act is codified at 15 U.S.C. § 2056d and requires the Commission to promulgate a final rule to require flame mitigation devices on portable fuel containers by June 27, 2023. The Act provides an exception to this requirement if the Commission determines that an existing voluntary standard for a class of portable fuel containers has requirements for flame mitigation devices for containers that impede the propagation of flames into the container.

The term "flame mitigation device" is not defined by the Act. However, staff concludes that ASTM F3429, *Standard Specification for Flame Mitigation Devices Installed in Disposable and Pre-Filled Flammable Liquid Containers,* which defines a "flame mitigation device" as "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," provides a definition consistent with congressional intent. A common type of flame mitigation device used with portable fuel containers is a flame arrestor (also known as flame arrester or flash arresting screen). A flame arrestor is a screen that quenches and cools a flame so that it cannot pass through the flame arrestor. Other examples of flame mitigation devices include expanded metal mesh, bladders, and pumps.

Over several years of research, collaboration with varied stakeholders, and experimentation, CPSC staff has gained substantial experience with approaches addressing flame-jetting hazards.

- CPSC staff first became involved with addressing flame jetting as part of the ASTM F15.10 subcommittee on portable fuel containers. In **2007**, the subcommittee decided to start researching FMDs.
- In **2011**, CPSC became aware of a then-emerging, flame-jetting hazard involving firepots, a new decorative outdoor lighting product on the market. Firepots typically used an ethanol-based gel fuel, which came in a plastic bottle for fueling and refueling. These products were highly susceptible to flame jetting. Figure 1 shows an image from a video by CPSC staff demonstrating this hazard.
- In **2017**, CPSC staff worked with the National Fire Protection Association (NFPA), American Chemistry Society (ACS), National Science Teachers Association (NSTA), US Chemical Safety Board and Hazardous Investigation Board (CSB), US Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), Portable Fuel Container Manufacturers Association (PFCMA), Fairfax County (Virginia) Fire Department, ASTM F15, and others, to discuss flame jetting and ways to improve awareness of the hazard. In **2021**, UL, LLC asked CPSC staff participate in developing the next edition of UL 30, specifically due to our knowledge of fire safety, the flame-jetting phenomenon, and FMDs.

Figure 1- Image from CPSC video demonstrating the hazard of flame jetting with gelled alcohol fuels, 2011.

In addition to these efforts by CPSC staff, in January **2021,** Health Canada issued a "Notice to Interested Parties" determining that pourable alcohol-based fuels that do not meet ASTM F3429 pose a danger to human health and safety. This notice prohibits the manufacture, importation, advertisement, and sale of pourable alcohol-based fuel containers in Canada that do not conform to ASTM F3429.

Statutory Definition of "Portable Fuel Container"

A "portable fuel container" is defined by 15 U.S.C. § 2056d(b)(8) as: "any container or vessel (including any spout, cap, and other closure mechanism or component of such container or vessel or any retrofit or aftermarket spout or component intended or reasonably anticipated for such use with such container)," that is

- "intended for flammable liquid fuels with a flash point less than 140 degrees Fahrenheit, including gasoline, kerosene, diesel, ethanol, methanol, denatured alcohol, or biofuels";
- "a consumer product with a capacity of five gallons or less"; and
- a container "that the manufacturer knows or reasonably should know is used by consumers for transporting, storing, and dispensing flammable liquid fuels."

Some examples of portable fuel containers include portable gasoline containers (*e.g.* gas cans) and containers for cigarette lighter fluid, charcoal lighter fluid, and liquid fireplace fuel (such as firepot fuel). Products that store substances such as liquified petroleum gas (LP-gas, commonly called "propane") are not within scope of the statutory definition of "portable fuel containers" because these substances are only liquid at high pressure and when exposed to ambient conditions readily vaporize.

Flame Jetting Hazard

The principal hazards that flame mitigation devices protect against are flame jetting and container rupturing. "Flame jetting," as defined in ASTM F3429, is a "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." Container rupturing is similar to flame jetting, except the burning vapor and liquid exit through a rupture in the container. The injury potential associated with each hazard is the same, severe burns and possible death. Flame jetting typically injures people away from the person holding the container, while container rupturing typically injures the person holding the container. Burning liquid from flame jetting generally travels further from the container than when the container ruptures. For the purposes of this memorandum, references to flame jetting also include container rupturing.

Rulemaking Requirement

As noted, the Act requires the Commission to promulgate a final rule requiring flame mitigation devices in portable fuel containers that impede the propagation of flame into the container within 30 months of December 27, 2020, unless the requirements for an exception under section 2056d(b)(3) are met. 15 U.S.C. § 2056d(b)(1). If the requirements of this exception are not met, then a final rule must be promulgated in accordance with section 553 of the Administrative Procedure Act. 15 U.S.C. § 2056d(b)(2)(A).

Voluntary Standard Exception

Rulemaking is not required for any class of portable fuel containers if the Commission determines that an existing voluntary standard has requirements for flame mitigation devices that impede the propagation of flame into the container. 15 U.S.C. § 2056d(b)(3). Specifically, the Commission may rely on voluntary standards instead of the required rulemaking for a class of portable fuel containers within the scope of the Act, if the following requirements are met:

- There is a voluntary standard for flame mitigation devices for containers that impede the propagation of flame into the container;
- The voluntary standard is or will be in effect not later than 18 months (June 27, 2022) after the date of enactment of the Act; and
- The voluntary standard is developed by ASTM International, or such other standard development organization that the Commission determines to have met the intent of this Act.

The Act states that if the Commission determines that a voluntary standard meets the conditions described above, then the requirements of such voluntary standard shall be treated as a consumer product safety rule promulgated under section 9 of the Consumer Product Safety Act (15 U.S.C. § 2058) beginning on the date which is the later of 180 days after publication of the Commission's determination, or the effective date contained in the voluntary standard. 15 U.S.C. § 2056d(b)(4). The Commission must publish any determination regarding a voluntary standard exception in the *Federal Register.*

In sum, if the Commission determines that the relevant voluntary standards meet the statutory requirements for an exception, the voluntary standards determinations would be considered mandatory standards 180 days after the publication in the *Federal Register* required by the statute. Staff actively participated in the development of voluntary standard requirements for flame mitigation devices and has concluded that three existing voluntary standards meet the voluntary standard exception requirement, as discussed below.

Classes of Portable Fuel Containers

The Act allows the Commission to separate portable fuel containers into different classes, 15 U.S.C. § 2056d(b)(3). Staff evaluated the specifications for many portable fuel containers and recommends separating portable fuel containers into two classes, containers sold *pre-filled* and containers sold *empty*.

Containers Sold Pre-Filled

Containers sold pre-filled are likely to be discarded by the consumer once the contents (the flammable liquid fuel) are completely used; whereas, containers sold empty are specifically designed to be reused many times. Pre-filled containers and empty containers are used differently and have different product lifespans. The differences also mean that the flame mitigation devices will be subjected to different conditions that can affect performance over time, and therefore requirements differ for pre-filled and empty containers. For example, pre-filled containers, such as those used for charcoal lighter fluid, can be squeezed easily, and therefore, are likely to create a larger vacuum force pulling external flames into the container.

Containers Sold Empty

Empty containers, such as gas cans, for example, are designed to receive a gasoline service station pump for transfer later into a fuel-powered product, such as a lawnmower. They are designed to be used in this manner many times and to hold flammable liquids for long periods of time, over large temperature variations.

Staff has also identified a subclass of empty containers, *safety cans*. Safety cans are portable fuel containers sold empty that the U.S. Occupational Safety and Health Administration (OSHA) regulates for use in the workplace. OSHA requires spring-loaded or self-closing openings and flash-arresting screens on safety cans, 29 CFR § 1926.155(l). OSHA also requires that safety

cans be approved by a nationally recognized testing laboratory (NRTL), 29 CFR § 1926.155(a). The OSHA requirements do not specify to which standard the NRTL must test the safety can. Safety cans tend to be more expensive than typical gas cans but are available for purchase by consumers at many physical and online retailers. Staff considers the generally accepted definition of a "safety can" to be a container that meets the OSHA requirements.

Voluntary Standards

There are three voluntary standards that pertain to the elements in the Act, for which staff actively provided support during their development (see Appendix A for details). The three standards are discussed below:

ASTM F3429 - Pre-Filled Portable Fuel Containers

Portable fuel containers sold pre-filled are within the scope of ASTM F3429, *Standard Specification for Performance of Flame Mitigation Devices Installed in Disposable and Pre-Filled Flammable Liquid Containers*. This standard was initially published in 2020 and has been in effect since September 2020. The standard was developed by the ASTM F15.72 subcommittee for Pre-Filled Containers of Flammable and Combustible Liquids. CPSC staff chaired the task group that developed the standard. The standard requires two performance tests of the container's flame mitigation devices. The first test is an endurance test, in which the container is subjected to an external and stationary 2.5-inch flame at the mouth of the container for 30 seconds. The second test is a flashback test, in which the container is subjected to an external flash fire near the container mouth. The container passes each test if the interior contents of the container do not catch fire or otherwise ignite in each of five consecutive trials. The two tests demonstrate that the flame mitigation device impedes the propagation of two different types of ignition sources, a stationary flame and a moving flame front. ASTM lists the standard as a dual standard in both metric (F3429M designation) and inch-pound (F3429 designation) units. ASTM F3429-20 and ASTM F3429M-20 are the current versions of the standard. Staff concludes that ASTM F3429/F3429M-20 effectively addresses the flame-jetting hazard for pre-filled portable fuel containers.

ASTM F3326 - Empty Portable Fuel Containers

Portable fuel containers sold empty, for general consumer use, are within the scope of ASTM F3326, *Standard Specification for Flame Mitigation Devices on Portable Fuel Containers*. It should be noted that "Portable Fuel Container" in the title of ASTM F3326 refers to containers that meet the scope of ASTM F852, *Standard Specification for Portable Gasoline, Kerosene, and Diesel Containers for Consumer Use*. Both standards are under the jurisdiction of the ASTM F15.10 subcommittee for Flammable Liquid Containers. ASTM F3326 was initially published in 2019 and has been in effect since March 2019. CPSC staff actively participated in developing ASTM F3326. The standard requires a performance test of the container's flame mitigation devices after the container is exposed to several use-and-abuse tests. The use-and-

abuse tests are designed to ensure an aged flame mitigation device still functions. The flame mitigation device performance test demonstrates that the container prevents a flame traveling at 5 m/s from igniting the contents of the container in each of five consecutive trials. The test also demonstrates that the flame mitigation device impedes the propagation of rapidly travelling flame front into the container. ASTM F3326-21 is the current version of the standard. Staff concludes that ASTM F3326-21 effectively addresses the flame-jetting hazard of empty portable fuel containers.

UL 30 for Safety Cans

Portable fuel containers that are sold empty and meet the U.S. OSHA requirements for safety cans are within the scope of ANSI/CANUL/ULC 30:2022, *Standard for Safety Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids* (herein referred to as UL 30:2022). UL 30:2022 is a voluntary standard that covers various requirements for safety cans, including requirements for flame mitigation devices. The standard is under the jurisdiction of UL Standard Technical Panel (STP) 30. The current version of the standard, UL 30:2022 was published in 2022, and it has been in effect since April 29, 2022. Section 18 of UL 30:2022 covers the performance requirements for flame mitigation devices and features. CPSC staff was active in the development of section 18. Section 18 has two performance test options. The first option is to subject the safety can mouth to an external and stationary 2.5-inch flame for 30 seconds. The safety can passes this test if the interior content of the safety can does not catch fire or otherwise ignite in each of five consecutive trials. The second performance test option is used for safety cans that use a flame arrestor. In this performance test, a 7.5-inch flame is balanced on one side of the flame arrestor as a fuel-air mixture passes through. The flame arrestor fails if the flame crosses the flame arrestor and ignites the fuel-air mixture. This is a common performance test for flame arrestors used in industrial process applications. Staff believes that compliance to section 18 of UL 30:2022 would meet the OSHA requirement for a "flash arresting screen." 29 CFR § 1926.155(l). UL 30:2022, is the current version of the standard. Staff concludes that UL 30:2022 effectively addresses the flame-jetting hazard for safety cans.

Staff Recommendations

Staff recommends that the Commission determine that three voluntary standards for two classes of portable fuel containers, containers sold pre-filled, and containers sold empty (including safety cans), meet the requirements of the Act for an exception to the rulemaking requirement because thee voluntary standards require flame mitigation devices in portable fuel containers that impede the propagation of flame into the container.

Staff Recommendation for Voluntary Standard for Pre-Filled Portable Fuel Containers

Staff recommends that the Commission determine that ASTM F3429-20/F3429M-20 for containers sold pre-filled meets the requirements of the Act. Staff concludes that ASTM F3429-20 and ASTM F3429M-20 meet the requirements of the Act's exception to rulemaking because they contain sufficient performance requirements for flame mitigation devices in portable fuel containers that impede the propagation of flame into the container. The standards were in effect before June 27, 2022, and they were developed by ASTM International.

Staff Recommendation for Voluntary Standard for Empty Portable Fuel Containers

Staff recommends that the Commission determine that ASTM F3326-21 for containers sold empty meets the requirements of the Act. Staff concludes that ASTM F3326-21 meets the requirements of the Act for an exception to rulemaking because it contains a sufficient performance requirement for flame mitigation devices in portable fuel containers that impede the propagation of flame into the container. The standard was in effect before June 27, 2022, and it was developed by ASTM International.

Staff Recommendation for Voluntary Standard for Safety Cans

Staff recommends that the Commission determine that UL 30:2022 for safety cans meets the requirements of the Act for flame mitigation devices in portable fuel containers that impede the propagation of flame into the container. Staff concludes that section 18 of UL 30:2022 meets the requirements of the Act because it contains a sufficient performance requirement for flame mitigation devices in portable fuel containers that impede the propagation of flame into the container. The standard was in effect before June 27, 2022, and it was developed by Underwriters Laboratories (UL), which, like ASTM International, is an American National Standard Institute (ANSI) accredited standards developer.

Staff Recommendation for Publication of Federal Register Notice

If the Commission determines that the three voluntary standards discussed above meet the statutory requirements for flame mitigation devices in portable fuel containers that impede the propagation of flame into the container, the Act requires the Commission to publish notice in the *Federal Register* regarding any such determination. Staff recommends that the Commission determine that the three voluntary standards discussed above meet the requirements of the Act regarding flame mitigation. Staff also recommends that the Commission publish these findings in a *Federal Register* notice.

Public Access to the Voluntary Standards

These standards are available to the public for review, free of charge.

For free-of-charge online, read-only online access to ASTM F3429-20/F3429M-20:

1. Access ASTM's CPSC reading room at: http://www.astm.org/cpsc.htm.
2. Search for ASTM F3429.
   Note: In the future, read-only access to the standard may move to ASTM's Reading Room at: https://www.astm.org/products-services/reading-room.html.

For free-of-charge, read-only online access to ASTM F3326-21:

1. Access ASTM's CPSC reading room at: http://www.astm.org/cpsc.htm.
2. Search for ASTM F3326.
   Note: in the future, read-only access to the standard may move to ASTM's Reading Room at: https://www.astm.org/products-services/reading-room.html.

For free-of-charge, read-only online access to ANSI/CAN/UL/ULC 30:2022:

1. Access UL's Standards Sale Site at: http://shopulstandards.com.
2. Click "Browse and Buy Standards," and search for UL 30.
3. Click "Digital View," and sign in, or create a user account.

ASTM F3429-20/F3429M-20, ASTM F3326-21, and ANSI/CAN/UL/ULC 30:2022 are available to review in person at CPSC offices, 4330 East West Highway, Bethesda, Maryland 20814.

Appendix A – Summary of Voluntary Standards

ASTM F3326, *Standard Specification for Flame Mitigation Devices on Portable Fuel Containers*, was first published in 2019, and subsequently revised in 2019 and 2021. The ASTM subcommittee began developing this test method in 2008. CPSC staff has actively participated in the subcommittee while the subcommittee reviewed the test method development from 2008 to 2016. This test method uses a premixed, fuel-air mixture inside the container and outside the nozzle in an enclosed cylinder. The fuel-air mixture is ignited outside the nozzle, creating a deflagration-type flame front and pressure front. The flame front is designed to reach the FMD at a speed of 5 m/s. This speed challenges a quenching type of FMD, by significantly reducing the interaction time that the FMD material interacts with the flame and gas. Additionally, the pressure wave requires the FMD to be securely attached to the container. If the FMD dislodges from the pressure wave, it would allow the flame to penetrate into the container. This standard also requires a permanency test devised by CPSC staff; the FMD must withstand both a pushing and pulling force of 15 lb. This ensures that a consumer that does not know whether the FMD should be there, cannot easily remove the FMD without the use of tools. Figure 2 illustrates a diagram of how ASTM F3326 is conducted.

ASTM F3429, *Standard Specification for Performance of Flame Mitigation Devices Installed in Disposable and Pre-Filled Flammable Liquid Containers*, was first published in 2020, and it has not been revised by ASTM. Research to develop a performance standard began from a CPSC-funded contract awarded in September 2016. The ASTM subcommittee began reviewing the CPSC contractor work in 2018. The subcommittee expressed concerns that the development work lacked an analysis of the effect of squeezing. The subcommittee concluded that disposable, pre-filled plastic bottles are more likely to be squeezed than gasoline containers because of the materials used and the size of the containers. In September 2018, CPSC funded a second contract to study this effect. The subcommittee reached consensus on a performance requirement based on an FMD endurance test method in 2019, and it added a second, based on an FMD flashback test method in 2020 to address the specific scenario of some plastics swelling in the presence of heat. In the FMD endurance test, the container with a fuel-air mixture is mounted with the mouth positioned at a downward 45-degree angle, illustrated in Figure 3. A 2.5-inch flame is then applied to the mouth of the container for 30 seconds; the container passes if the fuel inside of the container does not ignite. In the FMD flashback test, a thin-walled plastic tube is attached to the container with a fuel-air mixture, illustrated in Figure 4. The tube is ignited away from the container and allowed to burn towards the container; the container passes if the fuel inside of the container does not ignite.

UL 30:2022, *Standard for Safety Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids*, includes two performance-based test options for FMDs. The first is a flame arrestor-specific test based on established industrial test methods for flame arrestors.

Flame arrestors are frequently used in industrial applications and this test method mirrors the methods used to test flame arrestors in those applications. Figure 5 shows one such flame arrestor. In this test, a 7.5-inch flame is balanced on the down flow side of the flame arrestor. The flame arrestor passes if the flame does not cross the flame arrestor and does not ignite the fuel-air mixture upstream of the flame arrestor within 1 minute. This test does not test the flame arrestor while attached to the safety can.

The second test is based on the ASTM F3429 FMD endurance test procedure for FMDs in general; this test was developed under a CPSC contract. The safety can, with a fuel-air mixture, is mounted with the mouth positioned at a downward 45-degree angle, illustrated in Figure 6. A 2.5-inch flame is then applied to the mouth of the container for 30 seconds. The safety can passes the test if the fuel inside of the container does not ignite. This test would work for a variety of flame arrestors. The FMD flashback test was not needed because safety can FMDs are metal and do not swell like plastic FMDs typically used on gas cans and prefilled containers. This test is performed with the FMDs installed on the container. The CPSC contractor verified effective equivalency of the two test methods: a flame arrestor with a slightly larger hole size fails both tests; whereas, a flame arrestor with a slightly smaller hole size passes both tests.

CPSC technical staff concludes that all three voluntary standards provide effective assurance that flame mitigation devices on portable fuel containers will prevent flame jetting when dispensing near ignition sources.

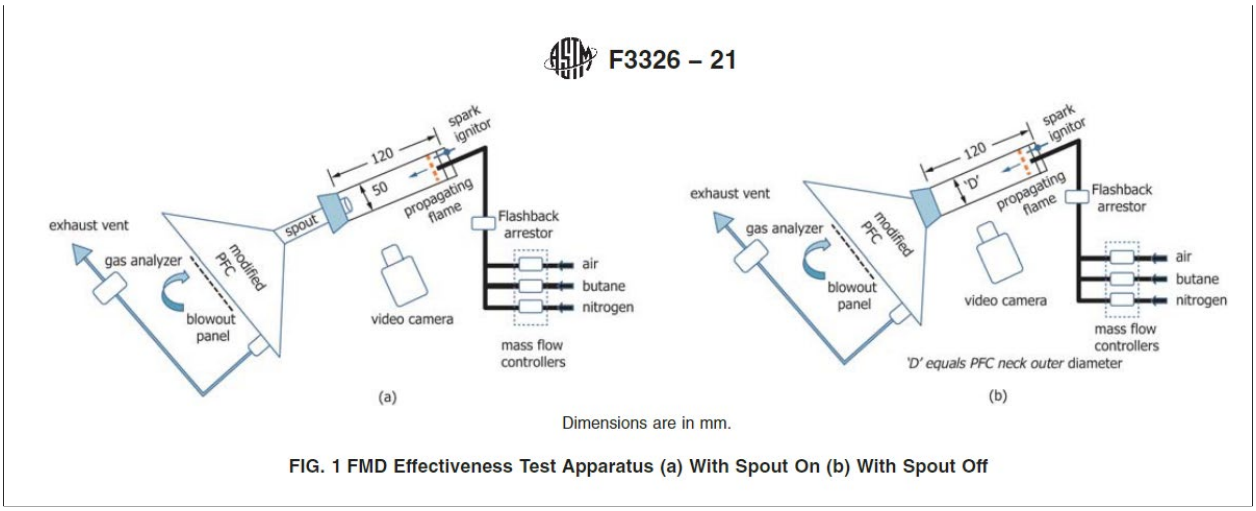

Figure 2- ASTM F3326 Test set-up diagram (Reprinted, with permission, from ASTM F3326-21 Standard Specification for Flame Mitigation Devices on Portable Fuel Containers, *copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org).*

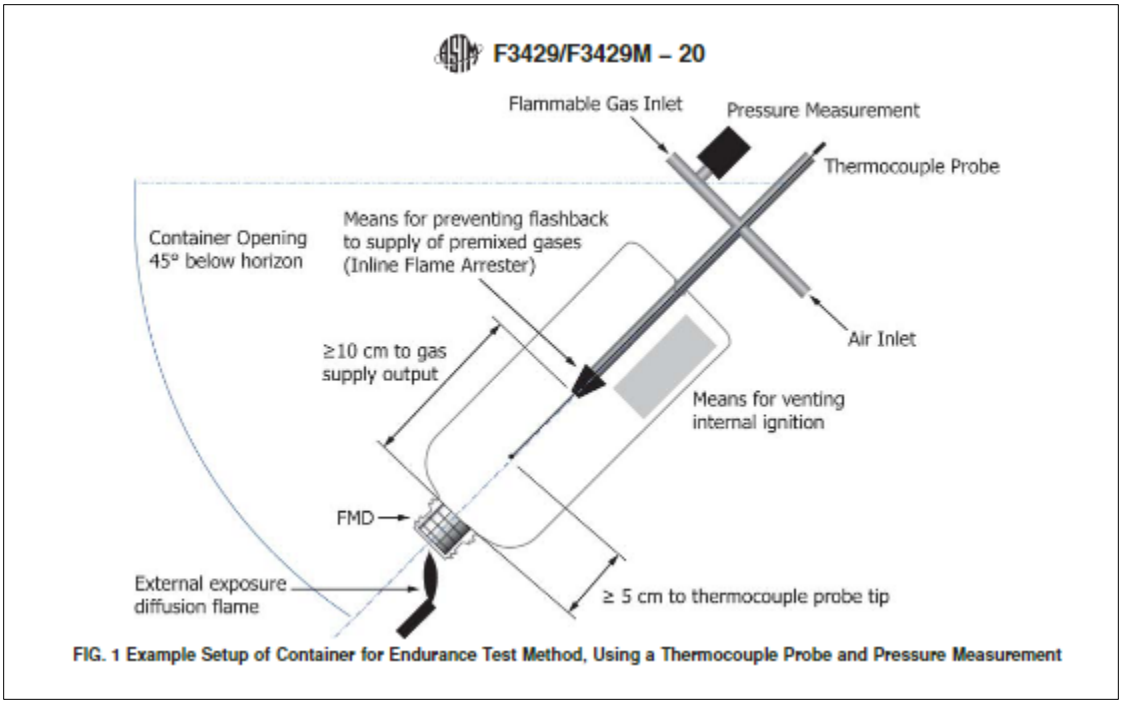

Figure 3- ASTM F3429 Endurance Test se-tup diagram (Reprinted, with permission, from ASTM F3429/F3429M-20 Standard Specification for Performance of Flame Mitigation Devices Installed in Disposable and Pre-Filled Flammable Liquid Containers, *copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org).*

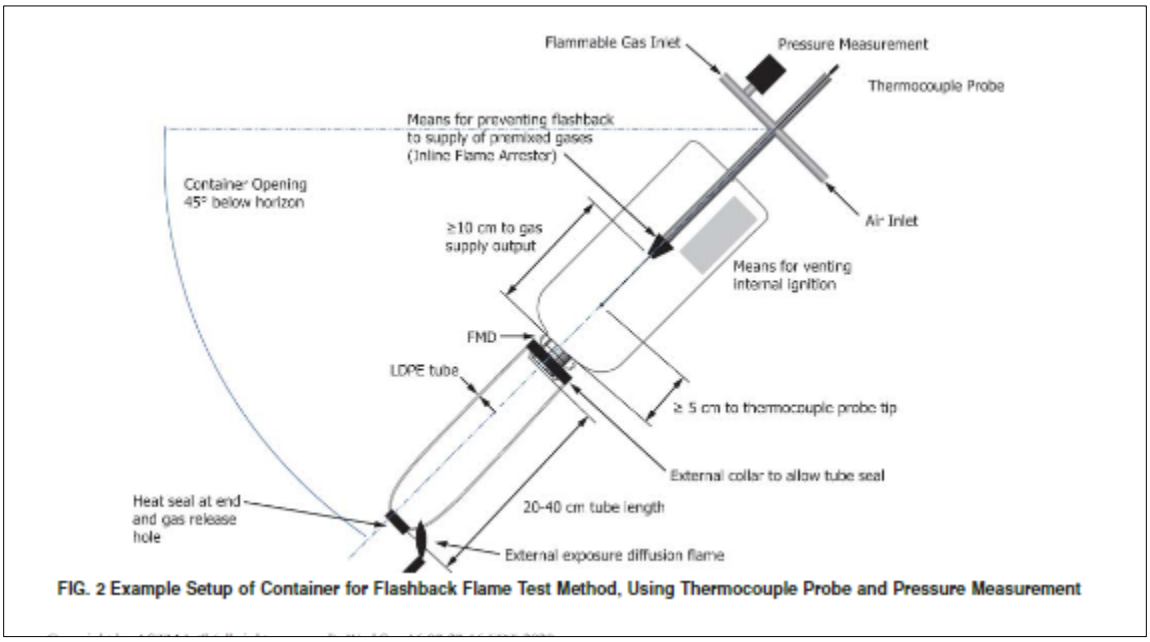

Figure 4 - ASTM F3429 Flashback Test set-up diagram (Reprinted, with permission, from ASTM F3429-20/F3429M-20 Standard Specification for Performance of Flame Mitigation Devices Installed in Disposable and Pre-Filled Flammable Liquid Containers, *copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org).*

Figure 5 - UL 30 Flame Arrestor Test picture (From ANSI/CAN/UL/ULC 30:2022, Standard for Safety Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids, *Figure 18.4 Example of Correct Stoichiometric Flame. Copyright ULS Inc. 2022).*

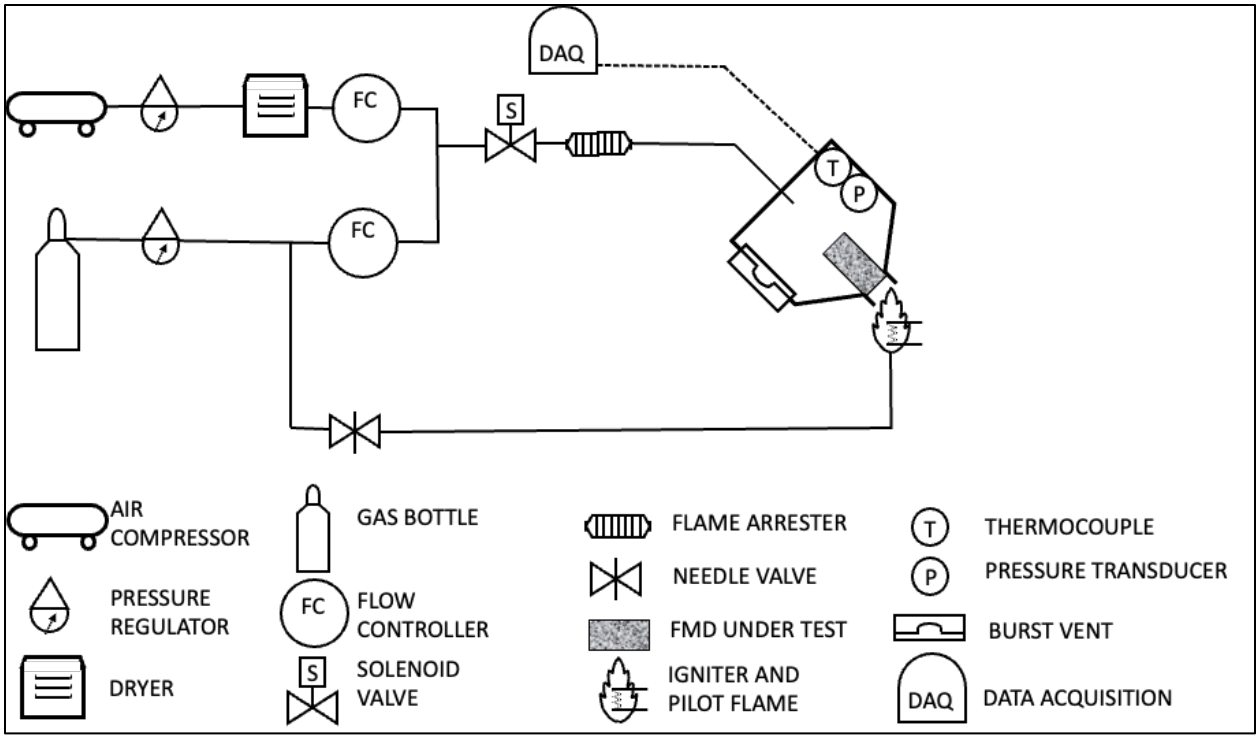

Figure 6 - UL 30 Generic FMD test set-up diagram (from UL 30 - UL 30 Generic FMD test set up diagram (From ANSI/CAN/UL/ULC 30:2022, Standard for Safety Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids, *Figure 18.2 Example of Set Up Using Compressed Air, and Ethane Gas from a Bottle, a Data Acquisition System, a Thermocouple, a Pressure Transducer, a Solenoid Valve, and a Needle Valve, to Test a Safety Can Without a Spout. Copyright ULS Inc. 2022).*