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Standard Specification for Determination of Child Resistance of Portable Fuel Containers for Consumer Use[1]

This standard is issued under the fixed designation F2517; 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.

ε[1] NOTE—Subsections 5.6.3, 5.6.10, 5.6.12, and X3.1 were corrected editorially in August 2022.

1. Scope

1.1 This specification establishes recognized requirements for determining the child resistance of portable fuel containers (PFCs) and other types of portable containers intended for use by consumers to hold, store, and transport liquid fuels such as gasoline, kerosene, and diesel.

1.1.1 "Portable Fuel Container" is defined in Specification F852 and includes the receptacle for gasoline, kerosene, or diesel fuel as well as spouts, caps, and other closure mechanisms and components for use with or on portable gasoline, kerosene, or diesel receptacles.

1.1.2 This specification is also applicable to spouts, caps, or other closure mechanisms sold separately for use with or on a fuel container.

1.1.3 This specification does not cover one-time use portable emergency fuel containers conforming to Specification F2874.

1.2 This standard addresses the effectiveness of the child resistance (CR) device only after closure cycling, but does not address closure effectiveness:

1.2.1 When at high or low temperatures,

1.2.2 After thermal aging of polymers,

1.2.3 After exposure to sunlight,

1.2.4 After exposure to intended fuels, and

1.2.5 After physical abuses, such as drops or impacts.

NOTE 1—Please see Appendix X2 for additional information on these exemptions.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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.*

1.5 *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]

D3475 Classification of Child-Resistant Packages

F852 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

2.2 *CSA Standards:*[3]

B376 Portable containers for gasoline and other petroleum fuels

3. Terminology

3.1 *Definitions:*

3.1.1 *dispensing system, n*—a component, or a combination of components, used for dispensing fuel from a container.

3.1.2 *closure, n*—any combination of components, including dispensing system components, that functionally seal any intended opening and prevents the stored fuel or its vapors from escaping during transportation and storage.

3.1.3 *filling opening, n*—opening intended to be used for the addition of fuel to the container which may also be the same opening used for dispensing fuel.

3.1.4 *portable fuel container (PFC), n*—a single or multi-compartment vessel intended for use by consumers to transport

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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 Canadian Standards Association (CSA), 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada, http://www.csagroup.org.

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 vessel including those supplied by manufacturers other than the PFC manufacturer.

4. Requirements

4.1 *General Requirements:*

4.1.1 Containers that share similar designs but vary in only color or size, up to a maximum of 32 L (8.45 U.S. gal) rated capacity, shall be considered a container family.

NOTE 2—Aspects which should be common in a container family include similar positioning of child resistance features on the receptacle, design of the child resistance features, gasket material and design and specification of O-rings and seals.

4.1.2 *Test Articles*—Child resistance testing in accordance with Section 5 shall be performed using the smallest container size of the container family and adult use testing in accordance with Section 6 shall be performed using the largest container size of the container family. Test articles shall be new containers and each test article may be used for testing up to five (5) panel participants. Test articles shall be handled so that no damage or jarring will occur during storage or transportation and shall be at room temperature (23 °C ± 3 °C (73.4 °F ± 5.4 °F) when testing is performed.

4.1.3 *Aftermarket Parts*—Spouts, caps, or other closure mechanisms or components sold separately for use with or on a container shall be demonstrated to comply with this specification for each container or container family for which the parts are identified as compatible.

4.2 *Child Resistance Requirements:*

4.2.1 *Without Demonstration*—Container closures shall achieve not less than 85 % child resistance effectiveness when tested in accordance with Section 5 in the first 5-min test period preceding the demonstration of the proper means of opening the designated closure.

4.2.2 *With Demonstration*—Container closures shall achieve no less than 80 % child resistance effectiveness when tested in accordance with Section 5 in the second 5-min test period following the demonstration of the proper means of opening the designated closure.

4.3 *Adult Functional Requirement*—Containers shall have an adult-use effectiveness (AUE) of not less than 90 % for the adult panel test of Section 6.

5. Child Resistance Test Procedure

5.1 *General:*

5.1.1 *Child Resistance Test Parameters:*

5.1.1.1 Test each child resistance feature using a panel of at least 50 children and up to 200 children.

5.1.1.2 Test containers with multiple child resistance features with each feature accessible at the same time as would be the likely scenario that a child would encounter the container.

5.1.1.3 Test with a child panel for each configuration of the container for those containers where the configuration intended for storage and transportation is different from the configuration for dispensing (for example, when the spout is stored under the filling opening closure and attached for pouring). If the CR feature (for example, the filling opening closure) is the same for both configurations, then test the filling opening closure in the configuration intended for transportation and storage and the dispensing system in the configuration for dispensing.

5.1.2 *Test Environment:*

5.1.2.1 Conduct the testing in a location that is familiar to the children, for example their customary nursery school. Alternatively, conduct the testing at a central location after making the children comfortable in that location.

5.1.2.2 Conduct the testing in a test area that is well-lit and where the children are isolated from all distractions.

5.1.2.3 An individual tester shall not conduct testing with more than 30 % of the of the child test panel.

5.1.2.4 Record all data, except the timing of the testing, before or after the conduct of the test to allow the tester's full attention to be on the children during the test period.

5.2 *Child Resistance Test Panel:*

5.2.1 Use from 1 to 4 groups of 50 children, as required under the sequential testing criteria in Table 1.

5.2.2 Document consent for each child participating in the testing, at the child or site level. If the testing is conducted at a central location, a consent form (Appendix X4) shall be completed for each child participating in the testing.

5.2.3 Ensure the geographical diversity of the panel participants using one of the following criteria:

5.2.3.1 Test no more than 20 % of child test panel participants at a single site.

5.2.3.2 Select no more than 20 % of the child test panel participants from a single geographical indicator (such as zip code, postal code, city or town) if testing is conducted at a central location.

5.2.4 Select each group of children to meet the following criteria:

(a) Select children without an obvious or overt physical or mental disability.

(b) Test with 30 % of the children in each group between the ages of 42 to 44 months.

TABLE 1 Number of Test Failures

Test Panel	Cumulative Number of Children	Test Failures					
		First 5 min			Full 10 min		
		Pass	Continue	Fail	Pass	Continue	Fail
1	50	0 – 3	1 – 10	11+	0 – 5	6 – 14	15+
2	100	4 – 10	11 – 18	19+	6 – 15	16 – 24	25+
3	150	11 – 18	19 – 25	26+	16 – 25	26 – 34	35+
4	200	19 – 30	...	31+	26 – 40	...	41+

(c) Test with 40 % of the children in each group between the ages of 45 to 48 months.

(d) Test with 30 % of the children in each group between the ages of 49 to 51 months.

(e) The difference between the number of boys and the number of girls in each age range shall not exceed 10 % of the number of children in that range.

5.2.4.1 Calculate the age of each child as described in Appendix X5.

5.2.5 Ensure that the panel participants are not offered a reward or led to believe that a reward will be provided.

5.3 *Test Article Preparation:*

5.3.1 Fill each test article to between 15 % and 35 % of its rated capacity with water, secure the closures, and invert to check for leakage. If leakage occurs, the closures may be resecured and the test repeated. Do not conduct testing with containers that exhibit leakage.

5.3.2 Empty each test article and condition it as follows:

5.3.2.1 *Low-temperature Exposure*—Soak continuously at 0 °F (–17.8 °C) for 8 h.

5.3.2.2 *Elevated Temperature Exposure*—Soak continuously at 140 °F (60 °C) for 8 h.

5.3.2.3 *Closure Cycling*—Open and close each 250 times.

5.3.3 Fill each test article to between 15 % and 35 % of its rated capacity with water, secure the closures, and invert to check for leakage. If leakage occurs, the closures may be resecured and the test repeated. Do not conduct testing with containers that exhibit leakage.

5.4 *Child-Resistance Sequential Test Procedure:*

5.4.1 *Sequential Test*—Groups of 50 children are tested sequentially, up to a maximum of 200 children, to establish that the child-resistance requirements (4.2) are met with high certainty. Testing is continued with a new group when the number of test failures observed during the testing in accordance with 5.5 fall in the 'continue' range of values in Table 1. When the cumulative number of test failures in the first 5 min of testing is below the values given in the inconclusive range in Table 1, the container has shown 85 % child resistance effectiveness without demonstration. When the cumulative number of test failures in the full ten minutes below the values given in the inconclusive range in Table 1, the container has shown 80 % child resistance effectiveness with demonstration.

5.4.2 *Child Resistance Test Failure*—A test failure occurs when the child accesses the liquid from any closure, regardless of which closure was designated and demonstrated. For closures that close automatically, access means dispensing liquid. For closures that do not close automatically, access means opening the closure.

5.4.3 Eliminate the pair of children from the test results if a test has been stopped due to a risk of danger (per 5.6.7).

5.4.4 Include the tests result of a child who has refused to participate (per 5.6.8).

5.5 *Test Procedures:*

5.5.1 Test the children in pairs following the child test instructions in 5.6. Test no more than 2 closures, which must have a different functional design and be on a different type of container. Present each container to the paired children in random order and record the order.

NOTE 3—Refer to Classification D3475 for guidance on functional design of CR closures.

5.5.2 Use a timing device (such as a stopwatch) to time the number of seconds it takes the child to open the container and to time the 5-min test periods.

5.6 *Child Test Instructions:*

5.6.1 Escort the pair of children to be tested to the test area and have the tester seat the children on the ground with no visual barrier between the children and the tester.

5.6.2 Have the tester talk to the children to make them feel at ease. Avoid giving the children the impression that they are in a race or contest or that the test is a game or that it is fun.

5.6.3 Begin the first 5 min test period by handing each child an identical test article and indicating by gesture which closure is the designated closure for this test. Say, "Please try to open this for me" or "Please try to get the liquid out."

5.6.4 If a child opens or unlocks any of the child resistance features, or otherwise accesses the liquid in the container (see 5.4.2), thank the child, take the test article from the child, and place it out of reach. Do not ask the child to open the test article a second time or open any other closure on the test article.

5.6.5 Allow the children freedom of movement during the test as long as the tester can watch both children (for example, they can stand up, get down on the floor, or bang or pry the package) and to talk to each other during, and watch each other performing, the test.

5.6.6 Do not allow a child to try to open the other child's test article.

5.6.7 Stop the test if a child is endangering himself or others at any time.

5.6.8 Reassure and gently encourage a child who refuses to participate after the test has started. Ask the child to hold the test article in his/her lap until the other child is finished if the child continues to refuse.

5.6.9 Minimize conversation with the children as long as they continue to attempt to open their test articles. Avoid discouraging the children verbally or with facial expressions.

5.6.10 Reassure and gently encourage the child to keep trying (for example, "Please keep trying to open this for me" or "Please keep trying to get the liquid out.") if a child gets frustrated or bored and stops trying to open his/her test article.

5.6.11 After 5 min has elapsed, ask the children to set their containers aside so that they cannot continue to try to open their containers during the demonstration period.

5.6.12 Demonstrate the operation (opening and closing or getting the liquid out) of the closure designated in 5.6.3 using an identical demonstration test article if either child has not opened his or her test article using the designated closure. Instruct the children to "Watch me open my container," and operate the designated closure normally at a distance of about 2 ft (0.6 m) from the children without explaining its operation.

5.6.13 Begin the second 5-min period by saying, "Now you try to open your container or get the liquid out," and allowing the children to pick up their test articles. Use the protocols of 5.6.5 to 5.6.10 as required during this test period.

5.6.14 End the second 5-min test period by asking the children to set their test articles aside and saying "Thank you for helping." Also say, "Never open containers like this when you are by yourself. This kind of container will have something in it that will make you sick."

5.6.15 Have the children stand up and stretch for a short time if they are to participate in a second test. Ensure that they do not disrupt other tests in progress.

5.6.16 Escort the children back to their classroom or other supervised area if their participation is completed.

6. Adult Use Effectiveness Test

6.1 *General:*

6.1.1 *Overview*—The Adult Use Effectiveness Test ensures that a sufficient portion of adults can open a CR feature. The test is divided into three phases: the first phase is a 5-min familiarization phase; then a 1-min dispensing closure phase; and ending with a 1-min filling closure phase. In each phase, the participant is given tasks to complete. The participant passes if s/he successfully completes certain tasks within the phase time frame.

6.1.2 Conduct testing in well-lit and distraction-free areas.

6.1.3 Test each adult test panel participant individually and not in the presence of other participants or onlookers.

6.1.4 Test only one type of container in a single sitting of an adult panel participant and execute all of the test protocol (6.3) in that sitting.

6.1.5 Record all data, except the timing of the testing, before or after the test to allow the tester's full attention to be on the test participant during the test period.

6.1.6 Do not allow an individual tester to conduct testing with more than 35 % of the of the adult test panel members.

6.1.7 *Opening and Closing Instructions*—At any time during the test, an adult test panel participant is allowed to consult instructions provided with the container and digitally available as indicated on the container. Adaptation of access to instructions to test facility or container constraints is permitted (for example, the tester may provide instructions that would normally be accessed by a QR code if the consumer attempts to scan a non-active QR code). The tester will not offer situation-specific opening and closing instructions during the conduct of the test. The tester will not provide any additional information to the adult test panel participant that is not provided or referenced on the market-ready product.

6.1.8 Test tasks are assigned to the adult panel participants using specific and consistent language. Include the tasks assigned and the language used in the test records.

6.1.9 Encourage a participant that stops attempting to complete the assigned task by asking, "Are you finished with that container or would you like to keep trying?"

6.1.10 Correct performance of the assigned tasks is confirmed by the tester. Include the verification method in the test records.

6.1.11 Fill each test article to between 15 % and 35 % of its rated capacity with water, secure the closures, and invert it to check for leakage. If leakage occurs, the closures may be resecured and the test repeated. Do not conduct testing with test articles that exhibit leakage.

6.2 *Adult Test Panel Composition:*

6.2.1 *Age and Gender Distribution*—The adult test panel is comprised of a total of 100 test participants, selected by age, which result in the distribution shown in Table 2. Include at least 30 female participants. Use test results in the order of testing if more adults are tested than required in Table 2.

6.2.2 *Effective Participation*—Do not perform testing with an adult with a permanent or temporary illness, injury, or disability that would interfere with his/her effective participation in the testing.

6.2.3 *Geographical Diversity*—Ensure the geographical diversity of the panel participants using one of the following criteria:

6.2.3.1 Test no more than 20 % of adult test panel participants at a single site.

6.2.3.2 Select no more than 20 % of adult test panel participants from a geographical indicator (such as zip code, postal code, city, or town) when testing is conducted at a central location.

6.2.4 *Recruitment of Adult Panel Participants*—Use appropriate language from the adult panel consent form (Appendix X3) to recruit participants.

6.2.5 Verify that selected participants have used a gas can in the preceding two years. It is permissible to use the term "gas can" when verifying previous usage as this is considered a term familiar to the general public for these types of containers.

6.3 *Test Protocol:*

6.3.1 Set up the test space. Have test articles prepared and ready for the participant to use. Bring the participant into the test space. Introduce the participant to the overall goal of the test.

6.3.2 *Consent Form*—Have each adult test panel participant read and sign the adult test consent form (Appendix X3) and attest to having used a gas can in the preceding two years. An adult unable to read the consent form shall not participate in the testing.

6.3.3 *Five Minute Familiarization Phase*—This test phase is intended to allow the participant to become familiar with the container and ensure the participant can perform certain actions within a reasonable timeframe when presented with the container for the first time.

6.3.3.1 Introduce the overall goal of following the instructions to use and properly resecure all of the closures. Then allow the participant to access the first test article and start the timing. Identify the location of instructions, if required by the circumstances, during the 5-min test period.

6.3.3.2 Assign each of these tasks to the participant (*1*) preparing the container for use (if applicable), (*2*) dispensing

TABLE 2 Age and Gender Distribution of Adult Test Panel

Age Range	Number of Participants	Minimum Number of Female Participants
18 to 29	22 – 28	5
30 to 49	45 – 55	15
50 to 70	22 – 28	5
Total	100	30[A]

[A] Note that the minimum number of female participants in each age group will not add up to the minimum total number of female participants needed. The remaining five female participants can be in any age category.

water from the container, (*3*) resecuring the container for storage, (*4*) opening the fill opening closure, and (*5*) resecuring the container for transportation.

6.3.3.3 Record the elapsed time, from the start of this test, for the participant to complete each applicable task. Deduct the time needed to assign the tasks and any time needed to address questions from the participant. The tester may remind the participant of the task without adjusting the time.

6.3.3.4 The participant is successful if s/he dispenses water from the container (Task 2 in 6.3.3.2) and opens the filling opening closure (Task 4 in 6.3.3.2) within 5 min.

6.3.3.5 End this phase when the participant has either completed the assigned tasks, declined to continue trying, or 5 min has elapsed. It is permissible for the participant to repeat any of the tasks on his/her initiative.

6.3.3.6 Remove the participant's access to the test article at the end of this phase.

6.3.4 *One-minute Dispensing Closure Phase*—This test phase is intended to determine whether a participant who is familiar with the container can dispense the container contents from the dispensing closure and then resecure it in a reasonable amount of time.

6.3.4.1 After successfully completing the 5-min familiarization phase, allow the participant access to another test article and start the timing. Use an identical test article as in the 5-min familiarization phase, however install or unstow the dispensing system (where applicable) prior to allowing the participant access.

6.3.4.2 Assign each of these tasks to the participant: (*1*) dispense water from the dispensing closure of the container, and (*2*) resecure the dispensing closure to a CR condition.

6.3.4.3 Record the elapsed time, from the start of the test, for the participant to complete each task. Deduct the time needed for the tester to assign the tasks and address any time needed to address questions from the participant.

6.3.4.4 The participant is successful if s/he dispenses water from the dispensing closure and resecures it within 1 min. Perform a leak check to verify the test article closure under test has been properly resecured.

6.3.4.5 End this phase when the participant has either completed the assigned tasks, declined to continue trying, or 1 min has elapsed.

6.3.5 *One Minute Fill Opening Closure Phase*—This test phase is intended to determine whether a participant who is familiar with the container can open the fill opening closure and then resecure it in a reasonable amount of time. This phase may be performed prior to the dispensing closure phase with appropriate adaptation of 6.3.4.1 and 6.3.5.1.

6.3.5.1 After successfully completing the 1-min dispensing closure phase, remove or stow the dispensing system (where applicable) and allow the participant continued access to the same test article and start the timer.

6.3.5.2 Assign each of these tasks to the participant: (*1*) open the fill opening closure, and (*2*) resecure the fill opening closure to a CR condition.

6.3.5.3 Record the elapsed time, from the start of the test, for the participant to complete each task. Deduct the time needed for the tester to assign the tasks and address any time needed to address questions from the participant.

6.3.5.4 The participant is successful if s/he opens the fill opening closure and resecures it within 1 min. Perform a leak check to verify the test article has been properly resecured.

6.3.5.5 End this phase, and the test, when the participant has either completed the assigned tasks, declined to continue trying, or 1 min has elapsed.

6.4 *Adult Use Effectiveness:*

6.4.1 Report the adult use effectiveness as the percent of adult panel test participants that successfully complete the assigned tasks of 6.3.3.4, 6.3.4.4, and 6.3.5.4 in the allotted time.

7. Records and Recommendations

7.1 The following instructions and procedures are recommended for use where appropriate.

7.2 *Report Format for Child Test:*

7.2.1 *Identification:*

7.2.1.1 Close-up color photograph(s) clearly identifying the container and showing the opening instructions on the closure.

7.2.1.2 Product name.

7.2.1.3 Product manufacturer.

7.2.1.4 Closure model (trade name–for example, "KLIK & SNAP").

7.2.1.5 Closure size (for example, 28 mm).

7.2.1.6 Closure manufacturer.

7.2.1.7 Closure material and color(s) (for example, white polypropylene).

7.2.1.8 Closure liner material.

7.2.1.9 TAC seal material.

7.2.1.10 Opening instructions (quote exactly, for example, "*While pushing down, turn right*"). Commas are used to separate words that are on different lines.

7.2.1.11 Symbols, numbers, and letters found inside the closure.

7.2.1.12 Container model.

7.2.1.13 Container material and color.

7.2.1.14 Net contents.

7.2.1.15 Symbols, numbers, and letters on the bottom of the container.

7.2.1.16 Other product identification, for example, EPA Registration Number.

7.2.2 *Procedures:*

7.2.2.1 Describe all procedures for preparing the test containers.

7.2.2.2 Describe the testing procedures.

7.2.2.3 Describe all instructions given to the children.

7.2.2.4 Define an individual container failure.

7.2.3 *Results:*

7.2.3.1 Openings in each 5-min period and total openings for males and females in each age group.

7.2.3.2 Opening methods (for example, normal opening, pried closure off, and so forth).

7.2.3.3 Mean opening times for each 5-min test period.

7.2.3.4 The percentage of containers tested at each site as a percentage of total containers.