



Designation: D7860 – 14 (Reapproved 2022)

Standard Test Methods for Measurement of Torque Retention for Child Resistant and Non-Child Resistant Packages with Continuous Thread Closures Using Automated Torque Testing Equipment¹

This standard is issued under the fixed designation D7860; 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 These test methods evaluate the torque retention of continuous thread closures on containers with matching finishes, for predetermined environmental conditions over time. Methods are defined for both Type I, style “A” push down and turn Type II² child resistant and non child resistant type closures.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

NOTE 1—The SI unit system is the recommended system.

1.3 *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.*

1.4 *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

D996 Terminology of Packaging and Distribution Environments

¹ These test methods are under the jurisdiction of ASTM Committee F02 on Primary Barrier Packaging and is the direct responsibility of Subcommittee F02.25 on Rigid Container Closure Systems.

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² For classification of child resistant styles, see ASTM D3475 Standard Classification of Child-Resistant Closures.

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.

D3198 Test Method for Application and Removal Torque of Threaded or Lug-Style Closures (Withdrawn 2016)⁴
D3474 Practice for Calibration and Use of Torque Meters Used in Packaging Applications
D3475 Classification of Child-Resistant Packages
D4169 Practice for Performance Testing of Shipping Containers and Systems
D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing
D7386 Practice for Performance Testing of Packages for Single Parcel Delivery Systems
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of general packaging and distribution terms, see Terminology **D996**.

3.1.2 For definitions of application torque and removal torque, see Test Method **D3198**.

3.1.3 For Definitions regarding conditioning, see Terminology E41.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dry torque, n*—dry torque is defined as applying torque in the absence of lubricant (i.e. product from the container or filling operation) on the threads.

3.2.2 *immediate removal torque, n*—removal torque that is measured at a stated interval, from 1 min to 5 min after closure application.

3.2.3 *torque retention, n*—a comparison between removal torque at the end of a test period and a predetermined immediate removal torque.

4. Summary of Test Methods

4.1 *Test Method A: Static Evaluation*—At predetermined time intervals, the removal torques of representative samples of a container/continuous thread closure system, previously stored at various environmental conditions, are measured.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

4.2 *Test Method B: Dynamic Evaluation*—Practices **D4169** and **D7386** are used to develop a uniform system of evaluating the ability of primary packages, in the shipping units, to withstand the distribution environment. At the end of pre-determined distribution cycles, the removal torques of representative samples of a container/continuous thread closure system are measured.

5. Significance and Use

5.1 This test method allows for the measurement of the torque retention properties of container/continuous thread closure systems of various designs, materials, and manufacture, and is suitable for package development and engineering evaluation.

5.2 Each test method can be used for the evaluation of non child resistant container/continuous thread closure systems under controlled conditions such as when the application torque is known and the applied downward force to the closure is zero or for Type I, style “A” push down and turn child resistant container/continuous thread closure systems under controlled conditions such as when the application torque and the applied downward force to the closure is known.

5.3 This test method measures torque retention properties of container/continuous thread closure systems with the use of an automated transducer based torque meter operating at a known rotational velocity (rpm) or known torque ramp.

5.4 This test method is intended for measurement of dry torque only.

6. Apparatus

6.1 *Automated Transducer Based Torque Meter*, with a programmable, fixed velocity or fixed torque ramp rate rotational torque head and digital output that accurately measures within the expected torque range for the particular container/continuous thread closure system to be evaluated. (See Note X for source(s) of equipment.)

6.2 *Torque Calibration Verification Device (Calibrated “Standard”)*, is a magnetic type device that produces a repeatable breakaway torque within the expected torque range for the particular container/continuous thread closure system to be evaluated. (A calibrated “standard” is a separate device calibrated to a known set torque value and used for verifying the measuring meter between calibration periods.)

7. Sampling and Test Specimens

7.1 Measure no less than ten test specimens for each torque measurement point per test variable.

7.2 Select previously unused continuous thread closures and containers as test specimens.

7.3 Select a single cap and container mold cavity number combination for testing if possible. A single combination will reduce the variability between samples.

7.4 For torque measurement and analysis of a production line system, sample size should be determined based upon the quantity of mold cavities used to produce the containers and closures used in production.

8. Calibration

8.1 Calibrate transducer based torque meters to a traceable industry recognized traceable standard (e.g. NIST) in accordance with the manufacturer’s procedures.

8.2 Verify dynamic calibration of the transducer based torque meter by measuring both the application and removal torque of a calibrated force meter with a torque calibration verification device (calibrated “standard”) five times before testing begins. Record results.

9. Conditioning and Preparation of Test Specimens

9.1 Perform test specimen conditioning in accordance with Specification E171 and Practice **D4332**.

9.2 Fill all of the containers with the specified volume or weight of product, or other materials that yield similar weight and thermal characteristics. See **Notes 2 and 3**.

NOTE 2—The total quantity of test specimens sampled will depend upon the method selected and the number of environmental storage conditions.

NOTE 3—Given the purpose of the evaluation, empty containers may be used as an option to filled containers for static testing.

10. Procedure (see **Note 4**)

10.1 *Test A: Static Evaluation Non-Child Resistant Closures:*

10.1.1 Select the minimum application torque for the container/continuous thread system as recommended by the closure manufacturer. (For example, the U.S. Pharmacopoeia, the Society for the Plastics Industry, the Glass Container Manufacturers Institute, or other sources.)

NOTE 4—Under certain conditions of product-filling, storage and distribution, it may be desirable to combine appropriate segments of Test Method A and Test Method B.

10.1.2 Set up torque meter for application torque operation based on manufacturer’s procedures.

10.1.3 Place a suitable closure onto the container.

10.1.4 For actuated container clamping type concentric with measuring device, place the container into the machine. For manual style container clamping type, place the container into the machines container holding device in such a manner that the axis of rotation of the closure is concentric with the center of the measuring device.

10.1.5 For positive actuated chuck style, start cycle and tighten the closure to the pre-determined application torque. For manual chuck style, affix the automated machine’s rotating measuring device to the closure and tighten the closure to the pre-determined application torque. Record both the pre-determined applied torque and the torque rate or rotation rate of the torque measuring head.

10.1.6 Verify that the machine stopped applying torque at the pre-determined application value. See **Note 5**.

10.1.7 Apply the balance of the closures or containers to the matching components as directed in **10.1.3**, **10.1.4**, and **10.1.5**.

10.1.8 Store the assembled test specimens as appropriate in accordance with Specification E171 or Practice **D4332**.

10.1.8.1 Maintain one group of test specimens as a control by storing this group at ambient laboratory conditions. See **Note 5**.

NOTE 5—The application torque range is usually determined on the basis of the desired removal torque range.

10.1.8.2 Maintain, as appropriate, one or more groups of test specimens at constant temperatures different than ambient laboratory conditions. If desired, cycling at various temperature and relative humidity conditions may be performed.

10.1.9 At the end of each predetermined time period, determine the removal torque for each test sample at ambient laboratory conditions or at the alternative temperature and relative humidity conditions.

10.1.9.1 The following test intervals are recommended: immediate (between 1 min and 5 min), 24 h, 48 h, 7 days, 14 days, and 28 days. See [Note 6](#).

NOTE 6—Sterilization cycles, if applied, using steam, ethylene oxide, gamma radiation, or other methods are known to affect certain plastics; these effects may influence removal torques.

10.1.10 Set-up machine for removal torque operation based on manufacturers procedures.

10.1.11 Determine the removal torque for each test specimen; for actuated container clamping type concentric with measuring device, place the container into the machine. For manual style container clamping type, place the container in the machine's container holding device in such a manner that the axis of rotation of the closure is concentric with the center of the measuring device.

10.1.12 For positive actuated chuck style, activate machine to remove and measure the cap removal torque from the container. For manual chuck style, affix the measuring device to the container closure and while avoiding contact with the fixed component, activate the machine to remove and measure the cap removal torque from the container. Note the maximum torque required to loosen the closure, the rotation speed or torque rate of the rotating torque measurement device and the dwell time and record these values for the test specimen. See [Note 7](#).

NOTE 7—It is recommended that the same automated torque instrument be used to remove all closures in a given test to reduce possible instrument inconsistencies and their associated variables.

10.1.13 Record the maximum torque required to loosen the closure and the dwell time for each remaining specimen.

10.1.14 Remove the balance of the movable components (normally the continuous thread closures) as directed in [10.1.11](#) and [10.1.12](#).

10.2 Test A1: Static Evaluation -Child Resistant Closures:

10.2.1 Select the minimum application torque for the container/continuous thread system as recommended by the closure manufacturer. (For example, the U.S. Pharmacopoeia, the Society for the Plastics Industry, the Glass Container Manufacturers Institute, or other sources.)

NOTE 8—Under certain conditions of product-filling, storage and distribution, it may be desirable to combine appropriate segments of Test Method A and Test Method B.

10.2.2 Set up torque meter for application torque operation based on manufacturer's procedures.

10.2.3 Place a suitable closure onto the container.

10.2.4 For actuated container clamping type concentric with measuring device, place the container into the machine. For

manual style container clamping type, place the container into the machine's container holding device in such a manner that the axis of rotation of the closure is concentric with the center of the measuring device.

10.2.5 Rotate the bottle and cap until the cap's CR outer locking lugs mesh with the inner lugs that allow the cap to be tightened or removed. Activate the CR locking mechanism with sufficient vertical force to prevent slipping of the lugs. Record the vertical downward force.

10.2.6 For positive actuated chuck style, start cycle and tighten the closure to the pre-determined application torque. For manual chuck style, affix the automated machine's rotating measuring device to the closure and tighten the closure to the pre-determined application torque. Record both the pre-determined applied torque and the torque rate or rotation rate of the torque measuring head.

10.2.7 Verify that the machine stopped applying torque at the pre-determined application value. See [Note 6](#).

10.2.8 Apply the balance of the closures or containers to the matching components as directed in [10.1.3](#), [10.1.4](#), and [10.1.5](#).

10.2.9 Store the assembled test specimens as appropriate in accordance with Specification E171 or Practice [D4332](#).

10.2.9.1 Maintain one group of test specimens as a control by storing this group at ambient laboratory conditions. See [Note 9](#).

NOTE 9—The application torque range is usually determined on the basis of the desired removal torque range.

10.2.9.2 Maintain, as appropriate, one or more groups of test specimens at constant temperatures different than ambient laboratory conditions. If desired, cycling at various temperature and relative humidity conditions may be performed.

10.2.10 At the end of each predetermined time period, determine the removal torque for each test sample at ambient laboratory conditions or at the alternative temperature and relative humidity conditions.

10.2.10.1 The following test intervals are recommended: immediate (between 1 min and 5 min), 24 h, 48 h, 7 days, 14 days, and 28 days. See [Note 10](#).

NOTE 10—Sterilization cycles, if applied, using steam, ethylene oxide, gamma radiation, or other methods are known to affect certain plastics; these effects may influence removal torques.

10.2.11 Set-up machine for removal torque operation based on manufacturers procedures.

10.2.12 Determine the removal torque for each test specimen; for actuated container clamping type concentric with measuring device, place the container into the machine. For manual style container clamping type, place the container in the machine's container holding device in such a manner that the axis of rotation of the closure is concentric with the center of the measuring device.

10.2.13 Rotate the bottle and cap until the cap's CR outer locking lugs mesh with the inner lugs that allow the cap to be tightened or removed. Activate the CR locking mechanism to hold the lugs meshed.

10.2.14 For positive actuated chuck style, activate machine to remove and measure the cap removal torque from the container. For manual chuck style, affix the measuring device