Designation: D3198 – 97 (Reapproved 2007)

Standard Test Method for Application and Removal Torque of Threaded or Lug-Style Closures[1]

This standard is issued under the fixed designation D3198; 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 test method covers the application with a given torque of a threaded or lug-style closure to a container, and measures the torque required to unscrew the closure from a container.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3474 Practice for Calibration and Use of Torque Meters Used in Packaging Applications

E105 Practice for Probability Sampling of Materials

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *application torque*—the moment of a force or system of forces tending to cause rotation of a closure over the neck finish of an appropriate container, causing the closure to be applied and secured to the container.

3.1.2 *removal torque*—the moment of a force or system of forces tending to cause rotation of an appropriate closure in a direction opposite to that of application, causing the closure to be unsecured from its position on the neck finish of an appropriate container.

4. Summary of Test Method

4.1 Representative specimens of a threaded or lug-style container are held in a torque-measuring device and either the predetermined amount of torque is applied to its closure, or the amount of torque necessary to loosen the closure is determined, or both.

5. Significance and Use

5.1 These torque measurements are of value in:

5.1.1 Rating the performance of automatic capping machines,

5.1.2 Measuring any tendency for threaded or lug-style closures to loosen during storage or shipment of the package, and

5.1.3 Measuring the force required to break hard plastic and overturn or “strip” soft plastic and metal closures.

5.2 The method may be used to establish performance specifications.

6. Apparatus

6.1 *Torque Meter* (see Note 1) with a scale that will read with the maximum point reading accuracy within the torque range expected to be measured (use a 0 to 25 torque inch pounds-force (T.I.P.) torque meter for readings under 25 T.I.P., not a 0 to 100 T.I.P. torque meter).

NOTE 1—A digital or automated torque instrument, if used, will have an appropriate design and scale capacity for the container/closure system to be evaluated. Torque results will be available in either electronic display or printout formats.

7. Sampling, Test Specimens, and Test Units

7.1 The number of samples will depend on the desired purpose for which this test is being run. However, for a given set of samples, sufficient measurements shall be taken in accordance with established statistical sampling procedures in order to obtain consistent results.

NOTE 2—Refer to Practices E105 and E122 for more specific information.

[1] This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.32 on Consumer, Pharmaceutical and Medical Packaging.

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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.

TABLE 1 Special Atmospheres

Environment	Temperature, °C (°F)	Relative Humidity, %
Cryogenic	−55 ± 3 (−67 ± 6)	...
Frozen food storage	−18 ± 2 (0 ± 4)	...
Refrigerated storage	5 ± 2 (41 ± 4)	85 ± 5
Temperature high humidity	20 ± 2 (68 ± 4)	85 ± 5
Tropical	40 ± 2 (104 ± 6)	85 ± 5
Desert	60 ± 3 (140 ± 6)	15 ± 2

7.2 Select unused closures, complete with liners, if appropriate, and unused containers, with the correct corresponding size finish, that are within specifications.

8. Calibration

8.1 Calibrate the torque meter in accordance with Practice D3474.

NOTE 3—Follow calibration procedure of manufacturer if a digital or automated torque instrument is to be used.

9. Conditioning

9.1 Control the relative humidity and temperature conditions such that the data may be reasonably comparable when repetitive testing of closure-container combinations for application and removal torque or torque strength is intended. If special conditions will be required, refer to ISO 2233 for a list of possible special conditions.

NOTE 4—Closure application and removal torque levels may be influenced by such variables as time, temperature, relative humidity, and conditioning of the closures and containers prior to testing, and by temperature and relative humidity during storage, and at the time of testing.

9.2 Condition the components separately in a controlled environment of temperature and relative humidity a minimum of 48 h prior to their being combined into closure-container systems to be evaluated. To assure an adequate circulation of air around the components, do not stack the components.

9.3 If special conditions are not required, store components at 23 ± 2°C (73.4 ± 3.4°F) and 50 ± 5 % relative humidity.

9.4 The atmosphere conditions in Table 1 may be used when special conditioning is appropriate. Other atmosphere conditions may be used as appropriate.

10. Procedure

10.1 *Application Torque Measurement :*

10.1.1 Firmly position the container between the four posts on the torque tester in such a manner that the axis of rotation of the cap is concentric with the center of the movable plate on which the container rests.

10.1.2 Grip the closure by hand, avoiding any contact with the container, and twist clockwise while closely watching the gauge. Apply torques smoothly and consistently, at a constant rate consistent with accurate reading of the gauge.

10.1.3 Apply torque continuously until the desired torque as indicated by the needle on the gauge is reached.

10.2 *Removal Torque Measurement :*

10.2.1 Firmly position the container between the four posts on the torque tester in such a manner that the axis of rotation of the cap is concentric with the center of the movable plate on which the container rests.

10.2.2 Grip the closure by hand, avoiding any contact with the container, and twist counterclockwise while closely watching the gauge.

NOTE 5—On occasion, when large numbers of samples are to be tested, or when measuring the torque required to break hard plastic caps, it may be necessary to exert a greater torque than can be achieved by gripping the closure with the bare hand. A rubber pad, strap wrench, or a rubber-lined "nut-cracker-type" device where the hole is slightly smaller in diameter than the closure may be used to gain a firm grip without scoring or scratching the closure, or deforming it "out-of-round." By whatever means the closure is held, it is imperative that the force be uniformly distributed around the periphery of the screw cap; otherwise, unequal pressure will force the closure "out-of-round" and lead to a false torque value. The use of pliers or a pipe wrench is to be avoided.

10.2.3 The highest figure indicated by the needle on the gauge before it "snaps back" is recorded as the removal or "take off" torque of the closure.

11. Report

11.1 The report shall include the following:

11.1.1 Thread finish or other designation of the closure,

11.1.2 Materials of construction of the closure, including any liner,

11.1.3 Material of construction and finish of the container,

11.1.4 Number of replicates,

11.1.5 Conditioning time, temperature, and humidity of the test, if any,

11.1.6 Temperature and humidity of the test area,

11.1.7 Time between application and removal of closures.

11.1.8 Device used, if any, for aiding the application and removal of closures (see Note 5),

11.1.9 All torques, expressed in pounds-force inches and newton metres (Note 6) in tabular form,

NOTE 6—1 lbf·in. × 0.113 = 1 N·m.

11.1.10 Average value, range, and standard deviation of the torques,

11.1.11 Evaluation of comparative results, if appropriate, and

11.1.12 Statement that this test was done in accordance with Test Method D3198.

12. Precision and Bias

12.1 *Precision*—The repeatability standard deviation is about 0.78 inch pounds or 5.8 % of the average. This is based on limited data of three packages from a single laboratory. Other packages may have different repeatability values. The reproducibility of this test method is being determined.

12.2 *Bias*—No justifiable statement can be made on the bias of this test method since a true value cannot be established by an accepted referee method.

13. Keywords

13.1 application torque; lug-style closure; removal torque; threaded closure