Designation: D3474 – 90 (Reapproved 2012)

Standard Practice for Calibration and Use of Torque Meters Used in Packaging Applications[1]

This standard is issued under the fixed designation D3474; 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 practice covers the calibration and use of torque meters of the type normally used in packaging applications.

1.2 *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]

D3198 Test Method for Application and Removal Torque of Threaded or Lug-Style Closures

3. Terminology

3.1 *Definitions*—For definitions of *application torque* and *removal torque*, see Test Method D3198.

3.1.1 *stripping torque*—a force or system of forces acting in a tightening direction that causes overrunning of the threads or rotation of an overshell with respect to its supporting member.

4. Summary of Practice

4.1 *Calibration*—Reference torque values are obtained by means of vertically suspended dead weights acting at specific distances from the axis of the mounting platform of the tester.

4.2 *Use*—Torque values to apply or remove closures are obtained by mounting containers on the platform and either applying or removing the closures. In some applications, the closure is mounted on the platform and the container is rotated.

5. Significance and Use

5.1 This practice can be used to check devices used to measure the application and removal torques of continuous or intermittent thread and lug closures.

5.2 This practice can be used to determine the amount of torque to either apply or remove a closure.

6. Apparatus

6.1 *Adapter*—A circular plate that can be mounted concentrically on the platform of the tester. If the platform itself is suitable, an adapter is not necessary. The adapter should be of such diameter that its radius multiplied by appropriate weights will give torque values equal to ¼, ½ , and full-scale meter readings. (Typical devices for packaging applications have ranges from: 0 to 10, 0 to 25, 0 to 50, and 0 to 100 lbf-in. (0 to 1.13, 0 to 2.8, 0 to 5.7, and 0 to 11.3 N/m, respectively).

6.2 *Connecting Means*—A very flexible, thin filament, such as a wire or fishing line that transmits the force of hanging weights to the circumference of the adapter.

6.3 *Pulley,* low friction, used to change the direction of the connecting means from horizontal to vertical.

6.4 *Appropriate Dead Weights,* for example: 2, 4, and 7-lb (0.9, 1.8, and 3.2-kg) for a torque meter with a 7 in. (178 mm) diameter plate or platform and a range of 0 to 25 in-lbs (0 to 2.8 N-m).

7. Conditioning

7.1 Prior to calibration, the torque meter and weights shall be allowed to come to ambient room conditions.

8. Calibration Procedures (see Fig. 1)

8.1 *Spring-Loaded Type Testers:*

8.1.1 Verify that the meter needle moves freely throughout its entire range and rests on zero when not loaded. Adjust if necessary.

8.1.2 If an adapter is used, fasten it securely and concentrically to the tester platform or spindle.

8.1.3 Secure the torque meter to a table or work surface.

8.1.4 Secure one end of the connecting means to a point on the circumference of the adapter or rotating platform and wrap it at least halfway around the circumference.

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

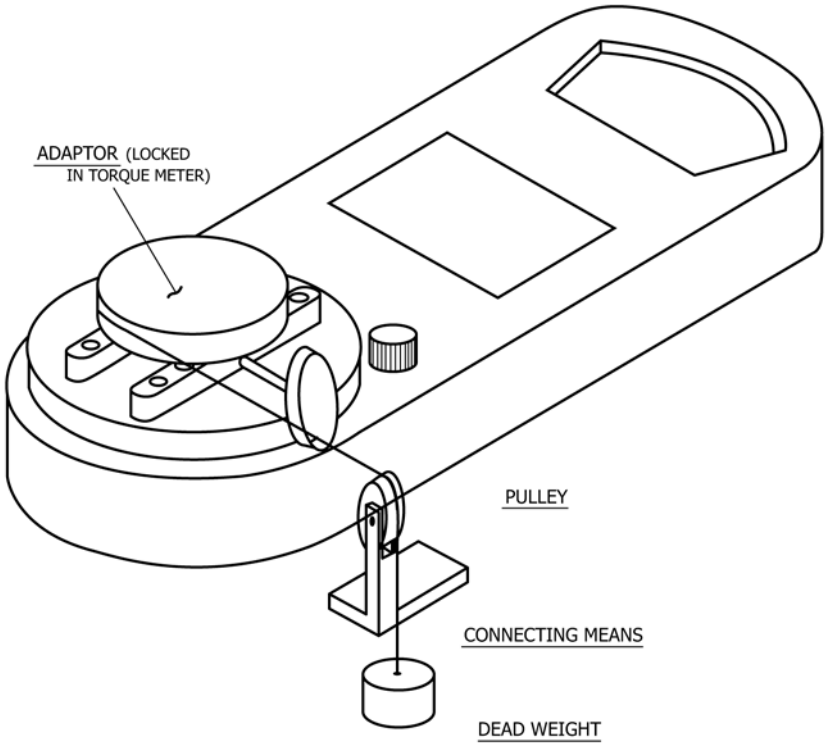

FIG. 1 Torque Meter Calibration Set Up

8.1.5 Run the connecting means over a low friction pulley located near the edge of a bench or table, and let it hang vertically for the attachment of weights.

8.1.6 Sequentially, attach dead weights appropriately to give torque values equal to ¼ , ½, and full-scale meter readings. Make certain that the weights are hanging freely. Record the weight, radius and the meter reading at each test point, making certain that the needle returns to zero when the weights are removed.

8.1.7 If the difference between the measured and indicated readings differ from the manufacturers' specification (usually ±4 % of full scale), the user will need to generate a calibration chart or have the instrument repaired.

8.1.8 For torque meters that measure both clockwise and counterclockwise, repeat 8.1.6, but with the platform rotation in the opposite direction.

8.2 *Automatic Type Testers:*

8.2.1 Attach a small flexible string at least halfway around the circumference of the platform and over a low friction pulley so that calibration weights can be attached.

8.2.2 Run the calibration program on the computer.

8.2.3 Hang dead weights from the string and enter the values when prompted by the computer program.

8.2.4 Repeat 8.2.1 to 8.2.3 for the opposite direction.

8.2.5 If the tester has downward force measurement capability, stack weights on the platform and enter their values as prompted by the computer program.

8.2.6 The program will automatically recalibrate and indicate errors if they occur.

9. Torque Measurement

9.1 *Spring-Loaded Type Testers:*

9.1.1 Remove the calibration adapter and install the posts in the movable cross members. It is important that the spacing between the posts shall be such that the container or closure is held securely but not deformed.

9.1.2 *Application Torque:*

9.1.2.1 Position the container or closure in the restraining grippers of the torque tester or holding jig so that the center of the neck is over the center line of the torque tester.

NOTE 1—It is important that the spacing between the posts be such that the container or closure is securely held but not deformed. Containers with offset necks must be offset.

9.1.2.2 Torque the movable component by rotating smoothly at a constant rate in a tightening direction to a predetermined level and then releasing the component gripping device immediately upon reaching the predetermined torque.

9.1.2.3 Record the torque applied to each of the closures.

9.1.3 *Removal Torque:*

9.1.3.1 Removal torque is determined by removing the closures from the test specimens.

9.1.3.2 Position each test specimen in the restraining grippers of the torque tester or holding jig. Remove the closures by increasing the removal torque gradually and smoothly until the maximum reading is attained.

9.1.3.3 Record the maximum torque required to loosen the closure for each of the test specimens and the elapsed time between application and removal torque.

NOTE 2—If removal torque is used for quality control purposes, the best reproducibility and correlation torque is obtained if the specimens are tested within 5 min of the time the closure is applied.

9.2 *Automatic Type Testing:*

9.2.1 Run the program, select the desired test, and place the bottles in the machine as directed.

9.2.2 Results will be automatically displayed and may be saved or printed out as desired.

9.3 *Stripping Torque:*

9.3.1 Position the bottle in the restraining grippers of the torque tester or holding jig.

9.3.2 Torque the closure by increasing the torque gradually and smoothly until stripping occurs.

9.3.3 Record the stripping torque level obtained on each of the test specimens.

10. Calculation

10.1 Calculate calibration torque, *T*, as follows:

10.1.1 SI units:

$$T = Mgr$$

where:

T = torque, N-m,
M = mass of dead weight, kg,
g = acceleration of gravity, 9.8 m/s^2, and
r = radius of adapter, m.

10.1.2 Inch·pound units:

$$T = Wg/g_c XR$$

where:

T = torque, lbf-in.,
W = weight of dead weight, lbm,
R = radius of adapter, in.,
g = local acceleration of gravity, and
g_c = standard acceleration of gravity (32.174 ft-lbm/lbf-s^2).

NOTE 3—Except for extreme altitude and large differences in latitude, the values of g and g_c can be considered to be nominally equal.

11. Report

11.1 *Torque Meters:*

11.1.1 Report the following information:

11.1.2 Date of test.

11.1.3 A statement that testing was done in accordance with Practice D3474.

11.2 *Application, Removal, or Stripping Torque:*

11.2.1 Report the following information:

11.2.1.1 Identification of containers and closures tested including size, style, material(s), and any other pertinent information. Bottle finish and closure dimensions should also be reported if applicable.

11.2.1.2 All readings of application, removal, and stripping torque, if applicable.

11.2.1.3 Number of specimens tested.

11.2.1.4 Date of test.

11.2.1.5 Average, range, and standard deviation of values for application removal and stripping torques.

11.2.1.6 A statement that testing was performed in accordance with Practice D3474.

11.2.1.7 Difference(s) from actual procedure.

12. Precision and Bias

12.1 *Precision*—It is not practicable to specify the precision in this practice because torque values can only be defined in terms of a test method.

12.2 *Bias*—The bias of this practice includes quantitative estimates of the uncertainties of the dimensional measuring devices, the calibration of test equipment and the skill of the operator. At this time, statements on bias should be limited to the developmental performance of particular laboratories.