Designation: D6534 – 05 (Reapproved 2010)

Standard Test Method for Determining the Peak Force-to-Actuate of a Mechanical Pump Dispenser[1]

This standard is issued under the fixed designation D6534; 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 determination of the peak force-to-actuate, sometimes called force-to-actuate (FTA), of a mechanical pump dispenser.

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.* Specific precautionary statements are given in Section 5.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3890 Test Method for Number of Strokes to Prime a Mechanical Pump Dispenser

3. Significance and Use

3.1 This test method can be used to compare the peak force-to-actuate performance of different mechanical pump dispensers.

3.2 This test method can be used to determine the perceived ease of use of a mechanical pump dispenser.

3.3 This test method can be used to determine the peak force-to-actuate of a mechanical pump dispenser.

4. Apparatus

4.1 *Motorized Compression Tester, or Custom Force-to-Action Machine,* with the capability to actuate the mechanical pump dispenser at a constant velocity and adjustable stroke lengths while accurately measuring the resulting force (that is, load cell).

NOTE 1—Since the velocity during actuation will affect the FTA of certain mechanical pump dispenser designs, care must be taken in selecting the correct type of equipment with the sufficient actuation velocity.

4.2 A device connected to the compression tester that can display the resulting force in newtons (N) or pounds force (lbf) of 0.1 accuracy.

4.3 A means to rigidly hold the mechanical pump dispenser during testing (that is, glass bottle or a holding fixture; see Fig. 1).

5. Precautions

5.1 Appropriate handling considerations should be given to flammable, toxic, caustic, or other potentially hazardous materials used.

5.2 Appropriate operating considerations should be taken with pinch points on the motorized compression tester.

5.3 Ensure that the exit orifice of the mechanical pump dispenser is pointed away from the operator and other people.

5.4 Ensure that the motorized compression tester is properly calibrated.

5.5 *Actuation Rate for Finger Pumps*—Care should be taken when selecting the travel speed of the ram. For some mechanical pump dispenser styles, the speed of actuation and length of stroke can affect the peak force to actuate. As a rule of thumb, mechanical pump dispensers with a stroke length of 7 mm or greater should use an actuation velocity of 35 to 75 mm per second, while mechanical pump dispensers with a stroke length of less than 7 mm should use an actuation velocity of 35 mm per second or less. Especially for fine mist spray pumps, the above mentioned rates are preferred. A different rate may be used; however, the true force-to-actuate during use may not be measured. The actuation rate used should be recorded in 10.

5.6 *Actuation Rate for Trigger Pumps*—Actuation rate for trigger sprayers to be 90 strokes per min.

[1] This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.33 on Mechanical Dispensers.

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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.

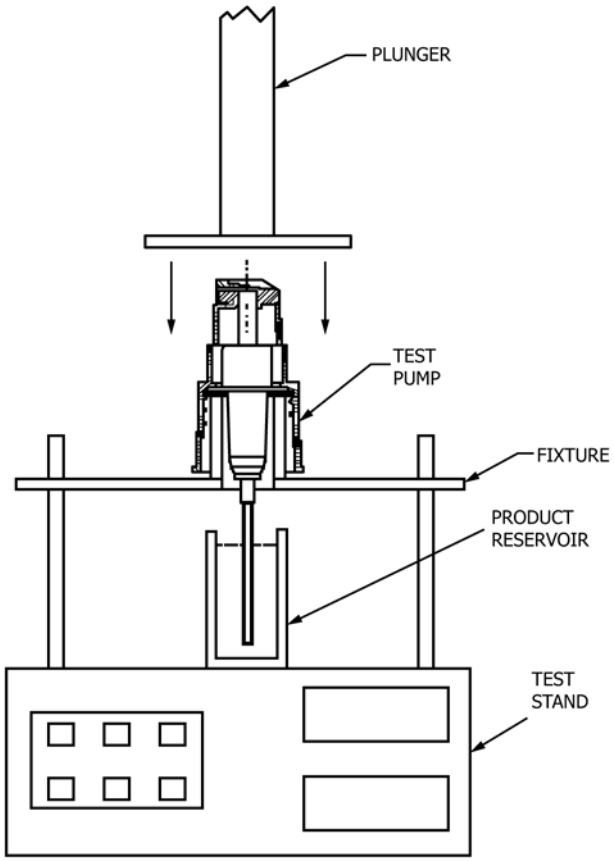

FIG. 1 Example of a Compression Test Machine

6. Sampling

6.1 Select an appropriate number of dry, unused pump dispensers at random for the precision and accuracy desired. A number of ten test specimens are recommended, but a minimum of three is acceptable.

7. Specimens

7.1 Test specimens shall be clean, dry, and previously unused pump dispensers assembled in the manner as in production.

8. Conditioning

8.1 If possible, condition the test specimens at 23 ± 3°C (73 ± 5.4°F) for not less than 4 h. If the test specimens are not conditioned at the recommended temperature, this should be noted in the test report discussed in 10.1.

8.2 Test pumps should be t ested no sooner than 24 h after assembly when possible. If pumps are not conditioned at the recommended time, this should be noted in the test report in 10.1.

9. Procedure

Force-to-Actuate Test Method Number 1

NOTE 2—This test method is used with a custom force-to-actuate test machine that can be adjusted to variable stroke lengths and rate. This is the recommended method for trigger sprayers.

9.1 Fill container with the appropriate liquid for testing.

NOTE 3—If unprimed pumps are to be tested only, do not fill container.

9.2 Place the mechanical pump dispenser on the rigid fixture used for holding the sample during testing.

9.3 Define and document the relevant data of:
9.3.1 Stroke length, if it pertains,
9.3.2 Actuation rate,
9.3.3 Number of strokes,
9.3.4 Description of pump,
9.3.5 Product tested.
9.3.6 For trigger pumps, document the average contact point distance from the end of the trigger.

9.4 If the test is to be performed on an unprimed mechanical pump dispenser, place the mechanical pump dispenser onto the holding fixture while directing the exit orifice of the mechanical pump dispenser away from the direction of the operator. If the test is to be performed on a primed mechanical pump dispenser, and the mechanical pump dispenser has not been primed, prime the mechanical pump dispenser in accordance with Test Method D3890.

NOTE 4—A product collection device or means of ventilation is recommended for the safety of the operator.

9.5 Activate the force-to-actuate tester.

NOTE 5—If the ram is allowed to bottom-out on the package, this will result in an excessive peak force value, a damaged package, or damaged machine, or combination thereof. Bottoming-out of the ram is detected by watching the force gage for a spike at the end of the travel. If the ram on the tester does bottom-out, the peak force value will be much greater than the actual peak force to actuate.

9.6 If the force-to-actuate tester does not automatically calculate the peak force to actuate, the operator must determine the peak force to actuate.

9.7 Record the peak force in 10.1.

Force-to-Actuate Test Method Number 2

NOTE 6—This test method is used with a compression testing machine. Not recommended for trigger sprayers.

9.8 Attach the mechanical pump dispenser securely to the filled container.

NOTE 7—The rigidity of the container can affect the results. A less rigid container can produce results lower than the actual peak force to actuate.

9.9 Prime the test specimens in accordance with Test Method D3890.

9.10 Place the package under the gage fixture of the compression testing machine.

9.11 Set the height of the actuation fixture so that it rests slightly above (less than 1 mm) the actuator of the mechanical pump dispenser.

9.12 Push the actuator of the mechanical pump dispenser against the gage fixture so that the actuator is completely depressed.

9.13 While holding the actuator against the gage fixture, lower the ram of the compression tester at a slow and safe speed until the base of the container is just touching the lower compression plate.

9.14 Fix the lower limit travel switch.

9.15 Return the ram to the upper limit position.

9.16 Set the speed of the ram.

NOTE 8—If the ram is allowed to bottom-out on the package, this will result in an excessive peak force value, a damaged package, or damaged machine, or combination thereof. Bottoming-out of the ram is detected by watching the force gage for a spike at the end of the travel. If the compression tester does bottom-out, the peak force value will be much greater than the actual peak force to actuate.

9.17 If the tester is not properly set up, repeat 9.11 – 9.16.

9.18 Run test with each test specimen.

9.19 Record the peak force value for each specimen in 10.1.

10. Report

10.1 Report the following information:

10.1.1 Product description, type of pump dispenser being tested, and for variable dosage pumps, the dosage selected,

10.1.2 Mean, maximum, minimum, and standard deviation peak force values,

10.1.3 The actuation rate, and

10.1.4 Stroke length.

11. Precision and Bias

11.1 *Precision*—The precision of this test method is highly dependent on the particular pump style and contents tested. One laboratory has investigated one particular pump style and a lotion product with ten replicate tests, yielding an average of 32.1 N with a range of 31.6 to 33.4 N and a standard deviation of 1.66 strokes. The stroke length was 7.6 mm and the actuation velocity was 5 mm per second. Other pumps and contents will have other averages of force to actuate and will have more or less variability between replicate tests. Users of this test method are suggested to reference historical files of previous tests of similar pumps and contents for an estimate of within laboratory repeatability. The Committee believes that because of this strong product and pump style dependency, further investigation of repeatability and reproducibility is not practicable.

11.2 *Bias*—This test method has no bias because an accepted reference or referee value is not available.

12. Keywords

12.1 dispensing; mechanical pump dispenser; peak force-to-actuate