



Designation: F2961 – 26

Standard Test Method for Characterizing Gripping Performance of Gloves Using a Torque Meter¹

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1. Scope

1.1 This test method is used for evaluating how gloves affect an individual wearer's ability to grip onto a hard surface object.

1.1.1 This test method establishes procedures for measuring the maximum torque that can be attained by an individual's bare hand as compared to the maximum torque that is attained by the same individual wearing a glove when dry, when wet with water, and when wet with oil. The torque is applied to a vertically mounted pole attached to a torque meter.

1.2 This test method is suitable for evaluating gloves and other forms of hand protection that require the wearer to maintain a secure hold on objects.

1.3 This test method does not address all effects of wearing gloves on hand functions. Other test methods include those for evaluating the effect of wearing gloves on dexterity, tactility, and other aspects of functional performance.

1.4 It is the responsibility of the test laboratory to obtain the necessary and appropriate approval(s) required by their institution for conducting tests using human subjects.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information.

1.6 *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.*

1.7 *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.*

¹ This test method is under the jurisdiction of ASTM Committee F23 on Personal Protective Clothing and Equipment and is the direct responsibility of Subcommittee F23.60 on Human Factors.

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2. Referenced Documents

2.1 ASTM Standards:²

D1776/D1776M Practice for Conditioning and Testing Textiles

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F1494 Terminology Relating to Protective Clothing

2.2 NFPA Standards:³

NFPA 1971 Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

3. Terminology

3.1 For definitions of other protective clothing-related terms used in this test method, refer to Terminology F1494.

4. Summary of Test Method

4.1 The maximum torque applied to a vertically oriented cylindrical rod is measured without gloves and then later while wearing dry gloves, and progressively, while wearing gloves wet with water and/or wet with oil. The bare hand maximum torque is compared to the gloved hand maximum torque in terms of a percentage. This percentage is useful in determining if a glove enhances or decreases an individual's ability to grip a hard object.

5. Significance and Use

5.1 This test method is intended to provide a quantitative measurement of wearing gloves on an individual's ability to grip a solid object and twist in a defined direction. The gripping performance may be different if twisted in the opposing direction or if pushing or pulling on a solid object while gripping.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

5.2 This method was originally developed to help understand how materials and construction of firefighting gloves affected grip. Methods available at the time showed very little statistical difference between a wide range of gloves, including many NFPA 1971 compliant firefighting gloves and also non-compliant gloves used in other applications. This method was shown to have less subject-to-subject variability and a greater range of measured grip than previous tests.⁴

5.3 Further research was conducted in 2022 using two disparate, non-firefighting protective gloves and a larger specimen size. The research showed that the test method could be used successfully on a variety of glove types other than structural firefighting.⁵ Key findings about the testing methodology have been included in the standard.

5.4 This test method does not discriminate all glove effects on wearer hand function, nor does it apply to all glove types and applications. Consider additional evaluations or tests representative of the glove use applications performed to determine the overall impact of gloves on wearer hand functions.

6. Apparatus

6.1 *Testing Apparatus*—The device used to characterize the gripping performance of gloves consists of a torque meter with adjustable rod holder and a smooth acrylic cylindrical rod (Fig. 1). The rod is secured tightly in the adjustable rod holder attached to the torque meter.

6.2 Use a torque meter capable of meeting the following requirements:

6.2.1 Measuring 0 to 10.0 ± 0.5 N·m (88.5 ± 4.5 lb-in.).

6.2.1.1 A torque meter with a higher measuring range is allowed provided it still has an accuracy of ± 0.5 N·m (± 4.5 lb-in.).

NOTE 1—Many people are able to torque more than 10 N·m; therefore, using a torque meter with this limiting factor could disproportionately eliminate stronger test subjects.

NOTE 2—Torque meter should be calibrated in accordance with manufacturer's guidance.

6.2.2 Able to be fastened in place or heavy enough to be immobile during testing.

6.2.3 Able to measure torque in either a clockwise or counterclockwise direction.

6.2.4 Fitting with an adjustable rod holder fixed to the upper surface of the meter.

6.2.4.1 The rod holder has four metal pins protruding upwards from the surface. Use 10 mm diameter pins that protrude 30 mm from the surface of the holder.

(1) Cover the metal pins with a rubber material that is between 2.5 and 3.0 mm thick.

6.3 Use transparent cast acrylic rod meeting the following requirements:

⁴ Ross, Barker, Watkins, and Deaton, "Methods for Measuring the Grip Performance of Structural Firefighting Gloves," *Performance of Protective Clothing and Equipment: Emerging Issues and Technologies*, ASTM STP 1544, Vol 9, A. Shepherd Ed., ASTM International, West Conshohocken, PA, 2012.

⁵ Burns, D., "Grip Characterization of Protective Gloves" (2022), Theses & Dissertations, 695. <https://digitalcommons.unmc.edu/etd/695>.



FIG. 1 Acrylic Rod Attached to a Torque Meter

6.4 Measures 600 mm (24 in.) in length and has a diameter of 41.5 mm (1.625 in.).

6.4.1 Has a surface roughness value of 0.10 ± 0.05 μ m (4 ± 2 μ in.) and is free of visual scratches and blemishes.

6.4.2 Use an acrylic rod with four grooves cut into the bottom of the rod. Grooves should match the size of the pins with rubber covering.

6.4.2.1 Fig. 2 shows an example of a rod cut with grooves at the bottom.

7. Sampling, Test Specimens, and Test Units

7.1 The testing process should be (a) bare hand, (b) dry glove, and then (c) either wet with water glove or wet with oil glove. If both wet tests are desired, then two test specimens are required for each test subject. See Fig. 3.

NOTE 3—There is no requirement to conduct all the tests. However, if conducting a wet test, the dry test must be conducted first.

7.2 Four test subjects are used for the testing.