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Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test[1]

This standard is issued under the fixed designation F2010/F2010M; 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 is used for evaluating hand dexterity while wearing gloves.

1.1.1 This test method covers procedures in which the wearer picks up small objects between the thumb and index finger.

1.2 This test method is suitable for evaluating gloves and other forms of hand protection that allow the wearer to pick up small objects between their thumb and index finger.

1.3 This test method does not address all effects of glove use on hand function. Other methods should be considered to evaluate the effects of gloves on grip, tactility, and other hand functions of interest.

NOTE 1—This test method may not apply to all glove types or applications.

1.4 The values stated in SI units or in other units shall be regarded separately as standard. The values stated in each system must be used independently of the other, without combining values in any way.

1.5 *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]

F1494 Terminology Relating to Protective Clothing

3. Terminology

3.1 *Definitions:*

3.1.1 *dexterity, n*—a hand function referring to the ability of the individual to manipulate objects with their hands.

3.1.1.1 *Discussion*—Dexterity may be classified as requiring fine motor skills in which relatively small objects are manipulated or those involving gross motor skills in which relatively large objects are handled.

3.1.2 *glove, n*—an item of protective clothing designed and constructed for protecting the hand and wrist.

3.1.3 *hand function, n*—the relative motion and manipulative abilities of the hand.

3.1.3.1 *Discussion*—In this test method, the effect of gloves on a specific hand function, dexterity, is evaluated.

3.1.4 *protective clothing, n*—a product which is designed and constructed for the purpose of isolating parts of the body from a potential hazard.

3.1.4.1 *Discussion*—In this test method, gloves are evaluated to determine the effect on the hand function of the wearer.

3.1.5 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 time required for a test subject to place pegs into a pegboard is measured without gloves and then later while wearing gloves. The additional time required to perform the task while wearing gloves is reported and is used to indicate the effects of the gloves on wearer dexterity.

5. Significance and Use

5.1 The test method is intended to provide a quantitative measurement about the effect of gloves on wearer dexterity by comparing the times required to perform a simple task with and without gloves.

5.2 This test method does not discriminate all glove effects on wearer hand function or apply to all glove types and applications. Additional evaluations or tests representative of the glove use application should be performed to determine the overall impact of gloves on wearer hand function.

6. Apparatus

6.1 *Test Apparatus,* a pegboard apparatus consisting of 25 stainless steel pins and a pegboard. Each stainless steel pin

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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.

shall have a diameter of 9.5 ± 0.26 mm [0.375 ± 0.01 in.] and length of 38.0 ± 0.25 mm [1.5 ± 0.01 in.]. The pegboard shall be 200 ± 13 mm [8.0 ± 0.5 in.]. The pegboard shall have 25 holes with each hole having a diameter of 10.0 ± 0.25 mm [0.39 ± 0.01 in.] and a depth of 13.0 ± 0.5 mm [0.5 ± 0.02 in.]. The holes shall be in a 5 by 5 pattern and each hole shall have a separation of 25 ± 2 mm [1.0 ± 0.1 in.] from adjacent holes.

6.2 *Stopwatch,* to measure the time to place the pegs into the pegboard in seconds.

6.3 *Test Surface,* an area at least 600 by 900 mm [23.5 by 33.5 in.] with a flat, level, smooth surface having a hardness of 50 ± 5 Shore A.

7. Test Specimen

7.1 For each style of glove evaluated, test five pairs (ten gloves), preferably of five different sizes. When less than five different glove sizes are available for the particular glove style, test different pairs of the same size so that a total of at least five different glove pairs are tested.

7.2 Test each glove in new, as distributed, condition. Do not apply special softening treatments to gloves prior to tests.

8. Test Preparation

8.1 Evaluate each pair of gloves with a separate test subject.

8.2 The hand dimensions of test subjects must be as close as possible to those specified in manufacturer's glove sizing guidelines.

8.3 Familiarize test subjects with the test apparatus and procedure by having test subjects practice the test three times before conducting an actual test, but not on the same day as the actual test. Each test subject should use their dominant hand in picking up pegs.

8.4 Use test subjects that have a baseline dexterity time between 25 and 45 s.

9. Procedure

9.1 Before each test, randomly scatter the pegs on the test surface adjacent to the pegboard (laying flat on the test surface) in the working area most comfortable to the test subject (that is, on the right side for right-handed test subjects and on the left side for left-handed test subjects, or directly in front).

9.2 Instruct the test subject to pick up with one hand (using their dominant hand) one peg at a time and place them in the pegboard beginning at the upper left corner and proceeding left to right and top to bottom. Instruct the test subject to pick up each peg with a pincer motion near the center of the barrel of the peg and not by sliding, standing, or otherwise supporting the peg with another object (such as the pegboard, another peg, or the test subject's free hand). Instruct the test subject to use only one hand, and not to alternate hands during the test series. Instruct the test subject that the pegboard may be stabilized, if necessary, such as with the use of the test subject's free hand.

9.3 Measure the time for the test subject to put pegs into the pegboard beginning when the test subject touches the first peg until the test subject places the last peg into the pegboard.

9.4 Perform steps 9.1-9.3 with the test subject barehanded. Repeat this procedure until the coefficient of variation in the times of the last three repetitions is less than 8 %. Use the average dexterity test time of the last three repetitions as the baseline dexterity test time (DTT_b). Conduct each test without the test subject's knowledge of the dexterity test time for each test.

9.5 Perform steps 9.1-9.3 with the test subject wearing the test gloves. Repeat this procedure until the coefficient of variation in the times of the last three repetitions is less than 8 %. Use the average dexterity test time of the last three repetitions as the dexterity test time with gloves (DTT_g). Conduct each test without the test subject's knowledge of the dexterity test time for each test.

10. Calculation

10.1 Determine the coefficient of variation (cov) as required in 9.4 and 9.5 by dividing the standard deviation of the last three replicate dexterity times by the average of the same three replicate dexterity times and then multiplying by 100.

10.2 Compare the dexterity test times with gloves with the baseline dexterity test time for each test subject. Calculate the percentage of barehand control for each test subject and glove size evaluated as follows:

$$\text{Percent of barehand control} = \frac{DTT_g}{DTT_b}(100) \quad (1)$$

where:

DTT_g = dexterity test time with gloves
DTT_b = the baseline dexterity test time

10.3 Calculate the average percentage of barehanded control for a glove style by averaging the values of percent of barehand control for each test subject.

11. Report

11.1 State that the test was conducted as directed in Test Method F2010.

11.2 Describe the type of glove tested, including the manufacturer, style name or number, and the glove sizes evaluated.

11.3 For each style of glove tested, report the percent of barehanded control for each test subject and the average percent of barehanded control for all test subjects.

12. Precision and Bias

12.1 *Precision*—The data in Table 1 are provided for the

TABLE 1 Precision and Bias Data

Test Subject	Glove Style						
	A	B	C	D	E	F	G
1	250.0	283.8	439.7	142.9	218.8	270.6	260.8
2	264.0	280.0	360.2	109.3	253.7	173.7	168.7
3	216.8	687.1	795.2	104.7	182.9	323.5	202.2
4	197.6	331.1	638.5	111.9	254.9	222.2	150.4
5	165.2	331.7	217.2	97.7	200.8	151.5	161.1
Average	218.7	380.9	490.2	113.3	222.2	228.3	188.6
Standard Deviation	39.8	168.0	228.6	17.4	31.9	70.3	44.8

evaluation of seven glove styles using five different test subjects. The gloves evaluated represent a range of glove styles for hazardous materials emergency response applications.

12.2 *Bias*—No information can be presented on the bias of the procedure in Test Method F2010 for measuring glove effects on wearer dexterity because no glove having an accepted reference value is available.

13. Keywords

13.1 dexterity; gloves; hand function; pegboard test