Designation: F 694 – 02ε1

Standard Test Method for Heel-Attaching Strength of Women's Shoes[1]

This standard is issued under the fixed designation F 694; 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.

ε[1] NOTE—Per Committee F13 Bylaws, editorially replaced term definitions with references to Terminology F 1646 in January 2004.

1. Scope

1.1 This test method covers the determination of heel attachment strength on women's and misses' shoes through application of a static load to the heel. Shoe heels may be made of various materials, including wood, plastic, leather, or rubber. The heels may be attached to the shoe body with nails, screws, staples, cement, or a combination of these.

1.2 This test method is applicable for testing heel heights 1½ in. (38 mm) and higher. (Heel heights are manufactured in ⅛-in. increments.) *This testing is applicable for front or back of heel.*

2. Referenced Documents

2.1 *ASTM Standards:*

F 1646 Terminology Relating to Safety and Traction for Footwear[2]

3. Terminology

3.1 See Terminology F 1646 for the following terms used in this test method:

3.1.1 Heel breast,
3.1.2 Insole,
3.1.3 Outsole,
3.1.4 Pricker points,
3.1.5 Shank,
3.1.6 Shankboard, and
3.1.7 Top lift.

4. Summary of Test Method

4.1 A shoe is mounted vertically on a mounting form and secured with holding clamps. Pressure is applied to the shoe heel by means of a vertical piston and a hand-operated hydraulic pump. A hydraulic pressure gage indicates the amount of pressure in pounds-force (or newtons) exerted against the heel. This pressure, when multiplied by the lever arm through which it is applied, gives the torque value for heel-attaching strength.

5. Significance

5.1 Heel-attaching strength is an important factor in the design of a safe and comfortable shoe that adequately supports the foot.

6. Apparatus

6.1 *Self-Contained Device*,[3] consisting of a hand-operated hydraulic pump, a piston, a pressure gage, and a suitable mount with security clamps to hold the test specimen rigidly in position as sketched in Fig. 1 and Fig. 2.

NOTE 1—The area of the piston head on this tester is 0.9968 in.^{2} (6.43 cm^2). This is sufficiently close enough to 1.000 in.^{2} (6.43 cm^2) to permit a direct gage reading of pounds-force (or newtons) exerted on the heel.

7. Sampling

7.1 Tests should be made on each new style shoe, and on any shoe where the construction method or material is changed, such as length of nail, insole material, nailing pattern, etc.

7.2 Conduct routine testing to determine if adequate heel-attaching strength is being maintained.

7.3 Perform random testing on a sufficient number of shoes from production or from stock to give reliable results.

8. Preparation of Apparatus and Test Specimens

8.1 Temporarily mount the test specimen on the shoe-mounting form.

8.2 Position pressure piston on the testing apparatus so as to obtain the maximum lever arm on the particular heel being tested. Secure the piston to the machine base with screws.

8.3 If the heel is to be tested from the heel breast side, make a mark on the breast at the point where the piston will engage the heel. If the heel is to be tested from the back side of the

[1] This method is under the jurisdiction of ASTM Committee F13 on Safety and Traction for Footwear and is the direct responsibility of Subcommittee F13.20 on Construction.

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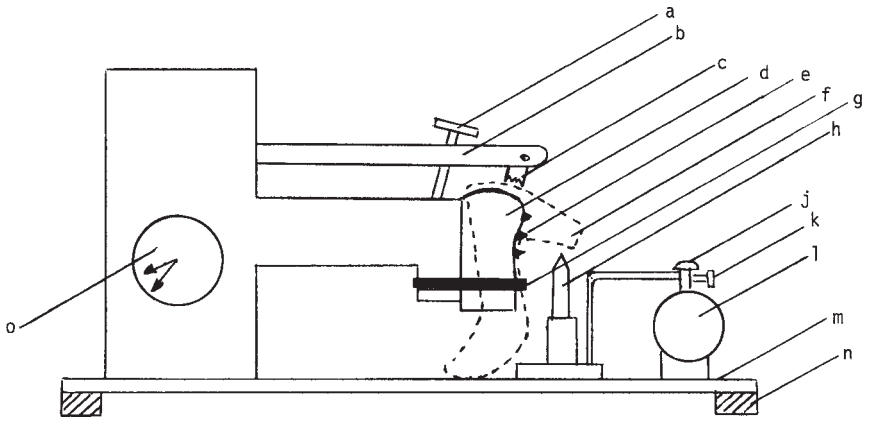
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] A suitable device is available from Creativity, Inc., 58 Rantoul St., Beverly, MA 01915 and Whitely Industries, Inc., 14 Everberg Road, Woburn, MA 01801.



a. Upper clamp operating screw
b. Upper clamp operating arm
c. Upper clamp
d. Shoe mounting form
e. Shoe holding points
f. Shoe heel
g. Shoe securing clamp
h. Piston
j. Pump handle
k. Pressure control valve
l. Reservoir
m. Machine base
n. Machine base support
o. Pressure gage with maximum reading pointer

FIG. 1 Test Apparatus (Front View)

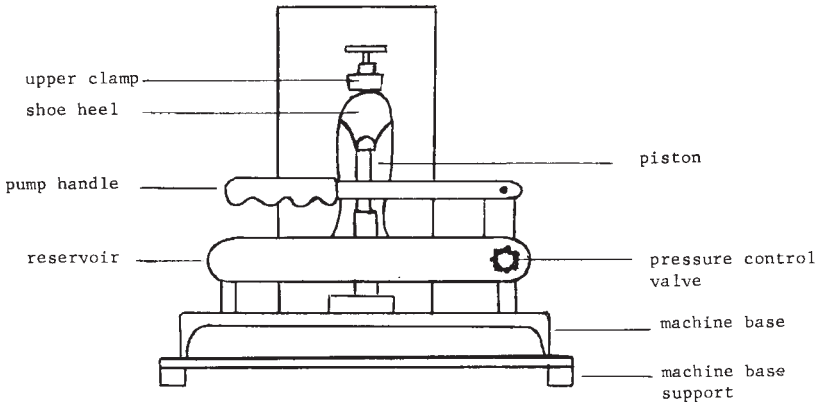


FIG. 2 Test Apparatus (End View)

heel, make a mark on the back of the heel at the point where the piston will engage the heel.

8.4 Remove the test specimen from the shoe-mounting form. Using a three-cornered file, make a groove in the heel parallel to the toplift at the point previously marked. The maximum depth of the groove is 1 mm.

8.5 Remount the test specimens on the mounting form. Place the lower clamping ring around the shoe just in front of the heel breast and tighten securely. Adjust the upper clamp so as to prevent vertical movement of the test sample during the test.

8.5.1 For the closed-back shoes (shoes with or without a counter), the upper clamp can be used so as to prevent vertical movement of the test shoe during the testing.

8.5.2 For open-back shoes, the foot form has been modified to include four pricker points (see section 3.1.4) approximately ⅛ in. (3.2 mm) long that penetrate the insole due to the lower clamping ring and prevent vertical movement of the test shoe during the testing. This method for preventing vertical movement of the test shoe can also be used for closed-back shoes.

8.6 Measure the horizontal distance between the point where the front edge of the heel is joined to the shoe upper and the point where the piston engages the heel. Record this distance as the torque lever arm (see Fig. 3 and Fig. 4).

8.7 Close the valve (*k*) on the right side of the hydraulic pressure reservoir (*l*) by turning the knob clockwise.

8.8 On heels less than 2 in. (50.8 mm) high, cut off the forepart of shoe so the shoe will clear the piston housing.

9. Conditioning

9.1 Maintain the temperature of the testing room at 73.4± 3.6°F (23 ± 2°C) and 50 ± 2 % relative humidity.

9.2 Condition the specimens in this atmosphere for not less than 24 h prior to testing.

10. Procedure

10.1 Apply pressure to the heel by pumping the handle continuously on the hydraulic reservoir.

10.2 Continue to apply increasing pressure to the heel until there is ⅛ + 1/32 , − 0 in. (3.2 + 0.8, − 0 mm) permanent

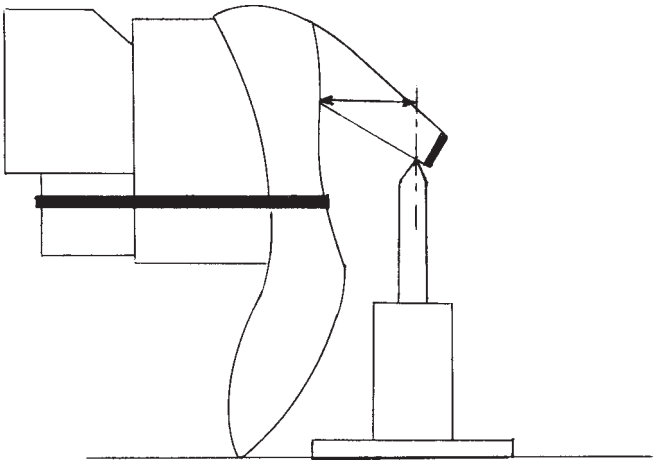


FIG. 3 Determination of Torque Lever Arm on Shoes with Cuban Heels

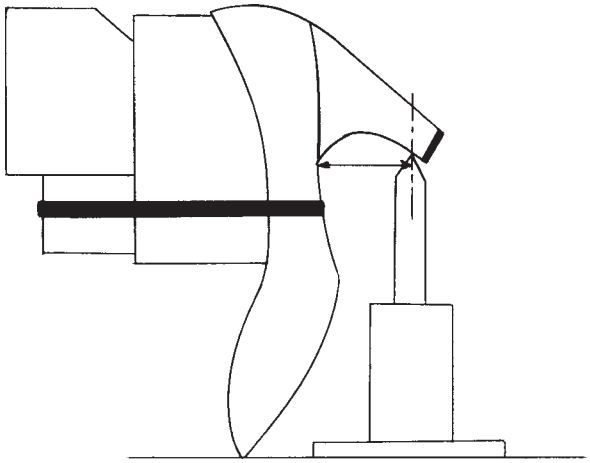


FIG. 4 Determination of Torque Lever Arm on Shoes with Louis Heels

separation between the heel and the shoe upper as measured by a measuring instrument accurate to 1/32 in. (0.8 mm), or there is a drop in the gage indicator needle. The maximum pressure reading pointer will indicate the maximum pressure obtained.

10.3 At 1/8-in. (3.2-mm) separation, release the piston pressure on the heel by opening the hydraulic pressure reservoir valve. The gage pressure indicator needle will return to zero and the maximum pressure reading pointer will indicate the maximum pressure obtained.

10.4 If, upon release of pressure, the heel moves back to less than 1/8-in. (3.2-mm) separation, repeat 8.7, 10.1, 10.2, and 10.3 until there is a 1/8-in. permanent separation.

10.5 Record the maximum gage reading in pound-force or newtons at 1/8-in. (3.2-mm) permanent separation as the failure point.

11. Calculation

11.1 Calculate the heel-attaching strength of the test specimen, expressed numerically by the torque required to produce 1/8-in. (3.2-mm) permanent separation as follows:

$$T = F \times L \quad (1)$$

where:

T = torque required to produce 1/8-in. (3.2-mm) permanent separation, lbf·in. (N·m),
F = maximum gage reading at 1/8-in. (3.2-mm) permanent separation, lbf (N), and
L = lever arm through which the force was applied to the heel, in. (m).

12. Report

12.1 Report the following information:

12.1.1 Torque required to produce 1/8-in. (3.2-mm) permanent separation.

12.1.2 Type of failure encountered, as follows:

12.1.2.1 Nails (or staples) pulled out of heel,

12.1.2.2 Nail (or staple) heads tore through insole,

12.1.2.3 Nail (or staple) heads tore through outsole,

12.1.2.4 Nail (or staple) heads tore through insole and outsole,

12.1.2.5 Shankboard bends, or

12.1.2.6 Other (describe).

12.1.3 Number of fasteners that pulled out or tore through.

12.1.4 Direction of applied load (against breast side of heel, or against back side of heel).

12.1.5 Heel height, heel material, and type or style.

12.1.6 Shoe type or style, and size.

12.1.7 Date and location of manufacture.

12.1.8 Fasteners used, including number, type, and dimensions.

12.1.9 Shankboard used, including type, quality, and thickness.

12.1.10 Type of shank used and location.

13. Precision and Bias

13.1 There is insufficient data from testing at this time to accurately establish the precision and bias. The precision and bias are being established.

14. Keywords

14.1 heel-attaching strength; torque; heel separation