

CHANGE NOTICES ARE NOT  
CUMULATIVE AND SHALL  
BE RETAINED UNTIL SUCH  
TIME AS THE ENTIRE STANDARD  
IS REVISED.

FED. TEST METHOD STD. NO. 311  
CHANGE NOTICE 2  
July 13, 1972

FEDERAL TEST METHOD STANDARD

LEATHER, METHODS OF SAMPLING AND TESTING

The following changes to Fed. Test Method Std. No. 311 dated January. 15, ,1969, have been approved by the Commissioner, Federal Supply Service, General Semites Administration for the use of all Federal agencies.

1. Delete Section 2 and substitute the attached Section 2.
2. Delete Methods 3211, 4211, 8011, 8021, 8111, 8112, and 8131, and substitute the following attached revised methods: 3211.1, 4211.1, 8011.1, 8021.1, 8111.1, 8112.1 and 8131.1.
- 3\* Add the following new methods: 3041 and 4212.

Military custodians:

Army - GL  
Navy - SA  
Air Force - 82

Review activity:

Navy - AS

User activities:

Amy - WC  
Navy - OS, YD, MC  
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Preparing activity:

Army - GL

Civil Agencies Coordinating Activities:

AGR-CMS  
GSA-FSS  
GSA-PCD  
HEW-HSM

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8231	Water Marks on Grain Leather

METHOD 3211.1  
July 13, 1972  

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SUPERSEDING  
Method 3211  
January 15, 1969

AREA STABILITY OF LEATHER TO PERSPIRATION

1. SCOPE

1.1 This method is intended for determining the effect of perspiration on glove, garment and lining leather. The leather is subjected to treatment with artificial perspiration, and loss in area caused by subsequent exposure to moisture and heat is measured.

2. TEST SPECIMEN

2.1 The specimen shall be a square of leather 2 by 2 inches (51 by 51 millimeters) cut from tile sample unit of leather.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

4. APPARATUS AND REAGENTS

4.1 A flat bottomed heat-resistant container made of plastic or other inert material with cover of sufficient size to accommodate a maximum of 15 specimens (a container 30 centimeters long, 12 centimeters wide and 10 centimeters deep has been found to be suitable).

4.2 A hanger for suspending the specimens shall be made from Nichrome wire having a maximum of 0.3 millimeter diameter. A loop shall be formed in the center of a piece of Nichrome wire. Both ends of the wire shall be shaped into hooks.

4.3 A forced circulating-air oven capable of maintaining a temperature of  $70 \pm 2^{\circ}\text{C}$ .

4.4 Ruler.

4.4.1 A ruler graduated to 0.1 inch or finer shall be used when the dimensions of the die used are in square inches, the measurements shall be estimated to the nearest .02 inch.

4.4.2 A ruler graduated to 2 millimeters or finer shall be used when the dimensions of the die used are in square millimeters, the measurements shall be estimated to the nearest millimeter.

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METHOD 3211.1

4.5 A metal die for cutting the specimen to the required dimensions.

4.6 Artificial perspiration - The artificial perspiration solution shall be as specified in method 3221.

4.7 Punch or other suitable instrument for making 90.3 millimeters diameter hole in the specimen.

4.8 Polyethylene wrapping.

4.9 Plastic tape to wrap glass rods to stick to outside of container.

4.10 Plastic tubing over glass rods for spacers.

5. PROCEDURE

5.1 Three measurements of each dimension of the specimen shall be made and averaged. The measurements shall be made 13 millimeters from each side of the specimen. The surface of the specimen shall be indelibly marked to indicate the points of measurement. The average measurements shall be used to calculate the original area of the specimen and this area recorded as A (The known dimensions of the die may be used instead of actually measuring tile specimen. When this option is taken the specimen shall still be marked at the points of measurement indicated above).

5.2 Two small holes shall be punched in adjacent corners of the specimen. The specimen shall then be placed in a beaker or tray containing not less than 10 milliliters of artificial perspiration solution per specimen.

5.3 The specimens shall be immersed in the artificial perspiration solution for a few minutes and then shall be worked by hand individually, while applying pressure with the fingertips until the grain and flesh surfaces have been thoroughly wetted. Some specimens may require many successive manipulations to be wetted.

5.4 The pieces shall be removed from the artificial perspiration solution after one hour and suspended on the hanger hooks. The hooks shall be inserted into the two holes punched in the specimen. A glass rod shall be passed through the loop. The glass rod shall be suspended over a container or blotter. To prevent the specimens from touching each other as additional specimens are suspended from the glass rod, pieces of plastic tubing 17 millimeters or longer shall be slipped on the glass rod between the loops. An additional piece of plastic tubing shall be added to each end of the glass rod.

## METHOD 3211.1

5.5 The glass rod with attached specimens shall be suspended inside a suitable container to which 200 cubic centimeters of luke warm distilled water have been added. The glass rod shall be suspended in such a manner that the container can be tightly covered and specimens do not get closer than 1/2 inch (12.7 millimeters) from the surface of the water. The glass rod with specimens may be supported by short glass rods attached to the inside wall at each end of the container. The short glass rods may be attached to the walls by wrapping them with plastic tape in a manner that permits the tacky side of the tape to be fastened to the outside of the container.

5.6 After the specimens are mounted, the lid shall be placed on the container. The container shall then be wrapped with polyethylene. The lid shall be weighted down to prevent it from warping when being heated. The container shall be carefully transferred to a shelf in a circulating, air oven preheated to  $70^{\circ} \pm 2^{\circ}\text{C}$ . The container with specimen shall be kept in the oven for 48 hours at  $70^{\circ} \pm 2^{\circ}\text{C}$ .

5.7 The container shall be removed from the oven and the specimens transferred flesh side up to a flat non-absorbing surface. The specimens shall be allowed to dry under standard conditions until they attain moisture equilibrium.

5.8 To determine area loss, a total of six measurements shall be taken on each test specimen by placing a ruler across the specimen at the points previously marked. Three measurements shall be taken in one dimension, averaged, and the average recorded as "E". Three measurements shall be taken in the other dimension, averaged, and the average recorded as "C". The averages shall be calculated to the nearest 0.1 millimeter or .02 inch. The average area change shall be calculated as follows:

$$\text{percent area change} = \frac{A - (B \times C) \times 100}{A}$$

Where: A - original area of the specimen (calculated from the known dimensions of the die).

B - average of three measurements in one dimension of the tested specimen.

C - average of three measurements in the other dimension of tested specimen.

METHOD 3211.1

In the event of increase in area of the test specimen, the calculations shall be made as follows:

$$\text{Percent area change} = \frac{(\mathbf{B \times C}) - \mathbf{A \times 100}}{\mathbf{A}}$$

6. REPORT

6.1 Area change shall be calculated to the nearest 0.1 percent.

METHOD 4211.1  
July 13, 1972  
SUPERSEDING  
Method 4211  
January 15, 1969

## STIFFNESS

### 1. SCOPE

1.1 This method is intended for determining the stiffness of leather by measuring the force required to bend the material through a given angle.

### 2. TEST SPECIMEN

2.1 Unless otherwise specified in the material specification, the specimen shall be a rectangle of leather 4 inches (101.6 millimeters) in length and 0.5 inch (12.7 millimeters) in width, die cut from the sample unit of leather.

### 3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

### 4. APPARATUS

4.1 A stiffness testing machine. A suitable apparatus is shown in figure 4211.

4.1.1 The machine shall contain a vise for clamping one end of the specimen, mounted on a horizontal shaft which is driven at about 0.2 revolutions per minute by a motor. A pendulum weight system equipped with a set of detachable weights shall be attached to the shaft. The force applied to turn the shaft is regulated by changing the weights on the pendulum. A range of bending moments can be obtained with weights calibrated in inch pounds as follows: .15, .25, .5, 1.0, 2.0 and 5.0. Any selected moment weight shall be increased by 0.1 inch pounds to account for the inertia of the apparatus.

4.1.2 The machine shall be equipped with a movable load scale graduated from 0 to 100 percent. The scale shall be adjusted to give a zero reading with the upright pointer at rest and the weight on the pendulum.

4.1.3 The machine shall be equipped with an angular deflection scale graduated in degrees. A pointer that moves over the scale shall be attached to the shaft. The scale shall measure the angle through which the specimen is bent.

## METHOD 4211.1

4.1.4 The machine shall contain a pin that can be fixed in different positions to regulate the length of the span between the vise and the free end of the specimen that rests against the pin to give spans of 0.25, 0.50 and 1.00 inch.

4.1.5 The machine shall be equipped so that the motor can be thrown in and out of gear, the vise moved to the original position by hand, and the pointers adjusted to zero positions.

### 4.1.6 Calibration

4.1.6.1 The instrument shall be calibrated using the .004 inch strip from the 9-blade feeler similar to the one specified in Federal Specification GGG-G-17 as type VIII, class 1, style B. The strip shall be permanently removed from the set.

4.1.6.2 No strip shall be bent to the extent that the load scale reading exceeds 60. Any strip that appears permanently bent (either because it has been accidentally bent too much in the apparatus or abused by improper handling) shall be discarded.

4.1.6.3 The machine shall be leveled by placing a leveller on top of it parallel and perpendicular to the long dimension. The weight shall be placed on the pendulum. The pin shall be adjusted to give the specified span. The motor shall be started and kept running throughout the test since its vibration minimizes friction effects in the weighting system. The strip shall be firmly clamped in the vise with the hole on the left and the printed figure .004 inch appearing between vise and pin.

4.1.6.4 The apparatus shall be adjusted by hand so that the free end of the strip rests on the pin, showing a 1 percent load scale reading. The pointer for the angular deflection shall be adjusted by hand to 0.

4.1.6.5 The motor engaging lever shall be held down and the apparatus maintained in action until the angular deflection scale indicates that the strip has been bent through the required number of degrees. At that instant, the load scale reading shall be read from the position of the pointer on the load scale and the value recorded as the load scale reading. This reading shall be corrected for the initial 1 percent load scale reading.

## METHOD 4211.1

4.1.6.6 The strip shall give the following load scale readings:

	<u>At 10°</u>	<u>At 20°</u>	<u>At 30°</u>
After loading with .25 inch-pound (.5 inch span)	23 ± 1	40 ± 1	--
After loading with .5 inch-pound (.5 inch span)	13 ± .5	26 ± .5	29 ± 1
After loading with .5 inch-pound (1.0 inch span)	--	15 ± .5	22 ± 1

## 5. PROCEDURE

5.1 Unless otherwise specified, this test shall be performed under the conditions and on material conditioned as specified in Section 5.

5.2 The machine shall be prepared and put in motion as described in 4.1.6.4 and 4.1.6.5, except that the specimen, grain side down and with the long side parallel to the edge of the dial plate, is clamped into the vise. One end of the specimen shall be flush with the left side of the vise.

5.3 Calculations.

5.3.1 When the bending moment is specified, it shall be applied when the specimen is bent to a 60 degrees angular deflection and shall be recorded as follows:

$$\text{Bending moment, inch-pounds} = \frac{\text{Load scale reading} \times \text{moment weight}}{100}$$

## 6. REPORT

6.1 The load scale reading of the specimen shall be reported to the nearest scale division.

6.2 The bending moment shall be reported to the nearest 0.001 inch-pound.

6.3 The size of the specimen, angle of deflection, moment weights, span and exceptions to calibration procedure shall be a part of the report.

## 7. NOTES

7.1 Apparatus which meets the requirements may be purchased from Tinius Olsen Testing Machine Co., 2100 Easton Road, Willow Grove, PA 19090.

METHOD 4211.1

# DIRECTIONAL STIFFNESS CANTILEVER BENDING APPARATUS

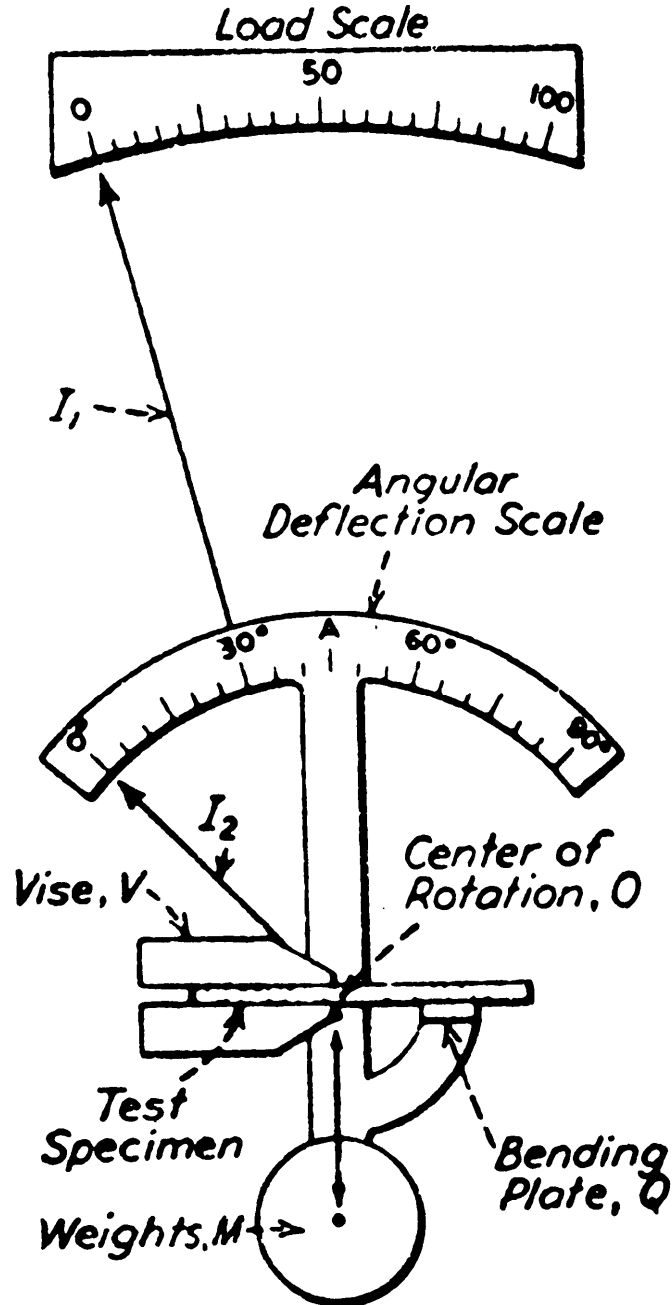


FIGURE 4211

FED. TEST METHOD STD. NO. 311

METHOD 8011.1  
July 13, 1972  
SUPERSEDING  
Method 8011  
January 15, 1969

PERMEABILITY, WATER VAPOR

1. SCOPE

1.1 This method is intended for determining the permeability of leather to water vapor by measuring the rate at which vapor passes through the material. Water vapor permeability is one of the several factors contributing to the relative comfort of footwear, handwear and garments.

2. TEST SPECIMEN

2.1 The specimen for test shall be a disc 2.75 inches (70 millimeters) die cut from the sample unit of leather.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

4. APPARATUS AND REAGENTS

4.1 Apparatus.

4.1.1 An assembly consisting of a round 6 ounce (175 cubic centimeters) clear polystyrene container with 70 millimeters thread top, 2-5/16 inches (58.9 millimeters) in height and 2-3/8 inches (60.5 millimeters) inside diameter; the threaded part of a two piece Mason jar lid (without the flat insert); and a rubber ring 2-13/16 inches (71.6 millimeters) outer-diameter.

4.1.2 A metal die for stamping or cutting the specimen to the required dimensions.

4.1.3 Plastic or similar nonporous tape 0.5 inch (12.7 millimeters) to 1 inch (25.4 millimeters) wide.

4.1.4 Turntable for 78 rpm. records, modified to hold up to eight containers. in column clamps. An improvised holder consisting of an inverted tripod mounted on the revolving table with wires or tapes, or both. The extension rods of the clamps are fastened to the legs of the tripod by suitable clamp

## METHOD 8011.1

holders so that when the containers are mounted, bottom up, the exposed surface of the specimen is approximately  $80 \pm 5$  millimeters above and parallel to the surface of the turntable and the distance between the center of the specimens and the axis of the turntable is 5-1/2 inches (140 millimeters). Column clamps, usable for the containers of 4.1.1, having a flat thumb screw adjustment from 2-1/2 or 3-1/2 inches in diameter, operating as a worm drive (Will Scientific, Inc. Catalog No. 10 Column Clamps 8722 or equal). Instead of the suggested improvisation, a permanent eight-station holder for the column clamps can be made using a metal or plastic frame that is securely fastened to the base.

## 4.2 Reagents.

4.2.1 A desiccant consisting of fresh 8 mesh anhydrous calcium chloride.

## 5. PROCEDURE

5.1 Unless otherwise specified in the material specification, the test shall be carried out under standard conditions specified in Section 5.

5.2 Unless otherwise specified in the material specification, the grain side of the specimen shall face the desiccant.

5.3 The container shall be filled with 40 grams of desiccant. The sample and the gasket shall be placed in the threaded lid and the lid screwed to the container. Tape shall be tautly wound at least twice around the closure to seal the container.

5.4 The container with the specimen shall be mounted, bottom up at the correct height and the turntable shall be turned on at once. After one hour the container shall be weighed for the first time. All weighings shall be recorded to the nearest .001 gram. A total of three weighings shall be made, separated by intervals of at least one hour. If the increase after the first hour is less than .020 grams, intervals between the next two weighings shall be extended sufficiently to insure that increases between weighings exceed .020 grams. After each weighing, the container shall be shaken gently to insure that a new surface of the desiccant is in contact with the specimen. A blank with an impermeable material placed in the threaded lid shall also be run simultaneously and the weight increase found shall be subtracted from those found with the materials tested. Permeability shall be calculated as follows:

METHOD 8011.1

$$\text{Permeability, grams per square meter per day} = \frac{W \times 10,300}{T}$$

Where: W = increase in weight of the assembly for exposure period, grams.

T = time of exposure in hours.

6. REPORT

6.1 The water vapor permeability of the specimen shall be reported to the nearest 10 grams per square meter per day when the figure is 1000 or larger, to the nearest 5 grams per square meter per day when the figure is 200 - 900 and to the nearest 1 gram per square meter per day when the figure is below 200.

7. NOTES

7.1 The polystyrene jars are available in case lots from Parkway Plastics P.O. Box 475, 565 Stelton Road, Piscataway, NJ 08854.

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METHOD 8021.1  
July 13, 1972  
SUPERSEDING  
Method 8021  
January 15, 1969

DYNAMIC WATER RESISTANCE OF LEATHER  
BY THE MAESER WATER PENETRATION TESTER

1. SCOPE

1.1 This method is intended for determining the dynamic water resistance of leather by the Maeser water penetration tester. The flex imparted to the leather is similar to the flex given the vamp of the shoe in actual wear. This method is not interchangeable with method 8131.

2. TEST SPECIMEN

2.1 The specimen for test shall be a square of leather approximately 4 by 4 inches (101.6 by 101.6 millimeters), cut from the sample unit. The minimum size shall be not less than 3-7/8 by 4 inches (98.3 by 101.6 millimeters); the maximum size shall be not greater than 4 by 4-1/2 inches (101.6 by 114.3 millimeters).

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

4. APPARATUS AND REAGENTS

4.1 Apparatus.

4.1.1 Maeser Water Penetration Tester or its equivalent. The essential features of the machine are:

4.1.1.1 The machine shall have a specimen holder made of two V-shaped clamps with rubber wedges for holding the specimen. The clamps shall be  $2.5 \pm 0.1$  inches ( $63.5 \pm 2.5$  millimeters) apart, inside measurement, when their tops are in the same horizontal plane. One clamp shall be in a fixed position; the other clamp shall be pivoted and attached through a connecting link to a motor-driven eccentric which runs at  $90 \pm 5$  rpm. In one rotation of the eccentric, the center of top of the moveable clamp shall move a distance of  $1.00 \pm 0.05$  inches ( $25.4 \pm 1.3$  millimeters) below the horizontal and return.

## METHOD 8021.1

4.1.1.2 A water tank made of copper, stainless steel, or other non-corrosive material. The tank shall be of such a size that it can be placed around the clamps and of such a depth that, when in position for use, the top is 1.25 to 1.50 inches (31.7 to 38.1 millimeters) above the lowest part of the moveable clamp.

4.1.1.3 A base for the water tank. The base shall be removable from between the machine frame and the water tank.

4.1.1.4 Two counting systems should be used to indicate the number of cycles through which the specimen is flexed. One shall be a mechanical reset counter connected to the moveable clamp. The other counter shall be electrical and shall consist of a high electrode and a common electrode. The resistance across the electrodes shall be between 5,000 and 10,000 ohms. When the resistance falls below this value, the relay shall be energized. The high electrode shall be placed inside the leather specimen in contact with the steel balls. The common electrode shall be in a salt solution which is in continuous contact with the specimen during flexing. The switch, when manually closed, shall start the machine and activate the testing circuit.

4.1.2 Monel or stainless steel balls, 1/8 inch (3 millimeters) in diameter, 400 series (seconds acceptable).

4.1.3 Magnet (to facilitate removal of balls.).

### 4.2 Reagents.

4.2.1 Sodium chloride solution (1 gram per liter). Dissolve 1 gram of sodium chloride in distilled water and dilute to 1 liter.

## 5. PROCEDURE

5.1 Unless otherwise specified in the material specification, this test shall be performed on material conditioned as specified in Section 5.

5.2 The machine shall be set with the tops of the clamps in the same horizontal plane. The specimen shall then be folded in half with the grain side on the outside, so that it will be exposed to the salt solution. The specimen shall be fastened in the clamp by means of the V-shaped wedges, so that a trough is formed with the sides of the leather under slight tension.

## METHOD 8021.1

5.3 The high electrode shall be adjusted so that it projects into the trough of the mounted specimen approximately 0.1 inch (2.5 millimeters) above the fold of the specimen when the distance between the clamps is at a minimum.

5.4 Cleaned and dried monel or stainless steel balls weighing  $135 \pm 5$  grams shall be placed into the trough formed by the folded specimen. The steel balls may be cleaned by placing them in a pint jar and turning on a rotating device for ball mills with a charge of 50 to 100 milliliters methyl ethyl ketone added to the jar. The first charge shall be decanted after 5 or 10 minutes. Successive charges shall be added and decanted after 40 to 60 minutes each until the balls are clean.

5.5 The water tank shall be put in place and filled with sodium chloride solution to a level  $0.75 \pm 0.05$  inches ( $19.1 \pm 1.3$  millimeters) above the lowest point of the specimen adjacent to the fixed clamp. The other electrode shall be attached to the pan, the mechanical counter set to zero, and the electrode circuit activated.

5.6 The power to the mechanical drive shall be turned on. The number of flexes indicated on the counter when the machine stops shall be recorded as initial water penetration.

## 6. REPORT

6.1 Initial water penetration shall be reported as the number of cycles recorded at the termination point.

## 7. NOTES

7.1 Apparatus of the type described in this method may be purchased from the Koehler Instrument Co., Inc., 168-56 Douglas Ave., Jamaica, L.I., NY 11433.

7.2 The electrical counter may be purchased from Digit Co., Marblehead, MA 01945.

7.3 Stainless steel balls may be purchased from Superior Steel Ball Co., 20 Lake St., New Britain, CT 06052.



METHOD 8111.1  
July 13, 1972  
SUPERSEDING  
Method 8111  
January 15, 1969

WATER ABSORPTION, STATIC METHOD

1. SCOPE

1.1 This method is intended for determining the amount of water absorbed by vegetable tanned leather at room temperature when immersed under static conditions.

2. TEST SPECIMEN

2.1 The specimen for test shall be a rectangle of leather  $76 \pm 1$  millimeters in length and  $38 \pm 1$  millimeters in width cut from the sample unit.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

4. APPARATUS

4.1 Blotting paper conforming to Federal Specification NNN-P-35, Paper, Blotting, (Laboratory).

4.2 Circulating air oven.

4.3 A flat bottomed, rectangular, heat-resistant tray, 18 by 12 inches (46 by 30.5 centimeters) made of plastic or other material (Fisher Catalog No. 15-241C or equal).

4.4 Weights for immersing and weighing the specimen.

4.5 Balance sensitive to 0.01 gram.

4.6 Punch or other suitable instrument for making a 1/8 inch (3.2 millimeters) hole.

5. PROCEDURE

5.1 Unless otherwise specified in the material specification, this test will be performed on material conditioned as specified in Section 5.

## METHOD 8111.1

5.2 A hole 1/8 inch (3.2 millimeters) in diameter shall be punched in one end of the specimen. The center of the hole shall be located approximately 1/4 inch (6 millimeters) from the cut edge and at the approximate center of the width dimension. Each specimen shall be weighed and the weight recorded as  $W_1$ . A metal clip shall be inserted in the hole, and the specimen and attached clip shall be weighed together. This weight shall be recorded as  $W_2$ . Eight 9-1/4 inch (236 millimeters) lengths of water resistant plastic coated 14 guage wire having a diameter of 0.125 inch (3.18 millimeters) shall be used to prevent the specimens from touching the bottom of the tray in which they are to be immersed. A 1/4 inch (6 millimeters) end section of each length of wire shall be bent at approximately a 90 degree angle to prevent the wire from rolling. Each length of wire shall be placed on the bottom of the tray with the length of the wire parallel to the width of the tray. The distance between adjacent wires shall be approximately 2 inches, (5 centimeters). A volume of distilled water (to the nearest 5 cubic centimeters) at  $23 \pm 1^\circ\text{C}$ , equivalent to 10 times the total weight of the specimens shall be added to the glass tray. The specimens with metal clips attached shall be completely immersed in the water by being placed on the wire, grain side up, in such a manner that the specimens do not touch the bottom or sides of the tray. There shall be a maximum of 4 rows of specimens with not more than 4 specimens in each row. The distance between adjacent specimens shall be not less than 1/2 inch (12.7 millimeters). Any specimen that tends to float after a 15 minute period shall be submerged by placing a glass rod on the specimen. When all the specimens are completely immersed, the tray shall be covered. After the specimens have been immersed for  $24 \pm 1/4$  hours, the tray shall be uncovered, and the specimens removed from the water by gripping the metal clip with tongs or other suitable device. The specimens shall be hung up and air-dried for 2 minutes. After the required drying time, the specimens shall be lightly blotted on any cut edges which show water droplets. The grain side and flesh side of the specimens shall not be blotted. Immediately after blotting, each specimen with attached metal clip shall be weighed and the weight recorded as  $W_3$ . The amount of water absorbed by each specimen shall be calculated as follows:

$$\text{Water absorbed, percent} = \frac{w_3 - w_2}{w_1} \times 100$$

Where:  $w_1$  = weight of original specimen, grams.

$w_2$  = weight of original specimen and metal clip, grams.

$w_3$  = weight of specimen and metal clip after immersion, grams.

All weighings shall be made to the nearest 0.01 gram.

## 6. REPORT

6.1 The amount of water absorbed by the test specimen shall be reported to the nearest 0.1 percent.

METHOD 8112.1  
July 13, 1972  
SUPERSEDING  
Method 8112  
January 15, 1969

WATER ABSORPTION, TUMBLE METHOD

1. SCOPE

1.1 This method is intended for determining the percent of water absorbed by leather.

2. TEST SPECIMEN

2.1 The specimen for test shall be a 2 inch (51 millimeters) die cut square of leather.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

4. APPARATUS

4.1 Balance sensitive to 0.01 gram and weights.

4.2 Two 32-ounce (950 cubic centimeters) glass containers. Each container shall have a wide mouth and a screw cap. The diameter of each container shall be  $3.5 \pm 0.25$  inches ( $89 \pm 0.6$  millimeters) and the total height (including screw cap) shall be  $7 \pm 0.25$  inches ( $178 \pm 0.6$  millimeters).

4.3 Tumbling machine. The machine shall be of the rotating type, equipped to hold two 32 ounce (950 cubic centimeters) containers, for end-over-end agitation. The speed of rotation shall be 55 to 60 revolutions per minute.

4.4 Blotting paper. The blotting paper shall conform to Federal Specification NNN-P--35, Paper, Blotting, (Laboratory).

4.5 A metal die having suitable measurements for cutting the specimen to the required dimensions.

4.6 Two non-absorbent flat plates approximately 2 inches by 2 inches (51 by 51 millimeters).

5. PROCEDURE

## METHOD 8112.1

5.1 Unless otherwise specified, this test shall be performed under the conditions and on material conditioned as specified in Section 5.

5.2 Each specimen shall be weighed to the nearest 0.01 gram and the weight recorded as  $w_1$ .

5.3 From 15 specimens of the lot being tested, 8 weighed specimens shall be placed in one container, and the 7 other weighed specimens plus 1 specimen for ballast, shall be placed in the other container.

5.4 Add to each container a volume of distilled water, at  $23 \pm 1^\circ\text{C}$ , equal to 10 times the weight of the specimens therein. The containers shall be tightly closed and immediately placed in a tumbling machine. The containers shall be mounted vertically in an end to end position, so that the point of contact between the 2 containers rotates at the horizontal axis of rotation of the tumbling machine. The machine shall be started immediately after the containers are mounted and the tumbling continued for  $30 \pm 1$  minutes.

5.5 The water shall then be removed from both containers. One container shall be resealed. Thirty-two squares of blotting paper shall be cut by the same 2 inch (51 millimeters) square die used to cut the leather specimens. A 2 by 2 inch (51 by 51 millimeters) non-water absorbing, rigid flat plate shall be placed on a level surface. Two dried squares of blotting paper shall be stacked upon the rigid flat plate. One test specimen shall be removed from the container and placed, grain up, on top of the blotting squares. Two more 2 inch (51 millimeters) square blotters shall be placed upon the first specimen. A second specimen shall be removed from the container and placed, grain up, upon the stack. This procedure shall be repeated until all the specimens are removed from the containers and stacked. Two 2 inch (51 millimeters) square blotters shall be placed on the last specimen added to the stack. The stack shall be topped by a second 2 by 2 inch (51 by 51 millimeters) non-water absorbing, rigid flat plate. The entire stack shall be immediately squared (i.e., the edges of the specimens, blotters and plates shall be made flush), and a 1,000 gram weight shall be centered on top of the upper plate. (NOTE: The total time required for removing the specimens from the containers, forming the stack and placing the 1,000 gram weight upon the stack shall not exceed 3 minutes). The 1,000 gram weight shall remain on the stack for 5 minutes. At the end of 5 minutes the weight shall be removed. The stack, held together by the plates, shall be turned upside down and in this position returned to the level surface. The 1,000 gram weight shall again be centered on top of the upper plate and allowed to remain for 5 minutes.

## METHOD 8112.1

The alignment of the stack shall not be disturbed during this procedure. At the end of 5 minutes the weight, top plate and first two blotters shall be removed. The top specimen shall then be removed and weighed to the nearest 0.01 gram. This weight shall be recorded as  $w_2$ . This procedure shall be repeated until all the specimens have been weighed. Each specimen shall remain covered by the blotters until it is removed from the stack for weighing. The total time required for weighing all the specimens shall not exceed 20 minutes. No blotting square shall be used more than once.

5.6 Calculation of results. The water absorbed by the specimen shall be calculated as follows:

$$\text{Water absorbed, percent} = \frac{w_2 - w_1}{w_1} \times 100$$

Where:  $w_1$  = initial weight of the specimen in grams.

$w_2$  = weight of the specimen after immersion in water in grams.

## 6. REPORT

6.1 The amount of water absorbed by the specimen shall be reported to the nearest 0.1 percent.



METHOD 8131.1  
July 13, 1972  
SUPERSEDING  
Method 8131  
January 15, 1969

DYNAMIC WATER RESISTANCE OF SHOE UPPER  
LEATHER BY THE DOW CORNING LEATHER TESTER

1. SCOPE

1.1 This method is intended for determining the dynamic water resistance of shoe upper leather. It measures initial water penetration of the upper leather by flexing the leather while in contact with water. The flex imparted to the leather is a magnification of the flex given the vamp of the shoe in actual wear. This method is not interchangeable with method-8021.

2. TEST SPECIMEN

2.1 The test specimen shall be a 4 by 4 inch (101.6 by 101.6 millimeters) square of leather cut from the sample unit.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

4. APPARATUS AND REAGENTS

4.1 Apparatus.

4.1.1 Test machine. The test machine shall have the following essential features:

4.1.1.1 Specimen holder. The specimen holder shall consist of two vertical clamps. Each clamp shall have two arms constructed of non-corrosive material, 7.5 by 0.5 by 0.5 inches (190.5 by 12.7 by 12.7 millimeters), one arm fixed, the other moveable. One clamp shall be mounted on a horizontal reciprocating shaft that is attached by a connecting link to a motor-driven eccentric which turns at 60 rpm. The bottom of the clamps shall be in the same horizontal plane. In one rotation of the eccentric, the minimum distance between clamps shall be  $1.50 \pm 0.01$  inches ( $38.1 \pm 0.25$  millimeters), inside measurement, and the maximum distance between clamps shall be  $2.50 \pm 0.01$  inches ( $63.5 \pm 0.25$  millimeters), inside measurement.

## METHOD 8131.1

4.1.1.2 A water tank made of copper, stainless steel or other non-corrosive material. It shall be of such a size that it can be placed around the clamps, and of such a depth that when in position for use, the top of the pan is at least 2.5 inches (63.5 millimeters) above the bottom of the clamps, and the bottom of the pan is at least 0.5 inches (12.7 millimeters) below the bottom of the clamps.

4.1.1.3 Cycle counters. In addition to having a mechanical reset counter attached to the moveable clamp, the test machine shall have an electrical counting system having a high electrode that is positioned so that it fits inside of the leather specimen and a common electrode which is immersed in a salt solution that is in continuous contact with the specimen during flexing. (Caution - see Note). The electrical counter shall be arranged so that it may be set in operation by a manual switch and automatically stopped when initial water penetration is detected by a current leakage from the high electrode through the specimen to the common electrode in the conduction solution.

NOTE : Caution - Specimens should be put into position or removed only when the electrode circuit is not energized.

4.1.2 Monel or stainless steel balls, 1/8 inch (3 millimeters) diameter, 400 series (seconds acceptable).

4.1.3 Rubber gasket material 0.25 inch (6.4 millimeters) thick (red sponge corrugated floor material has been found satisfactory.)

4.1.4 Magnet (to facilitate removal of balls.)

4.2 Reagents.

4.2.1 Sodium chloride solution (1 gram per liter). Dissolve 1.0 gram of sodium chloride in distilled water and dilute to 1 liter.

## 5. PROCEDURE

5.1 The sodium chloride solution shall be added to the pan until the level is  $1-7/16 \pm 1/16$  inches ( $36.5 \pm 1.6$  millimeters), above the bottom of the clamps when the pan is in operating position and there is no specimen in the clamps.

5.2 The drive shaft shall be turned until the clamps are at the maximum distance apart.

## METHOD 8131.1

5.3 The test specimen shall be folded in half with the surface to be exposed to the salt solution on the outside. A rubber gasket shall be folded in half and inserted into the folded specimen in a position flush with the edge of the specimen and in contact with the bottom of the fold. (A gasket cement may also be utilized.)

5.4 The edge of the specimen with the inserted gasket shall be securely clamped between the jaws of the back clamp and shall be positioned with the bottom of the fold flush with the bottom of the clamp. The same procedure shall be followed for the opposite end of the specimen, except that it shall be securely clamped between the jaws of the front clamp.

5.5 The high electrode shall be adjusted so that it projects into the trough of the mounted specimen at a position of  $0.125 \pm .0625$  inch ( $3.2 \pm 1.6$  millimeters) above the fold in the specimen when the distance between the clamps is at a minimum.

5.6  $135 \pm 5$  grams of cleaned and dried monel or stainless steel balls shall be placed in the pocket formed by the folded specimen. The steel balls may be cleaned by placing them in a pint jar and turning on a rotating device for ball mills with a charge of 50-100 milliliters methyl ethyl ketone added to the jar. The first charge shall be decanted after 5 or 10 minutes. Successive charges shall be added and decanted after 40 to 60 minutes each until the balls are clean. When a glass jar is used, it may be necessary to improve the friction between jar and cylinder of the ball mill by winding several strips of insulating tape around the jar. If no ball mill is available, a tumbler or shaker may be used.

5.7 The apparatus shall be started, after the pan containing the salt solution is in position, by engaging the drive link mechanism and actuating the electrode circuit.

5.8 The number of cycles indicated on the counter when the machine stops shall be recorded as initial water penetration.

## 6. REPORT

6.1 Initial water penetration shall be reported as the number of cycles recorded at the termination of the test.

## 7. NOTES

7.1 Apparatus of the type described in this method may be purchased from the Dow Corning Corp., Midland, MI 48640.

METHOD 8131.1

7.2 Stainless steel balls may be purchased from Superior Steel Ball Co., 20 Lake St., New Britain, CT 06052

7.3 Red Sponge Corrugated Floor Material may be purchased from American Mat Corporation 840 Park St., St., Wapakoneta, OH 45895

METHOD 3041  
July 13, 1972

## AREA STABILITY OF LEATHER TO LAUNDERING

### 1. SCOPE

1.1 This method is intended for determining the launderability of dyed leathers with or without a pigment finish.

### 2. TEST SPECIMEN

2.1 The specimen shall be a square of leather 2 by 2 inches (51 by 51 millimeters) cut from the sample unit of leather.

### 3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, three specimens from each sample unit shall be tested.

### 4. APPARATUS, REAGENTS AND METHOD CITED

4.1 Stainless steel balls, type 316, 1/4 inch (6 millimeters) diameter.

4.2 One pint steel jar with washer and cap.

4.3 Launder-Ometer or similar machine approved by Defense Personnel Support Center, Philadelphia, PA as being capable of producing similar results.

4.4 A circulating-air oven capable of maintaining the required temperature of  $120 \pm 2^{\circ}\text{F}$  ( $49 \pm 2^{\circ}\text{C}$ ).

4.5 Blotting paper. The blotting paper shall conform to Federal Specification NNN-P-35, Paper, Blotting, (Laboratory).

4.6 A metal die for cutting the specimen to the required dimensions.

4.7 Soap solution shall be prepared by dissolving 5 grams of standard neutral chip soap in one liter of distilled water.

4.8 Method cited. Method 8112, Water Absorption, Tumble Method.

### 5. PROCEDURE

5.1 Unless otherwise specified, this test shall be performed in accordance with standard atmospheric conditions (see Section 5). The conditioned samples shall be weighed to the nearest 0.1 gram.

## METHOD 3041

5.2 Three measurements of each dimension of the specimen shall be made and averaged. Two measurements shall be made 13 millimeters from each side, and one measurement running through the center of the specimen. The surface of the specimen shall be indelibly marked to indicate the points of measurement. The average measurement shall be used to determine the original area of the specimen and this area recorded as A (The known dimensions of the die may be used instead of actually measuring the specimen. When this option is taken, the specimen shall still be marked at the points of measurement indicated above.)

5.3 Three specimens and twenty stainless steel balls, shall be added to a one pint jar together with 150 milliliters of a soap solution which has been preheated to  $120 \pm 2^{\circ}\text{F}$  ( $49 \pm 2^{\circ}\text{C}$ ).

5.4 The jars shall be sealed and clamped into the rotor of a Launder-Ometer or other apparatus producing similar conditions. The apparatus shall then be run for 30 minutes at  $120 \pm 2^{\circ}\text{F}$  ( $49 \pm 2^{\circ}\text{C}$ ).

5.5 The jars shall be removed and the soap solution poured from the jars through a sieve to avoid losing the steel balls and specimens. The specimens shall then be placed flesh side down on a pad consisting of two 10 by 10 inches (25.4 by 25.4 centimeters) blotting papers and covered with a pad of two additional blotting papers of the same type. A non-absorbent flat rigid plate large enough to cover the blotters shall be placed on the cover blotter. If necessary, a weight shall be placed on the plate so as to subject the specimens to a 10 gram per square centimeter load for 5 minutes. At the end of this period the load shall be removed and the specimens transferred to a widemouth 1 gallon container previously filled with water preheated to  $120 \pm 2^{\circ}\text{F}$  ( $49 \pm 2^{\circ}\text{C}$ ). The volume of water in milliliters shall be approximately 100 times the initial weight of the conditioned specimens in grams.

5.6 The container shall be tumbled for 30 minutes in a machine as described in method 8112. The water shall be removed and the specimens shall be squeezed by hand and spread next to each other on a flat solid steel shelf which has been temporarily removed from a circulating air oven. No specimen shall be closer than 1/2 inch (12.7 millimeters) to the others.

5.7 The shelf shall be placed in a pre-heated circulating air oven for 30 minutes at  $120 \pm 2^{\circ}\text{F}$  ( $49 \pm 2^{\circ}\text{C}$ ). At the end of 30 minutes the dried specimens shall be returned to the steel jars, 3 specimens per jar, together with the steel balls and 150 milliliters of the soap solution preheated to  $120 \pm 2^{\circ}\text{F}$  ( $49 \pm 2^{\circ}\text{C}$ ). The entire procedure shall be repeated again except that the specimens shall not be squeezed by hand or dried in

## METHOD 3041

the oven, after being tumbled in the pre-heated water. Instead, the specimens shall be placed grain side up on a flat steel surface and allowed to dry under standard conditions for 48 hours.

5.8 Three measurements shall be taken in one dimension, averaged, and the average recorded as B. Three measurements shall be taken in the other dimension, averaged, and the average recorded as C. The averages shall be calculated to the nearest 0.1 millimeters or .02 inches. The average area change shall be calculated as follows:

$$\text{Percent area change} = \frac{A - (B \times C) \times 100}{A}$$

Where: A - original area of the specimen (calculated from the known dimensions of the die).

B - average of three measurements in one dimension the specimen.

C - average of three measurements in the other dimension of test specimen.

In the event of increase in area of tile test specimen, the calculations shall be made as follows:

$$\text{Percent area change} = \frac{(B \times C) - A \times 100}{A}$$

## 6. REPORT

6.1 Area change shall be calculated to the nearest 0.1 percent.

## 7. NOTES

7.1 The Launder-Ometer, stainless steel balls, and one pint steel jars may be purchased from Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 50613.

7.2 The standard neutral chip soap may be purchased from AATCC, Box 12215, Research Triangle Pk., NC 27709



METHOD 4212  
July 13, 1972

## TORSION WIRE STIFFNESS MEASUREMENT

### 1. SCOPE

1.1 This method is intended for determining the stiffness of leather.

### 2. TEST SPECIMEN

2.1 The specimen for test shall be a rectangle of leather  $4.0 \pm 0.1$  inches ( $10.16 \pm 0.2$  centimeters) in length and  $0.500 \pm 0.001$  inch ( $1.270 \pm 0.003$  centimeters) in width. The specimen shall be cut with the long dimension parallel to the backbone.

### 3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, one specimen from each sample unit shall be tested.

### 4. APPARATUS

4.1 Torsion wire apparatus (see 7.1 and figure 4212A).

### 5. PROCEDURE

5.1 Specimens to be tested shall be conditioned in accordance with Section 5. A length of  $3.5 \pm 0.1$  inches ( $8.9 \pm 0.2$  centimeters) shall be marked off on the specimen preferably using a bench marker so that the marks are each  $0.25 \pm 0.1$  inch, ( $.63 \pm .25$  centimeters) from the ends of the specimen.

5.2 Stiffness. The conditioned specimen shall be inserted into the jaws of the bottom clamp (E) so the edge of the clamp meets the bench mark and the specimen is perpendicular to the jaws. The other end of the specimen shall be inserted into the upper clamp (D) so the jaws touch the other bench mark. The bottom clamp shall then be inserted into the clamp guide (F). The top dial (K) shall be unlocked by turning knob (G) counterclockwise approximately  $1/4$  turn. Both clamps shall be brought into parallel position by turning knob (H) either clockwise or counterclockwise so there is no twist in the specimen. When the clamps are parallel, the top specimen clamp indicator (I) shall be adjusted so it is in alignment with one of the reference lines on the lower dial (J) (see figure 4212B). The adjustment shall be made by holding the upper clamp with one hand and moving the indicator with the other hand (NOTE: The indicator is attached to the upper clamp by a friction clamp). The top dial (K) shall then be locked by turning knob (G) clockwise until tight. The top dial shall be set at

## METHOD 4212

270 degrees by actually turning dial (K). (NOTE: By setting the dial to 270 degrees, the 90 degrees twist of the specimen will be subtracted out automatically and the reading obtained will be the twist of the wire necessary to give the desired 90 degrees twist to the specimen). If indicator (I) moves when the dial is set at 270 degrees, repeat the procedure beginning with parallel alignment of the clamps. Movement of indicator (I) means knob (G) was not tightened sufficiently. The specimen shall then be preflexed by applying a 90 degrees angular twist through two cycles as follows:

a. Loosen knob (G). Using knob (H), slowly rotate the top dial (K) in a counterclockwise direction until the specimen clamp indicator (I) shows that the specimen has been twisted 90 degrees (see figure 4212C). Use a uniform rate of rotation that will take 4 to 5 seconds to twist the specimen through 90 degrees.

b. Reverse the rotation to the clockwise direction and continue rotating slowly until the specimen clamp indicator (I) is realigned with the original reference line indicated on lower dial (J).

c. Lock top dial (K) by turning knob (G) until tight, then reset dial (K) to read 270 degrees.

d. Repeat the flexing operation by following steps a, b and c. When the second flexing cycle is completed, loosen knob (G), turn upper dial (K) slowly (4 to 5 seconds for 90 degrees rotation) in a counterclockwise direction using knob (H), until the specimen clamp indicator (I) shows a 90 degrees twist (see figure 4212C). Read the angle of torsion from the upper dial (K) and record the value to the nearest 5 degrees.

## 6. REPORT

6.1 The angle of torsion of each specimen shall be reported to the nearest 5 degrees.

## 7. NOTES

7.1 The torsion wire apparatus and replacement wires may be purchased from the Fulton County Machine Supply Co., 2 Van Road, Gloversville, NY 12078.

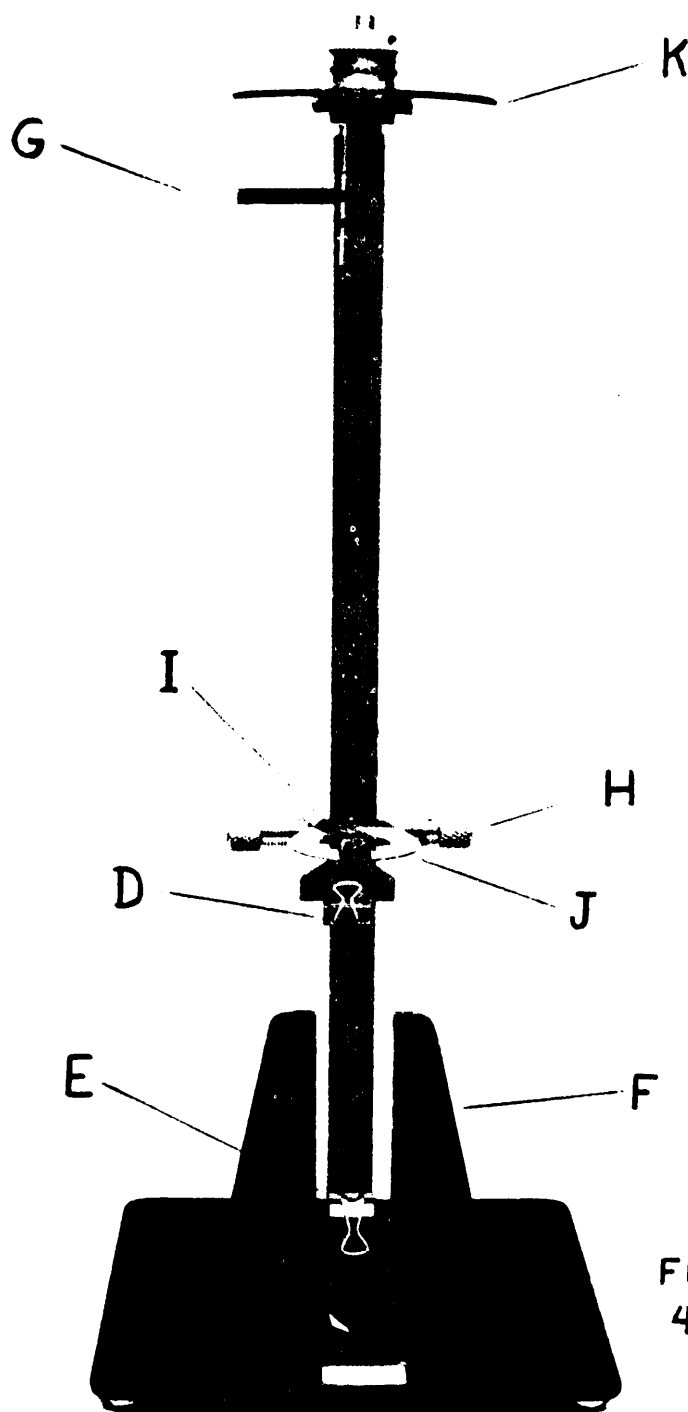


FIGURE  
4212 A

FIGURE 4212 A

METHOD 4212

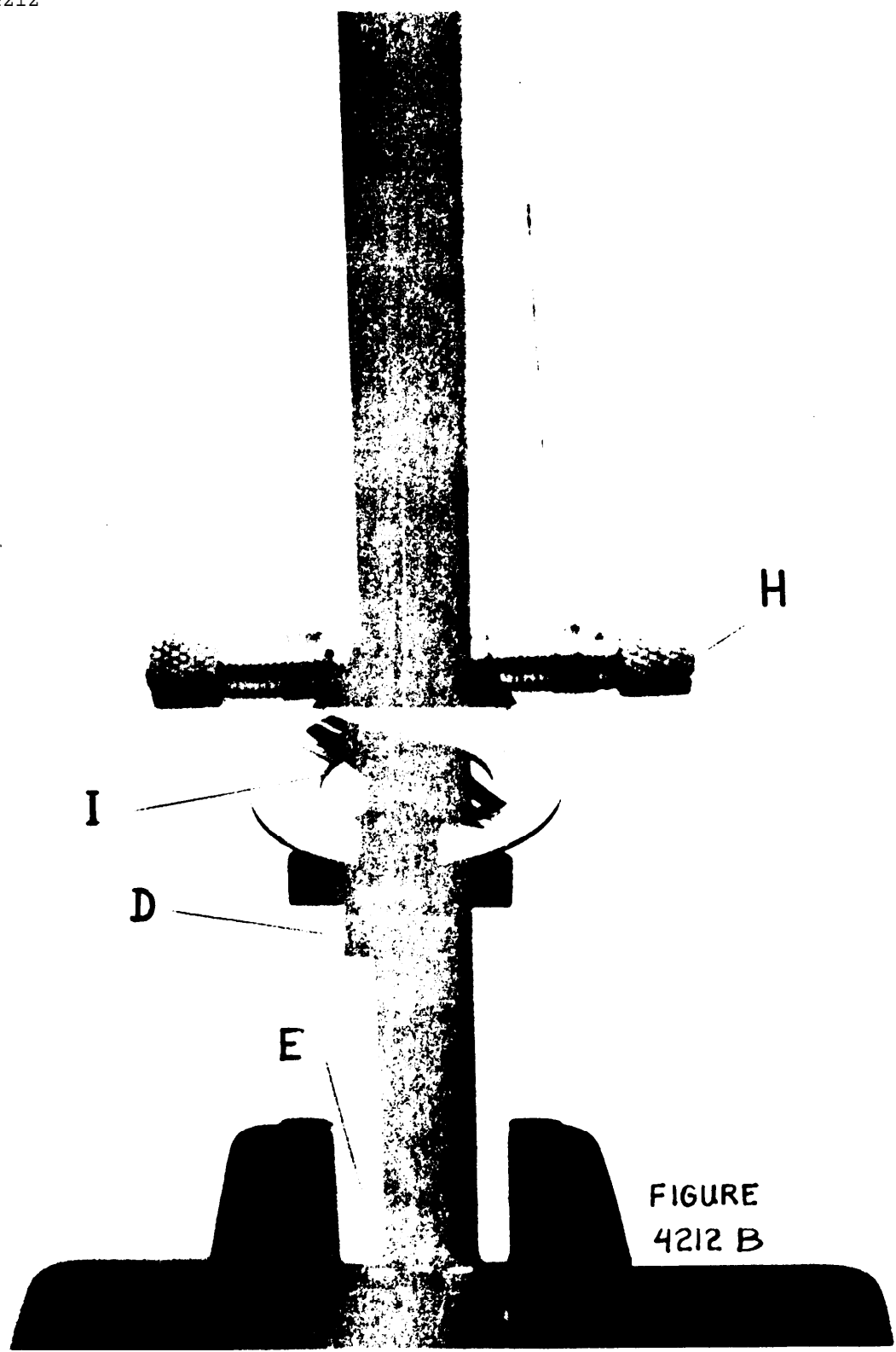


FIGURE  
4212 B

METHOD 4212

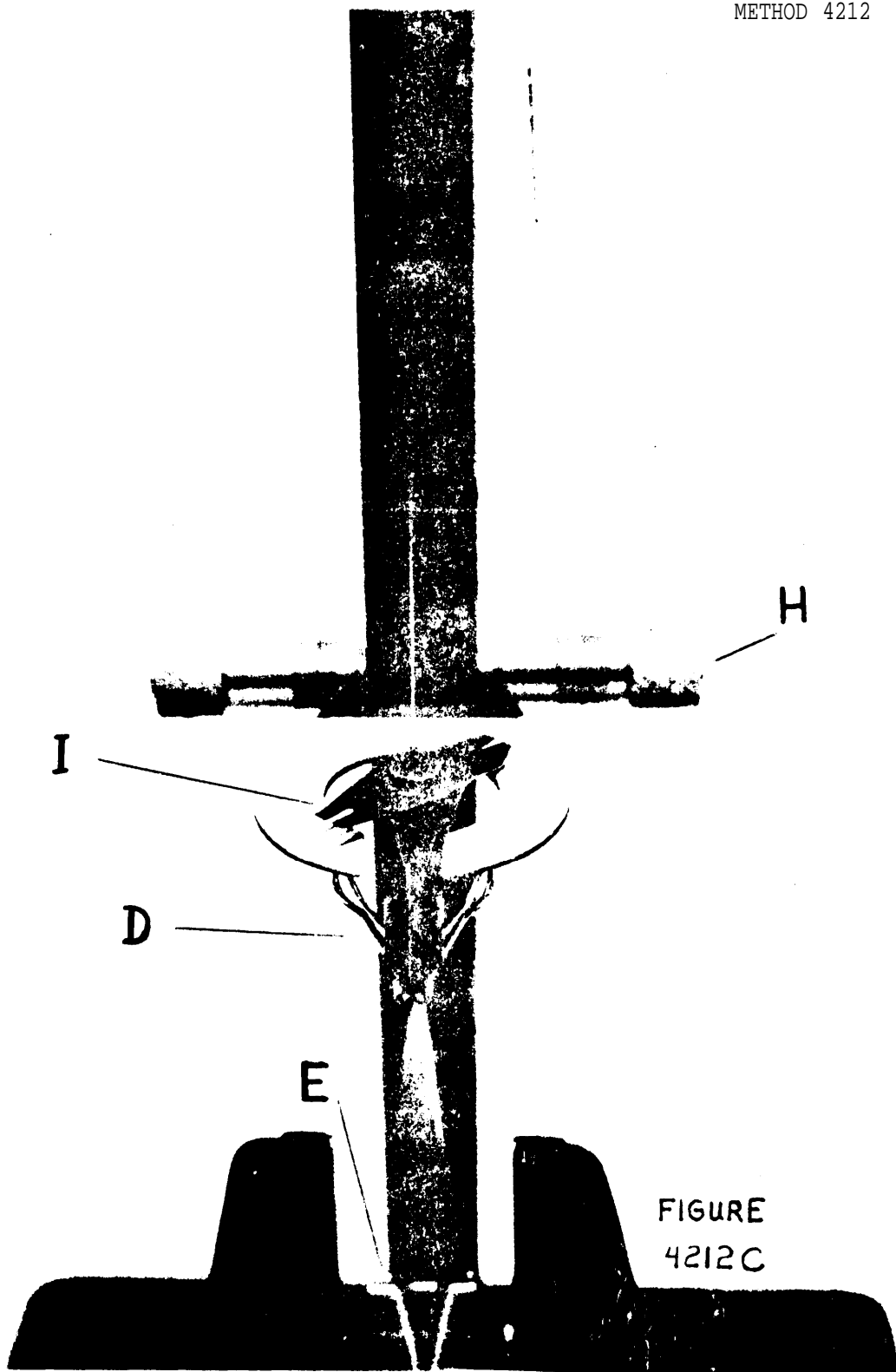


FIGURE 4212 C

FED. TEST METHOD STD. SO. 311

