Designation: D 120 – 95

Standard Specification for Rubber Insulating Gloves[1]

This standard is issued under the fixed designation D 120; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers acceptance testing of rubber insulating gloves for protection of workers from electrical shock.

1.2 Two types of gloves are provided and are designated as Type I, non-resistant to ozone, and Type II, resistant to ozone.

1.3 Six classes of gloves, differing in electrical characteristics, are provided and are designated as Class 00, Class 0, Class 1, Class 2, Class 3, and Class 4.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 The following safety hazards caveat pertains only to the test method portion, Sections 16, 17, 18, and 19, of this specification: *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.* For specific precaution statements, see 18.2.

2. Referenced Documents

2.1 *ASTM Standards:*

D 297 Test Methods for Rubber Products—Chemical Analysis[2]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension[2]

D 518 Test Method for Rubber Deterioration—Surface Cracking[2]

D 573 Test Method for Rubber—Deterioration in an Air Oven[2]

D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers[2]

D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber[2]

D 1415 Test Method for Rubber Property—International Hardness[2]

D 2240 Test Method for Rubber Property—Durometer Hardness[2]

2.2 *ANSI Standard:*

ANSI C84.1 Voltage Ratings for Electric Power Systems and Equipment[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *breakdown*—the electrical discharge or arc occurring between the electrodes and through the equipment being tested.

3.1.2 *color splash*—a smear or streak of contrasting color evident on the inside or outside surface of the gloves that was deposited during the dipping operation and is vulcanized into the glove as part of the homogenous compound.

3.1.3 *flashover*—the electrical discharge or arc occurring between electrodes and over or around, but not through, the equipment being tested.

3.1.4 *gauntlet*—the area of the glove between the wrist and the reinforced edge of the opening.

3.1.5 *glove cuff roll*—the roll or reinforced edge of an insulating glove at the cuff.

3.1.6 *halogenation*—exposure of the entire glove surface area to a halogen for the purpose of reducing surface friction.

3.1.7 *insulated*—separated from other conducting surfaces by a dielectric substance (including air space) offering a high resistance to the passage of current.

3.1.7.1 *Discussion*—When any object is said to be insulated, it is understood to be insulated in a suitable manner for the conditions to which it is subjected. Otherwise, it is, within the purpose of this definition, uninsulated. Insulating covering of conductors is one means of making the conductor insulated.

3.1.8 *isolated*—an object that is not readily accessible to persons unless special means of access are used.

3.1.9 *ozone*—a very active form of oxygen that may be produced by corona, arcing, or ultraviolet rays.

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[1] This specification is under the jurisdiction of ASTM Committee F-18 on Electrical Protective Equipment for Workers and is the direct responsibility of Subcommittee F18.15 on Worker Personal Equipment. This standard replaces ANSI Standard J 6.6, which is no longer available.

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[2] *Annual Book of ASTM Standards*, Vol 09.01.

[3] Available from American National Standards Institute, Inc., 11 West 42nd Street, 13th Floor, New York, NY 10036.

3.1.10 *ozone cutting and checking*—the cutting action produced by ozone on rubber under mechanical stress into a series of interlacing cracks.

3.1.11 *rubber*—a generic term that includes elastomers and elastomeric compounds, regardless of origin.

3.1.12 *user*—the employer or entity purchasing the equipment to be utilized by workers for their protection; in the absence of such an employer or entity, the individual purchasing and utilizing the protective equipment.

3.1.13 *voltage, maximum use*—the a-c voltage, (rms), rating of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase to phase voltage on multiphase circuits.

3.1.13.1 If there is no multiphase exposure in a system area and the voltage exposure is limited to the phase (polarity on d-c systems) to ground potential, the phase (polarity on d-c systems) to ground potential shall be considered to be the nominal design voltage.

3.1.13.2 If electrical equipment and devices are insulated, or isolated, or both, such that the multiphase exposure on a grounded wye circuit is removed, then the nominal design voltage may be considered as the phase-to-ground voltage on that circuit.

3.1.14 *voltage, nominal design*—a nominal value consistent with the latest revision of ANSI C84.1, assigned to the circuit or system for the purpose of conveniently designating its voltage class.

3.1.15 *working area*—all finger and thumb crotches, the palm (area between the wrist and the base of the finger and thumb) and the area of the finger and thumb facing the palm not extending beyond the center line of the crotch. See Fig. 1. Table 1

TABLE 1 Proof-Test/Use Voltage Relationship

Class of Glove	A-C Proof-Test Voltage rms V	D-C Proof-Test Voltage avg V	Maximum Use Voltage[A] a-c rms, V
00	2 500	10 000	500
0	5 000	20 000	1 000
1	10 000	40 000	7 500
2	20 000	50 000	17 000
3	30 000	60 000	26 500
4	40 000	70 000	36 000

[A] Except for Class 00 and Class 0 gloves, the maximum use voltage is based on the following formula:

Maximum A-C use voltage (maximum nominal design voltage) = 0.95 a-c proof-test voltage − 2000 V

This formula takes into account the reduction in the volts per mil capability of the glove with increasing thickness of the rubber.

4. Significance and Use

4.1 This specification covers the minimum electrical, chemical, and physical properties guaranteed by the manufacturer and the detailed procedures by which such properties are to be determined. The purchaser has the option to perform or have performed any of these tests in order to verify the guarantee. Claims for failure to meet the specification are subject to verification by the manufacturer.

4.2 Gloves are used for personal protection; therefore, when authorizing their use, a margin of safety shall be allowed between the maximum voltage on which they are used and the proof-test voltage at which they are tested. The relationship between proof-test voltage and the maximum voltage at which the gloves shall be used is shown in Table 1.

4.3 Work practices vary from user to user and are dependent upon many factors. These may include, but are not limited to, operating system voltages, construction design, work procedure techniques, weather conditions, etc. Therefore, except for the restriction set forth in this specification because of design

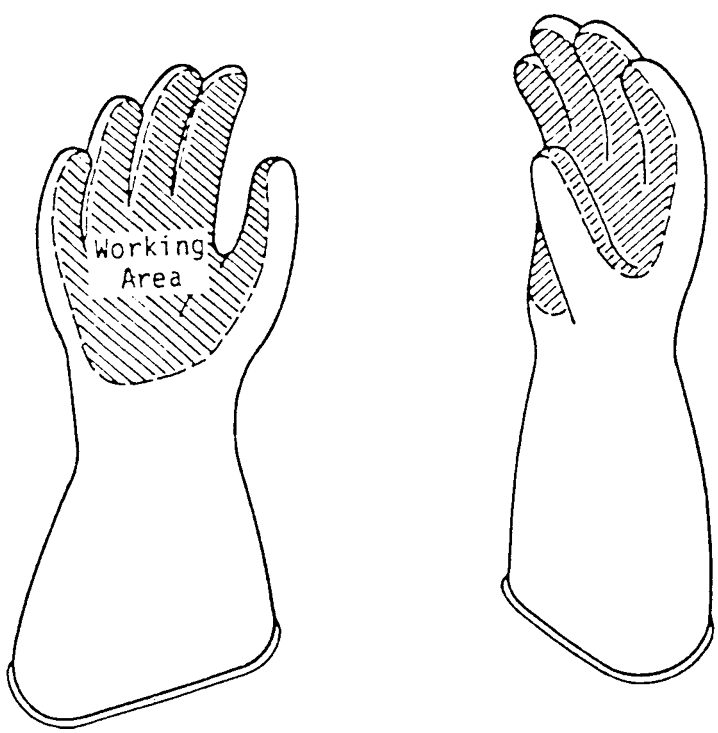

FIG. 1 Working Area of a Rubber Insulating Glove

limitations, the use and maintenance of this equipment is beyond the scope of this specification.

4.4 It is common practice and the responsibility of the user of this type of protective equipment to prepare complete instructions and regulations to govern the correct and safe use of such equipment.

5. Classification

5.1 Gloves covered under this specification shall be designated as Type I or Type II; Class 00, Class 0, Class 1, Class 2, Class 3, or Class 4.

5.1.1 *Type I*, non-resistant to ozone, made from a high-grade *cis*-1,4-polyisoprene rubber compound of natural or synthetic origin, properly vulcanized.

5.1.2 *Type II*, ozone-resistant made of any elastomer or combination of elastomeric compounds.

5.1.3 The class designation shall be based on the electrical properties as shown in Table 2 and Table 3.

6. Ordering Information

6.1 Orders for gloves under this specification should include the following information:

6.1.1 Type,

6.1.2 Class,

6.1.3 Length, Fig. 2

6.1.4 Size,

6.1.5 Color, and

6.1.6 Cuff design.

6.1.7 With or without a halogenation treatment.

6.2 The listing of types, classes, lengths, sizes, colors, and cuff designs is not intended to mean that all shall necessarily be available from manufacturers; it signifies only that, if made, they shall conform to the details of this specification.

7. Manufacture and Marking

7.1 The gloves shall be produced by a seamless process.

7.2 The gloves shall have a smooth finish and the cuff edges shall be finished with a roll or a reinforcing strip of rubber, unless otherwise specified.

7.3 Each glove shall be marked clearly and permanently with the name of the manufacturer or supplier, ANSI/ASTM D120, type, class, and size. All such marking shall be confined to the cuff portion of the glove and shall be nonconducting and applied in such a manner as to not impair the required properties of the glove.

7.3.1 Each glove shall be marked with a label that gives the information specified in 7.3. This label shall be the color specified for each voltage class: Class 00—beige, Class 0—red, Class 1—white, Class 2—yellow, Class 3—green, and Class 4—orange.

7.4 At the request of the user, the gloves may be given a halogenation treatment to reduce surface friction. This treatment shall have no detrimental effect on the electrical, chemical, or physical properties of the gloves.

TABLE 3 D-C Voltage Requirements

Class of Glove	Proof-Test Voltage avg V	Minimum Breakdown Voltage avg V
00	10 000	13 000
0	20 000	35 000
1	40 000	60 000
2	50 000	70 000
3	60 000	80 000
4	70 000	90 000

8. Dimensions and Permissible Variations

8.1 The thickness shall fall within the limits specified in Table 4, when determined in accordance with 17.1.

8.2 Standard sizes when determined in accordance with 17.2 are 203 mm (8 in.), 216 mm (8½ in.), 229 mm (9 in.), 241 mm (9½ in.), 254 mm (10 in.), 267 mm (10½ in.), 279 mm (11 in.), 292 mm (11½ in.), and 305 mm (12 in.). The permissible variation in size shall be ±13 mm (±½ in.).

8.3 Lengths shall be measured in accordance with 17.3.

8.3.1 Standard lengths for Class 00 gloves are 278 mm (11 in.), and 356 mm (14 in.). The permissible variations shall be ±13 mm (±½ in.).

8.3.2 Standard lengths for Class 0 gloves are 280 mm (11 in.), 360 mm (14 in.), 410 mm (16 in.), and 460 mm (18 in.). The permissible variations shall be ±13 mm (±½ in.).

8.3.3 Standard lengths for Class 1, 2, and 3 gloves are 360 mm (14 in.), 410 mm (16 in.), and 460 mm (18 in.). The permissible variation shall be ±13 mm (±½in.).

8.3.4 Standard lengths for Class 4 gloves are 410 mm (16 in.) and 460 mm (18 in.). The permissible variation shall be ±13 mm (±½ in.).

9. Workmanship and Finish

9.1 Gloves shall be free on both inner and outer surface of harmful physical irregularities that can be detected by thorough test and inspection.

9.1.1 Harmful physical irregularities may be defined as any feature that disrupts the uniform, smooth surface contour and represents a potential hazard to the user, such as pinholes,

TABLE 2 A-C Voltage Requirement Proof Test Currents[A]

Class of Glove	Proof-Test Voltage rms V	Minimum Breakdown Voltage rms V	Maximum Proof-Test Current, mA			
			280-mm (11-in.) Glove	360-mm (14-in.) Glove	410-mm (16-in.) Glove	460-mm (18-in.) Glove
00	2 500	4 000	8	12	[B]	[B]
0	5 000	6 000	8	12	14	16
1	10 000	20 000	...	14	16	18
2	20 000	30 000	...	16	18	20
3	30 000	40 000	...	18	20	22
4	40 000	50 000	...	...	22	24

[A] Proof test current shall be measured to an accuracy of ±1 mA.
[B] Not applicable.

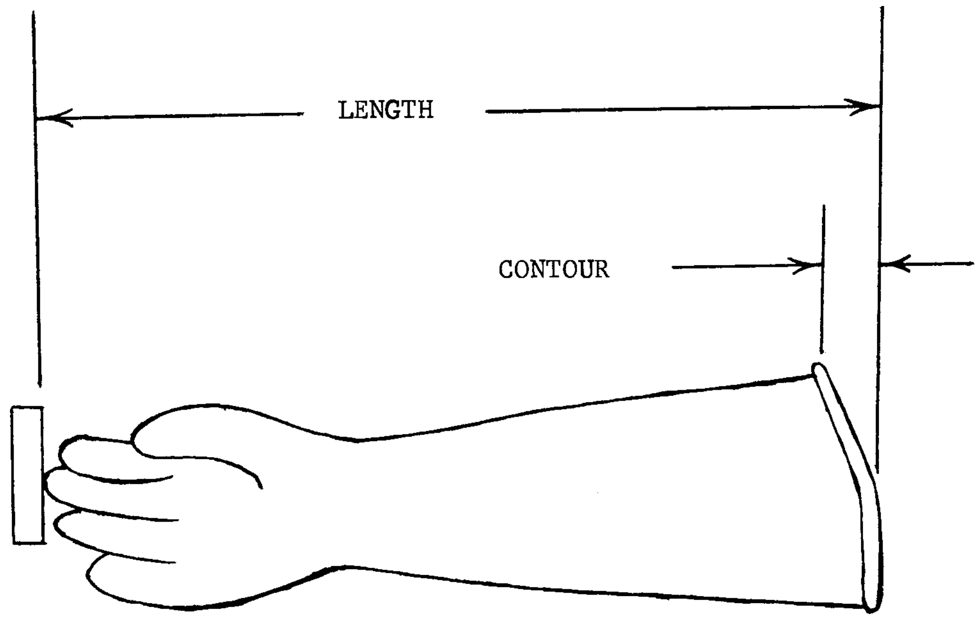

FIG. 2 Length and Contour Measurements on Contour Cuff Gloves

TABLE 4 Thickness Measurements

Class of Glove	Minimum Thickness				Maximum Thickness	
	In Crotch		Other Than Crotch			
	mm	in.	mm	in.	mm	in.
00	0.20	0.008	0.25	0.010	0.75	0.030
0	0.46	0.018	0.51	0.020	1.02	0.040
1	0.63	0.025	0.76	0.030	1.52	0.060
2	1.02	0.040	1.27	0.050	2.29	0.090
3	1.52	0.060	1.90	0.075	2.92	0.115
4	2.03	0.080	2.54	0.100	3.56	0.140

cracks, blisters, cuts, conductive imbedded foreign matter, creases, pinch marks, voids (entrapped air), prominent ripples, and prominent mold marks.

9.2 Nonharmful physical irregularities may be defined as surface irregularities present on the inner and outer surfaces of the rubber glove due to imperfections on forms or molds and inherent difficulties in the manufacturing process. These irregularities may appear as mold marks that look like cuts even though they are actually a raised ridge of rubber, indentations, protuberances, embedded foreign material, or color splashes that are acceptable provided that:

9.2.1 The indentations, protuberance or mold marks tend to blend into a smooth slope upon stretching of the material.

9.2.2 The rubber thickness at any irregularity conforms to the thickness requirements.

9.2.3 Foreign material remains in place when the glove is folded and stretched with the material surrounding it.

9.2.4 Color splashes are no larger than 1 mm in any direction on the inner surface of the work area.

9.2.4.1 The working area is defined as all finger and thumb crotches, the palm (area between the wrist and the base of the finger and thumb) and the area of the finger and thumb facing the palm not extending beyond the center line of the crotch. See Fig. 1.

10. Chemical and Physical Requirements

10.1 The glove material shall conform to physical requirements in Table 5, the accelerated aging in 19.2.6.

10.2 In the event of a dispute, the identification of the rubber polymer in Type I gloves shall be performed in accordance with 19.1.

10.3 The Type II glove material shall show no visible effects of ozone when tested in accordance with 18.6. Any visible signs of ozone deterioration of the glove material, such as checking, cracking, breaks, pitting, etc., shall be considered as evidence of failure to meet the requirements of Type II gloves. In case of dispute, Method A of the ozone resistance test shall be the referee test.

11. Electrical Requirements

11.1 Each glove shall be given a proof test and shall withstand the 60-Hz a-c proof-test voltage (rms value) or the d-c proof-test voltage (average value) specified in Table 2 or Table 3. The proof test shall be performed in accordance with Section 18. The test voltage shall be applied continuously for 3 min.

11.1.1 When the a-c proof test is used, the 60-Hz proof-test current shall not exceed the values specified in Table 2 at any time during the test period. (Note 4 and Note 1)

11.2 Sample gloves selected in accordance with 13.2 shall not break down at voltages below those specified in Table 2 or Table 3 when tested in accordance with Section 18.

TABLE 5 Physical Requirements

Property	Type I	Type II
Tensile strength, min, Die C, MPa (psi)	17.2 (2500)	10.3 (1500)
Tensile stress at 200 %, max, MPa (psi)	2.1 (300)	2.1 (300)
Ultimate elongation, min, %	600	500
Tension set, max at 400, %	25	25
Tear resistance, min, kN/m (lbf/in.)	21 (120)	14 (80)
Puncture resistance, min, kN/m (lbf/in.)	18 (100)	18 (100)
Hardness, max, shore A	47	47

11.2.1 Gloves that have been subjected to a minimum breakdown voltage test shall not be used for electric protection. Proof test current shall be measured to an accuracy of ±1 mA.

11.3 Sample gloves selected in accordance with 13.2 shall be subjected to a 60-Hz a-c moisture absorption/proof test in accordance with Section 18.

11.3.1 The 60-Hz a-c proof test current shall not exceed the values specified in Table 2 by more than 2 mA.

NOTE 1—If the a-c proof test is made at any frequency other than 60 Hz, the permissible proof-test current shall be computed from the direct ratio of the frequencies.

NOTE 2—A proof-test current is an indication of the validity of the glove make-up, the dielectric constant of the type of material used, the thickness, and the total contact area under test.

12. Guarantee

12.1 The manufacturer or supplier shall replace, without charge to the purchaser, unused gloves which, at any time within a period of nine (9) months from date of initial delivery of shipment to the purchaser or his designee, fail to pass the tests in this specification. This guarantee will be binding on the manufacturer or supplier only if the gloves have been properly stored and have not been subjected to more than an original acceptance test and one retest.

12.2 Any acceptance test made by the purchaser, or the purchaser's designee, shall be performed within the first two (2) months of the guarantee period unless otherwise specified.

NOTE 3—Proper storage means that gloves are stored right side out, not distorted and not stored directly above or in proximity to steam pipes, radiators, or other sources of artificial heat, or exposed to direct sunlight or other sources of ozone. It is desirable that the ambient storage temperature shall not exceed 35°C (95°F).

13. Sampling

13.1 Each glove in a lot or shipment shall be subjected to inspection and test to meet the requirements of Sections 7, 11.1, 9, and 15.

13.2 An original sample of 1 % of the lot or shipment or not less than two gloves, whichever is greater, shall be selected at random from the lot or shipment for the test requirements of 11.2, 11.3 and Section 8.

13.3 An original sample of 0.1 % of the lot or shipment or not less than two gloves, whichever is greater, shall be selected at random from the lot or shipment for the test requirements of Sections 10.1 and 10.3.

14. Rejection

14.1 Individual gloves shall be rejected if they fail to meet the requirements of Sections 7 and 9 and 11.1 and the minimum thickness requirements of 8.1.

14.2 Individual gloves may be rejected at the option of the purchaser if they fail to meet the requirements of Sections 8 and 15.

14.3 The entire lot or shipment of gloves shall be rejected under any of the following conditions:

14.3.1 If 5 % or more, but not less than two gloves, in a lot or shipment fail to meet the requirements of 11.1.

14.3.2 If two gloves in the first sample fail to meet the requirements of 11.2.

14.3.3 If one glove in the original sample and one or more gloves in the second sample fail to meet the requirements of 11.2.

14.3.4 If the sample of Type II gloves, using the sampling methods of 13.3, fails to meet the requirements of 10.3.

14.3.5 If the proof test current on two gloves in the first sample do not meet the requirements of 11.3.

14.3.6 If the proof test current on one glove in the original sample and the proof test current on one or more gloves in the second sample fail to meet the requirements of 11.3.

14.4 The testing shall be terminated and the manufacturer or supplier notified if, during the course of testing, the gloves in a lot or shipment fail to meet the requirements of 10.3, 11.1, 11.2, or 11.3 as determined by the rejection criteria of 14.3.1, 14.3.2, 14.3.3 14.3.4, 14.3.5, or 14.3.6. The manufacturer or supplier may in such a case require the purchaser to submit proof that the test procedure and equipment conform to the appropriate paragraphs of Section 18. When such proof has been furnished, the manufacturer or supplier may request that his representative witness the testing of additional gloves from the shipment.

14.5 The entire lot or shipment may be rejected at the option of the purchaser if two specimens of the first sample and one of the second sample, selected in accordance with 13.3, fail any of the separate requirements outlined in Section 10.

14.6 The entire lot or shipment of gloves may be rejected at the option of the purchaser if 25 % of the gloves in the lot or shipment fail to meet the requirements of Section 8 or 9.

14.7 All rejected material shall be returned as directed by the manufacturer, at his or the supplier's request, without being defaced by rubber stamp or other permanent marking. However, those gloves punctured when tested in accordance with 11.1, 11.2, and 11.3 shall be stamped, punched, or cut prior to being returned to the supplier to indicate that they are unfit for electrical use.

15. Packaging and Package Marking

15.1 Each pair of gloves shall be packaged in an individual container of sufficient strength to properly protect the gloves from damage in transit. The end of the container shall be marked with the name of the manufacturer or supplier, type, class, length, size, color, and cuff design.

TEST METHODS

16. Sequence of Testing

16.1 The following order of procedure is suggested for testing rubber insulating gloves:

16.1.1 Inspection of the surfaces in accordance with Section 9.

16.1.2 The dimensions in accordance with Section 17.

16.1.3 Electrical proof tests in accordance with 18.4.2 or 18.5.2.

16.1.4 A-C moisture absorption/proof test in accordance with 18.4.4.

16.1.5 Breakdown voltage tests in accordance with 18.4.3 or 18.5.3.

16.1.6 Ozone resistance tests in accordance with 18.6.

16.1.7 Chemical and physical property tests in accordance with Section 19.

17. Dimension Measurements

17.1 *Thickness*:

17.1.1 Thickness measurements shall be made at four or more points on the palm side, four or more points on the back side, one or more points in the crotch of the thumb and index finger, and one or more points in the crotches between the fingers. Table 5

17.1.2 Thickness measurements shall be made on complete gloves with a micrometer graduated to within 0.025 mm (0.001 in.), having an anvil about 6 mm (0.25 in.) in diameter and a presser foot of 3.17 ± 0.25 mm (0.125 ± 0.010 in.) in diameter. The presser foot shall exert a total force of 0.83 ± 0.03 N (3.0 ± 0.1 oz).

NOTE 4—A dial-type micrometer graduated in millimetres or inches and mounted in a manner similar to that shown in Fig. 3 and Fig. 4 is particularly convenient for making these measurements.

17.1.3 Make sample test specimen thickness measurements with a similar micrometer, except that the anvil shall be at least 38 mm (1.5 in.) in diameter or, if having a smaller anvil, be provided with equivalent means of supporting the specimen in a flat position. In addition, the presser foot shall be 6.3 ± 0.3 mm (0.25 ± 0.010 in.) in diameter.

17.2 Size shall be the interior circumference of the glove measured on a line parallel to the finger crotches and passing through the thumb crotch. The method of determining this dimension shall be to measure the outside width, *W*, at this line with the hand of the glove in a flattened state, subtract twice the median glove thickness, *T*, in the hand, and multiply this difference by a factor of 2.

$$S = 2\,(W - 2T)$$

FIG. 4 Dial-Type Micrometer for Measuring Glove Thickness at Fingertips

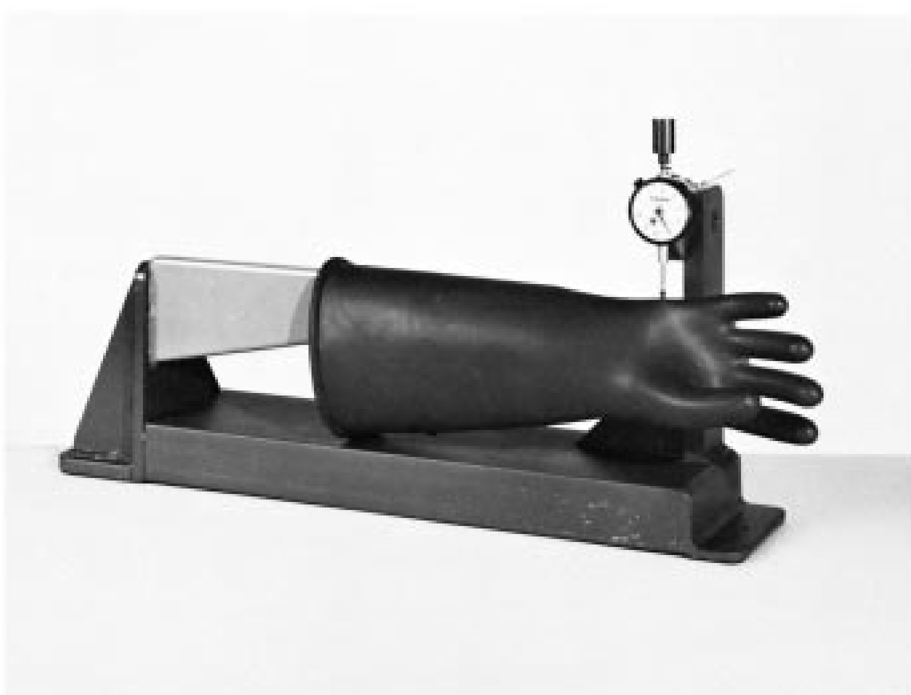

FIG. 3 Dial-Type Micrometer for Measuring Glove Thickness

where:
S = size of the glove,
W = outside width, and
T = median glove thickness.

17.3 *Length*:

17.3.1 Length shall be measured with the glove in a relaxed position and the edge of the cuff perpendicular to the line of measurement. Length is the distance from the tip of the second finger to the outside edge of the cuff as shown in Fig. 2 and Fig. 5.

17.3.2 Measure the difference in lengths for contour cuff gloves with the glove in the same position and along a line parallel to the length dimensions, as shown in Fig. 2.

18. Electrical Tests

18.1 All electrical tests shall be performed at room temperature. The gloves, right side out, shall be filled with tap water and immerse in water to a depth in compliance with Table 6 for the test voltage to be used. The water level during the test shall be the same inside and outside the glove. The water inside the glove that forms one test electrode shall be connected to one terminal of the voltage source by means of a chain or sliding rod that dips into the water. The water in the tank outside the glove that forms the other electrode shall be connected directly to the other terminal of the voltage source. The water shall be free of air bubbles and air pockets inside or outside the glove, and the exposed portion of the glove above the water line shall be dry.

NOTE 5—Both a-c and d-c voltage proof-test methods are included in this section. It is intended that one method be selected for the electrical acceptance tests. The method selected shall be at the option of the purchaser, and the supplier should be so notified of the selection.

18.2 **Caution**: It is recommended that the test apparatus be designed to afford the operator full protection in performance of his duties. Reliable means of de-energizing and grounding the high-voltage circuit shall be provided. It is particularly important to incorporate a positive means of grounding the high-voltage section of d-c test apparatus due to the likely presence of high-voltage capacitance charges at the conclusion of the test.

18.3 *Test Equipment*:

18.3.1 The test equipment used in the proof, acceptance, and dielectric breakdown tests shall be capable of supplying an essentially stepless and continuously variable voltage to the test specimen. Motor-driven regulating equipment is convenient and tends to provide uniform rate-of-rise to the test voltage. The test apparatus or each position, or both, should be protected by an automatic circuit-breaking device designed to open promptly on the current produced by breakdown of a specimen under test. This circuit breaking device should be designed to protect the test equipment under any conditions of short circuit. The equipment shall be inspected at least annually to ensure that the general condition of the equipment is acceptable and to verify the characteristics and accuracy of the test voltages.

18.3.1.1 Glove failure indicators or accessory circuits shall be designed to give positive indication of failure and shall require resetting by the operator before tests can be continued.

18.4 *A-C Tests*:

18.4.1 *Voltage Supply and Regulation*:

18.4.1.1 The desired test voltage may be obtained most readily from a step-up transformer energized from a variable low-voltage source. The transformer and its control equipment shall be of such size and design that, with the test specimen in the circuit, the crest factor (ratio of maximum to mean effective) of the test voltage shall differ by not more than 5 % from that of a sinusoidal wave over the upper half of the range of the test voltage.

18.4.1.2 The correct rms value of the sinusoidal voltage wave-form applied to the glove may be measured by one of the following methods: (*1*) a voltmeter used in conjunction with a calibrated instrument transformer connected directly across the high-voltage circuit, (*2*) a calibrated electrostatic voltmeter connected directly across the high-voltage circuit, (*3*) a voltmeter connected to a tertiary coil in the test transformer, provided it has been demonstrated that the assigned ratio of transformation does not change with load, or (*4*) an a-c meter connected in series with appropriate high-voltage type resistors directly across the high-voltage circuit. The accuracy of the adopted voltage-measuring circuit shall be within ± 2 % of full scale.

NOTE 6—A voltmeter connected to the low-voltage side of the testing transformer may be used only if the ratio of transformation has been properly determined and is known not to change appreciably with load. A calibrated sphere gap may be used to check the accuracy of the voltage as indicated by the voltmeter.

18.4.1.3 The crest factor may be checked by the use of a peak-reading voltmeter connected directly across the high-voltage circuit; or, if an electrostatic voltmeter or a voltmeter in

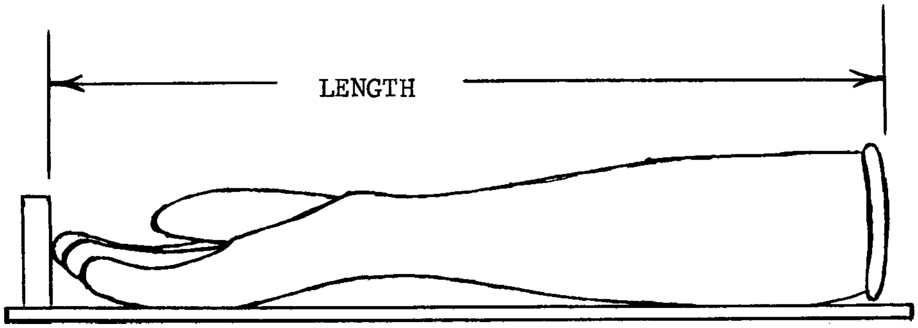

FIG. 5 Length Measurement on Standard Cuff Glove

TABLE 6 Clearances—Cuff to Water Line [A,B]

Class of Glove	A-C				D-C			
	Proof Test		Breakdown		Proof Test		Breakdown	
	mm	in.	mm	in.	mm	in.	mm	in.
00	38	1½	38	1½	38	1½	51	2
0	38	1½	38	1½	38	1½	51	2
1	38	1½	64	2½	51	2	102	4
2	64	2½	76	3	76	3	127	5
3	89	3½	102	4	102	4	152	6
4	127	5	165	6½	153	6	178	7

[A]Permissible tolerance clearance—Cuff to water± 13 mm (±½ in.).
[B]In those cases where atmospheric conditions make the specified clearances impractical, the clearances may be increased by a maximum of 25 mm (1 in.).

conjunction with an instrument potential transformer is connected across the high-voltage circuit, a standard sphere gap may be sparked over and the corresponding voltage compared with the reading of the rms voltmeter.

18.4.1.4 The proof-test current shall be measured by inserting a milliammeter in series with each individual glove. The reading should be taken near the end of the proof-test period.

18.4.2 *A-C Proof Tests*:

18.4.2.1 Each glove shall be given a proof test in accordance with the requirements of 11.1. The proof-test voltage shall be applied initially at a low value and increase at a constant rate-of-rise of approximately 1000 V/s until the prescribed test voltage level is reached, or failure occurs. The test period starts at the instant that the prescribed testing voltage is reached. The applied voltage should be reduced to at least half value, unless an electrical failure has occurred, at the end of the test period before opening the test circuit.

18.4.3 *A-C Breakdown Test*:

18.4.3.1 Each sample selected in accordance with 13.2 shall be given a breakdown test as specified in 11.2. The voltage shall be applied at a low value and increase at a constant rate-of-rise of approximately 1000 V/s until the prescribed minimum breakdown voltage is reached or failure occurs. The maximum voltage observed prior to failure shall be considered as the breakdown voltage.

18.4.4 *A-C Moisture Absorption/Proof Test*:

18.4.4.1 Each sample selected in accordance with 13.2 shall be given an A-C moisture absorption/proof test as specified in 11.3. Sample gloves that have passed the a-c proof test requirement of 18.4.2 shall be placed in the test equipment, immersed in water in accordance with 18.1 and soaked for 16 h. Alternately, the gloves may be soaked by submerging completely in water without trapping air and then transferring them directly to the test equipment in accordance with 18.1. The gloves will be soaked for 16 continuous hours at room temperature. Immediately after the soak period the gloves shall be tested in accordance with 18.4.2. The proof test voltage shall then be applied initially at a low value and increased at a constant rate-of-rise of approximately 1000 V/s until the prescribed test voltage level is reached or failure occurs. The proof test current shall then be measured and recorded. The applied voltage shall then be reduced to at least half value, unless an electrical failure has occurred, before opening the test circuit.

NOTE 7—If alternate method is used, ensure that the clearance area is dry to avoid flashover.

18.5 *D-C Tests*:

18.5.1 *Voltage Supply and Regulation*:

18.5.1.1 The d-c test voltage shall be obtained from a d-c source capable of supplying the required voltage. The peak to peak a-c ripple component of the d-c proof-test voltage shall not exceed 2 % of the average voltage value under no-load conditions.

18.5.1.2 Measure the d-c proof-test voltage by a method that provides the average value of the voltage applied to the glove. It is recommended that the voltage be measured by the use of a d-c meter connected in series with appropriate high-voltage type resistors across the high-voltage circuit. An electrostatic voltmeter of proper range may be used in place of the d-c meter-resistor combination. The accuracy of the voltage-measuring circuit shall be within ±2 % of full scale.

18.5.2 *D-C Proof Test*:

18.5.2.1 Each glove shall be given a proof test in accordance with the requirements of 11.1. The d-c proof-test voltage shall be applied in the same manner as for a-c proof tests except with a rate-of-rise of approximately 3000 V/s.

18.5.3 *D-C Breakdown Test*:

18.5.3.1 The d-c breakdown tests shall be performed in the same way as a-c breakdown tests except with a rate-of-rise of approximately 3000 V/s.

18.6 *Ozone Resistance Test*—The ozone resistance test shall be made in accordance with one of the following methods to ensure conformance of Type II gloves with the requirements of 10.3.

18.6.1 *Method A*—The ozone resistance test shall be made in accordance with Test Method D 1149, using Procedure A of Test Method D 518 to prepare the specimen. The specimen should be cut to a 12 by 100-mm (0.5 by 4-in.) rectangular size. Follow Procedure A using a 20 % extension. Maintain the ozone concentration at 50 ± 5 mPa partial pressure (50 ± 5 pphm by volume at standard atmospheric pressure) for a 3 h test period. Type II gloves shall show no effect from ozone exposure during this test period.

18.6.2 *Method B*:

18.6.2.1 The ozone resistance test shall be made on a 100 by 150-mm (4 by 6-in.) specimen of the glove material prepared from a sample suitably conditioned by lying flat for 24 h. The specimen should be draped over a 25-mm (1-in.) diameter metal tube of sufficient length to completely underlie the specimen, while possessing additional length for the required mounting supports. The metal tubing shall be electrically grounded. The free ends of the specimen shall be clamped beneath the tubing electrode so that an intimate contact is established between the specimen and the tubing along the upper half of the cylindrically-shaped electrode surface.

18.6.2.2 A piece of flat aluminum sheet foil, approximately 50 by 100 mm (2 by 4 in.), shall be placed over the draped specimen so as to provide adequate separation distance to prevent flashover between the foil and the metal tubing. An electrode wire shall be connected to the aluminum foil.

18.6.2.3 The outer electrode (metal foil) shall be energized to 15 kV ac (rms) from a stable 60-Hz source. The 15 kV potential may be derived from a suitably rated potential transformer energized from its low-voltage winding through a continuously variable autotransformer. An overcurrent protective device should be incorporated into the low-voltage control circuit in case of an electrical breakdown.

18.6.2.4 The ozone resistance of the specimen should be determined qualitatively, by inspection, after a 1-h exposure period in the test apparatus at the 15 kV potential. At least two specimens from each sample glove selected in accordance with 13.2 shall be tested. Two specimens should not be taken from the same section of the sample glove.

NOTE 8—The rate of ozone degradation by use of Method B is inversely proportional to the relative humidity of the surrounding air. Empirical data indicate, however, that visible ozone effects will be evident over a broad range of ambient humidities under these test conditions.

19. Chemical and Physical Tests

19.1 *Chemical Tests*:

19.1.1 The composition of the rubber hydrocarbon portion of Type I gloves may be determined in accordance with the test method in Methods D 297.

19.2 *Physical Tests*:

19.2.1 Physical tests should be performed to determine the physical requirements specified in Section 10. The glove samples should be conditioned by storing in a flat position for 24 h at a room temperature of 23 ± 4°C (73 ± 7°F).

19.2.2 The tensile strength, tensile stress at 200 % of elongation, and tension set tests shall be performed in accordance with Test Methods D 412, except for elongation time. The test specimen shall conform in dimensions to Die C. The elongation in the tension set shall be 400 % with grip separation at a rate of 500 ± 50 mm (20 ± 2 in.)/min.

19.2.3 The tear resistance test shall be performed in accordance with Test Method D 624. The test specimen shall conform to the dimensions of Die C.

19.2.4 The puncture resistance test shall be performed to determine the ability of the glove material to withstand puncture.

19.2.4.1 A glove specimen shall be cut to fit between the opposing faces of two flat metal plates having concentric openings. The thickness of each test specimen shall be measured at its approximate center using a micrometer having the characteristics described in Test Methods D 412. One of the plates shall have a circular opening 6 mm (0.25 in.) in diameter to allow the passage of a stainless steel needle. The other plate shall have an opening 25 mm (1.0 in.) in diameter to provide a fixed free area through which the specimen can elongate while being subjected to the pressure of the needle point. The edges of the openings should be rounded to a radius of approximately 0.8 mm (0.03 in.). The needle shall be made from 5-mm (0.19-in.) diameter Type 304 stainless steel rod. The rod should be machined at one end to produce a taper with an included angle of 12° with the tip of the tapered end rounded to a radius of 0.8 mm (0.03 in.). The needle shall be initially positioned perpendicularly to the specimen so that the point contacts the specimen through the small hole in the plate. The needle shall be driven into and through the specimen at a continuous rate of approximately 8.3 mm/s (20 in./min). The maximum force required to perform the puncturing operation shall be measured to the nearest 2 N (0.5 lbf). The puncture resistance shall be calculated by dividing the puncturing force by the specimen thickness and recorded in units of newtons per metre (or pounds-force per inch).

19.2.5 The durometer test shall be performed in accordance with Test Method D 1415 or Test Method D 2240, using a Type A durometer.

19.2.6 The accelerated aging tests shall be performed in accordance with Test Method D 573. After being subjected to a temperature of 70 ± 2°C (158 ± 3.6°F) in circulating air for 7 days, the tensile strength and elongation of the specimen shall not be less than 80 % of the original.