

**WAC 296-24-63599 Appendix E—Test methods for protective clothing.** This appendix contains test methods which must be used to determine if protective clothing affords the required level of protection as specified in chapter 296-811 WAC - fire brigades.

(1) **Puncture resistance test method for foot protection.**

(a) **Apparatus.** You must perform the puncture resistance test on a testing machine having a movable platform adjusted to travel at one-quarter-inch per minute (0.1 cm/sec). You must prepare two blocks of hardwood, metal, or plastic as follows: The blocks must be of such size and thickness as to insure a suitable rigid test ensemble and allow for at least one-inch of the pointed end of an 8D nail to be exposed for the penetration. One block must have a hole drilled to hold an 8D common nail firmly at an angle of 98°. The second block must have a maximum one-half inch (1.3 cm) diameter hole drilled through it so that the hole will allow free passage of the nail after it penetrates the insole during the test.

(b) **Procedure.** You must place the test ensemble consisting of the sample unit, the two prepared blocks, a piece of leather outsole 10 to 11 irons thick and a new 8D nail, as follows: The 8D nail in the hole, the sample of outsole stock superimposed above the nail, the area of the sole plate to be tested placed on the outsole, and the second block with hole so placed as to allow for free passage of the nail after it passes through the outsole stock and sole plate in that order. You must start the machine and the pressure, in pounds required for the nail to completely penetrate the outsole and sole plate, recorded to the nearest 5 pounds. You must make two determinations on each sole plate and the results averaged. A new nail shall be used for each determination.

(c) **Source.** These test requirements are contained in "Military Specification For Fireman's Boots," MIL-B-2885D (1973 and amendment dated 1975) and are reproduced for your convenience.

(2) **Test method for determining the strength of cloth by tearing:**

(a) **Test specimen.** The specimen must be a rectangle of cloth three-inches by six-inches (7.6 cm by 15.2 cm). The long dimension must be parallel to the warp for warp tests and parallel to the filling for filling tests. No two specimens for warp tests must contain the same warp yarns, nor must any two specimens for filling tests contain the same filling yarns. You must take the specimen no nearer the selvage than 1/10 the width of the cloth. You must mark an isosceles trapezoid having an altitude of three inches (7.6 cm) and bases of one inch (2.5 cm) and four inches (10.2 cm) in length, respectively, on each specimen, preferably with the aid of a template. You must then make a cut approximately three-eighths inch (1 cm) in length in the center of a perpendicular to the one inch (2.5 cm) edge.

(b) **Apparatus.**

(i) You must use 6 ounce (.17 kg) weight tension clamps so designed that the six ounces (.17 kg) of weight are distributed evenly across the complete width of the sample.

(ii) The machine must consist of three main parts: Straining mechanism, clamps for holding specimen, and load and elongation recording mechanisms.

(iii) You must use a machine wherein the specimen is held between 2 clamps and strained by a uniform movement of the pulling clamp.

(iv) You must adjust the machine so that the pulling clamp shall have a uniform speed of  $12 \pm 10.5$  inches per minute ( $0.5 \pm .02$  cm/sec).

(v) The machine must have 2 clamps with 2 jaws on each clamp. The design of the 2 clamps must be such that one gripping surface or jaw may be an integral part of the rigid frame of the clamp or be fastened to allow a slight vertical movement, while the other gripping surface or jaw must be completely moveable. The dimension of the immovable jaw of each clamp parallel to the application of the load shall measure one inch, and the dimension of the jaw perpendicular to this direction must measure 3 inches or more. The face of the moveable jaw of each clamp must measure one inch by 3 inches.

Each jaw face must have a flat, smooth, gripping surface. You must round all edges which might cause a cutting action to a radius of not over 1/64 inch (.04 cm). In cases where a cloth tends to slip when being tested, the jaws may be faced with rubber or other material to prevent slippage. The distance between the jaws (gage length) must be one inch at the start of the test.

(vi) You must use calibrated dial; scale or chart to indicate applied load and elongation. You must adjust or set the machine, so that the maximum load required to break the specimen will remain indicated on the calibrated dial or scale after the test specimen has ruptured.

(vii) The machine must be of such capacity that the maximum load required to break the specimen must be not greater than 85% or less than 15% of the rated capacity.

(viii) The error of the machine must not exceed 2% up to and including a fifty-pound load (22.6 kg) and 1% over a 50 pound load (22.6 kg) at any reading within its loading range.

(ix) You must disengage machine attachments for determining maximum loads during this test.

(c) **Procedure.**

(i) You must clamp the specimen in the machine along the nonparallel sides of the trapezoid so that these sides lie along the lower edge of the upper clamp and the upper edge of the lower clamp with the cut halfway between the clamps. The short trapezoid base must be held taut and the long trapezoid base must lie in the folds.

(ii) You must start the machine and you must observe the force necessary to tear the cloth by means of an autographic recording device. The speed of the pulling clamp must be 12 inches  $\pm$  0.5-inch per minute (0.5  $\pm$  .02 cm/sec).

(iii) If a specimen slips between the jaws, breaks in or at the edges of the jaws, or if for any reason attributable to faulty technique, an individual measurement falls markedly below the average test results for the sample unit, you must discard such result and test another specimen.

(iv) The tearing strength of the specimen must be the average of the five highest peak loads of resistance registered for three inches (7.6 cm) of separation of the tear.

(d) **Report.**

(i) You must test five specimens in each of the warp and filling direction must be tested from each sample unit.

(ii) The tearing strength of the sample unit must be the average of the result obtained from the specimens tested in each of the warp and filling directions and you must report separately to the nearest 0.1 pound (.05 kg).

(e) **Source.** These test requirements are contained in "Federal Test Method Standard 191, Method 5136," and are reproduced for your convenience.

(3) **Test method for determining flame resistance of cloth; vertical.**

(a) **Test specimen.** The specimen must be a rectangle of cloth two and three-quarter inches (7.0 cm) by twelve inches (30.5 cm) with the long dimension parallel to either the warp or filling direction of the cloth. No two warp specimens must contain the same warp yarns, and no two filling specimens must contain the same filling yarn.

(b) **Number of determinations.** You must test five specimens from each of the warp and filling directions from each sample unit.

(c) **Apparatus.**

(i) **Cabinet.** You must fabricate a cabinet and accessories in accordance with the requirements specified in Figures L-1, L-2, and L-3. You must use galvanized sheet metal or other suitable metal. You must paint the entire inside back wall of the cabinet black to facilitate the viewing of the test specimen and pilot flame.

(ii) **Burner.** The burner must be equipped with a variable orifice to adjust the flame height, a barrel having a 3/8 inch (9.5 mm) inside diameter and a pilot light.

(A) The burner may be constructed by combining a 3/8 inch (1 cm) inside diameter barrel  $3 \pm 1/4$ -inches ( $7.6 \pm .6$  cm) long from a fixed orifice burner with a base from a variable orifice burner.

(B) The pilot light tube must have a diameter of approximately 1/16 inch (.2 cm) and must be spaced 1/8 inch (.3 cm) away from the burner edge with a pilot flame 1/8 inch (.3 cm) long.

(C) The necessary gas connections and the applicable plumbing must be as specified in Figure L-4 except that a solenoid valve may be used in lieu of the stopcock valve to which the burner is attached. The stopcock valve or solenoid valve, whichever is used, must be capable of being fully opened or fully closed in 0.1 second.

(D) On the side of the barrel of the burner, opposite the pilot light there must be a metal rod of approximately 1/8 inch (.3 cm) diameter spaced 1/2 inch (1.3 cm) from the barrel and extending above the burner. The rod must have 2 5/16 inch (.8 cm) prongs marking the distances of 3/4 inch (1.9 cm), and one and 1/2 inches (3.8 cm) above the top of the burner.

(E) The burner must be fixed in a position so that the center of the barrel of the burner is directly below the center of the specimen.

(iii) There must be a control valve system with a delivery rate designed to furnish gas to the burner under a pressure of  $2-1/2 \pm 1/4$  (psi) ( $17.5 \pm 1.8$  kPa) at the burner inlet. You must include the manufacturer's recommended delivery rate for the valve system in the required pressure.

(iv) A synthetic gas mixture must be of the following composition within the following limits (analyzed at standard conditions):  $55 \pm 3\%$  hydrogen,  $24 \pm 1\%$  methane,  $3 \pm 1\%$  ethane, and  $18 \pm 1\%$  carbon monoxide which will give a specific gravity of  $0.365 \pm 0.018$  (air = 1) and a B.T.U. content of  $540 \pm 20$  per cubic foot ( $20.1 \pm 3.7$  kJL) (dry basis) at 69.8 F (21 C).

(v) There must be metal hooks and weights to produce a series of total loads to determine length of char. The metal hooks must consist of No. 19 gage steel wire or equivalent and must be made from 3 inch (7.6 cm) lengths of wire and bent 1/2 inch (1.3 cm) from one end to a 45-degree hook. You must fasten one end of the hook shall be fastened around the neck of the weight to be used.

(vi) There must be a stop watch or other device to measure the burning time 0.2 second.

(vii) There must be a scale, graduated in 0.1 inch (.3 cm) to measure the length of char.

(d) **Procedure.**

(i) You must evaluate the material undergoing test for the characteristics of after-flame time and char length on each specimen.

(ii) All specimens to be tested must be at moisture equilibrium under standard atmospheric conditions in accordance with subsection (3)(c) of this appendix. You must expose each specimen to be tested to the test flame within 20 seconds after removal from the standard atmosphere. In case of dispute, all testing will be conducted under standard atmospheric conditions in accordance with subsection (3)(c) of this appendix.

(iii) You must suspend the specimen in its holder vertically in the cabinet in such a manner that the entire length of the specimen is exposed and the lower end is 3/4 inch (1.9 cm) above the top of the gas burner. You must set up the apparatus in a draft-free area.

(iv) Prior to inserting the specimen, you must adjust the pilot flame to approximately 1/8 inch (.3 cm) in height measured from its lowest point to the tip.

You must adjust the burner flame by means of the needle valve in the base of the burner to give a flame height of 1 1/2 inches (3.8 cm) with the stopcock fully open and the air supply to burner shut off and taped. The 1 1/2 inch (3.8 cm) flame height is obtained by adjusting the valve so that the uppermost portion (tip) of the flame is level with the tip of the metal prong (see Fig. L-2) specified for adjustment of flame height. It is an important aspect of the evaluation that the flame height to be adjusted with the tip of the flame level with the tip of the metal prong. After inserting the specimen, the stopcock must be fully opened, and the burner flame applied vertically at the middle of the lower edge of the specimen for twelve seconds and the burner turned off. The cabinet door must remain shut during testing.

(v) The after-flame must be the time the specimen continues to flame after the burner flame is shut off.

(vi) After each specimen is removed, you must clear the test cabinet of fumes and smoke prior to testing the next specimen.

(vii) After both flaming and glowing have ceased, you must measure the char length. The char length must be the distance from the end of the specimen, which was exposed to the flame, to the end of a tear (made lengthwise) of the specimen through the center of the charred area as follows: You must fold the specimen lengthwise and crease it by hand along a line through the highest peak of the charred area. You must insert the hook in the specimen (or a hole, 1/4 inch (.6 cm) diameter or less, punched out for the hook) at one side of the charred area 1/4 inch (.6 cm) from the adjacent outside edge and 1/4 inch (.6 cm) in from the lower end. A weight of sufficient size load such that the weight and hook together must equal the total tearing load required in Table L-2 of this section must be attached to the hook.

(viii) You must apply a tearing force gently to the specimen by grasping the corner of the cloth at the opposite edge of the char from the load and raising the specimen and weight clear of the supporting surface. You must mark off the end of the tear on the edge and the char length measurement made along the undamaged edge.

Loads for determining char length applicable to the weight of the test cloth must be as shown in Table L-2.

TABLE L-2

Specified weight per square yard of cloth before any fire retardant treatment or coating - ounces	Total learning weight for determining the charred length - pound
2.0 to 6.0 .....	0.25

Specified weight per square yard of cloth before any fire retardant treatment or coating - ounces	Total learning weight for determining the charred length - pound
Over 6.0 to 15.0 .....	0.50
Over 15.0 to 23.0 .....	0.75
Over 23.0 .....	1.0

To change into S.I. (System International) units, 1 ounce =28.35 grams, 1 pound = 453 grams, 1 yard = .91 metre.

(ix) You must record the after-flame time of the specimen to the nearest 0.2 second and the char length to the nearest 0.1 inch (.3 cm).

(e) **Report.**

(i) The after-flame time and char length of the sample unit must be the average of the results obtained from the individual specimens tested. You must record all values obtained from the individual specimens.

(ii) You must report the after-flame time in the nearest 0.2 second and the char length to the nearest 0.1 inch (.3 cm).

(f) **Source.** These test requirements are contained in "Federal Test Method Standard 191, Method 5903 (1971)," and are reproduced for your convenience.

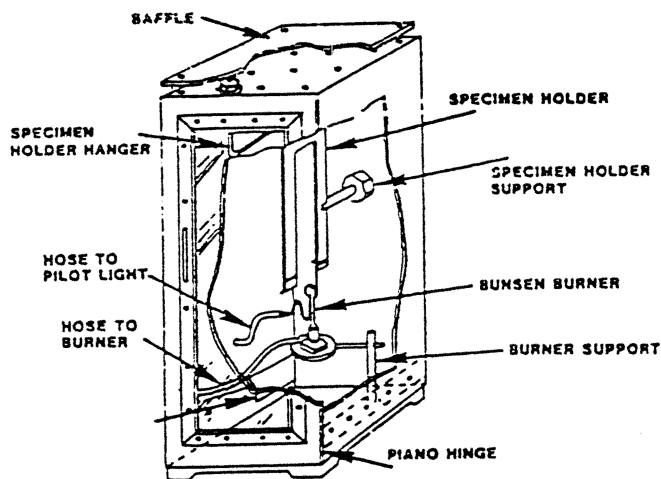


Figure L-1 - Vertical flame resistance textile apparatus. All given dimensions are in inches. System International (S.I.) unit: 1 inch = 2.54 cm.

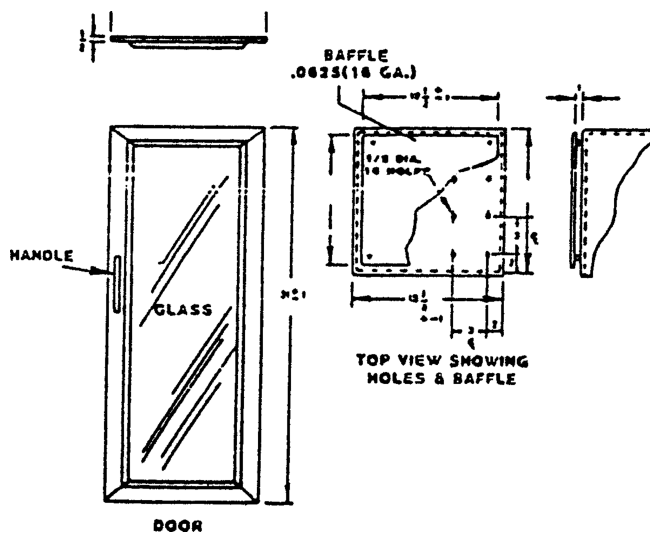


Figure L-2 - Vertical flame resistance textile apparatus, door and top view w/baffle. All given dimensions are in inches. System International (S.I.) unit: 1 inch = 2.54 cm.

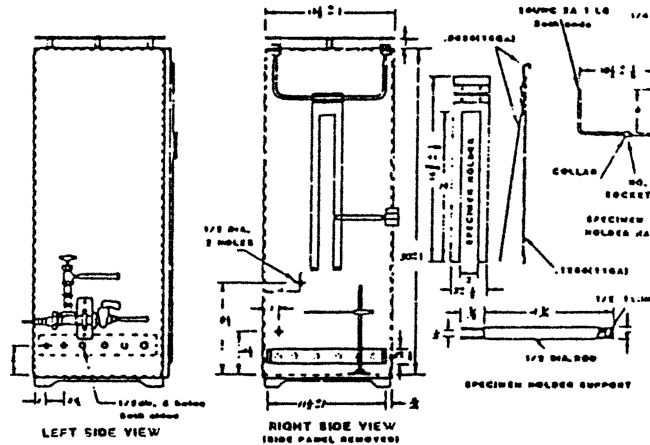


Figure L-3 - Vertical flame resistance textile apparatus, views and details. All given dimensions are in inches. System International (S.I.) unit: 1 inch = 2.54 cm.

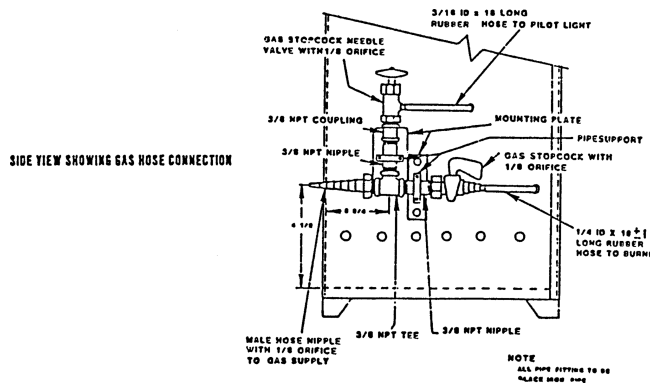


Figure L-4 - Vertical flame resistance textile apparatus. All given dimensions are in inches. System International (S.I.) unit: 1 inch = 2.54 cm.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-03-159, § 296-24-63599, filed 1/23/18, effective 2/23/18; WSR 15-24-100, § 296-24-63599, filed 12/1/15, effective 1/5/16. Statutory Authority: Chapter 49.17 RCW. WSR 92-23-017 (Order 92-13), § 296-24-63599, filed 11/10/92, effective 12/18/92; WSR 87-24-051 (Order 87-24), § 296-24-63599, filed 11/30/87. Statutory Authority: RCW 49.17.040 and 49.17.050. WSR 82-02-003 (Order 81-32), § 296-24-63599, filed 12/24/81.]