Personal radio transmitters, worn by an individual, can be used where the individual may be working such as in a remote location. Such personal radio transmitters shall send a distinct signal and should clearly indicate who is having an emergency, the location, and the nature of the emergency. All radio transmitters need a feedback system to assure that the emergency alarm is sent to the people who can provide assistance.

For multi-story buildings or single story buildings with interior walls for subdivisions, the more traditional alarm systems are recommended for these types of workplaces. Supervised telephone or manual fire alarm or pull box stations with paging systems to transmit messages throughout the building is the recommended alarm system. The alarm box stations should be available within a travel distance of 200 feet. Water flow detection on a sprinkler system, fire detection systems (guard's supervisory station) or tour signal (watchman's service), or other related systems may be part of the overall system. The paging system may be used for nonemergency operations provided the emergency messages and uses will have precedence over all other uses of the system.

4. ***Supervision.*** The requirements for supervising the employee alarm system circuitry and power supply may be accomplished in a variety of ways. Typically, electrically operated sensors for air pressure, fluid pressure, steam pressure, or electrical continuity of circuitry may be used to continuously monitor the system to assure it is operational and to identify trouble in the system and give a warning signal.

[45 FR 60715, Sept. 12, 1980; 46 FR 24557, May 1, 1981]

Appendix B to Subpart L of Part 1910—National Consensus Standards

The following table contains a cross-reference listing of those current national consensus standards which contains information and guidelines that would be considered acceptable in complying with requirements in the specific sections of subpart L.

Subpart L section	National consensus standard
1910.156	ANSI/NFPA No. 1972; Structural Fire Fighter's Helmets.
	ANSI Z88.5 American National Standard, Practice for Respirator Protection for the Fire Service.
	ANSI/NFPA No. 1971, Protective Clothing for Structural Fire Fighters.
	NFPA No. 1041, Fire Service Instructor Professional Qualifications.
1910.157	ANSI/NFPA No. 10, Portable Fire Extinguishers.
1910.158	ANSI/NFPA No. 18, Wetting Agents.
	ANSI/NFPA No. 20, Centrifugal Fire Pumps.
	NFPA No. 21, Steam Fire Pumps.
	ANSI/NFPA No. 22, Water Tanks.
	NFPA No. 24, Outside Protection.

NFPA standards are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

ANSI Standards are available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

Subpart L section	National consensus standard
	NFPA No. 26, Supervision of Valves.
	NFPA No. 13E, Fire Department Operations in Properties Protected by Sprinkler, Standpipe Systems.
	ANSI/NFPA No. 194, Fire Hose Connections.
	NFPA No. 197, Initial Fire Attack, Training for.
	NFPA No. 1231, Water Supplies for Suburban and Rural Fire Fighting.
1910.159	ANSI-NFPA No. 13, Sprinkler Systems.
	NFPA No. 13A, Sprinkler Systems, Maintenance.
	ANSI/NFPA No. 18, Wetting Agents.
	ANSI/NFPA No. 20, Centrifugal Fire Pumps.
	ANSI/NFPA No. 22, Water Tanks.
	NFPA No. 24, Outside Protection.
	NFPA No. 26, Supervision of Valves.
	ANSI/NFPA No. 72B, Auxiliary Signaling Systems.
	NFPA No. 1231, Water Supplies for Suburban and Rural Fire Fighting.
1910.160	ANSI/NFPA No. 11, Foam Systems.
	ANSI/NFPA 11A, High Expansion Foam Extinguishing Systems.
	ANSI/NFPA No. 11B, Synthetic Foam and Combined Agent Systems.
	ANSI/NFPA No. 12, Carbon Dioxide Systems.
	ANSI/NFPA No. 12A, Halon 1301 Systems.
	ANSI/NFPA No. 12B, Halon 1211 Systems.
	ANSI/NFPA No. 15, Water Spray Systems.
	ANSI/NFPA 16 Foam-Water Spray Systems.
	ANSI/NFPA No. 17, Dry Chemical Systems.
	ANSI/NFPA 69, Explosion Suppression Systems.
1910.161	ANSI/NFPA No. 11B, Synthetic Foam and Combined Agent Systems.
	ANSI/NFPA No. 17, Dry Chemical Systems.
1910.162	ANSI/NFPA No. 12, Carbon Dioxide Systems.
	ANSI/NFPA No. 12A, Halon 1211 Systems.
	ANSI/NFPA No. 12B, Halon 1301 Systems.
	ANSI/NFPA No. 69, Explosion Suppression Systems.
1910.163	ANSI/NFPA No. 11, Foam Extinguishing Systems.
	ANSI/NFPA No. 11A, High Expansion Foam Extinguishing Systems.
	ANSI/NFPA No. 11B, Synthetic Foam and Combined Agent Systems.
	ANSI/NFPA No. 15, Water Spray Fixed Systems.

NFPA standards are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

ANSI Standards are available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

Subpart L section	National consensus standard
	ANSI/NFPA No. 16, Foam-Water Spray Systems.
	ANSI/NFPA No. 18, Wetting Agents.
	NFPA No. 26, Supervision of Valves.
1910.164	ANSI/NFPA No. 71, Central Station Signaling Systems.
	ANSI/NFPA No. 72A, Local Protective Signaling Systems.
	ANSI/NFPA No. 72B, Auxiliary Signaling Systems.
	ANSI/NFPA No. 72D, Proprietary Protective Signaling Systems.
	ANSI/NFPA No. 72E, Automatic Fire Detectors.
	ANSI/NFPA No. 101, Life Safety Code.
1910.165	ANSI/NFPA No. 71, Central Station Signaling Systems.
	ANSI/NFPA No. 72A, Local Protective Signaling Systems.
	ANSI/NFPA No. 72B, Auxiliary Protective Signaling Systems.
	ANSI/NFPA No. 72C, Remote Station Protective Signaling Systems.
	ANSI/NFPA No. 72D, Proprietary Protective Signaling Systems.
	ANSI/NFPA No. 101, Life Safety Code.
Metric Conversion	ANSI/ASTM No. E380, American National Standard for Metric Practice.

NFPA standards are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

ANSI Standards are available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

[45 FR 60715, Sept. 12, 1980, as amended at 58 FR 35309, June 30, 1993]

Appendix C to Subpart L of Part 1910—Fire Protection References For Further Information

I. ***Appendix general references.*** The following references provide information which can be helpful in understanding the requirements contained in all of the sections of subpart L:

A. ***Fire Protection Handbook,*** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

B. ***Accident Prevention Manual for Industrial Operations,*** National Safety Council; 425 North Michigan Avenue, Chicago, IL 60611.

C. Various associations also publish information which may be useful in understanding these standards. Examples of these associations are: Fire Equipment Manufacturers Association (FEMA) of Arlington, VA 22204 and the National Association of Fire Equipment Distributors (NAFED) of Chicago, IL 60601.

II. ***Appendix references applicable to individual sections.*** The following references are grouped according to individual sections contained in subpart L. These references provide information which may be helpful in understanding and implementing the standards of each section of subpart L.

A. *§ 1910.156. Fire brigades:*

1. ***Private Fire Brigades,*** NFPA 27; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
2. ***Initial Fire Attack, Training Standard On,*** NFPA 197; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
3. ***Fire Fighter Professional Qualifications,*** NFPA 1001; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
4. ***Organization for Fire Services,*** NFPA 1201; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
5. ***Organization of a Fire Department,*** NFPA 1202; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
6. ***Protective Clothing for Structural Fire Fighting,*** ANSI/NFPA 1971; .
7. ***American National Standard for Men's Safety-Toe Footwear,*** ANSI Z41.1; American National Standards Institute, New York, NY 10018.
8. ***American National Standard for Occupational and Educational Eye and Face Protection,*** ANSI Z87.1; American National Standards Institute, New York, NY 10018.
9. ***American National Standard, Safety Requirements for Industrial Head Protection,*** ANSI Z89.1; American National Standards Institute, New York, NY 10018.
10. ***Specifications for Protective Headgear for Vehicular Users,*** ANSI Z90.1; American National Standards Institute, New York, NY 10018.
11. ***Testing Physical Fitness;*** Davis and Santa Maria. *Fire Command.* April 1975.
12. ***Development of a Job-Related Physical Performance Examination for Fire Fighters;*** Dotson and Others. A summary report for the National Fire Prevention and Control Administration. Washington, DC. March 1977.
13. ***Proposed Sample Standards for Fire Fighters' Protective Clothing and Equipment;*** International Association of Fire Fighters, Washington, DC.
14. ***A Study of Facepiece Leakage of Self-Contained Breathing Apparatus by DOP Man Tests;*** Los Alamos Scientific Laboratory, Los Alamos, NM.
15. ***The Development of Criteria for Fire Fighters' Gloves; Vol. II: Glove Criteria and Test Methods;*** National Institute for Occupational Safety and Health, Cincinnati, OH. 1976.
16. ***Model Performance Criteria for Structural Fire Fighters' Helmets;*** National Fire Prevention and Control Administration, Washington, DC. 1977.
17. ***Firefighters;*** Job Safety and Health Magazine, Occupational Safety and Health Administration, Washington, DC. June 1978.
18. ***Eating Smoke—The Dispensable Diet;*** Utech, H.P. The Fire Independent, 1975.
19. ***Project Monoxide—A Medical Study of an Occupational Hazard of Fire Fighters;*** International Association of Fire Fighters, Washington, DC.

20. *Occupational Exposures to Carbon Monoxide in Baltimore Firefighters;* Radford and Levine. Johns Hopkins University, Baltimore, MD. Journal of Occupational Medicine, September, 1976.

21. *Fire Brigades;* National Safety Council, Chicago, IL. 1966.

22. *American National Standard, Practice for Respiratory Protection for the Fire Service;* ANSI Z88.5; American National Standards Institute, New York, NY 10018.

23. *Respirator Studies for the Nuclear Regulatory Commission; October 1, 1977—September 30, 1978. Evaluation and Performance of Open Circuit Breathing Apparatus.* NU REG/CR-1235. Los Alamos Scientific Laboratory; Los Alamos, NM. 87545, January, 1980.

B. *§ 1910.157. Portable fire extinguishers:*

1. *Standard for Portable Fire Extinguishers,* ANSI/NFPA 10; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

2. *Methods for Hydrostatic Testing of Compressed Gas Cylinders,* C-1; Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

3. *Recommendations for the Disposition of Unserviceable Compressed Gas Cylinders,* C-2; Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

4. *Standard for Visual Inspection of Compressed Gas Cylinders,* C-6; Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

5. *Portable Fire Extinguisher Selection Guide,* National Association of Fire Equipment Distributors; 111 East Wacker Drive, Chicago, IL 60601.

C. *§ 1910.158. Standpipe and hose systems:*

1. *Standard for the Installation of Sprinkler Systems,* ANSI/NFPA 13; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

2. *Standard of the Installation of Standpipe and Hose Systems,* ANSI/NFPA 14; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

3. *Standard for the Installation of Centrifugal Fire Pumps,* ANSI/NFPA 20; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

4. *Standard for Water Tanks for Private Fire Protection,* ANSI/NFPA 22; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

5. *Standard for Screw Threads and Gaskets for Fire Hose Connections,* ANSI/NFPA 194; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

6. *Standard for Fire Hose,* NFPA 196; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

7. *Standard for the Care of Fire Hose,* NFPA 198; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

D. *§ 1910.159. Automatic sprinkler systems:*

1. *Standard of the Installation of Sprinkler Systems,* ANSI-NFPA 13; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

2. ***Standard for the Care and Maintenance of Sprinkler Systems,*** ANSI/NFPA 13A; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

3. ***Standard for the Installation of Standpipe and Hose Systems,*** ANSI/NFPA 14; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

4. ***Standard for the Installation of Centrifugal Fire Pumps,*** ANSI/NFPA 20; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

5. ***Standard for Water Tanks for Private Fire Protection,*** ANSI-NFPA 22; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

6. ***Standard for Indoor General Storage,*** ANSI/NFPA 231; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

7. ***Standard for Rack Storage of Materials,*** ANSI/NFPA 231C; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

E. ***§ 1910.160. Fixed extinguishing systems—general information:***

1. ***Standard for Foam Extinguishing Systems,*** ANSI-NFPA 11; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

2. ***Standard for Hi-Expansion Foam Systems,*** ANSI/NFPA 11A; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

3. ***Standard on Synthetic Foam and Combined Agent Systems,*** ANSI/NFPA 11B; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

4. ***Standard on Carbon Dioxide Extinguishing Systems,*** ANSI/NFPA 12; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

5. ***Standard on Halon 1301,*** ANSI/NFPA 12A; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

6. ***Standard on Halon 1211,*** ANSI/NFPA 12B; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

7. ***Standard for Water Spray Systems,*** ANSI/NFPA 15; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

8. ***Standard for Foam-Water Sprinkler Systems and Foam-Water Spray Systems,*** ANSI/NFPA 16; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

9. ***Standard for Dry Chemical Extinguishing Systems,*** ANSI/NFPA 17; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

F. ***§ 1910.161. Fixed extinguishing systems—dry chemical:***

1. ***Standard for Dry Chemical Extinguishing Systems,*** ANSI/NFPA 17; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

2. ***National Electrical Code,*** ANSI/NFPA 70; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

3. ***Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapor from Commercial Cooking Equipment,*** NFPA 96; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

G. ***§ 1910.162. Fixed extinguishing systems—gaseous agents:***

1. ***Standard on Carbon Dioxide Extinguishing Systems,*** ANSI/NFPA 12; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
2. ***Standard on Halon 1301,*** ANSI/NFPA 12B; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
3. ***Standard on Halon 1211,*** ANSI/NFPA 12B; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
4. ***Standard on Explosion Prevention Systems,*** ANSI/NFPA 69; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
5. ***National Electrical Code,*** ANSI/NFPA 70; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
6. ***Standard on Automatic Fire Detectors,*** ANSI/NFPA 72E; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
7. ***Determination of Halon 1301/1211 Threshold Extinguishing Concentrations Using the Cup Burner Method;*** Riley and Olson, Ansul Report AL-530-A.

H. ***§ 1910.163. Fixed extinguishing systems—water spray and foam agents:***

1. ***Standard for Foam Extinguisher Systems,*** ANSI/NFPA 11; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
2. ***Standard for High Expansion Foam Systems,*** ANSI/NFPA 11A; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
3. ***Standard for Water Spray Fixed Systems for Fire Protection,*** ANSI/NFPA 15; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
4. ***Standard for the Installation of Foam-Water Sprinkler Systems and Foam-Water Spray Systems,*** ANSI/NFPA 16; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

I. ***§ 1910.164. Fire Detection systems:***

1. ***National Electrical Code,*** ANSI/NFPA 70; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
2. ***Standard for Central Station Signaling Systems,*** ANSI/NFPA 71; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
3. ***Standard on Automatic Fire Detectors,*** ANSI/NFPA 72E; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

J. ***§ 1910.165. Employee alarm systems:***

1. ***National Electrical Code,*** ANSI/NFPA 70; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .

2. *Standard for Central Station Signaling systems,* ANSI/NFPA 71; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
3. *Standard for Local Protective Signaling Systems,* ANSI/NFPA 72A; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
4. *Standard for Auxiliary Protective Signaling Systems,* ANSI/NFPA 72B; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
5. *Standard for Remote Station Protective Signaling Systems,* ANSI/NFPA 72C; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 .
6. *Standard for Proprietary Protective Signaling Systems,* ANSI/NFPA 72D; National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
7. *Vocal Emergency Alarms in Hospitals and Nursing Facilities: Practice and Potential.* National Bureau of Standards. Washington, D.C., July 1977.
8. *Fire Alarm and Communication Systems.* National Bureau of Standards. Washington, D.C., April 1978.

[45 FR 60715, Sept. 12, 1980, as amended at 58 FR 35309, June 30, 1993]

Appendix D to Subpart L of Part 1910—Availability of Publications Incorporated by Reference in Section 1910.156 Fire Brigades

The final standard for fire brigades, section 1910.156, contains provisions which incorporate certain publications by reference. The publications provide criteria and test methods for protective clothing worn by those fire brigade members who are expected to perform interior structural fire fighting. The standard references the publications as the chief sources of information for determining if the protective clothing affords the required level of protection.

It is appropriate to note that the final standard does not require employers to purchase a copy of the referenced publications. Instead, employers can specify (in purchase orders to the manufacturers) that the protective clothing meet the criteria and test methods contained in the referenced publications and can rely on the manufacturers' assurances of compliance. Employers, however, may desire to obtain a copy of the referenced publications for their own information.

The paragraph designation of the standard where the referenced publications appear, the title of the publications, and the availablity of the publications are as follows:

Paragraph designation	Referenced publication	Available from
1910.156(e)(3)(ii)	"Protective Clothing for Structural Fire Fighting," NFPA No. 1971 (1975)	National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
1910.156(e)(4)(i)	"Development of Criteria for Fire Fighter's Gloves; Vol. II, Part II: Test	U.S. Government Printing Office, Washington, D.C. 20402. Stock No. for

Paragraph designation	Referenced publication	Available from
1910.156(e)(5)(i)	Methods" (1976) "Model Performance Criteria for Structural Firefighter's Helmets" (1977)	Vol. II is: 071-033-0201-1. U.S. Fire Administration, National Fire Safety and Research Office, Washington, D.C. 20230.

The referenced publications (or a microfiche of the publications) are available for review at many universities and public libraries throughout the country. These publications may also be examined at the OSHA Technical Data Center, Room N2439-Rear, United States Department of Labor, 200 Constitution Ave., N.W., Washington, D.C. 20210 (202-219-7500), or at any OSHA Regional Office (see telephone directories under United States Government-Labor Department).

[45 FR 60715, Sept. 12, 1980, as amended at 58 FR 33509, June 30, 1993; 61 FR 9239, Mar. 7, 1996]

Appendix E to Subpart L of Part 1910—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 § 1910.156, fire brigades.

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

A. ***Apparatus.*** The puncture resistance test shall be performed on a testing machine having a movable platform adjusted to travel at $^{1}/_{4}$-inch/min (0.1 cm/sec). Two blocks of hardwood, metal, or plastic shall be prepared as follows: the blocks shall 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 shall have a hole drilled to hold an 8D common nail firmly at an angle of 98°. The second block shall have a maximum $^{1}/_{2}$-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.*** 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, shall be placed 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. The machine shall be started and the pressure, in pounds required for the nail to completely penetrate the outsole and sole plate, recorded to the nearest five pounds. Two determinations shall be made 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: Trapezoid Method.***

A. ***Test specimen.*** The specimen shall be a rectangle of cloth 3-inches by 6-inches (7.6 cm by 15.2 cm). The long dimension shall be parallel to the warp for warp tests and parallel to the filling for filling tests. No two specimens for warp tests shall contain the same warp yarns, nor shall any two

specimens for filling tests contain the same filling yarns. The specimen shall be taken no nearer the selvage than $^{1}/_{10}$ the width of the cloth. An isosceles trapezoid having an altitude of 3-inches (7.6 cm) and bases of 1 inch (2.5cm) and 4 inches (10.2 cm) in length, respectively, shall be marked on each specimen, preferably with the aid of a template. A cut approximately $^{3}/_{8}$-inch (1 cm) in length shall then be made in the center of a perpendicular to the 1-inch (2.5 cm) edge.

B. *Apparatus.*

(i) Six-ounce (.17 kg) weight tension clamps shall be used so designed that the six ounces (.17 kg) of weight are distributed evenly across the complete width of the sample.

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

(iii) A machine wherein the specimen is held between two clamps and strained by a uniform movement of the pulling clamp shall be used.

(iv) The machine shall be adjusted so that the pulling clamp shall have a uniform speed of 12 ±10.5 inches per minute (0.5 ±.02 cm/sec).

(v) The machine shall have two clamps with two jaws on each clamp. The design of the two clamps shall 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 shall 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 shall measure three inches or more. The face of the movable jaw of each clamp shall measure one-inch by three inches.

Each jaw face shall have a flat smooth, gripping surface. All edges which might cause a cutting action shall be rounded 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) shall be one-inch at the start of the test.

(vi) Calibrated dial; scale or chart shall be used to indicate applied load and elongation. The machine shall be adjusted or set, 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 shall be of such capacity that the maximum load required to break the specimen shall be not greater than 85 percent or less than 15 percent of the rated capacity.

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

(ix) All machine attachments for determining maximum loads shall be disengaged during this test.

C. *Procedure.*

(i) The specimen shall be clamped 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 shall be held taut and the long trapezoid base shall lie in the folds.

(ii) The machine shall be started and the force necessary to tear the cloth shall be observed by means of an autographic recording device. The speed of the pulling clamp shall be 12 inches ±0.5 inch per minute (0.5 ±.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, such result shall be discarded and another specimen shall be tested.

(iv) The tearing strength of the specimen shall be the average of the five highest peak loads of resistance registered for 3 inches (7.6 cm) of separation of the tear.

D. ***Report.***

(i) Five specimens in each of the warp and filling directions shall be tested from each sample unit.

(ii) The tearing strength of the sample unit shall be the average of the results obtained from the specimens tested in each of the warp and filling directions and shall be reported 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 shall be a rectangle of cloth $2^{3}/_{4}$ inches (7.0 cm) by 12 inches (30.5 cm) with the long dimension parallel to either the warp or filling direction of the cloth. No two warp specimens shall contain the same warp yarns, and no two filling specimens shall contain the same filling yarn.

B. ***Number of determinations.*** Five specimens from each of the warp and filling directions shall be tested from each sample unit.

C. ***Apparatus.***

(i) Cabinet. A cabinet and accessories shall be fabricated in accordance with the requirements specified in Figures L-1, L-2, and L-3. Galvanized sheet metal or other suitable metal shall be used. The entire inside back wall of the cabinet shall be painted black to facilitate the viewing of the test specimen and pilot flame.

(ii) Burner. The burner shall be equipped with a variable orifice to adjust the flame height, a barrel having a $^{3}/_{8}$-inch (1 cm) inside diameter and a pilot light.

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

(b) The pilot light tube shall have a diameter of approximately $^{1}/_{16}$-inch (.2 cm) and shall 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 shall 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, shall 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 shall 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 shall have two 5/16-inch (.8 cm) prongs marking the distances of 3/4-inch (1.9 cm) and 1 1/2 inches (3.8 cm) above the top of the burner.

(e) The burner shall 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 shall be a control valve system with a delivery rate designed to furnish gas to the burner under a pressure of 2 1/2 ± 1/4 (psi) (17.5 ±1.8 kPa) per square inch at the burner inlet (see (g)(3)(vi)(A)). The manufacturer's recommended delivery rate for the valve system shall be included in the required pressure.

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

(v) There shall be metal hooks and weights to produce a series of total loads to determine length of char. The metal hooks shall consist of No. 19 gage steel wire or equivalent and shall 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. One end of the hook shall be fastened around the neck of the weight to be used.

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

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

D. *Procedure.*

(i) The material undergoing test shall be evaluated for the characteristics of after-flame time and char length on each specimen.

(ii) All specimens to be tested shall be at moisture equilibrium under standard atmospheric conditions in accordance with paragraph (3)C of this appendix. Each specimen to be tested shall be exposed 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 paragraph (3)C of this appendix.

(iii) The specimen in its holder shall be suspended 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. The apparatus shall be set up in a draft free area.

(iv) Prior to inserting the specimen, the pilot flame shall be adjusted to approximately 1/8-inch (.3 cm) in height measured from its lowest point to the tip.

The burner flame shall be adjusted 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 the 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 Figure L-2) specified for adjustment of flame height. It is an important aspect of the evaluation that the flame height be adjusted with the tip of the flame level with the tip of the metal prong.

After inserting the specimen, the stopcock shall be fully opened, and the burner flame applied vertically at the middle of the lower edge of the specimen for 12 seconds and the burner turned off. The cabinet door shall remain shut during testing.

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

(vi) After each specimen is removed, the test cabinet shall be cleared of fumes and smoke prior to testing the next specimen.

(vii) After both flaming and glowing have ceased, the char length shall be measured. The char length shall 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: The specimen shall be folded lengthwise and creased by hand along a line through the highest peak of the charred area. The hook shall be inserted 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 such that the weight and hook together shall equal the total tearing load required in Table L-2 of this section shall be attached to the hook.

(viii) A tearing force shall be applied 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. The end of the tear shall be marked off 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 shall be as shown in Table L-2.

TABLE L-2 [1]

Specified weight per square yard of cloth before any fire retardant treatment or coating—ounces	Total tearing weight for determining the charred length—pound
2.0 to 6.0	0.25
Over 6.0 to 15.0	0.50
Over 15.0 to 23.0	0.75
Over 23.0	1.0

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

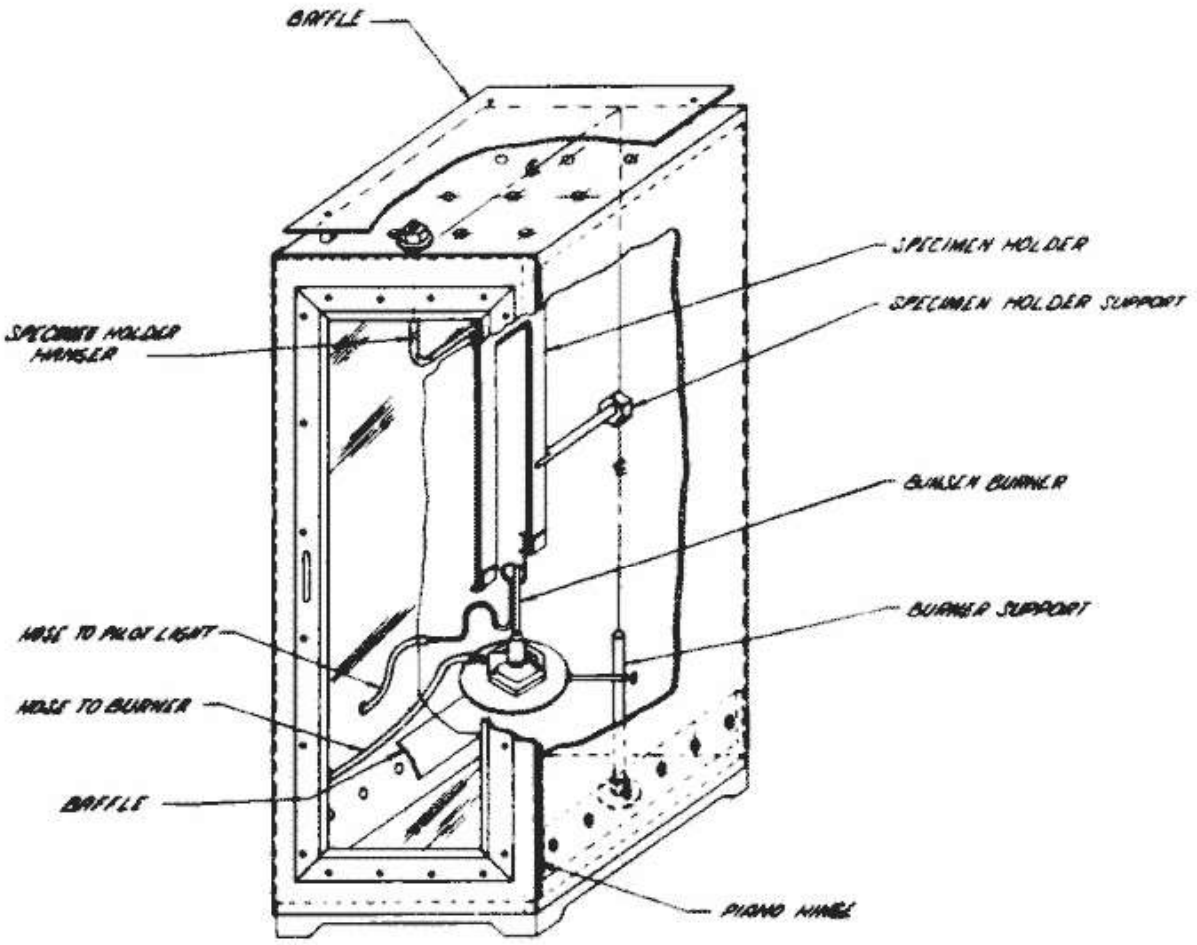
(ix) The after-flame time of the specimen shall be recorded to the nearest 0.2-second and the char length to the nearest 0.1-inch (.3 cm).

E. ***Report.***

(i) The after-flame time and char length of the sample unit shall be the average of the results obtained from the individual specimens tested. All values obtained from the individual specimens shall be recorded.

(ii) The after-flame time shall be reported to 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.



ILLUSTRATION

FIGURE L-1 - Vertical flame resistance textile apparatus. All given dimensions are in inches. System International (S. I.) Unit: 1-inch = 2/54 cm.

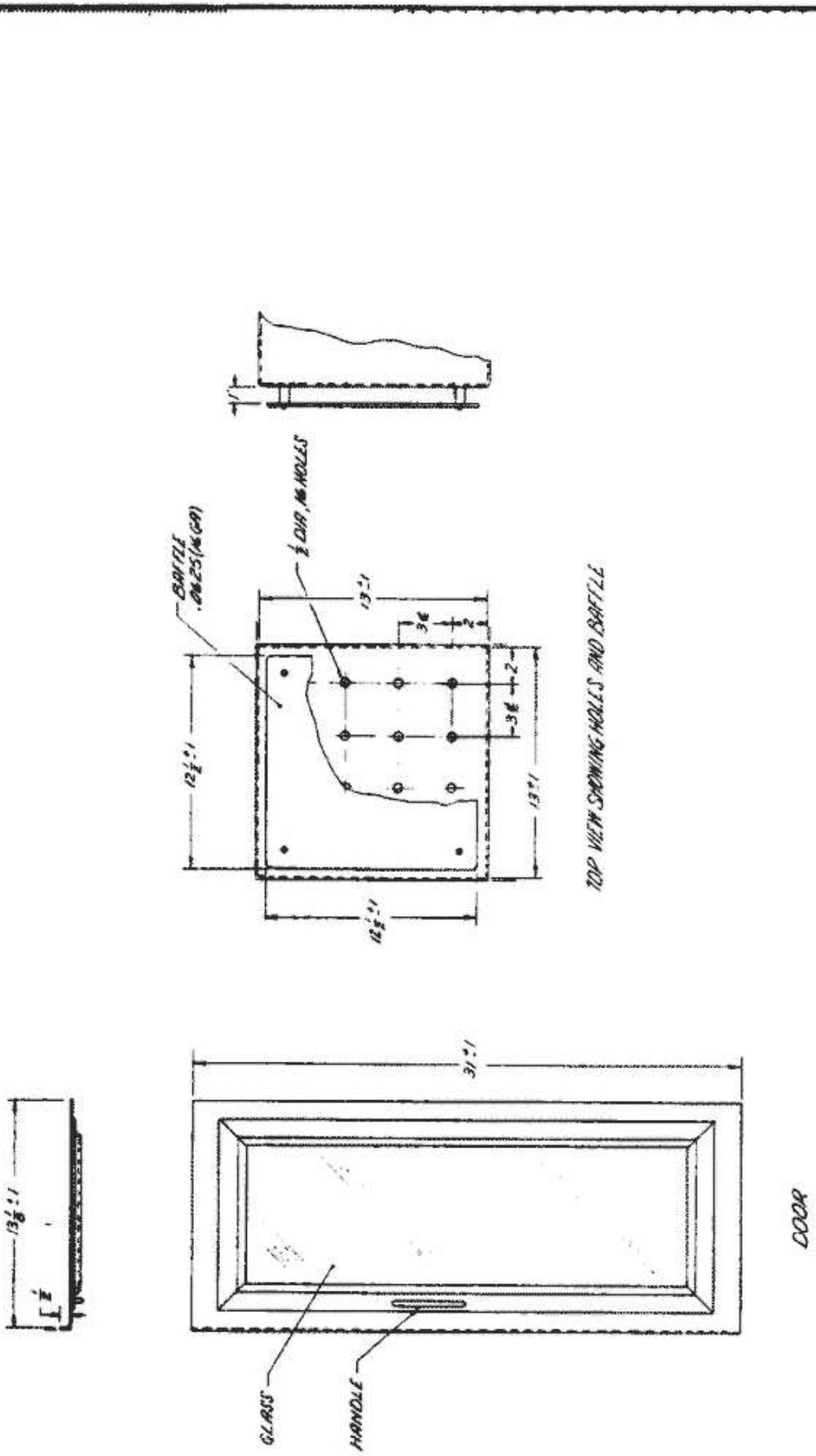


FIGURE L-2 - Vertical flame resistance textile apparatus, door and top view w/baffle. All given dimensions are in inches. System International (S. I.) Unit: 1-inch = 2.54 cm.

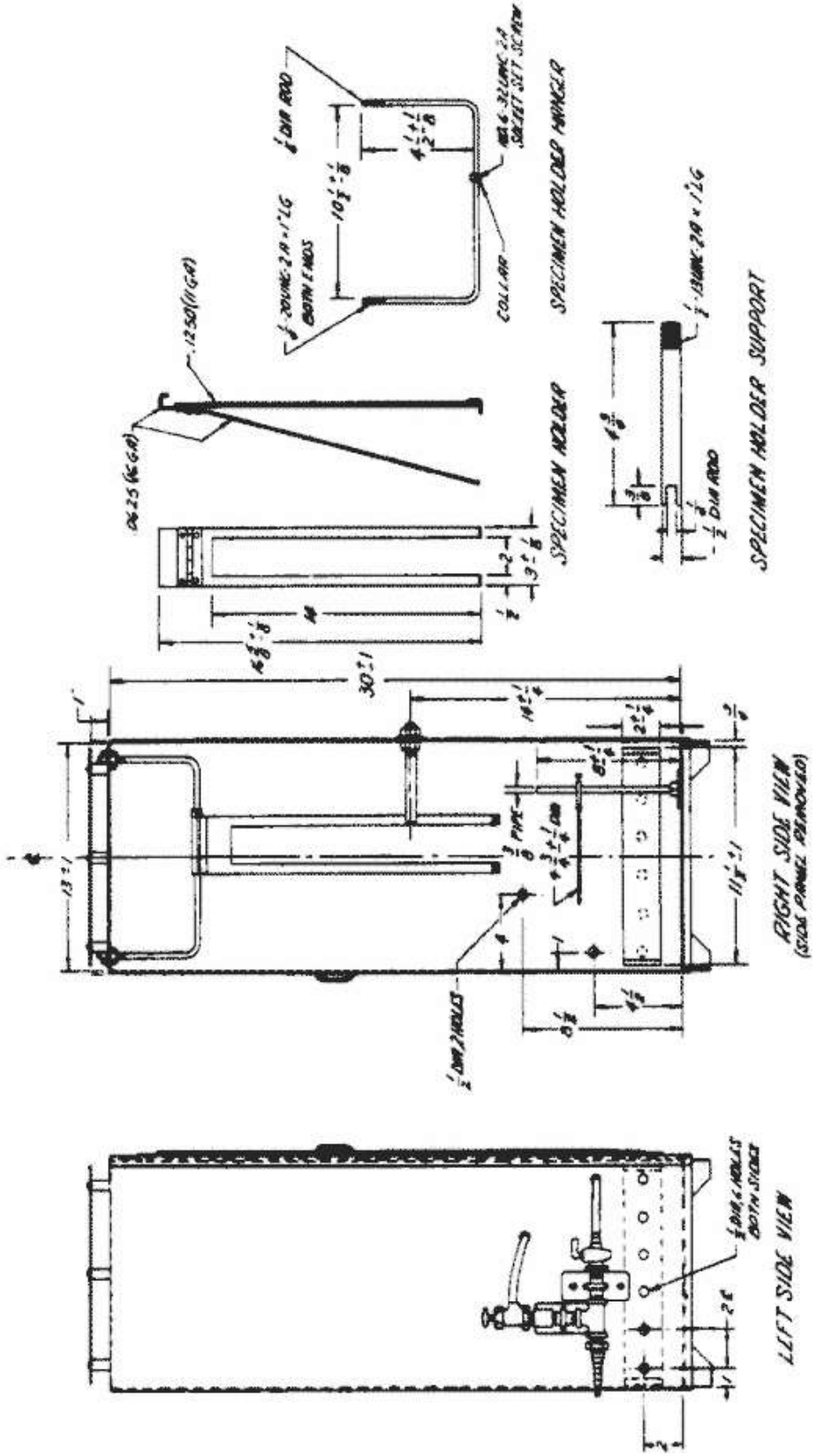


FIGURE L-3 -Vertical flame resistance textile apparatus, view and details. All given dimensions are in inches. System International (S. I.) Unit: 1-inch = 2.54 cm.

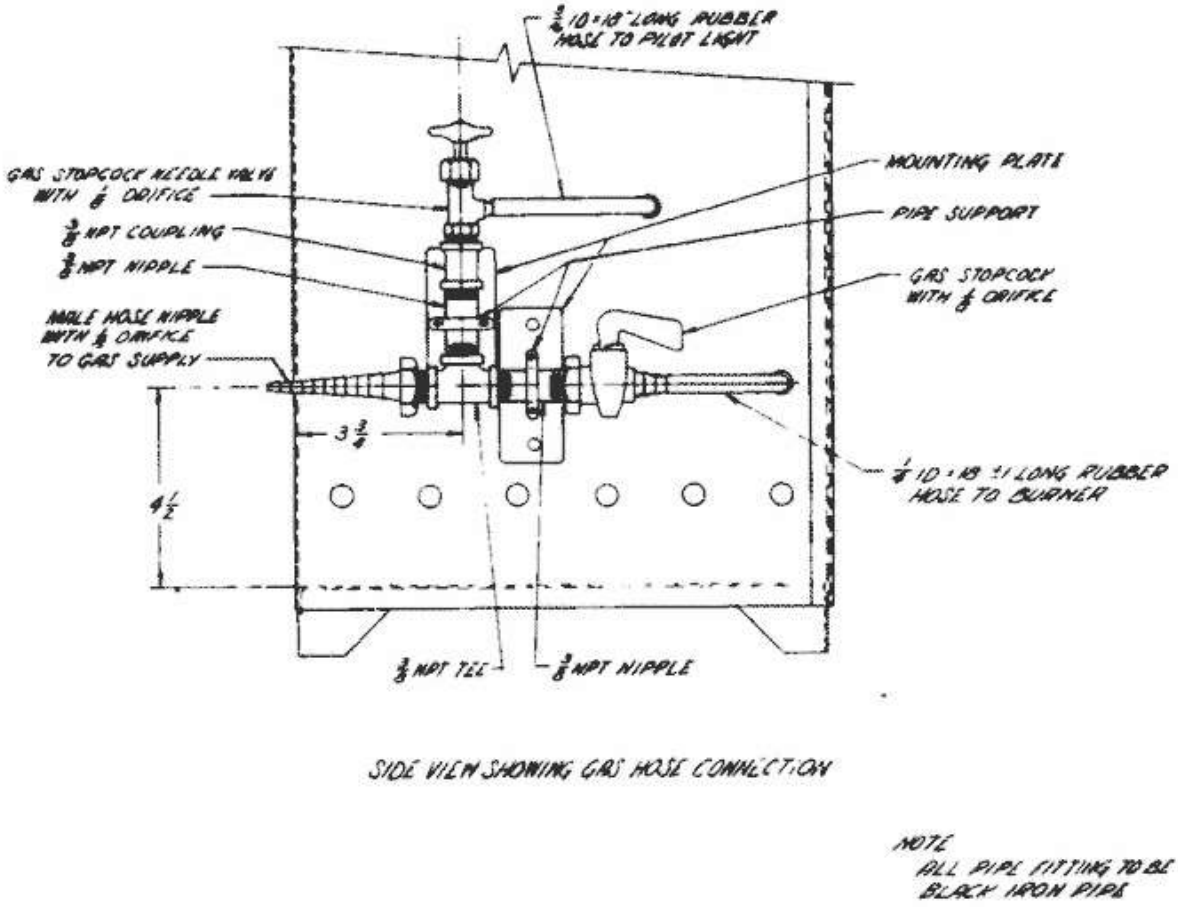


FIGURE L-4 - Vertical flame resistance textile apparatus. All given dimensions are in inches. System International (S. I.) Unit: 1 inch = 2.54 cm.

[45 FR 60715, Sept. 12, 1980; 46 FR 24557, May 1, 1981]

Subpart M—Compressed Gas and Compressed Air Equipment

Authority: Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), or 1-90 (55 FR 9033), as applicable.

§§ 1910.166-1910.168 [Reserved]

§ 1910.169 Air receivers.

(a) *General requirements* —