NFPA No.

1971

PROTECTIVE CLOTHING FOR STRUCTURAL FIRE FIGHTING 1975

NATIONAL FIRE PROTECTION ASSOCIATION

470 Atlantic Avenue, Boston, MA 02210

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See Inside Back Cover for Official NFPA Definitions

Standard on

Protective Clothing for Structural Fire Fighting

NFPA No. 1971 — 1975

Origin and Development of No. 1971

This standard sums up approximately 15 years of effort to develop a workable initial approach to protecting our nation's fire fighters against injury from fire and fire fighting duty. The text was prepared by NFPA Sectional Committee on Protective Equipment for Fire Fighters which reports to the Association through the Committee on Fire Department Equipment. It contains recommended performance criteria for the materials and construction of garments which the Sectional Committee believes to be essential for the protection of fire fighters in normal fireground and emergency operations.

The standard was processed in accordance with NFPA regulations governing technical committees and was adopted as a standard by the NFPA Membership at the NFPA Fall Conference on November 18, 1975 in Pittsburgh, PA.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

Interpretation Procedure of the Committee on Protective Equipment for Fire Fighters

Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

When applications involve actual field situations they shall so state and all parties involved shall be named.

The Interpretations Committee will reserve the prerogative to refuse consideration of any application that refers specifically to proprietary items of equipment or devices. Generally inquiries should be confined to interpretation of the literal text or the intent thereof.

Requests for interpretations should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

Contents

Standard on

Protective Clothing for Structural Fire Fighting

NFPA No. 1971 — 1975

Foreword

The goal of this standard is to get improved protective clothing for structural fire fighting on the backs of fire fighting personnel. The preparation and publication of this standard is an important step in meeting this goal.

This standard is a synthesis of present day knowledge and capabilities. It is not a research document and in that sense provides nothing hitherto unknown. It does, however, provide a wealth of guidance based on the National Bureau of Standards technical research program and information and suggestions given by a large number of groups and knowledgeable individuals with different interests and backgrounds. All were concerned with the well being of fire fighting personnel.

The publishing of this standard does not require anyone to use it; however, it is offered to regulatory agencies and jurisdictions as minimum acceptable standards. The standard does not solve all problems related to protective clothing for structural fire fighting; however, its use will improve the safety and effectiveness of fire fighting personnel.

The standard represents the summation of several years effort by the Program for Fire Services Technology of the National Bureau of Standards and the NFPA Sectional Committee on Protective Equipment for Fire Fighters. These efforts are directed towards defining nationally acceptable protective clothing for structural fire fighting. Nationally acceptable is meant to mean a consensus of the dictates of technical research, user demands, and manufacturing capabilities.

While the standard provides minimum acceptable requirements for many features, it still leaves abundant room for improvement, for local options and for competition among manufacturers. Manufacturers can still compete to supply products that surpass the minimum requirements by providing items such as padding, features that increase air circulation between the coat and wearer, and innovative closures.

The standard leaves many items to local option and each fire department must make its own selection from these options. All standards should be continually updated and upgraded, and this standard is no exception. New technology pertinent to the standard will continually become available and field experience with protective clothing for structural fire fighting meeting this standard will uncover needed improvements. This document is intended to provide performance, rather than material, requirements.

The problem of fire departments being sure that the protective clothing for structural fire fighting they purchase meets the standard when their purchase specifications so require is not a new problem. Fire departments, especially the medium and small sized departments, are often dependent on the competence, good will and ethics of distributors and manufacturers. This standard hopes to eliminate this dependence because the performance requirements and tests to be used in determining if the protective clothing for structural fire fighting meets the requirements are clearly stated. These tests can be performed by commercial laboratories as well as independent testing laboratories. As a practical matter, however, this is only a partial solution because the cost of performing these tests might be prohibitive unless the number of coats being purchased were large. This standard describes protective clothing for structural fire fighting that is considerably better than most coats now being used and its adoption and use would improve the safety and effectiveness of fire fighting personnel. Should this standard be made mandatory or referenced, it would be the intention of the document to provide for a transition period of existing clothing being replaced by new clothing.

This standard is the first in a series of standards on fire fighter's protective clothing and equipment and replaces the NFPA Tenative Standard No. 19A-T. Many of the requirements of this standard are based on the *Proposed Voluntary Standard for Fire Fighter's Turnout Coats* developed by the National Bureau of Standards in 1974.

Chapter 1 Introduction

(*See A-1-0.*)

1-1 Purpose. The purpose of this standard is to improve the protection afforded fire fighting personnel by their protective clothing for structural fire fighting. It is intended to serve as a guide for fire officers and others responsible for purchasing or preparing specifications for protective clothing for structural fire fighting for fire fighting personnel. This standard may be referenced completely or in part in purchase specifications. The standard is not intended to serve as a detailed manufacturing specification. It is prepared, as far as practicable, in terms of required performance, avoiding specifications of materials or designs which would preclude obtaining the desired results by other means. It is not the intention of this standard to bar from consideration materials of improved quality or special designs not known at the time of development of this standard's performance requirements. (*See A-1-1.*)

1-2 Scope. This standard applies to protective clothing for structural fire fighting worn for protection against extremes of temperature, steam, hot water, hot particles, and other hazards encountered during fires and related life saving. (*See A-1-2.*)

Chapter 2 Definitions

2-1 Definitions. Words defined in this standard are intended only for use with sections of this standard. Definitions set forth in any document referenced by this standard shall be the acceptable definition for use of that document only. Words not specifically defined in this standard, or other referenced documents, shall be interpreted as being the ordinary usage of the word as set forth in *Webster's Third New International Dictionary of the English Language, Unabridged*, as published by the G&C Merriam Company of Springfield, Massachusetts in 1966.

Coat means a garment worn to protect the upper part of the human body except the hands and head.

Lining means a material or material assemblage attached to the inside of the outer shell for the purpose of thermal protection and padding. *(See Section A-2-1.)*

Outer Shell means the outside material of the garment except trim.

Protective Clothing for Structural Fire Fighting means those garments which are worn by fire fighters in the course of performing fire fighting operations in buildings. The assembled garment consists of an outer shell, vapor barrier and lining.

Trim means a tape material permanently attached to the outer shell material for visibility enhancement.

Vapor Barrier means that material used to prevent or substantially inhibit the transfer of water, corrosive liquids and steam or other hot vapors from the outside of the garment to the wearer's body.

Chapter 3 Protective Clothing for Structural Fire Fighting

(*See A-3-0.*)

3-1 General.

3-1.1 Items of equal performance and safety may be substituted for those specified provided that adequate technical evidence is given and that the substitute is approved by a technically qualified representative of the purchaser (when applicable), the senior officer of the fire department and by the purchasing agent.

3-1.2 Design considerations for air circulation and impact resistance are given in the appendix, as are guidelines on padding, color selection, water repellency and pocket selection. (*See A-3-1.2.*)

3-1.3 The manufacturer shall furnish a certified statement that protective clothing manufactured by him for fire fighting personnel meets or exceeds the requirements of applicable tests as set forth in this standard. (*See A-3-1.3.*)

NOTE: Tests are used for comparison of materials or systems in ensuring their compliance with the minimum requirements of this standard and shall not be deemed as establishing performance levels for all fire fighting situations to which fire fighting personnel may be exposed.

3-1.4 Protective clothing shall be flame retardant, durable, lightweight, water resistant, nonirritating to the skin and cleanable as may be set forth hereafter in this standard.

3-1.5 Protective clothing for structural fire fighting shall be repaired in accordance with manufacturer's requirements. If protective clothing can not be repaired properly without decreasing the protective qualities, the protective clothing should be destroyed or otherwise rendered useless to guard against its use at emergency situations and shall be replaced with new protective clothing. (*See A-3-1.5.*)

3-1.6 Protective clothing shall be designed to give minimum interference to physical movement, the use of fire fighting tools and protective breathing apparatus. (*See A-3-1.6.*)

3-1.7 Materials used in garment construction shall not shrink more than 10 percent under heat exposures of 500° F (260° C) in a forced air oven for a period of five minutes.

3-2 Sizing.

3-2.1 Coats. The purchaser shall specify chest measurements, and back length in purchase specifications for protective coats for structrual fire fighting. (*See A-3-2.1.*)

3-2.1.1 Chest measurements are made well up under the arms, across the shoulder blades of the individual, with his normal station uniform on.

3-2.1.2 Back length is determined by measuring from the collar base to the coat bottom.

3-2.2 Trousers. The purchaser shall specify waist measurement and leg length.

3-2.2.1 The waist measurement shall be made in a horizontal plane at the top edge of the pelvic bones and over the top of a normally worn belt and trousers. Overlapping allowance for the trouser fly shall be in addition to the waist measurement. (*See A-3-2.2.1.*)

3-2.2.2 Leg length shall be the inseam length from the crotch to the bottom of the trouser leg. (*See A-3-2.2.2.*)

3-3 Stitching.

3-3.1 Seams. Each load-bearing seam, including pockets, their dividers, and the storm flap, shall possess a breaking strength of at least 80 pounds or 80 percent of the outer shell material when tested in accordance with ASTM D 1683-68, *Standard Method of Test for Seam Breaking Strength (Load) of Woven Textile Fabrics* (with the machine operated at a rate of 12 + ½ in/min).

3-3.2 Thread. The fiber shall be compatible with the material on which it is used and shall not carbonize at a temperature below 500° F (260° C).

3-4 Outer Shell. (*See A-3-4.*)

3-4.1 Material.

3-4.1.1 The outer shell shall be fabricated of material meeting the requirements specified in Table 3-4.1.1. All test requirements are applicable after five cycles of laundering and drying in accordance with American Association of Textile Chemists and Colorists (AATCC) Method 96-Test-IV-E. (*See A-3-4.1.1.*)

Table 3-4.1.1 Outer Shell Requirements

Characteristics and Test Methods*	Requirements
Tearing strength, lb. (min) ASTM Method D 2263, *Automotive Fabrics Testing, Trapezoid Tearing Load of Woven Fabrics Method*, except that the tearing strength of the specimen shall be the average of the five highest peak loads of resistance registered for 3 inches of separation of the tear. (Disregard the first high peak.)	22.0
Color fastness (minimum)	
To light, method 5660	Good
To laundering, method 5605 without bleach	Good
To crocking, method 5651	Good
Shrinkage in laundering	
AATCC method 96 — Test IV E	
Maximum change in length	± 3%
Maximum change in width	± 3%
Maximum difference between length and width	3%
Water absorption, method 5500 (*See Section A-3-5 in the appendix for information on water repellency.*)	28% maximum
Flame resistance (including trim)	
Method 5903	
Char length (inches), (max.)	4.0
After flame (seconds), (max.)	2.0

NOTE: All requirements above (except for trim) are also applicable after five cycles of laundering and drying in accordance with American Association of Textile Chemists and Colorists (AATCC) Method 96 Test IV-E. (*See A-3-4.1.1.*)

*Unless otherwise indicated, the test method references pertain to Federal Test Method Standard No. 191, *Textile Test Methods.*

3-4.1.2 The manufacturer shall provide the purchaser with the following information prior to purchase:

(a) A statement of the wearability of the garment.

(b) A statement of the stability of the fabric at high temperatures. This shall include temperature/shrinkage and tensile strength retention/temperature curves, and an indication of the temperature at which the fabric will char, separate, or melt and drip with all results showing the effects of temperature exposures up to 500° F (260° C) in a forced air laboratory oven for a period of ten minutes.

(c) A statement of the fabric's resistance to corrosive substances.

3-4.1.3 The outer shell material shall not char, separate or melt when placed in a forced air laboratory oven at a temperature of 500° F (260° C) for a period of five minutes. (*See A-3-4.1.3.*)

3-4.2 The coat shall be trimmed with retroreflective flourescent tape. At least 325 square inches of trim shall be provided on each coat. Trim configuration shall be as specified by the purchaser and shall include at least the following configuration:

(a) Circumference band on each sleeve near the cuff.

(b) Circumference band around bottom of coat within six inches of the coat hem.

All tape shall be at least two inches wide. (*See A-3-4.2.*)

3-4.3 Pockets. (*See A-3-4.3.*)

3-4.3.1 The location, size and number of pockets shall be as agreed upon between buyer and seller. (*See Section A-3-4.3 for guidelines on pocket selection.*)

3-4.3.2 Pockets shall be reinforced in the two top corners and in flap corners with a series of stitches, forming a bar.

3-4.3.3 Each outside pocket shall have a flap of at least 3 inches in depth.

3-4.3.4 The lowest 5 inches of each pocket attached to the exterior of the outer shell shall be reinforced with a double thickness of material meeting the requirements of Table 3-4.1.1. (*See A-3-4.3.4.*)

3-4.3.5 The pocket shall have two holes at the bottom, a means of drainage for water.

3-4.4 Labels. Each outer shell shall have sewn to the inside, in a location not covered by the lining (e.g., inside front or fly flap), one or more permanent labels stating the following:

(a) Fiber content of the outer shell fabric, to conform with the "Rules and Regulations under the Textile Fiber Products Identification Act."

(b) Size of the garment.

(c) Care instructions, including minimum instructions for washing or cleaning. These instructions shall include instructions for home machine laundering and a cautionary statement if this washing can remove the water repellent treatment.

(d) A warning that the garment is not a proximity or entry suit and should not be kept in direct contact with flames.

3-4.5 Protective Coats for Structural Fire Fighting.

3-4.5.1 Collar. (*See A-3-4.5.1.*)

3-4.5.1.1 The collar shall be snug fitting but comfortable and shall completely cover the neck and throat when in the raised position.

3-4.5.1.2 A throat strap of at least 3 inches in width shall be sewn to the underside of the collar on the left side and shall be closed by means of hook and pile fastener tape or by a snap fastener.

3-4.5.1.3 It shall be held in the stowed position by a piece of hook and pile fastener tape or by a snap fastener.

3-4.5.1.4 When used, hook and pile fastener tape shall conform to the requirements of Section 3-9.5.

3-4.5.1.5 Metal fasteners shall not contact the skin when the collar is in the closed position.

3-4.5.1.6 The collar shall provide water penetration protection at least equal to the vapor barrier. (*See Section 3-5.*)

3-4.5.2 Sleeves.

3-4.5.2.1 Sleeves shall be attached to the coat so that there is no restriction and the wrist remains covered when the arms are raised above the head. (*See A-3-4.5.2.1.*)

3-4.5.2.2 Wristlets.

3-4.5.2.2.1 Each sleeve shall have a suitable and durable wristlet which meets the flammability requirements for outer shell material. (*See Table 3-4.1.1.*)

3-4.5.2.2.2 The wristlet ensemble will be of a configuration such that the material will form a well to collect water below the wristlet when the arm is in the raised position.

3-4.5.2.2.3 Wristlet material shall be resilient so that the wristlet will fit snugly but not prohibit donning and will retain its shape for the expected life of the coat.

3-4.5.3 Closures. The front of the coat shall close in a manner which provides secure protection from steam and water when the coat is worn and shall allow freedom for leg movement. (*See A-3-4.5.3.*)

3-4.5.4 Hanger Loops. Unless otherwise specified, a fabric hanger loop shall be provided inside the neck. It shall be designed to provide long service and shall not tear or separate from the coat when the coat is hung up by the hanger loop, loaded evenly with a weight of 80 pounds, and allowed to hang for one minute.

3-4.5.5 Attachment of Linings. Linings shall be securely attached to the outer shell material by stitching in the neck area. Fastener tape meeting the requirements of Section 3-9.5 or snap fasteners meeting the requirements of Section 3-9.4 shall secure the rest of the liner to the front face and wristlet areas of the outer shell. (*See Section A-2-1.*)

3-4.6 Protective Trousers for Structural Fire Fighting. (*See A-3-4.6.*)

3-4.6.1 Trousers shall be provided with buttons or other holders for suspenders with one set of two buttons provided on each side of the fly on the front of the trousers and one set of two buttons on each side of the center back.

3-4.6.2 Trousers shall be provided with a fly front. Such fly shall be capable of being fastened and designed so as to remain fastened during all forms of vigorous physical movement.

3-5 Vapor Barrier. (*See A-3-5.*)

3-5.1 The vapor barrier shall have a minimum water penetration of 25 psi when tested using method 5512 of Federal Test Method Standard No. 191, *Textile Test Methods.*

3-5.2 The vapor barrier shall be insulated from the body.

3-6 Linings. (*Linings provide insulation, limited padding and, in many cases, the vapor barrier.*)

3-6.1 Material.

3-6.1.1 The linings shall be fabricated of material meeting the requirements specified in Table 3-6.1.1. The test requirements contained therein are applicable after five cycles of laundering and drying in accordance with AATCC Method 96-Test IIx-E. (*See A-3-6.1.1.*)

3-6.1.2 The manufacturer shall provide information to the purchaser on the high temperature stability of the fabric prior to purchase, including temperature/shrinkage curves, tensile strength retention/temperature curves, and an indication of the temperature at which a fabric will char, separate or melt and drip with all results showing the effects of various temperature exposures up to 500° F (260° C) in a forced air laboratory oven for a period of five minutes.

3-6.2 General Configuration and Measurements.

3-6.2.1 The linings shall extend to within 3 inches of the bottom hem of the coat.

3-6.2.2 Sizing must be compatible with that of the outer shell so they do not buckle, pull, or otherwise restrict body motion, even when the arms are raised directly overhead.

3-6.3 Labels. Each lining shall have sewn visibly to the inside, near the neck, one or more permanent labels stating the following:

(a) Fiber content of the lining fabric, to conform with the rules and regulations under the Textile Fiber Products Identification Act.

(b) Size of the coat for which the lining is designed (*See Section 3-2*).

(c) Care instructions, including minimum instructions for cleaning or washing. These instructions shall include home and commercial machine laundering instructions.

Table 3-6.1.1 Requirements For Linings

Characteristics and Test Methods*	Requirements
Tear strength, ASTM method D2263, *Trapezoid Tearing Load of Woven Fabrics Method*, except that the tearing strength of the specimen shall be the average of the five highest peak loads of resistance disregarding the first high peak, registered for 3 inches of separation of the tear.	Lining type Single layer composite of vapor barrier and lining (lining next to body); insulation liner in a multiple liner coat Warp — 15 pounds, minimum Fill — 10 pounds, minimum Separate vapor barrier only Warp—4 pounds minimum Fill — 3 pounds, minimum
Water absorption, method 5500	40% maximum
Shrinkage in laundering AATCC Method 96-Test IIx-E, except that for those linings next to the body which do not have the vapor barrier integral to them, the laundering requirement will be in accordance with the washing instructions on the label (5 cycles).	Lining type Single layer composite of vapor barrier and lining (lining next to body); insulation liner in a multiple liner coat Maximum change in length ±3% Maximum change in width ±3% Maximum difference between length and width ±3% Separate vapor barrier only Maximum change in length ±5% Maximum change in width ±5% Maximum difference between length and width ±5%
Flame resistance, method 5903	
Char length, maximum (inches)	4.0
After flame, maximum (seconds)	2.0

NOTE: All requirements above are also applicable after five cycles of laundering and drying in accordance with American Association of Textile Chemists and Colorists (AATCC) Method 96-Test IIx-E unless otherwise indicated.

*Unless otherwise indicated, the test method references pertain to Federal Test Method Standard No. 191, *Textile Test Methods*.

3-7 Thickness (insulation provision). (*See A-3-7.*)

3-7.1 The minimum thickness of the assembled garment shall be 0.175 inch when tested using a compressometer with a 3-inch diameter presser foot set at 0.05 psi, following the procedure outlined in American Society for Testing and Materials (ASTM) Method D1777-64 (70), allowing 5 seconds to lapse between the application of the load and the thickness reading.

3-8 Weight.

3-8.1 The garments shall be conditioned and weighed at standard atmospheric conditions in accordance with Section 4 of Federal Test Method Standard No. 191. (*See A-3-8.1.*)

3-8.2 Coat. The total weight of an assembled coat size 40 with 40 inch back length shall not exceed 7.0 pounds when weighed on a scale with an accuracy of ± 0.1 pound.

3-8.3 Trousers. The total weight of an assembled trousers size 36 with 32 inch inseam length shall not exceed 5.0 pounds when weighed on a scale with an accuracy of ± 0.1 pound.

3-9 Fasteners.

3-9.1 All outer surfaces on metal parts shall be nonferrous to avoid sparking and shall be rust resistant.

3-9.2 Hooks and Dees.

3-9.2.1 The hooks and dees shall be nonferrous and shall conform to the general design and dimensions shown in Figure 3-9.2.1 (4 vs 3 stays are allowed).

3-9.2.2 The casting shall be sound, smooth, and free from fracture and repair such as impregnations, peening and weld.

3-9.2.3 The commercial finish of the hooks and dees shall be free of any rough spots, burrs, and sharp or rough edges.

3-9.2.4 The top hook may be outward facing.

3-9.3 Rivets. The rivets shall be 9/64 inch nominal size and shall meet the requirements of Type XII, Class 3, Grade B of Federal Specification FF-R-556C, *Rivet, Solid, Small; Rivet, Split, Small; Rivet, Tubular, Small; Bur, and Cups, Rivet; General Purpose* except that the inside of the rivet shank may be chamfered.

3-9.4 Snap Fasteners. Snap fasteners shall meet the requirements of style 2 of Military Specifications MIL-F-10884D, *Fasteners, Snaps.*

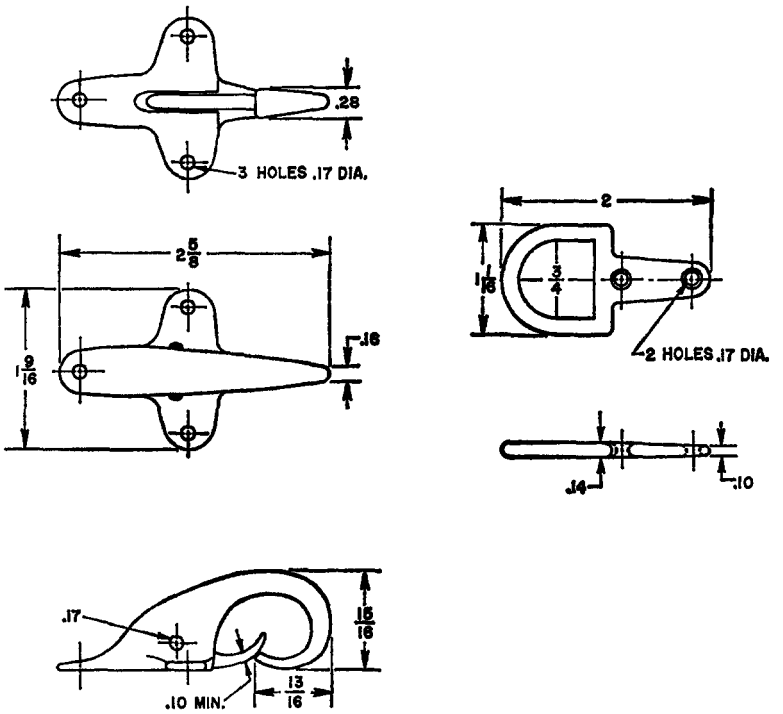

Figure 3-9.2.1 Hook and Dee Ring (inward facing).
(all dimensions in inches)

3-9.5 Fastener Tape. (*See A-3-9.5.*)

3-9.5.1 Fastener tape, hook and pile, used for pockets, collar, and storm flap closures shall meet the requirements of Type II, Class 4, of MIL-F-21840D, *Fastener Tapes, Hook and Pile, Synthetic.* (*See A-3-9.5.1.*)

3-9.5.2 The manufacturer shall provide information to the purchaser, prior to sale, on the high temperature stability of the fabric, to include an indication of the temperature at which the fabric will char, melt, or shrink, with all results showing the effects of various temperature exposures up to 300° F (149° C) in a forced air laboratory oven for 10 minutes.

Appendix A

This Appendix is not a part of this NFPA standard, but is included for information purposes only.

A-1-0 Reference Publications. The following publications are referenced in this standard and may be obtained from the organization indicated. The latest issues of all publications referenced may be used provided the requirements are applicable and consistent with the issue designated.

(a) General Services Administration, Specifications Activity; Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, DC 20407. (Single copies are generally available without charge at the General Services Administration Business Centers in cities throughout the U.S.A.)

Federal Test Method Standard No. 191, *Textile Test Methods.*

Federal Test Method Standard No. 311, *Leather, Methods of Sampling and Testing.*

Federal Specification FF-R-556C, *Rivet, Solid, Small; Rivet, Tubular Small; Bur, and Cups, Rivet; General Purpose.*

Federal Specification KK-L-162, *Leather, Cattlehide, Chrome Tanned for Gloves, Garments and Equipment.*

(b) American Association of Textile Chemists and Colorists (AATCC), P. O. Box 12215, Research Triangle Park, North Carolina 27709.

Method 96, *Dimensional Changes in Laundering of Woven and Knitted Textiles Except Wool.*

(c) American Society for Testing Materials (ASTM) 1916 Race Street, Philadelphia, Pennsylvania 19103

Method E 308-66, *Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.*

Method D 1535-68, *Standard Method of Specifying Color by the Munsell System.*

Method D 1683-68, *Standard Method of Test for Seam Breaking Strength (Load) of Woven Textile Fabrics.*

Method D 1777-64 (70), *Thickness of Textile Materials, Measuring.*

Method D 2263-68, *Automotive Fabrics, Testing.*

(d) Division of Public Records, Federal Trade Commission, Washington, DC 20580.

Textile Fiber Products Identification Act (available without charge).

(e) The Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120

Military Specification MIL-F-10884D, *Fasteners, Snaps.*

Military Specification MIL-F-21840D, *Fastener Tapes, Hook and Pile, Synthetic.*

A-1-1 If referenced in its entirety, care should be taken to specify the particular options which the standard allows, for example, the type of closures and the size and location of pockets.

A-1-2 The standard presents requirements that are applicable to both coated and uncoated outer shells. Additional requirements applicable only to coated or rubberized outer shells which should be included in the purchase specification when ordering are: brittleness at low temperature, coating thickness, and coating adhesion.

A-2-1 Any reference to linings in the body of this standard is not intended to refer to a winter liner which is a detachable extra lining used to give added protection to the wearer against the effects of cold weather and wind.

A-3-0 Protective clothing for structural fire fighting may be referred to by fire department personnel as turn-outs, bunkers, or in the case of trousers as "night hitch." This standard is not intended to apply to protective clothing for structural fire fighting purchased or under purchase agreement prior to this standard's official adoption by the NFPA membership; however, fire departments and fire fighters possessing clothing less than this standard should urgently consider replacing such clothing within three years.

A-3-1.2 Design Considerations.

(a) Air Circulation. Air circulation within the coat is desirable for cooling. Designs which could promote this characteristic would be the use of spacers within the coat, billowing designs at the bottom of the coat, air inlets under the flap in the shoulder area, and air inlets under the arms. The effect of air inlets under the arms, however, appears to be small. Billow designs should not be such as to allow easy entry of flames to the linings of the coat. Belts, it should be noted, serve to increase the heat storage level.

(b) Impact Resistance. Striking and being struck by objects are the most frequent causes of injury at a fire and, of these, injuries to the upper extremities are the most numerous. Incorporation of impact protection in the coat by means of padding should be considered highly desirable, provided the weight of the coat is not increased beyond the specified weight requirements, thereby increasing the danger of fatigue and heart strain, the most severe of the various types of injuries.

(c) Padding. Consideration should be given by the purchaser to specifying elbow protection for wear resistance and heat protection when crawling. Padding material shall meet the requirements of Table 3-6.1.1 and shall not melt and drip.

A-3-1.3 Tests are not set forth for the purpose of providing minimum levels of performance of protective clothing components or systems.

A-3-1.5 Repairs may be accomplished by fire department personnel if proper repair material and equipment are available and repair capabilities have been reviewed by the garment manufacturer.

A-3-1.6 Protective clothing which is uncomfortable to wear or makes the performance of fire fighting actions difficult will cause fire fighters to alter or not wear the protective clothing after a period of time, which increases the likelihood of injury to the involved personnel. Designers of protective clothing must realize that a fire fighter must wear many items of protective clothing or equipment and any interference by one item with another's use may lead to fireground inefficiency and an unsafe situation. Fire fighter protective clothing and equipment must be designed and worn as a system.

A-3-2.1 In selecting a coat length, consideration should be given to the protection afforded the leg and buttocks area by boots and protective trousers for structural fire fighting. While the coats shall be made to allow room for air circulation, in cities with very cold winters it may be desirable to order coats slightly larger than needed to allow room for sweaters or vests, or to specify that an additional detachable liner be added (other than that required by Section 3-6). This additional liner shall not be considered an insulation liner for the purpose of meeting the requirements of Section 3-6. The coat should not be of a length which will interfere with the knee movement of fire fighting personnel. Sleeve length should be specified if an individual has unusually long or short arms. Normal practice is to correlate sleeve length to chest measurements.

A-3-2.2.1 For purchasing purposes, the fire department should add one or two inches to actual waist measurements to insure ease of donning.

A-3-2.2.2 Trousers should be ordered shorter than normal suit or station uniform trousers due to boot bulkiness and high instep construction. Trousers should never be cuffed or rolled on the bottom and should not drag on the ground when worn.

A-3-4 It should be noted that it will be difficult, if not impossible, for existing coated fabric or rubberized outer shells to meet the com-

bination of requirements for the outer shell in this standard. For those fire departments who consider the purchase of coated or rubberized outer shells necessary for the reasons indicated in Section A-3-5, the variations from this standard for the outer shell shall be specified in the purchase document.

A-3-4.1.1 The referenced test is a commercial laundering and drying cycle which provides a 203°–212° F (95°–100° C) exposure in a water environment for the materials (outer shell material only).

A-3-4.1.3 The time temperature requirement for the outer shell material is not intended to establish the limiting working environment for the wearer but is strictly for establishing material performance characteristics.

A-3-4.2 It is recommended that the coat have a minimum lightness in color. Minimum color visibility should be not less than Munsell Valve 7 (43.06%) for CIE source "C" (6774K) when tested in accordance with either American Society for Testing and Materials (ASTM) Method D 1535–68, *Standard Method of Specifying Color by the Munsell System* or ASTM E308–66, *Standard Recommended Practice for Spectrophotometry and Descriptions of Color in CIE 1931.* This acceptable level of visibility includes most whites and yellow. Of the non-white colors, yellow and yellow green have been found to be highly visible. To continue the benefits of a light color coat, the outer shell should be periodically cleaned. A label with washing instructions is required on the inside of the coat. (*See Section 3-4.4.*)

A possible configuration for striping on the front and back of the coat would be:

(a) Back:

Two 15-inch vertical stripes (separation between vertical stripes should be 15 inches).

(b) Front:

One 30-inch vertical stripe down the center and two 17-inch vertical side stripes (separation between vertical stripes to be approximately 3 inches).

The following information is offered for guidance in the selection of outer shell color.

(a) Light colors assist visibility.

(b) For thermal comfort in sunlight, color has a strong effect on solar heating load, and light colors tend to be best. When the coat is soiled, this effect is reduced.