Second Revision No. 30-NFPA 1977-2020 [Global Comment]

Change reference from "NFPA 1977, 2021 Edition" to "NFPA 1977, 2022 Edition" throughout the document.

Submitter Information Verification

Committee:
Submittal Date: Mon Jun 15 14:54:31 EDT 2020

Committee Statement

Committee Statement: NFPA 1977 moved from the Fall 2020 to the Annual 2021 revision cycle at Second Draft. Publication date will be 2022 Edition.
Response Message: SR-30-NFPA 1977-2020

Second Revision No. 22-NFPA 1977-2020 [Detail]

Change title to:

6.10 Fire Shelter Design Requirements.

Submitter Information Verification

Committee:
Submittal Date: Wed Apr 08 12:28:48 EDT 2020

Committee Statement

Committee Statement: Add "Fire Shelter" in front of Design Requirements to clarify the the applicability of the Section 6.10.
Response Message: SR-22-NFPA 1977-2020

Second Revision No. 19-NFPA 1977-2020 [Section No. 2.2]

2.2 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471, www.nfpa.org.

NFPA 1500™, *Standard on Fire Department Occupational Safety, Health, and Wellness Program,* ~~2020~~ 2021 edition.

NFPA 1984, *Standard on Respirators for Wildland Fire-Fighting Operations,* ~~2021~~ 2022 edition.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Fri Apr 03 13:50:42 EDT 2020

Committee Statement

Committee Statement: Edition date for NFPA 1500 corrected.
Response Message: SR-19-NFPA 1977-2020

Second Revision No. 12-NFPA 1977-2020 [Section No. 2.3.1]

2.3.1 AATCC Publications.

American Association of Textile Chemists and Colorists, 1 Davis Drive, Research Triangle Park, NC 27709. www.aatcc.org

AATCC TM 135, *Dimensional Changes of Fabrics After Home Laundering*, ~~2018~~ 2004 .

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 15:25:25 EDT 2020

Committee Statement

Committee Statement: The committee determined the 2004 edition over the 2018 edition. the 2018 has some challenges that conflict with the NFPA Standard.
Response Message: SR-12-NFPA 1977-2020

Second Revision No. 1-NFPA 1977-2020 [Section No. 2.3.4]

2.3.4 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. www.astm.org

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 2018.

ASTM B152/B152M, *Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar*, 2013.

ASTM D1424, *Standard Test Method for the Tearing Strength of Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus*, 2009, reapproved 2013, editorial change 1, 2015.

ASTM D1683/D1683M, *Standard Test Method for Failure in Sewn Seams of Woven Fabrics*, 2017, reapproved 2018.

ASTM D1776/D1776M, *Standard Practice for Conditioning and Testing Textiles*, 2016.

ASTM D1777, *Standard Test Method for Thickness of Textile Materials*, 1996, reapproved 2015.

ASTM D2256/D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method,* 2010, reapproved 2015.

ASTM D3787, *Standard Test Method for Bursting Strength of Textiles — Constant-Rate-of-Traverse (CRT) Ball Burst Test*, 2016.

ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)*, 2012, reapproved 2016.

ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, 2009, reapproved 2017.

ASTM D5587, *Standard Test Method for Tearing Strength of Fabrics by Trapezoid Procedure*, 2015.

ASTM D6413/D6413M, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, 2015.

~~ASTM D6797, *Standard Test Method for Bursting Strength of Fabrics Constant-Rate-of-Extension (CRE) Ball Burst Test* , 2015.~~

ASTM D3786M, *Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method* , 2017.

ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, 2016.

ASTM E809, *Standard Practice for Measuring Photometric Characteristics of Retroreflectors*, 2008, reapproved 2013.

ASTM E810, *Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry*, 2003, reapproved 2013.

ASTM F1060, *Standard Test Method for Evaluation of Conductive and Compressive Heat Resistance (CCHR)*, 2018.

ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, 2005, reapproved 2013, e1.

ASTM F1414, *Standard Test Method for Measurement of Cut Resistance to Chain Saw in Lower Body (Legs) Protective Clothing*, 2015.

ASTM F1790/F1790M, *Standard Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing with CPP Test Equipment*, 2015.

~~ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate* , 2017.~~

ASTM F1897, *Standard Specification for Leg Protection for Chain Saw Users*, 2014.

ASTM F1939, *Standard Test Method for Radiant Heat Resistance of Flame Resistant Clothing Materials with Continuous Heating*, 2015.

ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Finger Dexterity Using a Modified Pegboard Test*, 2018.

ASTM F2299/F2299M, *Standard Test Method for Determining the Initial Efficiency of Materials Used in Medical Face Masks to Penetration by Particulates Using Latex Spheres*, 2003, reapproved 2017.

ASTM F2370, *Standard Test Method for Measuring the Evaporative Resistance of Clothing Using a Sweating Manikin*, 2016.

ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, ~~2014~~ 2019 .

ASTM F2913, *Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester*, 2019.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Tue Mar 31 13:11:17 EDT 2020

Committee Statement

Committee Statement: References updated.
Response Message: SR-1-NFPA 1977-2020

Public Comment No. 23-NFPA 1977-2019 [Section No. 2.3.4]

Second Revision No. 2-NFPA 1977-2020 [Section No. 2.3.9]

2.3.9 US Government Publications – Military Specifications and Commercial Item Descriptions.

DLA Document Production Service Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094. http://quicksearch.dla.mil

Commercial Item Description A-A-55126B, *Fastener Tapes, Hook and Loop, Synthetic,* 7 September 2006.

Commercial Item Description A-A-55195, *Thread, Para-Aramid, Spun, Intermediate Modulus*, 7 April 1993.

Commercial Item Description A-A-55217B, *Thread, Aramid, Spun Staple*, March 2011.

Commercial Item Description ~~A-A-55634A~~ A-A-55634B , *Zippers (Fasteners, Slide Interlocking),*~~23 March 2004~~ 9 August 2018 .

Military Specification MIL-DTL-10884H, *Fastener, Snap*, 20 July 2005.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Tue Mar 31 13:21:42 EDT 2020

Committee Statement

Committee Statement: A-A-55634A has been updated. A-A-55634B is the new version and should be the new referenced document.
Response Message: SR-2-NFPA 1977-2020

Public Comment No. 10-NFPA 1977-2019 [Section No. 2.3.9]

Second Revision No. 31-NFPA 1977-2020 [Section No. 4.1.8]

4.1.8

The certification organization shall not issue any new certifications to the ~~2021~~ 2016 edition of this standard on or after the NFPA effective date for the 2022 edition of NFPA 1977 .

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Fri Jul 17 13:19:17 EDT 2020

Committee Statement

Committee Statement: A sunset provision is required for issuing certification to the 2016 edition.
Response Message: SR-31-NFPA 1977-2020

Second Revision No. 32-NFPA 1977-2020 [Section No. 4.1.9]

4.1.9

The certification organization shall not permit any manufacturer to continue to label any protective clothing and equipment certified as compliant with the ~~2021~~ 2016 edition of this standard on or after the NFPA effective date for the 2022 edition of NFPA 1977 .

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Fri Jul 17 13:24:02 EDT 2020

Committee Statement

Committee Statement: Labeling of garments and other items covered in NFPA 1977 require a transition to the 2022 edition.
Response Message: SR-32-NFPA 1977-2020

Second Revision No. 33-NFPA 1977-2020 [Section No. 4.1.10]

4.1.10

The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the ~~2021~~ 2016 edition of this standard from all protective clothing and equipment that are under the control of the manufacturer on the NFPA effective date, and the certification organization shall verify that this action is taken.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Fri Jul 17 13:27:31 EDT 2020

Committee Statement

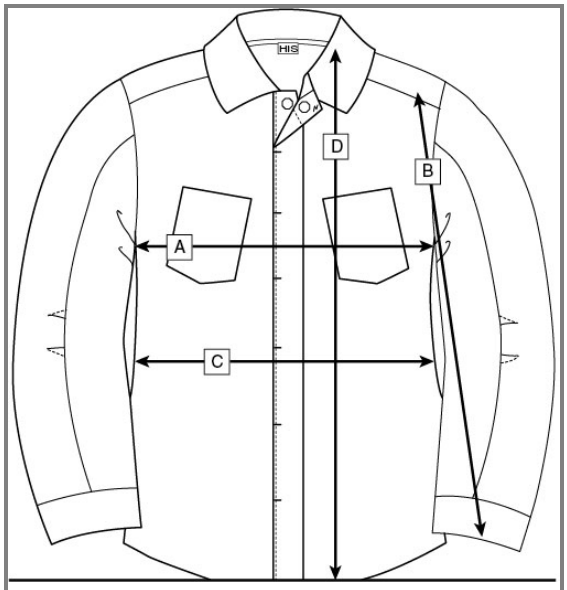
Committee Statement: Section requires to removal of labels certified to the 2016 edition.
Response Message: SR-33-NFPA 1977-2020

Second Revision No. 18-NFPA 1977-2020 [Section No. 6.1.14.6]

6.1.14.6

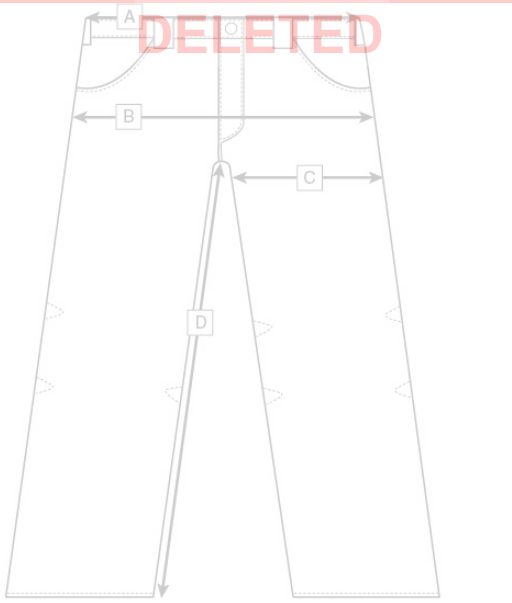
Garments shall be closed, laid flat, smoothed, and gently stretched when measured as defined in Section 3.3 and as specified in Section 6.1 and in Figure 6.1.14.6(a) through Figure 6.1.14.6(c)~~Figure 6.1.14.6(c)~~ .

Figure 6.1.14.6(a) Upper Torso Measurements [to be used with Table 6.1.14.6(a)~~ and Table 6.1.14.6(b)~~].



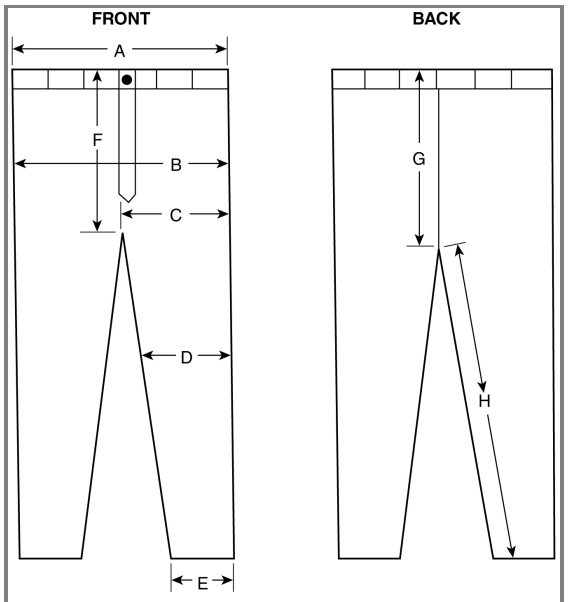
A. Chest Circumference. Measurement of upper toso garment from folded edge to folded edge, at base of armholes and multiplied by 2 to obtain circumference.
B. Sleeve Length. Measurement from midpoint of shoulder diagonally down sleeve to bottom edge of cuff.
C. Waist Circumference. A garment measurement from top edge of wastband from folded edge to folded edge, and multiplied by 2 to obtain circumference.
D. Total Length. Upper torso garment measurement from high point of shoulder at base of collar to bottom edge of garment.

~~**Figure 6.1.14.6(b) Lower Torso Measurements [to be used with Table 6.1.14.6(c) and Table 6.1.14.6(d)].**~~



A. Waist Circumference. A garment measurement from top edge of waistband from folded edge to folded edge and multiplied by 2 to obtain circumference.
B. Seat Circumference. Lower torso measurement from 2.54 cm (1 in.) above bottom of fly curve from folded edge to folded edge, and multiplied by 2 to obtain circumference.
C. Thigh Circumference. Lower torso garment measurement from 5.08 cm (2 in.) below the bottom of the crotch from folded edge to folded edge, and multiplied by 2 to obtain circumference.
D. Inseam. Lower torso garment measurement along inseam from base of the crotch seam to bottom edge of cuff.

Figure 6.1.14.6(b) Lower Torso Measurements [to be used with Table 6.1.14.3(b) and Table 6.1.14.3(c)].

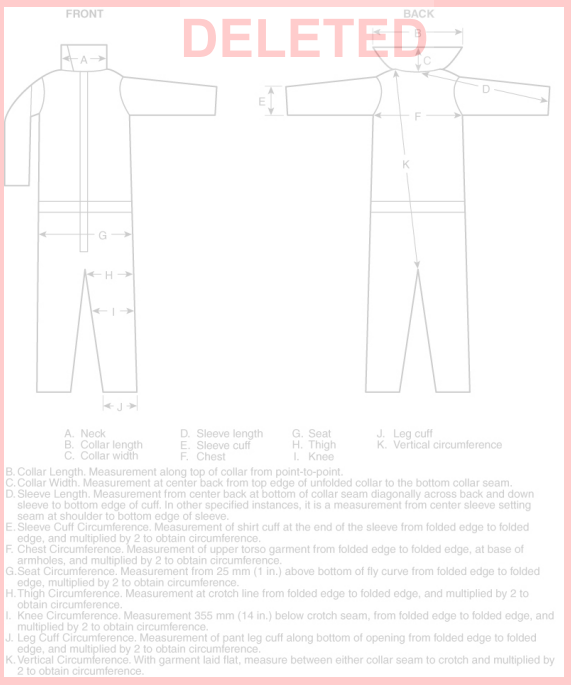


A. Waist
B. Seat
C. Thigh
D. Knee
E. Leg cuff
F. Front rise
G. Back rise
H. Inseam

A. Waist Circumference. A garment measurement from top edge of waistband from folded edge to folded edge, and multiplied by 2 to obtain circumference.
B. Seat Circumference. Lower torso garment measurement 25 mm (1 in.) above the intersection of seat, front, and inseams from folded edge to folded edge, multiplied by 2 to obtain circumference. In the case of no intersection of seams, mark the garment where the medial line of the trouser legs meets the midsection line of the front and rear panels.
C. Thigh Circumference. Lower torso garment measurement from the intersection of seat, front, and inseams to lateral folded edge, multiplied by 2 to obtain circumference. In the case of no intersection of seams, mark the garment where the medial line of the trouser legs meets the midsection line of the front and rear panels.
D. Knee Circumference. Lower torso garment measurement 355 mm (14 in.) below crotch seam, from folded edge to folded edge, and multiplied by 2 to obtain circumference.
E. Leg Cuff Circumference. Measurement of pant leg cuff along bottom of opening from folded edge to folded edge, and multiplied by 2 to obtain circumference.
F. Front Rise. Lower torso garment measurement from crotch seam to top of waistband at front center.
G. Back Rise. Lower torso garment measurement from crotch seam to top of waistband at back center.
H. Inseam Length. Lower torso garment measurement along inseam from crotch seam to bottom edge of cuff.

Figure 6.1.14.6(c) One-Piece Garment Torso Measurements [to be used with Table 6.1.14.6(d)].

DELETED



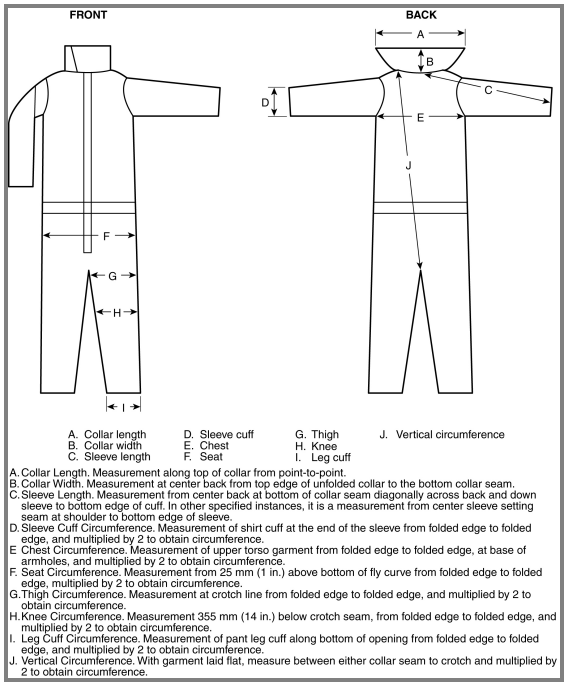


Table 6.1.14.6(a) Minimum Sizing Requirements for Protective Upper Torso Garments (in.)

	Garment Size						
Dimension Measured*	**XS**	**S**	**M**	**L**	**XL**	**2XL**	**Amount of Change†**
Collar length (A)	14¾	15¾	16¾	17¾	18¾	19¾	1
Collar width (B)	3	3	3	3	3	3	0
Front length (C)	24¾	25¾	26¾	27¾	28¾	29¾	1
Back length (D)	28	29	30	31	32	33	1
Sleeve length (E)	30½	31½	32½	33½	34½	35½	1
Sleeve cuff circumference (F)	12	12 ½	13	13 ½	14	14 ½	½
Chest circumference (G)	39	43	47	51	55	59	4
Waist circumference (H)	33	37	41	45	49	53	4

Dimension Measured*	Garment Size XS	S	M	L	XL	2XL	Amount of Change†
Bottom circumference (I)	38	42	46	50	54	58	4

Note: To convert measurements to millimeters, multiply by 25.4.

*Letters in parentheses refer to Figure 6.1.14.6(a).

†The amount of change between two consecutive garment sizes for the dimension measured.

Table 6.1.14.6(b) Minimum Sizing Requirements for Men's Lower Torso Protective Garments (in.)

Dimension Measured*	Garment Size 26	28	30	32	34	36	38	40	Amount of Change†
Waist circumference (A)	26	28	30	32	34	36	38	40	2
Seat circumference (B)	37	39	41	43	45	47	49	51	2
Thigh circumference (C)	25	26	27	28	29	30	31	32	1
Knee circumference (D)	17 1/2	18 1/4	19	19 3/4	20 1/2	21 1/4	22	22 3/4	3/4
Leg cuff circumference (E)	15 1/2	16	16 1/2	17	17 1/2	18	18 1/2	19	1/2
Front rise (F)	9 7/8	10 3/16	10 1/2	10 13/16	11 1/8	11 7/16	11 3/4	12 1/16	5/16
Back rise (G)	15 3/8	15 11/16	16	16 5/16	16 5/8	16 15/16	17 1/4	17 9/16	5/16
Inseam length (H)	Cut to order or provided in 1 in. increments between 28 and 36 in.								

Note: To convert measurements to millimeters, multiply by 25.4.

*Letters in parentheses refer to Figure 6.1.14.6(b).

†The amount of change between two consecutive garment sizes for the dimension measured.

Table 6.1.14.6(c) Minimum Sizing Requirements for Women's Lower Torso Protective Garments (in.)

Dimension Measured*	Garment Size ~~23~~ 25	~~25~~ 27	~~27~~ 29	~~29~~ 31	~~31~~ 33	~~33~~ 35	~~35~~ 37
Waist circumference (A)	~~23~~ 25	~~25~~ 27	~~27~~ 29	~~29~~ 31	~~31~~ 33	~~33~~ 35	~~35~~ 37
Seat circumference (B)	37	39	41	43	45	47	49
Thigh circumference (C)	25	26	27	28	29	30	31
Knee circumference (D)	17 3/4 1/2	18 1/2 1/4	19 1/4	~~19~~ 20 3/4	20 3/4 1/2	21 1/2 1/4	22 1/4
Leg cuff circumference (E)	15 1/2	~~16~~ 15 1/2	16 1/2	~~17~~ 16 1/2	17 1/2	~~18~~ 17 1/2	18 1/2

Dimension Measured*	Garment Size						
	~~23~~ 25	~~25~~ 27	~~27~~ 29	~~29~~ 31	~~31~~ 33	~~33~~ 35	~~35~~ 37
Front rise (F)	~~9~~ 8 7/8	~~10~~ 9 3/16	~~10~~ 9 1/2	~~10~~ 9 13/16	~~11~~ 10 1/8	~~11~~ 10 7/16	~~11~~ 10 3/4
Back rise (G)	~~15~~ ~~3/8~~ 14 7/8	15 3/16 ~~11/16~~	~~16~~ 15 1/2	~~16~~ 15 13/16 ~~5/16~~	16 1/8 ~~5/8~~	16 7/16 ~~15/16~~	~~17~~ ~~1/4~~ 16 3/4
Inseam length (H)	Cut to order or provided in 1 in. increments between 28 and 36 in.						

Note: To convert measurements to millimeters, multiply by 25.4.

*Letters in parentheses refer to Figure 6.1.14.6(b).

†The amount of change between two consecutive garment sizes for the dimension measured.

Table 6.1.14.6(d) Minimum Sizing Requirements for Protective One-Piece Garments (in.)

Dimension Measured*	Garment Size					Amount of Change†
	XS	S	M	L	XL	
Collar length (A)	14 3/4	15 3/4	16 3/4	17 3/4	18 3/4	1
Collar width (B)	3	3	3	3	3	0
Sleeve length (C)	30 1/2	31 1/2	32 1/2	33 1/2	34 1/2	1
Sleeve cuff circumference (D)	12 1/2	13	13 1/2	14	14 1/2	1/2
Chest circumference (E)	32	36	40	44	48	4
Seat circumference (F)	37	41	45	49	53	4
Thigh circumference (G)	25	27	29	31	33	2
Knee circumference (H)	17 1/2	19	20 1/2	22	23 1/2	1 1/2
Leg cuff circumference (I)	17 1/2	18 1/2	19 1/2	20 1/2	21 1/2	1
Vertical circumference (J)						
S (short size)	—	—	69	71 1/2	74	—
R (regular size)	63 1/2	63 1/2	71	73 1/2	76	—
T (tall size)	65 1/2	65 1/2	73	75 1/2	78	—
Height range						
S (short size)	—	—	64–67	—	—	—
R (regular size)	63–66	—	67 1/2–72	—	—	—
T (tall size)	66 1/2–69	—	72 1/2–75	—	—	—

Note: To convert measurements to millimeters, multiply by 25.4.

*Letters in parentheses refer to Figure 6.1.14.6(c).

†The amount of change between two consecutive garment sizes for the dimension measured.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 16:28:45 EDT 2020

Committee Statement

Committee Statement: Committee determined that the figure for lower torso from the 2016 edition is required to illustrate the measurement points indicated in the tables. The Minimum Sizing Requirements for Women's Lower Torso Protective Garments are revised.

Response SR-18-NFPA 1977-2020

Message:

Public Comment No. 34-NFPA 1977-2019 [Section No. 6.1.14]

Second Revision No. 34-NFPA 1977-2020 [Section No. 6.10.6]

6.10.6

The packing volume of the shelter shall not exceed 4916 ~~mL~~ cm ^{3} (300 in.^{3})

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Fri Jul 17 13:29:59 EDT 2020

Committee Statement

Committee Statement: Units of measure corrected to correspond to the standard unit of measure for volume.
Response Message: SR-34-NFPA 1977-2020

Second Revision No. 23-NFPA 1977-2020 [Section No. 6.10.9]

6.10.9

Fire shelters shall be available in at least the following two sizes:

(1) To accommodate an individual wearing up to the maximum pant and shirt sizes defined in Table 6.1.14.6(a) and Table 6.1.14.6(b)or Table 6.1.14.6(c)

(2) To accommodate an individual wearing a medium shirt and size 32 pant

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 08 12:32:24 EDT 2020

Committee Statement

Committee Statement: Section updated to reflect lower torso tables for male and female.
Response Message: SR-23-NFPA 1977-2020

Second Revision No. 4-NFPA 1977-2020 [Section No. 7.1.6]

7.1.6*

A wildland garment material/composite , excluding cold weather outerwear ~~garments~~ garment materials and winter liners where provided, shall be tested for ~~garment~~ total heat loss as specified in Section 8.5 and shall have a total heat loss of not less than ~~150~~ 500 W/m^2.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Tue Mar 31 16:31:22 EDT 2020

Committee Statement

Committee Statement: Whole Garment Heat Loss testing where the whole garment would be place on the walking sweating manikin. The whole garment heat loss would be measured under the current THL conditions because the THL, non-isothermal, conditions better represent a human bodies response. This whole garment testing was proposed in addition to not in-place of the Total Heat Loss (THL) testing currently required on garment materials. The THL requirement for 500 W/m2 is based on fabric research to allow a balance between THL and RPP. Lab testing has shown a dangerous increase in body core temperature with THL of 450. The committee determined to improve on the minimum performance by moving away from the 450 THL level.

Response Message: SR-4-NFPA 1977-2020

Public Comment No. 36-NFPA 1977-2019 [Section No. 7.1.6]

Public Comment No. 35-NFPA 1977-2019 [Section No. 7.1.6]

Public Comment No. 30-NFPA 1977-2019 [Section No. 7.1.6]

Public Comment No. 29-NFPA 1977-2019 [Section No. 7.1.6]

Public Comment No. 6-NFPA 1977-2019 [Section No. 7.1.6]

Second Revision No. 3-NFPA 1977-2020 [Section No. 7.1.7 [Excluding any Sub-Sections]]

~~Garment composite, excluding cold weather outerwear garments~~ Woven garment textile fabrics, collar linings, and winter liners where provided~~,~~ shall be individually tested for resistance to tearing as specified in Section 8.7 and shall have a ~~Ret value~~ tear strength of not less than ~~20~~ 22 N (5 lbf) .

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Tue Mar 31 16:24:43 EDT 2020

Committee Statement

Committee Statement: The committee determined that RET does not belong in this section. The sub-paragraph still refers to strength testing and the intention was not to replace the strength testing with RET.

Response Message: SR-3-NFPA 1977-2020

Public Comment No. 7-NFPA 1977-2019 [Section No. 7.1.7 [Excluding any Sub-Sections]]

Public Comment No. 32-NFPA 1977-2019 [Section No. 7.1.7 [Excluding any Sub-Sections]]

Public Comment No. 31-NFPA 1977-2019 [Section No. 7.1.7 [Excluding any Sub-Sections]]

Second Revision No. 14-NFPA 1977-2020 [Section No. 7.1.16]

7.1.16

Garment zippers shall be tested for crosswise breaking strength of chain; crosswise breaking strength of separating unit; holding strength of stops, retainers, and separating units; operating force; and slider lock strength requirements of Commercial Item Description ~~A-A-55634A~~ A-A-55634B , *Zippers (Fasteners, Slide Interlocking)*.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 16:09:07 EDT 2020

Committee Statement

Committee Statement: A-A-55634A has been updated. A-A-55634B is the new version.
Response Message: SR-14-NFPA 1977-2020

Public Comment No. 12-NFPA 1977-2019 [Section No. 7.1.16]

Second Revision No. 13-NFPA 1977-2020 [Section No. 7.1.17]

7.1.17

Garment textile fabric shall be tested for breaking strength as specified in Section ~~8.9~~ 8.40 and shall have a breaking strength of not less than 400 N (90 lbf).

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 15:53:39 EDT 2020

Committee Statement

Committee Statement: Incorrect test method reference. Test method should include garments.
Response Message: SR-13-NFPA 1977-2020

Public Comment No. 8-NFPA 1977-2019 [Section No. 7.1.17]

Second Revision No. 5-NFPA 1977-2020 [New Section after 7.1.18]

7.1.19

Fabrics used for wildland garments shall have a minimum tensile strength in the warp and fill direction of 540 N (121 lbf).

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Tue Mar 31 16:35:53 EDT 2020

Committee Statement

Committee Statement: The committee determined that:

(a) The NFPA 1977 standard does not currently have a performance requirement for fabric tensile strength in Section 7.

(b) Fabric tensile strength is used to determine several items: (1) establish Major 'A' seam strength requirements; and (2) establish Major 'B' seam strength performance requirements to be discussed in Section 7.1.9.

(c) ASTM D5034 identifies the grab break tensile stress at which a woven fabric fails and is no longer functional. There is also a relationship between fabric weight and other terms which address various mechanical performance and protective performance characteristics. These include: tear resistance and seam strength efficiency, radiant protection performance (RPP) and total heat loss (THL). In short, all of the performance characteristics are inter-related.

(d) The source of data used to support the proposed wording in Section 7.1.X is the average fabric tensile strength reported by the fabric suppliers and which are published in the literature of the fabric suppliers.

Response Message: SR-5-NFPA 1977-2020

Public Comment No. 4-NFPA 1977-2019 [New Section after 7.1]

Public Comment No. 26-NFPA 1977-2019 [New Section after 7.1]

Second Revision No. 21-NFPA 1977-2020 [Section No. 7.1.18]

7.1.18 Additional Performance Requirement for Optional Urban Interface Protection.

~~Garment~~ Optional urban interface protection of garment textile fabrics that incorporate a particulate blocking layer shall ~~be tested~~ include testing for particulate blocking as specified in Section 8.49 and shall have a particulate filtration efficiency of 90 percent or greater for each particle size from 0.1 µm to 1.0 µm.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 08 10:49:41 EDT 2020

Committee Statement

Committee Statement: Manual of style adjustment of text.
Response Message: SR-21-NFPA 1977-2020

Second Revision No. 15-NFPA 1977-2020 [Section No. 7.5.13]

7.5.13

Zippers shall be tested for crosswise breaking strength of chain; crosswise breaking strength of separating unit; holding strength of stops, retainers, and separating units; operating force; and slider lock strength requirements of Commercial Item Description ~~A-A-55634A~~ A-A-55634B , *Zippers (Fasteners, Slide Interlocking)*.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 16:11:48 EDT 2020

Committee Statement

Committee Statement: A-A-55634A has been updated. A-A-55634B is the new version to be referenced.
Response Message: SR-15-NFPA 1977-2020

Public Comment No. 13-NFPA 1977-2019 [Section No. 7.5.13]

Second Revision No. 16-NFPA 1977-2020 [Section No. 7.5.14]

7.5.14

Protective face/neck shroud textile fabric shall be tested for breaking strength as specified in Section ~~8.9~~ 8.40 and shall have a breaking strength of not less than 300 N (67 lbf).

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 16:24:26 EDT 2020

Committee Statement

Committee Statement: Correcting test method reference.
Response Message: SR-16-NFPA 1977-2020

Public Comment No. 9-NFPA 1977-2019 [Section No. 7.5.14]

Second Revision No. 17-NFPA 1977-2020 [Section No. 7.9.1]

7.9.1

Load-carrying equipment shall be tested for resistance to heat as specified in Section 8.4 and shall not melt, drip, separate, or ignite. All hardware items and closure systems shall remain functional.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 16:25:53 EDT 2020

Committee Statement

Committee Statement: Closure systems reinstated to section.
Response Message: SR-17-NFPA 1977-2020

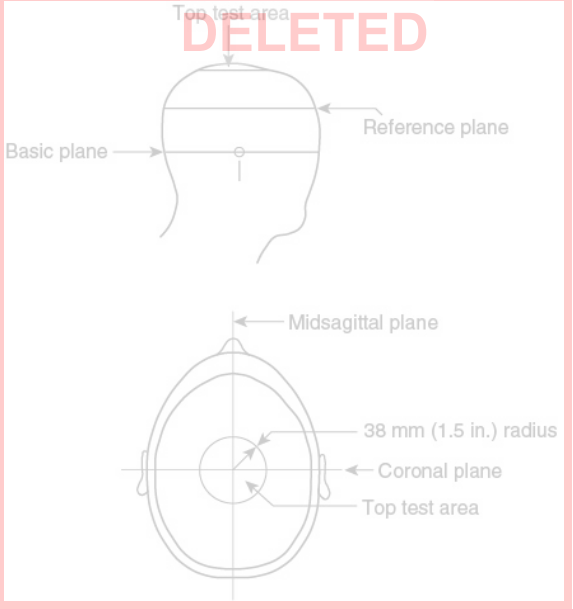
Public Comment No. 18-NFPA 1977-2019 [Section No. 7.9.1]

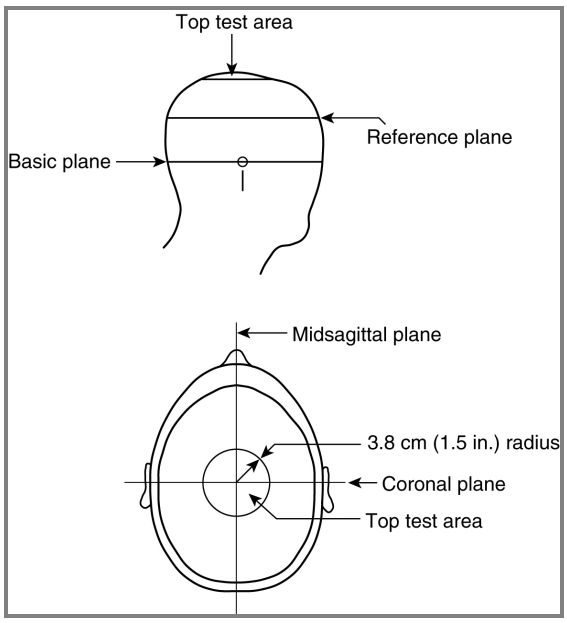
Second Revision No. 29-NFPA 1977-2020 [Section No. 8.1.4.1]

8.1.4.1

Sample helmets shall be conditioned by exposing the area to be impacted/penetrated to a radiant heat source. The test area to be impacted/penetrated shall be as specified in Figure 8.1.4.1.

Figure 8.1.4.1 Helmet Test Area and Landmarks.





Supplemental Information

File Name	Description	Approved
1977_Fig._8.1.4.1.pdf	For staff use	

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Tue Jun 09 10:33:41 EDT 2020

Committee Statement

Committee Statement: Change 38 mm to 3.8 cm in Figure 8.1.4.1
Response Message: SR-29-NFPA 1977-2020

Second Revision No. 8-NFPA 1977-2020 [Section No. 8.3.15]

8.3.15 Specific Requirements for Testing Padding ~~Materials~~ and Reinforcement Materials .

8.3.15.1

Five specimens shall be tested.

8.3.15.2

Samples for conditioning shall be at least 1 m (1 yd) square of each material.

8.3.15.3

Testing shall be performed as described in 8.3.2 through 8.3.8.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 13:45:40 EDT 2020

Committee Statement

Committee Statement: Reinforcement materials added for correlation with section 8.3.8. Section 8.3.8 references padding and reinforcements.
Response Message: SR-8-NFPA 1977-2020

Public Comment No. 19-NFPA 1977-2019 [Section No. 8.3.15]

Second Revision No. 9-NFPA 1977-2020 [Section No. 8.6]

~~**8.6** Evaporative Resistance Test (Ret).~~

~~**8.6.1** Application.~~

~~**8.6.1.1**~~

~~This test method shall apply to protective garment composites and reinforcement composites but shall not apply to cold weather outerwear composites.~~

~~**8.6.1.2**~~

~~Modifications to this test method for testing reinforcement composites shall be as specified in 8.5.8 .~~

~~**8.6.2** Samples.~~

~~**8.6.2.1**~~

~~Samples shall consist of all the layers of the protective garment composite, with the exception of the winter liner, arranged in the order and orientation they are worn.~~

~~**8.6.2.2**~~

~~Samples shall be conditioned for five laundering cycles as specified in 8.1.2 , then conditioned at a temperature of 35°C ± 7°C (77°F ± 12.6°F) and a relative humidity of 40 percent ± 5 percent for at least 4 hours.~~

~~**8.6.3** Specimens.~~

~~**8.6.3.1**~~

~~Specimens for testing shall be the same as samples for conditioning.~~

~~**8.6.3.2**~~

~~Testing shall be conducted on a minimum of three specimens.~~

~~**8.6.4** Apparatus.~~

~~The test apparatus shall be as specified in ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate* .~~

~~**8.6.5** Procedure.~~

~~Testing shall be conducted in accordance with ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate* , using Part B.~~

~~**8.6.6** Report.~~

~~The evaporative resistance (Ret) of the sample shall be calculated, recorded, and reported.~~

~~**8.6.7** Interpretation.~~

~~Pass or fail determination shall be based on the average evaporative resistance (Ret) measurement of all specimens tested.~~

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 13:49:37 EDT 2020

Committee Statement

Committee Statement: R et is not referenced within standard as a test method.
Response Message: SR-9-NFPA 1977-2020

Public Comment No. 20-NFPA 1977-2019 [Section No. 8.6]

Public Comment No. 33-NFPA 1977-2019 [Section No. 8.6]

Second Revision No. 10-NFPA 1977-2020 [Section No. 8.40.1]

8.39.1 Application.

This test shall apply to both woven and nonwoven materials ~~used in fire shelters~~ .

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 14:11:26 EDT 2020

Committee Statement

Committee Statement: Test method is not restricted to fire shelters, it is also required for garments, etc.
Response Message: SR-10-NFPA 1977-2020

Public Comment No. 21-NFPA 1977-2019 [Section No. 8.40.1]

Second Revision No. 26-NFPA 1977-2020 [Section No. 8.44.4]

8.43.4 Apparatus.

The testing machine shall be as described in ASTM ~~D6797~~ D3786M , *Standard Test Method for Bursting Strength of ~~Fabrics Constant-Rate-of-Extension (CRE) Ball Burst Test~~ Textile Fabrics—Diaphragm Bursting Strength Tester Method* , except that a ball burst apparatus shall replace the clamp assembly. The polished steel ball specified in Method 5120 shall be replaced with the modified blunt end probe. The blunt end probe shall have a diameter of 9.5 mm (0.375 in.) and shall be chamfered at 45° to remove the sharp corner.

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Mon Jun 08 15:31:22 EDT 2020

Committee Statement

Committee Statement: Test method number and name updated.
Response Message: SR-26-NFPA 1977-2020

Second Revision No. 27-NFPA 1977-2020 [Section No. 8.44.5]

8.43.5 Procedure.

Specimens shall be tested as specified in ASTM ~~D6797~~ D3786M , *Standard Test Method for Bursting Strength of ~~Fabrics Constant-Rate-of-Extension (CRE) Ball Burst Test~~ Textile Fabrics —Diaphragm Bursting Strength Tester Method* .

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Mon Jun 08 16:26:34 EDT 2020

Committee Statement

Committee Statement: Test number and title updated
Response Message: SR-27-NFPA 1977-2020

Second Revision No. 11-NFPA 1977-2020 [Section No. 8.45.5]

8.44.5 Procedure.

The burst test shall be ~~tested~~ performed as specified in ASTM ~~D6797~~ D3786M , *Standard Test Method for Bursting Strength of Textile Fabrics ~~Constant Rate of Extension (CRE) Ball Burst Test~~ —Diaphragm Bursting Strength Tester Method* .

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Wed Apr 01 14:12:27 EDT 2020

Committee Statement

Committee Statement: Corrected Test Method Reference.
Response Message: SR-11-NFPA 1977-2020

Public Comment No. 22-NFPA 1977-2019 [Section No. 8.45.5]

Second Revision No. 28-NFPA 1977-2020 [Section No. 8.49.6]

8.48.6 Report.

The following shall be recorded and reported:

(1) Temperature at the 50 mm (2 in.) level after the end of exposure [°C (°F)]
(2) Temperature at the 254 mm (10 in.) level after the end of exposure [°C (°F)]
(3) Peak concentration of CO and CO_2, HCL and HCN ~~(acceptable levels tbd)~~
(4) Minimum O_2 level ~~(acceptable levels tbd)~~
(5) Time of visual interior shelter degradation (sec)

Submitter Information Verification

Committee: FAE-WFF
Submittal Date: Mon Jun 08 20:16:07 EDT 2020

Committee Statement

Committee Statement: (acceptable levels tbd) term removed, TC did not bring forward acceptable levels.
Response Message: SR-28-NFPA 1977-2020

Second Revision No. 20-NFPA 1977-2020 [Chapter B]

Annex B Description of Performance Requirements and Test Methods

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Global SR-30

B.1 Overview.

Annex B is intended to serve as a guide for both experienced and rookie fire fighters who want to better understand the performance requirements (tests) of the wildland and urban interface fire fighting gear they wear and to develop a basic understanding of the minimum test requirements for the wildland and urban interface fire fighting gear described in Chapter 7 of the ~~2021~~2022 edition of NFPA 1977. This annex will also help the reader gain a clearer understanding of the limits of the protective ensemble. However, Annex B only addresses performance requirements and test methods for protective elements (garments, helmets, gloves, footwear, and hoods) used for wildland and urban interface fire fighting.

Interpretations of tests, test methods, or test results will not be found here. Instead, Annex B provides background information and explains performance requirements and test methods in layman's terms. Fire department or agency equipment officers, safety officers, purchasing agents, members of the selection committee, and end users/wearers will also find this information helpful.

The tests required by NFPA 1977 do not guarantee that the ensemble or ensemble element will not fail in the field. The tests evaluate representative samples of the protective ensemble elements or materials used in their construction to determine whether the element will pass defined minimum performance requirements under controlled test conditions. These tests cannot be performed in the field—they must be performed by the qualified laboratory of an accredited certification organization.

Annex B also gives a brief description of the required NFPA tests performed by the certification organization (chosen by the manufacturer) on the elements of the wildland and urban interface fire fighting ensemble—protective garment (the coat and pants or coveralls), protective helmets, protective gloves (work and driving), protective footwear, protective face/neck shrouds, protective goggles, protective chain saw protectors, and load-carrying equipment—with a section and corresponding table for each element.

The Test Method column in each table shows the number and name of the section in the standard that is described; the Test Method Description column provides an overview of the test, which indicates what is tested and, in general, how it is tested; and the Test Method Application column explains why the test method is specified and how the method is used to assess the performance of fire fighter protective clothing.

Some tests evaluate a representative piece or sample of the element while other tests evaluate the whole element as specified in the table. In general, tests are conducted on multiple specimens, not just one specimen. Tests are designed by experts familiar with fire-fighting field conditions. They are evaluated by fire fighters on the NFPA 1977 committee before they are put in the standard to ensure the performance requirements translate to an appropriate minimum level of protection.

Throughout the document, references are made to specimens being tested "as received" and "after conditioning." Specific descriptions and instructions for each type of conditioning can be found in Chapter 8: Test Methods, along with the test method details. In general, however, "as received" means the specimens tested are new, out-of-the-box samples that have not been laundered or subjected to other environmental conditioning; "conditioning" generally refers both to laundering the samples and to exposing the samples to specific environmental conditions. Again, all the specific details for sample treatment can be found in Chapter 8.

To ensure environmental consistency prior to testing, the as received samples are conditioned in an environmental chamber for 24 hours at 21°C ± 2.8°C (70°F ± 5°F) and 65 percent ± 5 percent humidity. The specific procedure used to condition samples to these parameters is found in ASTM D1776, *Standard Practice for Conditioning Textiles for Testing*. As outlined in specific tests, elements might also require conditioning by one or more of the following procedures before testing can proceed:

(1) Washing and drying procedures (AATCC TM 135, *Dimensional Changes of Fabrics after Home Laundering*)

(2) Low temperature environmental conditioning

(3) Convective heat conditioning

(4) Radiant heat conditioning

(5) Wet conditioning

The Test Method Description column in the tables references specific test methods from other standards organizations such as ASTM or ISO. In these instances, some details found in the referenced test method, but not in NFPA 1977, are described for the respective test method. This information includes specific details that are key to understanding the test method in the context of how it might relate to what is experienced in the field and, therefore, included in this annex.

Fire fighters face many hazards that manufacturers of personal protective equipment attempt to mitigate. The minimum performance requirements that protective ensemble elements have to meet are included in the ~~2021~~2022 edition of NFPA 1977. Certification organizations and their laboratories perform these tests and determine whether or not the samples provided pass the tests. Compliance for a particular product is indicated by the certification mark on the product label that is permanently attached to the element item. The certification mark means representative samples have passed rigorous tests and are compliant with the ~~2021~~2022 edition of NFPA 1977. If the certification organization mark is not on the label, the equipment is neither NFPA-compliant nor third-party certified and should not be used.

B.2 Garments.

Table B.2 is intended to serve as an abbreviated guide to specified tests that apply to garments and materials used in the construction of the garment. These tests evaluate whether or not the garment meets the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing the garment.

Table B.2 Garments

Test Method	Test Method Description	Test Method Application
7.1.1 Radiant Protective Performance (RPP) Test	This test is performed in accordance with ASTM F1939, *Standard Test Method for Radiant Heat Resistance of Flame Resistant Clothing Materials with Continuous Heating*, on five specimens representative of the garment composite, which are tested as received and after preconditioning with five laundering cycles.	The Radiant Protective Performance (RPP) test is used to measure the insulating performance of the garment by evaluating how quickly radiant heat is transferred from the outside of the garment to the inside.
	Specimens comprise all layers of the garment and are tested in the order in which they are worn. The outer shell exterior is exposed to a radiant heat source.	Under the given test conditions, which simulate only radiant heat exposure but not severe flashover conditions, the RPP rating multiplied by two indicates the approximate number of seconds until a fire fighter would receive a second-degree burn.
	The rate of temperature rise is recorded and compared to the known skin response to heat; the recorded time is multiplied by the heat exposure energy to determine the RPP rating. The RPP rating of the garment must be at least 7.0.	This is the primary test to measure the garment's ability to protect the fire fighter from severe radiant heat. The higher the number, the higher the protection from heat (under the specific test conditions), and, in general, the higher the heat stress on the fire fighter. Fire fighters should always consider the RPP rating as it relates to the Total Heat Loss (THL) rating.
7.1.2 Flame Resistance Test ~~See Figure B.2(a) and Figure B.2(b).~~	This test is performed in accordance with ASTM D6413/D6413M, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, on garment components as received and after conditioning with five laundering cycles (hook and pile fasteners, elastic, and interlinings can be excluded from the test depending on their location in the garment).	The Flame Resistance Test is used to evaluate the material, under controlled test conditions, for its ability to self-extinguish after the flame is removed. The char length of the material after exposure to flame is also measured. This is the primary test to establish the flame-resistant properties of the materials used in garment construction.
	Each separable layer of multilayer composites is tested individually. The specimen is suspended over a flame for 12 seconds to determine the time it takes for the material to self-extinguish and how badly the material is damaged by the flame. Afterflame time (the time it takes to self-extinguish) and char length (how badly the material is damaged by the flame) are observed and recorded.	

Test Method	Test Method Description	Test Method Application
	Char length is not the size of the visible char on the material. Instead, it is the length that the material tears when subjected to a predefined tearing weight after the flame exposure. Materials cannot have a char (tear) length of more than 100 mm (4 in.), cannot show afterflame of more than 2~~.0~~ seconds after removal of the test flame, and cannot melt or drip.	
7.1.3 Heat and Thermal Shrinkage Resistance Test (shrinkage)	This test is performed in accordance with ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, on garment components as received and after conditioning with five laundering cycles. All garment material layers are tested individually. Fabric samples are marked and measured before exposure to five minutes of heat in a 260°C (500°F) oven. ~~Postexposure~~ Post-exposure measurements are taken and averaged, and no more than 10 percent shrinkage is permitted.	The Heat and Thermal Shrinkage Resistance Test is used to evaluate the materials for shrinkage after exposure to high temperatures. Excessive shrinkage could compromise the fire fighter’s mobility and impact the insulating qualities of the garment.
7.1.4 Heat and Thermal Shrinkage Resistance Test (melting, dripping, separation, ignition) ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM F2894 on garment components as received and after conditioning with five laundering cycles, except for hook and loop and elastic, when placed where they will not contact the fire fighter's body. Samples are suspended in a 260°C (500°F) oven for 5 minutes. Garment components cannot melt, drip, separate, or ignite. Garment components also cannot be charred, which would indicate evidence of ignition.	The Heat and Thermal Shrinkage Resistance Test is used for this requirement to determine whether or not components used to construct protective garments will melt, separate, or easily ignite. The test conditions are not intended to simulate actual wildland and urban interface fire fighting exposures but rather serve as a means to establish a minimum level of thermal stability for the materials used in the construction of protective clothing elements.
7.1.5 Heat and Thermal Shrinkage Resistance Test (Garment Hardware Functionality) ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM F2894 on at least three complete garment hardware items. Samples are prepped and exposed to 5 minutes of heat in a 260°C (500°F) oven. Within 10 minutes of exposure, hardware is tested for functionality (snaps and buckles must open and close, zippers must slide, etc.). This is a simple pass/fail requirement.	The Heat and Thermal Shrinkage Resistance Test is used in this case to evaluate the functionality of garment hardware after a high heat exposure. Nonfunctioning hardware could prevent a wildland and urban interface fire fighter from safely removing garments after a high heat exposure.

Test Method	Test Method Description	Test Method Application
7.1.6 Total Heat Loss (THL) Test	This test is performed in accordance with ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate* (Part C), on samples of the garment composite (but not including any cold weather outerwear), washed five times, conditioned at room temperature, and arranged in the order and orientation as it is worn. Specimens are placed on a sweating hot plate to evaluate heat transfer under wet conditions and thermal resistance under dry conditions. These values are combined in an equation to provide a total heat loss value.	The Total Heat Loss (THL) Test is used to evaluate the amount of heat that can be transferred out of the garment composite via both sweat evaporation from the wearer's skin and conduction through the garment to the outside environment. The test does not account for other materials attached to the base garment composite such as trim, pockets, and other layers, provided those other layers cover less than a specified area *(see Table 7.1.6.1)*. When additional layers exceed that coverage, the additional layer must also be tested for THL. Higher values indicate better performance and more heat loss. However, appropriate THL values for your department must be considered with RPP values. *(See A.7.1.6 for more detail.)*
7.1.7 Tear Resistance Test (WOVEN garment fabrics, collar linings, and winter liners)	This test is performed in accordance with ASTM D1424, *Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus*, on woven garment fabrics, collar linings, and winter liners in the as-received condition only. Five specimens are cut and tested in each direction (lengthwise and widthwise). A specimen is precut to approximately 19.1 mm (¾ in.) and placed into the test apparatus. One side of the specimen is mounted to a fixed point on the apparatus, and the other side is mounted to the end of a weighted pendulum. The pendulum is allowed to fall/swing, causing the tear to propagate across the specimen. The force required to propagate this tear across the specimen is recorded and averaged for five specimens in each direction. The average tear strength in both directions must be at last 23 N (5 lbf).	The Tear Resistance Test is used for this requirement to measure the ability of the garment or liner fabric to resist further tearing when a small tear occurs. Fabric tears further expose the fire fighter to the products of combustion. It also is a test of the strength and durability of the fabric. Fire fighting occurs in a harsh environment that includes many hazards that might tear a garment.
7.1.7.1 Burst Strength Test (knit garment fabrics, collar linings, and winter liners)	This test is performed in accordance with ASTM D3787, *Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of-Traverse (CRT) Ball Burst Test*, on knit garment fabrics, collar linings, and winter liners in the as-received condition only. This test is nondirectional, so ten specimens are tested without regard for length/width direction. A knit specimen is mounted into a circular clamp and a 25.4 mm (1 in.) steel ball is forced through the material until it bursts. The force required to burst	Since tear resistance is only applicable for woven fabrics, ball burst strength is a good representative assessment of the strength of knit fabrics. As with tears in woven fabrics, ruptures of knit fabrics further expose the fire fighter to the products of combustion. It also is a test of the strength and durability of the fabric. Fire fighting occurs in a harsh environment that includes many hazards that might rupture a knit garment.

Test Method	Test Method Description	Test Method Application
	the ball through the knit material is recorded. Test Method 1. All knit specimens must have at least 22.7 kg (50 lb) of burst strength.	
7.1.8 Cleaning Shrinkage Resistance Test (garment fabrics, winter liners, and collar linings)	This test is performed on three conditioned specimens of garment fabrics, winter liners (when provided), and collar liners, each tested individually. This requirement allows no more than a 5 percent change in the width and length dimensions after five wash and dry cycles in accordance with AATCC TM 135, *Dimensional Changes of Fabrics After Home Laundering*, using a normal wash cycle, 48.89°C (120°F) water, and permanent press dry cycle. Knit specimens are allowed to be stretched to their original dimensions, but then relax, prior to measuring for shrinkage.	The Cleaning Shrinkage Resistance Test is used to evaluate how much garment materials shrink after repeated laundering; excessive shrinkage could decrease the fire fighter's mobility and potentially reduce thermal insulation provided by personal protective equipment.
7.1.9 Seam Breaking Strength Test ~~See Figure B.2(e).~~	This test is performed in accordance with ASTM D1683/D1683M, *Standard Test Method for Failure in Sewn Seams of Woven Fabrics*, on all garment seam assemblies. Samples are tested after conditioning. Opposite ends of a 50 mm x 200 mm (2 in. x 8 in.) specimen with the seam bisecting the length are gripped in a machine and pulled apart until the specimen breaks. Minimum seam strength varies with type of material and location in the garment.	The Seam Breaking Strength Test is used to evaluate the strength of garment seams under stress. The test demonstrates the durability of the seam as an indicator of physical performance when subjected to repeated wearer movement, such as bending and stretching.
7.1.10 Thread Melting Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of the garment in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 260°C (500°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of the garment to determine whether it meets at least the same minimum heat resistance as the fabric used in the garment's construction.
7.1.11 Thread-Breaking Strength Test	This test is performed in accordance with ASTM D2256/D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method*, on three specimens of thread as received and after a 10-minute exposure in a 140.56°C (285°F) oven. Single strands of yarn are pulled until failure, and that force is recorded and averaged. Since thread strength varies with thread size, Table 7.1.11 details minimum breaking strength for various thread sizes.	The Thread-Breaking Strength Test is used to evaluate the thread used in construction of the garment to ensure it will be strong enough to maintain the integrity of the garment. If sewing thread is too weak, or weak after a heat exposure, it could compromise the garment and expose the fire fighter to a high temperature environment.
7.1.12 Label Durability and Legibility Test 1	This test is performed on garment labels attached to sample fabric. Garment label specimens are exposed to 10 laundry cycles in accordance with AATCC TM	The Label Durability and Legibility Test is used to evaluate whether or not the label stays in place and is legible after exposure to multiple

Test Method	Test Method Description	Test Method Application
	135 and evaluated for legibility.	launderings, abrasion, and convective heat. The retention and legibility of labels is important for garment identification and tracking.
	Separate specimens are subjected to abrasion in accordance with ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)*, and evaluated for legibility.	
	Separate specimens are subjected to a 10-minute exposure in a 140.56°C (285°F) oven and evaluated for legibility.	
7.1.13 Fastener Tape Strength Test (breaking)	This test is performed in accordance with Commercial Item Description A-A-55126B, *Fastener Tapes, Hook and Loop, Synthetic*. It is used to evaluate the breaking strength of hook and pile tape by separately pulling the hook and pile tapes in the jaws of a tensile testing machine until the tape breaks. The force used at the breaking point is recorded as the breaking strength.	The Fastener Tape Strength Test is used for this requirement to assess the overall strength of tapes used in hook and pile fasteners. The material must meet or exceed industry-established requirements based on the composition and width of the tape.
7.1.14 Fastener Tape Strength Test (shear)	This test is performed in accordance with A-A-55126B. It is used to evaluate the shear strength of the hook and pile tape by measuring the force required to separate hook tape overlapping pile tape when pulled between two jaws of a tensile testing machine.	The Fastener Tape Strength Test is used for this requirement to assess the durability and functionality of the hook and pile to not separate after repeated use.
	Testing is performed after the tapes have been repeatedly attached and detached. The maximum measured force is reported as the shear strength.	
7.1.15 Fastener Tape Strength Test (peel)	This test is performed in accordance with A-A-55126B. It is used to evaluate the peel strength of the hook and pile tape.	The Fastener Tape Strength Test is used for this requirement to assess the durability and functionality of the hook and pile to stay sealed after repeated use.
	In the test, hook tape is sealed over an equal length of pile tape, and the end of the two tapes are separated half their length. The two open ends of tape are attached to the jaws of a tensile testing machine and pulled to measure the force required to completely separate the two tapes. This testing is performed after the tapes have been repeatedly sealed and resealed several times.	
7.1.16 Zipper Strength Test	This test is performed in accordance with Commercial Item Description ~~A-A-55634A~~ A-A-55634B , *Zippers (Fasteners, Slide Interlocking)*. It is used to evaluate zippers for crosswise breaking strength of the chain and of the separating unit.	The Zipper Strength Test is used to assess the durability and functionality of zippers after repeated use.
	Zippers are also tested for holding strength of stops, retainers, and separating units and for operating force and slider lock strength.	

Test Method	Test Method Description	Test Method Application
7.1.18 Particulate Blocking Test	This test is performed as specified in ASTM F2299/F2299M, *Standard Test Method for Determining the Initial Efficiency of Materials Used in Medical Face Masks to Penetration by Particulates Using Latex Spheres* , to verify particulate blocking ability of garment materials.	Garments for urban interface protection are tested for particulate filtration efficiency of 90 percent or greater for each particulate size from 0.1 µm to 1.0 µm.

Figure B.2(a) Test Apparatus in Ready Position.

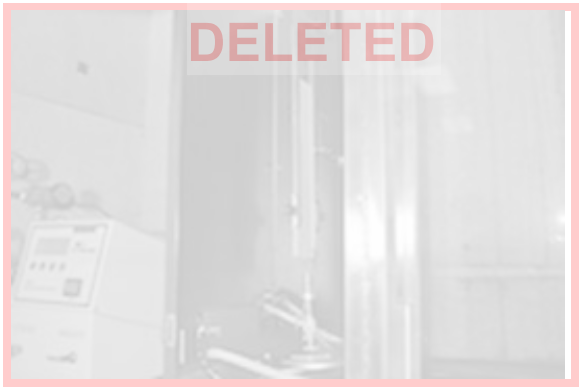
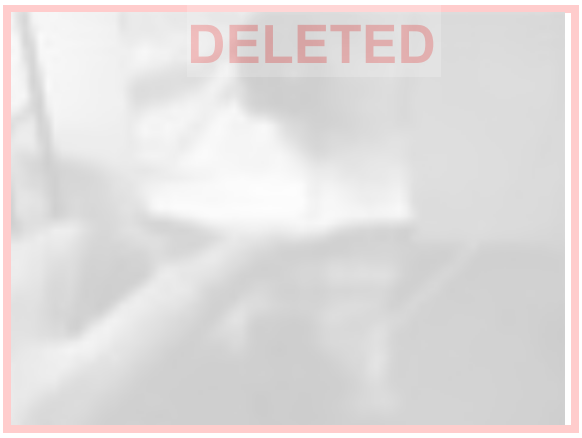


Figure B.2(b) Flame Test Being Performed.

Figure B.2(c) Oven Exterior.

Figure B.2(d) Oven Interior.

~~Figure B.2(c)~~



B.3 Helmets.

Table B.3 is intended to serve as an abbreviated guide to specified tests for helmets, including the whole helmet, and materials used in the construction of the whole helmet. The tests evaluate whether or not the helmet meets the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing the helmet.

Table B.3 Helmets

Test Method	Test Method Description	Test Method Application
7.2.1 Thread Heat Resistance Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of the garment in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 260°C (500°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of the garment to determine whether it meets at least the same minimum heat resistance as the fabric used in the garment's construction.
7.2.2 Thread-Breaking Strength Test	This test is performed in accordance with ASTM D2256/D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method* on three specimens of thread as received and after a 10-minute exposure in a 140.56°C (285°F) oven. Single strands of yarn are pulled until failure, and that force is recorded and averaged. Since thread strength varies with thread size, Table 7.1.11 details minimum breaking strength for various thread sizes.	The Thread-Breaking Strength Test is used to evaluate the thread used in construction of the garment to ensure it will be strong enough to maintain the integrity of the garment. If sewing thread is too weak, or weak after a heat exposure, it could compromise the garment and expose the fire fighter to a high temperature environment.
7.2.3 Top Impact Resistance Test (Force) After Radiant Conditioning	This test is performed in accordance with ANSI/ISEA Z89.1, *Industrial Head Protection*, on helmet specimens that are exposed to radiant heat conditioning.	The Top Impact Resistance Test (Force) is used to evaluate the helmet's shock absorption characteristics from the impact of a falling object (such as ceiling material) as well as fire fighter protection from striking an object while walking, crawling, or falling.
	After conditioning, the helmet is mounted on an aluminum head and adjusted to the size providing the least amount of clearance. A specific weight steel drop mass is dropped from a height that yields a specific impact velocity. The peak force and impact velocity are recorded for a pass or fail performance. No helmet specimen shall transmit an average force of more than 3780 N (850 lbf) and no individual helmet specimen shall transmit a force of more than 4450 N (1000 lbf).	This test is used to assess the effect of force on the top of the helmet when struck by falling or stationary objects. It also assesses the level of protection from a head and or neck injury from the force of impact with a moving or stationary object.
7.2.4 Helmet Physical Penetration Resistance Test After Radiant Conditioning	This test is performed in accordance with ANSI/ISEA Z89.1, *Industrial Head Protection*, on helmet specimens that are exposed to radiant heat conditioning.	The Helmet Physical Penetration Resistance Test is used to assess how well the helmet will resist penetration by falling sharp objects (such as a nail in a structural member or a shard of glass) or by stationary sharp objects that the fire fighter might strike while walking, crawling, or falling.

Test Method	Test Method Description	Test Method Application
	The test uses an ISO headform, a penetration striker, and an electrical contact indicator. A penetration striker is dropped from a height that yields a consistent velocity for the test on the helmet. A minimum of two penetration tests applied at different test areas on each helmet are performed. If the test striker electrically or physically contacts the headform in one or more specific tests, the helmet fails.	
7.2.5 Helmet Antiglare Flammability Test	This test is performed on antiglare materials on a helmet specimen as received. A standard Bunsen burner is used to test the antiglare specimen in an as worn position. The flame is applied to the antiglare specimen for a total of 5 seconds. Once the flame is removed the afterflame is recorded. The antiglare specimen cannot show any afterflame greater than 5 seconds.	The Helmet Antiglare Flammability Test is used to evaluate the helmet's antiglare materials, under controlled test conditions, for the ability to self-extinguish after the flame is removed.
7.2.6 Heat and Thermal Shrinkage Resistance Test (helmet: heat resistance) ~~See Figure B.2(c).~~	This test is performed on complete helmet specimens that are tested with all components in place, as received. The helmet is placed in a preheated convective oven for 5 minutes. The helmet cannot have any deformation of the brim or peak exceeding 25 percent of its original length.	The Heat and Thermal Shrinkage Resistance Test is used to evaluate whether the helmet shell, specifically the helmet brim or peak, can resist heat.
7.2.7 Suspension System Retention Test	This test is performed on helmets tested as received on a tensile testing machine. The strap is cut to ensure a sufficient length of strap is secured by the jaws of the machine. An increasing force is applied along the centerline of the suspension strap. The specimen is inspected for separation from the helmet shell, and the adjusting mechanisms must function properly.	The Suspension System Retention Test is used to evaluate whether or not the helmet suspension system separates from the helmet shell under applied force. If the helmet suspension system separates from the helmet, the helmet is more likely to fall off the wearer, which will increase the risk of injury to the fire fighter.
7.2.8 Retroreflectivity Test	The conditioned helmet trim is tested for retroreflectivity. The coefficient of retroreflection is tested in accordance with ASTM E810, *Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry*.	The Retroreflectivity Test is used to evaluate how well samples of retroreflective material retain their retroreflectivity. The standard has requirements for retroreflectivity to enhance nighttime/low light visibility (retroreflection). For fire fighter safety, it is important that helmets have effective retroreflectivity attributes.

Test Method	Test Method Description	Test Method Application
	Retroreflection/retroreflectivity is the reflection of light in which the reflected rays are preferentially returned in the direction close to the opposite of the direction of the incident rays, with the property being maintained over wide variations of the direction of the incident rays.	
7.2.9 Retention System Test	This test is performed on complete helmets tested as received using a mechanical chin structure. This test measures the retention of the chinstrap of a helmet after specific force is applied for a specific time by a tensile test machine. The distance between the top of the helmet and the bottom of the rollers is measured. Each helmet is observed for breaks and slip or stretch. Failure occurs if any helmet specimen shows a break or shows slip or stretch measured at more than what is allowed in the requirement.	The Retention System Test is used to evaluate the helmet chinstrap's elongation and its resistance to breaking or stretching under applied force. If the helmet chinstrap breaks or stretches too much, the helmet is more likely to fall off the wearer, which increases the risk of injury to the fire fighter.
7.2.10 Goggle and Headlamp Clip Attachment Test	This test is performed on complete helmets as received with goggle and headland clips in place. The testing is performed using a wire loop test fixture with an attached weight. The wire loop is configured under the clip, and without allowing for a vertical drop, the weight is suspended from the clip. After five seconds, each clip is inspected to determine if the clip pulled away from the helmet or if it moved more than 6 mm (¼ in.) from its original position.	The Goggle and Headlamp Clip Attachment Test is used to evaluate if the clip can stay in place under an applied force. If the clip were to break or reposition too much, the helmet goggle or headlamp would fall off the helmet and no longer be accessible for the fire fighter.
7.2.11 Label Durability and Legibility Test 2	This test is performed on helmets with labels attached, each of which is conditioned prior to testing at room temperature and after radiant heat exposure. After all conditioning methods are completed, the labels are visually evaluated by a person with 20/20 vision or corrected to 20/20 at a distance of 305 mm (12 in.) in a well-illuminated area. Helmet labels are examined to determine whether they are still legible. One or more label specimens failing the legibility test results in failure.	The Label Durability and Legibility Test 2 is used to evaluate whether the label is legible after room temperature and radiant heat exposure. The legibility of labels is important for helmet identification and tracking.

B.4 Protective Work Gloves.

Table B.4 is intended to serve as an abbreviated guide to specified tests for protective work gloves and materials used in the construction of the whole glove. These tests evaluate whether or not the protective work gloves meet the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing the protective work gloves. Some tests are performed on “new, as distributed” gloves that have undergone conditioning. This might seem contradictory, but the conditioning is limited to environmental parameters, and “new, as distributed” condition ensures that the gloves have not been broken in in any way.

Table B.4 Protective Work Gloves

Test Method	Test Method Description	Test Method Application
7.3.1 Heat and Thermal Shrinkage Resistance Test	This test is performed in accordance with ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, after conditioning the whole glove. Whole glove samples are measured in length and width directions, laundered, exposed to heat, and then measured a second time. For the heat exposure, the glove fingers are filled with ~~a finite amount of~~ glass beads, ~~and~~ the glove body is ~~packed~~ filled with a ~~mesh bag containing a finite amount~~ pouch of glass beads, ~~then~~ and the glove opening is clamped ~~together~~ shut . The glove is suspended by a clamp and placed in a preheated oven for a specified period. After the heat exposure and second measuring, the glove is donned and flexed. The specimen cannot melt, separate, ignite, or shrink more than 10 percent in length or width. The specimen also has to be donnable and flexible.	The Heat and Thermal Shrinkage Resistance Test is used for this requirement to evaluate the gloves for melting, separation, ignition, and shrinkage after exposure to high temperatures. Specimens cannot melt, separate, or ignite, and they cannot shrink more than 10 percent. Excessive shrinkage will limit the dexterity and thermal protection of the glove. The glass beads simulate the mass of the hand inside the glove.
7.3.2 Flame Resistance Test ~~See Figure B.2(a) and Figure B.2(b).~~	This test is performed in accordance with ASTM D6413/D6413, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, on protective work glove body composites and glove interface component composites (hook and loop are excluded from the test where not in direct contact with the skin) as received and after conditioning with five laundering cycles. The specimen is suspended over a flame for 12 seconds to determine the time it takes for the material to self-extinguish and how badly the material is damaged by the flame. Afterflame time (the time it takes to self-extinguish) and char length (how badly the material is damaged by the flame) are observed and recorded. Char length is not the size of the visible char on the material. Instead, it is the length that the material tears when subjected to a predefined tearing weight after the flame exposure.	The Flame Resistance Test is used to evaluate the material, under controlled test conditions, for its ability to self-extinguish after the flame is removed. The char length of the material after exposure to flame is also measured. This is the primary test to establish the flame-resistant properties of the materials used in protective work glove construction.

Test Method	Test Method Description	Test Method Application
	Materials cannot have a char (tear) length more than 100 mm (4 in.), cannot show afterflame more than 2.0 seconds after removal of the test flame, and cannot melt or drip. Protective work gloves are also evaluated for the percentage of material consumed in this test, which cannot exceed 5 percent of the specimen's original weight.	
7.3.3 Conductive Heat Resistance Test ~~See Figure B.4(a) and Figure B.4(b).~~	This test is performed on protective work glove body composites. Samples are tested both before and after being subjected to laundering. Sample pouches are compressed 0.034 bar (0.5 psi) onto a plate heated to 280°C (536°F) and a sensor determines the time to pain and time to second-degree burn. The time to pain must be at least 4 seconds, and the time to burn must be at least 7 seconds.	The Conductive Heat Resistance (CHR) Test is used to evaluate the properties of specific areas of the protective work glove, which are likely to become compressed; thermal insulation is reduced under compression. The requirement sets a minimum number of seconds until the fire fighter would feel pain and receive a second-degree burn when these areas of the glove are under compression.
7.3.4 Thermal Protective Performance (TPP) Test ~~See Figure B.4(c) and Figure B.4(d).~~	This test is performed in accordance with ISO 17492, *Clothing for protection against heat and flame – Determination of heat transmission on exposure to both flame and radiant heat*, on the protective work glove body composite as received and after conditioning with five laundering cycles. The protective work glove body composite is exposed to direct flame and radiant heat to simulate flashover. Where the composite varies throughout the protective work glove body, each variation is considered to be a different composite and must be tested individually and be subject to the minimum TPP rating. The rate of rise in temperature is recorded and compared to the known skin response to heat; the recorded time is multiplied by the heat exposure energy to determine the TPP rating. The average TPP rating has to be at least 20.	The Thermal Protective Performance (TPP) Test is used to measure the insulating performance of the composite by evaluating how quickly heat is transferred from the outside of the protective work glove body to the inside. Under the given test conditions, which simulate severe flashover conditions, the TPP rating divided in half indicates the approximate number of seconds until a fire fighter would receive a second-degree burn. This is the primary test to measure the protective work glove body's ability to protect the fire fighter from severe heat and flame. The higher the number, the higher the protection from heat (under the specific test conditions).

Test Method	Test Method Description	Test Method Application
7.3.5 Cut Resistance Test	This test is performed in accordance with ASTM F1790/F1790M, *Standard Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing with CPP Test Equipment*, on at least three conditioned samples of the protective work glove body composite under a specific load. Small specimens of the protective work glove body composite are clamped to a metal rod while a blade, which is under a 100 g (0.22 lb) load, passes across the specimen until it makes contact with the metal rod. Where the composite varies throughout the protective work glove body, each variation is considered to be a different composite and must be tested individually and be subject to the minimum cut resistance rating. The distance the blade passes across each specimen without cutting through the material is recorded then averaged. The average distance the blade travels across the material without cutting through the material has to be more than a 20 mm (0.8 in.).	The Cut Resistance Test is used for this requirement to evaluate the ability of the glove body composite to resist being cut, under specific test conditions. Longer blade travel distances represent greater cut resistance because it takes longer for the blade to cut through the material.
7.3.6 Puncture Resistance Test	This test is performed in accordance with ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, on protective work glove composite pouches. Specimens are clamped into a fixture while force is applied to puncture the specimen with a nail-like probe. Where the composite varies throughout the protective work glove body, each variation is considered to be a different composite and must be tested individually and be subject to the minimum puncture resistance rating. The force required to puncture each sample is recorded then averaged, and the samples have to resist puncture under at least 40 N (8.9 lbf) of force.	The Puncture Resistance Test is used to evaluate the ability of the protective work gloves to resist puncture under specific test conditions. (Note: This test does not ensure that gloves will be puncture-proof, only puncture resistant.) Higher force averages indicate greater puncture resistance.
7.3.7 Dexterity Test	This test is performed in accordance with ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Finger Dexterity Using a Modified Pegboard Test*, on at least three “as-received” pairs of whole protective work gloves each in size small and size large (for a total of six pairs). A test subject first uses bare hands to pick up metal pins and places them in a horizontal pegboard. The subject immediately repeats the test while wearing the correct size specimen gloves. The time it takes to complete the task is recorded for both tests, and an average is calculated and used to calculate a percentage that represents how much faster the test was completed bare-handed than with gloved hands.	The Dexterity Test is used to determine whether the protective work glove meets a minimum requirement for dexterity. The lower percentages indicate that the gloves have fewer adverse effects on fire fighter dexterity. To meet this requirement, bare-handed control cannot offer more than 200 percent better control than gloved hands. In other words, if it takes, on average, 60 seconds to complete the test barehanded, it cannot take more than 120 seconds, on average, to complete the same task with gloved hands.

Test Method	Test Method Description	Test Method Application
	That percentage is reported as the bare-handed control for each glove size. The average result for bare-handed control cannot exceed 200 percent.	
7.3.8 Grip Test	This test is performed on at least three as-received pairs of whole protective work gloves each in size small and size large (for a total of six pairs). Protective work glove specimens are submersed in water for 15 seconds immediately prior to testing. While wearing the wet protective work gloves, the test subject pulls downward on a wet pole three times. The peak pull force value for each individual pull is recorded and reported. The minimum pull force value that occurs after the peak pull force value is recorded and reported. The individual percentage drop between the peak pull force value and the minimum pull force value is calculated and used to determine pass or fail performance (the drop cannot be more than 30 percent). Failure during any individual pull (not average percentage drop) constitutes glove failure of the overall test.	The Grip Test is used to evaluate the protective work glove's gripping ability under applied force and specific test conditions. The test is designed to simulate the use of certain hand tools.
7.3.9 Label Durability and Legibility Test 1	This test is performed on protective work glove labels attached to whole gloves. Protective work glove label specimens are exposed to 10 laundry cycles in accordance with AATCC TM 135, *Dimensional Changes of Fabrics After Home Laundering*, and evaluated for legibility. Separate specimens are subjected to abrasion in accordance with ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)*, and evaluated for legibility. Separate specimens are subjected to a 10-minute exposure in a 140.56°C (285°F) oven and evaluated for legibility.	The Label Durability and Legibility Test is used to evaluate whether or not the label stays in place and is legible after exposure to multiple launderings, abrasion, and convective heat. The presence and legibility of labels is important for protective work glove identification and tracking.
7.3.10 Thread Melting Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of protective work gloves in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 260°C (500°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of protective work gloves to determine whether it meets at least the same minimum heat resistance as the material used in the glove’s construction.

Test Method	Test Method Description	Test Method Application
7.3.11 Thread-Breaking Strength	This test is performed in accordance with ASTM D2256/D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method*, on three specimens of thread as received and after a 10-minute exposure in a 140.56°C (285°F) oven. Single strands of yarn are pulled until failure, and that force is recorded and averaged. Since thread strength varies with thread size, Table 7.3.11 details minimum breaking strength for various thread sizes.	The Thread-Breaking Strength Test is used to evaluate the thread used in construction of protective work gloves to ensure it will be strong enough to maintain the integrity of the glove. If sewing thread is too weak, or weak after a heat exposure, it could compromise the glove and expose the fire fighter to a high temperature environment.
7.3.12 Torque Test	This test is performed on at least three "as-received" pairs of whole protective work gloves each in size small and size large (for a total of six pairs). The test subject dons the glove and attempts to twist a vertical rod mounted on a torque meter. The maximum force applied by the test subject in this twisting motion is measured. The test is performed both bare-handed and with gloves donned. The test results are recorded and averaged, and the percent difference between the bare-handed results and the results for tests using gloves is used to determine glove performance. Protective work gloves must allow at least 80 percent of the twisting force for the test subject compared to tests performed bare-handed.	The Torque Test is used to evaluate how gloves affect a fire fighter's ability to perform gripping and twisting actions. The results compare the same gripping/twisting action performed both bare-handed and with the gloves. Percentages less than 100 percent mean that the gloves diminish gripping/twisting action while percentages over 100 percent mean that the gloves enhance gripping/twisting motion.

~~Figure B.4(a)~~

~~Figure B.4(b)~~

~~Figure B.4(c)~~

~~Figure B.4(d)~~

B.5 Footwear.

Table B.5 is intended to serve as an abbreviated guide to specified tests for footwear, including the whole footwear boot, the footwear upper, and materials used in the construction of the whole footwear element. The tests are intended to evaluate whether or not the footwear meets the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing the footwear.

Table B.5 Footwear

Test Method	Test Method Description	Test Method Application
7.4.1 Heat and Thermal Shrinkage Resistance Test (Heat Resistance Only) ~~See Figure B.2(a).~~	This test evaluates heat resistance only and is performed in accordance with ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, on at least three men's size 9 complete footwear elements as received. The footwear component is filled with glass beads and exposed to heat for a specified period of time.	The Heat and Thermal Shrinkage Resistance Test is used to evaluate the footwear for heat degradation effects after exposure to high temperatures. Footwear is not permitted to melt, separate, or ignite under these conditions.
	Postexposure, the specimen is examined inside and outside before conditioning in an environmental chamber and again after conditioning for melting, separation, or ignition. All components must remain functional.	
7.4.2 Corrosion Resistance Test	This test is performed in accordance with ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, on all footwear hardware as received to measure corrosion. Metal hardware is exposed to a saline solution for a specified period.	The Corrosion Resistance Test is used to evaluate whether hardware will (1) corrode and (2) remain functional after extended exposure to salt spray.
	Following the test, the hardware is evaluated for the appearance of corrosion or oxidation and to see if it remains functional. Evidence of corrosion on the base metal signifies failure.	Hardware failure can result in loss of thermal and physical protection for the fire fighter.
7.4.3 Cut Resistance Test ~~See Figure B.4(a) and Figure B.4(b).~~	This test is performed in accordance with ASTM F1790/F1790M, *Standard Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing with CPP Test Equipment*, on representative footwear materials as received under a specific load.	The Cut Resistance Test is used to evaluate the ability of the footwear upper composite to resist cutting under specific test conditions. Longer blade travel distances represent greater cut resistance because it takes longer for the blade to cut through the material.
	The specimen (a composite of footwear upper used in the actual footwear construction, including the tongue but excluding the gusset, with layers arranged in proper order) is clamped to a metal rod while a blade passes across the specimen until it makes contact with the metal rod. After testing, the average distance of blade travel is recorded and cannot be more than the specified length.	
7.4.4 Puncture Resistance Test	This test is performed in accordance with ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, Test Method A, on footwear uppers as received.	The Puncture Resistance Test is used to evaluate the ability of the footwear uppers to resist puncture under specific test conditions. Higher average force measurements indicate greater puncture resistance.

Test Method	Test Method Description	Test Method Application
	Footwear uppers are clamped into a fixture while force is applied to a nail-like probe in an effort to puncture the specimen. The force required to puncture each specimen is recorded and averaged, and the resulting average cannot be lower than the specified force.	
7.4.5 Protective Footwear Abrasion Resistance Test	This test is performed in accordance with ISO 4649, *Rubber, vulcanized or thermoplastic – Determination of abrasion resistance using a rotating cylindrical drum device*, Method A, on material pieces removed from the footwear soles and heel as received. These material specimens are repetitively rubbed against a specific type of sandpaper under a specified pressure; then the amount of material removed by abrasion is measured. Abrasion resistance of the footwear sole and heel materials is adjusted by relative loss of material.	The Protective Footwear Abrasion Resistance Test is used to evaluate the footwear's ability to resist abrasion under specified test conditions. The test is intended to measure how easily sole and heel material wear away.
7.4.6 Footwear Conductive Heat Resistance Test	This test is performed on the conditioned complete footwear element with removable soles in place.	The Footwear Conductive Heat Resistance Test is used to evaluate the footwear's resistance to heat transferred through the sole by conduction.
	Thermocouples are taped to the insole surface inside the footwear, and the footwear is filled with a specified weight of steel balls. The weighted footwear is placed on a hot plate set at a specific temperature for a specific time. The thermocouples inside the boot measure the temperature of the footwear insole.	The steel balls weigh the footwear down to place pressure on the sole against the hot surface, similar to what happens on the fireground. The test conditions are not intended to simulate actual fireground exposures but rather serve as a means for measuring the footwear's response to heat. The performance requirement relates to the temperature that causes pain sensation.
	The average temperature at each test location of the specimen at the end of the specified period is recorded. The temperature of the insole cannot exceed the allowed temperature.	
7.4.7 Slip Resistance Test	This test is performed in accordance with ASTM F2913, *Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester*, on the whole footwear element. A footwear specimen is placed in a machine that slides the footwear along a wet tile surface. This test measures the friction (traction) between the soles of the footwear and the tile surface.	The Slip Resistance Test is used to evaluate the ability of the footwear to resist slipping under specified test conditions. The surface condition is chosen to simulate a typical slippery surface encountered by fire fighters.
	The coefficient of friction is recorded for each specimen and averaged. The result should be 0.40 or greater.	
7.4.8 Eyelet and Stud Post Attachment Test	This test is performed on footwear eyelets and stud posts as received. Specimens are removed from the footwear element and attached to the upper position of the tensile testing machine using the proper puller fixture. The test is started and force is applied.	The Eyelet and Stud Post Attachment Test is used to evaluate the footwear stud posts and eyelets for attachment strength when force is applied. This test is used to determine whether stud posts and eyelets

Test Method	Test Method Description	Test Method Application
	At a minimum, the average of all specimen tests can be no less than the specified force. The footwear eyelets and stud posts have to be able to withstand, on average, at least the specified force.	will stay attached under normal use conditions.
7.4.9 Flame Resistance Test for Protective Footwear	This test is performed on the whole footwear element as received in a draft-free area. A tray of fuel is used to create the flame exposure. The fuel in the tray is ignited and is allowed to burn to produce a stable flame. The footwear specimen is clamped on a fixture, then positioned above the burning tray where a shutter controls the exposure of the footwear specimen to flames for a specified period. Once the flame exposure is stopped, the footwear specimen is examined for afterflame (not more than 5.0 seconds allowed), melting, dripping, and burn-through. The specimen cannot melt, drip, or exhibit any burn-through.	The Flame Resistance Test for Protective Footwear is used to evaluate whether the footwear melts, drips, or exhibits burn-through and determines whether it has an afterflame lasting more than 5.0 seconds. This is the primary test to establish the flame resistant properties of the materials used in footwear construction.
7.4.10 Label Durability and Legibility Test 1	This test is performed in accordance with ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)*, on the complete footwear element, with labels attached. Legibility is assessed with labels attached to the footwear after convective heat/thermal exposure and assessed on individual labels after abrasion. Footwear specimens are subjected to abrasion and exposed to convective heat to test for heat durability. Footwear labels are examined for continued presence (have to remain attached to the footwear) and for legibility.	The Label Durability and Legibility Test 1 is used to evaluate whether or not the label stays in place and is legible to the unaided eye after abrasion and thermal exposure. The presence and legibility of labels is important for footwear identification and tracking.
7.4.11 Thread Melting Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of the footwear in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 260°C (500°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of the footwear to determine whether it meets at least the same minimum heat resistance as the fabric used in the footwear's construction.
7.4.12 Thread-Breaking Strength Test	This test is performed in accordance with ASTM D2256/ D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method*, on three specimens of thread as received and after a 10-minute exposure in a 140.56°C (285°F) oven. Single strands of yarn are pulled until failure, and that force is recorded and averaged. Since thread strength varies with thread size, Table 7.1.11 details minimum breaking strength for various thread sizes.	The Thread-Breaking Strength Test is used to evaluate the thread used in construction of the footwear to ensure it will be strong enough to maintain the integrity of the footwear. If sewing thread is too weak, or weak after a heat exposure, it could compromise the footwear and expose the fire fighter to a high temperature environment.

B.6 Face/Neck Shrouds.

Table B.6 is intended to serve as an abbreviated guide to specified tests that apply to face/neck shrouds and materials used in the construction of the face/neck shroud. These tests evaluate whether or not the face/neck shroud meets the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing the face/neck shroud.

Table B.6 Face/Neck Shrouds

Test Method	Test Method Description	Test Method Application
7.5.1 Radiant Protective Performance (RPP) Test	This test is performed in accordance with ASTM F1939, *Standard Test Method for Radiant Heat Resistance of Flame Resistant Clothing Materials with Continuous Heating*, on five specimens representative of the face/neck shroud composite, which are tested as received and after preconditioning with five laundering cycles.	The Radiant Protective Performance (RPP) Test is used to measure the insulating performance of the face/neck shroud by evaluating how quickly radiant heat is transferred from the outside of the face/neck shroud to the inside.
	Specimens comprise all layers of the face/neck shroud and are tested in the order in which they are worn. The outer shell exterior is exposed to a radiant heat source.	Under the given test conditions, which simulate only radiant heat exposure but not severe flashover conditions, the RPP rating multiplied by two indicates the approximate number of seconds until a fire fighter would receive a second-degree burn.
	The rate of temperature rise is recorded and compared to the known skin response to heat; the recorded time is multiplied by the heat exposure energy to determine the RPP rating.	This is the primary test to measure the face/neck shroud's ability to protect the fire fighter from severe radiant heat. The higher the number, the higher the protection from heat (under the specific test conditions).
	The RPP rating of the face/neck shroud must be at least 7.0.	
7.5.2 Flame Resistance Test ~~See Figure B.4(a) and Figure B.4(b).~~	This test is performed in accordance with ASTM D6413/D6413M, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, on face/neck shroud components (hook and pile fasteners, elastic, and interlinings can be excluded from the test depending on their location in the face/neck shroud) as received and after conditioning with five laundering cycles.	The Flame Resistance Test is used to evaluate the material, under controlled test conditions, for its ability to self-extinguish after the flame is removed. The char length of the material after exposure to flame is also measured.
	Each separable layer of multilayer composites is tested individually. The specimen is suspended over a flame for 12 seconds to determine the time it takes for the material to self-extinguish and how badly the material is damaged by the flame. Afterflame time (the time it takes to self-extinguish) and char length (how badly the material is damaged by the flame) are observed and recorded.	This is the primary test to establish the flame-resistant properties of the materials used in face/neck shroud construction.

Test Method	Test Method Description	Test Method Application
	Char length is not the size of the visible char on the material. Instead, it is the length that the material tears when subjected to a predefined tearing weight after the flame exposure. Materials cannot have a char (tear) length more than 100 mm (4 in.), cannot show afterflame more than ~~2.0~~ 2 seconds after removal of the test flame, and cannot melt or drip.	
7.5.3 Heat and Thermal Shrinkage Resistance Test (shrinkage)	This test is performed in accordance with ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, on face/neck shroud components as received and after conditioning with five laundering cycles. All face/neck shroud material layers are tested individually. Fabric samples are marked and measured before exposure to five minutes of heat in a 260°C (500°F) oven. Postexposure measurements are taken and averaged, and no more than 10 percent shrinkage is permitted.	The Heat and Thermal Shrinkage Resistance Test is used to evaluate the materials for shrinkage after exposure to high temperatures. Excessive shrinkage could compromise the fire fighter's mobility and impact the insulating qualities of the face/neck shroud.
7.5.4 Heat and Thermal Shrinkage Resistance Test (melting, dripping, separation, ignition) ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM F2894 on face/neck shroud components, except for hook and loop and elastic when placed where they will not contact the fire fighter's body, as received and after conditioning with five laundering cycles. Samples are suspended in a 260°C (500°F) oven for 5 minutes. Face/neck shroud components cannot melt, drip, separate, or ignite. Face/neck shroud components also cannot be charred, which would indicate evidence of ignition.	The Heat and Thermal Shrinkage Resistance Test is used for this requirement to determine whether or not components used to construct face/neck shrouds will melt, separate, or easily ignite. The test conditions are not intended to simulate actual wildland and urban interface fire-fighting exposures but rather serve as a means to establish a minimum level of thermal stability for the materials used in the construction of protective clothing elements.
7.5.5 Heat and Thermal Shrinkage Resistance Test (Face/Neck Shroud Hardware Functionality) ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM F2894 on at least three complete face/neck shroud hardware items. Samples are prepped and exposed to 5 minutes of heat in a 260°C (500°F) oven. Within ten minutes of the exposure, hardware is tested for functionality (snaps and buckles must open and close, zippers must slide, etc.). This is a simple pass/fail requirement.	The Heat and Thermal Shrinkage Resistance Test is used in this case to evaluate the functionality of face/neck shroud hardware after a high heat exposure. Nonfunctioning hardware could prevent a wildland and urban interface fire fighter from safely removing face/neck shrouds after a high heat exposure.
7.5.6 Tear Resistance	This test is performed in accordance with ASTM D1424, *Standard Test Method for*	The Tear Resistance Test is used for this requirement to measure the

Test Method	Test Method Description	Test Method Application
~~Resistance Test (woven face/neck shroud textile fabrics) See Figure B.2(a).~~	~~ASTM D1424, *Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus*~~, on woven face/neck shroud fabrics in the as-received condition only. Five specimens are cut and tested in each direction (lengthwise and widthwise). A specimen is precut to approximately 19.1 mm (¾ in.) and placed into the test apparatus. One side of the specimen is mounted to a fixed point on the apparatus, and the other side is mounted to the end of a weighted pendulum. The pendulum is allowed to fall/swing, causing the tear to propagate across the specimen. The force required to propagate this tear across the specimen is recorded and averaged for five specimens in each direction. The average tear strength in both directions must be at last 23 N (5 lbf).	~~for this requirement to measure the~~ ability of the face/neck shroud fabric to resist further tearing when a small tear occurs. Fabric tears further expose the fire fighter to the products of combustion. It also is a test of the strength and durability of the fabric. Fire fighting occurs in a harsh environment that includes many hazards that might tear a face/neck shroud.
7.5.6.1 Burst Strength Test (knit face/neck shroud fabrics)	This test is performed in accordance with ASTM D3787, *Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of-Traverse (CRT) Ball Burst Test*, on knit face/neck shroud fabrics in the as-received condition only. This test is nondirectional, so 10 specimens are tested without regard for length/width direction. A knit specimen is mounted into a circular clamp, and a 25.4 mm (1 in.) steel ball is forced through the material until it bursts. The force required to burst the ball through the knit material is recorded and averaged. All knit specimens must have at least 113 N (25 lbf) of burst strength.	Since Tear Resistance is only applicable for woven fabrics, Ball Burst Strength is a good representative assessment of the strength of knit fabrics. As with tears in woven fabrics, ruptures of knit fabrics further expose the fire fighter to the products of combustion. It also is a test of the strength and durability of the fabric. Fire fighting occurs in a harsh environment that includes many hazards that might rupture a knit face/neck shroud.
7.5.7 Cleaning Shrinkage Resistance Test	This test is performed on three conditioned specimens of face/neck shroud fabrics, each tested individually. This requirement allows no more than a 5 percent change in the width and length dimensions after five wash and dry cycles in accordance with AATCC TM 135, *Dimensional Changes of Fabrics After Home Laundering*, using a normal wash cycle, 48.89°C (120°F) water, and permanent press dry cycle. Knit specimens are allowed to be stretched to their original dimensions, but then relax, prior to measuring for shrinkage.	The Cleaning Shrinkage Resistance Test is used to evaluate how much face/neck shroud materials shrink after repeated laundering; excessive shrinkage could decrease the fire fighter's mobility and potentially reduce thermal insulation provided by personal protective equipment.
7.5.8 Seam Breaking Strength Test ~~See Figure B.2(e).~~	This test is performed in accordance with ASTM D1683/D1683M, *Standard Test Method for Failure in Sewn Seams of Woven Fabrics*, on all face/neck shroud seam assemblies. Samples are tested after conditioning. Opposite ends of a 50 mm x 200 mm (2 in. x 8 in.) specimen with the seam bisecting	The Seam Breaking Strength Test is used to evaluate the strength of face/neck shroud seams under stress. The test demonstrates the durability of the seam as an indicator of physical performance when subjected to repeated wearer movement, such as bending and

Test Method	Test Method Description	Test Method Application
	the length are gripped in a machine and pulled apart until the specimen breaks. Minimum seam strength must be 225 N (50 lbf) for woven face/neck shroud seams. Where the face/neck shroud fabric itself does not meet this minimum, the seam must be at least stronger than the fabric itself. Note: Knit seams are not included in the NFPA 1977 standard.	twisting of the head and neck.
7.5.9 Thread Melting Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of the face/neck shroud in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 260°C (500°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of the face/neck shroud to determine whether it meets at least the same minimum heat resistance as the fabric used in the face/neck shroud's construction.
7.5.10 Thread-Breaking Strength	This test is performed in accordance with ASTM D2256/D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method*, on three specimens of thread as-received and after a 10-minute exposure in a 140.56°C (285°F) oven. Single strands of yarn are pulled until failure, and that force is recorded and averaged. Since thread strength varies with thread size, Table 7.5.10 details minimum breaking strength for various thread sizes.	The Thread-Breaking Strength Test is used to evaluate the thread used in construction of the face/neck shroud to ensure it will be strong enough to maintain the integrity of the face/neck shroud. If sewing thread is too weak, or weak after a heat exposure, it could compromise the face/neck shroud and expose the fire fighter to a high temperature environment.
7.5.11 Label Durability and Legibility Test 1	This test is performed on face/neck shroud labels attached to complete face/neck shrouds. Face/neck shroud label specimens are exposed to 10 laundry cycles in accordance with AATCC TM 135 and evaluated for legibility. Separate specimens are subjected to abrasion in accordance with ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)*, and evaluated for legibility. Separate specimens are subjected to a 10-minute exposure in a 140.56°C (285°F) oven and evaluated for legibility.	The Label Durability and Legibility Test is used to evaluate whether or not the label stays in place and is legible after exposure to multiple launderings, abrasion, and convective heat. The presence and legibility of labels is important for face/neck shroud identification and tracking.
7.5.12 Fastener	This test is performed in accordance with Commercial Item Description A-A-55126B	The Fastener Tape Strength Test is used for this requirement to assess

Test Method	Test Method Description	Test Method Application
Fastener Tape Strength Test (breaking)	Commercial Item Description A-A-55126B, Fastener Tapes, Hook and Loop, Synthetic, uses this test method to evaluate the breaking strength of hook and pile tape by separately pulling the hook and pile tapes in the jaws of a tensile testing machine until the tape breaks. The force used at the breaking point is recorded as the breaking strength.	used for this requirement to assess the overall strength of tapes used in hook and pile fasteners. The material must meet or exceed industry-established requirements based on the composition and width of the tape.
7.5.12.1 Fastener Tape Strength Test (shear)	This test is performed in accordance with A-A-55126B. It is used to evaluate the shear strength of the hook and pile tape by measuring the force required to separate hook tape overlapping pile tape when pulled between two jaws of a tensile testing machine. Testing is performed after the tapes have been repeatedly attached and detached. The maximum measured force is reported as the shear strength.	The Fastener Tape Strength Test is used for this requirement to assess the durability and functionality of the hook and pile to not separate after repeated use.
7.5.12.2 Fastener Tape Strength Test (peel)	This test is performed in accordance with A-A-55126B. It is used to evaluate the peel strength of the hook and pile tape. In the test, hook tape is sealed over an equal length of pile tape, and the end of the two tapes are separated half their length. The two open ends of tape are attached to the jaws of a tensile testing machine and pulled to measure the force required to completely separate the two tapes. This testing is performed after the tapes have been repeatedly sealed and resealed several times.	The Fastener Tape Strength Test is used for this requirement to assess the durability and functionality of the hook and pile to stay sealed after repeated use.
7.5.13 Zipper Strength Test	This test is used to evaluate zippers for crosswise breaking strength of the chain and of the separating unit. They are also tested for holding strength of stops, retainers, and separating units and for operating force and slider lock strength.	The Zipper Strength Test is used to assess the durability and functionality of zippers after repeated use.

B.7 Goggles.

Table B.7 is intended to serve as an abbreviated guide to specified tests for goggles and materials used in the construction of the goggles. The tests evaluate whether or not the goggles meet the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing the goggles.

Table B.7 Goggles

Test Method	Test Method Description	Test Method Application
7.6.1 Heat Resistance ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed on complete goggle specimens as received that are placed on a cap-style NFPA 1977-compliant helmet. The goggles on a cap-style NFPA 1977-compliant helmet are placed in a preheated convective oven at 177°C (350°F) for 5 minutes. The goggles should show no evidence of dripping, melting, or ignition; the lens should not separate from the frame and the goggles should remain above the brim of the helmet. The retention strap should not dislodge from the goggles. The goggles should be capable of securing to a headform in the area surrounding the eyes. A test subject dons the helmet with goggles and is able to read 20/100 on the standard eye chart with each eye.	The Heat Resistance Test is used to evaluate whether the goggles and goggle retention strap can resist heat.
7.6.2 Thread Melting Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of the goggles in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 260°C (500°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of the goggles to determine whether it exceeds the minimum heat resistance required for the goggles' construction.

B.8 Chain Saw Protectors.

Table B.8 is intended to serve as an abbreviated guide to specified tests that apply to chain saw protectors and materials used in the construction of the chain saw protectors. These tests evaluate whether or not the chain saw protectors meets the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing the chain saw protectors.

Table B.8 Chain Saw Protectors

Test Method	Test Method Description	Test Method Application
7.7.1 Chain Saw Protector Cut Resistance Test	This test is performed in accordance with ASTM F1414, *Standard Test Method for Measurement of Cut Resistance to Chainsaw in Lower Body (Legs) Protective Clothing*, on chain saw protective clothing (chaps, pants, or trousers) as received and after conditioning with five laundering cycles. Samples are placed on a wooden cylinder and exposed to a chain speed 50 (CS50) of 15.25 m/sec (3000 fpm) and tested at 45 degrees and 90 degrees to the longitudinal direction of the test specimen. After removal of the sample, layers are examined for evidence of cut through.	The Chain Saw Cut Resistance Test is used to evaluate the protective material, under controlled test conditions, for its ability to withstand complete cut through.
7.7.2 Heat and Thermal Shrinkage Resistance Test (melting, dripping, separation, ignition) ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, only on chain saw protector materials as received. Samples are suspended in a 232°C (450°F) oven for 5 minutes. Chain saw protector materials cannot melt, drip, separate, or ignite.	The Heat Resistance Test is used for this requirement to determine whether or not components used to construct chain saw protectors will melt, separate, or easily ignite. The test conditions are not intended to simulate actual wildland and urban interface fire fighting exposures but rather serve as a means to establish a minimum level of thermal stability for the materials used in the construction of chain saw protectors.
7.7.3 Heat and Thermal Shrinkage Resistance Test (hardware functionality) ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM F2894 only on chain saw protector hardware elements as received. Samples are suspended in a 232°C (450°F) oven for 5 minutes. Chain saw protector hardware must remain functional when tested within 5 minutes after removal from the oven.	The Heat Resistance Test is used for this requirement to determine whether or not hardware on chain saw protectors remains functional after heat exposure. The test conditions are not intended to simulate actual wildland and urban interface fire fighting exposures but rather serve as a means to establish a minimum level of thermal stability for the materials used in the construction of chain saw protectors.

Test Method	Test Method Description	Test Method Application
7.7.4 Thread Melting Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of chain saw protectors in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 232°C (450°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of chain saw protectors to determine whether it meets at least the same minimum heat resistance as the fabric used in the chain saw protectors' construction.

B.9 Protective Driving Gloves.

Table B.9 is intended to serve as an abbreviated guide to specified tests for protective driving gloves and materials used in the construction of the whole glove. These tests evaluate whether or not the protective driving gloves meet the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. Compared to protective work gloves, protective driving gloves have fewer requirements for thermal protection and more requirements for dexterity; therefore, they are not intended to be worn outside of the apparatus. These tests do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while wearing protective driving gloves. Some tests are performed on “new, as distributed” gloves that have undergone conditioning. This might seem contradictory, but the conditioning is limited to environmental parameters, and “new, as distributed” condition ensures that the gloves have not been broken in in any way.

Table B.9 Protective Driving Gloves

Test Method	Test Method Description	Test Method Application
7.8.1 Heat and Thermal Shrinkage Resistance Test	This test is performed in accordance with ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, after conditioning the whole glove.	The Heat and Thermal Shrinkage Resistance Test is used for this requirement to evaluate the gloves for melting, separation, ignition, and shrinkage after exposure to high temperatures.
	Whole glove samples are measured in length and width directions, laundered, exposed to heat, and then measured a second time. For the heat exposure, the glove fingers are filled with a finite amount of glass beads and the glove body is packed with a mesh bag containing a finite amount of glass beads, then the glove opening is clamped together. The glove is suspended by a clamp and placed in a preheated oven for a specified period.	Specimens cannot melt, separate, or ignite, and they cannot shrink more than 10 percent. Excessive shrinkage will limit the dexterity and thermal protection of the glove. The glass beads simulate the mass of the hand inside the glove.
	After the heat exposure and second measuring, the glove is donned and flexed.	
	The specimen cannot melt, separate, ignite, or shrink more than 10 percent in length or width. The specimen also has to be donnable and flexible.	
7.8.2 Flame Resistance Test ~~See Figure B.4(a) and Figure B.4(b).~~	This test is performed in accordance with ASTM D6413/D6413M, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, on protective driving glove body composites and glove interface component composites (hook and loop are excluded from the test where not in direct contact with the skin) as received and after conditioning with five laundering cycles.	The Flame Resistance Test is used to evaluate the material, under controlled test conditions, for its ability to self-extinguish after the flame is removed. The char length of the material after exposure to flame is also measured.
	The specimen is suspended over a flame for 12 seconds to determine the time it takes for the material to self-extinguish and how badly the material is damaged by the flame. Afterflame time (the time it takes to self-extinguish) and char length (how badly the material is damaged by the flame) are observed and recorded.	This is the primary test to establish the flame-resistant properties of the materials used in protective driving glove construction.

Test Method	Test Method Description	Test Method Application
	Char length is not the size of the visible char on the material. Instead, it is the length that the material tears when subjected to a predefined tearing weight after the flame exposure. Materials cannot have a char (tear) length more than 100 mm (4 in.), cannot show afterflame more than 2.0 seconds after removal of the test flame, and cannot melt or drip. Protective driving gloves are also evaluated for the percentage of material consumed in this test, which cannot exceed 5 percent of the specimen's original weight.	
7.8.3 Thermal Protective Performance (TPP) ~~See Figure B.4(c) and Figure B.4(d).~~	This test is performed in accordance with ISO 17492, *Clothing for protection against heat and flame – Determination of heat transmission on exposure to both flame and radiant heat*, on the protective driving glove body composite as received and after conditioning with five laundering cycles. The protective driving glove body composite is exposed to direct flame and radiant heat to simulate flashover.	The Thermal Protective Performance (TPP) test is used to measure the insulating performance of the composite by evaluating how quickly heat is transferred from the outside of the protective driving glove body to the inside. Under the given test conditions, which simulate severe flashover conditions, the TPP rating divided in half indicates the approximate number of seconds until a fire fighter would receive a second-degree burn.
	Where the composite varies throughout the protective driving glove body, each variation is considered to be a different composite and must be tested individually and be subject to the minimum TPP rating. The rate of rise in temperature is recorded and compared to the known skin response to heat; the recorded time is multiplied by the heat exposure energy to determine the TPP rating. The average TPP rating has to be at least 10.	This is the primary test to measure the protective driving glove body's ability to protect the fire fighter from severe heat and flame. The higher the number, the higher the protection from heat (under the specific test conditions).
7.8.4 Cut Resistance Test	This test is performed in accordance with ASTM F1790/F1790M, *Standard Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing with CPP Test Equipment*, on at least three conditioned samples of the protective driving glove body composite under a specific load. Small specimens of the protective driving glove body composite are clamped to a metal rod while a blade, which is under a 100 g (0.22 lb) load, passes across the specimen until it makes contact with the metal rod. Where the composite varies throughout the protective driving glove body, each variation is considered to be a different composite, and must be tested individually and be subject to the minimum cut resistance rating.	The Cut Resistance Test is used for this requirement to evaluate the ability of the glove body composite to resist being cut under specific test conditions. Longer blade travel distances represent greater cut resistance because it takes longer for the blade to cut through the material.

Test Method	Test Method Description	Test Method Application
	The distance the blade passes across each specimen without cutting through the material is recorded then averaged. The average distance the blade travels across the material without cutting through the material has to be more than a 20 mm (0.8 in.).	
7.8.5 Dexterity Test	This test is performed in accordance with ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Finger Dexterity Using a Modified Pegboard Test*, on at least three as-received pairs of whole protective driving gloves each in size small and size large (for a total of six pairs).	The Dexterity Test is used to determine whether the protective driving glove meets a minimum requirement for dexterity. The lower percentages indicate that the gloves have fewer adverse effects on fire fighter dexterity.
	A test subject first uses bare hands to pick up metal pins and places them in a horizontal pegboard. The subject immediately repeats the test while wearing the correct size specimen gloves. The time it takes to complete the task is recorded for both tests, and an average is calculated and used to calculate a percentage that represents how much faster the test was completed bare-handed than with gloved hands.	To meet this requirement, bare-handed control cannot offer more than 110 percent better control than gloved hands. In other words, if it takes, on average, 60 seconds to complete the test bare-handed, it cannot take more than 66 seconds, on average, to complete the same task with gloved hands.
	That percentage is reported as the bare-handed control for each glove size. The average result for bare-handed control cannot exceed 110 percent.	
7.8.6 Grip Test	This test is performed on at least three as-received pairs of whole protective driving gloves each in size small and size large (for a total of six pairs).	The Grip Test is used to evaluate the protective driving glove's gripping ability, under applied force and specific test conditions. The test is designed to simulate the use of certain hand tools.
	Protective driving glove specimens are submersed in water for 15 seconds immediately prior to testing. While wearing the wet protective driving gloves, the test subject pulls downward on a wet pole three times.	
	The peak pull force value for each individual pull is recorded and reported. The minimum pull force value that occurs after the peak pull force value is recorded and reported.	
	The individual percentage drop between the peak pull force value and the minimum pull force value is calculated and used to determine pass or fail performance (the drop cannot be more than 30 percent).	
	Failure during any individual pull (not average percentage drop) constitutes glove failure of the overall test.	

Test Method	Test Method Description	Test Method Application
7.8.7 Label Durability and Legibility Test 1	This test is performed on protective driving glove labels attached to whole gloves. Protective driving glove label specimens are exposed to 10 laundry cycles in accordance with AATCC TM 135, *Dimensional Changes of Fabrics After Home Laundering*, and evaluated for legibility. Separate specimens are subjected to abrasion in accordance with ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)*, and evaluated for legibility. Separate specimens are subjected to a 10-minute exposure in a 140.56°C (285°F) oven and evaluated for legibility.	The Label Durability and Legibility Test is used to evaluate whether or not the label stays in place and is legible after exposure to multiple launderings, abrasion, and convective heat. The presence and legibility of labels is important for protective driving glove identification and tracking.
7.8.8 Thread Melting Test	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, on three different specimens of sewing thread used in the construction of protective driving gloves in the as-received condition. The temperature at which the thread melts or decomposes is recorded, and if it melts below 260°C (500°F), it fails.	The Thread Melting Test is used to evaluate the thread used in the construction of protective driving gloves to determine whether it meets at least the same minimum heat resistance as the material used in the glove's construction.
7.8.9 Thread-Breaking Strength Test	This test is performed in accordance with ASTM D2256/D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method*, on three thread specimens both as received and after a 10-minute exposure in a 140.56°C (285°F) oven. Single strands of yarn are pulled until failure, and that force is recorded and averaged. Since thread strength varies with thread size, Table 7.8.9 details minimum breaking strength for various thread sizes.	The Thread-Breaking Strength Test is used to evaluate the thread used in construction of protective driving gloves to ensure it will be strong enough to maintain the integrity of the glove. If sewing thread is too weak, or weak after a heat exposure, it could compromise the glove and expose the fire fighter to a high temperature environment.
7.8.10 Torque Test	This test is performed on at least three as-received pairs of whole protective driving gloves each in size small and size large (for a total of six pairs). The test subject dons the glove and attempts to twist a vertical rod mounted on a torque meter. The maximum force applied by the test subject in this twisting motion is measured. The test is performed both bare-handed and with gloves donned. The test results are recorded and averaged, and the percent difference between the bare-handed results and the results for tests using gloves is used to determine glove performance. Protective driving gloves must allow at least 80 percent of the twisting force for the test subject compared to tests performed bare-handed.	The Torque Test is used to evaluate how gloves affect a fire fighter's ability to perform gripping and twisting actions. The results compare the same gripping/twisting action performed both bare-handed and with the gloves. Percentages less than 100 percent mean that the gloves diminish gripping/twisting action while percentages over 100 percent mean that the gloves enhance gripping/twisting motion.

B.10 Load-Carrying Equipment.

Table B.10 is intended to serve as an abbreviated guide to specified tests that apply to load-carrying equipment and materials used in the construction of the load-carrying equipment. These tests evaluate whether or not the load-carrying equipment meets the minimum performance requirements of the ~~2021~~ 2022 edition of NFPA 1977. They do not guarantee the safety of the fire fighter or ensure the fire fighter will not experience injury while using the protective item.

Table B.10 Load-Carrying Equipment

Test Method	Test Method Description	Test Method Application
7.9.1 Heat and Thermal Shrinkage Resistance Test (melting, dripping, separation, ignition) ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, on complete load-carrying equipment as received. The load-carrying equipment will have all hardware secured that is used for the wearer to put on and take off the item in its normal wearing position. Samples are suspended in a 232°C (450°F) oven for 5 minutes.	The Heat and Thermal Shrinkage Resistance Test is used for this requirement to determine whether or not components used to construct protective load-carrying equipment will melt, separate, or easily ignite.
	Load-carrying equipment cannot melt, drip, separate, or ignite.	The test conditions are not intended to simulate actual wildland and urban interface fire fighting exposures but rather serve as a means to establish a minimum level of thermal stability for the materials used in the construction of load-carrying equipment.
7.9.3 Thread Melting Test ~~See Figure B.2(c) and Figure B.2(d).~~	This test is performed in accordance with ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers* on three different specimens of sewing thread used in the construction of the load-carrying equipment in the as-received condition.	The Thread Melting Test is used to evaluate the thread used in the construction of the load-carrying equipment to determine whether it meets at least the same minimum heat resistance as the fabric used in the garment's construction.
	The temperature at which the thread melts or decomposes is recorded, and if it melts below 232°C (450°F), it fails.	
7.9.4 Retroreflectivity Test	The conditioned load-carrying equipment trim is tested for retroreflectivity. The coefficient of retroreflection is tested in accordance with ASTM E810, *Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry*.	The Retroreflectivity Test is used to evaluate how well samples of retroreflective material retain their retroreflectivity. The standard has requirements for retroreflectivity, when optional visibility markings are present on the load-carrying equipment, to enhance nighttime/low light visibility (retroreflection).
	Retroreflection/retroreflectivity is the reflection of light in which the reflected rays are preferentially returned in the direction close to the opposite of the direction of the incident rays, with the property being maintained over wide variations of the direction of the incident rays.	

Submitter Information Verification

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Committee Statement

Committee Statement: Test method for work protective gloves updated to be consistent with other NFPA glove standards. Photos of the tests are removed for clarity. The test for particulate blocking ability of garments used with urban interface conditions are added to the annex.

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C.1.2.3 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. www.astm.org

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 2018.

ASTM D1424, *Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus*, 2009, reapproved 2013, editorial change 1.

ASTM D1683/D1683M, *Standard Test Method for Failure in Sewn Seams of Woven Fabrics*, 2017, reapproved 2018.

ASTM D1776/D1776M, *Standard Practice for Conditioning and Testing Textiles*, 2016.

ASTM D2256/D2256M, *Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method*, 2010, reapproved 2015.

ASTM D3787, *Standard Test Method for Bursting Strength of Textiles—Constant-Rate-of-Traverse (CRT) Ball Burst Test*, 2016.

ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)*, 2012, reapproved 2016.

ASTM D6413/D6413M, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, 2015.

ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, 2016.

ASTM E810, *Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry*, 2003, reapproved 2013.

ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, 2005, reapproved 2013, e1.

ASTM F1414, *Standard Test Method for Measurement of Cut Resistance to Chainsaw in Lower Body (Legs) Protective Clothing*, 2015.

ASTM F1790/F1790M, *Standard Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing with CPP Test Equipment*, 2015.

ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate*, 2017.

ASTM F1939, *Standard Test Method for Radiant Heat Resistance of Flame Resistant Clothing Materials with Continuous Heating*, 2015.

ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Finger Dexterity Using a Modified Pegboard Test*, 2018.

ASTM F2299/F2299M, *Standard Test Method for Determining the Initial Efficiency of Materials Used in Medical Face Masks to Penetration by Particulates Using Latex Spheres* , 2017.

ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, ~~2014~~ 2019 .

ASTM F2913, *Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester*, 2019.

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C.1.2.6 US Government Publications—Military Specifications and Commercial Item Descriptions.

DLA Document Production Service Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094. http://quicksearch.dla.mil

Commercial Item Description A-A-55126B, *Fastener Tapes, Hook and Loop, Synthetic*, 7 September 2006.

Commercial Item Description ~~A-A-55634A~~ A-A-55634B , *Zippers (Fasteners, Slide Interlocking)*, ~~23 March 2004~~ 9 August 2018 .

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