NATIONAL FIRE PROTECTION ASSOCIATION
The leading information and knowledge resource on fire, electrical and related hazards

AGENDA

Technical Committee on Protective Ensembles for Structural and Proximity Firefighting (FAE-SPF)
NFPA 1850 (1851) Second Draft meeting

August 14 - 16, 2024
8:00 a.m. – 5:00 p.m. (CDT)

Sheraton Kansas City Hotel at Crown Center
2345 McGee Street
Kansas City, MO

To join the meeting, please contact ysmith@nfpa.org

1. **Call to order at 8:00 am.** Tim Tomlinson.
2. **Introduction of Committee members and guests.** See committee roster attached.
3. **Chair report.** Tim Tomlinson
4. **Staff liaison report.** Barry Chase.
5. **Previous meeting minutes.** NFPA 1970 TIA Development Meeting, May 9, 2024, Microsoft Teams. See attached.
6. **NFPA 1970 Status Update.**
    a. **Report on 2024 NFPA Technical Meeting results.**
    b. **Report on tentative interim amendments.**
7. **NFPA 1850 (1851) Second Draft.**
   Note: If the committee is unable to complete its work on all Public Comments, the second draft meeting will be extended to additional meeting sessions.
    a. **Public comments.** See attached.
    b. **Task group reports.**
        i. *Restricted substances.* Jeff Stull.
        ii. *Test procedures.* Amanda Newsom.
        iii. *Program.* Matthew Cox.
        iv. *Compliance.* Webster Marshall.
        v. *Editorial.* Karen Lehtonen.
    c. **Second revisions.**

8. Other business.

9. Future meetings.

   a. NFPA 1970 First Draft Meeting [January 2027].

10. Adjourn.

AGENDA ITEM #2 ATTACHMENT

COMMITTEE ROSTER

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AGENDA ITEM #5 ATTACHMENT

PREVIOUS MEETING MINUTES

MINUTES

**NFPA Technical Committee on Protective Ensembles
for Structural and Proximity Firefighting (FAE-SPF)
NFPA 1970 (1971) TIA development meeting**

May 9th, 2024
11am - 1pm eastern

1. **Called to order at 11am.** Chairman Tim Tomlinson called the meeting to order at 11am.
2. **Introduction of Committee members and guests.** Committee members and guests introduced themselves and their affiliations.
3. **Chair report.** Tim Tomlinson welcomed attendees and outlined the purpose for the meeting.
4. **Staff liaison report.** Chris Farrell gave a brief staff liaison report and reminded all participants this is not a first or second draft meeting, thus no votes on this material will be taken.
5. **Previous meeting minutes.** The previous meeting minutes from March 22, 2024, were approved.
6. **NFPA 1970 (1971) post-Second Draft.**
    a. Discussed potential TIAs for NFPA 1970
        i. Jeff Stull, restricted substances task group
            1. Proposed TIA revising restricted substances criteria. [attached]
            2. Proposed TIA revising PFAS-free claim. [attached]
        ii. Amanda Newsom
            1. Proposed TIA revising multiple sections. [attached]
                a. Several parts are related to the glove flame changes based on second draft failed ballot item.
            2. Proposed TIA revising hoods. [attached]
            3. Proposed TIA revising certification dates. [attached]

a. Potentially affects four separate committees; this TC advised they will only vote on chapters associated with their work.

iii. Web Marshall

1. Proposed TIA for light degradation. [attached]

7. Other business.

a. Chairman Tim Tomlinson held a discussion about NFPA 1850 and moving forward based on what is happening with NFPA 1970. He raised the possibility of slipping cycle to accommodate more time to complete their work.

8. Future meetings.

a. NFPA 1850, Summer 2024. Contracted with hotel in Kansas City, MO; still waiting on the booking link. NFPA meetings department is aware and is working on it.

9. **Adjourn.** Tim Tomlinson adjourned the meeting at 1:05pm eastern.

<u>Committee Members:</u>

x	**Tomlinson, Tim**	Chair	Addison Fire Department
	Berger, George	Principal	US Marine Corps Installations Command
x	**Cinque, Vince**	Principal	Broward Sheriff Fire Rescue
	Cox, Matthew	Principal	Fairfax County Fire & Rescue Department
	Deaton, Anthoney	Principal	NC State University
x	**Dennison, Tyler**	Principal	L.N. Curtis & Sons
	Durby, Tim	Principal	Prescott Fire Department
	Eysser, Christopher	Principal	Fire Department City of New York
x	**Falkenstein-Smith, Ryan**	Principal	National Institute of Standards and
x	**Fanning, David**	Principal	E. D. Bullard Company
x	**Fesik, Jonathan**	Principal	Fire Industry Repair Maintenance Inc.
x	**Fithian, William**	Principal	ASTM/Safety Equipment Institute (SEI)
x	**Herring, Todd**	Principal	Fire-Dex
x	**Lehtonen, Karen**	Principal	LION Group, Inc.
x	**Marshall, Webster**	Principal	Fire Fighter Cancer Foundation
	McClintock, Steve	Principal	National Volunteer Fire Council

x	**McKenna, Michael**	Principal	Michael McKenna & Associates, LLC
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x	**Ragan, Tom**	Principal	Shelby Specialty Gloves
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	Shiels, Brian	Principal	ArcWear
x	**Silvestri, Daniel**	Principal	Verified Independent Services Providers
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x	**Stull, Jeffrey**	Principal	International Personnel Protection, Inc.
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Guests:

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David Eskew	Milliken
Desiree Marquant	US Navy
Jessica Andrews	UL
Chris Gaudette	Orafol
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Sarah Frey	Phenix Technologies
Jeremy Lawson	Cal Fire
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Jennifer Wise	WL Gore
Jim Walter	MES
Josh Ingram	PBI
John Morris	3M
Rick Swan	NFPA PPE CC chair
Chris Archibald	Stedfast

Dave Fanning	Bullard
Janeane Leggett	Majestic Fire
Luke Votaw	WL Gore
Stuart Blenkiron	Draeger

Total Attendance: 54

PROPOSED AMENDMENT TO REVISE RESTRICTED SUBSTANCES CRITERIA

Proposed Changes

1. Update existing references and add new reference(s) to Chapter 2:

2.3.5* ASTM Publications.

ASTM D7359, *Standard Test Method for Total Fluorine, Chlorine, and Sulfur in Aromatic Hydrocarbons and There Mixtures by Oxidative Pyrohydrolytic Combustion, followed by Ion Chromatography Detection (Combustion Iron Chromatography-CIC)*,2023.

2.3.9 DIN Publications.

2.3.11 EN Publications.

EN 17134-2, *Textiles and textile products - Determination of biocide additives - Part 2: Chlorophenol-based preservatives, method using gas chromatography*, 2023.

2.3.15 ISO Publications.

ISO 6401, *Plastics – Poly (vinyl chloride) – Determination of residual vinyl chloride monomer – gas chromatographic method*, 2022.

ISO 22818, Textiles – Determination of short-chain chlorinated paraffins (SCCP) and middle-chain chlorinated paraffins (MCCP) in textile products out of different matrices by use of gas chromatography negative ion chemical ionization mass spectroscopy (GC-NCI&-MS), 2021.

ISO 23702, *Leather – Organic fluorine – Part 1: Determination of the nonvolatile compound content by extraction method using liquid chromatography/tandem mass spectrometry detector (LC-MS/MS)*, 2023.

2. Update annex for definition of restricted substance and add new definition in Chapter 3:

3.3.170* Restricted Substance.
A specific substance that poses a potential threat to human health or the environment, which can include, but is not limited to, an ingredient, treatment, or byproduct of the manufacturing that is subject to specific concentration limits or being present in a material or component used in the construction of a protective element.

A.3.3.170
Restricted substances can be hazardous, toxic, corrosive, ignitable, explosive, chemically reactive, persistent, or bioaccumulative. These substances are restricted because governments or other organizations have established specific limits for their use in various tribes that either prohibit their use or set maximum limits for the concentration in the respective product. Limits

for restricted substances are specifically addressed for forms of PPE given the potential for exposure of individual wearers of the PPE or to individuals handling the PPE, or for potential for contamination of environment in the manufacture of PPE.

3.3.X* Restricted Substance Attestation Organization.
An independent organization that provides test services for assuring supplier conformity of materials or components used in protective elements against the criteria in a recognized restricted substances list.
A.3.3.X
Specific criteria for restricted substances and their measurement are established in Chapters 4, 7, 8, and 9 as part of this standard. It

3. Revise related sections for component recognition in Chapter 4 related to restricted substances requirements:

4.3.10*
In lieu of the requirements in 4.3.9, compliance of recognized components to the requirements specified in 7.1.14, 7.4.9, 7.7.6, 7.10.10, 7.13.7, and 8.21 shall be permitted to be based on a certificate provided by a restricted substance attestation organization that meets the following requirements:
(1) The restricted substance attestation organization shall be independent from the supplier.
(2) The restricted substance attestation organization shall use a restricted substance list that is at least equivalent or more rigorous than the specific criteria for restricted substances as specified in Section 8.21.
(3) A separate test report shall be provided along with the certificate that provides the results of all applicable restricted substances evaluations.
A.4.3.10
An example of a restricted substance attestation organization meeting these requirements is OEKO-TEX in their application of OEKO-TEX Standard 100 and the OEKO-TEX Standard 100 Supplement PPE & Materials for PPE.
4.3.10.1
The certificate in 4.3.10 shall be required only for initial certification or if there is a change to the materials used in the recognized component.
A.4.3.10.1
Modification of the finish, coating, fiber type, or fiber sources considered a change to recognize component.

4. Provide clarifications of scope statement with respect to hazards in Chapter 5:

5.1.2* Purpose.
A.5.1.2
This standard is not designed to be utilized as a purchase specification. It is prepared, as far as practicable, with regard to required performance, avoiding restriction of design wherever possible. Purchasers should specify departmental requirements for items such as color, markings, closures, pockets, and patterns, or other features related to specific elements or ensembles. Tests

specified in this standard should not be deemed as defining or establishing performance levels for protection from all structural or proximity firefighting environments.

5.1.2.1

The purpose of Chapters 5 through 9 of this standard shall be to establish minimum levels of protection for firefighting personnel assigned to fire department operations including, but not limited to, structural firefighting, proximity firefighting, rescue, emergency medical, and other emergency first responder functions.

5.1.2.1.1*

To achieve this purpose, Chapters 5 through 9 of this standard shall establish minimum requirements for structural firefighting protective ensembles and ensemble elements designed to provide firefighting personnel limited protection from thermal, physical, environmental, biological, electrical, person-position, person-equipment, and other hazards encountered during structural firefighting operations.

A.5.1.2.1.1

A list of potential fireground and other related emergency hazards that can be addressed in this standard appears in Table A.5.1.2.1.1 (the same as Table A.5.1.1 that appears in NFPA 1851). These hazards include not only hazards arising from the emergency scene but also hazards that that may be present from wearer contact with and use of protective ensembles and ensemble elements before, during, and after emergency operations.

5.1.2.1.2*

To achieve this purpose, Chapters 5 through 9 of this standard shall establish minimum requirements for proximity firefighting protective ensembles and ensemble elements designed to provide firefighting personnel limited protection from thermal exposures where high levels of radiant heat as well as convective and conductive heat are released, and from physical, environmental, and biological, electric, person-position, person-equipment, and other hazards encountered during proximity firefighting operations.

5.1.2.2

The purpose of Chapters 5 through 9 of this standard shall also be to establish a minimum level of protection for structural and proximity firefighting personnel from exposure to liquid and particulate contaminants as an option for compliant structural firefighting garments, for compliant proximity firefighting garments, and for compliant elements for both garments.

<For Information: Table A.5.1.1 from NFPA 1851>

Table A.5.1.1 List of Potential Fire Ground and Other Related Emergency Hazards

Physical Hazards	*Chemical Hazards*
Falling objects	Inhalation
Flying debris	Skin absorption or contact
Projectiles or ballistic objects	Chemical ingestion or injection
Abrasive or rough surfaces	Liquefied gas contact
Sharp edges	Chemical flashover
Pointed objects	Chemical explosions
Slippery surfaces	*Electrical Hazards*
Excessive vibration	High voltage
Environmental Hazards	Electrical arc flashover
High heat and humidity	Static charge buildup
Ambient cold	*Radiation Hazards*
Wetness	Ionizing radiation
High wind	Non-ionizing radiation
Insufficient or bright light	*Person–Position Hazards*
Excessive noise	Daytime visibility
Thermal Hazards	Nighttime visibility
High convective heat	Falling
Low radiant heat	Drowning
High radiant heat	*Person–Equipment Hazards*
Flame impingement	Material biocompatibility
Steam	Ease of contamination
Hot liquids	Thermal comfort
Molten metals	Range of motion
Hot solids	Hand function
Hot surfaces	Ankle and back support
Biological Hazards	Vision clarity
Bloodborne pathogens	Communications ease
Airborne pathogens	Fit (poor)
Biological toxins	Ease of donning and doffing
Biological allergens	

5. Update Restricted Substances Limits in Chapter 8:

8.21* Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

Components that are required to be certified for individual protective elements shall meet the acceptable restricted substances as established in Table 8.21(a) when tested as specified in Section 9.10.1, Test Method for Acceptable Levels of Specific Restricted Substances, subject to the following applications or exceptions:

1. Testing for acetophenone and 2-Phenyl-s-propanol shall only be applied to polymers that contain ethylene vinyl acetate.
2. Testing for acidic or alkaline substances (pH) shall be excluded for materials and components that are plastics, rubber, or polymers.

3. Testing for azo-amines and aryl amine salts shall be excluded for materials and components that are plastics, rubber, or polymers.
4. Testing for bisphenols shall only be applied to materials and components that are plastics, rubber, or polymers, including elastomers.
5. Testing for chlorobenzenes and chlorotoluenes shall only be applied to materials and components that include synthetic fibers, natural and synthetic fiber blends, or artificial leather.
6. Testing for chlorinated paraffins shall be excluded for materials that include natural or synthetic fibers.
7. Testing for chlorophenols shall be only applied to materials and components that include natural fibers, synthetic fibers, or natural and synthetic fiber blends.
8. Testing for dyes shall only be applied to materials and components that include synthetic fibers or natural and synthetic fiber blends.
9. Testing for formaldehyde shall be excluded for materials and components that are plastics or polymers.
10. Testing for heavy metal Chromium VI shall be only applied to materials and components that consist of natural fibers or synthetic fibers.
11. Testing for total heavy metal content that includes arsenic, cadmium, lead, and mercury shall be excluded for materials and components that include synthetic fibers.
12. Testing for monomers shall be only applied to materials and components that include artificial leather or are plastics, rubber, and polymers.
13. Testing for nitrosamines shall be only applied to materials and components that are rubber.
14. Testing for ortho-phenylphenol shall be excluded for materials and components that are plastics, rubber, or polymers.
15. Testing for phthalates shall be excluded for materials and components that include natural fibers, synthetic fibers, and natural and synthetic fiber blends.
16. Testing for polycyclic aromatic hydrocarbons shall be excluded for materials and components that include natural fibers, synthetic fibers, and natural and synthetic fiber blends.
17. Testing for quinoline shall be applied to materials and components that include synthetic fibers or natural and synthetic fiber blends.
18. Testing for solvent residuals shall be applied to materials and components that include artificial leather or are polyurethane-based plastics or polymers.
19. Testing for UV stabilizers shall be applied to materials and components that include plastics, rubber, or polymers.
20. Testing for volatile organic compounds shall be applied to materials and components that include artificial leather or are polyurethane-based plastics or polymers.
21. Perfluorinated and polyfluorinated alkyl substances shall be tested in relevant materials and components for both total PFAS and individual PFAS chemicals.

A.8.21

The certification organization should use its best judgment in determining the relevant categories restricted substances to be evaluated based on the information provided by the manufacturer or supplier for the respective material (s) and component(s).

Table 8.21(a) Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components

Chemical Class or Group	Restricted Substance(s)	Maximum Level
Acetophenone and 2-Phenyl-2-propanol	Acetophenone and 2-Phenyl-2-propanol	10 mg/kg
Acidity and alkaline substances	Measured by reporting pH	Acceptable range 4.0–7.5
Akyl phenols and ethoxylates	Sum of 4-tert butylphenol, nonylphenol, octylphenol, heptaphenol, and pentylphenol	10.0 mg/kg
	Sum of 4-tert butylphenol, nonylphenol, octylphenol, heptaphenol, pentylphenol, nonylphenolethoxylates, and octylphenol-ethoxylates	100.0 mg/kg
Azo-amines and aryl amine salts	Each individual substance in Table 8.21(b)	20 mg/kg
Bisphenols	Bisphenol A. Bisphenol B, and Bisphenol S, each	1000 mg/kg
Chlorinated benzenes and toluenes	Sum of all chemicals in Table 8.21(c) except Chlorobenzene as indicated below and in Note A	1.0 mg/kg
	Chlorobenzene	30 mg/kg (Note A)
Chorinated paraffins	Short-chain chlorinated paraffins (SCCPs) (C10-C13)	1000 mg/kg
	Short-chain chlorinated paraffins (SCCPs) (C10-C13)	1000 mg/kg
Chlorinated phenols	Pentachlorophenol	0.5 mg/kg
	Tetrachlorophenols	0.5 mg/kg
	Trichlorophenols	2.0 mg/kg
	Dichlorophenols	3.0 mg/kg
	Monochlorophenols	3.0 mg/kg
Dyes	Each individual substance in Table 8.21(d)	50 mg/kg
	Navy blue	Not present
Flame retardants	Each individual substance in Table 8.21(e)	10 mg/kg
	Sum of all chemicals in Table 8.21(e)	50 mg/kg
Formaldehyde	Free and partially releasable	75 mg/kg
Heavy metals, extractable	Antimony	30.0 mg/kg
	Arsenic	1.0 mg/kg
	Barium	1000 mg/kg
	Cadmium	0.1 mg/kg
	Chromium	2.0 mg/kg

Chemical Class or Group	Restricted Substance(s)	Maximum Level
	Chromium VI	0.5 mg/kg
	Cobalt	4.0 mg/kg
	Copper	50.0 mg/kg
	Lead	1.0 mg/kg
	Mercury	0.02 mg/kg
	Nickel	4.0 mg/kg
	Selenium	100 mg/kg
Heavy metals, total content	Arsenic	100 mg/kg
	Cadmium	40.0 mg/kg
	Lead	90.0 mg/kg
	Mercury	0.5 mg/kg
Monomers	Styrene	0.005 mg/m^3
	Vinyl chloride	0.002 mg/m^3
Nitrosamines	Each individual substance in Table 8.21(f)	0.5 mg/kg
	Sum of N-nitrosatable substances	5 mg/kg
Organotin compounds	Tributyltin (TBT)	1.0 mg/kg
	Triphenyltin (TPhT)	1.0 mg/kg
	Each individual substance in Table 8.21(g)	2.0 mg/kg
Ortho-phenylphenol	Ortho-phenylphenol	25 mg/kg
Perfluorinated and polyfluorinated alkyl substances (PFAS)	Total fluorine content [includes non-PFAS]	Report
	Sum of C9-C14 PFCA-related substances	260 µg/kg
	Sum of PFOS, PFOSA, PFOSF, N-Me-FOSA, N-Et-FOSA, N-Me-FOSE, N-Et-FOSE	1 µg/m^2
	Each and sum of PFHpA, PFNA, PFDA, PFUdA, PFDoA, PFTrDA, PFTeDA and further perfluorinated carboxylic acids in Table 8.21(j)	25 µg/kg
	Sum of perfluorinated sulfonic acids in Table 8.21(j)	250 µg/kg
	Each partially fluorinated carboxylic/sulfonic acids in Table 8.21(j)	250 µg/kg
	Sum of partially fluorinated linear alcohols in Table 8.21(j)	250 µg/kg
	Sum of esters of fluorinated alcohols with acrylic acid in Table 8.21(j)	250 µg/kg
	Sum of PFOA and salts	25 µg/kg
	Sum of PFOA-related substances	250 µg/kg
Phthalates	Sum of substances listed in Table 8.21(h)	

Chemical Class or Group	Restricted Substance(s)	Maximum Level
		500 mg/kg
Polycyclic aromatic hydrocarbons (PAH)	Benzo(a)pyrene	1.0 mg/kg
	Benzo(e)pyrene	1.0 mg/kg
	Benzo(a)anthracene	1.0 mg/kg
	Chrysene	1.0 mg/kg
	Benzo(b)fluoroanthrene	1.0 mg/kg
	Benzo(j)fluoroanthrene	1.0 mg/kg
	Benzo(k)fluoroanthrene	1.0 mg/kg
	Dibenzo(a,h)anthracene	1.0 mg/kg
	Sum of substances listed in Table 8.21(i)	10.0 mg/kg
Quinoline	Quinoline	50.0 mg/kg
Solvent residues	Dimethylacetamide (DMAC)	500 mg/kg 1000 mg/kg Note B
	Dimethylformamide (DMF)	500 mg/kg 1000 mg/kg Note B 3.0% Note C
	Formamide	200 mg/kg
	N-Methyl-2-pyrrolidone (NMP)	500 mg/kg 1000 mg/kg Note B 3.0% Note C
UV absorbers or stabilizers	2-Benzotriazol-2-yl-4,6-di-tert-butylphenol (UV 320)	1000 mg/kg
	2,4-Di-tert-butyl-6-(5-chlorobenzotriazol-2-yl) phenol (UV 327)	1000 mg/kg
	2-(2H-Benzotriazol-2-yl)-4,6-di-tert-penthylphenol (UV 328)	1000 mg/kg
	2-(2H-Benzotriazol-2-yl)-4-(tert-butyl)-6-(sec-butyl)phenol (UV 350)	1000 mg/kg
Volatile organic compounds (VOCs)	Benzene	5 mg/kg
	Each VOC listed in Table 8.21(k)	10 mg/kg

Note A – A maximum level of 30 mg/kg of 1,2-Dichlorobenzene shall be permitted when C.I. Pigment Violet 23 (CAS No. 6358-30-1), Yellow 93 (CAS No. 5580-57-4), Orange 61 (CAS No. 40716-47), and Red 214 (CAS No. 82643-43-4) solution-dyed fibers are used.

Note B – A maximum level of 1000 mg/kg shall be permitted for materials made of acrylic, elastane, polyurethane, polyimide, aramids, and coated textiles.
Note C – A maximum level of 3.0 weight percent shall be permitted for material products that must undergo further industrial production stages, such as fibers that are spun with the aid of NMP.

Table 8.21(b) List of Restricted Azo-amines and Aryl Amine Salts

Azo-amine or Aryl Amine Salt Chemical	CAS Number
4-Aminobiphenyl	92-67-1
Benzidine	92-87-5
4-Chloro-o-toluidine	95-69-2
2-Naphthylamine	91-59-8
o-Aminoazotoluene	97-56-3
2-Amino-4-nitrotoluene	99-55-8
p-Chloraniline	106-47-8
2,4-Diaminoanisole	615-05-4
4,4’-Diaminodiphenylmethane	101-77-9
3,3’-Dichlorobenzidine	91-94-1
3,3’-Dimethoxybenzidine	119-90-4
3,3’-Dimethylbenzidine	119-93-7
3,3’-dimethyl-4,4’-diaminodiphenylmethane	838-88-0
p-Cresidine	120-71-8
4,4’-Methylen-bis(2-chloraniline)	101-14-4
4,4’-Oxydianiline	101-80-4
4,4’-Thiodianiline	139-65-1
o-Toluidine	95-53-4
2,4-Toluenediamine	95-80-7
2,4,5-Trimethylaniline	137-17-7
2,4 Xylidine	95-68-1
2,6 Xylidine	87-62-7
2-Methoxyaniline (= o-Anisidine)	90-04-0
p-Aminoazobenzene	60-09-3
4-Chloro-o-toluidinium chloride	3165-93-3
2-Naphthylammoniumacetate	553-00-4
4-Methoxy-m-phenylene diammonium sulphate	39156-41-7
2,4,5-Trimethylaniline hydrochloride	21436-97-5

Table 8.21(c) List of Restricted Chlorinated Benzenes and Toluenes

Chlorinated Benzene or Toluene Chemical	CAS Number
2-Chlorotoluene	95-49-8
3-Chlorotoluene	108-41-8
4-Chlorotoluene	106-43-4

Chlorinated Benzene or Toluene Chemical	CAS Number
2,3-Dichlorotoluene	32768-54-0
2,4-Dichlorotoluene	95-73-8
2,5-Dichlorotoluene	19398-61-9
2,6-Dichlorotoluene	118-69-4
3,4-Dichlorotoluene	95-75-0
3,5-Dichlorotoluene	25186-47-4
2,3,5-Trichlorotoluene	56961-86-5
2,3,6-Trichlorotoluene	2077-46-5
2,4,5-Trichlorotoluene	6639-30-1
3,4,5-Trichlorotoluene	21472-86-6
2,4,6-Trichlorotoluene	23749-65-7
2,3,4,5-Tetrachlorotoluene	76057-12-0
2,3,4,6-Tetrachlorotoluene	875-40-1
2,3,5,6-Tetrachlorotoluene	1006-31-1
2,3,4,5,6-Pentachlorotoluene	877-11-2
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
Dichorobenzenes	25321-22-6
1,4-Dichlorobenzene	106-46-7
1,2,3-Trichlorobenzene	87-61-6
1,2,4-Trichlorobenzene	120-82-1
1,3,5-Trichlorobenzene	108-70-3
Trichlorbenzenes	12002-48-1
1,2,3,4-Tetrachlorobenzene	634-66-2
1,2,3,5-Tetrachlorobenzene	634-90-2
1,2,4,5-Tetrachlorobenzene	95-94-3
Pentachlorobenzene	608-93-5
Hexachlorobenzene	118-74-1
p-Chlorobenzotrichloride	5216-25-1
Benzotrichloride	98-07-7
Benzyl chloride	100-44-7

Table 8.21(d) List of Restricted Dyes

Dye Chemical	CAS Number
C.I. Acid Red 26	3761-53-3
C.I. Acid Red 114	6459-94-5
C.I. Basic Blue 26	2580-56-5
C.I. Basic Green 4	569-4-2, 10309-95-2, and

Dye Chemical	CAS Number
	2437-29-8
C.I. Basic Red 9	569-61-9
C.I. Basic Violet 3	548-62-9
C.I. Basic Violet 14	632-99-5
C.I. Basic Yellow 2	2465-27-2 and 492-80-9
C.I. Direct Black 38	1937-37-7
C.I. Direct Blue 6	2602-46-2
C.I. Direct Blue 15	2429-74-5
C.I. Direct Brown 95	16071-86-6
C.I. Direct Red 28	573-58-0
C.I. Disperse Blue 1	2475-45-8
C.I. Disperse Blue 3	2475-46-9
C.I. Disperse Blue 7	3179-90-6
C.I. Disperse Blue 26	3860-63-7
C.I. Disperse Blue 35	12222-75-2
C.I. Disperse Blue 102	12222-97-8
C.I. Disperse Blue 106	12223-01-7
C.I. Disperse Blue 124	61951-51-7
C.I. Disperse Brown 1	23355-64-8
C.I. Disperse Orange 1	2581-69-3
C.I. Disperse Orange 3	730-40-5
C.I. Disperse Orange 11	82-28-0
C.I. Disperse Orange 37/59/76	12223-33-5, 13301-61-6, and 51811-42-8
C.I. Disperse Orange 149	85136-74-9
C.I. Disperse Red 1	2872-52-8
C.I. Disperse Red 11	2872-48-2
C.I. Disperse Red 17	3179-89-3
C.I. Disperse Red 60	12223-37-9 and 17418-58-5
C.I. Disperse Yellow 1	119-15-3
C.I. Disperse Yellow 3	2832-40-8
C.I. Disperse Yellow 9	6373-73-5
C.I. Disperse Yellow 23	6250-23-3
C.I. Disperse Yellow 49	54824-37-2
C.I. Pigment Red 104 (lead chromate molybdate sulphate red)	12656-85-8
C.I. Pigment Yellow 34 (lead sulfochromate yellow)	1344-37-2
C.I. Solvent Blue 4	6786-83-0
C.I. Solvent Yellow 1 (4-Aminoazobenzene)	60-09-2

Dye Chemical	CAS Number
C.I. Solvent Yellow 3 (2-Aminoazobenzene)	97-56-3
4,4'-bis(dimethylamino)-4''-(methylamino)trityl alcohol	561-41-1

Table 8.21(e) List of Restricted Flame Retardant Substances

Flame Retardant Chemical	CAS Number
Decabromodiphenyl ethane (DBDPE)	84852-53-9
Pentabromodiphenyl ether (PentaBDE)	32534-81-9
Octabromodiphenyl ether (OctaBDE)	32536-52-0
Decabromodiphenyl ether (DecaBDE)	1163-19-5
All other polybrominated diphenyl ethers (PBDEs)	Various
Tetrabromobisphenol A (TBBP A)	79-94-7
Polybromobiphenyls (PBB)	59536-65-1
Hexabromocyclododecane (HBCDD)	3194-55-6
2,2-bis(bromomethyl)-1,3-propanediol (BBMP)	3296-90-0
Tris(1,3-dichloro-isopropyl) phosphate (TDCPP)	13674-87-8
Trixylyl phosphate (TXP)	25155-23-1
Tris(2,3,-dibromopropyl) phosphate (TRIS)	126-72-7
Tris(1-aziridinyl)phosphine oxide) (TEPA)	545-55-1
Tris(2-chloroethyl)phosphate (TCEP)	115-96-8
Bis(2,3-dibromopropyl) phosphate (BIS)	5412-25-9

Table 8.21(f) List of Restricted Nitrosamines

Nitrosamine Chemical	CAS Number
N-nitrosodimethylamine (NDMA)	62-75-9
N-nitrosodiethylamine (NDEA)	55-18-5
N-nitrosodipropylamine (NDPA)	621-64-7
N-nitrosodibutylamine (NDBA)	924-16-3
N-nitrosopiperidine (NPIP)	100-75-4
N-nitrosopyrrolidine (NPYR)	930-55-2
N-nitrosomorpholine (NMOR)	59-89-2
N-nitroso N-methyl N-phenylamine (NMPhA)	614-00-6
N-nitroso N-ethyl N-phenylamine (NEPhA)	612-64-6

Table 8.21(g) List of Restricted Organotin Substances

Organotin Chemical	CAS Number
Dibutyltin (DBT)	Various
Dimethyltin (DMT)	Various
Dicotyltin (DOT)	Various
Diphenyltin (DPhT)	Various
Dipropyltin (DPT)	Various

Organotin Chemical	CAS Number
Monobutyltin (MBT)	Various
Monooctyltin (MOT)	Various
Monomethyltin (MMT)	Various
Monophenyltin (MPhT)	Various
Tetrabutyltin (TeBT)	Various
Tetraethyltin (TeET)	Various
Tetraoctyltin (TeOT)	Various
Tricylohexyltin (TCyHT)	Various
Trimethyltin (TMT)	Various
Trioctyltin (TOT)	Various
Triproyltin (TPT)	Various

Table 8.21(h) List of Restricted Phthalate Substances

Phthalate Chemical	CAS Number
Butylbenzylphthalate (BBP)	85-68-7
Dibutylphthalate (DBP)	84-74-2
Diethylphthalate (DEP)	84-66-2
Dimethylphthalate (DMP)	131-11-3
Di-(2-ethylhexyl)-phthalate (DEHP)	117-81-7
Di-(2-methoxyethyle)-phthalate (DMEP)	117-82-8
Di-C6-8 branched alkylphthalates (DIHP)	71888-89-6
Di-C7-11 branched and linear alkylphthalates (DHNUP)	68515-42-4
Di-cyclohexyl phthalate (DCHP)	84-61-7
Di-hexylphthalates, branched and linear (DHxP)	68515-50-4
Di-iso-butylphthalate (DIBP)	84-69-5
Di-iso-hexyl phthalate (DIHxP)	71850-09-4
Di-iso-octyl phthalate (DIOP)	27554-26-3
Di-iso-nonylphthalate (DINP)	28553-12-0, 68515-48-0
Di-iso-decylphthalate (DIDP)	26761-40-0, 68515-49-1
Di-n-propyl phthalate (DPrP)	131-16-8
Di-n-hexylphthalate (DHP)	84-75-3
Di-n-octylphthalate (DNOP)	117-84-0
Di-n-nonylphthalate (DNP)	84-76-4
Di-n-pentyl phthalate (DPP), also iso-, or mixed	131-18-0, 605-50-5, 776297-69-9, and 84777-06-0
1,2-Benzenedicarboxylic acid, di-C6-10-alkyl esters	68515-51-5
1,2-Benzenedicarboxylic acid, mixed decyl and hexyl and octyl diesters	68648-93-1

Table 8.21(i) List of Restricted Polycyclic Aromatic Hydrocarbon (PAH) Substances

PAH Chemical	CAS Number
Acenaphtene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo[a]anthracene	56-55-3
Benzo[a]pyrene	50-32-8
Benzo[b]fluoranthene	205-99-2
Benzo[e]pyrene	192-97-2
Benzo[g,h,i]perylene	191-24-2
Benzo[j]fluoranthene	205-82-3
Benzo(k)fluoranthene	207-08-9
Chrysene	218-01-9
Cyclopenta[c,d]pyrene	27208-37-3
Dibenzo[a,h]anthracene	53-70-3
Dibenzo[a,e]pyrene	192-65-4
Dibenzo[a,h]pyrene	189-64-0
Dibenzo[a,i]pyrene	189-55-9
Dibenzo[a,l]pyrene	191-30-0
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(1,2,3-cd)pyrene	193-39-5
1-Methylpyrene	2381-21-7
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0

Table 8.21(j) List of Perfluorinated and Polyfluorinated Compounds (PFCs)

PFC Chemical	CAS Number	Acronym
C9-C14 PFCA-related substances		
Perfluorooctane sulfonic acid and sulfonates	1763-23-1, et. al.	PFOS
Perfluorooctane sulfonamide	754-91-6	PFOSA
Perfluorooctane sulfonfluoride	307-35-7	PFOSF/POSF
N-Methyl perfluorooctane sulfonamide	31506-32-8	N-Me-FOSA
N-Ethyl perfluorooctane sulfonamide	4151-50-2	N-Et-FOSA
N-Methyl perfluorooctane sulfonamide ethanol	24448-09-7	N-Me-FOSE
N-Ethyl perfluorooctane sulfonamide ethanol	1691-99-2	N-Et-FOSE
Perfluoroheptanoic acid and salts	375-85-9, et. al.	PFHpA
Perfluorooctanoic acid and salts	335-67-1, et. al.	PFOA
Perfluorononanoic acid and salts	375-95-1, et. al.	PFNA
Perfluorodecanoic acid and salts	335-76-2, et. al.	PFDA
Henicosafluoroundecanoic acid and salts	2058-94-8, et. al.	PFUdA

PFC Chemical	CAS Number	Acronym
Tricosafluorododecanoic acid and	307-55-1, et. al.	PFDoA
Pentacosafluorotridecanoic acid and salts	72629-94-8, et. al.	PFTrDA
Heptacosafluorotetradecanoic acid and salts	376-06-7, et. al.	PFTeDA
Further perfluorinated carboxylic acids		
Perfluorobutanoic acid and salts	375-22-4, et. al.	PFBA
Perfluoropentanoic acid and salts	2706-90-3, et. al.	PFPeA
Perfluorohexanoic acid and salts	307-24-4, et. al.	PFHxA
Perfluoro(3,7-dimethyloctanoic acid) and salts	172155-07-6, et. al.	PF-3,7-DMOA
Perfluorinated carboxylic and sulfonic acids under observation		
2,3,3,3-tetrafluoro-2-(heptafluoro propoxy) propionic acid, its various salts and its acyl halides	various	
Perfluorinated sulfonic acids		
Perfluorobutane sulfonic acid and salts	375-73-5, 59933-66-3, et. al.	PFBS
Perfluorohexane sulfonic acid and salts	355-46-4, et. al.	PFHxS
Perfluoroheptane sulfonic acid and salts	375-92-8, et. al.	PFHpS
Henicosafluorodecane sulfonic acid and salts	335-77-3, et. al.	PFDS
Partially fluorinated carboxylic/sulfonic acids		
7H-Perfluoro heptanoic acid and salts	1546-95-8, et. al.	7HPFHpA
2H,2H,3H,3H-Perfluoroundecanoic acid and salts	34598-33-9, et. al.	4HPFUnA
1H,1H,2H,2H-Perfluorooctane sulfonic acid and salts	27619-97-2, et. al.	6:2 FTS
PFOA-related substances		
1H,1H,2H,2H-Perfluordecyl acrylate	27905-45-9	8:2 FTA
1H,1H,2H,2H-Perfluoro-1-decanol	678-39-7	8:2 FTOH
1H,1H,2H,2H-Perfluorodecanesulphonic acid and its salts	39108-34-4, et. al.	8:2 FTS
Partially fluorinated linear alcohols		
1H,1H,2H,2H-Perfluoro-1-decanol	678-39-7	8:2 FTOH
1H,1H,2H,2H-Perfluoro-1-dodecanol	865-86-1	10:2 FTOH
Esters of fluorinated alcohols with acrylic acid		
1H,1H,2H,2H-Perfluorooctyl acrylate	17527-29-6	6:2 FTA
1H,1H,2H,2H-Perfluorodecyl acrylate	27905-45-9	8:2 FTA
1H,1H,2H,2H-Perfluorododecyl acrylate	17741-60-5	10:2 FTA

Table 8.21(k) List of Restricted Volatile Organic Compounds

Volatile Organic Compound	CAS Number
Carbon disulfide	71-43-2
Carbon tetrachloride	75-15-0
Chloroform	67-66-3
Cyclohexanone	108-94-1
1,2-Dichloroethane	107-06-2
1,2-Dichlorethylene	75-35-4
Ethylbenzene	100-41-4
Pentachloroethane	76-01-7
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	73-34-5
Tetrachloroethylene	127-18-4
Toluene	108-88-3
1,1,1-Trichloroethane	71-55-6
1,1,2-Trichloroethane	79-00-5
Trichloroethylene	79-01-6
Xylenes (meta-, ortho-, para-)	1330-20-7, 108-38-3, 95-47-6, and 106-24-3

6. Update Tests for Restricted Substances Limits in Chapter 9:

9.10.1 Tests for Acceptable Levels of Specific Restricted Substances.
9.10.1.1
Specified components of specified protective elements shall be evaluated for each listed restricted substance or category of restricted substances and not exceed the maximum concentration as specified in Table 9.10.1.1.

Table 9.10.1.1 Test Methods for Evaluating Protective Element Components for Specific Restrictive Substances

Chemical Class or Group	Restricted Substance(s)	Test Method
Acetophenone and 2-Phenyl-2-propanol	Acetophenone and 2-Phenyl-2-propanol	Extraction in acetone or methanol, sonification for 30 minutes at 60ºC (140ºF); analysis by GC/MS
Acidity and alkaline substances	Measured by reporting pH	Textiles and artificial leather: ISO 3071 using KCl solution
Akyl phenols and ethoxylates	4-tert Butylphenol, nonylphenol, octylphenol, heptaphenol, and pentylphenol	Textiles: ISO 21084
		Polymers and other materials: 1 g sample/20 mL THF, sonification for 60 min at 70°C (158°F) with analysis in accordance with ISO 21084

Chemical Class or Group	Restricted Substance(s)	Test Method
	Nonylphenolethoxylates and octylphenol-ethoxylates	All materials: ISO 18254-1 with analysis using LC/MS or LC/MS/MS
Azo-amines and aryl amine salts	See Table 8.21(b)	All materials: ISO 14362-1 For p-aminoazobenzene: All materials: ISO 14362-3
Bisphenol	Bisphenol A, Bisphenol B, and Bisphenol S	All materials, extraction: 1 g sample/20 ml THF, sonication for 60 minutes at 60°C (140°F), analysis with LC/MS
Chlorinated benzenes and toluenes	See Table 8.21(c)	All materials: EN 17137
Chorinated paraffins	Short-chain and medium chain chlorinated paraffins	ISO 22818
Chlorinated phenols	Pentachlorophenol Tetrachlorophenols Trichlorophenols Dichlorophenols Monochlorophenols	All materials: EN 17134-2
Dyes	See Table 8.21(d)	All materials: DIN 54231
	Navy Blue: Component 1: $C_{39}H_{23}ClCrN_7O_{12}S.2Na$; and Component 2: $C_{46}H_{30}CrN_{10}O_{20}S_2.3Na$	All materials: DIN 54231
Flame retardants	See Table 8.21(e)	All materials: ISO 17881-1 and ISO 17881-2
Formaldehyde	Free and partially releasable	All materials: ISO 14184-1
Heavy metals, extractable	Antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, and selenium	All materials: EN 16711-2
	Chromium VI	Textiles: EN 16711-2 with ISO 17075-1 if chromium is detected

Chemical Class or Group	Restricted Substance(s)	Test Method
Heavy metals, total content	Arsenic, cadmium, and mercury	All materials: EN 16711-2
	Lead	All materials: CPSC-CH-E1002-08.3
Monomers	Styrene, free	Extraction in methanol; GC/MS, sonication at 60°C (140°F) for 60 minutes
	Vinyl chloride	All materials: ISO 6401
Nitrosamines	See Table 8.21(f)	All materials: ISO 19577
Organotin compounds	Tributyltin (TBT), triphenyltin (TPhT), and chemicals in Table 8.21(g)	All materials: ISO/TS 16179
Ortho-phenylphenol	Ortho-phenylphenol	All materials: DIN 50009 All materials: Combustion ion chromatography in accordance with modified ASTM D7359 or particle-induced gamma emission (PIGE) with a minimum detection limit of 0.5 mg/kg All materials: EN 14582 or ASTM D7359
Perfluorinated and polyfluorinated compounds	Total fluorine	All materials: ISO 23702-1 or EN 17681-1 and EN 17681-2
	Total organic fluorine (extractable) individual chemicals in accordance with Table 8.21(j)	EN 14582 or ASTM D7359
Phthalates	See Table 8.21(h)	Sample preparation for all materials: CPSC-CH-C1001-09.4 Measurement: Textiles: GC/MS, ISO 14389 All materials except textiles: GC/MS
Polycyclic aromatic hydrocarbons (PAH)	See Table 8.21(i)	All materials: AFPS GS 2019:01
Quinoline	Quinoline	All materials: DIN 54231 with methanol extraction at 70°C (158°F)
Solvent residues	Dimethylformamide, and N-methyl-2-pyrrolidone	Textiles: EN 17131 All other materials: ISO/TS 16189
UV stabilizers	2-Benzotriazol-2-yl-4,6-di-tert-butylphenol (UV 320),	EN 62321-6; extraction
	2,4-Di-tert-butyl-6-(5-chlorobenzotriazol-2-yl) phenol (UV 327),	in THF, analysis by GC/MS)

Chemical Class or Group	Restricted Substance(s)	Test Method
	2-(2H-Benzotriazol-2-yl)-4,6-di-tert-penthylphenol (UV 328), and 2-(2H-Benzotriazol-2-yl)-4-(tert-butyl)-6-(sec-butyl)phenol (UV 350)	
Volatile organic compounds (VOCs)	See Table 8.21(k)	GC/MS headspace 45 minutes at 120ºC (248ºF)

9.10.1.2
Alternative test methods shall be permitted if the test method can demonstrate it is capable of providing a lower limit of quantification that is at the specified limit established for the respective substance in Table 8.21(a), unless otherwise stated in Table 9.10.1.1, and that provides an 80 percent or better recovery of the respective substance from the tested material or component.
9.10.1.3
The report for this testing shall include the identification of the recognized component, the specific restricted substances evaluated, and the measured level for each restricted substance against the limits established in Section 8.21.

7. Add reference to Annex H.:

H.1.2.X OEKO-TEX Standards.
OEKO-TEX Service GmbH, Genferstrasse 23, CH-8002 Zurich.
OEKO-TEX Standard 100, 2024
Supplement PPE & Materials OEKO-TEX Standard 100, 2024

Technical Merit

The technical committee agreed-upon restricted substance criteria provided in the second draft for the revision of NFPA 1971 was updated to reflect the most recent industry practices related to specific criteria and test methods as reflected in both trade association and independent verification organization services for the range of restricted substances applicable to personal protective equipment, including PPE for firefighter protective clothing. To further clarify intent for how these requirements can be implemented, clarifications were provided in the various sections regarding the recognition of materials and components to the requirements of the NFPA 1971 standard to allow for existing independent verification organizations to ascertain material or component conformity against the new requirements as part of the certification process. To this end, permissive language is introduced to allow for the use of certificates from independent organizations that attest to the qualification of materials and components for meeting restricted substances limits.

Additional changes have been made to the purpose statement within the NFPA 1971 portion of NFPA 1972 clarify already existing practice for addressing hazards that arise from the wearing of firefighting and other emergency responder PPE that have been described in the companion NFPA 1851 document related to the selection, care, and maintenance of PPE addressed in NFPA 1971.

Emergency Nature

(a) The document contains an error or an omission that was overlooked during a regular revision process.
(c) The proposed TIA intends to correct a previously unknown existing hazard.
(d) The proposed TIA intends to offer to the public a benefit that would lessen a recognized (known) hazard or ameliorate a continuing dangerous condition or situation.

PROPOSED AMENDMENT TO REVISE OPTIONAL PFAS-FREE CLAIM

Specific Proposed Changes

1. Modify annex language for definition of PFAS:

A.3.3.133 PFAS.
There are various ways PFAS is defined, ranging from specific target analytes with registered Chemical Abstract Service (CAS) numbers to the group of specific chemicals as a 'family' or class of substances.

For this standard, the definition of PFAS is based on the U.S. House of Representatives (HR 5987 – The PFAS Definition Improvement Act) in November 2021 to amend Section 8(a)(7) of the Toxic Substances Control Act (15 U.S.C. 2607(a)(7)) inserted the phrase "that contains at least one fully fluorinated carbon atom," after "perfluoroalkyl or polyfluoroalkyl substance'. This definition and other definitions have been used by both different regulatory authorizations and other organizations.

An alternative definition for PFAS is "fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom, which are primarily categorized through the presence or absence of a non-fluorinated functional group." This second definition is derived from 2021 OECD PFAS definition in: Organization for Economic Co-operation and Development (OECD), Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance, OECD Series on Risk Management, No. 61, OECD Publishing, Paris, 2021.

In this standard, the presence of PFAS is determined using an analytical test that detects and quantifies all possible PFAS using current available state-of-the-art technology for measuring the total fluorine content in materials. A different set of tests is applied for detecting and quantifying specific PFAS chemicals that are found in materials and components subject to restricted substance requirements in the standard.

2. Add a new definition for total fluorine:

3.3.X. Total Fluorine.
A measurement that includes organic and inorganic fractions of fluorine.

A.3.3.X. Total Fluorine.
The measurement of total fluorine is used as surrogate or proxy estimate technique for the total amount of PFAS in a material or component by determining the amount of fluorine in the sample. Because total fluorine measurements can include findings for both non-PFAS organic chemicals well as inorganic fluorine-based chemicals, total fluorine are likely to overestimate the levels of PFAS found in any material or component sample.

3. Permit the applications of PFAS claims for recognized components:

4.3.9.6
Suppliers of recognized components shall be permitted to make specific claims related to the PFAS levels in their specific materials or components according to 6.1.7.5, which in turn can be applied by protective elements manufacturers as the basis of their optional claims according to 6.1.7.5.
4.3.9.6.1
Suppliers of recognized components shall be permitted to provide a certificate with test results demonstrating compliance with the optional claim when the organization performing the testing meets the following requirements:
(1) The test organization shall be independent from the supplier.
(2) The test organization shall provide a separate test report along with the certificate that meets the requirements of 6.5.11 and 6.5.11.1.
4. Revise permissive requirement for identifying product as being PFAS-Free:

6.1.7.5*
Manufacturers shall be permitted to include the following statement as part of their product label when the required evidence is provided as specified in 6.5.11 for indicated PFAS levels in the respective protective element:
THIS *[type of protective element]* UPON CERTIFICATION HAS A PFAS (TOTAL FLUORINE) CONCENTRATION OF NO MORE THAN 100 PPM.

A.6.1.7.5
There is currently no standardized or technically practical way to fully determine the exact amount of all PFAS chemicals that may be present in a protective element. However, there are accepted industry practices for measuring the total fluorine in a given material or component that have been used for representing the total PFAS that may be present. The current techniques for measuring total fluorine will report fluorine levels that potentially include fluorine from both organic fluorine chemicals as well as inorganic fluorine chemicals that are not considered PFAS.

It is further recognized that while manufacturers or their suppliers may not intentionally add or believe PFAS has been added to a specific material or component, PFAS may still be present at measurable levels in the tens to hundreds of parts per million based on contaminated raw materials, fabrication processes, or various ways of handling materials. Some regulatory bodies have established limits for PFAS that account for some level of measurable total fluorine or total organic fluorine. A method for total organic fluorine had not been standardized at the time this standard was completed. None the less, the prevailing limits for total fluorine in products have been established as 100 ppm for textile-based products such as found in the State of California [insert reference], the 2024 edition of OEKO-TEX Standard 100, and the 2024 edition of the AFIRM Restricted Substances List. Consequently, the limit of 100 ppm of total fluorine has become

Manufacturers choosing to apply this language as part of their label are encouraged to provide supplemental information as part of their user information that helps explain the specific total fluorine measurements that applied to their certified protective elements.

5. Revise basis of PFAS-Free Claim

6.5.11
If the manufacturer makes the claim permitted in 6.1.7.5, than the claim shall be based on test results when their protective elements are evaluated as specified in 9.10.2, Test for Total Fluorine.

6.5.11.1*
If the manufacturer makes the claim permitted in 6.1.7.5, then the manufacturer shall make the report specified in 9.1.2.6.3 available to the Authority Having Jurisdiction upon request.

A.6.5.11.1
See A.6.1.7.5.

6. Add New Test Method 9.1.2:

9.1.2 Test for Total Fluorine.
9.1.2.1 Application.
This test method shall apply to any protective element for which the manufacturer is making the claim that is permitted in 6.1.7.5.
9.1.2.2 Selection of Samples for Evaluation.
9.1.2.2.1
Protective garment samples shall include outer shells, moisture barriers, thermal barriers, and wristlet/garment–glove interface components.
9.1.2.2.2
Protective helmet samples shall include ear cover fabric material layers, textile-based suspension materials, and textile-based retention system materials.
9.1.2.2.3
Protective glove samples shall include glove principal textile-based fabric materials, including shells, moisture barriers, linings, wristlets, and any non-textile moisture barrier materials.
9.1.2.2.4
Protective footwear samples shall include all footwear upper principal textile-based fabric material layers, including any exterior layer(s), barrier layers(s), lining(s), and any non-textile barrier layers.
9.1.2.2.5
Protective hood interface component samples shall include all hood fabric materials, including the outer layer, inner layers (where different), and particulate-blocking layers, as applicable.
9.1.2.3 Samples.
9.1.2.3.1
The size of the respective samples from the applicable material or component shall be as specified in the specific procedure applied.
9.1.2.3.2
A minimum default sample size of 50 g shall be used if specimen size or weight is not specified in the selected procedure.
9.1.2.3.3
The selected samples shall include all specific non-separable parts, layers, or attributes of the applicable material or component.

9.1.2.3.4
The selected samples shall be taken in the same way from each source material or component so that they are as identical as possible in representing the specific material or component.
9.1.2.3 Specimens.
A minimum of three specimens taken from separate unique lots for each applicable material or component shall be evaluated.
9.1.2.4 Apparatus.
Where cryomilling is specified in the preparation of samples for testing, the cryomilling equipment shall have the following characteristics:
(1) The cryomilling equipment shall not have any measurement levels of PFAS that come into contact with the sample.
(2) The cryomilling equipment shall be capable of producing a mesh size of 50 µm.
9.1.2.5 Procedures.
9.1.2.5.1
Total fluorine shall be measured in accordance with ASTM D7359, *Standard Test Method for Total Flooring, Chlorine, and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion all by Ion Chromatography Detection (Combustion Ion Chromatography – CIC)*, with the following modifications:
(1) Samples for analysis shall be prepared by cryomilling using an apparatus that meets the criteria specified in 9.1.2.4.
(2) Only total fluorine shall be measured.
(3) The total fluorine measurement shall be reported in ppm.
9.1.2.6 Report.
9.1.2.6.1
The total fluorine measurements for each specimen of each test it material and component shall be reported.
9.1.2.6.2
The average total fluorine measurement of all specimens shall be reported.
9.1.2.6.3
A separate laboratory report shall be prepared all total fluorine results of all applicable materials and component specific to the protective element for which the product label claim in 6.1.7.5 is being made and include the additional information:
(1) The name and address for the laboratory.
(2) The specific procedures used for the measurement of total fluorine.
(3) Specific laboratory quality control procedures used in the measurement of total fluorine.
(4) The individual specimen and average total fluorine results for each evaluated material and component of the subject protective element.
(5) An indication of the material or component that has the highest reported average total fluorine measurement.
9.1.2.7 Interpretation.
The total fluorine concentration to be used as the basis of permitting the optional product label claim in 6.1.7.5 shall be the highest reported average total fluorine measurement of any materials or components that are evaluated for the respective protective element.

7. Add new references to Annex H, Paragraph H.H.2:

H.H.2 Other Publications.

Organization for Economic Co-operation and Development (OECD), Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance, OECD Series on Risk Management, No. 61, OECD Publishing, Paris, 2021. https://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/terminology-per-and-polyfluoroalkyl-substances.pdf.

Technical Merit

The proposed revisions address the clarifications to and provide for the implementation of a. technically feasible alternative approach for addressing PFAS in protective elements. The second draft of NFPA 1970 contained provisions for manufacturers to add a claim that their protective helmets were “PFAS-free” as based on the measurement of total fluorine. At the time the Technical Committee decided on this approach, there was uncertainty as to the reasonableness and the validity of a 1 ppm limit, which was established at the time on the basis of the perceived detection limit for the total fluorine method involving combustion Ion chromatography for related products. There was also missing details for which materials and components would be measured and how the total fluorine measurements would be reported for the large range of materials and components that would be subject to this optional label claim.

The proposed revisions to the applicable sections use an alternative approach that is based on reporting the maximum average fluorine measurement of any material or component used in the respective protective element for labeling purposes. These revisions further identify which materials are tested and provide additional details for how the testing is to be conducted based on industry accepted methods for the determination of total fluorine. This approach provides a means for which manufacturers can make claims relative to PFAS if they choose to do so. As the labeling requirement is optional; however, if made, these claims would be standardized and how the information is generated to allow the fire service and other end users to be consistently informed as to how PFAS levels are determined and reported.

Additional information substantiating the proposed revisions includes:

1. The Annex item for the definition of PFAS has been updated to include the observation that it can be defined differently by various groups and provides the basis of the current definition in the second draft.

2. A definition for “total fluorine” has been provided given its use as the basis for relating PFAS level claims in firefighter protective clothing products.

3. An option has been provided to allow suppliers of recognized components to apply the same claims for the protective element to individual materials or components. This approach is seen as instrumental for the implementation of the optional requirement by allowing recognize components that a review by the certification organization to be part of the overall claim for the respective protective element.

4. As described above, the specific permissible claim for the product label is now based on the reported maximum total fluorine concentration in the respective protective element. Additional information is provided in an Annex section that explains the basis for this approach and its limitations. It also suggests that manufactures provide supplemental information as part of the user information guide to help explain to in users how this information may be interpreted.

5. Paragraph 6.5.11 has been revised for establishing the basis for making the claim and requires that the manufacturer provide a report to the Authority Having Jurisdiction upon request as a way of providing disclosure to respective end users.

6. Specific details have been provided for the conduct of one of two methods for making total fluorine measurements using current methods that are part of established industry practice. Within the test method, details are provided for the specification of samples to be included for the analysis of total fluorine content. Other details are indicated for carrying out the methods including how test measurements are to be reported and interpreted in terms of placement of information on the optional product label claim.

7. The source of the proposed revised definition for PFAS is identified for inclusion in Annex H. Also, the additional cited reference provides the basis of Method B in the proposed new test method in 9.10.2 for the conduct of Particle Induced Gamma Ray Emission (PIGE), which is one option for the determination of total fluorine.

Emergency Nature

(a) The document contains an error or an omission that was overlooked during a regular revision process.
(c) The proposed TIA intends to correct a previously unknown existing hazard.
(d) The proposed TIA intends to offer to the public a benefit that would lessen a recognized (known) hazard or ameliorate a continuing dangerous condition or situation.
(e) The proposed TIA intends to accomplish a recognition of an advance in the art of safeguarding property or life where an alternative method is not in current use or is unavailable to the public.

Tentative Interim Amendment (TIA) Request Form

Submitter's Information

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Proposed TIA Information

NFPA Standard No.: NFPA 1970

Editions affected (Current and/or Proposed): Proposed

Proposed text of the TIA

Note: *Proposed text is to be in legislative text. Specifically, underscore new wording to be inserted (e.g. new text proposed) and strike-through to current text to be deleted (e.g. ~~current text proposed to be removed~~).*

~~8.1.27~~

~~Garment outer shells, moisture barriers, and thermal barriers shall be separately evaluated for ease of cleaning where the garment manufacturer or component supplier is required to report the contaminant removal efficiency for semi-volatile organic compounds and heavy metals as specified in Section 9.9.4, Flame Resistance Following Fuel Exposure and Cleaning Test.~~

8.2.8

Where the garment manufacturer or component supplier is required to report the contaminant removal efficiency for semi-volatile organic compounds and heavy metals in the user information, outer shells, moisture barriers, and thermal barriers shall be evaluated for ease of cleaning as specified in Section 9.9.3, Contamination Removal Efficiency Tests.

~~8.4.17 Helmet ear cover materials, suspension system materials, and retention system materials that come in contact with the wearer's head or neck without a protective hood shall be evaluated for ease of cleaning where the helmet manufacturer or component supplier is required to report the contaminant removal efficiency for semi-volatile organic compounds and heavy metals as specified in Section 9.9.3, Contamination Removal Efficiency Tests.~~

8.5.4 Faceshield/goggle component lenses shall be tested for transmittance of light as specified in Section 9.8.2, Faceshield/Goggle Component Lens ~~Trim~~ Luminous (Visible) Transmittance Test, and shall have clear lenses transmit a minimum of 85 percent of the incident visible radiation, and shall have colored lenses transmit a minimum of 43 percent of the incident visible radiation.

8.5.11

Where the helmet manufacturer or component supplier is required to report the contaminant removal efficiency for semi-volatile organic compounds and heavy metals in the user information, helmet ear cover materials, textile-based suspension system materials, and textile-based retention system materials that come in contact with the wearer's head or neck without a protective hood shall be evaluated for ease of cleaning as specified in Section 9.9.3, Contamination Removal Efficiency Tests.

8.6.10 Helmet faceshield component lenses shall be tested for transmittance of light as specified in Section 9.8.2, Faceshield/Goggle Component Lens ~~Trim~~ Luminous (Visible) Transmittance Test, and shall transmit not less than 30 percent of the incident visible radiation.

8.7.6 The glove body composite, including, but not limited to, trim, external labels, external nonvisual/machine-readable tags, and external tags, but excluding hardware, and excluding hook and pile fasteners that do not directly contact the wearer's body, shall be tested for resistance to flame as specified in Section ~~8.4~~9.2.3, Flame Resistance Test 3, and shall not have an average char length of more than 100 mm (4 in.), shall not have an average afterflame of more than 2.0 seconds, shall not melt or drip, and shall not have the amount of consumed materials exceed 5 percent.

8.7.7 The glove interface component composite, including but not limited to trim, external labels, external nonvisual/machine-readable tags, and external tags, but excluding hardware and hook and pile fasteners that do not directly contact the wearer's body, shall be tested for resistance to flame as specified in Section ~~9.4~~9.2.3, Flame Resistance Test 3, and shall not have an average char length of more than 100 mm (4 in.), shall not have an average afterflame of more than 2.0 seconds, shall not melt or drip, and shall not have the amount of consumed materials exceed 5 percent.

8.7.8 The glove extension composite, including but not limited to trim, external labels, external nonvisual/machine-readable tags, and external tags, but excluding hardware and hook and pile fasteners that do not directly contact the wearer's body, shall be tested for resistance to flame as specified in Section 9.2.3, Flame Resistance Test ~~4~~3, and shall not have an average char length of more than 100 mm (4 in.), shall not have an average afterflame of more than 2.0 seconds, shall not melt or drip, and shall not have the amount of consumed materials exceed 5 percent.

8.~~13.11~~14.4

Where the hood manufacturer is required to report the contaminant removal efficiency for semivolatile organic compounds and heavy metals in the user information, ~~H~~hood composites shall be evaluated for ease of cleaning as specified in Section 9.9.3, Contamination Removal Efficiency Tests~~, where the hood manufacturer is required to report the contaminant removal efficiency for semivolatile organic compounds and heavy metals as specified in the user information~~.

9.1.5

Convective Heat Conditioning Procedure for Helmets, Faceshield/Goggle Components, Gloves, Footwear, Moisture Barriers, Moisture Barrier Seams, Labels, Particulate Blocking Layer(s), and Trim.

Samples shall be conditioned by exposing them to the procedures specified in 9.2.4.4 and 9.2.4.5.2 through 9.2.4.5.3, with the following modifications:

1. The oven temperature shall be stabilized at 140°C, +6/−0°C (285°F, +10°/−0°F), for helmets, footwear, moisture barriers, moisture barrier seams, labels, particulate blocking layer(s), trim, and outer shells for testing in accordance with ~~9.1.12~~9.1.21, and the test exposure time shall be 10 minutes, +15/−0 seconds.

9.1.12.3

The wash cycle procedure and water levels specified in Table 9.1.12.3(a) and Table 9.1.12.3(b) shall be followed. In addition, the *g* force shall not exceed 125 *g* throughout the wash cycle.

Table 9.1.12.3(a) Front-Loading Wash Cycle

-	-	Temperature		-
Operation	**Time (min)**	**±3°C**	**±5°F**	**Water Level**
Suds using AATCC detergent #1993 without optical brighteners, 1.0 g/gal ±1% water	10	~~60~~49	~~140~~120	Low*
Drain	1	—	—	—

Carryover	5	~~60~~49	~~140~~120	Low*
Drain	1	—	—	—
Rinse	2	~~Unheated~~38	~~Unheated~~100	High*
Drain	1	—	—	—
Rinse	2	~~Unheated~~38	~~Unheated~~100	High*
Drain	1	—	—	—
Rinse	2	~~Unheated~~38	~~Unheated~~100	High*
Drain	1	—	—	—
Extract	5	—	—	—

*See Table 9.1.2.3(b) for high and low water levels.

Table 9.1.12.3(b) Water Level for Front-Loading Wash Cycle Procedure

Low Water Level ±1 cm (3⁄18 in.)		**High Water Level ±1 cm (3⁄18 in.)**	
cm	**in.**	**cm**	**in.**
12.7	5.0	25.4	10.0

9.1.12.4

Samples shall be dried using a tumble dryer with a stack temperature of 38°C to 49°C (100°F to 120°F) when measured on an empty load 20 minutes into the drying cycle.

9.1.12.5

Samples shall be tumbled ~~until dry~~ for 60 minutes and shall be removed immediately at the end of the drying cycle. At the conclusion of the final drying cycle, the garment samples shall be allowed to air dry for at least 48 hours prior to conducting the test and the use of a forced-air dryer operated at ambient temperature, −0°+ 5°C (−0°+ 10°F) shall be permitted.

9.1.12.5.1

At the conclusion of the final drying cycle, glove or glove pouch samples shall be dried on a forced-air, non-tumble-drying mechanism operated at 10ºC ± 5°C (18°F ± 9°F) above current room temperature until dry but not less than 8 hours.

9.1.12.6

Garments, garment materials, wristlets, hoods, gloves, and glove pouches shall be washed and dried for a total of ~~thirty~~five cycles unless otherwise specified.

9.1.18.2

Samples shall be flexed within 4 hours of removal of the conditions as specified in 9.1.21.2 (3) ~~at 21°C ± 3°C (70°F ± 5°F) and a relative humidity of 65 percent ± 5 percent~~.

9.1.18.4*

The mandrels shall be spaced at a distance of ~~235~~204 mm ± 6 mm (~~9 1⁄4~~8 in. ± 1⁄4 in.), in the starting position and ~~25~~50 mm (~~3 1⁄4~~2 in.) at the closed position when measured from the back sample holding area of each mandrel.

A.9.1.18.4

The mandrel spacing should be measured according to Figures A.9.18.4(a) and A.9.18.4(b).

Figure A.9.18.4(a) Mandrel starting position

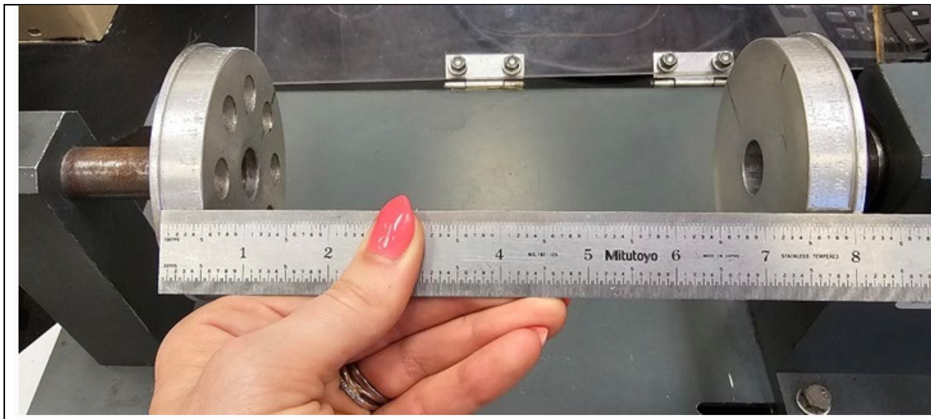
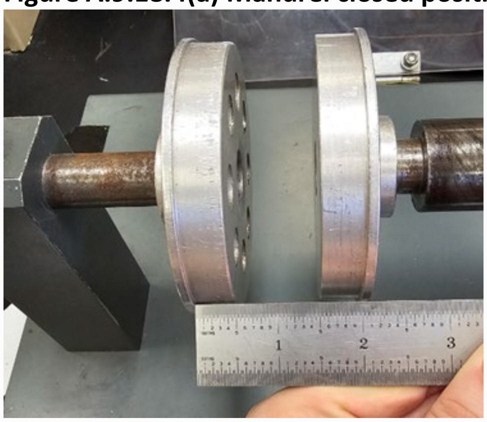


Figure A.9.18.4(a) Mandrel closed position



9.1.21 Multienvironmental Conditioning Procedure.

9.1.21.1

Samples of outer shell measuring 381 mm × 381 mm (15 in. × 15 in.) shall be prepared by cutting and sewing or serging the edges to prevent fraying.

9.1.21.2

~~Composite~~Outer shell samples shall be subject to the various conditions in the following order:

(1) Outer shell samples shall be laundered a total of 20 laundering cycles as specified in 9.1.~~1~~2.
(2) Outer shell samples shall be subjected to convective heat conditioning procedures as specified in 9.1.5.
(3) Outer shell samples shall be conditioned for a minimum of 4 hours as specified in 9.1.3
(4) ~~Composite~~Outer shell samples shall be subject to repeated flexing for 3000 cycles as specified in 9.1.~~3~~18.
(5) Outer shell specimens for testing shall be taken so that one warp and one fill specimen is cut from the center of the conditioned samples.

9.2.3 Flame Resistance Test 3.

9.2.3.1 Application.

9.2.3.1.1 This test method shall apply to the protective glove body, glove interface components, and glove extension composites.

9.2.3.1.2 Modifications to this test method for evaluation of glove body composites shall be as specified in 9.2.3.8.

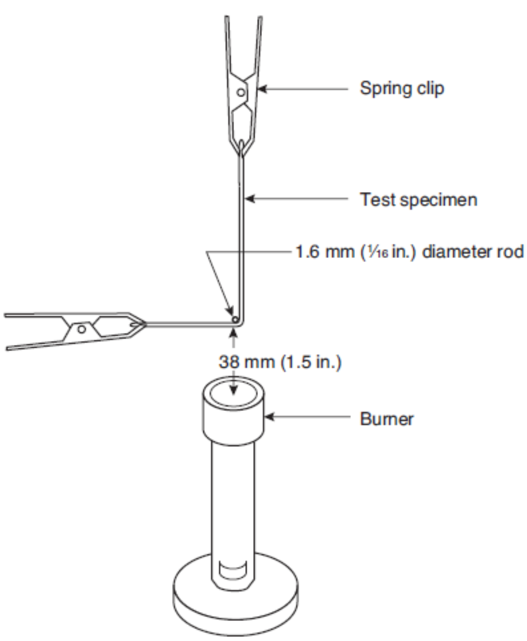
9.2.3.1.3 Modifications to this test method for evaluation of glove interface components other than wristlet composites shall be as specified in 9.2.3.9.

9.2.3.1.4 Modifications to this test method for evaluation of wristlet glove interface components shall be as specified in 9.2.3.10.

9.2.3.1.5 Modifications to this test method for evaluation of glove extension composites shall be as specified in 9.2.3.11.

9.2.3.2 Specimens. Three specimens shall be tested for each material. Three specimens shall be tested after the conditioning specified in 9.1.3. Three additional specimens shall be tested after the conditioning specified in 9.1.12 followed by the conditioning specified in 9.1.3.

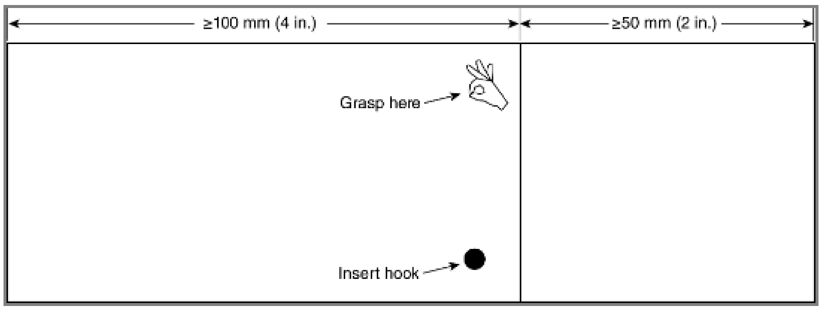
9.2.3.3 Samples.
9.2.3.3.1 Samples shall be prepared for each glove body, glove interface component, and glove extension composite.
9.2.3.3.2 Samples shall be conditioned as specified in 9.1.12 and 9.1.3.
9.2.3.4 Apparatus.
9.2.3.4.1 The test apparatus specified in Method 5905.1, *Flame Resistance of Material; High Heat Flux Flame Contact*, of Federal Test Method Standard 191A, *Textile Test Methods*, shall be used.
9.2.3.4.2 A freestanding flame height indicator shall be used to assist in adjusting the burner flame height. The indicator shall mark a flame height of 75 mm (3 in.) above the top of the burner.
9.2.3.4.3 A specimen support assembly shall be used that consists of a frame and steel rod of 2 mm (1 / 16 in.) in diameter to support the specimen in an L-shaped position as shown in Figure 9.2.3.4.3.
9.2.3.4.4 The horizontal portion of the specimen shall be not less than 50 mm (2 in.), and the vertical portion shall be not less than 100 mm (4 in.). The specimen shall be held at each end by spring clips under light tension as shown in Figure 9.2.3.4.3.
9.2.3.5 Procedure.
9.2.3.5.1 A balance shall be used to determine the weight of each specimen to the nearest 0.1 g (0.04 oz) before and after testing.
9.2.3.5.2 The burner shall be ignited and the test flame shall be adjusted to a height of 75 mm (3 in.) with the gas on/off valve fully open and the air supply completely and permanently off, as it is important that the flame height be closely controlled. The 75 mm (3 in.) height shall be obtained by adjusting the
orifice in the bottom of the burner so that the top of the flame is level with the marked flame height indicator.
9.2.3.5.3 With the specimen mounted in the support assembly, the burner shall be moved so that the middle of the folded corner projects into the flame 38 mm (11⁄2 in.) as shown in Figure 9.2.3.4.3.
9.2.3.5.4 The burner flame shall be applied to the specimen for 12 seconds. After 12 seconds, the burner shall be removed.
9.2.3.5.5 The afterflame time shall be measured as the time, in seconds, to the nearest 0.2 second that the specimen continues to flame after the burner is removed from the flame.
9.2.3.5.6 Each layer of the specimen shall be examined for melting or dripping.
FIGURE 9.2.3.4.3 Relationship of Test Material to Burner.



9.2.3.5.7 Each tested sample shall be reconditioned as specified in 9.1.3 and then weighed to the nearest 0.1 g (0.04 oz).
9.2.3.5.8 The specimen then shall be further examined for char length. The char length shall be determined by measuring the length of the tear through the center of the charred area as specified in 9.2.3.5.8.1 through 9.2.3.5.8.4.
9.2.3.5.8.1 The specimen shall be folded lengthwise and creased, by hand, along a line through the highest peak of the

charred area.
9.2.3.5.8.2 The hook shall be inserted into a hole punched in the specimen that is 6 mm (1⁄4 in.) in diameter or less. The hole shall be punched out for the hook at one side of the charred area that is 6 mm (1⁄4 in.) from the adjacent outside edge, at the point where the specimen contacted the steel rod, and 6 mm (1⁄4 in.) away from the point where the specimen contacted the steel rod in the 101 mm (4 in.) direction as shown in Figure 9.2.3.5.8.2.

FIGURE 9.2.3.5.8.2 Position of Hole and Side to Grasp for Determining Char Length.



9.2.3.5.8.3 A weight of sufficient size so that the weight and hook together equal the total tearing weight required by Table 9.2.3.5.8.3 shall be attached to the hook. The total tearing weight for determining charred length shall be based on the weight of the composite specimen and shall be determined from Table 9.2.3.5.8.3.
9.2.3.5.8.4 A tearing force shall be applied gently to the specimen by grasping the side of the material at the edge of the char opposite the load as shown in Figure 9.2.3.5.8.2 and raising the specimen and weight clear of the supporting surface. The end of the tear shall be marked off on the edge, and the char length measurement made along the undamaged edge.
9.2.3.6 Report.
9.2.3.6.1 The afterflame time and char length shall be recorded and reported for each specimen. The average afterflame time and char length shall also be calculated, recorded, and reported. The afterflame time shall be recorded and reported to the nearest 0.2 second and the char length to the nearest 2.5 mm (0.10 in.).
9.2.3.6.2 The percent consumed shall be calculated using the following formula:

[9.2.3.6.2]

$$\text{Percent consumed} = \frac{W - R}{W} \times 100$$

where:
W = original conditioned weight
R = conditioned weight 24 hours after testing

Table 9.2.3.5.8.3 Determination of Tearing Weight

Specified Weight per Square Yard of Material Before Any Fire-Retardant Treatment or Coating		Total Tearing Weight for Determining Charred Length	
g/m²	oz/yd²	kg	lb
68–203	2.0–6.0	0.1	¼
>203–508	>6.0–15.0	0.2	½
>508–780	>15.0–23.0	0.3	¾
>780	>23.0	0.45	1

9.2.3.6.2.1 The percent consumed shall be recorded and reported for each specimen to the nearest 0.1 percent. The average percent consumed shall be calculated, recorded, and reported to the nearest 0.1 percent.
9.2.3.6.3 Observations of melting or dripping for each specimen shall be recorded and reported.

9.2.3.7 Interpretation. Pass or fail performance shall be based on melting or dripping, the average afterflame time, and the average char length.
9.2.3.8 Specific Requirements for Testing Glove Body Composites.
9.2.3.8.1 Samples for conditioning shall be glove body composite pouches as specified in 9.2.3.8.3.
9.2.3.8.2 Specimens shall be representative of each glove body composite construction.
9.2.3.8.3 For glove body composites, samples for conditioning shall be in the form of a pouch as described in 9.1.14.
9.2.3.9.2.3 After conditioning, the pouch and necessary stitching shall be cut to form 50 mm × 150 mm (2 in. × 6 in.) specimens for testing.
9.2.3.9 Specific Requirements for Testing Protective Glove Interface Components Other than Wristlet Composites.
9.2.3.9.1 Samples for conditioning shall be glove interface component composite swatches as specified in 9.2.3.9.3.
9.2.3.9.2 Specimens shall be representative of the glove interface component composite construction.
9.2.3.9.3 For glove interface component composites, samples for conditioning shall be in the form of a pouch as described in 9.1.14.
9.2.3.9.4 After conditioning, the necessary stitching shall be cut to form 50 mm × 150 mm (2 in. × 6 in.) specimens for testing.
9.2.3.10 Specific Requirements for Testing Protective Wristlet Glove Interface Components.
9.2.3.10.1 Samples for conditioning shall be wristlet glove interface component composite swatches as specified in 9.2.3.10.3.
9.2.3.10.2 Specimens shall be representative of the wristlet glove interface component composite construction.
9.2.3.10.3 For wristlet glove interface component composites, samples for conditioning shall include wristlet material. Three specimens shall be tested after the conditioning specified in 9.1.3. Three additional specimens shall be tested after the conditioning specified in 9.1.2 followed by the conditioning specified in 9.1.3.
9.2.3.11 Specific Requirements for Testing Protective Glove Extension Composites.
9.2.3.11.1 Samples for conditioning shall be glove extension composite swatches as specified in 9.2.3.11.3.
9.2.3.11.2 Specimens shall be representative of the glove extension composite construction.
9.2.3.11.3 For glove extension composites, samples for conditioning shall be in the form of a pouch as described in 9.1.14.
9.2.3.11.4 After conditioning, the necessary stitching shall be cut to form 50 mm × 150 mm (2 in. × 6 in.) specimens for testing.

~~**9.2.4.4.1** The specific holder for footwear shall provide the following mounting and position of the specimen:~~
~~(1) The toe shall be at an angle of 7.5 degrees ± 2.5 degrees, above the heel.~~
~~(2) The height of the lowest edge of the specimen shall be 305 mm ± 25 mm (12 in. ± 1 in.) from the surface of the water and n-heptane fluid as measured before ignition.~~
~~(3) The heel-toe axis of the specimen shall be parallel with the 457 mm (18 in.) side of the fuel pan.~~

9.2.4.14.13 After flexing, the footwear specimen shall be marked with a water height line on the exterior at a height of 75 mm (3 in.) below the height of the boot as defined in 7.10.3.1 but no lower than 225 mm (8.86 in.) ~~25 mm (1 in.) lower than the minimum height for the size of footwear specimen being tested~~ where measured up from the center of the insole at the heel as specified in 9.1.22.

9.2.7.7.2 For glove body composites, specimens for conditioning shall be in the form of a pouch as described in 9.1.14 ~~9.1.15~~.

~~**9.2.17 Small-Scale Flash Fire Exposure Test**~~
Delete entire test method

9.2.4.3.3
The unit area weight of materials specified in 9.2.4.3.2 shall be measured in accordance with the method in ASTM D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric within 4 hours of removal from conditioning as described in ASTM D1776.

9.2.4.8 Specific Requirements for Testing Garment Outer Shell~~, Moisture Barrier~~, Thermal Liner, Winter Liner Materials, Helmet Ear Cover, Helmet Shrouds, Helmet Covers, and Glove Lining Materials.

9.2.4.9.1.2
Where samples are prepared for evaluating the moisture barrier material only, marks shall be placed on the moisture barrier at ~~305~~250 mm (~~12~~10 in.) intervals on the moisture barrier layer for the post-oven exposure assessment of moisture barrier shrinkage.

9.2.7.3.2
The thickness of each specimen shall be measured in accordance with ASTM D1777, Standard Test Method for Thickness of Textile Materials within 4 hours of removal from conditioning as described in ASTM D1776.

9.2.7.3.3
The weight of each specimen shall be measured in accordance with the method in ASTM D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric within 4 hours of removal from conditioning as described in ASTM D1776.

7.1.15
The shoulder areas shall consist of reinforcement composite meeting the requirements of 8.1.9. The composite meeting those requirements shall be at least 100 (4 in.) wide on the crown of each shoulder and extend down from the crown on both the front and back of the garment by at least 50 mm (2 in.). The crown of the shoulder shall be the uppermost line of the shoulder when the garment is lying flat on an inspection surface with all closures fastened.

7.1.16
The knee areas shall consist of reinforcement composite meeting the requirements of 8.1.9. The composite meeting those requirements shall measure at least 150 mm x 150 mm (6 in. x 6 in.).

~~9.2.10.2.1.1~~
~~Samples of garment shoulder areas shall be representative of the area in the actual garment that measures at least 100 (4 in.) along the crown of the shoulder and extending down from the crown on both the front and back of the garment at least 50 mm (2 in.). The crown of the shoulder shall be the uppermost line of the shoulder when the garment is lying flat on an inspection surface with all closures fastened.~~

~~9.2.10.2.1.2~~
~~Samples of the garment knee areas shall be representative of the knee area in the actual garment that measures at least 150 mm x 150 mm (6 in. x 6 in.).~~

9.2.10.3.2
The thickness of each specimen shall be measured in accordance with ASTM D1777, Standard Test Method for Thickness of Textile Materials within 4 hours of removal from conditioning as described in ASTM D1776.

9.2.14.3.5
The thickness of each specimen shall be measured in accordance with ASTM D1777, Standard Test Method for Thickness of Textile Materials within 4 hours of removal from conditioning as described in ASTM D1776.

9.2.14.3.6
The weight of each specimen shall be measured in accordance with the method in ASTM D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric within 4 hours of removal from conditioning as described in ASTM D1776.

9.2.15.8.2

The thickness of each specimen shall be measured in accordance with ASTM D1777, Standard Test Method for Thickness of Textile Materials within 4 hours of removal from conditioning as described in ASTM D1776, and provided in the report.

9.2.15.8.3
The weight of each specimen shall be measured in accordance with the method in ASTM D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric within 4 hours of removal from conditioning as described in ASTM D1776, and provided in the report.

9.2.15.9 Specific Requirements for Testing Particulate Blocking Hoods.
9.2.15.9.1
Specimens for conditioning shall measure 150 mm x 150 mm ± 6 mm (6 in. x 6 in.± 1⁄4 in.).
9.2.15.9.2
Specimens shall consist of a composite constructed of all layers used in the particulate blocking hoods, oriented in the order as worn.
9.2.15.9.3
A total of 5 specimens in each condition shall be tested.
9.2.15.9.4
One set of specimens shall be preconditioned in accordance with 9.1.9 with the following modifications:
(1) The volume of water applied shall be ~~by uniformly applying~~ 3.4 grams ± 0.2 grams. ~~of~~
(2) The water shall be applied to the innermost layer of the composite and be tested within 2 minutes after preconditioning.

9.2.15.9.5
Transmitted and stored thermal energy testing shall be conducted in accordance with Procedure B of ASTM F2731, *Standard Test Method for Measuring the Transmitted and Stored Thermal Energy of Firefighter Protective Clothing Systems*, with the following modifications:
1. The upper mounting plate shall be replaced with an alternate upper mounting plate whose thickness shall not exceed 2 mm ± 1 mm. Alternate methods, meeting the minimum thickness requirements may be used to achieve specimen mounting. ~~Testing shall be conducted without the use of the 6 mm (1⁄4 in.) spacer.~~

The exposure time shall be for a period of 120 seconds, + 1/– 0 seconds, or until a time to predicted second-degree burn is achieved up to 240 seconds. No compression period shall be used for this testing.

9.2.16.3.3
The thickness of each specimen shall be measured in accordance with ASTM D1777, Standard Test Method for Thickness of Textile Materials within 4 hours of removal from conditioning as described in ASTM D1776.

9.2.16.3.4
The weight of each specimen shall be measured in accordance with the method in ASTM D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric within 4 hours of removal from conditioning as described in ASTM D1776.

9.3.1.1.2.4 Separate outer shell samples shall be tested after being conditioned as specified in 9.1.2~~2~~1.

9.3.8.4.1* The shell retention test fixtures shall consist of rigid material of sufficient thickness to facilitate firm attachment of the helmet shell while attached to a~~the chinstrap~~ tensile testing machine ~~specified in 9.3.10.4.1~~.

9.3.9.4.1 The chin strap elongation text fixture shall consist of rigid material to facilitate firm attachment of the helmet assembly while attached to a~~the chinstrap~~ tensile testing machine specified in 9.3.8.4.1 ~~9.3.10.4.1~~.

A.9.3.9.4.2 Figure A.9.3.9.4.2 represents an example of an appropriate retention test fixture. Other appropriate test fixtures might be used.

A.9.3.9.5.4 The retention system test is measuring vertical movement. When applying the load, the helmet could shift from its original horizontal plane position. If this occurs, the helmet should be secured in such a manner that the horizontal plane position is maintained, but the vertical movement is not influenced. ~~For example, this could be accomplished with a securing mechanism for the brim that moves vertically with the helmet.~~

Figure A.9.3.9.4.2 Retention Test Fixture.

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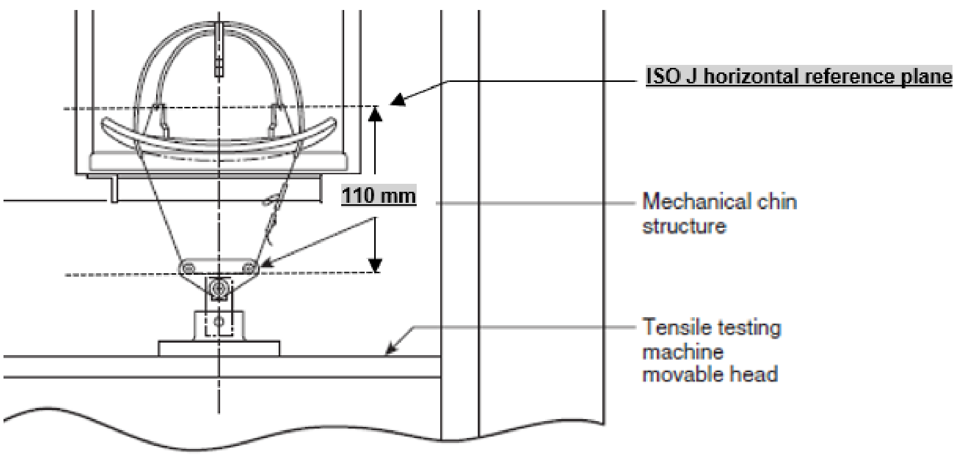

2.3.5 ASTM Publications.

~~ASTM D5034, Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test), 2021.~~

ASTM D5035, *Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)*, 2011, reapproved 2019.

9.3.19.4.1

Fastener tape breaking strength shall be measured in accordance with ASTM D503~~4~~5, *Standard Test Method for Breaking ~~Strength~~Force and Elongation of Textile Fabrics (~~Grab Test~~Strip Method)*, with the following modifications:

(1) Specimens shall be tested in the provided width only in lieu of the specified 100 mm (3.9 in.) width.

(2) Only specimens parallel to the length of the tape shall be tested.

9.4.2.4.1

Specimens shall be tested at 172 kPa (25 psi) in accordance with ASTM D751, *Standard Test Method for Coated Fabrics, Hydrostatic Resistance,* Procedure A.

9.7.1.3.3
The thickness of each specimen shall be measured in accordance with ASTM D1777, Standard Test Method for Thickness of Textile Materials within 4 hours of removal from conditioning as described in ASTM D1776.

9.7.1.3.4
The weight of each specimen shall be measured in accordance with the method in ASTM D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric within 4 hours of removal from conditioning as described in ASTM D1776.

9.7.2.2 Samples.
Samples shall be conditioned in accordance with 9.1.3~~at a temperature of 35°C ± 2°C and a relative humidity of 40 percent ± 5 percent~~ for at least 4 hours.

9.8.2 Faceshield/Goggle Component Lens ~~Trim~~ Luminous (Visible) Transmittance Test

9.8.11.4.3.3*
The SCBA facepiece shall be sized to fit the test technician and be obscured according to the following:
(1) An adhesive vinyl shall be adhered to the external side of the viewing area of the facepiece.
(2) The vinyl shall be hazed so that there is a maximum of 71 percent blackout and a minimum of 50 percent blackout.
(3) The vinyl shall cover enough of the viewing area so that the test technician cannot perform the test without looking through the blackout area.

9.8.11.4.4
One particulate-blocking hood certificate as compliant with this standard shall be provided.

9.8.12.4.1.1 Specimens shall be subjected to ten cycles of laundering and drying using Machine Cycle 1, Wash Temperature V, and Drying Procedure Ai of AATCC LP1 ~~TM 135~~, *Home Laundering: Machine Washing* ~~*Test Method for Dimensional Changes of Fabrics after Home Laundering*~~.

9.8.12.11 Specific Requirements for Testing Nonvisual/Machine-Readable Tags.

9.8.12.11.1 Garment, hood, and glove n~~N~~onvisual/machine-readable tags shall be tested to 9.8.12.4.1 and 9.8.12.4.3 only.

9.8.12.11.1.1 Footwear nonvisual/machine-readable tags shall be tested to 9.8.12.4.3 only.

9.8.12.11.2 For testing after laundering, garment specimens shall include tags attached to a 1 m^2 (1 yd^2) square of ballast material no closer than 51 mm (2 in.) apart in parallel strips. The ballast material shall be a material that meets the outer shell requirements of this standard.

9.8.12.11.2.1 For testing after laundering, hood specimens shall include complete hoods with tags attached.

9.8.12.11.2.2 For testing after laundering, glove specimens shall include complete gloves with tags attached. For the drying cycles of the laundering durability test specified in 9.8.12.4.1.1, gloves shall be tumble dried for 60 minutes and shall be removed immediately at the end of the drying cycle. At the conclusion of the final drying cycle, the gloves shall be direct dried on a forced-air, non-tumble-drying
mechanism operated at 10°C ± 5°C (18°F ± 9°F) above current room temperature until dry but not less than 8 hours.

9.8.12.11.3 For testing after convective heat exposure, garment specimens shall include tags attached to a separate

380 mm ± 13 mm (15 in. ± 1⁄2 in.) square of material that meets the outer shell requirements of this standard.

9.8.12.11.3.1 For testing after convective heat exposure, hood specimens shall include tags attached to a separate 380 mm ± 13 mm (15 in. ± 1⁄2 in.) square of hood material that meets the hood material requirements of this standard.

9.8.12.11.3.2 For testing after convective heat exposure, glove specimens shall include complete gloves with tags attached.

9.8.12.11.3.3 For testing after convective heat exposure, footwear specimens shall include complete footwear items with tags attached or representative sections of the footwear with tags attached.

9.8.12.11.4 Sample conditioning shall be the same conditioning as specified for the respective tests.

9.8.12.11.5 Garment, hood, and glove s~~S~~pecimens shall be tested separately for functionality after laundering and heat durability tests as specified in 9.8.12.4.1 and 9.8.12.4.3 respectively.

9.8.12.11.5.1 Footwear specimens shall be tested separately for functionality after the heat durability test as specified in 9.8.12.4.3 only.

9.8.12.11.6 Specimens shall be tested for functionality within 15 minutes of removal of the respective conditioning.
9.9.1.4.1
Specimens shall be tested using five cycles of the laundering procedure in 9.1.2~~9.1.12~~.

9.9.3.2 Sample Preparation.
Garment, helmet, and hood samples shall be subject to five cycles of laundering conditioning as specified in 9.1.2~~9.1.12~~.

9.11.2.2
A minimum of six samples shall be prepared for each moisture barrier material and a minimum of ~~three~~six samples for each moisture barrier seam.

9.11.2.3
Moisture barrier material and moisture barrier seam specimens shall be tested after being twice subjected to the following conditioning process:
1. Specimens shall be subjected to the procedure specified in 9.1.2~~9.1.12~~.

A.9.4.3.4.2 The list of common fireground chemicals is intended to provide a number of substances to which fire fighters might be exposed during ordinary fireground and other emergency operations. It is not intended to be an all-inclusive list of hazardous liquids to which fire fighters might be exposed while wearing protective clothing.

~~In 2015, the list was reviewed by a task group of the NFPA Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment. The investigation involved a review of information indicating differences in the effect of hydraulic fluid on moisture barrier materials; an examination of the types of hydraulic fluids used throughout industry, including those in fire service tools; and a detailed survey with more than 1500 responses that addressed fire service member exposure to different liquids on the fireground, including hydraulic fluid. These findings, including the survey results, are captured in supplemental material that was made available to NFPA. As a result of this investigation, it was concluded that different types of fire-resistant hydraulic fluid are still in use throughout a variety of industries, and that some of these hydraulic fluids contain low molecular weight phosphate esters. It was further concluded that most gasoline contains ethanol, and that antifreeze fluid, which predominantly contains ethylene glycol, is frequently encountered and should be added to the list of the original five fireground liquid chemicals.~~

The list of chemicals is used in the evaluation of the liquid penetration resistance of moisture barriers provided in structural and proximity fire-fighting protective ensemble elements with the objective that moisture barrier materials and seams should not allow the penetration of these liquids through the element onto the fire fighter’s skin. This penetration might occur as the result of the liquid causing degradation of the moisture barrier material or seam. In some cases, such as in glove and footwear elements, it might not be possible to inspect the moisture barrier.

Statement of the problem and substantiation for the TIA

Changes to 8.1.27, 8.2.8, 8.4.17, 8.5.11

Adding the contamination removal efficiency test for garment composite materials as this was not meant to be removed during second draft. The first draft document contained this language in 8.1.29 and there is no record of a second revision to remove it.

Moving 8.4.17 section: This test reference is in the performance requirement section that covers both structural and proximity firefighting helmets (8.4). The statement only references helmet ear covers and should therefore be moved to the performance requirement section that covers structural firefighting helmets only (8.5). This TIA moves this test reference to 8.5.

Adding textile-based for helmets: This TIA also adds the clarification of textile-based suspension and retention system materials. The intention of this requirement and the capability of this testing is for textile-based materials. This clarification will eliminate the evaluation of foam, plastic, etc. components that cannot be evaluated with this testing and were not intended for evaluation. The use of the wording "textile-based" is aligned with the wording in 7.4.9, Acceptable Levels of Restricted Substances for helmet materials.

Changes to 8.7.6, 8.7.7, 8.7.8

Correcting test method section number and name: SR-13 contained language to change the glove body flame performance requirement from specifying test method 9.4 Flame Resistance Test 3 to 9.2.17 Small-Scale Flash Fire Exposure Test. SR-13 did not pass ballot. As a result, CC-13 reverted the language back to the language in the 2018 edition. SR-82, an SR related to SR-13, removed 9.4 Flame Resistance Test 3. SR-82 did pass ballot. Therefore, the 2018 edition language references a test method that is no longer in the revised draft standard. This TIA changes the referenced test method section and name for all three glove flame performance requirements (8.7.6 - 8.7.8) to 9.2.3 Flame Resistance Test 3. A separate TIA is being submitted along with this TIA to add Flame Resistance Test 3 back into the new edition under section number 9.2.3.

Also adding back external nonvisual/machine-readable tags within 8.7.6: FR-89 included the addition of external nonvisual/machine-readable tags for glove body flame resistance evaluation. When SR-13, which addressed 8.7.6, did not pass ballot, the text for 8.7.6 was reverted to the 2018 edition via CC-13. This removed the requirement from FR-89 for external nonvisual/machine-readable tags inadvertently.

Changes to 8.13.11

Rearranged language so that testing does not appear to be compulsory. Testing is only required if data is requested (by an AHJ, for example) to be reported in the User Information. Also moved this to the structural hoods only since this aligns the requirements with the garments.

Changes to 9.1.12

During the first draft meeting, section 9.1.12 was updated to reflect wash temperatures and cycles that were supposed to align the preconditioning more closely with what actually happens during product use. During the second revision, the committee reverted that decision and moved this wash method back to only being used on gloves. As a result, the wash procedure should have been reverted as well. These revisions change the conditioning requirements back to those that were in the 2018 edition of NFPA 1971.

Changes to 9.1.18.4

Updating the mandrels to align with current equipment used in the lab as well as what is required in order to test the specimens as outlined in the tear resistance test method. Also adding a description and annex that includes figures for where to take the measurements for clarity.

Changes to 9.1.21.2

Samples updated to reflect outer shells instead of composites, since the sample being tested under this conditioning is outer shells and not composites. Also correction to reference for flexing.

Changes to 9.2.3

Test method: SR-13 contained language to change the glove body flame performance requirement from specifying test method 9.4 Flame Resistance Test 3 to 9.2.17 Small-Scale Flash Fire Exposure Test. SR-13 did not pass ballot. As a result, CC-13 reverted the language back to the language in the 2018 edition. SR-82, an SR related to SR-13, removed 9.4 Flame Resistance Test 3. SR-82 did pass ballot. Therefore, the 2018 edition language references a test method that is no longer in the revised draft standard. This TIA adds Flame Resistance Test 3 back into the standard under section number 9.2.3. The language in this TIA reverts back to the same language for Flame Resistance Test 3 from the 2018 edition except for updated section number references to align with the new edition, plus clarification language regarding char length determination that was approved under FR-90.

Changes to 9.2.4.4.1

During the editing process related to FR-71 and/or SR-21, both for footwear Flame Resistance Test 4, language from this flame test was inadvertently added to the apparatus section of 9.2.4 Heat and Thermal Shrinkage Resistance Test. This language does not apply. This TIA removes this language.

Changes to 9.1.18.2, 9.2.4.4.3, 9.2.7.3.2, 9.2.7.3.3, 9.2.10.3.2, 9.2.14.3.5, 9.2.14.3.6, 9.2.15.8.2, 9.2.15.8.3, 9.2.16.3.3, 9.2.16.3.4, 9.7.1.3.3, 9.7.1.3.4

Adding a time frame for which the specimens must be measured after removal from conditioning. Since conditioning may impact the results, it is important to obtain measurements before the specimen is brought back to ambient.

Changes to 9.2.4.8

This section no longer relates to moisture barriers.

Changes to 9.2.4.9.1.2

This test method refers to ASTM F2894, which then refers to AATCC 135 for marking specimens for shrinkage. The benchmarks referenced in AATCC 135 are 10 inch benchmarks and not 12 inch.

Changes to 9.2.4.14.13

Text was added to this section under FR-97 that referred to a height per footwear size methodology that was added to 7.10.3 under FR-95. However, the height per footwear size methodology was removed under SR-160 and 7.10.3 reverted to requiring one height for all footwear sizes. The change in text under this TIA removes the reference to a height per size methodology that is no longer in the standard and instead inserts the specific water line height that applies (25 mm below the minimum footwear height of 250 mm). This TIA does not change the way the waterline is determined.

Changes to 9.2.7.7.2

Other reference correction was made.

Changes to 9.2.15.9

A standardized wetting procedure already exists. Referenced 9.1.9 Wet Conditioning Procedure 2 for Glove Composites, with modifications. The reference to a "spacer" implies a reference to the 6.4 mm thick upper mounting plate as defined in ASTM F2731. Removal of this mounting plate removes the means of holding the specimen in place. Methods of holding the specimen in place are proposed, with a minimum thickness and tolerance.

Changes to 9.2.17

Removing this test method due to there being no performance requirements utilizing this test method (also see changes to 8.7.6-8.8.8, and 9.2.3).

Changes to 9.2.10.2.1.1 and 9.2.10.2.1.2 (including new sections 7.1.15 and 7.1.16)

The design requirements related to reinforcement composites is buried within the test method instead of in the design requirements where it should be. This change moves that already existing requirement into the design chapter. This is an editorial move only as the requirement was already present.

Changes to 9.3.8.4.1, 9.3.9.4.1, A.8.34.5.4, A.9.3.9.4.2

The Helmet Retention System Test (9.3.8) was changed under FR-74 to include aligning the test fixture with the test fixture specified in the Helmet Shell Retention Test (9.3.9). However, 9.3.8.4.1 still contains a reference to the test fixture in 9.3.10. This was an editorial error in previous editions and was not caught during the changes made in FR-74. For the text fixture specified in 9.3.9 Helmet Retention System Test to be correct, the test fixture specified in 9.3.8 Helmet Shell Retention Test also has to be correct.

A.9.3.9.4.2: Replacing the figure of the test set up from the 2018 edition with the test set up under FR-74. This replacement figure was included in the original public input (No. 269) but inadvertently left out of FR-74.

A.9.3.9.5.4: This last statement no longer applies with the test fixture changes made under FR-74.

Changes to 9.3.1.1.2.4

Correcting reference. 9.1.22 refers to footwear conditioning, however this should be 9.1.21

Changes to 2.3.5 and 9.3.19.4.1

The reference to ASTM D5034 is inappropriate considering the revision to A-A-55126C. A-A-55126C references ASTM D5035, which specifies a grip width of at least 10mm wider than the specimen. ASTM D5034 specifies 1x1 or a 1x2 inch grips. Specimens are to be tested in the provided width per 9.3.19.4.1. A-A-55126C specifies requirements for materials up to 4 inches in width.

ASTM D5034 does not accommodate materials wider than 1 inch. ASTM D5035 is appropriate for all materials, including those exceeding 1 inch in width.

Changes to 9.4.2.4.1

During the update under SR-36, the test method was updated to show the correct title for ASTM D751. However, there are over 30 methods within ASTM D751 and therefore this revision is being added to be clear about which part of ASTM D751 applies.

Changes to 9.7.2.2

Updating conditioning to be consistent with testing as it is performed in other PPE standards, and within this document for other tests.

Changes to 8.5.4, 8.6.10, 9.8.2

During editing of the second draft, the incorrect term “Trim” was used, but this test method applies to Faceshield/Goggle Component Lenses. This TIA replaces the word Trim with the naming convention used for other faceshield/goggle component lens tests.

Changes to 9.8.11.4.3.3

There was no minimum added during the revision process and if there is no minimum, then no blackout would be required. Added a minimum level so that there is consistency with the materials used.

Changes to 9.8.12.11 (subsections)

Aligns with top-loading wash method changes found in 9.1.2 under SR-31.

Specific Requirements for Testing Nonvisual/Machine-Readable Tags is a new section introduced under FR-152 that addresses testing of nonvisual/machine-readable tags. This new section addressed the specific requirements utilized for traditional labels for garments but did not consider the specific requirements utilized for traditional labels for hoods (in 9.8.12.8), gloves (in 9.8.12.9), or footwear (in 9.8.12.10). The specific specimen preparation and test requirements for nonvisual/machine-readable tags for hoods, gloves, and footwear should align with the specific requirements for traditional labels for these product types. These revisions add the same specific sample preparation and test requirements specified for traditional labels for these product types found under the respective sections referenced above.

Changes to 9.11.2.2

Changing the necessary specimens from three to six since there are two tests to perform, according to 9.11.4 where three are required for item (3) and three are required for item (4).

Changes to A.9.4.3.4.2

The type of hydraulic fluid specified in 9.4.3, Liquid Penetration Resistance Test, was changed under SR-52. The committee statement for SR-52 is as follows: Phosphate ester based fire-resistant hydraulic fluid is not a “common fire ground hazard” as would be required for this list (Annex B - Description of Performance Requirements and Test Methods for NFPA 1971 states in B.2 Garments, 7.1.15 - "The Liquid Penetration Resistance Test is used to evaluate whether or not the garment's moisture barrier and seams resist penetration of liquids meant to be representative of those commonly encountered on the fireground."). Phosphate ester based fire-resistant hydraulic fluid has been phased out by hydraulic rescue tool manufacturer (since 2008), and is not commonly used in any form of application outside the aviation industry. Current tactics and practices of pump-&-roll extinguishment for aviation incidents ensures that any such low frequency occurrence poses little risk from this hazard. As such this specific fluid hazard is not representative of the common hazards structural firefighting PPE will encounter. However, a more common hydraulic fluid used in rescue tools is specified in its place. This TIA removes the annex item related to the use of phosphate ester based hydraulic fluids.

All other changes were corrections to references.

Emergency Nature of the Proposed TIA*

Select one or all that apply as to why you believe the TIA is of an Emergency Nature:

- ☒ The standard contains an error or an omission that was overlooked during the regular revision process.
- ☐ The NFPA Standard contains a conflict within the NFPA Standard or within another NFPA Standard.
- ☐ The proposed TIA intends to correct a previously unknown existing hazard.
- ☐ The proposed TIA intends to offer to the public a benefit that would lessen a recognized (known) hazard or ameliorate a continuing dangerous condition or situation.
- ☐ The proposed TIA intends to accomplish a recognition of an advance in the art of safeguarding property or life where an alternative method is not in current use or is unavailable to the public.
- ☐ The proposed TIA intends to correct a circumstance in which the revised NFPA Standard has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety) justification for the action.

***NOTE: a TIA cannot be processed without identification of Emergency Nature above.**

Detailed Bases Supporting That the TIA Is of an Emergency Nature Requiring Prompt Action:

The changes in this TIA are all corrections or revisions to the standard that allow the testing labs and certification organizations the ability to consistently apply the requirements to products they are testing and certifying. The technical content being changed was all discussed during the regular revision cycle, but due to the consolidation of the document and the reorganization of the paragraphs, several cross references or supporting information was missed. Without these changes, there would be significant room for interpretation of how to apply the standard.

Additional Requirements

Per Section 5.2(g) of the *Regulations Governing the Development of NFPA Standards,* please include the written agreement of at least two members of the responsible Technical Committee or Correlating Committee to the processing of the TIA. The agreement to the processing of the TIA is for the sole purpose to allow the TIA to be processed and does not imply support for the proposed text or emergency nature of the TIA.

Signature: Click here to enter text. **Date:** Click here to enter text.

Submit Completed Form and Required Committee Members' Support for Processing to:
Secretary, Standards Council • National Fire Protection Association at
TIAs_Errata_FIs@nfpa.org

Tentative Interim Amendment (TIA) Request Form

Submitter's Information

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Proposed TIA Information

NFPA Standard No.: NFPA 1970

Editions affected (Current and/or Proposed): Proposed

Proposed text of the TIA

Note: *Proposed text is to be in legislative text. Specifically, underscore new wording to be inserted (e.g. new text proposed) and strike-through to current text to be deleted (e.g. ~~current text proposed to be removed~~).*

7.13.3

The hood shall be designed to cover and provide the limited protection as specified within this section to the head, face, and neck areas, ~~except~~but not including the face opening specified in 7.13.6.

7.13.5*

The hood shall be donned properly, in accordance with the manufacturer's instructions for wearing, on the ISO size J headform specified in Figure 9.3.6.4.1.~~The single size or multiple sizes of the protective hoods shall demonstrate fit on each of the respective headforms specified in ISO 16900-5, *Respiratory protective devices — Methods of test and test equipment — Part 5: Breathing machine, metabolic simulator, RPD headforms and torso, tools and verification tools*, as specified in 7.13.5.1 through 7.13.5.3.~~

A.7.13.5

When designing hoods for proper fit, the headforms specified in ISO 16900-5, *Respiratory protective devices — Methods of test and test equipment — Part 5: Breathing machine, metabolic simulator, RPD headforms and torso, tools and verification tools* can provide a range of head sizes that should be considered when trying to properly fit a hood to a range of users.

7.13.5.1*

A single size or multiple sizes of the protective hoods shall be permitted.~~The hood shall be donned in accordance with the manufacturer's instructions for wearing on the respective headform that is fitted with a surrogate SCBA facepiece meeting the design requirements set forth by Chapter 17.~~

~~**A.7.13.5.1**~~

~~To aid in the determination of the requirements in 7.13.5.2 and 7.13.5.3, it is recommended that the headform be mounted on a pedestal. The suggested surrogate SCBA facepiece should meet the design requirements set forth in Chapter 17.~~

~~**7.13.5.3**~~

~~In this position, the hood shall provide minimum full coverage around the circumference of the reference plane as specified in Table 7.13.5.3.~~

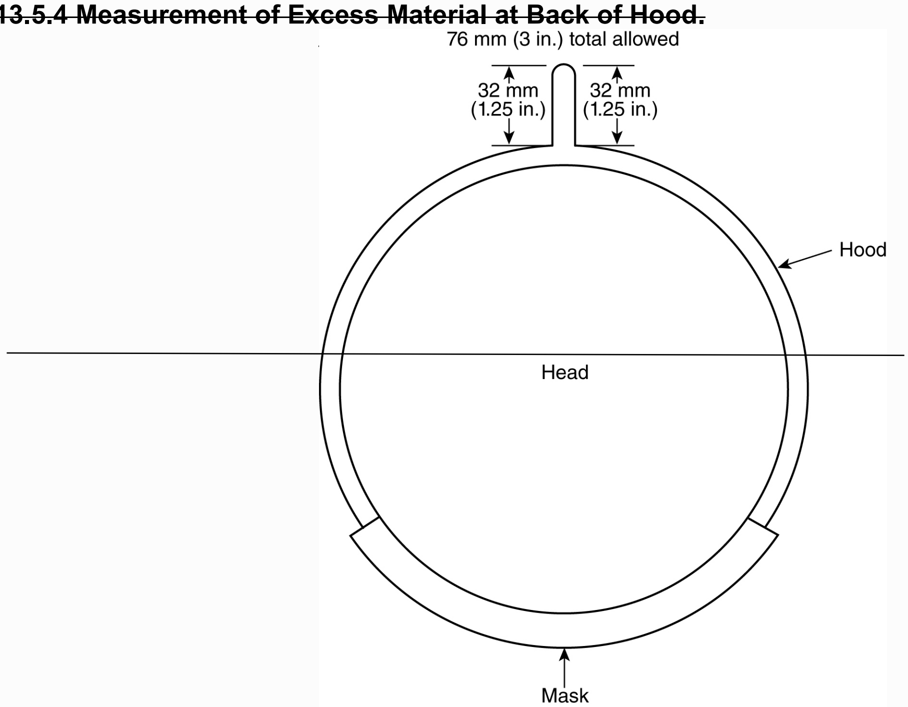
~~**Table 7.13.5.3 Minimum Coverage**~~

~~Size~~	~~Minimum Coverage~~
~~Small~~	~~400 mm (15.7 in.)~~
~~Short/Wide~~	~~410 mm (16.14 in.)~~
~~Medium~~	~~420 mm (16.5 in.)~~
~~Long/Narrow~~	~~430 mm (16.92 in.)~~
~~Large~~	~~440 mm (17.3 in.)~~

~~**7.13.5.4**~~

~~The hood shall further be evaluated for proper fit on the headform by vertically gathering the excess material of the hood at the back of the headform without stretching it at the intersection of the reference plane and the midsagittal plane does not result in an extension of the outermost layer of the hood from the headform that is more than 32 mm (1.25 in.) as illustrated in Figure 7.13.5.4.~~

~~**Figure 7.13.5.4 Measurement of Excess Material at Back of Hood.**~~



~~**7.13.5.5**~~

~~The conformity of the hood in the area adjacent to the SCBA facepiece up to 76 mm (3 in.) away from the SCBA facepiece seal on the headform shall lay flat against the headform surface.~~

7.13.5.3~~6~~*

~~Alternatively,~~ Hoods shall be provided in ~~a sufficient number of sizes~~sizes that accommodate the range of ~~specific~~ head sizes for both men and women as shown in Table 7.13.5.3. ~~based on achieving the accommodation of the 5th to 95th percentile dimensions in the following measurements as established in the NIOSH Firefighter Anthropometric Data Base:~~

~~(1) Bitragion arc length, sitting~~

~~(2) Head arc length, sitting~~

~~(3) Head circumference, sitting~~

Table 7.13.5.3 Sizing Requirements for Hoods

Measurement location	Men's sizing (mm)	Women's sizing (mm)
Bitragion arc length, sitting	343-384	327-366
Head arc length, sitting	328-386	306-371
Head circumference, sitting	553-601	538-582

A.7.13.5.3

The sizing specified is based on the hoods meeting the 5th to 95th percentile dimensions found in the NIOSH Firefighter Anthropometric Database. This information can be found online at www.cdc.gov/niosh.

8.14.1

Hood composite materials and seams including a particulate blocking layer shall be tested for particulate blocking as specified in Section 9.4.4, Particulate Blocking Test, and shall have a particulate filtration efficiency of 90 percent or greater for each particle size from 0.1 μm to 1.0 μm.

8.14.3

Where the manufacturer is required to report the results in the user information, h~~H~~ood composite materials including a particulate blocking layer shall be tested for transmitted and stored thermal energy as specified in Section 9.2.15, Transmitted and Stored Thermal Energy Test~~, where the manufacturer is required to report the results in the user information~~.

9.1.18 Flexural Fatigue Procedure for ~~Particle Barrier Layer and~~ Outer Shells.

9.4.4.1 Application.

This test shall apply to hood particulate-blocking layers and seams or hood composites comprising the function of the particulate-blocking layer and composite seams.

9.4.4.2.4

Sets of particulate-blocking-layer samples and composite seam samples shall be tested both before and after being twice subjected to the following conditioning~~ and sample size changes~~:

(1) Specimens shall be first subjected twice to the procedure specified in 9.1.2.
(2) Specimens shall then be conditioned as specified in 9.1.3.
(3) Specimens shall then be conditioned as specified in 9.1.5.

1. ~~Composite samples shall be conditioned as specified in 9.1.22 except for flexing.~~
2. ~~Composite samples shall be subject to flexing for 100 cycles.~~
3. ~~Composite samples shall be conditioned for UV light exposure as specified in 9.2.16.12.5(2).~~

9.4.4.3 Specimens.

9.4.4.3.1

The samples subjected to the full conditioning as specified in 9.4.4.2.4 shall become the particulate blocking test specimens.

9.4.4.3.1.1

Composite specimens and composite seam specimens shall be large enough to cover the testing area with sufficient overlap to prevent any particulate leakage.

9.4.4.3.1.2

Composite seam specimens shall be centered on the sample holder so that it is bisected by the seam.

9.4.4.3.2

The center of each conditioned sample shall be the specimen and considered to be the test area.

9.4.4.3.~~2~~3

All specimens to be tested shall be conditioned as specified in 9.1.3.

9.4.4.3.~~2~~4

All reference specimens to be tested shall be conditioned as specified in ~~9.1.18~~9.1.3.

9.4.4.3.~~3~~5

A total of three~~four~~ particulate-blocking layer composite specimens ~~representing two specimens from each material direction~~ and three composite seam specimens shall be tested for each condition. One reference specimen shall be tested.

9.4.4.5 Procedure.

9.4.4.5.1

Prior to conditioning in 9.4.4.2.4 and testing, the composite and composite seam samples shall be tested for air permeability in accordance with ASTM D737, *Standard Test Method for Air Permeability of Textile Fabrics*.

9.4.4.6.2

Where testing in 9.4.4.5 is waived due to the air permeability result, the air permeability shall be recorded and reported along with the following statement:

"PARTICULATE BLOCKING TEST WAIVED FOR [sample name and identification] BECAUSE AIR PERMEABILITY WAS MEASURED AS BEING BELOW THE DETECTION LIMIT OF ASTM D737 AND IS PRESUMED TO HAVE A PARTICULATE BLOCKING EFFICIENCY OF 99%~~90%~~ OR GREATER FOR EACH PARTICLE SIZE FROM 0.1 μm TO 1.0 μm."

Statement of the problem and substantiation for the TIA

The data provided in FR-51 does indicate that minimal testing was performed to validated the ISO headforms, and while the fit of the hood on the headform may have initially indicated the improvement of fit on the SCBA facepiece, the rest of the performance requirements in the standard were not aligned to allow this improved fit to occur. For example, the heat and thermal shrinkage and cleaning shrinkage testing still maintained the use of a face opening measuring device that did not change in size. Therefore the design criteria within this standard may be contradictory.

The purpose of 7.13.5 is to determine whether or not the hood is long enough in the bib area to ensure there is proper overlap between the coat, collar and the hood. It is not intended to be used to determine the fit of the hood to the respirator facepiece. The testing used to determine the fit of the respirator relies on the use of a standardized hood measuring device already contained within this standard.

Additionally, the method cannot be performed in a reproduceable manner as written due to the following issues:

1. The headforms described do not have reference or midsagittal planes indicated and therefore the measurements described in 7.13.5.2 are not possible.
2. 7.13.5.1 indicates to use an SCBA facepiece that conforms to chapter 17 of this standard. SCBA facepieces do not have the same shape or circumference, and therefore the selection of the SCBA facepiece would be performed by the testing laboratory. The test labs could select different masks and therefore performance would not be consistent.
3. 7.13.5.4 is a highly subjective method for determining fit of the hood. Further investigation needs to be done in order to determine if this is a reproducible method for determining fit of the hood.

When compared to NFPA 1971-2018 conditioning (NFPA 1971-2018, 8.27.3.4), specimens conditioned per the proposed multi-environment conditioning (NFPA 1970 2nd Draft, 9.4.4.2.4) have comparable or higher average percent particulate blocking efficiency.

The below data shows that the proposed conditioning procedure to introduce more rigor was not achieved and the effort and timing associated with the proposed conditioning procedure is not resulting in the perceived gains. As demonstrated by the data below, the conditioning as outlined in the 2018 edition of the standard, results in the lowest test result on average.

Maintaining the conditioning procedures as described in NFPA 1971-2018, for composites, and extending to seams currently reflects the most rigorous conditioning procedure that has been evaluated.

Table 1 - Composites					
ID	Particulate Blocking Efficiency (%)				
	NFPA 1971-2018				**NFPA 1970**
	As Received		Conditioned		Multi-Environment
	%	ST.DEV.	%	ST.DEV.	%
A	98.84	0.92	98.94	0.61	99.06
C	94.80	1.38	92.70	1.08	94.67
D	99.92	*No Data*	99.98	*No Data*	99.73
E	99.21	0.47	98.80	1.12	99.82
Avg	98.19	-	97.61	-	98.32

Table 2 - Seams			
ID	Particulate Blocking Efficiency (%)		
	NFPA 1971-2018		**NFPA 1970**
	As Received	Conditioned	Multi-Environment
F	93.44	*No Data*	96.26
H	95.75	*No Data*	95.98
I	96.03	*No Data*	96.53
J	93.73	*No Data*	99.15
K	97.15	*No Data*	98.22
L	93.53	*No Data*	99.50
Avg	94.94	-	97.61

The relationship between as received and conditioned samples for seams is as expected. Particulate blocking efficiency is improved with laundering and convective heat exposure. Needle holes formed during seam construction shrink during the conditioning procedures, increasing the particulate blocking efficiency.

Table 3 – Material Key		
ID		Composite Type
Composite	Seams	
A	F	Knit / Laminated Knit PB
C	H, I	Knit / Spunlace / Knit (Quilted)
D	J	Knit / Spunlace / Knit (Laminated) - 1
E	K, L	Knit / Spunlace / Knit (Laminated) - 2

By excluding the flexing portion of the proposed conditioning, neither the conditioning nor the method is impacted by material direction. Three specimens are required for composite specimens (NFPA 1971-2018), and three are proposed for the composite seam specimens, as well.

The number of seam specimens was not specified. Clarified that three specimens are required for each condition.

The second draft language of “90% of greater” is related to the NFPA 1970 performance requirement, not the actual performance of the composite. Historical test results for air-impermeable products support the change to report “99% OR GREATER.” Reporting otherwise is misleading and misrepresents the product performance.

Emergency Nature of the Proposed TIA*

Select one or all that apply as to why you believe the TIA is of an Emergency Nature:

☐ The standard contains an error or an omission that was overlooked during the regular revision process.

☐ The NFPA Standard contains a conflict within the NFPA Standard or within another NFPA Standard.

☐ The proposed TIA intends to correct a previously unknown existing hazard.

☐ The proposed TIA intends to offer to the public a benefit that would lessen a recognized (known) hazard or ameliorate a continuing dangerous condition or situation.

☐ The proposed TIA intends to accomplish a recognition of an advance in the art of safeguarding property or life where an alternative method is not in current use or is unavailable to the public.

☒ The proposed TIA intends to correct a circumstance in which the revised NFPA Standard has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety) justification for the action.

***NOTE: a TIA cannot be processed without identification of Emergency Nature above.**

Detailed Bases Supporting That the TIA Is of an Emergency Nature Requiring Prompt Action:

The changes contained in this TIA are intended to correct the standard so that it can be applied consistently between laboratories as it relates to the hood design requirement changes. If these changes are not implemented, the same hood could be considered compliant at one laboratory and non-compliant at another laboratory. Additionally, the multienvironment conditioning did not prove to be a test for durability like it was intended and therefore could reduce the requirements for hoods with no justification for this testing adjustment.

Additional Requirements

Per Section 5.2(g) of the *Regulations Governing the Development of NFPA Standards,* please include the written agreement of at least two members of the responsible Technical Committee or Correlating Committee to the processing of the TIA. The agreement to the processing of the TIA is for the sole purpose to allow the TIA to be processed and does not imply support for the proposed text or emergency nature of the TIA.

Signature: Click here to enter text. **Date:** Click here to enter text.

Submit Completed Form and Required Committee Members' Support for Processing to:
Secretary, Standards Council • National Fire Protection Association at
TIAs_Errata_FIs@nfpa.org

Tentative Interim Amendment (TIA) Request Form

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Proposed TIA Information

NFPA Standard No.: NFPA 1970

Editions affected (Current and/or Proposed): Proposed

Proposed text of the TIA

Note: *Proposed text is to be in legislative text. Specifically, underscore new wording to be inserted (e.g. new text proposed) and strike-through to current text to be deleted (e.g. ~~current text proposed to be removed~~).*

[Changes to Chapter 4]

~~**4.1.7**~~

~~The certification organization shall not issue any new certifications based on the following standards on or after the NFPA effective date of the 2024 edition of NFPA 1970:~~

1. ~~2018 edition of NFPA 1971~~
2. ~~2019 edition of NFPA 1975~~
3. ~~2019 edition of NFPA 1981~~
4. ~~2018 edition of NFPA 1982~~

~~**4.1.8**~~

~~The certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2018 edition of NFPA 1971, the 2019 edition of NFPA 1975, the 2019 edition of NFPA 1981, or the 2018 edition of NFPA 1982 on the effective date of the 2024 edition of NFPA 1970, plus 18 months.~~

~~**4.1.9**~~

~~The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2018 edition of NFPA 1971, the 2019 edition of NFPA 1975, the 2019 edition of NFPA 1981, or the 2018 edition of NFPA 1982 from all products that are under the control of the manufacturer on the effective date of the 2024 edition of NFPA 1970, plus 18 months, and the certification organization shall verify that this action is taken.~~

[Changes to Chapter 5]

5.2.1

The process of certification for structural and proximity ensembles as being compliant with Chapters 5 through 9 of this standard shall meet the requirements of Sections 4.1 through 4.9

5.2.2

~~The respiratory protection shall be a specific model self-contained breathing apparatus (SCBA) that is certified as compliant with Chapters 15 through 19 of this standard.~~All compliant products that are labeled as being compliant with Chapters 5 through 9 of this standard shall meet or exceed all applicable requirements specified in Chapters 5 through 9 and shall be certified.

5.2.3
The certification organization shall not issue any new certifications based on the 2018 edition of NFPA 1971 after the NFPA effective date of the 2024 edition of NFPA 1970.

5.2.4
The certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2018 edition of NFPA 1971 on the effective date of the 2024 edition of NFPA 1970, plus 12 months.

5.2.5
The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2018 edition of NFPA 1971 from all products that are under the control of the manufacturer on the effective date of the 2024 edition of NFPA 1970, plus 12 months, and the certification organization shall verify that this action is taken.

<renumber subsequent paragraphs>

[Changes to Chapter 10]

10.2.3
The certification organization shall not issue any new certifications based on the 2019 edition of NFPA 1975 after the NFPA effective date of the 2024 edition of NFPA 1970.

10.2.4
The certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2019 edition of NFPA 1975 on the effective date of the 2024 edition of NFPA 1970, plus 12 months.

10.2.5
The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2019 edition of NFPA 1975 from all products that are under the control of the manufacturer on the effective date of the 2024 edition of NFPA 1970, plus 12 months, and the certification organization shall verify that this action is taken.

<renumber subsequent paragraphs>

[Changes to Chapter 15]

15.2.5
The certification organization shall not issue any new certifications based on the 2019 edition of NFPA 1981 after the NFPA effective date of the 2024 edition of NFPA 1970.

15.2.6
The certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2019 edition of NFPA 1981 on the effective date of the 2024 edition of NFPA 1970, plus 18 months.

15.2.7
The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2019 edition of NFPA 1981 from all products that are under the control of the manufacturer on the effective date of the 2024 edition of NFPA 1970, plus 18 months, and the certification organization shall verify that this action is taken.

<renumber subsequent paragraphs>

[Changes to Chapter 20]

20.2.2
The certification organization shall not issue any new certifications based on the 2018 edition of NFPA 1982 after the NFPA effective date of the 2024 edition of NFPA 1970.

<u>20.2.3</u>
<u>The certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2018 edition of NFPA 1982 on the effective date of the 2024 edition of NFPA 1970, plus 18 months.</u>

<u>20.2.4</u>
<u>The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2018 edition of NFPA 1982 from all products that are under the control of the manufacturer on the effective date of the 2024 edition of NFPA 1970, plus 18 months, and the certification organization shall verify that this action is taken.</u>

<renumber subsequent paragraphs>

Statement of the problem and substantiation for the TIA

Within the NFPA 1971 certification chapter, there was no requirement to conform with the requirements of 4.1 through 4.9, this is being added back into the requirements.

The existing 5.2.2 is being removed since this refers to respiratory protection and should not be included within the certification chapter for NFPA 1971 ensembles.

During the revision process, the implementation time was updated to reflect that the certification of products to the 2024 edition of NFPA 1970 must occur within 18 months from the standard being issued. This timeline was increased from the historical 12 months due several other PPE and Emergency Response documents updating to that timeline. However, due to the significant changes being made to the ensemble chapters (NFPA 1971 and NFPA 1975), there is a need to reduce the implementation time to 12 months so that new products are made available to the industry in a shorter timeframe which will positively impact the health and safety of the fire service. In order to reduce the timeline for two of the NFPA standards, the requirement had to be moved into those individual certification chapters.

Emergency Nature of the Proposed TIA*

Select one or all that apply as to why you believe the TIA is of an Emergency Nature:

☐ The standard contains an error or an omission that was overlooked during the regular revision process.

☐ The NFPA Standard contains a conflict within the NFPA Standard or within another NFPA Standard.

☐ The proposed TIA intends to correct a previously unknown existing hazard.

☒ The proposed TIA intends to offer to the public a benefit that would lessen a recognized (known) hazard or ameliorate a continuing dangerous condition or situation.

☐ The proposed TIA intends to accomplish a recognition of an advance in the art of safeguarding property or life where an alternative method is not in current use or is unavailable to the public.

☐ The proposed TIA intends to correct a circumstance in which the revised NFPA Standard has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety) justification for the action.

***NOTE: a TIA cannot be processed without identification of Emergency Nature above.**

Detailed Bases Supporting That the TIA Is of an Emergency Nature Requiring Prompt Action:

This amendment reduces the timeline for certification to the new standard so that the new technologies become available to the fire service within a shorter amount of time.

Additional Requirements

Per Section 5.2(g) of the *Regulations Governing the Development of NFPA Standards,* please include the written agreement of at least two members of the responsible Technical Committee or Correlating Committee to the processing of the TIA. The agreement to the processing of the TIA is for the sole purpose to allow the TIA to be processed and does not imply support for the proposed text or emergency nature of the TIA.

Signature: Click here to enter text. **Date:** Click here to enter text.

Submit Completed Form and Required Committee Members' Support for Processing to:
Secretary, Standards Council • National Fire Protection Association at
TIAs_Errata_FIs@nfpa.org

AGENDA ITEM #6a ATTACHMENT

PUBLIC COMMENTS FOR COMMITTEE ACTION

Public Comment No. 1, Assigned to FAE-SPF, Refer to FAE-RPE

Public Comment No. 1-NFPA 1850-2024 [Global Input]

Sections 1.1, 1.2

The correlating committee identified that different approaches in scoping for the consolidated document are used and that a joint effort to reexamine the provided narrative will improve the overall understanding that how each technical committee differently approaches selection, care and maintenance. The correlating committee directs the Technical Committees on Respiratory Protective Equipment, and Structural Firefighting Protective to consider changes to scope statements to better reflect the unique nature of requirements in NFPA 1852 as related to selection, care, and maintenance of SCBA as contrasted to those in NFPA 1851 and provide harmonization as deemed appropriate.

Additional Proposed Changes

File Name	Description	Approved
1850_CustA2025_FAE_AAC_FD_CorrelatingNotes.pdf	1850_CCNote_No.1	

Statement of Problem and Substantiation for Public Comment

See First Revision No. 32

Related Item

- First Revision No. 32

Submitter Information Verification

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Submittal Date: Tue Mar 19 11:12:33 EDT 2024
Committee: FAE-SPF

Public Comment No. 25-NFPA 1850-2024 [Global Input]

Advancing the requirement for certified ISPs to have to achieve a minimum average contaminant removal of 70% is necessary to best protect end user fire fighters for the inherent dangers of PAH and S-VOC exposure. It is also within the capabilities of ISPs through advanced cleaning at 49C (120F) wash temperatures.

Statement of Problem and Substantiation for Public Comment

70% laundering efficacy is a compromise to a desire by end users to have truly clean PPE post-laundering. It is imperative that advances to the present requirements for ISPs occurs through increased contaminant removal.

Related Item

- 11.1.1.1 Table

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Public Comment No. 46-NFPA 1850-2024 [Global Input]

Move Chapter 7 Cleaning and Decontamination (NFPA 1851) to before Chapter 6 Inspection (NFPA 1851).

Statement of Problem and Substantiation for Public Comment

Multiple persons working on the PPE Technician material, including fire department and ISP members, will not conduct an inspection without cleaning gear and would like the chapter order of the standard to reflect that. It makes more sense for the fire service if the chapters of the standard are in the order of operations.

Related Item

- FR-91

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 47-NFPA 1850-2024 [Global Input]

Remove all requirements for, and references to, “PPE Technician”, . Specifically, Remove 4.1.1.5, 4.1.2.3, 4.1.3.5, 4.2.2.1*, A.4.2.2.1, and all references to “PPE Technician” after 4.2.4

Remove "Verified Training Organization" and all language added throughout the document in conjunction with "PPE Technician" and, specifically, to the table in 4.3.4

Statement of Problem and Substantiation for Public Comment

Much work has been done to refine the PPE Technician requirements included in the First Draft based on feedback received from the committee and the simplest way to implement these changes is to remove all references to PPE Technician in the First Draft. Additional Public Comments will be submitted to update the definition for PPE Technician (and the related annex) and add a definition for PPE Manager (with a related annex); insert one requirement for an organization to assign a PPE Manager/PPE Technician to their program (with related annex material); and add an Annex focused on the PPE Manager/PPE Technician roles, responsibilities, and training curriculum.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 48-NFPA 1850-2024 [Section No. 3.3.122.1]	
Public Comment No. 51-NFPA 1850-2024 [Section No. 4.2.4]	
Public Comment No. 53-NFPA 1850-2024 [Global Input]	
Public Comment No. 77-NFPA 1850-2024 [Section No. 4.3.4]	

Related Item

• FR-32 • PI-141 • PI-149 • PI-150 • PI-48 • PI-234 • PI-256 • PI-258 • PI-259 • PI-260 • PI-36 • PI-155 • PI-261 • PI-26

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Committee: FAE-SPF

Public Comment No. 53-NFPA 1850-2024 [Global Input]

ADD NEW ANNEX E PPE MANAGER and PPE TECHNICIAN

PPE Management Program

The AHJ needs to establish a PPE Program for Structural Firefighting gear. The program should have a PPE Manager and a minimum of one Technician(s) position (which could be the same individual).

PPE Manager

A PPE Manager is a managerial role within a fire department or organization responsible for overseeing the entire lifecycle of firefighter Personal Protective Equipment (PPE).

While following all the requirements of this standard, the functions of the PPE Manager include, but are not limited to:

- **Maintaining an understanding of current NFPA Standards (e.g. NFPA 1970) as well as other required standards and laws (e.g. OSHA) for the purchase of appropriate PPE.**
- **Reviewing the Department Operations to complete a Risk Assessment for the type of PPE required.**
- **Establishing Policy and Procedures for the proper use and care of PPE within the organization. The Policy and Procedures must be re-evaluated periodically. (A best practice is to review these at least annually.)**
- **Establishing a system to Monitor, Track and document PPE over its life**
- **Determining the useful life of the PPE**
- **Establishing criteria for assessing PPE selection.**
- **Actively participating in the selection of the department's PPE.**
- **Establishing processes for returning product that does not meet specifications.**
- **Following retirement and disposal criteria of PPE.**
- **Establishing procedures for the inspection, cleaning, and repair of PPE.**
- **Establishing a process for the fitting of gear for firefighters.**
- **Developing a Training program specific for the job functions of the PPE Technician(s).**
- **Developing and implementing a Training program for the entire department detailing the proper fit, function, limitations, and handling of PPE as well as the expected inspection and routine cleaning [MS1] of PPE. The Manager may train and assign the PPE Technician (or other indidividual) to deliver departmental training.**
- **Assisting with, including providing input to, the budgeting process and strategic planning related to PPE acquisition and maintenance.**
- **Establishing exposure procedures and controls for the handling of contaminated PPE sent for cleaning, inspection, and/or repair.**
- **Representing the organization (or assigning a designee) as the primary point of contact with**

the element manufacturer and/or verified ISP for matters pertaining to the PPE maintenance and repairs.

PPE Technician:

The PPE Technician(s) is an individual(s) who is assigned and has received specialized training for the care and maintenance of the department's PPE. The technician ensures that all PPE is in proper working condition, compliant with relevant standards such as NFPA.

The PPE Technician(s) role can be performed by the PPE Manager, another employee of the organization, verified organization, or verified ISP or a combination thereof, depending on the organization's structure or size.

While following all the requirements of this standard, the functions of the PPE Technician include, but are not limited to:

- Examining and filing information that comes with PPE
- With the PPE Manager, establishing the schedule for cleaning inspecting, and repairing PPE
- Determining the need for repair or additional cleaning (example: bloodborne pathogen or specialized cleaning)
- Performing advanced inspections on all ensemble elements to determine serviceability
- Coordinating all repairs
    - If properly trained, performs basic element repair. (Advanced repair may be performed by a verified organization.)
    - If designated by the PPE Manager, consults the element manufacturer and/or verified ISP on advanced ensemble element repair
    - Evaluates moisture barrier repair requirement
- Documents the action taken on the PPE in the tracking system
- Evaluates the process in an on-going manner and reports concerns and improvements to the PPE Manager, including any safety and health concerns in the receiving process of contaminated PPE.

Training and Curriculum

This outline is provided to illustrate everything that should be included in a training course for Firefighter PPE Technician

I. Introduction to Firefighter PPE

(1) Definition of PPE

(2) Importance of PPE in Firefighting

(3) Evolution of Firefighter PPE

II. NFPA and OSHA Regulations

(1) Overview of NFPA (National Fire Protection Association) Standards

(2) OSHA (Occupational Safety and Health Administration) Regulations Related to PPE

(3) Compliance Requirements for Firefighter PPE

III. Selection of Firefighter PPE

(1) **Understanding Different Types of PPE**

(2) **Factors Influencing PPE Selection (e.g., Hazards, Comfort, Fit)**

(3) **Evaluating PPE for Compliance with NFPA Standards**

IV. Care and Maintenance of Firefighter PPE

(1) **Importance of Proper Care and Maintenance**

(2) **Inspection Procedures for PPE**

(3) **Handling and Storage Guidelines**

(4) **Record-Keeping Requirements**

V. Cleaning of Firefighter PPE

(1) **Importance of Cleaning PPE**

(2) **Cleaning Methods for Different Types of PPE (e.g., Turnout Gear, Helmets, Boots)**

(3) **Recommended Cleaning Agents and Techniques**

(4) **Drying Procedures**

VI. Repairs of Firefighter PPE

(1) **Identifying Damage and Wear**

(2) **Repair vs. Replacement Considerations**

(3) **Basic Repair Techniques for PPE Components (e.g., Stitching, Patching)**

(4) **Guidelines for Outsourcing Repairs to Certified Professionals**

VII. Practical Training and Exercises

(1) **Hands-On Inspection and Maintenance Demonstrations**

(2) **Simulated Cleaning and Repair Exercises**

(3) **Role-Playing Scenarios to Reinforce Learning**

VIII. Conclusion

(1) **Recap of Key Points Covered**

(2) **Importance of Ongoing Training and Education**

(3) **Resources for Further Information and Support**

This outline is meant to provide a comprehensive framework for establishing a training program for Firefighter PPE Technicians and Managers. Each section may be expanded into detailed modules with relevant content, activities, and assessments.

Statement of Problem and Substantiation for Public Comment

After considering committee input from the First Draft meeting, simplifying the requirements for a PPE Manager and PPE Technician, and drafting additional content for the annex, adding an Annex focused on the PPE Manager/PPE Technician roles, responsibilities, and training curriculum seems beneficial to the fire service.

Providing essential descriptive information in a stand-alone annex makes it easier for anyone using the standard to focus on this information without bogging down Annex A.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 47-NFPA 1850-2024 [Global Input]	

Related Item

- FR-34

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 7-NFPA 1850-2024 [Global Input]

Update the references to NFPA 1971 throughout the document as incorporated into NFPA 1970 as necessary based on the actual publication and edition date.

Statement of Problem and Substantiation for Public Comment

The actual publication and published edition date of NFPA 1970 references may need to be changed based on actual publication timing of the standard.

Related Item

- FR33

Submitter Information Verification

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Public Comment No. 84-NFPA 1850-2024 [Global Input]

For the glove and boot water infltration test the brown paper towel should be 3 inch by 3inch for the glove test and the boot test should be 3 inch by 8 inch for the boot test.

This shall be perforomed as part of the advanced inspection each year for the glove and boot inspection.

Any water infiltration is a fail during the test. leakiing areas should be noted for failure tracking of boot or glove batches.

The glove dunk test must not go past the depth of the palm of the glove closest to the wrist of the glove when submerged.

Statement of Problem and Substantiation for Public Comment

This should aid in resolving the questions surrounding the proposed glove and boot dunk test performed annually.

Related Item

- Glove or boot dunk test

Submitter Information Verification

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Submittal Date: Thu May 30 16:53:57 EDT 2024
Committee: FAE-SPF

Public Comment No. 85-NFPA 1850-2024 [Global Input]

Gear stored should only have to be tested every three years if not issues for use.

Statement of Problem and Substantiation for Public Comment

Gear storage issues should not be required to annual inspection each year if not used for up to 3 years

Related Item

• Gear storage and annual inspection

Submitter Information Verification

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Submittal Date:	Thu May 30 16:59:14 EDT 2024
Committee:	FAE-SPF

Public Comment No. 86-NFPA 1850-2024 [Global Input]

Type your content here

These items need to be added to Chapter 11 by reference from their respective chapters.

By doing this, the certifying agency can enforce it during verification.

Advance Cleaning

(1) Scrubbing of outer shells shall not be allowed as part of the advance cleaning process.

  (a) During the 1st public comment meeting in San Diego, both Safety Components & Tencate were in attendance. Each of these mills were asked, “as part of the advance cleaning process, do you agree/support ISP scrubbing of the outer shells. Each mills answered, No

(1)

  (a) Scrubbing of outer shells will still be allowed during the specialized cleaning process

(1) If an ISP is utilizing CO2 cleaning process, in conjunction with a wet wash process, this must be disclosed.

Pre-Treatment

(1) Pretreatments that can be done as part of advanced cleaning.

  (a) Disclosing pretreatment blend

  (b) Disclosing pretreatment dwell time.

  (c) As part of the verification process, the verifying organization shall observe the pretreatment blend must being prepared.

Pre-Soaking

(1) Disclosing pre-soak blend percentage

(2) Disclosing pre-soak time

(3) As part of the verification process, the verifying organization shall observe the pre-soak blend must being prepared.

Cleaning Efficacy

(1) required disclosures of cleaning effectiveness data

(1) information should be displayed directly from paperwork received from the certifying organization.

(1) requires disclosure of what process was utilized during verification testing.

  (a) When ISPs are provided their cleaning efficiency results, the process utilized

must be displayed on the same sheet as their cleaning efficiency removal percentage.

(1) **If an ISP is utilizing CO2 cleaning process, in conjunction with a wet wash process, this must be disclosed.**

Reapplying Finishes

(1) **Prohibition of reapplication of finishes by ISPs without some form of mandatory assessment.**

(a) **If an ISP is not removing 95+ percent of all contaminates, reapplying of any finish will lock in any remaining contaminates.**

(b) **Also, most finishes need to be reapplied outside of the maximum temperature currently allowed by NFPA 1851**

...

Statement of Problem and Substantiation for Public Comment

By requiring ISP to follow these suggested changes, the fire service will have more transparency in how well their gear is cleaned. This also closes some gaps on having ISP being more transparent about what process they follow.
By not allowing scrubbing of the outer shell material will prevent premature degradation of the fire dept. PPE.

Related Item

- public comment

Submitter Information Verification

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Submittal Date: Thu May 30 17:24:30 EDT 2024
Committee: FAE-SPF

Public Comment No. 6-NFPA 1850-2024 [Chapter 2]

Chapter 2 Referenced Publications

2.1 General.

The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications.

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

NFPA 600, *Standard on Facility Fire Brigades,* 2020 edition.

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

NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting* , 2020

NFPA 1852, *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)* , 2019

NFPA 1900, *Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances,* 2024 edition.

NFPA 1950, *Standard on Protective Clothing, Ensembles, and Equipment for Technical Rescue Incidents, Emergency Medical Operations, and Wildland Firefighting, and Urban Interface Firefighting,* 2025 edition.

NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents,* 2020 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2018 edition.

NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting and Urban Interface Fire Fighting,* 2022 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2019 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2013 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2007 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2002 edition.

NFPA 1982, *Standard on Personal Alert Safety Systems (PASS),* 2018 edition.

NFPA 1986, *Standard on Respiratory Protection Equipment for Tactical and Technical Operations,* 2023 edition.

NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection,* 2019 edition.

NFPA 1990, *Standard for Protective Ensembles for Hazardous Materials and CBRN Operations,* 2022 edition.

NFPA 1999, *Standard on Protective Clothing and Ensembles for Emergency Medical Operations,* 2018 edition.

2.3 Other Publications.

2.3.1 AATCC Publications.

American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

AATCC TM135, *Test Method for Dimensional Changes of Fabrics after Home Laundering*, 2018.

AATCC TM198, *Test Method for Horizontal Wicking of Textiles*, 2020.

2.3.2 ASTM Publications.

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

ASTM D2261, *Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)*, 2013, ~~2017e1~~ (2024) .

ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, 2021.

ASTM E2406, *Standard Test Method for Evaluation of Laundry Sanitizers and Disinfectants for Use in High Efficiency Washing Operations*, 2016.

2.3.3 ISO Publications.

International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland.

ISO/IEC 17011, *Conformity assessment — Requirements for accreditation bodies accrediting conformity assessment bodies*, 2017.

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, 2017.

ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*, 2012.

2.3.4 US Government Publications.

US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1910.1030, "Bloodborne Pathogens."

Title 29, Code of Federal Regulations, Part 1910.134, "Respiratory Protection," 7 August 2012.

Title 29, Code of Federal Regulations, Part 1910.156, "Fire Brigades," 12 December 2008.

2.3.5 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Statement of Problem and Substantiation for Public Comment

Updating of referenced publications

Related Item

- FR32

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Committee:	FAE-SPF

Public Comment No. 8-NFPA 1850-2024 [Section No. 2.3.4]

2.3.4 US Government Publications.

US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1910.1030, "Bloodborne Pathogens."

Title 29, Code of Federal Regulations, Part 1910.134, "Respiratory Protection," 7 August 2012.

Title 29, Code of Federal Regulations, Part 1910.156, ~~"Fire Brigades~~ "Emergency Response ," ~~12 December 2008~~ 2024 .

Additional Proposed Changes

File Name	Description	Approved
OSHA_Emergency_Reponse_Standard_Feb._2024.pdf	OSHA Emergency Response Standard framework	

Statement of Problem and Substantiation for Public Comment

With the delay in publication of NFPA 1850, it is expected that the OSHA Emergency Response Standard will be issued as the replacement for the Fire Brigade Standard of 2008. The new OSHA Emergency Response Standard references NFPA, and it would corelate well to have the newly published OSHA standard referenced once NFPA 1850 is published.

Related Item

- n/a

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Submittal Date: Sun May 26 13:37:50 EDT 2024

Committee: FAE-SPF

Public Comment No. 9-NFPA 1850-2024 [Section No. 3.3.17]

3.3.17* Contamination/Contaminated.

The presence and/or accumulation of products of combustion and/or other hazardous materials on or in protective clothing and equipment including, but not limited to, carcinogenic, toxic, corrosive, or allergy-causing chemicals; body fluids; infectious microorganisms; or CBRN terrorism agents.

Statement of Problem and Substantiation for Public Comment

Contamination, or the presence of contaminants is not limited to an accumulation of hazardous agents, but may be inherent in products covered by this standard. The initial language assumes that the presence of contaminants is only possible through the accumulation of toxins from combustion.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 17-NFPA 1850-2024 [Section No. A.3.3.17]	

Related Item

- n/a

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Submittal Date: Sun May 26 13:48:21 EDT 2024

Committee: FAE-SPF

Public Comment No. 10-NFPA 1850-2024 [Section No. 3.3.55]

3.3.55 Inherent Flame Resistance.

Flame resistance that is derived from the essential characteristics of the fiber or polymer <u>without additives, coatings, or finishes</u> .

Statement of Problem and Substantiation for Public Comment

Strengthening this definition would ensure that the reader correctly understands that inherences means without added performance enhancers.

Related Item

- n/a

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 19-NFPA 1850-2024 [Section No. 3.3.106]

3.3.106* Spot Cleaning.

The application of a cleaning agent, including but not limited to a mild detergent with a pH of no less than 6.0 and no greater than 9.5 undiluted, in concert with warm water and agitation from a soft bristled brush, or a specialized and effective non-destructive process that is focused on a small area of the protective element.

Statement of Problem and Substantiation for Public Comment

Spot cleaning is ill-defined throughout this draft. For the purposes of A.3.3.74 Preliminary Exposure Reduction (PER), there is no mention of the advantage of soap and water. As such, a more illustrative definition of Spot Cleaning is necessary.

Related Item

- A.3.3.74 Preliminary Exposure Reduction (PER).

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Submittal Date: Sun May 26 17:54:20 EDT 2024

Committee: FAE-SPF

Public Comment No. 50-NFPA 1850-2024 [New Section after 3.3.122.1]

Add new definition (and annex) for "PPE Manager"

3.3.xx* PPE Manager _ A PPE Manager is a managerial role within a fire department or organization responsible for overseeing the entire lifecycle of firefighter Personal Protective Equipment (PPE).

A.3.3.xx

The PPE Program Manager is a person designated by the Organization to administer the NFPA 1851 Program adopted by the Organization. This Person shall have been trained in the selection and care of PPE as well as has been trained to perform Advanced Cleaning and Advanced Inspection, This person oversees the PPE Repairs and is trained to make decisions of replacement of PPE.

The PPE Manager is the person(s) responsible for the organization's overall PPE program, including but not limited to seeing that selection, procurement, distribution, training, care, maintenance, and retirement of PPE is compliant with applicable standards. In addition, the PPE Manager is responsible for educating the organization's members on the use and limitations of each PPE elements (this includes donning, doffing, and storage).

The PPE Manager typically works closely with the Fire Department Safety Officer (HSO), Deputy/Assistant Fire Chief and/or the Fire Chief. to ensure compliance with safety regulations and standards. They may also be involved in budgeting, risk assessment, and policy development related to PPE the program.

Depending on the size of the department, and available resources, the PPE Manager may also be the PPE Technician.

PPE protects every fire department's most valuable asset, its members. Therefore, it is essential that proper attention be given to PPE and the PPE program by including a PPE Technician (or Managers) in an organization's PPE program SOPs/SOGs.

Ensuring PPE is afforded proper attention for selection, care, and maintenance includes intentionally assigning a person (or persons) in the department to perform the functions included in this standard. Historically, many departments have assigned a civilian or someone on light duty to the care and maintenance of PPE. Because of the well-documented need to reduce exposure to contamination and because PPE has become so sophisticated, it is critical that an organization identifies, trains, and empowers an individual (or individuals) to be responsible for tracking, inspecting, and cleaning structural firefighting PPE.

The fire service has had training and qualification requirements for a health and safety officer, an incident safety officer, an EVT Manager, Firefighter I and II, driver operator, company officer, and others. The need for organizations to have a PPE Manager(s) has emerged because managing a PPE program is more comprehensive than before.

Certainly, contamination control has been a catalyst in bringing attention to PPE. However, many other aspects of PPE have become more critical to fire departments. Design, materials, and components are more sophisticated, and every department needs a PPE Manager(s) who is (are) knowledgeable in these areas. Of utmost importance is a thorough understanding about record-keeping, selection, fit, cleaning, drying, inspection, repair, storage, retirement, and disposal. If the fire service expects the highest quality PPE which is independently third-party certified, then it must use and care for those products in a similar manner. Moreover, the cost of purchasing PPE and its subsequent care costs is now a much higher percentage of a department's budget than in previous years and must be managed appropriately.

The PPE Manager should be knowledgeable about the design, materials, and components of the PPE used by the department and must be trained on, and given the tools to track, inspect, clean, and repair (to the level allowed by this standard) PPE.

To this end, a PPE Manager is a skilled employee who is properly trained and equipped clean, maintain, and repair of the department's PPE worn for fire suppression.

The individual or individuals who are appointed by the organization must meet the qualifications outlined in this standard. It is important that the individual or individuals have the requisite knowledge and skills to function effectively in this position. The individual or individuals might or might not be directly involved the in the hands-on application of this standard. If they are not directly involved, they are responsible to ensure those involved have the requisite knowledge and skills to function effectively in their position.

The PPE Manager is the competent person who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees. The competent person has the authority to impose prompt corrective measures to eliminate these hazards.

The PPE Manager should be expected to maintain cleaning and inspection records for each individual piece of PPE, conduct Advanced Inspection, Complete Liner Inspection, and determine whether the PPE can be repaired (according to the requirements of this standard.

The PPE Manager should be part of the gear evaluation and selection team and should provide bring their experience handling the department's PPE to every selection discussion.

Statement of Problem and Substantiation for Public Comment

After considering committee input from the First Draft meeting, it is clear that the standard needs to allow for both a PPE Manager and PPE Technician. This Public Comment establishes the definition and annex material for the PPE Manager.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 48-NFPA 1850-2024 [Section No. 3.3.122.1]	

Related Item

- PI-234

Submitter Information Verification

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Submittal Date:	Tue May 28 20:48:50 EDT 2024
Committee:	FAE-SPF

Public Comment No. 48-NFPA 1850-2024 [Section No. 3.3.122.1]

3.3.122.1* PPE Technician.

The PPE Technician(s) is an individual(s) ~~trained and certified to professional qualifications and assigned and authorized by the organization to manage the PPE program as described in this standard, including training users on basics of PPE function, care, and maintenance~~ who is assigned and has received specialized training for the care and maintenance of the department's PPE and who ensures that all PPE is in proper working condition and compliant with relevant standards such as NFPA .

Statement of Problem and Substantiation for Public Comment

After considering committee input from the First Draft meeting, it is clear that the standard needs to allow for both a PPE Manager and PPE Technician. This Public Comment updates the definition and annex material for the PPE Technician.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 47-NFPA 1850-2024 [Global Input]	
Public Comment No. 49-NFPA 1850-2024 [Section No. A.3.3.122.1]	
Public Comment No. 50-NFPA 1850-2024 [New Section after 3.3.122.1]	

Related Item

• FR-41 • PI-111 • PI-234

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 62-NFPA 1850-2024 [Section No. 3.3.122.1]

3.3.122.1* PPE Technician.

The individual(s) trained and certified to professional qualifications and assigned and authorized by the organization to manage the PPE program ~~as~~ and other trained technician personnel as described in this standard, including training users on basics of PPE function, care, and maintenance.

Statement of Problem and Substantiation for Public Comment

Adding clarification that the PPE program does not have to be managed by one person, there can be a team of people that perform the duties.

Related Item

- PPE technician

Submitter Information Verification

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Submittal Date: Thu May 30 12:47:25 EDT 2024

Committee: FAE-SPF

Public Comment No. 51-NFPA 1850-2024 [Section No. 4.2.4]

4.2.4*

~~**4.2.4.3**~~ –

~~The PPE technician(s) shall be knowledgeable and responsible for the following areas of each PPE element: education, selection, sizing, cleaning, drying, inspection, repair, storage, retirement, and disposal.~~

The ~~program shall have one or more PPE technicians to manage the organization's PPE program.~~

~~**4.2.4.1**~~ –

~~The PPE technician(s) shall be knowledgeable about the performance characteristics and limitations of each PPE element.~~

~~**4.2.4.2**~~ –

~~The PPE technician(s) shall be responsible for educating and training all organizational members who use PPE on the performance characteristics and limitations of each element.~~

organization , as part of the PPE Program, shall appoint a PPE Manager and a minimum of one PPE Technician (s) as described in Annex E

Statement of Problem and Substantiation for Public Comment

After considering committee input from the First Draft meeting, it is clear that the standard needs to allow for both a PPE Manager and PPE Technician and that the requirements needed to be simplified so that they are not spread throughout the standard. This change (one base requirement in lieu of 100+ requirements throughout the document) will make it easier for departments to implement and will make the roles and responsibilities of each position much easier to work with. This requirement acknowledges the need for these roles given the importance and technical nature of firefighting PPE and serves the fire service through its clarity and efficiency.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 47-NFPA 1850-2024 [Global Input]	
Public Comment No. 52-NFPA 1850-2024 [Section No. A.4.2.2.1]	

Related Item

- FR-34

Submitter Information Verification

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Submittal Date: Tue May 28 20:57:30 EDT 2024
Committee: FAE-SPF

Public Comment No. 77-NFPA 1850-2024 [Section No. 4.3.4]

4.3.4*

The organization’s PPE technician(s) shall ensure one or any combination thereof of the following to perform advanced cleaning, sanitization or disinfection, advanced inspection, and repair services of ensembles and ensemble elements *(see Table 4.3.4)*:

(1) ~~Verified training organization~~

(2)

(3) Manufacturer verified in cleaning

(4) Verified organization

(5) Verified independent service provider (ISP)

(6) Verified cleaner

(7) Manufacturer-trained organization for the organization’s ensembles and ensemble elements only

(8) Ensemble or ensemble element manufacturer

Table 4.3.4 Responsibilities for Garment Element Inspection, Cleaning, and Repair

			-	~~**PPE Technician Overall Responsibilities**~~	~~**Verified Training Organization Knowledge & Skills Training Only**~~	**Manufacturer Verified in Cleaning**	**Verified ISP or Verified Organization**	**Verified Cleaner**	**M C**
Routine inspections (Section 6.2)							X	~~X~~	
Preliminary exposure reduction (Section 7.2)							X	~~X~~	
Advanced inspection (Section 6.3)			X	X		X		X	
Complete liner inspection (Section 6.4)			X	X		X		X	
Advanced cleaning (Section 7.3)			X	X	X	X	~~X~~	~~X~~	
Sanitization or disinfection (Section 7.4)			X	X	X	X	~~X~~	~~X~~	
Specialized cleaning (Section 7.5)			X	X	X	X	~~X~~	~~X~~	
Repair management	~~X~~	-	-	-	-	-	-	-	
Basic repair (Sections 8.2 and 8.3)	-	-			X	X	-		

			-	~~PPE Technician Overall Responsibilities~~	~~Verified Training Organization Knowledge & Skills Training Only~~	Manufacturer Verified in Cleaning	Verified ISP or Verified Organization	Verified Cleaner	M C
Advanced repair (Sections 8.2 and 8.4)	-	-			X	X	-	-	
Training for cleaning			X	X	X			X	
Training for repairs	-	-			X	X	-	-	
Training for the management of repairs	~~X~~	-	-	-	-	-	-	-	
Training for inspection			X	X				X	
Training for record keeping (Section 4.4)	~~X~~	~~X~~	-	-	-	-	-	-	

4.3.4.1

The following entities shall meet the requirements of Chapter 11 and be verified by a third-party certification organization according to the requirements outlined in Table 11.1.1.1:

(1) Verified organizations

(2) Verified ISPs

(3) Manufacturers verified in cleaning

(4) Verified cleaners

4.3.4.2*

Where the organization is a verified organization, uses a verified ISP, or uses a verified cleaner, approval from the element manufacturer shall not be required.

4.3.4.3*

Verified training organizations and manufacturer-trained organizations shall meet the training requirements in this section and shall be permitted to perform the activities identified in Table 4.3.4 for verified training organizations and manufacturer-trained organizations.

4.3.4.3.1*

Training shall be provided by a verified training organization, an element manufacturer of the same element type, a verified ISP, a verified organization, a verified cleaner, or any combination thereof.

4.3.4.3.2*

The PPE technician shall be responsible for training consistent with the requirements and information provided in this standard and shall incorporate at least the following:

(1) Program *(see Section 4.3)*

(2) Education of the organization's members on the basics of PPE components, use, limitations, routine inspection, and preliminary exposure reduction

(3) Records *(see Section 4.4)*

(4) Protecting the public and personnel from exposure to contaminated PPE *(see Section 4.6)*

(5) Selection *(see Chapter 5)*

(6) Inspection *(see Chapter 6)*

(7) Cleaning *(see Chapter 7)*

(8) Repair *(see Chapter 8)*

(9) Storage *(see Chapter 9)*

(10) Retirement, disposition, and special incident procedures *(see Chapter 10)*

(11) Specific instructions, parameters, or procedures applicable to ensembles or ensemble elements with unique properties or performance as necessary

4.3.4.3.3*

The entity conducting the training shall provide documentation that the organization has received the required training.

4.3.4.3.4

Organizations shall obtain and complete within one year of the edition issuance date the training required in 4.3.4.3.2 each time a new edition of NFPA 1850 is issued or there is a change in PPE technician(s) overseeing or performing the required aspects of an organization's program.

4.3.4.3.5

Organizations shall consult with an ensemble or ensemble element manufacturer when additional training is necessary for special requirements specific to products, components, or materials that are unique to a manufacturer.

Statement of Problem and Substantiation for Public Comment

Much work has been done to refine the PPE Technician requirements included in the First Draft based on feedback received from the committee and the simplest way to implement these changes is to remove all references to PPE Technician in the First Draft. Additional Public Comments will be submitted to update the definition for PPE Technician (and the related annex) and add a definition for PPE Manager (with a related annex); insert one requirement for an organization to assign a PPE Manager/PPE Technician to their program (with related annex material); and add an Annex focused on the PPE Manager/PPE Technician roles, responsibilities, and training curriculum.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 47-NFPA 1850-2024 [Global Input]	

Related Item

• FR-21 • PI-161 • PI-342

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 11-NFPA 1850-2024 [Section No. 6.2.2.5]

6.2.2.5

Footwear elements shall be inspected for the following:

(1) Soiling

(2) Contamination

(3) Physical damage such as the following:

- (4) <u>Cuts, tears, and punctures</u>
- (5) <u>Thermal damage (such as charring, burn holes, melting, or discoloration of any layer)</u>
- (6) <u>Exposed or deformed protective toe, protective midsole, or shank</u>

(7) Loss of water resistance

(8) Closure system component damage and functionality

(9) Loss of seam integrity and broken or missing stitches

(10) <u>Peeling or separation of outer sole from upper or mid-sole</u>

Statement of Problem and Substantiation for Public Comment

Adhesives used in cementing outer soles to mid-soles and uppers can be compromised by submersion in heated liquids (water) attacking the bond between the outer and upper footwear components. In the absence of a test within the standard to prevent the delamination of outer soles under such conditions, specifying inspection for these potential occurrences is reasonable.

<u>Related Item</u>

• n/a

Submitter Information Verification

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Submittal Date: Sun May 26 14:18:05 EDT 2024

Committee: FAE-SPF

Public Comment No. 63-NFPA 1850-2024 [Section No. 6.3.5.2.1.1]

6.3.5.2.1.1

Particulate-blocking barrier in the hood material shall be evaluated by the light test to have no damage, defects, or separations from original construction to retain particulate protection efficiencies. *[See Figure 6.3.5.2.1.1(a) through Figure 6.3.5.2.1.1(c).]*

Figure 6.3.5.2.1.1(a) Example of a ~~Quilted Head Lamp.~~ Quilted Hood

Figure 6.3.5.2.1.1(b) Example of a ~~Laminated Head Lamp~~ Laminated Hood .

Figure 6.3.5.2.1.1(c) Example of a Hood Inspection Device.

Statement of Problem and Substantiation for Public Comment

Correcting title of figure.

Related Item

- Hood Evaluation

Submitter Information Verification

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Submittal Date: Thu May 30 12:50:09 EDT 2024
Committee: FAE-SPF

Public Comment No. 64-NFPA 1850-2024 [Sections 6.4.3, 6.4.4, 6.4.5]

Sections 6.4.3, 6.4.4, 6.4.5

6.4.3

Complete liner inspection of all garment elements shall be conducted ~~by the organization's PPE technician(s)~~ as part of the advanced inspection annually and whenever a routine inspection determines potential damage. The liner system shall be opened to expose all layers for inspection and testing.

6.4.4

The findings of the complete liner inspection shall be documented ~~by the organization's PPE technician(s)~~ .

6.4.5

The complete liner inspection shall include, as a minimum, the inspection specified in 6.4.5.1 through 6.4.5.3.

6.4.5.1*

The moisture barrier and the thermal barrier shall be inspected for the following:

(1) Physical damage to all layers and sides of each layer such as the following:

  (2) <u>Rips, tears, cuts, and abrasions</u>

  (3) <u>Thermal damage (charring, burn holes, melting, or discoloration of any layer)</u>

(4) Loss of seam integrity, broken or missing stitches, and loose or missing moisture barrier seam tape

(5) Material physical integrity; UV or chemical degradation as evidenced by discoloration, significant changes in material texture, loss of material strength, loss of liner material, or shifting of liner material

(6) Delamination as evidenced by separation of film from substrate fabric, flaking, or powdering

6.4.5.2

The moisture barrier shall be tested using the hydrostatic test to evaluate the water penetration barrier, as specified in Section 12.3, and shall show no leakage.

6.4.5.2.1

The area of the moisture barrier that is tested shall be marked in accordance with 12.3.2.1.3.

6.4.5.3

The result of each water penetration barrier evaluation shall be recorded ~~by the organization's PPE technician(s)~~ .

Statement of Problem and Substantiation for Public Comment

Sections 6.4.1 – 6.4.2.1.1 clarifies who is responsible for conducting the liner inspection.

<u>Related Item</u>

• PPE Technician

Submitter Information Verification

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Submittal Date:	Thu May 30 12:54:06 EDT 2024
Committee:	FAE-SPF

Public Comment No. 79-NFPA 1850-2024 [Section No. 7.1.1.2]

7.1.1.2

The organization's PPE technician(s) shall use the decision tool provided in Figure 7.1.1.2(a) and Figure 7.1.1.2(b) to assist in determining the appropriate cleaning procedures to follow as specified in Sections 7.2 through 7.5.

<u>ADD "LITHIUM ION BATTERY FIRES" and "MOSESS (Mobile or Stationary Energy Storage Systems)" to the decision tree and/or to specialty cleaning, as necessary.</u>

Figure 7.1.1.2(a) Approach for Deciding Handling, Cleaning, and Disposition of Ensemble Elements.

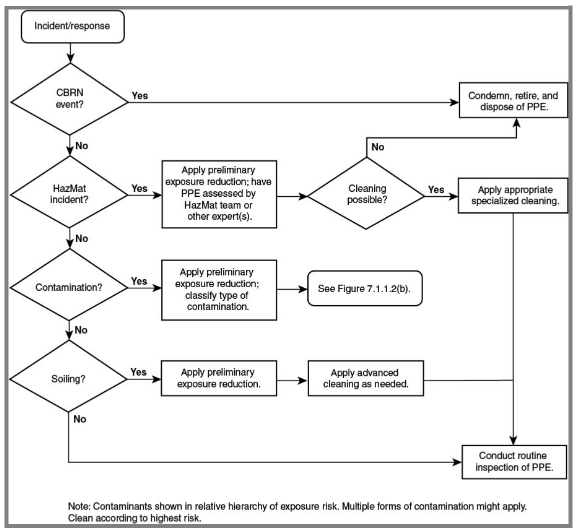
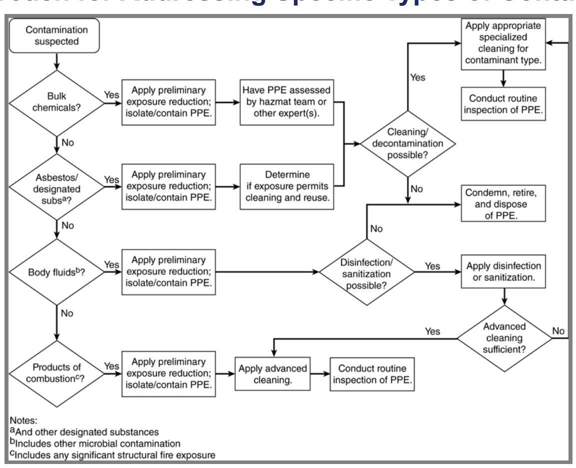


Figure 7.1.1.2(b) Approach for Addressing Specific Types of Contamination.



Statement of Problem and Substantiation for Public Comment

With increased risks and exposures to Li-Ion battery and MOSESS fires, the decision tree and requirements should be updated to help the fire service easily determine next steps after exposure.

<u>Related Item</u>

• FR-92

Submitter Information Verification

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Submittal Date:	Thu May 30 15:27:01 EDT 2024
Committee:	FAE-SPF

Public Comment No. 38-NFPA 1850-2024 [Section No. 7.3.7.2]

7.3.7.2*

For advanced cleaning, a mild detergent with a pH range of not less than 6.0 pH and not greater than 9.5 pH undiluted as indicated on the product safety data sheet (SDS) ~~, original product container, or a detergent or other cleaning/decontamination product usable in a washer/extractor that is verified to the requirements in Section 11.8 shall~~ or the original product container shall be used.

Statement of Problem and Substantiation for Public Comment

Removing the text as a result of the removal of product certification to this standard.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 31-NFPA 1850-2024 [Sections 12.12, 12.13]	
Public Comment No. 40-NFPA 1850-2024 [Sections 11.7, 11.8]	

Related Item

- FR-162

Submitter Information Verification

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Submittal Date: Tue May 28 10:01:04 EDT 2024
Committee: FAE-SPF

Public Comment No. 5-NFPA 1850-2024 [Section No. 7.3.9.1]

7.3.9.1

Where machine washing with a washer/extractor is specified, the following procedures shall be used:

(1) * The washer/extractor shall not be overloaded or under loaded.

(2) * Heavily soiled or spotted areas shall be pretreated.

(3) All closures, including pocket closures, hooks and loops, snaps, zippers, and hooks and dees, shall be fastened.

(4) * Water temperature shall not exceed 49°C (120°F).

(5)* ~~A water softener~~ Water hardness shall be ~~considered if water hardness is above~~ below 60 ppm.

(6) * The specific formulation for the washer/extractor shall include a series of steps for filling the wash basket, adding detergent, performing multiple rinses, and including separate extractions between wash and rinse steps.

(7) The element shall be inspected and rewashed if necessary.

Statement of Problem and Substantiation for Public Comment

Stating that a water softener shall be considered is still optional language. This requirement was added during first draft because there was concern that hard water would introduce heavy metal contaminants to the PPE and present health concerns. If the water hardness needs to be below 60 ppm to prevent that from happening (or reduce the likelihood), it should just be stated as such and how that achieved is up to the individual ISPs.

Related Item

• FR-115

Submitter Information Verification

Submitter Full Name: Amanda Newsom
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Submittal Date: Wed May 22 15:41:34 EDT 2024
Committee: FAE-SPF

Public Comment No. 65-NFPA 1850-2024 [Section No. 7.3.9.1]

7.3.9.1

Where machine washing with a washer/extractor is specified, the following procedures shall be used:

(1) * The washer/extractor shall not be overloaded or under loaded.

(2) * Heavily soiled or spotted areas shall be pretreated.

(3) All closures, including pocket closures, hooks and loops, snaps, zippers, and hooks and dees, shall be fastened.

(4) * Water temperature shall not exceed 49°C (120°F).

(5) * ~~A~~ water ~~softener shall be considered if water hardness is above~~ <u>hardness shall not exceed</u> 60 ppm.

(6) * The specific formulation for the washer/extractor shall include a series of steps for filling the wash basket, adding detergent, performing multiple rinses, and including separate extractions between wash and rinse steps.

(7) The element shall be inspected and rewashed if necessary.

Statement of Problem and Substantiation for Public Comment

Water hardness should be a criteria, it is up to the organization to determine how they will achieve this criteria. Section 11.3.7.3 notes water hardness as a requirement.

<u>Related Item</u>

- Cleaning

Submitter Information Verification

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Organization: LION

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Submittal Date: Thu May 30 13:01:39 EDT 2024

Committee: FAE-SPF

Public Comment No. 82-NFPA 1850-2024 [Section No. 7.3.9.1]

7.3.9.1

Where machine washing with a washer/extractor is specified, the following procedures shall be used:

(1) * The washer/extractor shall not be overloaded or under loaded.

(2) * Heavily soiled or spotted areas shall be pretreated.

(3) All closures, including pocket closures, hooks and loops, snaps, zippers, and hooks and dees, shall be fastened.

(4) * Water temperature shall not exceed 49°C (120°F).

(5) * A water softener shall be considered if water hardness is above 60 ppm.

(6) * The specific formulation for the washer/extractor shall include a series of steps for filling the wash basket, adding detergent, performing multiple rinses, and including separate extractions between wash and rinse steps.

(7) The element shall be inspected and rewashed if necessary.

(8) <u>The washer/extractor shall be cleaned and disinfected between laundry loads.</u>

Statement of Problem and Substantiation for Public Comment

To minimize cross contamination from residue in the washer/extractor to future loads, the washer/extractor (or ultrasonic, CO2, etc.) should be cleaned and disinfected between laundry loads. Specific methods for this cleaning should be identified either in the legislative text or in the annex - neither of which are submitted by this submitter.

Related Item

• FR-115 • PI-83

Submitter Information Verification

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Submittal Date: Thu May 30 16:08:05 EDT 2024
Committee: FAE-SPF

Public Comment No. 66-NFPA 1850-2024 [Section No. 7.3.12.1]

7.3.12.1

Garment elements shall be subjected to advanced cleaning using a washer/extractor with an appropriate formulation.

7.3.12.1.1

A top-loading washing machine or utility sink shall not be used for advanced cleaning.

7.3.12.1.2

Other machine technologies shall be permitted if the type of machine and procedures meet the cleaning verification requirements as specified in 11.3.7 ~~and do not adversely impact garment material performance~~ .

7.3.12.1.2.1 Optional testing to evaluate cleaning process impacts may be performed as specified in Section 11.5.

7.3.12.1.3

Separate washer/extractor or other type of machine formulations shall be permitted for garment outer shells and liners. *[See A.7.3.9.1(6).]*

Statement of Problem and Substantiation for Public Comment

Section 7.3.12.1.2 The First Revision Report (FR 159) indicates that degradation criteria testing was meant to be an optional requirement.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 67-NFPA 1850-2024 [Section No. 11.5]	
Public Comment No. 68-NFPA 1850-2024 [Section No. 12.5]	

Related Item

- Cleaning

Submitter Information Verification

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Submittal Date: Thu May 30 13:04:15 EDT 2024
Committee: FAE-SPF

Public Comment No. 12-NFPA 1850-2024 [Section No. 7.3.13.4]

7.3.13.4*

Unless otherwise specified, helmets shall be hand washed in a utility sink using the following procedures:

(1) The individual washing the helmet shall observe universal precautions and put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at temperature no warmer than ~~40°C~~ 49°C (~~105°F~~ 120°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 undiluted and at the detergent manufacturer's recommended ratio of detergent to water.

(3) The individual shall use a soft bristle brush to reach between components and scrub both the exterior and interior of the helmet.

(4) The helmet shall be thoroughly rinsed following washing.

(5) Following rinsing, the helmet shall be air dried. It shall be permitted to use a soft towel to aid in drying the helmet after cleaning.

Statement of Problem and Substantiation for Public Comment

The effectiveness of contaminant removal at higher temperatures and defined detergent pH has been shown and is justification for the identical changes to advanced cleaning of garments. Conformity with the laundering methods for garments would be reasonable considering the materials and components are subject to the same contaminants, and are made from materials that can sustain the increase in wash temperature and detergent pH.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 13-NFPA 1850-2024 [Section No. 7.3.14.2]	
Public Comment No. 14-NFPA 1850-2024 [Section No. 7.3.15.2]	
Public Comment No. 15-NFPA 1850-2024 [Section No. 7.3.16.5]	

Related Item

- n/a

Submitter Information Verification

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Submittal Date: Sun May 26 14:41:21 EDT 2024

Committee: FAE-SPF

Public Comment No. 41-NFPA 1850-2024 [Section No. 7.3.13.4]

7.3.13.4*

Unless otherwise specified, helmets shall be hand washed in a utility sink using the following procedures:

(1) The individual washing the helmet shall observe universal precautions and put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at temperature no warmer than 40°C (105°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 ~~at the detergent manufacturer's recommended ratio of detergent to water~~ undiluted as indicated on the product safety data sheet (SDS) or the original product container .

(3) The individual shall use a soft bristle brush to reach between components and scrub both the exterior and interior of the helmet.

(4) The helmet shall be thoroughly rinsed following washing.

(5) Following rinsing, the helmet shall be air dried. It shall be permitted to use a soft towel to aid in drying the helmet after cleaning.

Statement of Problem and Substantiation for Public Comment

This revision was made under FR-113 for garment washing, but the remaining ensemble elements were not updated to correlate. This revision aligns the requirements for pH for all products in this document.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 42-NFPA 1850-2024 [Section No. 7.3.14.2]	
Public Comment No. 43-NFPA 1850-2024 [Section No. 7.3.15.2]	
Public Comment No. 44-NFPA 1850-2024 [Section No. 7.3.16.5]	

Related Item

- FR-113

Submitter Information Verification

Submitter Full Name: Amanda Newsom
Organization: UL LLC
Street Address:
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Submittal Date: Tue May 28 10:13:49 EDT 2024
Committee: FAE-SPF

Public Comment No. 69-NFPA 1850-2024 [Sections 7.3.14, 7.3.15]

Sections 7.3.14, 7.3.15

7.3.14 Additional Requirements for Advanced Cleaning of Glove Elements.

7.3.14.1*

Gloves shall not be machine washed or dried using equipment that produces mechanical action by tumbling or agitation, except as permitted in 7.3.14.3.

7.3.14.2

Unless otherwise specified, gloves shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the gloves shall observe universal precautions and shall put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at temperature no warmer than 40°C (105°F) and a mild detergent having a pH of not less than 6.0 or more than 10.5 at the detergent manufacturer's recommended ratio of detergent to water.

(3) The individual shall then don the firefighting gloves over the examination gloves and shall briskly rub the gloves together, ensuring the cleaning of all surfaces. A soft bristle brush shall be permitted to scrub the exterior of the gloves.

(4)* The individual shall then remove the firefighting gloves and refill the utility sink with clean water.

(5) The interior and exterior of the gloves shall be thoroughly rinsed with clean water.

(6) Gloves shall not be wrung out, but instead slightly squeezed to remove excess water.

(7)* Gloves shall be dried using ambient or slightly raised temperatures no warmer than 40°C (105°F). Equipment that provides airflow into the interiors of gloves shall be permitted to aid the faster drying of gloves.

7.3.14.3

Gloves shall be permitted to be cleaned using alternative cleaning processes, including washer/extractors and other machine-based cleaning~~, if information is available to demonstrate the efficacy of the process for removing contamination and the process does not damage gloves~~ .

7.3.14.3.1

Where washer/extractors or other water based machine cleaning processes are used, the wash temperature shall not exceed 49°C (120°F).

7.3.15 Additional Requirements for Advanced Cleaning of Footwear Elements.

7.3.15.1*

Footwear shall not be machine cleaned or dried using equipment that produces mechanical action by tumbling or agitation, except as permitted in 7.3.15.3.

7.3.15.2

Unless otherwise specified, footwear shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the footwear shall observe universal precautions and put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at a temperature no warmer than 40°C (105°F) and a mild detergent having a pH of not less than 6.0 or more than 10.5 at the detergent manufacturer's recommended ratio of detergent to water.

(3)* The individual shall first scrub the interior of the footwear with a soft bristle brush.

(4) The individual shall then scrub the exterior of the footwear with a soft bristle brush, ensuring the cleaning of all exterior surfaces.

(5) The interior and exterior of the footwear shall be thoroughly rinsed with clean water.

(6)* In the absence of specialized drying equipment, the footwear shall be suspended upside down to dry, with attention that water runoff does not create a slip hazard.

(7) If specified by the manufacturer, a sealant, conditioning, or polish shall be applied to leather footwear after the footwear has completely dried.

7.3.15.3

Footwear shall be permitted to be cleaned using alternative cleaning processes, including different forms of machine-based cleaning~~, if information is available to demonstrate the efficacy of the process for removing contamination and the process does not damage footwear~~ .

7.3.15.3.1

Where machine-based cleaning processes are used, the wash temperature shall not exceed 49°C (120°F).

Statement of Problem and Substantiation for Public Comment

There are no cleaning performance requirements or degradation testing requirements included in the standard to prove cleaning efficacy or damage.

Related Item

- Cleaning

Submitter Information Verification

Submitter Full Name:	Tricia Hock
Organization:	LION
Street Address:	
City:	
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Submittal Date:	Thu May 30 13:26:41 EDT 2024
Committee:	FAE-SPF

Public Comment No. 13-NFPA 1850-2024 [Section No. 7.3.14.2]

7.3.14.2

Unless otherwise specified, gloves shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the gloves shall observe universal precautions and shall put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at temperature no warmer than ~~40°C~~ 49°C (~~105°F~~ 120°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 undiluted and at the detergent manufacturer's recommended ratio of detergent to water.

(3) The individual shall then don the firefighting gloves over the examination gloves and shall briskly rub the gloves together, ensuring the cleaning of all surfaces. A soft bristle brush shall be permitted to scrub the exterior of the gloves.

(4)* The individual shall then remove the firefighting gloves and refill the utility sink with clean water.

(5) The interior and exterior of the gloves shall be thoroughly rinsed with clean water.

(6) Gloves shall not be wrung out, but instead slightly squeezed to remove excess water.

(7)* Gloves shall be dried using ambient or slightly raised temperatures no warmer than 40°C (105°F). Equipment that provides airflow into the interiors of gloves shall be permitted to aid the faster drying of gloves.

Statement of Problem and Substantiation for Public Comment

The effectiveness of contaminant removal at higher temperatures and defined detergent pH has been shown and is justification for the identical changes to advanced cleaning of garments. Conformity with the laundering methods for garments would be reasonable considering the materials and components are subject to the same contaminants, and are made from materials that can sustain the increase in wash temperature and detergent pH.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 12-NFPA 1850-2024 [Section No. 7.3.13.4]	
Public Comment No. 14-NFPA 1850-2024 [Section No. 7.3.15.2]	
Public Comment No. 14-NFPA 1850-2024 [Section No. 7.3.15.2]	
Public Comment No. 15-NFPA 1850-2024 [Section No. 7.3.16.5]	

Related Item

- public comment 12

Submitter Information Verification

Submitter Full Name: Neil McMillan

Organization: International Association of Fire Fighters

Street Address:

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Submittal Date:	Sun May 26 14:46:32 EDT 2024
Committee:	FAE-SPF

Public Comment No. 42-NFPA 1850-2024 [Section No. 7.3.14.2]

7.3.14.2

Unless otherwise specified, gloves shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the gloves shall observe universal precautions and shall put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at temperature no warmer than 40°C (105°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 ~~at the detergent manufacturer's recommended ratio of detergent to water~~ undiluted as indicated on the product safety data sheet (SDS) or the original product container .

(3) The individual shall then don the firefighting gloves over the examination gloves and shall briskly rub the gloves together, ensuring the cleaning of all surfaces. A soft bristle brush shall be permitted to scrub the exterior of the gloves.

(4)* The individual shall then remove the firefighting gloves and refill the utility sink with clean water.

(5) The interior and exterior of the gloves shall be thoroughly rinsed with clean water.

(6) Gloves shall not be wrung out, but instead slightly squeezed to remove excess water.

(7)* Gloves shall be dried using ambient or slightly raised temperatures no warmer than 40°C (105°F). Equipment that provides airflow into the interiors of gloves shall be permitted to aid the faster drying of gloves.

Statement of Problem and Substantiation for Public Comment

This revision was made under FR-113 for garment washing, but the remaining ensemble elements were not updated to correlate. This revision aligns the requirements for pH for all products in this document.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 41-NFPA 1850-2024 [Section No. 7.3.13.4]	
Public Comment No. 43-NFPA 1850-2024 [Section No. 7.3.15.2]	
Public Comment No. 44-NFPA 1850-2024 [Section No. 7.3.16.5]	

Related Item

- FR-113

Submitter Information Verification

Submitter Full Name: Amanda Newsom

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Submittal Date:	Tue May 28 10:17:22 EDT 2024
Committee:	FAE-SPF

Public Comment No. 14-NFPA 1850-2024 [Section No. 7.3.15.2]

7.3.15.2

Unless otherwise specified, footwear shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the footwear shall observe universal precautions and put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at a temperature no warmer than ~~40°C~~ 49°C (~~105°F~~ 120°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 undiluted and at the detergent manufacturer's recommended ratio of detergent to water.

(3)* The individual shall first scrub the interior of the footwear with a soft bristle brush.

(4) The individual shall then scrub the exterior of the footwear with a soft bristle brush, ensuring the cleaning of all exterior surfaces.

(5) The interior and exterior of the footwear shall be thoroughly rinsed with clean water.

(6)* In the absence of specialized drying equipment, the footwear shall be suspended upside down to dry, with attention that water runoff does not create a slip hazard.

(7) If specified by the manufacturer, a sealant, conditioning, or polish shall be applied to leather footwear after the footwear has completely dried.

Statement of Problem and Substantiation for Public Comment

The effectiveness of contaminant removal at higher temperatures and defined detergent pH has been shown and is justification for the identical changes to advanced cleaning of garments. Conformity with the laundering methods for garments would be reasonable considering the materials and components are subject to the same contaminants, and are made from materials that can sustain the increase in wash temperature and detergent pH.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 12-NFPA 1850-2024 [Section No. 7.3.13.4]	corelates
Public Comment No. 13-NFPA 1850-2024 [Section No. 7.3.14.2]	corelates
Public Comment No. 13-NFPA 1850-2024 [Section No. 7.3.14.2]	
Public Comment No. 15-NFPA 1850-2024 [Section No. 7.3.16.5]	

Related Item

• n/a

Submitter Information Verification

Submitter Full Name: Neil McMillan

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Submittal Date:	Sun May 26 14:49:51 EDT 2024
Committee:	FAE-SPF

Public Comment No. 43-NFPA 1850-2024 [Section No. 7.3.15.2]

7.3.15.2

Unless otherwise specified, footwear shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the footwear shall observe universal precautions and put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2)* The utility sink shall be filled with warm water at a temperature no warmer than 40°C (105°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 ~~at the detergent manufacturer's recommended ratio of detergent to water~~ undiluted as indicated on the product safety data sheet (SDS) or the original product container .

(3)* The individual shall first scrub the interior of the footwear with a soft bristle brush.

(4) The individual shall then scrub the exterior of the footwear with a soft bristle brush, ensuring the cleaning of all exterior surfaces.

(5) The interior and exterior of the footwear shall be thoroughly rinsed with clean water.

(6)* In the absence of specialized drying equipment, the footwear shall be suspended upside down to dry, with attention that water runoff does not create a slip hazard.

(7) If specified by the manufacturer, a sealant, conditioning, or polish shall be applied to leather footwear after the footwear has completely dried.

Statement of Problem and Substantiation for Public Comment

This revision was made under FR-113 for garment washing, but the remaining ensemble elements were not updated to correlate. This revision aligns the requirements for pH for all products in this document.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 41-NFPA 1850-2024 [Section No. 7.3.13.4]	
Public Comment No. 42-NFPA 1850-2024 [Section No. 7.3.14.2]	
Public Comment No. 44-NFPA 1850-2024 [Section No. 7.3.16.5]	

Related Item

- FR-113

Submitter Information Verification

Submitter Full Name: Amanda Newsom
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Submittal Date: Tue May 28 10:19:22 EDT 2024

Committee:	FAE-SPF

Public Comment No. 15-NFPA 1850-2024 [Section No. 7.3.16.5]

7.3.16.5

Where hoods are subjected to hand cleaning and unless otherwise specified, hoods shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the hood shall observe universal precautions and put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2) The utility sink shall be filled with warm water at temperature no warmer than ~~40°C~~ 49°C (~~105°F~~ 120°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 undiluted and at the detergent manufacturer's recommended ratio of detergent to water.

(3) After allowing the hood to presoak for a period of at least 10 minutes, the individual shall lightly rub the hood material together, starting with the exterior and then turning the hood inside out and similarly rubbing the material against itself. A soft wash cloth shall be permitted for washing the hoods.

(4) Stretching or wringing the hood out shall be avoided during hand washing.

(5) The hood shall be thoroughly rinsed following washing.

(6) Following rinsing, if using air drying, the hood shall be air dried by laying on a drying rack or other surface that helps promote draining of water from the hood.

Statement of Problem and Substantiation for Public Comment

The effectiveness of contaminant removal at higher temperatures and defined detergent pH has been shown and is justification for the identical changes to advanced cleaning of garments. Conformity with the laundering methods for garments would be reasonable considering the materials and components are subject to the same contaminants, and are made from materials that can sustain the increase in wash temperature and detergent pH. Additionally, hoods are worn against skin that have a higher absorbance as compared to other topographical regions of the body. This justifies an increase in measures that can remove greater concentrations of contaminants.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 12-NFPA 1850-2024 [Section No. 7.3.13.4]	
Public Comment No. 13-NFPA 1850-2024 [Section No. 7.3.14.2]	
Public Comment No. 14-NFPA 1850-2024 [Section No. 7.3.15.2]	

Related Item

• n/a

Submitter Information Verification

Submitter Full Name: Neil McMillan

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Submittal Date:	Sun May 26 15:01:36 EDT 2024
Committee:	FAE-SPF

Public Comment No. 44-NFPA 1850-2024 [Section No. 7.3.16.5]

7.3.16.5

Where hoods are subjected to hand cleaning and unless otherwise specified, hoods shall be hand washed in a utility sink or other container of sufficient size using the following procedures:

(1) The individual washing the hood shall observe universal precautions and put on a pair of examination gloves, an apron and protective sleeves or coveralls, and a pair of safety glasses or goggles.

(2) The utility sink shall be filled with warm water at temperature no warmer than 40°C (105°F) and a mild detergent having a pH of not less than 6.0 or more than ~~10~~ 9 .5 ~~at the detergent manufacturer's recommended ratio of detergent to water~~ undiluted as indicated on the product safety data sheet (SDS) or the original product container .

(3) After allowing the hood to presoak for a period of at least 10 minutes, the individual shall lightly rub the hood material together, starting with the exterior and then turning the hood inside out and similarly rubbing the material against itself. A soft wash cloth shall be permitted for washing the hoods.

(4) Stretching or wringing the hood out shall be avoided during hand washing.

(5) The hood shall be thoroughly rinsed following washing.

(6) Following rinsing, if using air drying, the hood shall be air dried by laying on a drying rack or other surface that helps promote draining of water from the hood.

Statement of Problem and Substantiation for Public Comment

This revision was made under FR-113 for garment washing, but the remaining ensemble elements were not updated to correlate. This revision aligns the requirements for pH for all products in this document.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 41-NFPA 1850-2024 [Section No. 7.3.13.4]	
Public Comment No. 42-NFPA 1850-2024 [Section No. 7.3.14.2]	
Public Comment No. 43-NFPA 1850-2024 [Section No. 7.3.15.2]	

Related Item

• FR-113

Submitter Information Verification

Submitter Full Name: Amanda Newsom

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Submittal Date: Tue May 28 10:20:58 EDT 2024

Committee:	FAE-SPF

Public Comment No. 70-NFPA 1850-2024 [Sections 7.4, 7.5]

Sections 7.4, 7.5

7.4 Disinfection or Sanitization and Biological Decontamination.

7.4.1

~~In collaboration with the organization's PPE technician(s),~~ processes for disinfecting or sanitizing, cleaning, and decontaminating protective ensembles and ensemble elements that have been contaminated with body fluids and other potentially infectious materials shall be performed by a manufacturer verified in cleaning, a verified cleaner, a manufacturer-trained organization, a verified organization, or a verified ISP.

7.4.1.1

In the absence of a method to verify effectiveness of cleaning, manufacturers of certified protective ensembles and ensemble elements shall be permitted to perform disinfection or sanitization and biological decontamination.

7.4.2*

Organizations and other facilities that engage in disinfection or sanitization and biological decontamination of protective ensembles and ensemble elements contaminated with body fluids and other potentially infectious materials shall comply with the applicable regulations in 29 CFR 1910.1030, “Bloodborne Pathogens.”

7.4.3*

Protective ensembles and ensemble elements that are contaminated with body fluids and other potentially infectious materials shall be subject to either disinfection or sanitization.

7.4.3.1

If not already part of an advanced cleaning process, disinfection or sanitization shall be followed by advanced cleaning depending on the type of disinfection or sanitization, the cleaning agents and processes that are available, and the type and composition of the ensemble or ensemble element.

7.4.3.2*

Disinfectants and sanitizers shall be registered with the US Environmental Protection Agency (EPA) for efficacy for hard surfaces or fabrics and textiles, whichever is applicable.

7.4.3.2.1*

Where disinfection or sanitization is required for specific microbial contamination as determined by the organization or qualified experts, those disinfectants and sanitizers registered with the EPA for the specific form of microbial contamination shall be used.

7.4.3.2.2

Where disinfection or sanitization does not rely on the use of a disinfectant or sanitizer, processes shall be permitted where demonstrated for sanitization as specified in Section 11.7.

7.4.3.3*

Where disinfectants and sanitizers are used, they shall not degrade the performance properties of the protective ensemble or ensemble elements.

7.4.3.4

Disinfectants and sanitizers shall be used in accordance with the instructions provided by the supplier.

7.4.3.5*

It shall be permitted to include disinfection or sanitization as part of the advanced cleaning process only when its effectiveness has been demonstrated as providing the disinfection or sanitization required for the specific ensemble or ensemble element.

7.4.3.6*

In cases where the area of contamination is limited and clearly visible, spot sanitization or disinfection followed by spot cleaning shall be permitted for the sanitization or disinfection of the affected contaminated area of the ensemble or ensemble element.

7.4.3.7*

Specialized cleaning shall be permitted to be used in lieu of advanced cleaning when ensembles and ensemble elements are disinfected or sanitized.

7.4.4 Additional Requirements for Sanitization and Cleaning of Garment Elements.

7.4.4.1*

Garment elements shall be subjected to a minimum of sanitization.

7.4.4.2

The sanitizer or process used for the sanitization of the garment element shall meet the verification testing requirements in 11.3.7.2

7.4.4.3*

Handling of garment elements shall be kept to a minimum prior to sanitization.

7.4.4.4

Where specific components such as the DRD or fall protection devices are provided as part of garment elements, these items shall only be removed from the garment if their presence will interfere with the sanitization process.

7.4.4.4.1*

Both garment element outer shells and liners shall be subject to sanitization, including garments that have been contaminated with pathogenic bioaerosols.

7.4.4.5

Advanced cleaning procedures that are used in conjunction with or that follow sanitization for removal of soils associated with body fluids or other infectious materials shall meet the applicable garment requirements specified in Section 7.3.

7.4.4.6

Advanced cleaning or specialized cleaning shall be performed after sanitization.

7.4.4.6.1*

Advanced cleaning shall be permitted in lieu of sanitization or disinfection if the procedures for advanced cleaning have proven effective for sanitization or disinfection of the ensemble or ensemble elements.

7.4.5 Additional Requirements for Disinfection or Sanitization and Cleaning of Helmet Elements.

7.4.5.1*

Detachable or separate components shall be removed from the helmet and shall be sanitized or disinfected separately.

7.4.5.2

Detachable components that are textile based shall be sanitized as specified in 7.4.4 for garment elements.

7.4.5.3*

Hard surface components of the helmet shall be subject to disinfection using an appropriate disinfection process.

7.4.5.4

Subsequent advanced cleaning of helmets following their disinfection or sanitization shall meet the requirements specified in 7.3.13.

7.4.6 Additional Requirements for Sanitization and Cleaning of Glove Elements.

7.4.6.1*

Sanitizers or processes for sanitization of gloves shall be selected as appropriate for the materials used in the construction of the glove.

7.4.6.2

Subsequent advanced cleaning of gloves following their sanitization shall meet the requirements specified in 7.3.14.

7.4.7 Additional Requirements for Sanitization and Cleaning of Footwear Elements.

7.4.7.1*

Sanitizers or processes for sanitization of footwear shall be selected as appropriate for the materials used in the construction of the footwear.

7.4.7.2

Subsequent advanced cleaning of footwear following their sanitization shall meet the requirements specified in 7.3.15.

7.4.8 Additional Requirements for Sanitization and Cleaning of Hood Elements.

7.4.8.1*

Hoods shall be sanitized as specified in 7.4.4 for garment elements.

7.4.8.2

Subsequent advanced cleaning of hoods following their sanitization shall meet the requirements specified in 7.3.16.

7.4.9 Additional Requirements for Sanitization and Cleaning of Proximity Firefighting Ensembles and Ensemble Elements.

7.4.9.1

Any sanitizer or process used for sanitization shall not degrade the radiant reflective outer shell or other radiant reflective elements of the ensemble or ensemble elements.

7.4.9.2

Any additional cleaning of proximity firefighting ensembles and ensemble elements shall meet the requirements specified in 7.3.17.

7.4.9.3

Nonreflective portions of the ensemble or ensemble elements shall be treated as specified in 7.4.4.

7.4.10 Additional Requirements for Sanitization and Cleaning of Garments Certified to the Optional Liquid and Particulate Contaminant Protection Requirements of NFPA 1970.

The manufacturer shall be consulted to determine if any special handling procedures exist for the sanitization or disinfection and subsequent cleaning of the elements of the protective ensemble or ensemble element.

7.5 Specialized Cleaning.

7.5.1

~~In collaboration with the organization's PPE technician(s),~~ specialized cleaning of protective ensembles and ensemble elements shall be performed by a manufacturer verified in cleaning, a manufacturer-trained organization, a verified organization, a verified cleaner, or a verified ISP.

7.5.1.1

In the absence of a method to verify effectiveness of cleaning for specific types of soils or contaminants, manufacturers of certified ensembles or ensemble elements shall be permitted to perform specialized cleaning.

7.5.2*

Organizations shall employ specialized cleaning when the ensemble or ensemble elements cannot be adequately cleaned with advanced cleaning.

7.5.2.1

Organizations shall apply disinfection or sanitization in accordance with Section 7.4 with specialized cleaning for the removal of body fluids or other infectious materials that cannot be removed using disinfection or sanitization with advanced cleaning.

7.5.3*

Organizations shall designate any specific substances or contaminants that warrant specialized cleaning and shall determine specific approaches for decontamination for these substances, if warranted.

7.5.4

The organization's PPE technician(s) shall coordinate with and rely on expertise from hazardous materials teams, infection control specialists, verified independent service providers, or other individuals knowledgeable for the type of contaminant and how it can be removed from protective clothing and equipment.

7.5.4.1

The expertise described in 7.5.4 shall be relied upon for determining whether the type of contamination can be effectively removed and for determining the procedures to be used for the removal of the specific contaminant(s), if applicable.

7.5.4.2

Where deemed appropriate for the purpose of specialized cleaning of garment elements, a maximum washer/extractor water temperature shall be permitted to be 60°C (140°F) for those ensembles or ensemble elements that are specified for advanced cleaning using a washer/extractor or other machine-based cleaning technologies. *[See A.7.3.9.1(4).]*

7.5.4.3

Where it is determined that the contaminant(s) cannot be sufficiently removed, the ensembles or ensemble elements shall be condemned and disposed of in accordance with federal, state, and local regulations for the handling and disposal of hazardous materials.

7.5.4.4*

Where it is determined that the contaminant(s) can be sufficiently removed, specific procedures shall be conducted for cleaning, treating, or decontaminating the contaminated ensembles or ensemble elements based on one of the following:

(1) Evidence is provided from a documented source that the applied procedures have shown effectiveness in the past under similar exposure circumstances and contamination conditions.

(2) Testing of the contaminated clothing items is performed that provides detailed results showing the absence of any residual contamination or showing levels of contaminants that are deemed to be safe.

7.5.4.5*

Any testing procedures that are used for assessing residual levels of contamination shall be specific to the contaminants of concern and shall be performed by a laboratory that is accredited for the specific types of analysis carried out on the ensembles or ensemble elements.

7.5.4.6

Where specialized cleaning is applied for the cleaning of ensembles or ensemble elements involving highly hazardous contaminants, the organization's PPE technician(s) shall give consideration to the disposition of the effluent from the cleaning process and whether disposal into the local sewer system is acceptable according to federal, state, and local regulations.

Statement of Problem and Substantiation for Public Comment

It should not be mandatory that verified cleaners or ISPs collaborate with PPE technicians on their processes or should repairs be managed by the PPE technician when performed at a verified ISP.

Related Item

- PPE Technician

Submitter Information Verification

Submitter Full Name:	Tricia Hock
Organization:	LION
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Submittal Date:	Thu May 30 13:34:02 EDT 2024
Committee:	FAE-SPF

Public Comment No. 71-NFPA 1850-2024 [Sections 8.1, 8.2]

Sections 8.1, 8.2

8.1 Requirements for All Ensembles and Ensemble Elements.

8.1.1

All repairs shall be ~~managed by the organization's PPE technician(s) and~~ performed by the original manufacturer, a verified ISP, or a member of the organization who has received training.

8.1.1.1

Training shall be provided by an element manufacturer of the same element type or by a verified ISP in the repair of ensembles or ensemble elements.

8.1.1.2

Requirements for garment element repair shall be specified in Sections 8.2 through 8.4.

8.1.2

The member(s) of the organization who has received training in the repair of the ensembles or ensemble elements shall be responsible for performing repairs.

8.1.3

Ensembles or ensemble elements shall be subjected to advanced cleaning, when necessary, before any repair work is undertaken. Ensembles contaminated by CBRN terrorism agents shall be immediately retired by the organization's PPE technician(s) after CBRN exposure is confirmed and shall not be reused.

8.1.4*

All repairs and alterations to the ensemble or ensemble element shall be done in a manner and using like materials and components that are compliant with NFPA 1971, incorporated in the 2024 edition of NFPA 1970.

8.1.5

Due to the different methods of construction, the ensemble or ensemble element manufacturer shall be contacted if the organization's PPE technician(s) or verified ISP is unsure of whether a repair can be accomplished without adversely affecting the integrity of the ensemble or ensemble element.

8.1.6

Replacement interface components shall be installed in a manner consistent with the ensemble or ensemble element manufacturer's method of construction.

8.2 Requirements for Both Basic and Advanced Garment Element Repair.

8.2.1

All repairs and alterations shall be performed in the same manner and using like materials as the garment element manufacturer, including, but not limited to, fabric, thread type, seam construction, hardware, and hardware backing, unless approved by the garment element manufacturer.

8.2.2

Repairs shall be made to all components and to all layers of the composite that have been damaged or that have been affected by the repair.

8.2.3

Repairs of minor tears, char marks, ember burns, and abraded areas shall be limited to those where the damaged area can be covered by a maximum 160 cm^2 (25 $in.^2$) patch of the same material that is compliant with NFPA 1970. ~~In collaboration with the organization's PPE technician(s),~~ for any tears, char marks, ember burns, and abraded areas that require a patch larger than 160 cm^2 (25 $in.^2$), the manufacturer or the verified ISP shall be consulted.

8.2.3.1

The finished edges of the patch shall extend at least 25 mm (1 in.) in all directions beyond the damaged area.

8.2.3.2

To prevent fraying, the patch shall have no raw edges.

8.2.3.3

Where tears, holes, or abrasions are being repaired, the damaged areas shall be mended using flame-resistant (FR) thread that is compliant with NFPA 1971, incorporated in the 2024 edition of NFPA 1970, to prevent further damage prior to application of the patch.

8.2.3.4

Where moisture barrier tears, holes, or abrasions are being repaired, the repair tape shall be required to extend at least 12.5 mm (½ in.) in all directions beyond the edge of the repaired damage. Where the moisture barrier has a hole or abrasion measuring more than 12.5 mm (½ in.) in diameter in any direction or a tear greater than 75 mm (3 in.) in length, a patch consisting of the same moisture barrier fabric shall be used for repair. Where a moisture barrier manufacturer provides repair tape in various sizes, it shall be permitted to be used for the repair.

8.2.4*

Replacement hardware shall be installed in a manner consistent with the garment element manufacturer’s method of construction.

8.2.4.1

When hardware is replaced, the reinforcement backing material shall be reinstalled or, if it is no longer serviceable, the backing material shall be replaced.

8.2.5

If the complexity of the repair is uncertain, the garment element manufacturer shall be consulted by the organization's PPE technician(s).

8.2.6

Replacement visibility markings shall be installed in a manner consistent with the garment element manufacturer’s method of construction, unless an alternative method is approved by the garment element manufacturer.

8.2.6.1

Visibility markings being replaced shall be completely removed so that no new visibility marking is sewn over an older sewn visibility marking. New visibility markings shall be permitted to be applied over older visibility markings by alternative methods where approved by the garment manufacturer.

8.2.6.2

No repair or alteration shall result in the reduction of the minimum required visibility marking pattern specified in Section 7.2.3 of NFPA 1970.

8.2.6.3

Visibility marking patches that do not exceed 75 mm (3 in.) in length shall be permitted. The visibility marking patch shall extend 25 mm (1 in.) beyond the damaged area. A maximum of two visibility marking patches per stripe shall be permitted.

8.2.6.4

Where a repair or alteration necessitates replacing visibility markings, an equal amount of visibility markings shall be installed.

8.2.6.5

Where the complexity of the visibility marking repair is uncertain, the garment element manufacturer shall be consulted by the organization's PPE technician(s).

Statement of Problem and Substantiation for Public Comment

It should not be mandatory that verified cleaners or ISPs collaborate with PPE technicians on their processes or should repairs be managed by the PPE technician when performed at a verified ISP.

Related Item

- PPE Technician

Submitter Information Verification

Submitter Full Name:	Tricia Hock
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Submittal Date:	Thu May 30 13:39:48 EDT 2024
Committee:	FAE-SPF

Public Comment No. 16-NFPA 1850-2024 [Section No. 9.2.3 [Excluding any Sub-Sections]]

Contaminated or soiled clothing shall not be transported or staged in the cab of fire department ~~apparatus when not being worn for operational duties unless~~ apparatus unless placed in an airtight protective case or bag to prevent cross contamination.

Statement of Problem and Substantiation for Public Comment

This article is specific to the 'transport' and 'staging' of contaminated PPE within apparatus cabs. There are no reasonable "operational duties" of an emergency nature that would necessitate to wearing of contaminated turnout gear for the purpose of transport or staging. There are many provisions and operational logistics that can be implemented to accommodate fire fighters once their PPE is contaminated.

Related Item

- n/a

Submitter Information Verification

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Submittal Date:	Sun May 26 15:10:45 EDT 2024
Committee:	FAE-SPF

Public Comment No. 72-NFPA 1850-2024 [Section No. 9.4.3]

9.4.3

The bag shall be accompanied by a form that indicates the following:

(1) Name of individual and their assignment

(2) Name of department (if being sent outside of the agency)

(3) List of ensembles and ensemble elements

(4) ~~Type of exposure~~

(5) ~~Date of exposure~~

(6)

(7)

(8) Checked if preliminary exposure reduction was completed

Statement of Problem and Substantiation for Public Comment

Type of exposure and date of exposure is excessive for advanced cleaning, this information is better suited for specialized cleans.

Related Item

• Storage

Submitter Information Verification

Submitter Full Name: Tricia Hock

Organization: LION

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City:

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Submittal Date: Thu May 30 13:42:09 EDT 2024

Committee: FAE-SPF

Public Comment No. 36-NFPA 1850-2024 [Section No. 11.1.1.1 [Excluding any Sub-Sections]]

Verification of the organization or ISP shall include advanced inspection, advanced cleaning, sanitization, and advanced repairs of garment elements only as specified in Table 11.1.1.1.

Table 11.1.1.1 ISP and Organization Verification Designation Criteria

Function/Capability	Verified ISP or Verified Organization	Verified Cleaner
Advanced cleaning	Required	Required
Heavy metals cleaning efficiency	≥70% for average of all metals	≥70% for average of all metals
Semivolatile organic compound cleaning efficiency	≥70% for average of all compounds	≥70% for average of all compounds
Biological sanitization effectiveness — *Staphylococcus aureus*	3 log reduction or better	3 log reduction or better
Biological sanitization effectiveness — *Klebsiella pneumoniae*	3 log reduction or better	3 log reduction or better
Advanced inspection	All ensembles and ensemble elements of structural and proximity firefighter protective clothing	Not allowed
Advanced repair~~All ensembles and ensemble elements capable of being repaired for structural and proximity firefighter protective clothing that they have been specifically verified to repair~~	Outer shell and thermal barrier categories required	No repairs allowed
Advanced repairs for moisture barriers	ISPs have a choice of which moisture barriers to verify	Not allowed
~~Verification testing timing~~	~~Every two years, or when processes change~~	~~Every two years, or when processes change~~
~~Verification facility quality review and inspection~~	~~Every six months~~	~~Every six months~~

Statement of Problem and Substantiation for Public Comment

Two changes are being made in this revision:
1. Updating the text for advanced repairs to indicate that only outer shells and thermal barriers are required. No other ensemble elements are considered within this verification chapter and therefore it is inappropriate to state that they should be required.
2. Removing the verification timeline from this table since it is being moved to a new table under 11.2.12

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 35-NFPA 1850-2024 [Section No. 11.2.12]	

Related Item

- FR-146

Submitter Information Verification

Submitter Full Name:	Amanda Newsom
Organization:	UL LLC
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Submittal Date:	Tue May 28 09:49:13 EDT 2024
Committee:	FAE-SPF

Public Comment No. 57-NFPA 1850-2024 [Section No. 11.1.1.1 [Excluding any Sub-Sections]]

Verification of the organization or ISP shall include advanced inspection, advanced cleaning, sanitization, and advanced repairs of garment elements only as specified in Table 11.1.1.1.

Table 11.1.1.1 ISP and Organization Verification Designation Criteria

Function/Capability	Verified ISP or Verified Organization	Verified Cleaner
Advanced cleaning	Required	Required
Heavy metals cleaning efficiency	~~≥70%~~ ≥65% for average of all metals~~≥70%~~	≥65% for average of all metals
Semivolatile organic compound cleaning efficiency	~~≥70%~~ ≥65% for average of all compounds~~≥70%~~	≥65% for average of all compounds
Biological sanitization effectiveness — *Staphylococcus aureus*	3 log reduction or better	3 log reduction or better
Biological sanitization effectiveness — *Klebsiella pneumoniae*	3 log reduction or better	3 log reduction or better
Advanced inspection	All ensembles and ensemble elements of structural and proximity firefighter protective clothing	Not allowed
Advanced repair	All ensembles and ensemble elements capable of being repaired for structural and proximity firefighter protective clothing that they have been specifically verified to repair	No repairs allowed
Advanced repairs for moisture barriers	ISPs have a choice of which moisture barriers to verify	Not allowed
Verification testing timing	Every two years, or when processes change	Every two years, or when processes change
Verification facility quality review and inspection	Every six months	Every six months

Statement of Problem and Substantiation for Public Comment

UL Verification Data shows that a 70% removal rate for both VOC and heavy metals may not be a realistic level. Data shows that a 65% removal rate for both VOC and heavy metals could be achieved by ISPs and verified cleaners.

All wash methods - VOC: 63.07 Metals: 64.44
Water wash only - VOC: 61.49 Metals: 64.99
Alternative wash only - VOC: 82.34 Metals: 57.81
Without pretreatment - VOC: 63.29 Metals: 64.10
With pretreatment - VOC: 62.73 Metals: 64.89
Without presoak - VOC: 61.89 Metals: 66.11
With presoak - VOC: 63.92 Metals: 63.05

Related Item

• FR 146 • PI 253 • PI 127 • PI 254

Submitter Information Verification

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Submittal Date:	Wed May 29 15:57:42 EDT 2024
Committee:	FAE-SPF

Public Comment No. 73-NFPA 1850-2024 [Section No. 11.1.1.5.3]

11.1.1.5.3*

The listing for advanced cleaning and sanitization verification services shall include the following:

(1) ~~A generic description of the type of advanced cleaning equipment, supplies, and process used, including any pretreatments and additional treatments that are always used as part of the advanced cleaning process.~~

(2) ~~A generic description of the type of sanitization equipment, supplies, and process used, including any pretreatments and additional treatments that are always used as part of the sanitization process.~~

(3)

(4)

(5) The average cleaning efficiency for the removal of heaving metals.

(6) The average cleaning efficiency for the removal of semivolatile organic compounds.

(7) The biological sanitization effectiveness for *Staphylococcus aureus*.

(8) The biological sanitization effectiveness for *Klebsiella pneumoniae*.

(9) The dates that the reports for the verification of advanced cleaning and sanitization were issued.

Statement of Problem and Substantiation for Public Comment

It is not common or necessary to include process details on a verification listing. This type of information is included in the verification report which can be available upon request.

Related Item

• Cleaning

Submitter Information Verification

Submitter Full Name: Tricia Hock
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Submittal Date: Thu May 30 13:44:06 EDT 2024
Committee: FAE-SPF

Public Comment No. 34-NFPA 1850-2024 [Section No. 11.1.1.5.4]

~~**11.1.1.5.4**~~ –

~~Repair categories shall be garment outer shell repairs, garment moisture barrier repairs, and garment thermal barrier repairs.~~

Statement of Problem and Substantiation for Public Comment

This is a duplicate to 11.1.1.5.4

Related Item

- FR-147

Submitter Information Verification

Submitter Full Name: Amanda Newsom

Organization: UL LLC

Street Address:

City:

State:

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Submittal Date: Tue May 28 09:39:24 EDT 2024

Committee: FAE-SPF

Public Comment No. 33-NFPA 1850-2024 [Section No. 11.1.1.6]

11.1.1.6

Where the certification listing includes the moisture barrier repair category, the listing shall include the moisture barrier ~~manufacturer and~~ , the moisture barrier ~~family designation that includes which moisture barriers are included in the family, and~~ manufacturer, and the repair tape manufacturer and trade name or part number.

~~**11.1.1.6.1 ***~~

~~The moisture barrier family designation shall be provided to the certification organization by the moisture barrier manufacturer.~~

Statement of Problem and Substantiation for Public Comment

New moisture barriers are being introduced into the market and their performance is unknown. Allowing for one material to be tested to represent another could lead to unintended consequences. Additionally, allowing for moisture barrier families will lead to confusion in the industry on which materials are actually tested.

Related Item

- FR-147

Submitter Information Verification

Submitter Full Name: Amanda Newsom
Organization: UL LLC
Street Address:
City:
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Submittal Date: Tue May 28 09:33:02 EDT 2024
Committee: FAE-SPF

Public Comment No. 4-NFPA 1850-2024 [Section No. 11.1.1.7 [Excluding any Sub-Sections]]

Where the verified ISP or verified cleaner is mobile, the physical address of where the mobile facility ~~performs the services or a~~ is registered and a unique identifier shall be listed on the certification organization's website.

Statement of Problem and Substantiation for Public Comment

Mobile facilities perform services at many different and having the location where they perform services wouldn't be appropriate. The term registered is being proposed, but there may be other terms that are more relevant. Also changing "or" to "and" because if the registered facility has multiple trucks, there would be no way to distinguish between them. Having the unique identifier present ensures that each truck can be identified separately as it relates to their testing performance.

Related Item

- FR-147

Submitter Information Verification

Submitter Full Name: Amanda Newsom
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Submittal Date: Wed May 22 15:34:00 EDT 2024
Committee: FAE-SPF

Public Comment No. 45-NFPA 1850-2024 [Sections 11.1.4, 11.1.5]

Sections 11.1.4, 11.1.5

11.1.4

The certification organization shall not issue ~~any new verifications~~ any verifications to the 2020 edition of NFPA 1851 on or after the NFPA effective date for the 2025 edition of NFPA 1850 (1851).

~~**11.1.5**~~

~~Organizations, ISPs, or manufacturers verified to the 2020 edition of NFPA 1851 shall undergo verification to the 2025 edition of NFPA 1850 (1851) within 12 months of the NFPA effective date for the 2025 edition.~~

Statement of Problem and Substantiation for Public Comment

Verification within this standard is based on a 2 year cycle. The requirement in 11.1.5 is an unfair requirement to place on a number of ISPs simply based on when they decided to become verified initially. The impact of having a 12 month implementation period would be significant to not only the ISPs, but also on the certification organizations and laboratories. If the 12 month implementation period were to remain, and depending on when the standard is issued, there could be as many as 44 of UL Solution's 57 customers that would have to complete their verification prior to their certificate expiration date. More importantly, this means that there would be 44 ISPs that would be trying to perform testing at nearly the same time, and the same backlog would occur every two years after that.

By removing the implementation time all-together, this allows the ISPs to maintain their certificate until it expires. If that expiration date falls after the issue date of the 2025 edition of NFPA 1850 (1851), then the new verification will be performed according to the new standard.

Related Item

- FR-149

Submitter Information Verification

Submitter Full Name: Amanda Newsom

Organization: UL LLC

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State:

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Submittal Date: Tue May 28 11:21:35 EDT 2024

Committee: FAE-SPF

Public Comment No. 61-NFPA 1850-2024 [Section No. 11.1.5]

11.1.5

Organizations, ISPs, or manufacturers verified to the 2020 edition of NFPA 1851 shall undergo verification to the 2025 edition of NFPA 1850 (1851) within ~~12 months~~ 18 months of the NFPA effective date for the 2025 edition.

Statement of Problem and Substantiation for Public Comment

Can the committee for NFPA 1850 consider the reverification timeline to be 18 months after the release of the new edition? The reason being a financial one, for those ISPs who would be due for verification in 2024, it would potentially be a double up on the high cost of verification. Since 1851-2020 edition made verification every two years, this would give all ISPs the ability to plan and budget the new versions verification.

Related Item

- First Revision No. 149-NFPA 1850-2023 [Sections 11.1.4, 11.1.5]

Submitter Information Verification

Submitter Full Name: Inge Pudelek

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State:

Zip:

Submittal Date: Thu May 30 11:45:59 EDT 2024

Committee: FAE-SPF

Public Comment No. 35-NFPA 1850-2024 [Section No. 11.2.12]

11.2.12*

The certification organization shall have a follow-up inspection program of the facilities of the compliant services with at least one random and unannounced visit in accordance with Table 11.~~1~~ 2 .~~1~~ 12 . ~~1.~~

Table 11.2.12 Verification Schedule

Task	Timeline	Method of Verification
Verification	Every two years, or when processes change	Shall be performed on-site. Virtual witnessing shall be permitted in addition to the on-site visit.
Quality review inspection	Every six months	12 month inspection shall be performed on-site; virtual inspection is permitted for the 6 and 18 month inspections

Statement of Problem and Substantiation for Public Comment

Historically, this standard has not been clear on whether or not virtual inspections are allowed. Since the 2020 edition of the standard was issued the same year that the pandemic started, the certification and testing laboratories had to rely on virtual witnessing. After the pandemic ended, questions about returning to in-person and onsite visits were raised. This table intends to provide clarity to how those inspections should occur.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 36-NFPA 1850-2024 [Section No. 11.1.1.1 [Excluding any Sub-Sections]]	

Related Item

- FR-146

Submitter Information Verification

Submitter Full Name: Amanda Newsom

Organization: UL LLC

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City:

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Submittal Date: Tue May 28 09:42:11 EDT 2024

Committee: FAE-SPF

Public Comment No. 55-NFPA 1850-2024 [Section No. 11.3.6]

11.3.6

Sampling levels for testing and inspection shall be established by the certification organization and the organization or the ISP to ensure reasonable and acceptable reliability at a reasonable and acceptable confidence level that the cleaning and repair services are compliant to this standard, unless such sampling levels are specified herein.

11.3.6.1

Where an organization, ISP, or manufacturer operates multiple facilities in different locations, each separate location shall be subject to verification.

11.3.6.2*

For the purpose of verification of advanced cleaning and sanitization, the certification organization ~~shall review the respective facility to determine the~~ shall determine the equipment and procedures that, through engineering judgment, will result in the lowest level of cleaning and be subjected to the verification procedures in 11 . 3.7 .

11.3.6.3*

The equipment and procedures ~~shall be selected and~~ subjected to the verification procedures in 11.3.7 shall not include the procedures utlized by the organization or ISP for specialized cleaning as determined by a review of the organization or ISP quality manual .

A.11.3.6.3

Oranizations and ISPs perform specialized cleaning only when advanced cleaning is not adequate. Many of the techniques utlized by organizations or ISPs for specialized cleaning includes extended soaking or scrubbing in a specific area of the garment. The purpose of the verification procedures in 11.3.7 is to verify whether or not a standard, advanced cleaning process utilized by the organization or ISP is effective.

Statement of Problem and Substantiation for Public Comment

The purpose of cleaning verification in this standard is to determine whether or not the ISP has adequate advanced cleaning procedures. Techniques used within specialized cleaning are inappropriate to use for this testing as they would not be employed on a standard day-to-day basis. They would also not be adequate to consider the entire garment cleaned since many of the specialized cleaning procedures are targeted towards a specific contaminate, or location on the garment.

Related Item

- FR-151

Submitter Information Verification

Submitter Full Name:	Amanda Newsom
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City:	
State:	
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Submittal Date:	Wed May 29 13:37:23 EDT 2024
Committee:	FAE-SPF

Public Comment No. 26-NFPA 1850-2024 [Section No. 11.3.7.3]

11.3.7.3*_

For verification of cleaning, water hardness testing shall be performed by the ISP, the cleaner only, the manufacturer, or the organization and shall not exceed 60 ppm.

11.3.7.3.1

The facility shall perform water hardness testing a minimum of every two years.

11.3.7.3.2

Where the facility is mobile, the facility shall test water hardness prior to performing any services at each remote location.

11.3.7.3.3

Where the facility is mobile, the facility shall be permitted to use water from a location where that location is tested and complies with 11.3.7.3.1.

<u>A.11.3.7.3</u>

<u>Water hardness can be performed in a number of ways, including the use of test strips that indicate a water harness range that falls below the requirement, or laboratory testing that provides an actual water hardness value. Any method used should indicate that the water falls below the requirement, whether an exact value or range is provided.</u>

Statement of Problem and Substantiation for Public Comment

Adding clarity that any method for measuring water hardness is appropriate so that certification organizations can interpret how to meet this requirement.

Related Item

- FR-151

Submitter Information Verification

Submitter Full Name: Amanda Newsom
Organization: UL LLC
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City:
State:
Zip:

Submittal Date: Tue May 28 08:17:59 EDT 2024
Committee: FAE-SPF

Public Comment No. 28-NFPA 1850-2024 [Section No. 11.3.8.2 [Excluding any Sub-Sections]]

For moisture barrier pinhole repairs, the certification organization shall inspect the pinholes in the material(s) to be repaired and shall witness the repair of the samples to be tested. The pinholes shall be created in the material(s) by using a size 8 gauge sewing needle to completely puncture the moisture barrier five times in a 25 mm (1 in.) square located in the center of a ~~152 mm~~ 203 mm × ~~152 mm~~ 203 mm (~~6 in~~ 8 in . × ~~6 in~~ 8 in .) sample. The 25 mm (1 in.) square shall be clearly marked to identify the damaged area.

Statement of Problem and Substantiation for Public Comment

During first draft, this section was updated to reduce the sample size, but after discussion with the lab, it was determined that this was a little too small and the additional two inches will be sufficient to make sure that there is enough of an edge around the test area.

Related Item

- FR-152

Submitter Information Verification

Submitter Full Name: Amanda Newsom
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Submittal Date: Tue May 28 08:26:40 EDT 2024
Committee: FAE-SPF

Public Comment No. 27-NFPA 1850-2024 [Section No. 11.3.10]

11.3.10

For verification of the advanced cleaning and sanitization services of ISPs, cleaners, manufacturers, or organizations, the documentation and measurements specified in Table 11.3.10 shall be evaluated for compliance by the certification organization.

Table 11.3.10 Advanced Cleaning Evaluation

NFPA 1850 Clause to Be Evaluated	Method of Evaluation
7.3.4	Audit or review of procedures and documentation by certification organization
7.3.4.2	Audit or review of procedures and documentation by certification organization
7.3.5	Audit or review of procedures and documentation by certification organization
7.3.6	Audit or review of procedures and documentation by certification organization
7.3.7.2	Audit or review of procedures and documentation by certification organization
7.3.8	Audit or review of procedures and documentation by certification organization
7.3.9(1)–(3) and 7.3.9(5)–(6)	Audit or review of procedures and documentation by certification organization
7.3.9(4)	Direct measurement or observation by a representative of the certification organization
7.3.11	Audit or review of procedures and documentation by certification organization
7.3.16	Audit or review of procedures and documentation by certification organization
7.3.10	Audit or review of procedures and documentation by certification organization
7.3.10.1(1)(c), 7.3.10.1(2)(c), or 7.3.10.1(3)(d)	Direct measurement or observation by a representative of the certification organization
7.4.4.3	Audit or review of procedures and documentation by certification organization
7.4.4.4	Audit or review of procedures and documentation by certification organization
7.4.4.5	Audit or review of procedures and documentation by certification organization
7.4.4.6	Audit or review of procedures and documentation by certification organization
11.3.7. 3	Direct measurement or observation by a representative of the certification organization
11.3.7. 5	Audit or review of procedures and documentation by certification organization

Statement of Problem and Substantiation for Public Comment

While the requirement to perform the water hardness testing is present in 11.3.7.3, this adds clarity to the requirement for the certification organizations and what is required for documentation purposes.

Related Item

- FR-151

Submitter Information Verification

Submitter Full Name:	Amanda Newsom
Organization:	UL LLC
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Submittal Date:	Tue May 28 08:21:42 EDT 2024
Committee:	FAE-SPF

Public Comment No. 67-NFPA 1850-2024 [Section No. 11.5]

11.5 Evaluation of Cleaning Process Impact on Protective Garments.

Where specified or where undertaken as an optional evaluation, advanced cleaning procedures shall be evaluated for their impact on key performance properties as specified in Section 12.~~14~~ 5 , where the measured performance of each garment material property is in accordance with the criteria specified in the requirements of NFPA 1970 (1971).

Statement of Problem and Substantiation for Public Comment

Section 7.3.12.1.2 The First Revision Report (FR 159) indicates that degradation criteria testing was meant to be an optional requirement.

Section 11.5 referenced the wrong section; the correct section is being referenced.

Sections 12.5.1 and 12.5.3.1 If performance requirements are being made to NFPA 1970 (1971) we should use the equivalent preconditioning cycles, which is 5 cycles.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 66-NFPA 1850-2024 [Section No. 7.3.12.1]	cross reference

Related Item

- cleaning

Submitter Information Verification

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Submittal Date: Thu May 30 13:17:13 EDT 2024

Committee: FAE-SPF

Public Comment No. 74-NFPA 1850-2024 [Section No. 11.6]

~~**11.6** – Optional Verifications for Contaminant Removal.~~

~~**11.6.1** – Advanced Cleaning and Sanitization Verification for Garment Outer Shells, Moisture Barriers and Thermal Barriers.~~

~~Where undertaken, selected outer shell, moisture material, and thermal barrier materials shall be evaluated for both advanced cleaning and sanitization efficacy as specified in Section 12.6 and meet the criteria in 11.6.1.1 and 11.6.1.2 .~~

~~**11.6.1.1** –~~

~~The cleaning process shall provide a 70 percent or greater average cleaning efficiency for the average of all semivolatile organic compounds and the average of all surrogate heavy metal contaminants, separately.~~

~~**11.6.1.2** –~~

~~The sanitization process shall provide for at least a log $_{10}$ 3 reduction of each challenge microorganism.~~

~~**11.6.2** – Advanced Cleaning and Sanitization Verification of Protective Hoods.~~

~~Where undertaken, hoods shall be evaluated for both advanced cleaning and sanitization efficacy as specified in Section 12.7 and meet the criteria in 11.6.2.1 and 11.6.2.2 .~~

~~**11.6.2.1** –~~

~~The cleaning process shall provide a 70 percent or greater average cleaning efficiency for the average of all semivolatile organic compounds and the average of all surrogate heavy metal contaminants, separately.~~

~~**11.6.2.2** –~~

~~The sanitization process shall provide for at least a log $_{10}$ 3 reduction of each challenge microorganism.~~

~~**11.6.3** – Advanced Cleaning Verification for Removal of Additional PAHs from Garments.~~

~~Where undertaken, garment outer shell materials shall be evaluated for advanced cleaning efficacy in removing PAH contamination as specified in Section 12.8 where the cleaning process provides a 70 percent or greater average cleaning efficiency for the average of all PAH compounds.~~

~~**11.6.4** – Advanced Cleaning Verification for Removal of Semivolatile PFAS from Garments.~~

~~Where undertaken, garment outer shell materials shall be evaluated for advanced cleaning efficacy in removing PFAS contamination as specified in Section 12.9 where the cleaning process provides a 70 percent or greater average cleaning efficiency for the average of all PFAS compounds.~~

~~**11.6.5** – Advanced Cleaning Verification for Removal of Mobile and Stationary Energy Storage System Fire Decomposition Products from Garments.~~

~~Where undertaken, garment outer shell materials shall be evaluated for advanced cleaning efficacy in removing mobile and stationary energy storage system fire decomposition product contamination as specified in Section 12.10 where the cleaning process provides a 70 percent or greater average cleaning efficiency for the average of all target surrogate compounds.~~

~~**11.6.6** – Advanced Cleaning Verification for Removal of Asbestos from Garments.~~

~~Where undertaken, garment outer shell materials shall be evaluated for advanced cleaning efficacy in removing asbestos fiber contamination as specified in Section 12.11 where the cleaning process removes asbestos fibers to a level below the detection limit.~~

Statement of Problem and Substantiation for Public Comment

Delete entire section and corresponding test sections and move to annex for reference as optional testing.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 75-NFPA 1850-2024 [Sections 12.6, 12.7, 12.8, 12.9, 12.10, 12.11]	

Related Item

- Cleaning

Submitter Information Verification

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Submittal Date:	Thu May 30 13:46:00 EDT 2024
Committee:	FAE-SPF

Public Comment No. 39-NFPA 1850-2024 [Sections 11.6.5, 11.6.6]

~~**Sections 11.6.5, 11.6.6**~~

~~**11.6.5** – Advanced Cleaning Verification for Removal of Mobile and Stationary Energy Storage System Fire Decomposition Products from Garments.~~

~~Where undertaken, garment outer shell materials shall be evaluated for advanced cleaning efficacy in removing mobile and stationary energy storage system fire decomposition product contamination as specified in Section 12.10 where the cleaning process provides a 70 percent or greater average cleaning efficiency for the average of all target surrogate compounds.~~

~~**11.6.6** – Advanced Cleaning Verification for Removal of Asbestos from Garments.~~

~~Where undertaken, garment outer shell materials shall be evaluated for advanced cleaning efficacy in removing asbestos fiber contamination as specified in Section 12.11 where the cleaning process removes asbestos fibers to a level below the detection limit.~~

Statement of Problem and Substantiation for Public Comment

The test methods outlined in chapter 12 are insufficient to apply this requirement.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 30-NFPA 1850-2024 [Section No. 12.10]	

Related Item

- FR-163

Submitter Information Verification

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Submittal Date: Tue May 28 10:05:37 EDT 2024
Committee: FAE-SPF

Public Comment No. 40-NFPA 1850-2024 [Sections 11.7, 11.8]

~~**Sections 11.7, 11.8**~~

~~**11.7** – Verification of Cleaning Equipment and Processes Used for Advanced Cleaning and Sanitization for Garments.~~

~~**11.7.1**~~ –

~~Manufacturers of specific cleaning equipment and providers of separate cleaning processes for advanced cleaning and sanitization shall not make claims for compliance with NFPA 1850 (1851) unless the separate machines or processes have been verified for use in advanced cleaning and sanitization of garments with the requirements of Section 11.7 .~~

~~**11.7.2**~~ –

~~The verification shall be performed by a certification organization that meets at least the requirements specified in Section 11.2 and that is accredited for personal protective equipment (PPE) in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services* . The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies* .~~

~~**11.7.3**~~ –

~~The manufacturer or provider of cleaning equipment or cleaning processes shall not use the NFPA name or the name or identification of this standard in any statements about its services unless the cleaning equipment or process is verified as compliant to this standard.~~

~~**11.7.3.1**~~ –

~~No manufacturer or provider of cleaning equipment or cleaning processes covered by this standard shall claim to offer cleaning equipment or cleaning processes verified for advanced cleaning and sanitization unless they comply with all of the requirements in Section 11.7 and are third-party verified in accordance with the requirements of this chapter.~~

~~**11.7.4**~~ –

~~The manufacturer or provider of the cleaning equipment or process shall provide explicit instructions for the use or operation of the cleaning equipment or process that includes at least the following information, as applicable:~~

(1) ~~The specific wash formulation that is applicable~~

(2) ~~The need for applying any pretreatments or posthandling of protective garments~~

(3) ~~Limitations on the use of any detergents of cleaning/decontamination products~~

(4) ~~Other limitations in the implementation of the equipment or process~~

~~**11.7.5**~~ –

~~Where cleaning equipment or a cleaning process is being verified for advanced cleaning as specified in Section 12.12 , the cleaning process shall provide a 70 percent or greater average cleaning efficiency for the average of all semivolatile organic compounds and the average of all surrogate heavy metal contaminants, separately.~~

~~**11.7.6**~~ –

~~Where cleaning equipment or a cleaning process is being verified for sanitization as specified in Section 12.12 , the sanitization process shall provide for at least a log~~ $_{10}$ ~~3 reduction of each challenge microorganism.~~

~~**11.8** – Verification of Detergents and Cleaning/Decontamination Products for PER, Advanced Cleaning, and Sanitization.~~

~~**11.8.1**~~ –

~~Manufacturers or suppliers of detergents or cleaning/decontamination products for PER, advanced cleaning, and sanitization shall not make claims for compliance with NFPA 1850 (1851) unless the detergents or cleaning/decontamination products have been verified for use in advanced cleaning and sanitization of garments with the requirements of Section 11.8 .~~

~~**11.8.2**~~ –

~~The verification shall be performed by a certification organization that meets at least the requirements specified in Section 11.2 and that is accredited for personal protective equipment (PPE) in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services* . The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies* .~~

~~**11.8.3**~~ –

~~The manufacturer or supplier of the detergents or cleaning/decontamination products shall not use the NFPA name or the name or identification of this standard in any statements about its services unless the cleaning equipment or process is verified as compliant to this standard.~~

~~**11.8.3.1**~~ –

~~No manufacturer or supplier of detergents or cleaning/decontamination products covered by this standard shall claim to offer detergents or cleaning/decontamination products verified for advanced cleaning and sanitization unless they comply with all of the requirements in Section 11.8 and are third-party verified in accordance with the requirements of this chapter.~~

~~**11.8.4**~~ –

~~The manufacturer or supplier of the detergent or cleaning/decontamination product shall provide explicit instructions for the use of detergent or cleaning/decontamination products that includes at least the following information, as applicable:~~

(1) ~~The specific wash formulation that is applicable~~

(2) ~~The range of acceptable water hardness~~

(3) ~~Other limitations in the use of the detergent or cleaning/decontamination product~~

~~**11.8.5**~~ –

~~Where a detergent or cleaning/decontamination product is verified for advanced cleaning as specified in Section 12.13 , the cleaning process shall provide a 70 percent or greater average cleaning efficiency for the average of all semivolatile organic compounds and the average of all surrogate heavy metal contaminants, separately.~~

~~**11.8.6**~~ –

~~Where cleaning equipment or a cleaning process is verified for sanitization as specified in Section 12.13 , the sanitization process shall provide for at least a log~~ $_{10}$ ~~3 reduction of each challenge microorganism.~~

Statement of Problem and Substantiation for Public Comment

Manufacturers of these products would want to label their products as compliant with this standard. This standard is a selection, care and maintenance document and therefore there is a lack of labeling, quality management and inspection procedures to allow for product marking and it would be considered out of scope.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 38-NFPA 1850-2024 [Section No. 7.3.7.2]	

Related Item

- FR-162

Submitter Information Verification

Submitter Full Name:	Amanda Newsom
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Committee:	FAE-SPF

Public Comment No. 59-NFPA 1850-2024 [Sections 12.1.5, 12.1.6]

Sections 12.1.5, 12.1.6

12.1.5 Results.

Results shall be determined by evaluating areas where the light is brighter through some areas than others.

12.1.6* Interpretation.

Brighter areas shall be considered a possible indication of a defect or other damage that compromises the hood's performance. The AHJ shall establish parameters to determine if the amount of light transmittance requires retirement of the hood.

Statement of Problem and Substantiation for Public Comment

Additional guidance should be given to organizations on what constitutes the need for retirement of hoods. Is some light transmittance acceptable. Is there a definable area or amount of brightness. While brighter indicates a change in some cases there is still particulate blocking material remaining. Additional guidance and language is needed.

Related Item

- fr156

Submitter Information Verification

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Submittal Date: Thu May 30 08:34:50 EDT 2024
Committee: FAE-SPF

Public Comment No. 37-NFPA 1850-2024 [Section No. 12.4.5.1]

12.4.5.1

Each individual contaminated and ~~noncontaminated~~ non-contaminated specimen shall be placed in ~~a separate contamination~~ a contamination -free or sterile container ~~with a label identifying the specimen and shipped overnight~~ or package so that each contaminated specimen is isolated from the other and the non-contaminated specimens are in a separate container or package. The specimens shall be shipped by the certification organization or its designated laboratory to the cleaning facility ~~for receipt on the scheduled day of testing~~ .

Statement of Problem and Substantiation for Public Comment

Two changes are being made under this revision:
1. Updating the packaging so that multiple contaminated specimens may be combined into a single package as long as that packaging ensures isolation between specimens.
2. Removing the requirement that shipments must be delivered overnight. The packaging options are capable of maintaining proper conditions for longer periods of time. Shipping carriers are often unreliable and therefore having this mandatory text opens the certification organizations open to audit findings when there is no control over this step.

Related Item

- FR-144

Submitter Information Verification

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Submittal Date: Tue May 28 09:53:25 EDT 2024
Committee: FAE-SPF

Public Comment No. 76-NFPA 1850-2024 [Section No. 12.4.7.2]

12.4.7.2

Specimens shall be shipped ~~in a manner to maintain their temperature at~~ with the packing material provided by the verification organization to maintain desired temperature of 4°C (39°F) after testing at the cleaning facility.

Statement of Problem and Substantiation for Public Comment

Verification organizations provide the packing material for returned test samples, there is no way to monitor and verify the temperature maintained a specific degree.

Related Item

- Verification

Submitter Information Verification

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Submittal Date: Thu May 30 13:50:27 EDT 2024
Committee: FAE-SPF

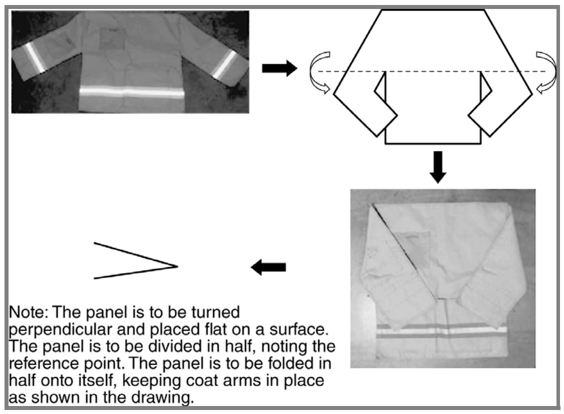
Public Comment No. 54-NFPA 1850-2024 [Sections 12.4.14.2.7, 12.4.14.2.8]

~~Sections~~ [Replace figures 12.4.14.2.7 ~~, 12~~ and 12 .4.14.2.8 with the modified figures attached to this comment]

12.4.14.2.7

The surrogate coat shall be folded and placed into the wash load as shown in Figure 12.4.14.2.7.

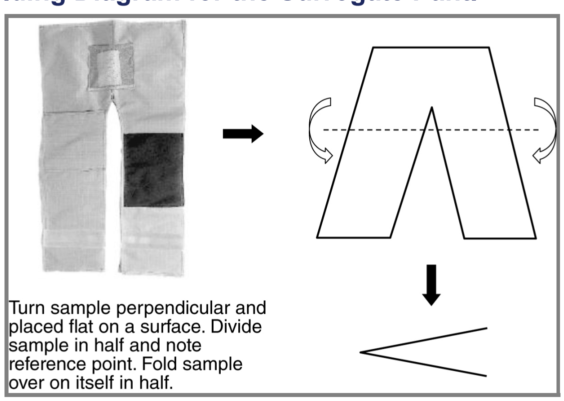
Figure 12.4.14.2.7 Folding Diagram for the Surrogate Coat.



12.4.14.2.8

The surrogate pant shall be folded and placed into the wash load as shown in 12.4.14.2.8.

Figure 12.4.14.2.8 Folding Diagram for the Surrogate Pant.



Additional Proposed Changes

File Name	Description	Approved
Surrogate_figures.docx	Surrogate Figures	

Statement of Problem and Substantiation for Public Comment

During first draft, the surrogate garments were updated to remove the reflective trim. The figures need to be updated to remove the photographs of the surrogates that indicate that trim is present. The sketched diagrams are sufficient to determine how to fold them when putting them into the wash.

Related Item

- FR-144

Submitter Information Verification

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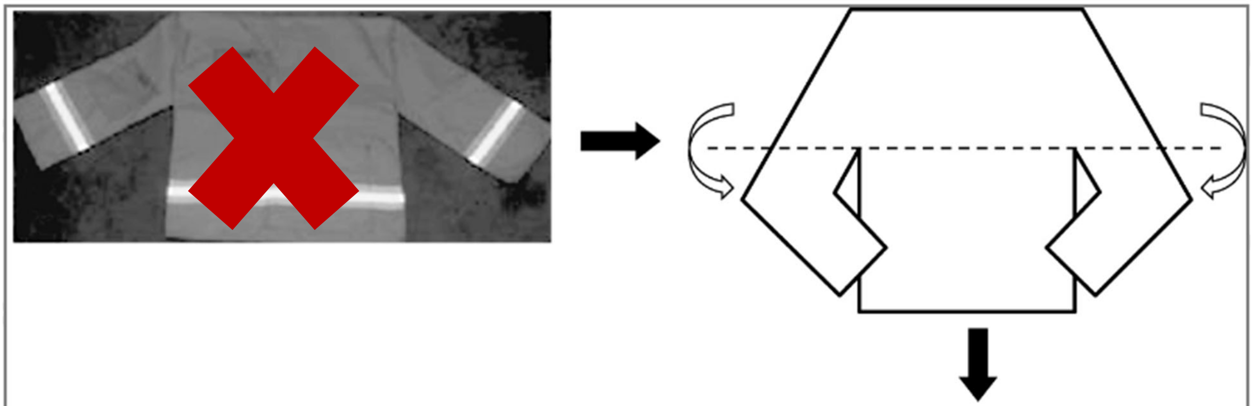
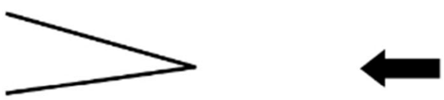
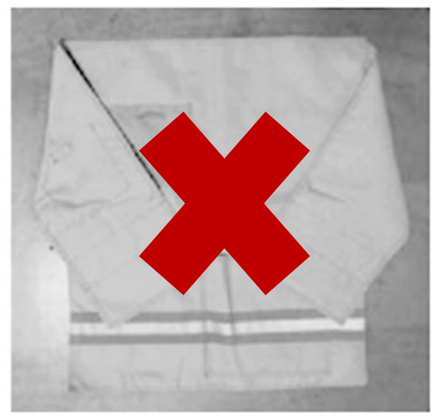
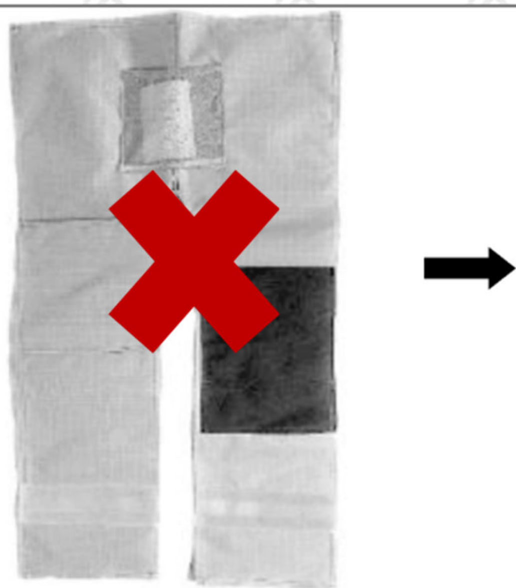
Submittal Date:	Wed May 29 09:30:19 EDT 2024
Committee:	FAE-SPF

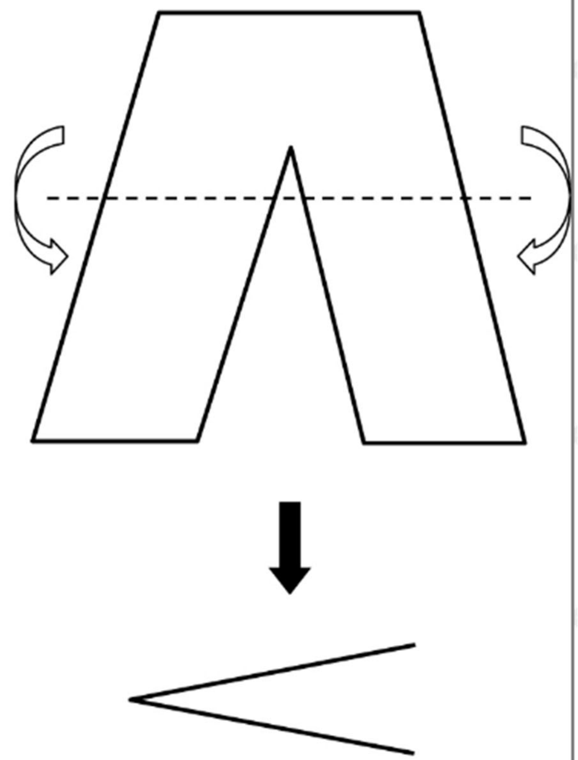






Note: The panel is to be turned perpendicular and placed flat on a surface. The panel is to be divided in half, noting the reference point. The panel is to be folded in half onto itself, keeping coat arms in place as shown in the drawing.





Turn sample perpendicular and placed flat on a surface. Divide sample in half and note reference point. Fold sample over on itself in half.

Public Comment No. 68-NFPA 1850-2024 [Section No. 12.5]

12.5 Cleaning Process Impact on Garment Materials Test.

12.5.1 Overview.

Two sets of garment material samples shall be prepared and subject to a minimum of ~~30 cycles~~ 5 cycles of advanced cleaning for the process to be evaluated where the results for testing of specimens taken from samples subjected to the multiple cycles of advanced cleaning are compared against both the existing NFPA 1970 (1971) performance criteria and against the results for samples that were not subject to advanced cleaning.

12.5.2 Selection of Garment Materials for Evaluation.

12.5.2.1

Two different garment element composites consisting of a different outer shell material, a different moisture barrier material, and a different thermal barrier material shall be selected.

12.5.2.2

Two different high-visibility trim materials shall be selected.

12.5.2.3

Composite panels measuring 66 cm × 66 cm (26 in. × 26 in.) shall be prepared in a sufficient number to provide the necessary specimens specified in Table 12.5.2.3 using selected composite materials using the following construction details:

(1) Outer shell material layers shall be prepared as a single layer and shall have a finished edge of each side.

(2) Liner panels shall be prepared using a layer of moisture barrier and layer of thermal barrier where the combination of both layers has a finished edge on each side.

(3) Some panels shall include a seam of the respective layer(s) that bisects the panel.

(4) Some panels shall include three rows equally separated of one high-visibility trim that is parallel to one side. Separate outer shell panels shall have the second trim.

(5) Some outer shell panels shall have a product label attached to either side of the shell material layer.

(6) Some liner panels shall have a product label lining panel attached to the thermal barrier side of the panel.

(7) Some outer shell panels without seams shall have parallel sets of three marks in both panel directions on one surface of the panel for the measurement of cleaning shrinkage.

(8) Some liner panels without seams shall have parallel sets of three marks in both panel directions on both the moisture barrier and thermal barrier sides for the measurement of cleaning shrinkage.

(9) The material direction shall be marked in each direction.

(10) All marks shall be made in a way that they are not removed by the cleaning.

Table 12.5.2.3 Selected Performance Properties and Sample Requirements

Performance Property	Test Method (in NFPA 1970)	Type of Sample(s)	Specimens Required
Thermal protective performance (TPP)	Section 9.2.16	Composite	Three 150 mm (6 in.) squares
Flame resistance	Section 8.2	Outer shell, moisture barrier, thermal barrier	Five 75 mm × 305 mm (3 in. × 12 in.) rectangles (in each material direction)
Tear resistance	Section 9.3.1	Outer shell, moisture barrier, thermal barrier	Five 75 mm × 150 mm (3 in. × 6 in.) rectangles (in each material direction)
Breaking strength	Section 9.3.2	Outer shell	Five 100 mm × 200 mm (4 in. × 8 in.) rectangles (in each material direction)
Seam-breaking strength	Section 9.3.4	Major outer shell, moisture barrier, thermal barrier	Five 100 mm × 200 mm (4 in. × 8 in.) rectangles where seam bisects long dimension
Water absorption resistance	Section 9.4.1	Outer shell	Three 200 mm (8 in.) squares
Cleaning shrinkage resistance	Section 9.9.1	Outer shell, moisture barrier, thermal barrier	Five 375 mm (15 in.) squares
Liquid penetration resistance–Fuel H	Section 9.4.3	Moisture barrier seams	Three 75 mm (3 in.) squares
Viral penetration resistance	Section 9.4.5	Moisture barrier seams	Four 75 mm (3 in.) squares
Retroreflectivity and fluorescence	Section 9.8.1	Trim sections	Four 305 mm (12 in.) lengths

Performance Property	Test Method (in NFPA 1970)	Type of Sample(s)	Specimens Required
Label legibility	Section 9.8.12	Labels applied to specific layers	Three labels of each type

12.5.3 Evaluation Procedures.

12.5.3.1

Panels shall be subject to at least ~~30 cycles~~ 5 cycles of advanced cleaning using the same steps applied in the verification of the advanced cleaning process.

12.5.3.2

The wash load shall be permitted to be adjusted to the specified load level by using a suitable ballast material.

12.5.3.3

Following the completion of laundering, panels shall be inspected, and specimens removed for testing in accordance with the specified procedures from NFPA 1970 (1971) with the exception that no laundering conditioning is applied to any specimens.

12.5.3.4

Test results shall be obtained for the same performance properties on pristine materials (uncleaned) for all relevant tests (except labels and cleaning shrinkage).

12.5.4 Report.

12.5.4.1

All individual test results shall be tabulated, and the average results calculated as specified in the respective NFPA 1970 (1971) test procedures.

12.5.4.2

The average test results for each test property shall be tabulated for both cleaning and uncleaned conditions for each fabric. This tabulation shall include the percentage difference between cleaned and uncleaned specimen test results.

12.5.5 Interpretation.

Passing performance shall be determined by the basis of the performance criteria specified in NFPA 1970 (1971) garment element requirements.

Statement of Problem and Substantiation for Public Comment

Section 7.3.12.1.2 The First Revision Report (FR 159) indicates that degradation criteria testing was meant to be an optional requirement.

Section 11.5 referenced the wrong section; the correct section is being referenced.

Sections 12.5.1 and 12.5.3.1 If performance requirements are being made to NFPA 1970 (1971) we should use the equivalent preconditioning cycles, which is 5 cycles.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 66-NFPA 1850-2024 [Section No. 7.3.12.1]	

Related Item

- Cleaning

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 75-NFPA 1850-2024 [Sections 12.6, 12.7, 12.8, 12.9, 12.10, 12.11]

Sections 12.6, 12.7, 12.8, 12.9, 12.10, 12.11

~~**12.6** – Cleaning Efficacy Test 2.~~

~~The procedures in Section 12.4 shall be adapted for application to other outer shell materials and to moisture barrier and thermal barrier materials using the following modifications:~~

(1) ~~Where a different outer shell material is to be evaluated, the new outer shell shall be substituted for the current outer shell material specified in 12.4.3.1 .~~

(2) ~~Where a moisture barrier is used, samples of moisture barrier shall be substituted for the current outer shell material specified in 12.4.3.1 and the side of the moisture barrier facing the outer shell shall be contaminated.~~

(3) ~~Where a thermal barrier is used, samples of moisture barrier shall be substituted for the current outer shell material specified in 12.4.3.1 and the side of the thermal barrier facing the moisture barrier shall be contaminated.~~

~~**12.7** – Cleaning Efficacy Test 3.~~

~~**12.7.1** – Application.~~

~~This test method shall determine the cleaning efficacy for hoods that are subjected to advanced cleaning procedures by a cleaning facility.~~

~~**12.7.2** – General Procedures.~~

~~**12.7.2.1** –~~

~~The certification organization or its designated laboratory shall contaminate hood specimens with semivolatile organic compounds and heavy metals.~~

~~**12.7.2.2** –~~

~~Contaminated and noncontaminated specimens of the selected hood shall be prepared, appropriately packaged, and sent by the certification organization to the respective cleaning facility with the supplies necessary for subjecting the specimens to the cleaning facility's advanced cleaning procedures.~~

~~**12.7.2.3** –~~

~~Under the supervision of a representative from the certification organization, ISP personnel shall contaminate the hood specimens that shall then be specially placed with designated ballast materials in the cleaning facility's advanced cleaning equipment to form the wash load.~~

~~**12.7.2.3.1** –~~

~~If the cleaning facility uses a presoak or other scrubbing method as part of their documented advanced cleaning process, this process shall be conducted under the supervision of the certification organization.~~

~~**12.7.2.4** –~~

~~The contaminated hood specimens and designated ballast material shall be subjected to one full cycle of the cleaning facility's advanced cleaning procedures.~~

~~**12.7.2.5** –~~

~~Following the completion of the cleaning facility's advanced cleaning procedures and under the supervision of a representative from the certification organization, the washed hood specimens shall be removed by cleaning facility personnel, placed in suitable containers, and shipped back to the certification organization or its designated laboratory.~~

~~**12.7.2.6** –~~

~~The certification organization or its designated laboratory shall analyze the washed hood specimens as well as control specimens and determine the cleaning efficiency of the cleaning facility's advanced cleaning procedures for each of the specified contaminants.~~

~~**12.7.2.7** –~~

~~The certification organization shall separately interpret the cleaning efficiency results for both semivolatile organic compounds and heavy metals to determine compliance with the criteria for the respective cleaning facility cleaning efficiency specified in 11.3.7 .~~

~~**12.7.3** – Specimen Preparation.~~

~~**12.7.3.1** –~~

~~The specimens for testing shall consist of finished hoods with the following specifications:~~

(1) ~~Layers shall consist of one outer layer of 7.0 oz/yd ^{2} (+1.0/-0.5 oz/yd ^{2}) 20 percent Nomex/80 percent Lenzing FR rib knit with the inner layer consisting of a particulate blocking material.~~

(2) ~~Finished hoods for testing shall meet the requirements of NFPA 1970 and shall be certified.~~

~~**12.7.3.2** –~~

~~Finished hoods used for testing shall be prepared by laundering for 10 cycles as specified in AATCC LP1, *Home Laundering: Machine Washing* , using Machine Cycle 1, Wash Temperature V, and Drying Procedure Ai. A 1.82 kg ± 0.1 kg (4.0 lb ± 0.2 lb) load shall be used. A laundry bag shall not be used.~~

~~**12.7.4** – Preparation of Test Specimens for Semivolatile Organic Compounds and Heavy Metals.~~

~~**12.7.4.1** –~~

~~A minimum of three specimens shall be contaminated as specified in 12.7.11.1 and 12.7.11.2 and a minimum of three specimens shall be contaminated as specified in 12.7.12.1 and 12.7.12.2 .~~

~~**12.7.4.2** –~~

~~Two additional specimens shall be prepared as specified in 12.7.3.2 but not contaminated.~~

~~**12.7.4.3** –~~

~~One specimen of each of the contaminated semivolatile organic compounds and heavy metal–contaminated hoods shall remain at the certification organization or its designated laboratory.~~

~~**12.7.4.4** –~~

~~One noncontaminated specimen shall remain at the certification organization or its designated laboratory.~~

~~**12.7.4.5** –~~

~~One noncontaminated specimen shall be shipped to the cleaning facility for advanced cleaning.~~

~~**12.7.5** – Specimen Handling.~~

~~**12.7.5.1** –~~

~~Each individual contaminated and noncontaminated specimen shall be placed in a separate contamination-free container or bag with a label identifying the specimen and the certification organization or its designated laboratory shall utilize expedited shipping to ensure samples are delivered to the cleaning facility on the scheduled day of testing.~~

~~**12.7.5.1.1** –~~

~~Specimens shall be placed in the container or bag so that folding of the hood is not necessary.~~

~~**12.7.5.2** –~~

~~Under the supervision of a representative from the certification organization, the contaminated and noncontaminated hood specimens shall be unpacked with the individual handling the specimens wearing clean disposable gloves.~~

~~**12.7.5.3** –~~

~~Caution shall be taken by the individual handling the specimens so that the marked areas of contamination are not touched during the unloading process.~~

~~**12.7.6** – Assembly of Wash Load.~~

~~**12.7.6.1** –~~

~~The wash load shall be assembled as specified in 12.7.13 and adjusted according to the cleaning facility's procedures for load size.~~

~~**12.7.6.2** –~~

~~If the cleaning facility's procedures for advanced cleaning involve a pretreatment, then the cleaning facility shall be permitted to apply the pretreatment only to the test specimens.~~

~~**12.7.6.3** –~~

~~The wash load consisting of the test specimens, along with the specified number of ballast panels, shall be subject to the cleaning facility's advanced cleaning procedures for which verification is being performed.~~

~~**12.7.6.4** –~~

~~To shorten the drying time, the test specimens shall be permitted to dry without the ballast panels.~~

~~**12.7.7** – Removal and Shipping.~~

~~**12.7.7.1** –~~

~~Following the advanced cleaning and under the supervision of a representative from the certification organization, the specimens shall be removed from wash load and placed in labeled, contamination-free containers or bags; and packaged for expedited shipment to the certification organization or its designated laboratory for evaluation.~~

~~**12.7.7.2** –~~

~~Specimens shall be placed in the container or bag so that folding of the hood is not necessary.~~

~~**12.7.8** – Specimen Evaluation.~~

~~**12.7.8.1** –~~

~~Test specimens for semivolatile organic compound contamination removal shall be subject to the extraction and analysis procedures specified in 12.7.11.3 through 12.7.11.5 .~~

~~**12.7.8.2** –~~

~~Test specimens for heavy metal contamination removal shall be subject to the extraction and analysis procedures specified in 12.7.12.3 through 12.7.12.4 .~~

~~**12.7.9** – Report.~~

~~The following information shall be reported for each semivolatile compound and heavy metal contaminants:~~

(1) ~~Contaminant concentration in the contaminated specimen that stayed at the certification organization or its designated laboratory~~

(2) ~~Contaminant concentration in the contaminated traveling specimen, if applicable~~

(3) ~~Contaminant concentration in the unwashed traveling specimen, if applicable~~

(4) ~~Contaminant concentration in each of the washed specimens~~

(5) ~~Average contaminant concentration of the washed specimens~~

(6) ~~Contaminant concentration in the washed, blank specimen~~

(7) ~~Calculated cleaning efficiency by contaminant~~

(8) ~~The average calculated cleaning efficiency for all contaminants~~

~~**12.7.10** – Interpretation.~~

~~**12.7.10.1** –~~

~~Overall compliance with the requirement for chemical decontamination involving semivolatile organic compound contaminants shall be based on the average calculated cleaning efficiency for all chemical contaminants.~~

~~**12.7.10.2** –~~

~~Overall compliance with the requirement for chemical decontamination involving heavy metals shall be based on the average calculated cleaning efficiency for all heavy metal contaminants.~~

~~**12.7.11** – Specific requirements Semivolatile Organic Compound Contained Specimen Preparation, Extraction, and Analysis.~~

~~**12.7.11.1** – Selection of Contaminants.~~

~~The following semivolatile organic compounds shall be prepared at a concentration of 200 ppm in a 1:1 mixture of benzene and methylene chloride:~~

(1) ~~Acenaphthene (CAS No. 83-32-9)~~

(2) ~~Anthracene (CAS No. 120-12-7)~~

(3) ~~Diethyl phthalate (CAS No. 84-66-2)~~

(4) ~~Di-n-octyl phthalate (CAS No. 117-84-0)~~

(5) ~~Fluorene (CAS No. 86-73-7)~~

(6) ~~Phenanthrene (CAS No. 85-01-8)~~

(7) ~~Pyrene (CAS No. 129-00-0)~~

(8) ~~2-Nitrophenol (CAS No. 88-75-5)~~

(9) ~~Phenol (CAS No. 108-95-2)~~

(10) ~~2,4,6-Trichlorophenol (CAS No. 88-06-2)~~

(11) ~~Benzo[a]pyrene (CAS No. 50-32-8)~~

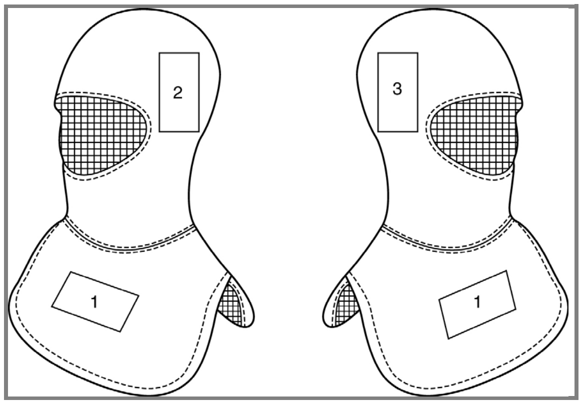
(12) ~~Benzyl Butyl phthalate (CAS No. 117-81-7)~~

~~**12.7.11.2** – Procedures for Contamination of Specimens.~~

~~**12.7.11.2.1**~~ –

~~Hood specimens prepared as specified in 12.7.3.2 shall be marked according to Figure 12.7.11.2.1 so that there are three 75 mm × 150 mm (3 in. × 6 in.) areas indicated on each hood for contamination.~~

~~**Figure 12.7.11.2.1 Marking Areas for Contamination**~~



~~**12.7.11.2.2**~~ –

~~Using a gastight syringe, a volume of 300 µL of the polycyclic aromatic hydrocarbons (PAH)/ phthalate/phenols contamination mixture specified in 12.7.11.1 shall be dispensed uniformly onto each specimen by drawing the solution into the syringe and slowly depressing the plunger onto the specimen in location two and location three of each specimen hood while gently rubbing the end of the syringe onto the specimen.~~

~~**12.7.11.2.3**~~ –

~~Contaminated specimens shall be permitted to dry under ambient laboratory conditions for no more than 15 minutes following the application of the PAH/phthalate/phenols mixture.~~

~~**12.7.11.2.4**~~ –

~~The specimen shall be placed in a refrigerator at 4°C (39°F) until ready for shipping.~~

~~**12.7.11.2.5**~~ –

~~Alternative techniques for contaminating the specimens shall be permitted if it can be demonstrated that the selected technique provides a specimen concentration of the specific contaminant(s) that are ±20 percent of the target concentration following the application of the technique.~~

~~**12.7.11.3**~~ – ~~Extraction of Specimens.~~

~~**12.7.11.3.1**~~ –

~~All labware, jars, or extraction vessels made of glass or other degradation-resistant and contamination-free materials shall be thoroughly cleaned, rinsed, and dried.~~

~~**12.7.11.3.1.1**~~ –

~~Where specified, other types of labware shall be substituted if it can be demonstrated that the labware will not contribute to cross contamination of the extraction liquids.~~

~~**12.7.11.3.2**~~ –

~~An extraction solvent of 50 percent methylene chloride, 25 percent acetonitrile, and 25 percent cyclohexane shall be prepared.~~

~~**12.7.11.3.3**~~ –

~~A PAH/phthalate/phenols dilution solution of a 1:1 ratio of benzene and methylene chloride shall be prepared.~~

~~**12.7.11.3.4**~~ –

~~The specimen to be analyzed shall be cut from the finished hood and into eight smaller pieces and placed in a 300 mL (10.1 oz) extraction vessel with a lid.~~

~~**12.7.11.3.5**~~ –

~~Six 16 mm (~~ $\frac{5}{8}$ ~~in.) polytetrafluoroethylene (PTFE) bearing balls shall be placed in the extraction vessel with the cut specimen pieces.~~

~~**12.7.11.3.6**~~ –

~~A volume of 50 mL (1.7 oz) of the extraction solvent prepared per 12.7.11.3.2 shall be added to the extraction vessel.~~

~~**12.7.11.3.7**~~ –

~~The extraction vessel shall be placed on a platform shaker set at 230 RPM ± 10 RPM and shall be shaken for 30 minutes.~~

~~**12.7.11.3.8**~~ –

~~The extraction vessel shall be removed from the platform shaker and shall be placed in a sonicator for 20 minutes at a no-heat condition.~~

~~**12.7.11.3.9**~~ –

~~Immediately after sonification has been concluded, the extraction vessel shall be vented by lifting the lid to prevent the creation of a vacuum within the vessel.~~

~~**12.7.11.3.10**~~ –

~~The specimens shall be allowed to rest in the extraction vessel until it has returned to room temperature after approximately 10–15 minutes.~~

~~**12.7.11.3.11**~~ –

~~The resulting solution in the extraction vessel shall be filtered using a glass vacuum filtration flask assembly, with a 45 mm (1.77 in.) glass fiber filter placed on the fritted surface of the filtration apparatus and the apparatus then clamped to the flask and connected to a laboratory vacuum line.~~

~~**12.7.11.3.12**~~ –

~~The glass filtration flask and specimen pieces shall be rinsed with 5 mL (1 tsp) of extraction solvent.~~

~~**12.7.11.3.13**~~ –

~~Any excess solvent shall be squeezed from the specimen pieces into the filtration flask.~~

~~**12.7.11.3.14**~~ –

~~The liquid content of the vacuum filtration flask shall be transferred to an oil tube or other graduated condensation vessel suitable for measuring extract evaporation using a small glass funnel.~~

~~**12.7.11.3.15**~~ –

~~Modifications to the specimen extraction procedures provided in 12.7.11.3 shall be permitted, provided that extraction recovery average efficiencies of 80 percent or better can be demonstrated.~~

~~**12.7.11.4**~~ – ~~Preparation of Extract for Analysis.~~

~~**12.7.11.4.1**~~ –

~~The condensation vessel and contents prepared as specified in 12.7.11.3 shall be placed on the rack under a miniature evaporator/concentrator that is connected to ultra-high-purity nitrogen, and the contents shall be evaporated to less than or equal to 2 mL (0.4 tsp).~~

~~**12.7.11.4.2**~~ –

~~After reconstitution, the condensation vessel shall be placed in a vortex tube and vortexed 10–15 seconds to incorporate any solids that have dried on the side of the tube.~~

~~**12.7.11.4.3**~~ –

~~The contents of the vortex tube shall be measured using a disposable sterile pipette and the volume shall be recorded.~~

~~**12.7.11.4.4**~~ –

~~The contents of the vortex tube shall be returned to the oil tube with an appropriate amount of solvent to increase the final volume to 2 mL (0.4 tsp).~~

~~**12.7.11.4.5**~~ –

~~The oil tube shall be vortexed, and the contents shall be transferred with a disposable glass pipette into a 10 mL (2 tsp) glass beaker.~~

~~**12.7.11.4.6**~~ –

~~The contents from the beaker shall be removed using a 3 mL (0.6 tsp) syringe with an attached polyvinylidene fluoride (PVDF) 0.45 µm syringe.~~

~~**12.7.11.4.7**~~ –

~~The contents of the syringe shall be filled into auto-sampler vial.~~

~~**12.7.11.4.8**~~ –

~~Alternative procedures for preparing the extract for analysis shall be permitted, provided that the extraction recovery average efficiencies of 80 percent or better can be demonstrated.~~

~~**12.7.11.5**~~ – ~~Analysis of Specimens.~~

~~**12.7.11.5.1**~~ –

~~Calibration curves shall be prepared for each contaminant by applying known concentrations to specimens and extracting the specimens using the procedures specified in 12.7.11.3 and 12.7.11.4 using the analysis conditions specified in 12.7.11.5.2 .~~

~~**12.7.11.5.2**~~ –

~~Extracts prepared as specified in 12.7.11.4 shall be analyzed using gas chromatography and mass spectroscopy using the following analysis parameters:~~

(1) ~~A fused silica nonpolar 30 m, 0.25 mm ID, 0.50 µm mass spectroscopy column with a guard column that has been deactivated but not coated with stationary phase~~

(2) ~~Inlet temperature of 200°C (392°F)~~

(3) ~~Transfer line temperature of 300°C (572°F)~~

(4) ~~Ion source temperature of 300°C (572°F)~~

(5) ~~Oven temperature of 60°C (140°F); held for 2 minutes~~

(6) ~~Temperature ramp of 7°C (44.6°F) per minute to 310°C (590°F); held for 10 minutes~~

(7) ~~A carrier gas of ultra-high-purity helium at 1.2 L/min (40.6 oz)~~

(8) ~~1 µL sample splitless injection via autosampler into inlet containing split/splitless straight with wool topaz liner~~

~~**12.7.11.5.3**~~ –

~~The output from the gas chromatography and mass spectroscopy shall be used to integrate and calculate the concentration of each chemical per mass of specimen remaining with the percentage removal based on the calibration curves.~~

~~12.7.11.5.3.1~~ ~~–~~

~~The concentration in each specimen shall be reported in µg/g specimen.~~

~~12.7.11.5.4~~ ~~–~~

~~Cleaning efficiency shall be calculated for each contaminant with the following equation and as specified in 12.7.11.5.4.1 and 12.7.11.5.4.2 :~~

$$\text{cleaning efficiency} = \left[\frac{(C_c - C_M) - (C_W - C_P)}{(C_C - C_M)}\right] \times 100 \qquad \text{[12.7.11.5.4]}$$

~~where:~~

~~C_C = Contaminated specimen~~

~~C_M = Material specimen (unwashed, not contaminated)~~

~~C_W = Contaminated specimen (washed)~~

~~C_P = Material specimen (washed, not contaminated)~~

~~12.7.11.5.4.1~~ ~~–~~

~~The actual masses used in the calculation of cleaning efficiency shall be the specific measured concentration of contaminant.~~

~~12.7.11.5.4.2~~ ~~–~~

~~If the measured mass is below the limit of quantitation, a value of “0” shall be used.~~

~~12.7.11.5.5~~ ~~–~~

~~The average cleaning efficiency shall be determined for each of the following chemical groups:~~

(1) ~~Phenols, as follows:~~

- (2) ~~2-Nitrophenol~~
- (3) ~~Phenol~~
- (4) ~~2,4,6-Trichlorophenol~~

(5) ~~PAHs, as follows:~~

- (6) ~~Acenaphthene~~
- (7) ~~Anthracene~~
- (8) ~~Fluorene~~
- (9) ~~Phenanthrene~~
- (10) ~~Pyrene~~
- (11) ~~Benzo[a]pyrene~~

(12) ~~Phthalates, as follows:~~

- (13) ~~Diethyl phthalate~~
- (14) ~~Di-n-octyl phthalate~~
- (15) ~~Benzyl butyl phthalate~~

~~**12.7.11.5.5.1**~~ –

~~If any cleaning efficiencies are indicated as being above 100 percent, a cleaning efficiency of 100 percent shall be used for calculating the average cleaning efficiency.~~

~~**12.7.11.5.5.2**~~ –

~~If any cleaning efficiencies are indicated as being below 0 percent, a cleaning efficiency of 0 percent shall be used for calculating the average cleaning efficiency.~~

~~**12.7.11.5.5.3**~~ –

~~If any analytical anomaly that cannot be rationalized on the basis of the data set and other measurements is encountered for the analysis of a specific contaminant, discarding one contaminant from the calculation of the average cleaning efficiency shall be permitted.~~

~~**12.7.11.5.6**~~ –

~~Alternative procedures for the analysis of specimens specified in 12.7.11.5.1 through 12.7.11.5.3 shall be permitted, provided that the procedures take the concentrations of the controls into account by providing sufficient sensitivity to allow for the measurement of a 1.0 percent difference or lower in cleaning efficiency.~~

~~**12.7.12**~~ – ~~Specific Requirements for Heavy Metal–Contaminated Specimen Preparation, Extraction, and Analysis.~~

~~**12.7.12.1**~~ – ~~Selection of Contaminants.~~

~~**12.7.12.1.1**~~ –

~~A certified solution shall be obtained that contains the following metals, each at a concentration of 100 ppm:~~

(1) ~~Antimony~~

(2) ~~Arsenic~~

(3) ~~Cadmium~~

(4) ~~Chromium~~

(5) ~~Cobalt~~

(6) ~~Lead~~

~~**12.7.12.1.2**~~ –

~~Alternative techniques for preparing a mixture shall be permitted if it can be demonstrated that the selected technique provides a specimen concentration of the specific contaminant(s) that are ±20 percent of the target concentration following the application of the technique.~~

~~**12.7.12.2**~~ – ~~Procedures for Contamination of Specimens.~~

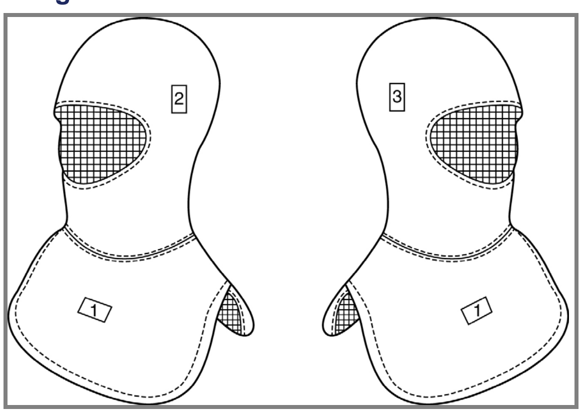
~~**12.7.12.2.1**~~ –

~~All handling of specimens and metal solutions shall be performed while wearing disposable gloves. Use of glassware for contamination or extraction shall not be permitted as the use of these items can lead to cross contamination.~~

~~**12.7.12.2.2**~~ –

~~Hood specimens shall be prepared as specified in 12.7.3.2 and shall be marked according to Figure 12.7.12.2.2 so that there are three 25 mm × 50 mm (1 in. × 2 in.) areas indicated on each hood for contamination.~~

~~**Figure 12.7.12.2.2 Marking Areas for Contamination.**~~



~~**12.7.12.2.3**~~ –

~~A volume of 100 μL of a 1000 ppm metals standard solution shall be pipetted onto location two and a separate volume of 1.0 mL (0.2 tsp) of a 100 ppm metals standard solution shall be pipetted onto location three.~~

~~**12.7.12.2.3.1**~~ –

~~The operator shall ensure that all applied metals standard solution remains on the specimen.~~

~~**12.7.12.2.3.2**~~ –

~~Contaminated specimens shall be permitted to be dried in an oven at 50°C ± 5°C for up to 60 minutes.~~

~~**12.7.12.2.4**~~ –

~~After the specimens have been allowed to fully dry, hood specimens shall be placed in a contaminate and metal-free packaging.~~

~~**12.7.12.2.4.1**~~ –

~~Specimens shall be placed in packaging that does not require the hood to be folded.~~

~~**12.7.12.2.5**~~ –

~~The concentration in each specimen shall be reported in µg/g.~~

~~**12.7.12.3** – Extraction of Specimens.~~

~~**12.7.12.3.1** – Acid Digestion.~~

~~**12.7.12.3.1.1**~~ –

~~Each specimen location shall be removed from the finished hood and added to an individual PFA microwave reaction vessel.~~

~~**12.7.12.3.1.2**~~ –

~~A volume of 10 mL ($^{1}/_{3}$ oz) concentrated nitric acid, approximately 70 percent weight/volume, shall be added to each PFA reaction vessel.~~

~~**12.7.12.3.1.3**~~ –

~~Each PFA reaction vessel shall be microwaved at 1600 W, 90 percent power, for 20 minutes at 170°C (338°F) and held for 30 minutes for a total 50-minute cycle.~~

~~**12.7.12.3.1.4**~~ –

~~The specimens in the PFA reaction vessels shall be allowed to cool for approximately 30 minutes.~~

~~**12.7.12.3.1.5**~~ –

~~The PFA microwave reaction vessel shall be carefully opened in the vent hood away from lab technicians due to the potential release of nitric acid fumes.~~

~~**12.7.12.3.1.6**~~ –

~~A volume of 10 mL ($^{1}/_{3}$ oz) deionized water shall be added to the microwave reaction vessel and the reaction vessel shall be turned over three times.~~

~~**12.7.12.3.1.7**~~ –

~~The reaction vessel shall be permitted to "breathe" if needed by opening the lid to off-gas.~~

~~**12.7.12.3.1.8**~~ –

~~Modifications to the specimen acid digestion procedures provided in 12.7.12.3 shall be permitted, provided that extraction recovery average efficiencies of 90 percent or better can be demonstrated.~~

~~**12.7.12.4** – Filtration.~~

~~**12.7.12.4.1**~~ –

~~The deionized water and acid-digested mixture solution shall be placed into a digestion tube gravitation filtration system consisting of a PTFE body material and a sufficient pore size to adequately filter the sample solution.~~

~~**12.7.12.4.1.1**~~ –

~~It shall be permitted to allow the solution to sit in the digestion tube untouched for a minimum of 12 hours in lieu of the digestion filtration system.~~

~~**12.7.12.4.2**~~ –

~~The addition of deionized water shall be repeated two more times, for a total of 30 mL (2 tbsp) deionized water rinsed through.~~

~~**12.7.12.4.3**~~ –

~~Each sample solution shall be brought to a volume of 40 mL (1.35 oz) volume using deionized water.~~

~~**12.7.12.4.4**~~ –

~~The sample solution shall then be filtered using the digestion filtration system as specified in 12.4.12.4.1 .~~

~~**12.7.12.4.5**~~ –

~~The sample solution shall be vortexed.~~

~~**12.7.12.4.6**~~ –

~~Modifications to the specimen filtration procedures provided in 12.7.12.4 shall be permitted, provided that extraction recovery average efficiencies of 80 percent or better can be demonstrated.~~

~~**12.7.12.5**~~ – ~~Instrument Sample Preparation.~~

~~**12.7.12.5.1**~~ –

~~An internal standard shall be prepared in a 100 mL (3.38 oz) volumetric flask to receive 10 ppb using the following constituents:~~

(1) ~~2 percent nitric acid~~

(2) ~~0.2 mL of 100 ppm Ga~~

(3) ~~0.2 mL of 100 ppm In~~

(4) ~~0.2 mL of 100 ppm La~~

~~**12.7.12.5.2**~~ –

~~A 1 mL (0.2 tsp) volume of the extracted sample and a 25 µL volume of the internal standard shall be added to a 10 mL (2 tsp) volumetric flask and diluted to volume with 2 percent nitric acid, and the resultant sample shall be vortexed.~~

~~**12.7.12.5.3**~~ –

~~A 10 mL ($^1/_3$ oz) sample of each instrument calibration standard shall be prepared at the following concentrations using 2 percent nitric acid to bring volume to 10 mL ($^1/_3$ oz):~~

(1) ~~0 ppb (to serve as blank)~~

(2) ~~100 ppb~~

(3) ~~1 ppm~~

(4) ~~10 ppm~~

(5) ~~100 ppm~~

~~**12.7.12.5.4**~~ –

~~The internal standard shall be added.~~

~~**12.7.12.5.4.1**~~ –

~~Once the test method recovery is established, the use of the internal standard shall be permitted to be optional.~~

~~**12.7.12.5.5**~~ –

~~All samples shall be vortexed.~~

~~**12.7.12.5.6** –~~

~~Alternative sample preparation procedures in lieu of 12.7.12.5 shall be permitted if a suitable scheme for demonstrating calibration of the respective metals achieved a linear correlation coefficient of 0.90 or better.~~

~~**12.7.12.6** – Analysis of Specimens.~~

~~**12.7.12.6.1** – Instrumentation Setup.~~

~~**12.7.12.6.1.1** –~~

~~An inductively coupled plasma-mass spectrometer (ICP-MS) shall be prepared using the following method parameters to include those metals of interest:~~

(1) ~~Sweeps/readings: 20~~

(2) ~~Readings/replicates: 1~~

(3) ~~Number of replicates: 3~~

(4) ~~Dwell time: 50.0 ms~~

(5) ~~Mode: KED~~

(6) ~~RPq: 0.25~~

(7) ~~Detector mode: Dual~~

(8) ~~Measurement units: Counts~~

(9) ~~Automatic lens: On~~

(10) ~~Spectral peak processing: Sum~~

(11) ~~Signal profile processing~~

(12) ~~Baseline readings: 0~~

(13) ~~Smoothing: Yes, Factor 5~~

~~**12.7.12.6.1.2** –~~

~~The blank, all samples, and instrument calibration standards shall be run on ICP-MS.~~

~~**12.7.12.6.1.3** –~~

~~An alternative analytical technique shall be permitted if it demonstrates sensitivity to the respective metals to a minimum of 100 ppb, provides for a linear calibration for determining each metal concentration with a correlation coefficient of 0.90 or better, and permits the ability for discerning a difference of 1.0 percent or lower in cleaning efficiency.~~

~~**12.7.12.7** – Data Analysis.~~

~~**12.7.12.7.1** –~~

~~The slope, intercept, and regression coefficient shall be calculated using standard metal solutions (0 ppb–100 ppm).~~

~~**12.7.12.7.2** –~~

~~The calculated slope and intercept shall be used to calculate the concentration of each individual metal each digested fabric swatch (ppb) in the 10 mL vial described in 12.7.12.7.1 using Equation 12.7.12.7.2:~~

$$\text{metal concentration (ppb)} = \frac{\text{metal ion counts} - \text{metal ion intercept}}{\text{metal ion slope}} \qquad \text{[12.7.12.7.2]}$$

~~**12.7.12.7.3** –~~

~~The calculated concentration in ppb shall be used to calculate the mass in µg of each metal in the original 40 mL vial described in 12.7.12.7.2 .~~

~~**12.7.12.7.3.1** –~~

~~A correction factor of 0.401 shall be used as calculated by the two dilution factors in Equation 12.7.12.7.3.1:~~

$$0.010025\ \text{L} \times 0.040\ \text{L} = 0.000401\ \text{L}$$ ~~[12.7.12.7.3.~~

~~**12.7.12.7.4** –~~

~~The cleaning efficiency shall be calculated using Equation 12.7.12.7.4:~~

$$\text{cleaning efficiency} = \left[\frac{(C_C - C_M) - (C_W - C_P)}{(C_C - C_M)}\right] \times 100$$ ~~[12.7.12.7.4]~~

~~where:~~

~~C_C = Contaminated specimen in µg~~

~~C_M = Material specimen (unwashed, not contaminated) in µg~~

~~C_W = Contaminated specimen (washed) in µg~~

~~C_P = Material specimen (washed, not contaminated) in µg~~

~~**12.7.12.7.4.1** –~~

~~If any cleaning efficiencies are indicated as being above 100 percent, a cleaning efficiency of 100 percent shall be reported.~~

~~**12.7.12.7.4.2** –~~

~~If any cleaning efficiencies are indicated as being below 0 percent, a cleaning efficiency of 0 percent shall be reported.~~

~~**12.7.12.7.4.3** –~~

~~If any analytical anomaly that cannot be rationalized on the basis of the data set and other measurements is encountered for the analysis of a specific contaminant, discarding one contaminant from being reported and interpreted for the determination of heavy metal cleaning efficiencies shall be permitted.~~

~~**12.7.12.7.5** –~~

~~The percent recovery shall be calculated using Equation 12.7.12.7.5:~~

$$\frac{\mu\text{g extracted}}{\mu\text{g deposited onto individual fabric swatch}} \times 100\ \text{percent}$$ ~~[12.7.12.7.5]~~

~~**12.7.13** – Preparation Procedures for Wash Load.~~

~~**12.7.13.1** –~~

~~The ballast material panels shall be as specified in 12.4.14.2 .~~

~~**12.7.13.2** –~~

~~The hoods shall be placed in the wash, lying flat and unfolded.~~

~~**12.7.13.3**~~ –

~~The sequencing within the wash load shall be as follows:~~

(1) ~~The ballast and hoods shall be placed in the wash load with the mass capacity, ± 5 percent, as specified by the cleaning facility.~~

(2) ~~A minimum of three hoods shall be located in each load.~~

(3) ~~Each load shall contain at least one noncontaminated hood.~~

(4) ~~The hoods contaminated with semivolatile organic compounds and heavy metals are permitted to be washed in the same load.~~

~~**12.7.13.4**~~ –

~~The hoods shall be alternatively placed and be evenly distributed within the wash load so that there is a near equal number of ballast panels between each surrogate garments.~~

~~**12.8**~~ – ~~PAH Removal Efficacy Test.~~

~~The procedures in Section 12.4 shall be adapted for application to outer shell, moisture barrier, and thermal barrier materials using the following modifications:~~

(1) ~~The list of PAHs to be evaluated shall include the chemicals listed in Table 12.8 .~~

(2) ~~A mixture of the PAHs shall be prepared that is in the same concentration for each PAH as specified in 12.4.11.2 .~~

~~Table 12.8 List of Polycyclic Aromatic Hydrocarbon (PAH) Substances~~

~~PAH Chemical CAS~~
~~Number Acenaphtene 83-32-9 Acenaphthylene 208-96-8 Anthracene 120-12-7 Benzo[a]anthracene 56-55-3 Benzo[a]pyrene 50-32-8 Benzo[b]fluoranthene 205-99-2 Benzo[e]pyrene 192-97-2 Benzo[g,h,i]perylene 191-24-2 Benzo[j]fluoranthene 205-82-3 Benzo(k)fluoranthene 207-08-9 Chrysene 218-01-9 Cyclopenta[c,d]pyrene 27208-37-3 Dibenzo[a,h]anthracene 53-70-3 Dibenzo[a,e]pyrene 192-65-4 Dibenzo[a,h]pyrene 189-64-0 Dibenzo[a,i]pyrene 184-55-9 Dibenzo[a,l]pyrene 191-30-0 Fluoranthene 206-44-0 Fluorene 86-73-7 Indeno(1,2,3-cd)pyrene 193-39-5 1-Methylpyrene 2381-21-7 Naphthalene 91-20-3 Phenanthrene 85-01-8 Pyrene 129-00-0~~

~~**12.9**~~ – ~~PFAS Removal Efficacy Test.~~

~~The procedures in Section 12.4 shall be adapted for application to outer shell, moisture barrier, and thermal barrier materials using the following modifications:~~

(1) ~~The PFAS chemicals to be evaluated shall include the chemicals listed in Table 12.9 .~~

(2) ~~The challenge concentration of PFAS chemical in the solution shall be at 0.1 mg/kg.~~

(3) ~~The test procedures for the analysis of PFAS shall be in accordance with ISO 23702-1, *Leather — Organic Fluorine — Part 1: Determination of the Non-Volatile Compound Content By Extraction Method Using Liquid Chromatography/Tandem Mass Spectrometry Detector (LC-MS/MS)* .~~

~~Table 12.9 Per- and Polyfluorinated Compounds Subject to Analysis~~

~~Per- and Polyfluorinated Compounds CAS Number Perfluorooctane Sulfonic Acid and Sulfonates (PFOS) 1763-23-1, et al. Perfluorooctane Sulfonamide (PFOSA) 754-91-6 Perfluorooctance Sulfonfuoride (PFOSF) 307-35-7 N-Methyl Perfluorooctane Sulfonamide (N-Me-FOSA) 31506-32-8 N-Ethyl Perfluorooctane Sulfonamide (N-Et-FOSA 4151-50-2 N-Methyl Perfluorooctane Sulfonamide Ethanol (N-Me-FOSE) 24448-09-7 N-Ethyl Perfluorooctane Sulfonamide Ethanol (N-Et-FOSE) 1691-99-2 Perfluorooctanoic Acid (PFOA) 375-85-9 Perfluoroheptanoic Acid (PFHpA) 335-67-1 Perfluorononanoic Acid (PFNA) 375-95-1 Perfluorodecanoic Acid (PFDA) 335-76-2 Henicocafluoroundecanoic Acid (PFUdA) 2058-94-8 Trisafluorododecanoic Acid (PFDoA) 307-55-1 Pentacosafluorotridecanoic~~

~~Acid (PFTrDA) 72629-94-8 Heptacosafluorotetradecanoic Acid (PFTeDA) 376-06-7, et al. 1H,1H,2H,2H-Perfluorooctyl Acrylate (8:2 FTA) 27905-45-9 1H,1H,2H,2H-Perfluoro-1-decanol (8:2 FTOH) 678-39-7 1H,1H,2H,2H-Perfluorodecanesuphonic Acid (8:2 FTS) 39108-34-4, et al.~~

~~**12.10** – Mobile and Stationary Energy Storage System Fire Decomposition Products Removal Efficacy Test.~~

~~The procedures in Section 12.4 shall be adapted for application to outer shell, moisture barrier, and thermal barrier materials using modifications based on the principles established in “Firefighters’ Clothing Contamination in Fires of Electric Vehicle Batteries and Photovoltaic Modules—Literature Review and Pilot Tests Results” [Szmytke, E., et al.) and “Firefighters’ Clothing Contamination in Fires of Electric Vehicle Batteries and Photovoltaic Modules—Literature Review and Pilot Tests Results,” *International Journal of Environmental Research and Public Health,* 19(19), 12442].~~

~~**12.11** – Asbestos Removal Efficacy Test. [Reserved]~~

Statement of Problem and Substantiation for Public Comment

Delete entire section and corresponding test sections and move to annex for reference as optional testing.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 74-NFPA 1850-2024 [Section No. 11.6]	

Related Item

- Cleaning

Submitter Information Verification

Submitter Full Name: Tricia Hock
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State:
Zip:
Submittal Date: Thu May 30 13:49:00 EDT 2024
Committee: FAE-SPF

Public Comment No. 2-NFPA 1850-2024 [Section No. 12.9]

12.9 PFAS Removal Efficacy Test.

The procedures in Section 12.4 shall be adapted for application to outer shell, moisture barrier, and thermal barrier materials using the following modifications:

(1) The PFAS chemicals to be evaluated shall include the chemicals listed in Table 12.9.

(2) The challenge concentration of PFAS chemical in the solution shall be at 0.1 mg/kg.

(3) The test procedures for the analysis of PFAS shall be in accordance with ISO 23702-1, *Leather — Organic Fluorine — Part 1: Determination of the Non-Volatile Compound Content By Extraction Method Using Liquid Chromatography/Tandem Mass Spectrometry Detector (LC-MS/MS)*.

Table 12.9 Per- and Polyfluorinated Compounds Subject to Analysis

Per- and Polyfluorinated Compounds	CAS Number
Perfluorooctane Sulfonic Acid and Sulfonates (PFOS)	1763-23-1, et al.
Perfluorooctane Sulfonamide (PFOSA)	754-91-6
Perfluorooctance Sulfonfuoride (PFOSF)	307-35-7
N-Methyl Perfluorooctane Sulfonamide (N-Me-FOSA)	31506-32-8
N-Ethyl Perfluorooctane Sulfonamide (N-Et-FOSA	4151-50-2
N-Methyl Perfluorooctane Sulfonamide Ethanol (N-Me-FOSE)	24448-09-7
N-Ethyl Perfluorooctane Sulfonamide Ethanol (N-Et-FOSE)	1691-99-2
Perfluorooctanoic Acid (PFOA)	375-85-9
Perfluoroheptanoic Acid (PFHpA)	335-67-1
Perfluorononanoic Acid (PFNA)	375-95-1
Perfluorodecanoic Acid (PFDA)	335-76-2
Henicocafluoroundecanoic Acid (PFUdA)	2058-94-8
Trisafluorododecanoic Acid (PFDoA)	307-55-1
Pentacosafluorotridecanoic Acid (PFTrDA)	72629-94-8
Heptacosafluorotetradecanoic Acid (PFTeDA)	376-06-7, et al.
1H,1H,2H,2H-Perfluorooctyl Acrylate (8:2 FTA)	27905-45-9
1H,1H,2H,2H-Perfluoro-1-decanol (8:2 FTOH)	678-39-7
1H,1H,2H,2H-Perfluorodecanesuphonic Acid (8:2 FTS)	39108-34-4, et al.
Perfluorohexane sulfonic acid (PFHxS)	355-46-4

Statement of Problem and Substantiation for Public Comment

A 2020 journal article published by the National Library of Medicine titled, On the Ability of Perfluorohexane Sulfonate (PFHxS) Bioaccumulation by Two Pseudomonas sp. Strains Isolated from PFAS-Contaminated Environmental Matrices, states that PFHxS, "...has been largely used as an efficient surfactant in place of both PFOS and PFOA due to its physical-chemical stability,..."

The European Chemicals Agency (ECHA) states, "PFHxS is one of the most frequently detected perfluorinated substances (PFAS) in human blood samples worldwide."

Since PFAS blood testing for Department of Defense (DoD) firefighters began in October 2020, PFHxS has been detected in most DoD firefighters; several test results indicating significant levels of PFHxS.

Because PFHxS is a known replacement to certain PFAS chemicals and is a known carcinogen, adding PFHxS to the list of PFAS chemicals to be tested for in Table 12.9 would be logical. If PFHxS were not tested for, there would be no way of knowing if PFHxS exists in the outer shell, moisture barrier, and thermal barrier materials.

Related Item

- 12.9 PFAS Removal Efficacy Test

Submitter Information Verification

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Submittal Date: Mon Mar 25 15:57:02 EDT 2024

Committee: FAE-SPF

Public Comment No. 30-NFPA 1850-2024 [Section No. 12.10]

~~**12.10** Mobile and Stationary Energy Storage System Fire Decomposition Products Removal Efficacy Test.~~

~~The procedures in Section 12.4 shall be adapted for application to outer shell, moisture barrier, and thermal barrier materials using modifications based on the principles established in "Firefighters' Clothing Contamination in Fires of Electric Vehicle Batteries and Photovoltaic Modules—Literature Review and Pilot Tests Results" [Szmytke, E., et al.) and "Firefighters' Clothing Contamination in Fires of Electric Vehicle Batteries and Photovoltaic Modules—Literature Review and Pilot Tests Results,"~~ ~~*International Journal of Environmental Research and Public Health,*~~ ~~19(19), 12442].~~

Statement of Problem and Substantiation for Public Comment

While supporting that this is an emerging issue, this text does not provide adequate direction to apply these principals for the purposes of verification.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 39-NFPA 1850-2024 [Sections 11.6.5, 11.6.6]	

Related Item

- FR-163

Submitter Information Verification

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Submittal Date: Tue May 28 08:41:42 EDT 2024
Committee: FAE-SPF

Public Comment No. 31-NFPA 1850-2024 [Sections 12.12, 12.13]

~~**Sections 12.12, 12.13**~~

~~**12.12** – Cleaning Efficacy Test 4.~~

~~The procedures in Section 12.4 shall be adapted for application for verifying a specific type of cleaning equipment or process using the following modifications:~~

(1) ~~Where a specific type of cleaning equipment is being verified, the manufacturer shall specify a detergent to be used with their equipment.~~

(2) ~~Where a specific type of cleaning process is being verified, the provider shall specify all parts of the process that is being applied for protective garments.~~

~~**12.13** – Cleaning Efficacy Test 5.~~

~~The procedures in Section 12.4 shall be adapted for application for verifying a specific type of cleaning equipment or process using a washer/extractor that meets the requirements of this standard.~~

Statement of Problem and Substantiation for Public Comment

The test methods as written is insufficient to apply these requirements consistently between certification organizations and test laboratories.

Additionally, by adding this testing methods, the manufacturer of those products will be labeling actual products. This standard is not a product standard that includes labeling and marking requirements, as well as inspection of those products. Therefore, considered out of scope for this standard.

Related Public Comments for This Document

Related Comment	**Relationship**
Public Comment No. 38-NFPA 1850-2024 [Section No. 7.3.7.2]	

Related Item

- FR-163

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 29-NFPA 1850-2024 [Sections 12.14, 12.15, 12.16, 12.17, 12.18]

~~**Sections 12.14, 12.15, 12.16, 12.17, 12.18**~~

~~**12.14** – Biological Decontamination Efficacy Test.~~

~~**12.14.1** * – Application.~~

~~This test method shall determine the biological decontamination efficacy for outer shell materials in protective garments that are subjected to cleaning facility procedures for the disinfection or sanitization of structural firefighting protective garments.~~

~~**12.14.2** * – General Procedures.~~

~~**12.14.2.1** –~~

~~The certification organization or its designated laboratory shall contaminate sets of selected outer shell material specimens with the two specific microorganisms.~~

~~**12.14.2.2** –~~

~~Biologically contaminated and noncontaminated specimens of the selected outer shell material shall be prepared, appropriately packaged, and sent by the certification organization to the respective ISP with the supplies necessary for subjecting the specimens to the cleaning facility's sanitization procedures.~~

~~**12.14.2.3** –~~

~~Under the supervision of a representative from the certification organization, cleaning facility personnel shall insert the biologically contaminated and noncontaminated outer shell specimens into surrogate clothing samples that shall then be specially placed with designated ballast materials in the cleaning facility's sanitization equipment to form the wash load.~~

~~**12.14.2.4** –~~

~~The surrogate clothing samples with biologically contaminated and noncontaminated outer shell specimens and designated ballast material shall be subjected to one full cycle of the cleaning facility's sanitization procedures.~~

~~**12.14.2.5** –~~

~~Following completion of the cleaning facility's sanitization cleaning procedures and under the supervision of a representative from the certification organization, the washed biologically contaminated and noncontaminated outer shell specimens shall be removed by cleaning facility personnel, placed in suitable containers, and shipped back to the certification organization or its designated laboratory.~~

~~**12.14.2.6** * –~~

~~The certification organization or its designated laboratory shall analyze the washed biologically contaminated and noncontaminated specimens as well as control specimens (contaminated but not laundered) and determine the log reduction of the cleaning facility's advanced sanitization procedures for each of the specified biological contaminants.~~

~~**12.14.2.7** –~~

~~The certification organization shall separately interpret the log reduction results for each selected microorganism to determine compliance with the criteria for the respective cleaning facility sanitization efficiency specified in 11.3.7 .~~

~~**12.14.3** – Specimen Preparation.~~

~~**12.14.3.1**~~ –

~~The garment outer shell material used for specimens shall be an undyed 60 percent para-aramid/40 percent PBI base fabric with a reinforcement grid and shall meet the following specifications:~~

(1) ~~The outer shell fabric shall have a unit area weight of 240 to 268 g/m~~ ^{2} ~~(7.1 oz/yd~~ ^{2} ~~to 7.9 oz/yd~~ ^{2} ~~).~~

(2) ~~The outer shell fabric shall have a thickness of 0.584 mm ± 0.254 mm (0.023 in. ± 0.10 in.).~~

(3) ~~The outer shell fabric shall have a water absorption resistance of less than 5 percent when tested in accordance with Section 8.25 of NFPA 1970.~~

~~**12.14.3.2**~~ –

~~A total of two specimens shall be prepared for each bacterium as specified in Section 12.17, and outer shell fabric to be used for testing shall be prepared by laundering for 10 cycles as specified in AATCC 135,~~ ~~*Dimensional Changes of Fabrics after Home Laundering*~~ ~~, using Machine Cycle 1, Wash Temperature V, and Drying Procedure Ai. A 1.82 kg ± 0.1 kg (4.0 lb ± 0.2 lb) load shall be used. A laundry bag shall not be used.~~

~~**12.14.3.3**~~ –

~~A minimum of six specimens shall be contaminated with each bacterium as specified in 12.17.2.~~

~~**12.14.3.3.1**~~ –

~~The number of contaminated specimens required by 12.14.3.3 shall be permitted to be reduced from six to five specimens if the certification organization can demonstrate that the transportation of the specimens to the cleaning facility does not affect the travel specimen's condition or the bacterial contamination level.~~

~~**12.14.3.4**~~ –

~~Four additional specimens shall be prepared for each type of bacteria as specified in 12.14.3.2 but not contaminated.~~

~~**12.14.3.4.1**~~ –

~~The number of noncontaminated specimens required by 12.14.3.4 shall be permitted to be reduced from four to three specimens if the certification organization can demonstrate that the transportation of the specimens to the cleaning facility does not result in the inadvertent biocontamination of the travel specimen.~~

~~**12.14.3.5**~~ –

~~One contaminated specimen and one noncontaminated specimen shall remain at the certification organization or its designated laboratory.~~

~~**12.14.4**~~ – ~~Specimen Handling, Sample Load Assembly, and Sanitization.~~

~~**12.14.4.1**~~ – ~~General.~~

~~Each individual contaminated and noncontaminated specimen shall be placed in a separate sterile container with a label identifying the specimen and shipped overnight by the certification organization or its designated laboratory to the cleaning facility for receipt on the scheduled day of testing.~~

~~**12.14.4.1.1**~~ –

~~Specimens shall be shipped in a manner to maintain their temperature at 4°C (39°F) prior to testing at the cleaning facility.~~

~~**12.14.4.2**~~ – ~~Surrogate Garments.~~

~~**12.14.4.2.1**~~ –

~~The certification organization or its designated laboratory shall provide surrogate garments that have been prepared as specified in 12.18.1 .~~

~~**12.14.4.2.2**~~ –

~~Prior to shipping, each surrogate garment shall be autoclaved for 90 minutes at 121°C (250°F) and then packaged in a manner to maintain the garments' sterility prior to use at the cleaning facility.~~

~~**12.14.4.2.3**~~ –

~~The surrogate garments shall be permitted to be provided separately from the contamination and noncontaminated specimens.~~

~~**12.14.4.3**~~ – ~~Ballast Material Panels.~~

~~**12.14.4.3.1**~~ –

~~The certification organization shall either provide or have the cleaning facility use a white, plain weave, 100 percent polyester ballast fabric that conforms to the following specifications:~~

(1) ~~The ballast fabric shall have a unit area weight of 346 g/m ^{2} ± 34 g/m ^{2} (10.2 oz/yd ^{2} ± 1.0 oz/yd ^{2}).~~

(2) ~~The ballast fabric shall have a construction of at least 35 threads in the warp direction and at least 20 threads in the fill or weft direction.~~

(3) ~~The ballast fabric shall be uncoated and have a durable water repellent finish that results in a horizontal wicking of less than 10 mm (0.40 in) in any direction when tested as specified in AATCC 198, *Horizontal Wicking of Textiles* , after the fabric has been washed a total of 5 cycles as specified in AATCC 135, *Dimensional Changes of Fabrics after Home Laundering* .~~

(4) ~~The ballast fabric shall have a tensile strength of at least 1560 N (350 lb) when tested as specified in ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)* .~~

(5) ~~The ballast fabric shall have a tear strength of at least 116 N (26 lb) when tested as specified in ASTM D2261, *Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)* .~~

~~**12.14.4.3.2**~~ –

~~An alternative ballast material shall be permitted if it is shown to have at least the same weight range specified in 12.4.14.2.1 (1) and meets the horizontal wicking requirement in 12.4.14.2.1 (3).~~

~~**12.14.4.3.3**~~ –

~~A sufficient number of different cut and shaped ballast fabric–based wash panels for creating the wash load shall be prepared in advance of the testing as specified in 12.18.2 .~~

~~**12.14.4.4**~~ – ~~Handling and Disposition of Contaminated Specimens.~~

~~12.14.4.4.1~~ ~~*~~ –

~~Under the supervision of a representative from the certification organization, the biologically contaminated and noncontaminated outer shell fabric test specimens shall be unpacked with the following disposition as related separately to both types of bacteria:~~

(1) ~~One contaminated specimen and one noncontaminated specimen shall remain in their containers, untouched at the cleaning facility, and shall be identified as the "travel specimens." These specimens shall be permitted to be excluded if the certification organization can demonstrate that the transportation of the specimens to the cleaning facility does not affect the travel specimen's condition or the biological contamination level.~~

(2) ~~One noncontaminated specimen shall be inserted in Specimen Pocket 1 of the surrogate coat; one individual contaminated specimen shall be inserted in Specimen Pocket 2 of the surrogate coat, while a second individual contaminated specimen shall be inserted in Specimen Pocket 3 of the surrogate coat.~~

(3) ~~One noncontaminated specimen shall be inserted in Specimen Pocket 1 of the surrogate pant; one individual contaminated specimen shall be inserted in Specimen Pocket 2 of the surrogate pant, while a second individual contaminated specimen shall be inserted in Specimen Pocket 3 of the surrogate pant.~~

~~12.14.4.4.2~~ –

~~The individual handling the specimens shall be wearing clean disposable gloves and shall use tweezers provided by the certification organization for inserting the specimens into the surrogate clothing item pockets.~~

~~12.14.4.4.3~~ –

~~The tweezer surfaces that contact the specimens shall be cleaned with an alcohol solution–based disposable wipe between uses.~~

~~12.14.4.5~~ – ~~Assembly of Sanitization Load and Application of Sanitization.~~

~~12.14.4.5.1~~ –

~~The sanitization load shall be assembled as specified in 12.18.3 and adjusted according to the cleaning facility's procedures for load size.~~

~~12.14.4.5.2~~ –

~~If the cleaning's procedures for sanitization involve a pretreatment, such as a presoaking of clothing prior to placement in a washer/extractor or other type of laundering machine, then it shall be permitted to subject only the surrogate clothing with inserted outer shell specimens to the pretreatment without the ballast materials.~~

~~12.14.4.5.3~~ –

~~The sanitization load consisting of the surrogate clothing items with inserted outer shell fabric specimens, along with the specified number and types of ballast fabric–based wash panels, shall be subject to the cleaning facility's sanitization procedures for which verification is being performed.~~

~~12.14.4.5.4~~ –

~~To shorten the drying time, the surrogate clothing items with inserted outer shell specimens shall be allowed to dry without the ballast fabric–based wash panels.~~

~~12.14.4.5.4.1~~ –

~~It shall be permitted to remove the inserted outer shell specimens from the respective surrogate clothing items for faster drying using appropriate tweezers for the type of sample and minimizing any contact or handling with the specimen before drying is complete.~~

~~**12.14.4.5.5**~~ –

~~Following the sanitization process and under the supervision of a representative from the certification organization, the specimens shall be removed from the surrogate clothing items using tweezers, placed in labeled, contamination-free containers, and packaged for overnight shipment to the certification organization or its designated laboratory for evaluation.~~

~~**12.14.5**~~ – ~~Specimen Evaluation.~~

~~Test specimens for determining sanitization shall be subject to the extraction and analysis procedures specified in 12.17.3 .~~

~~**12.14.6**~~ – ~~Report.~~

~~The following information shall be reported for each bacterial contaminant in each outer shell material:~~

(1) ~~Original bacterial count applied to each specimen~~

(2) ~~Post-cleaning bacterial count for the unwashed, traveling specimen, if applicable~~

(3) ~~Post-cleaning bacterial count for each of the washed specimens, if applicable~~

(4) ~~Average post-cleaning bacterial count for the washed specimens~~

(5) ~~Post-cleaning bacterial count for the washed, blank specimen~~

(6) ~~Calculated log $_{10}$ reduction~~

~~**12.14.7**~~ – ~~Interpretation.~~

~~Overall compliance with the requirements for biological decontamination shall be based on the individual reported log $_{10}$ reduction for each biological contaminant.~~

~~**12.15**~~ – ~~Semivolatile Organic Compound Contained Specimen Preparation, Extraction, and Analysis.~~

~~**12.15.1**~~ – ~~Selection of Contaminants.~~

~~The following semivolatile organic compounds shall be prepared at a concentration of 200 ppm in a 1:1 mixture of benzene and methylene chloride:~~

(1) ~~Acenaphthene (CAS No. 83-32-9)~~

(2) ~~Anthracene (CAS No. 120-12-7)~~

(3) ~~Diethyl phthalate (CAS No. 84-66-2)~~

(4) ~~Di-n-octyl phthalate (CAS No. 117-84-0)~~

(5) ~~Fluorene (CAS No. 86-73-7)~~

(6) ~~Phenanthrene (CAS No. 85-01-8)~~

(7) ~~Pyrene (CAS No. 129-00-0)~~

(8) ~~2-Nitrophenol (CAS No. 88-75-5)~~

(9) ~~Phenol (CAS No. 108-95-2)~~

(10) ~~2,4,6-Trichlorophenol (CAS No. 88-06-2)~~

~~**12.15.2**~~ – ~~Procedures for Contamination of Specimens.~~

~~**12.15.2.1**~~ –

~~Outer shell fabric prepared as specified in 12.4.3.2 shall be cut into 75 mm × 150 mm (3 in. × 6 in.) specimens.~~

~~**12.15.2.2**~~ –

~~Using a gastight syringe, a volume of 300 µL of the polycyclic aromatic hydrocarbons (PAH)/ phthalate/phenols contamination mixture specified in 12.15.1 shall be dispensed uniformly onto each specimen by drawing the solution into the syringe and slowly depressing the plunger onto the specimen while gently rubbing the end of the syringe onto the specimen.~~

~~**12.15.2.3**~~ –

~~Contaminated specimens shall be permitted to dry under ambient laboratory conditions for no more than 30 minutes following the application of the PAH/phthalate/phenols mixture.~~

~~**12.15.2.4**~~ –

~~The specimen shall be placed in a labeled jar or other container and kept in a refrigerator at 4°C (39°F) until ready for shipping.~~

~~**12.15.2.5**~~ –

~~Alternative techniques for contaminating the specimens shall be permitted if it can be demonstrated that the selected technique provides a specimen concentration of the specific contaminant(s) that are ±20 percent of the target concentration following the application of the technique.~~

~~**12.15.3**~~ – ~~Extraction of Specimens.~~

~~**12.15.3.1**~~ –

~~All labware, jars, or extraction vessels made of glass or other degradation-resistant and contamination-free materials shall be thoroughly cleaned, rinsed, and dried.~~

~~**12.15.3.1.1**~~ –

~~Where specified, other types of labware shall be substituted if it can be demonstrated that the labware will not contribute to cross contamination of the extraction liquids.~~

~~**12.15.3.2**~~ –

~~An extraction solvent of 50 percent methylene chloride, 25 percent acetonitrile, 25 percent cyclohexane shall be prepared.~~

~~**12.15.3.3**~~ –

~~A PAH/phthalate/phenols dilution solution of a 1:1 ratio of benzene and methylene chloride shall be prepared.~~

~~**12.15.3.4**~~ –

~~The specimen to be analyzed shall be cut into eight smaller pieces and placed in a 300 mL (10.1 oz) extraction vessel with a lid.~~

~~**12.15.3.5**~~ –

~~Six 16 mm ($^5/_8$ in.) polytetrafluoroethylene (PTFE) bearing balls shall be placed in the extraction vessel with the cut specimen pieces.~~

~~**12.15.3.6**~~ –

~~A volume of 50 mL (1.7 oz) of the extraction solvent prepared per 12.15.3.2 shall be added to the extraction vessel.~~

~~**12.15.3.7**~~ –

~~The extraction vessel shall be placed on a platform shaker set at 230 RPM ± 10 RPM and shall be shaken for 30 minutes.~~

~~**12.15.3.8**~~ –

~~The extraction vessel shall be removed from the platform shaker and shall be placed in a sonicator for 20 minutes at a “no heat” condition.~~

~~**12.15.3.9**~~ –

~~Immediately after sonification has been concluded, the extraction vessel shall be vented by lifting the lid to prevent the creation of a vacuum within the vessel.~~

~~**12.15.3.10**~~ –

~~The specimens shall be allowed to rest in the extraction vessel until it has returned to room temperature after approximately 10–15 minutes.~~

~~**12.15.3.11**~~ –

~~The resulting solution in the extraction vessel shall be filtered using a glass vacuum filtration flask assembly, with a 45 mm (1.77 in.) glass fiber filter placed on the fritted surface of the filtration apparatus and the apparatus then clamped to the flask and connected to a laboratory vacuum line.~~

~~**12.15.3.12**~~ –

~~The glass filtration flask and specimen pieces shall be rinsed with 5 mL of extraction solvent.~~

~~**12.15.3.13**~~ –

~~Any excess solvent shall be squeezed from the specimen pieces into the filtration flask.~~

~~**12.15.3.14**~~ –

~~The liquid content of the vacuum filtration flask shall be transferred to an oil tube or other graduated condensation vessel suitable for measuring extract evaporation using a small glass funnel.~~

~~**12.15.3.15**~~ –

~~Modifications to the specimen extraction procedures provided in 12.15.3.1 through 12.15.3.13 shall be permitted, provided that extraction recovery average efficiencies of 80 percent or better can be demonstrated.~~

~~**12.15.4**~~ – ~~Preparation of Extract for Analysis.~~

~~**12.15.4.1** *~~ –

~~The condensation vessel and contents prepared as specified in 12.15.3 shall be placed on the rack under a miniature evaporator/concentrator that is connected to ultra-high-purity nitrogen, and the contents shall be evaporated to less than or equal to 2 mL.~~

~~**12.15.4.2**~~ –

~~After reconstitution, the condensation vessel shall be placed in a vortex tube and vortexed 10–15 seconds to incorporate any solids that have dried on the side of the tube.~~

~~**12.15.4.3**~~ –

~~The contents of the vortex tube shall be measured using a disposable sterile pipette and the volume shall be recorded.~~

~~**12.15.4.4**~~ –

~~The contents of the vortex tube shall be returned to the oil tube with an appropriate amount of solvent to increase the final volume to 2 mL.~~

~~**12.15.4.5**~~ –

~~The oil tube shall be vortexed and the contents shall be transferred with a disposable glass pipette into 10 mL glass beaker.~~

~~**12.15.4.6**~~ –

~~The contents from the beaker shall be removed using a 3 mL syringe with an attached polyvinylidene fluoride (PVDF) 0.45 μm syringe.~~

~~**12.15.4.7**~~ –

~~The contents of the syringe shall be filled into auto-sampler vial.~~

~~**12.15.4.8** *~~ –

~~Alternative procedures for preparing the extract for analysis shall be permitted, provided that extraction recovery average efficiencies of 80 percent or better can be demonstrated.~~

~~**12.15.5** – Analysis of Specimens.~~

~~**12.15.5.1**~~ –

~~Calibration curves shall be prepared for each contaminant by applying known concentrations to specimen fabrics and extracting the specimens using the procedures specified in 12.15.3 and 12.15.4 using the analysis conditions specified in 12.15.5.2 .~~

~~**12.15.5.2**~~ –

~~Extracts prepared as specified in 12.15.4 shall be analyzed using gas chromatography and mass spectroscopy using the following analysis parameters:~~

(1) ~~A fused silica nonpolar 30 m, 0.25 mm ID, 0.50 µm mass spectroscopy column with a guard column that has been deactivated but not coated with stationary phase~~

(2) ~~Inlet temperature of 200°C (392°F)~~

(3) ~~Transfer line temperature of 300°C (572°F)~~

(4) ~~Ion source temperature of 300°C (572°F)~~

(5) ~~Oven temperature of 60°C (140°F); held for 2 minutes~~

(6) ~~Temperature ramp of 7°C (44.6°F) per minute to 310°C (590°F); held for 10 minutes~~

(7) ~~A carrier gas of ultra-high-purity helium at 1.2 L/min (40.6 oz)~~

(8) ~~1 µL sample splitless injection via autosampler into inlet containing split/splitless straight with wool topaz liner~~

~~**12.15.5.3**~~ –

~~The output from the gas chromatography and mass spectroscopy shall be used to integrate and calculate the concentration of each chemical per mass of specimen remaining with the percentage removal based on the calibration curves.~~

~~**12.15.5.3.1**~~ –

~~The concentration in each specimen shall be reported in µg/g specimen.~~

~~**12.15.5.4**~~ –

~~Cleaning efficiency shall be calculated for each contaminant with the following equation and as specified in 12.15.5.4.1 and 12.15.5.4.2 :~~

$$\text{cleaning efficiency} = 1 - \left[\frac{(C_C - C_M) - (C_W - C_P)}{(C_C - C_M)} \right] \times 100 \qquad \textbf{[12.15.5.4]}$$

~~where:~~

C_C = ~~contaminated specimen~~

C_M = ~~material specimen (unwashed, not contaminated)~~

C_W = ~~contaminated specimen (washed)~~

C_P = ~~material specimen (washed, not contaminated)~~

~~**12.15.5.4.1**~~ –

~~The actual masses used in the calculation of cleaning efficiency shall be the specific measured concentration of contaminant.~~

~~**12.15.5.4.2**~~ –

~~If the measured mass is below the detection limit, a value of “0” shall be used.~~

~~**12.15.5.5**~~ –

~~The average cleaning efficiency shall be determined for all contaminants.~~

~~**12.15.5.5.1**~~ –

~~If any cleaning efficiencies are indicated as being above 100 percent, a cleaning efficiency of 100 percent shall be used for the purpose of calculating the average cleaning efficiency.~~

~~**12.15.5.5.2**~~ –

~~If any cleaning efficiencies are indicated as being below 0 percent, a cleaning efficiency of 0 percent shall be used for the purpose of calculating the average cleaning efficiency.~~

~~**12.15.5.5.3**~~ –

~~If any analytical anomaly that cannot be rationalized on the basis of the data set and other measurements is encountered for the analysis of a specific contaminant, discarding one contaminant from the calculation of the average cleaning efficiency shall be permitted.~~

~~**12.15.5.6**~~ * –

~~Alternative procedures for the analysis of specimens specified in 12.15.5.1 through 12.15.5.3 shall be permitted, provided that the procedures take the concentrations of the controls into account by providing sufficient sensitivity to allow for the measurement of a 1.0 percent difference or lower in cleaning efficiency.~~

~~**12.16** – Heavy Metal Contaminated Specimen Preparation, Extraction, and Analysis.~~

~~**12.16.1** – Selection of Contaminants.~~

~~**12.16.1.1**~~ –

~~A certified solution shall be obtained that contains the following metals, each at a concentration of 100 ppm:~~

(1) ~~Antimony~~

(2) ~~Arsenic~~

(3) ~~Cadmium~~

(4) ~~Chromium~~

(5) ~~Cobalt~~

(6) ~~Lead~~

~~**12.16.1.2**~~ –

~~Alternative techniques for preparing a mixture of the target heavy metal contaminants shall be permitted if it can be demonstrated that the heavy metal concentrations are 100 ppm ± 10 ppm.~~

~~**12.16.2** – Procedures for Contamination of Specimens.~~

~~**12.16.2.1**~~ –

~~All handling of specimens and metal solutions shall be performed while wearing disposable gloves. Use of glassware for contamination or extraction shall not be permitted as the use of these items can lead to cross contamination.~~

~~**12.16.2.2**~~ –

~~Outer shell fabric prepared as specified in 12.4.3.2 shall be cut into 25 mm × 50 mm (1 in. × 2 in.) specimens, and the weight of each specimen shall be recorded in grams to the nearest 0.001 g.~~

~~**12.16.2.3**~~ * –

~~Using tweezers, one specimen shall be horizontally placed on a wire rack or other suitable support structure that minimizes the contact of the bottom surface of the specimens with the table or counter service.~~

~~**12.16.2.4**~~ –

~~A volume of 1.0 mL of a 100 ppm metals standard solution shall be pipetted onto each fabric specimen.~~

~~**12.16.2.4.1**~~ –

~~The operator shall ensure that the specimen is at the bottom of the plastic tube and sufficiently wetted by the metals standard solution.~~

~~**12.16.2.4.2**~~ –

~~A total volume of 500 µL of the metals standard solution shall be pipetted and allowed to dry before pipetting the remaining 500 µL.~~

~~**12.16.2.4.3** *~~ –

~~The operator shall ensure that all applied metals standard solution remains on the specimen.~~

~~**12.16.2.4.4**~~ –

~~Contaminated specimens shall be permitted to be dried in an oven at 50°C ± 5°C for up to 60 minutes.~~

~~**12.16.2.5**~~ –

~~The weight of the contaminated specimens shall be recorded in grams to the nearest 0.001 g.~~

~~**12.16.2.6**~~ –

~~After the specimens have been allowed to fully dry, plastic tweezers shall be used to insert specimens into metal-free plastic tubes.~~

~~**12.16.2.7**~~ –

~~The amount of standard solution on the specimen shall be verified using the following equation:~~

$$\text{amount of standard solution applied } (\mu g) = \left[\text{final specimen weight } (g) - \text{initial specimen weight } (g)\right] \times 1000 \ \mu g/g \qquad \text{[12.16.2.7]}$$

~~**12.16.3** – Extraction of Specimens.~~

~~**12.16.3.1** – Acid Digestion.~~

~~**12.16.3.1.1**~~ –

~~Each specimen shall be added to an individual PFA microwave reaction vessel.~~

~~**12.16.3.1.2**~~ –

~~A volume of 10 mL (**1/3** oz) concentrated nitric acid, approximately 70 percent weight/volume, shall be added to each PFA reaction vessel.~~

~~**12.16.3.1.3**~~ –

~~Each PFA reaction vessel shall be microwaved at 1600 W, 90 percent power, for 20 minute at 170°C (338°F) and held for 30 minutes for a total 50-minute cycle.~~

~~**12.16.3.1.4**~~ –

~~The specimens in the PFA reaction vessels shall be allowed to cool for approximately 30 minutes.~~

~~**12.16.3.1.5** *~~ –

~~Modifications to the specimen acid digestion procedures provided in 12.16.3.1.1 through 12.16.3.1.4 shall be permitted, provided that extraction recovery average efficiencies of 90 percent or better can be demonstrated.~~

~~**12.16.3.2** – Filtration.~~

~~**12.16.3.2.1**~~ –

~~The gravitation filtration system shall be set up using a grade 40 quantitative ashless (0.007 percent ash maximum) filter paper and plastic beakers for the filter solution.~~

~~**12.16.3.2.2**~~ –

~~The PFA microwave reaction vessel shall be carefully opened in the vent hood away from lab technicians due to the potential release of nitric acid fumes.~~

~~**12.16.3.2.3**~~ –

~~A volume of 10 mL ($^{1}/_{3}$ oz) deionized water shall be added to the microwave reaction vessel and the reaction vessel shall be turned over three times.~~

~~**12.16.3.2.3.1**~~ –

~~The reaction vessel shall be permitted to “breathe” if needed by opening the lid to off-gas.~~

~~**12.16.3.2.4**~~ –

~~Deionized water and the acid-digested sample mixture shall be poured into the filter setup.~~

~~**12.16.3.2.5**~~ –

~~The addition of deionized water shall be repeated to microwave reaction vessel two more times, for a total of 30 mL deionized water rinsed through microwave reaction vessel.~~

~~**12.16.3.2.6**~~ –

~~The resulting solution shall be filtered thoroughly once, then a second time, rinsing the filter paper with a small amount (<5 mL) of deionized water both times.~~

~~**12.16.3.2.7**~~ –

~~Each sample solution shall be brought to a volume of 40 mL (1.35 oz) volume using deionized water.~~

~~**12.16.3.2.8**~~ –

~~The sample solution shall be vortexed.~~

~~**12.16.3.2.9 ***~~ –

~~Modifications to the specimen filtration procedures provided in 12.16.3.2.3.1 through 12.16.3.2.8 shall be permitted, provided that extraction recovery average efficiencies of 80 percent or better can be demonstrated.~~

~~**12.16.3.3**~~ – ~~Instrument Sample Preparation.~~

~~**12.16.3.3.1**~~ –

~~An internal standard shall be prepared in a 100 mL (3.38 oz) volumetric flask to receive 10 ppb using the following constituents:~~

(1) ~~2 percent nitric acid~~

(2) ~~0.2 mL of 100 ppm Ga~~

(3) ~~0.2 mL of 100 ppm In~~

(4) ~~0.2 mL of 100 ppm La~~

~~**12.16.3.3.2**~~ –

~~A 1 mL volume of the extracted sample and a 25 µL volume of the internal standard shall be added to a 10 mL volumetric flask and diluted to volume with 2 percent nitric acid, and the resultant sample shall be vortexed.~~

~~**12.16.3.3.3**~~ –

~~A 10 mL ($^1/_3$ oz) sample of each instrument calibration standard shall be prepared at the following concentrations using 2 percent nitric acid to bring volume to 10 mL ($^1/_3$ oz):~~

(1) ~~0 ppb (to serve as blank)~~

(2) ~~100 ppb~~

(3) ~~1 ppm~~

(4) ~~10 ppm~~

(5) ~~100 ppm~~

~~**12.16.3.3.4**~~ –

~~The internal standard shall be added.~~

~~**12.16.3.3.4.1**~~ –

~~Once the test method recovery is established, the use of the internal standard shall be permitted to be optional.~~

~~**12.16.3.3.5**~~ –

~~All samples shall be vortexed.~~

~~**12.16.3.3.6**~~ –

~~Alternative sample preparation up procedures in lieu of 12.16.3.3.2 and 12.16.3.3.3 shall be permitted if a suitable scheme for demonstrating calibration of the respective metals achieved a linear correlation coefficient of 0.90 or better.~~

~~**12.16.4**~~ – ~~Analysis of Specimens.~~

~~**12.16.4.1**~~ – ~~Instrumentation Set-Up.~~

~~**12.16.4.1.1**~~ –

~~An inductively coupled plasma-mass spectrometer (ICP-MS) shall be prepared using the following method parameters to include those metals of interest:~~

(1) ~~Sweeps/readings: 20~~

(2) ~~Readings/replicates: 1~~

(3) ~~Number of replicates: 3~~

(4) ~~Dwell time: 50.0 ms~~

(5) ~~Mode: KED~~

(6) ~~RPq: 0.25~~

(7) ~~Detector mode: Dual~~

(8) ~~Measurement units: Counts~~

(9) ~~Automatic lens: On~~

(10) ~~Spectral peak processing: Sum~~

(11) ~~Signal profile processing~~

(12) ~~Baseline readings: 0~~

(13) ~~Smoothing: Yes, Factor 5~~

~~**12.16.4.1.2**~~ –

~~The blank, all samples, and instrument calibration standards shall be run on ICP-MS.~~

~~**12.16.4.1.3**~~ ~~*~~ –

~~An alternative analytical technique shall be permitted if it demonstrates sensitivity to the respective metals to a minimum of 100 ppb, provides for a linear calibration for determining each metal concentration with a correlation coefficient of 0.90 or better, and permits the ability for discerning a difference of 1.0 percent or lower in cleaning efficiency.~~

~~**12.16.4.2**~~ – ~~Data Analysis.~~

~~**12.16.4.2.1**~~ –

~~The slope, intercept, and regression coefficient shall be calculated using standard metal solutions (0 ppb–100 ppm).~~

~~**12.16.4.2.2**~~ –

~~The calculated slope and intercept shall be used to calculate the concentration of each individual metal each digested fabric swatch (ppb) in the 10 mL vial described in 12.16.3.3.1 using the following equation:~~

$$\text{metal concentration} \quad (\text{ppb}) = \frac{\text{metal ion counts} - \text{metal ion intercept}}{\text{metal ion slope}}$$ ~~**[12.16.4.2.2]**~~

~~**12.16.4.2.3**~~ –

~~The calculated concentration in ppb shall be used to calculate the mass in µg of each metal in the original 40 mL vial described in 12.16.3.3.3 .~~

~~**12.16.4.2.3.1**~~ –

~~A correction factor of 0.401 shall be used as calculated by the two dilution factors in the following equation:~~

$$0.010025 \text{ L} \times 0.040 \text{ L} = 0.000401 \text{ L}$$ ~~**[12.16.4.2.3.**~~

~~**12.16.4.2.4**~~ –

~~The blank and blank specimen from each contaminated specimens shall be subtracted.~~

~~**12.16.4.2.5**~~ –

~~The cleaning efficiency shall be calculated using the following equation:~~

$$\text{cleaning efficiency} = \frac{\mu\text{g metals}_1 - \mu\text{g metals}_f}{\mu\text{g metals}_i} \times 100 \text{ percent}$$ ~~**[12.16.4.2.5]**~~

~~**12.16.4.2.5.1**~~ –

~~If any cleaning efficiencies are indicated as being above 100 percent, a cleaning efficiency of 100 percent shall be reported.~~

~~**12.16.4.2.5.2**~~ –

~~If any cleaning efficiencies are indicated as being below 0 percent, a cleaning efficiency of 0 percent shall be reported.~~

~~**12.16.4.2.5.3**~~ –

~~If any analytical anomaly that cannot be rationalized on the basis of the data set and other measurements is encountered for the analysis of a specific contaminant, discarding one contaminant from being reported and interpreted for the determination of heavy metal cleaning efficiencies shall be permitted.~~

~~12.16.4.2.6~~ –

~~The percent recovery shall be calculated using the following equation:~~

$$\frac{\mu\text{g extracted}}{\mu\text{g deposited onto individual fabric swatch}} \times 100 \text{ percent} \quad [12.16.4.2.6]$$

~~12.17~~ – ~~Bacterial Contaminated Specimen Preparation, Extraction, and Analysis.~~

~~12.17.1~~ – ~~Preparation of Test Microorganisms.~~

~~12.17.1.1~~ –

~~Testing shall be performed in accordance with Section 9 of ASTM E2274,~~ ~~*Standard Test Method for Evaluation of Laundry Sanitizers and Disinfectants*~~ ~~, with the following modifications:~~

(1) ~~The test microorganisms shall be~~ ~~*Klebsiella pneumoniae*~~ ~~(ATCC 4352) and~~ ~~*Staphylococcus aureus*~~ ~~(ATCC 6538).~~

(2) ~~A soil load shall not be added to the inoculum.~~

~~12.17.1.2~~ ~~*~~ –

~~Modifications in the procedures for the preparation of test microorganisms shall be permitted if the laboratory can demonstrate viability of alternate procedures used to prepare cultures for both~~ ~~*Klebsiella pneumoniae*~~ ~~(ATCC 4352) and~~ ~~*Staphylococcus aureus*~~ ~~(ATCC 6538) to be used in the contamination step specified in~~ ~~12.17.2~~ ~~.~~

~~12.17.2~~ – ~~Procedures for Contamination of Specimens.~~

~~12.17.2.1~~ –

~~All handling of specimens and metal solutions shall be performed while wearing disposable gloves.~~

~~12.17.2.2~~ –

~~Outer shell fabric prepared as specified in~~ ~~12.14.3.2~~ ~~shall be cut into 25 mm × 38 mm (1 in. × 1.5 in.) specimens.~~

~~12.17.2.2.1~~ –

~~An additional outer shell specimen shall be prepared as specified in~~ ~~12.17.2.2~~ ~~for the verification of the sterilization process specified in~~ ~~12.17.2.3~~ ~~and subjected to suitable sterilization assurance procedures.~~

~~12.17.2.3~~ –

~~The outer shell specimens shall be wrapped in aluminum protective foil and autoclaved for 90 minutes at 121°C (250°F).~~

~~12.17.2.4~~ –

~~Each specimen to be contaminated shall be inoculated with 0.03 mL of the prepared inoculum for the respective type of bacteria by dispersing the inoculum in such a way that covers as much of the specimen area as possible.~~

~~12.17.2.4.1~~ –

~~Individual specimens shall be inoculated with only one type of bacteria.~~

~~12.17.2.5~~ –

~~The contaminated specimens shall be placed in an individual petri dish and incubated at 37°C (98.6°F) for 30 minutes.~~

~~12.17.2.6~~ –

~~Following incubation, the specimen shall be kept in a refrigerator at 4°C (39°F) until ready for shipping.~~

~~**12.17.2.7** *~~ –

~~Modifications to the procedures in 12.17.2.1 and 12.17.2.2 for the contamination of specimens shall be permitted if the laboratory can demonstrate consistency of bacterial counts as part of alternative procedures in the preparation of contaminated specimens for each bacterium.~~

~~**12.17.3**~~ – ~~Analysis of Specimens for Bacterial Contamination.~~

~~**12.17.3.1**~~ –

~~Specimens shall be analyzed for bacterial contamination in accordance with Sections 12.12, 13, and 15 of ASTM E2274, *Standard Test Method for Evaluation of Laundry Sanitizers and Disinfectants*, with the following modifications:~~

(1) ~~A 5-hour threshold shall be used to calculate the initial concentration of viable bacterial cells attached to the specimen that could not be estimated at the initial inoculation.~~

(2) ~~A polymerase chain reaction (PCR) detection method shall be permitted to be used to identify and quantify the levels of microorganisms present on the test specimens.~~

(3) ~~Viable bacterial levels shall be determined by colony-counting techniques for establishing the number of colony forming units (CFU).~~

(4) ~~A minimum average of 1.0×10^3 CFU/specimen shall be able to be recovered for a valid test.~~

~~**12.17.3.2**~~ –

~~The $\log_{10}$ reduction shall be determined using the following steps:~~

(1) ~~The average bacterial count for contaminated specimens that were subjected to sanitization will be determined separately for each bacterium and shall be converted to a $\log_{10}$ value.~~

(2) ~~The bacterial count for the contaminated, traveling specimen shall be converted to a $\log_{10}$ value.~~

(3) ~~The $\log_{10}$ reduction shall be calculated using the equation below:~~

$$\log_{10} \text{ reduction} = \log_{10}(\text{contaminated, traveling}) - \log_{10}(\text{average contaminated, sanitized}) \qquad \textbf{[12.17.3.2]}$$

(4) ~~The $\log_{10}$ value for the bacterial count of the contaminated, control specimens shall be permitted to be used in place of the contaminated, travel specimen, subject to the requirement in 12.14.4.4.1 (1).~~

~~**12.17.3.3**~~ –

~~Other control specimens including the noncontaminated specimens shall be used to assess the viability of the procedures and the potential for cross-contamination with foreign bacteria as needed to determine $\log_{10}$ reduction due to the application of sanitization procedures.~~

~~**12.17.3.4** *~~ –

~~Modifications to the analysis procedures provided in 12.17.3.1 through 12.17.3.3 shall be permitted if the alternative methods are able to achieve viable bacterial counts in specimens subjected to the sanitization process for determination of $\log_{10}$ reductions for the "sanitized" contaminated specimens as compared to the contaminated, traveling specimens.~~

~~**12.18**~~ – ~~Preparation and Handling of Contaminated Specimens and Surrogate Clothing.~~

~~**12.18.1**~~ – ~~Preparation of Surrogate Garments.~~

~~12.18.1.1~~ –

~~Surrogate garment outer shells shall be made from an undyed 60 percent para-aramid/40 percent polybenzimidazole (PBI) base fabric with a reinforcement grid meeting the following specifications:~~

(1) ~~The outer shell fabric shall have a unit area weight of 240 g/m~~ ^{2} ~~to 268 g/m~~ ^{2} ~~(7.1 oz/yd~~ ^{2} ~~to 7.9 oz/yd~~ ^{2} ~~).~~

(2) ~~The outer shell fabric shall have a thickness of 0.584 mm ± 0.254 mm (0.023 in. ± 0.10 in.).~~

(3) ~~The outer shell fabric shall have a water absorption resistance of less than 5 percent when tested in pristine condition in accordance with Section 8.25 of NFPA 1971, incorporated in the 2024 edition of NFPA 1970.~~

~~12.18.1.2~~ –

~~Fabric used for the creation of the sample mesh pockets on each garment shall be an aramid-based, warp-knit, mesh-style fabric having an open area of 20 to 40 percent and a unit area weight ranging from 220 g/m~~ ^{2} ~~to 270 g/m~~ ^{2} ~~(6.5 oz/yd~~ ^{2} ~~to 8.0 oz/yd~~ ^{2} ~~).~~

~~12.18.1.3~~ –

~~Surrogate garments shall consist of a surrogate coat and surrogate pants.~~

~~12.18.1.4~~ –

~~Surrogate coats shall be made from a single layer of outer shell fabric using appropriate seams, finished edges, and mesh pockets with thread that complies with the respective requirements of NFPA 1971 (incorporated in the 2024 edition of NFPA 1970) and shall be fabricated as shown in Figure 12.18.1.4 with the following additional specifications:~~

(1) ~~Surrogate coats shall be prepared with a body width of 74 cm ± 5 cm (29 in. ± 2 in.) and a sleeve length of 47 cm ± 5 cm (18 1/2 in. ± 2 in.) when measured from the top of coat seam to the end of the sleeve hem.~~

(2) ~~Surrogate coats shall not have front closures, collars, coat sleeve end reinforcements, hardware, or any other materials not specified in this section.~~

(3) ~~Each surrogate coat shall have a 254 mm × 254 mm (10 in. × 10 in.) outer shell pocket positioned on the front lower left side of the garment, approximately 50 mm (2 in.) from the bottom hem and 50 mm (2 in.) from the left side seam, that is secured using a double needle seam and has a top finished edge with a 152 mm (6 in.) strip of hook-and-loop closure to secure the top of the pocket.~~

(4) ~~Each surrogate coat shall have a 75 mm (3 in.) wide strip of reflective trim compliant with the respective requirements of NFPA 1971 (incorporated in the 2024 edition of NFPA 1970), sewn 75 mm (3 in.) above the bottom hem of the coat and on each sleeve at 75 mm (3 in.) above the bottom edge of the sleeve end.~~

(5) ~~Each surrogate coat shall have three 152 mm × 152 mm (6 in. × 6 in.) sample mesh pockets in accordance with the following requirements:~~

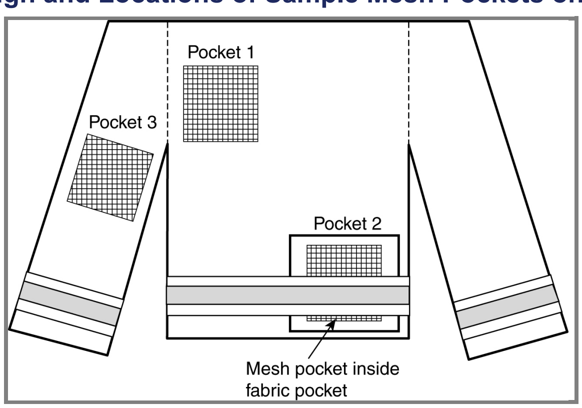
   (6) ~~The pockets shall be positioned on the front of the garment and numbered as indicated in Figure 12.18.1.4 .~~

   (7) ~~One pocket shall be positioned on top right side (Pocket 1), a second pocket shall be positioned in the center inside of the lower left side pocket (Pocket 2), and a third pocket shall be positioned on the upper right sleeve (Pocket 3).~~

   (8) ~~The openings of all three pockets shall be oriented toward the top.~~

   (9) ~~The pockets shall include a 101 mm (4 in.) strip of 21 mm (0.8125 in.) hook-and-loop tape for securing the open end of the pocket.~~

~~Figure 12.18.1.4 Design and Locations of Sample Mesh Pockets on Surrogate Coats.~~



~~**12.18.1.5**~~ –

~~Surrogate pants shall be made from a single layer of outer shell fabric using appropriate seams, finished edges, and mesh pockets with thread that complies with the respective requirements of NFPA 1971, incorporated in the 2024 edition of NFPA 1970, and shall be fabricated as shown in Figure 12.18.1.5 with the following additional specifications:~~

(1) ~~Surrogate pants shall be prepared with a 56 cm ± 5 cm (22 in. ± 2 in.) width at the garment waist and an inseam length of 76.2 cm ± 5.0 cm (30 in. ± 2 in.) as measured from the garment crotch to the bottom of the pant leg hem.~~

(2) ~~Surrogate pants shall not have fly closures, suspender hardware, pant hem reinforcements, other hardware, or any other materials not specified in this section.~~

(3) ~~Each surrogate pant shall have a 254 mm × 254 mm (10 in. × 10 in.) outer shell pocket positioned in the middle of the upper right leg of the garment that is secured using a double needle seam and has a top finished edge with a 152 mm (6 in.) strip of hook-and-loop closure to secure the top of the pocket.~~

(4) ~~Each surrogate pant shall have a 254 mm × 254 mm (10 in. × 10 in.) coated outer shell fabric reinforcement in the middle of left leg that is secured using a double needle seam and has a top finished edge with a 152 mm (6 in.) strip of hook-and-loop closure to secure the top of the reinforcement.~~

(5) ~~Each surrogate pant shall have a 75 mm (3 in.) wide strip of reflective trim compliant with the respective requirements of NFPA 1971, incorporated in the 2024 edition of NFPA 1970, attached circumferentially around each lower leg of the garment at 75 mm (3 in.) above the bottom hem of the leg.~~

(6) ~~Each surrogate pant shall have three 152 mm × 152 mm (6 in. × 6 in.) sample mesh pockets in accordance with the following requirements:~~

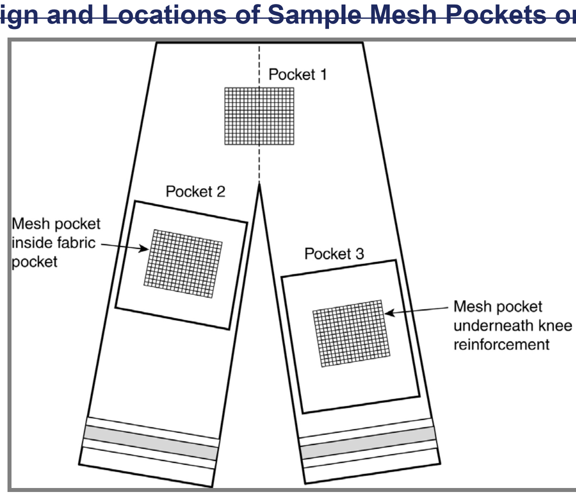
   (7) ~~The pockets shall be positioned on the front of the garment.~~

   (8) ~~One pocket shall be positioned in the middle approximately 101 mm (4 in.) from the waistline (Pocket 1), a second pocket shall be centered inside of the right leg outer shell pocket (Pocket 2), and a third pocket shall be centered inside of the left knee reinforcement pocket (Pocket 3).~~

   (9) ~~The openings of all three pockets shall be oriented toward the top, as shown in Figure 12.18.1.5 .~~

   (10) ~~The pockets shall include a 101 mm (4 in.) strip of 21 mm (0.8125 in.) hook-and-loop tape for securing the open end of the pocket.~~

~~Figure 12.18.1.5 Design and Locations of Sample Mesh Pockets on Surrogate Pants.~~



~~**12.18.1.6** –~~

~~Surrogate garments shall be subjected to an advanced cleaning by the verification organization prior to use by the cleaning facility.~~

~~**12.18.2** – Preparation of Ballast Fabric-Based Wash Panels.~~

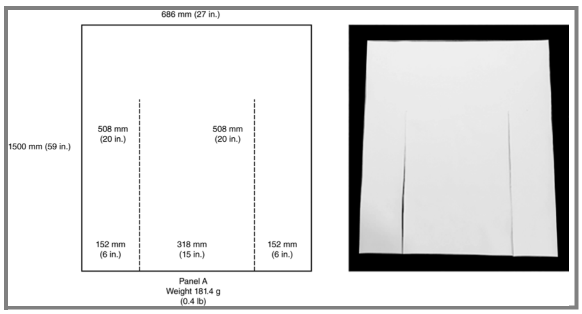
~~**12.18.2.1** –~~

~~Four different ballast fabric–based wash panels — Panel A, Panel B, Panel C, and Panel F — shall be prepared from the ballast materials specified in 12.4.14.2 according to the instructions provided in 12.18.2.2 through 12.18.2.5 . All panel edges shall be unfinished. Panel D shall be the surrogate coat and Panel E shall be the surrogate pants prepared according to 12.18.1 .~~

~~**12.18.2.2** –~~

~~Panel A shall be a 686 mm × 686 mm (27 in. × 27 in.) square with two 508 mm (20 in.) slits set 152 mm (6 in.) from each edge as shown in Figure 12.18.2.2 .~~

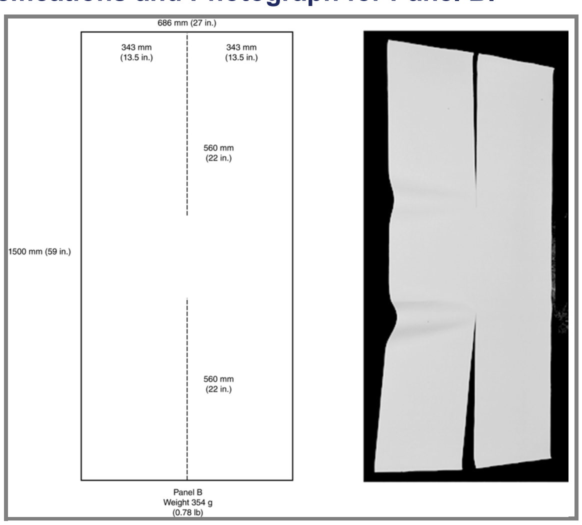
~~**Figure 12.18.2.2 Specifications and Photograph for Panel A.**~~



~~**12.18.2.3** –~~

~~Panel B shall be a 686 mm × 1500 mm (27 in. × 59 in.) rectangle with two bisecting 560 mm (22 in.) slits originating from opposite sides on the shorter dimensions of the shape as shown in Figure 12.18.2.3 .~~

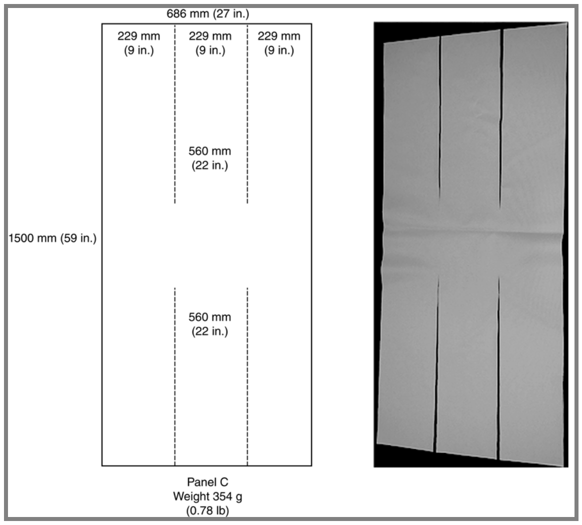
~~**Figure 12.18.2.3 Specifications and Photograph for Panel B.**~~



~~12.18.2.4~~ –

~~Panel C shall be a 686 mm × 1500 mm (27 in. × 59 in.) rectangle with two sets of two bisecting 560 mm (22 in.) slits originating from opposite sides on the shorter dimensions of the shape, spaced at 229 mm (9 in.) intervals from each edge and from each other, as shown in Figure 12.18.2.4 .~~

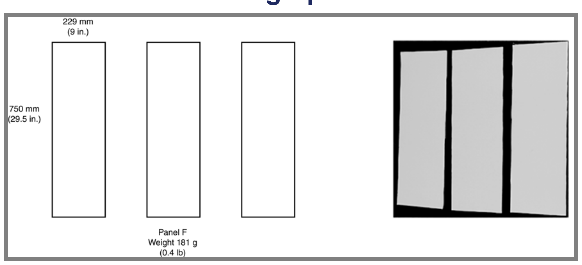
~~Figure 12.18.2.4 Specifications and Photograph for Panel C.~~



~~12.18.2.5~~ –

~~Panel F shall be a total of three rectangular panels that measure 228 mm × 750 mm (9 in. × 29.5 in.) as shown in Figure 12.18.2.5 .~~

~~Figure 12.18.2.5 Specifications and Photograph for Panel F.~~



~~12.18.2.6~~ –

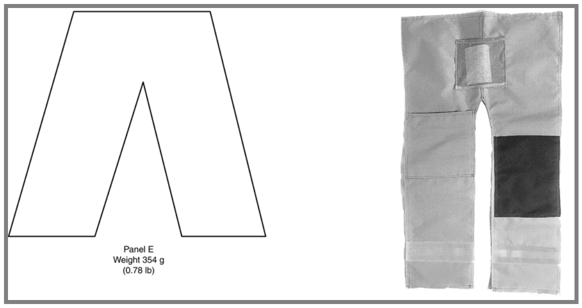
~~Panel D shall be depicted as shown in Figure 12.18.2.6 .~~

~~Figure 12.18.2.6 Diagram and Photograph for Panel D.~~

~~**12.18.2.7**~~ –

~~Panel E shall be depicted as shown in Figure 12.18.2.7 .~~

~~**Figure 12.18.2.7 Diagram and Photograph for Panel E.**~~

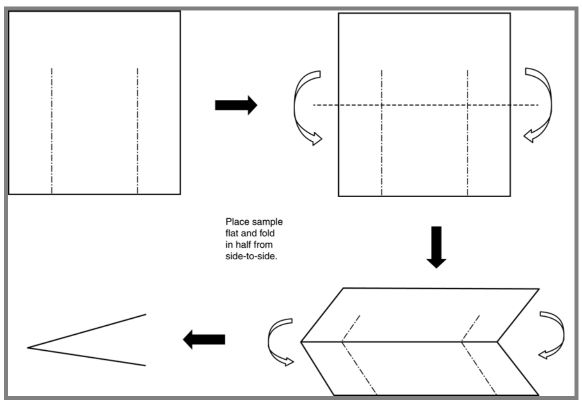


~~**12.18.3**~~ – ~~Preparation of Wash Load.~~

~~**12.18.3.1**~~ –

~~Panel A shall be folded and placed into the wash load as shown in Figure 12.18.3.1 .~~

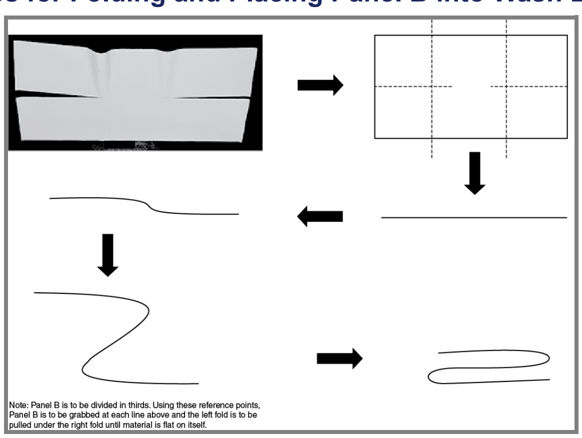
~~**Figure 12.18.3.1 Steps for Folding and Placing Panel A into Wash Load.**~~



~~**12.18.3.2**~~ –

~~Panel B shall be folded and placed into the wash load as shown in Figure 12.18.3.2 .~~

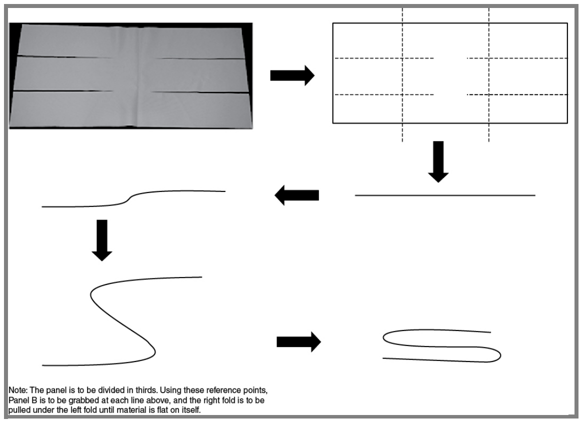
~~**Figure 12.18.3.2 Steps for Folding and Placing Panel B into Wash Load.**~~



~~**12.18.3.3**~~ –

~~Panel C shall be folded and placed into the wash load as shown in Figure 12.18.3.3 .~~

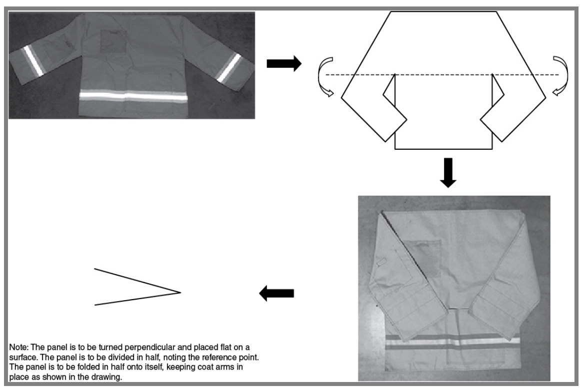
~~**Figure 12.18.3.3 Steps for Folding and Placing Panel C into Wash Load.**~~



~~**12.18.3.4**~~ –

~~Panel D shall be folded and placed into the wash load as shown in Figure 12.18.3.4 .~~

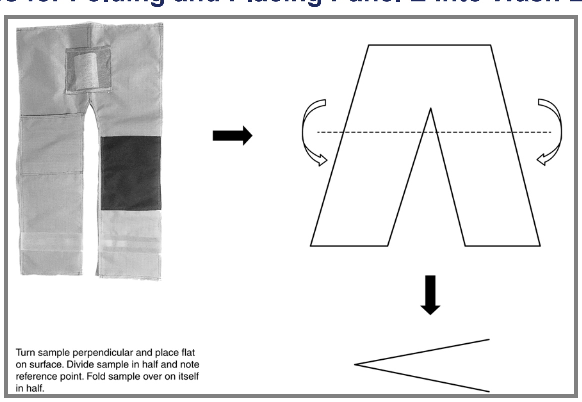
~~**Figure 12.18.3.4 Steps for Folding and Placing Panel D into Wash Load.**~~



~~**12.18.3.5**~~ –

~~Panel E shall be folded and placed into the wash load as shown in Figure 12.18.3.5 .~~

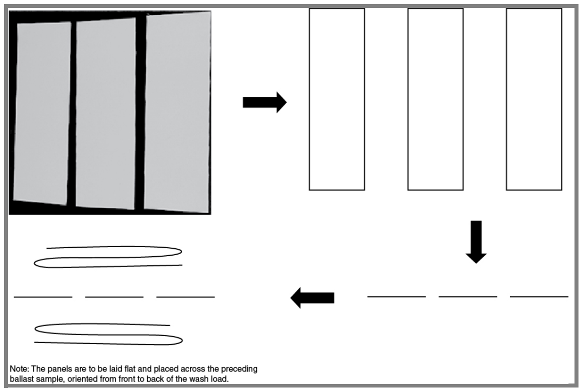
~~**Figure 12.18.3.5 Steps for Folding and Placing Panel E into Wash Load.**~~



~~12.18.3.6~~ –

~~Panel F shall be folded and placed into the wash load as shown in Figure 12.18.3.6 .~~

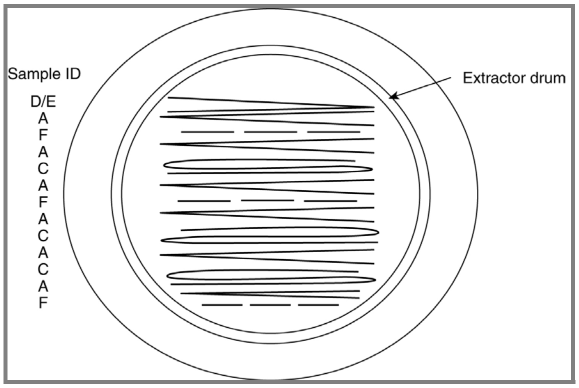
~~Figure 12.18.3.6 Steps for Folding and Placing Panel F into Wash Load.~~



~~12.18.3.7~~ –

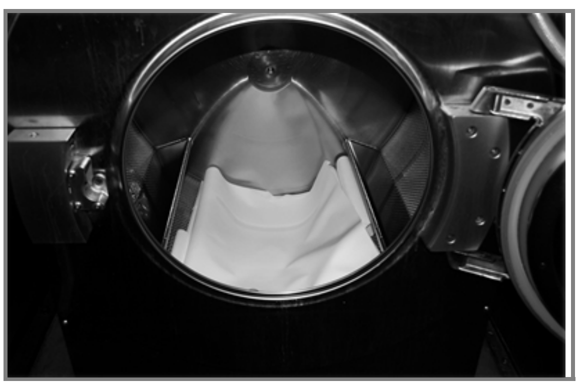
~~The panels shall be placed in the washer/extractor according to the sequence provided in Figure 12.18.3.7(a) , starting at the bottom, and depicted in Figure 12.18.3.7(b) through Figure 12.18.3.7(f) .~~

~~Figure 12.18.3.7(a) Sequence for Placing Panels in Washer/Extractor Drum.~~

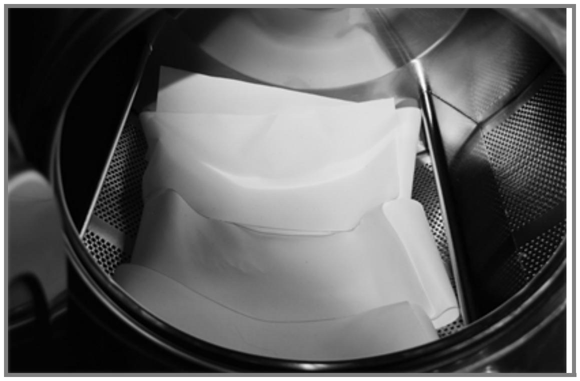


~~Figure 12.18.3.7(b) Placement of Panel F (3 Pieces) into Washer/Extractor Drum.~~

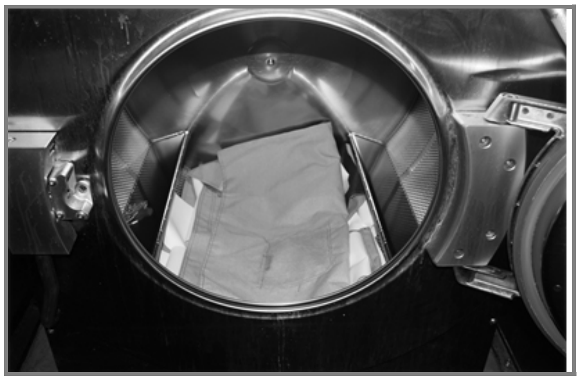
~~Figure 12.18.3.7(c) Placement of Panel C into Washer/Extractor Drum.~~



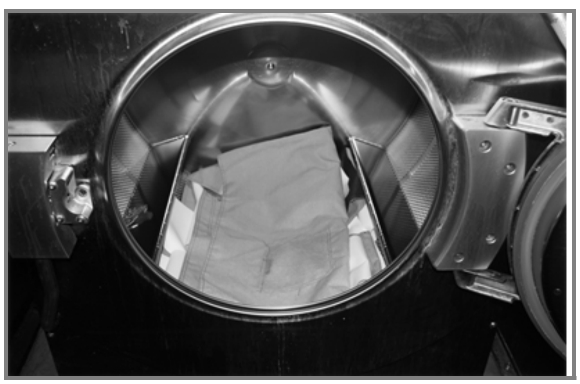
~~Figure 12.18.3.7(d) Placement of Panel A into Washer/Extractor Drum.~~



~~**Figure 12.18.3.7(e) Placement of Panel D into Washer/Extractor Drum.**~~



~~**Figure 12.18.3.7(f) Placement of Panel E into Washer/Extractor Drum.**~~



~~**12.18.3.7.1**~~ –

~~It shall be permitted to place the wash load with all of the panels at a 90-degree angle with respect to their orientations shown in~~ 12.18.3.7 ~~.~~

~~**12.18.3.8** * ~~

~~The sequencing of panels shall be as follows:~~

(1) ~~The sequencing shall be repeated for attaining a wash load with the mass capacity, ± 5 percent, as specified by the cleaning facility.~~

(2) ~~Panel D and Panel E shall be alternated in the sequencing.~~

(3) ~~A total of three panels each shall be used for Panel D and Panel E.~~

(4) ~~Panel D and Panel E shall alternatively be evenly distributed within the wash load so that there are a near equal number of nonsurrogate panels between each surrogate garments (Panel D or Panel E).~~

(5) ~~It shall be permissible to adjust the sequence of the panels to meet the requirements of 12.18.3.8 (1) through 12.18.3.8 (4) in order to attain the target wash load mass capacity.~~

Statement of Problem and Substantiation for Public Comment

FR-144 updated the test method in 12.4 to include all these sections in a reformatted test method. This should have been deleted as part of that first revision as this is a duplicate.

Related Item

- FR-144

Submitter Information Verification

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Submittal Date: Tue May 28 08:33:43 EDT 2024
Committee: FAE-SPF

Public Comment No. 17-NFPA 1850-2024 [Section No. A.3.3.17]

A.3.3.17 Contamination.

Ensembles and ensemble elements can be ~~exposed~~ found with hazardous chemicals, polymers, or metals. They can also be exposed to products of combustion and other hazardous materials in several ways through contact with gases/vapors, liquids, ~~or~~ or particulates. A fire in which the firefighter wears SCBA and is exposed to fire smoke, other particulates, and fire gases represents a common source of contamination.

The extent and persistency of the contamination in the ensemble or ensemble element will vary with the type of contaminant, the length of the contamination period, and the means by which the ensemble or ensemble elements are contaminated. In general, contamination that is persistent represents the greatest concern since these forms of contaminants might remain in the clothing for extended periods of time and provide continued exposure to the firefighter.

Examples of common contaminants found ~~in fires~~ on or within ensembles include, but are not limited to, the following:

(1) Heavy inorganic metals (e.g., arsenic, antimony, cadmium, chromium, mercury, lead)

(2) Semivolatile organic compounds, including but not limited to, the following:

  (3) Polynuclear aromatic hydrocarbons (PAHs) (e.g., anthracene, chrysene, fluoranthene, naphthalene, pyrene)

  (4) Phthalate plasticizers [e.g., benzyl butyl phthalate (BPP), bis(2-ethylhexyl) phthalate (DEHP), dimethyl phthalate]

  ~~Polybrominated diphenyl ether flame retardants (PBDEs)~~

  (a) Chloronated, brominated, and organohalogenated flame retardants [e.g., pentabromodiphenyl ether (BDE 99), hexabromodiphenyl ether (BDE 153) , decabromodiphenyl ethane (DBDPE), polybrominated diphenyl ethers or ethanes (PBDE), 3,3',4,4',5,'5',6,6'-decabromodiphenyl ether (BDE 209)]

  (b) Polychlorinated biphenyls (PCBs) (e.g., 2,2,3,3,4,4,5,5-Octachlorobiphenyl)

  (c) Substituted phenols (e.g., 2-methylphenol and pentachlorophenol)

(5) Hazardous particulates (e.g., soot, asbestos, silica, lead dust)

(6) Per- and polyfluoroalkyl substances (PFAS)

(7) Hazardous aerosols and vapours (e.g., oils, acids)

(8) Organic pathogens

In contrast, many volatile organic chemicals such as formaldehyde and benzene, while hazardous, easily evaporate unless bound in the materials used in the element. In addition, carbon particles that make up the majority of smoke actually absorb and hold many products of combustion, resulting in persistent contamination.

Certain materials, components, or portions of an ensemble element or ensemble might be more susceptible to contamination. For example, the textile fabric components of a protective helmet might be more easily contaminated than the hard surface of the helmet shell.

Statement of Problem and Substantiation for Public Comment

The added content gives a more comprehensive definition and explanation of what contamination is known to exist on fire fighter ensembles.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 9-NFPA 1850-2024 [Section No. 3.3.17]	

Related Item

- n/a

Submitter Information Verification

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Committee:	FAE-SPF

Public Comment No. 18-NFPA 1850-2024 [Section No. A.3.3.74]

A.3.3.74 Preliminary Exposure Reduction (PER).

The primary purposes for PER actions are to reduce the exposure of the individual end users to soiling, products of combustion, and persistent contamination during doffing of ensembles, ensemble elements, and SCBA; and to minimize the spread of that contamination to apparatus, vehicles, <u>fire stations,</u> and the outside environment. PER techniques for the outside of the ensemble, ensemble elements, and SCBA include brushing off dry debris with a soft bristle brush, rinsing off debris with a low-pressure, low-volume water hose, and spot cleaning for nonaluminized elements. Only a soft cloth or sponge should be used to remove debris on aluminized element surfaces.

These actions, conducted by an individual with assistance, are intended to begin the removal of soiling and contamination following the exposure of the individual on the fireground or at the emergency scene. The goal of PER is reducing contamination for the exposed ensemble or ensemble elements prior to leaving the scene. These techniques should be applied while the member is still wearing their SCBA and is still on air to prevent respiratory exposure from any off-gassing of contaminants or to dust from airborne debris. It is realized that unforeseen circumstances due to the limitation of resources (e.g., spare ensembles, ensemble elements, or SCBA), inclement weather, and other factors can affect the ability to apply PER; however, it is important PER be conducted after fireground and other emergency operations where protective ensembles and SCBA are subject to soiling and contamination.

In the hazardous materials industry, these actions are often referred to by the term *gross decontamination*, indicating the rinsing of the first responder or the actions to partially remove chemical residues or other hazardous substances after leaving the hot (i.e., contaminated) zone and before entering the cold (i.e., clean) zone during a hazardous materials incident. NFPA 1850 uses the term *preliminary exposure reduction* because the term *decontamination* suggests removal of contaminant. While there is an expectation that some of the surface contamination could be removed from protective ensembles or ensemble elements, gross decontamination or preliminary exposure reduction does not guarantee full cleaning or decontamination for all parts of the protective ensembles or ensemble elements.

Statement of Problem and Substantiation for Public Comment

Housekeeping item, studies regarding fire station contamination necessitates the inclusion of the Fire Station in the context of this Annex article.

<u>Related Item</u>

- n/a

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Committee: FAE-SPF

Public Comment No. 20-NFPA 1850-2024 [Section No. A.3.3.91]

A.3.3.91 Restricted Substance.

Restricted substances can be hazardous, toxic, corrosive, ignitable, explosive, chemically reactive, carcinogenic, persistent, or bioaccumulative. These substances are restricted because governments or other organizations have established specific limits for their use in various products that either prohibit their use or set maximum limits for their concentration in the respective product.

Statement of Problem and Substantiation for Public Comment

Harmonizing the language to capture the intent of the term.

Related Item

- n/a

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Submittal Date: Sun May 26 18:00:48 EDT 2024

Committee: FAE-SPF

Public Comment No. 49-NFPA 1850-2024 [Section No. A.3.3.122.1]

A.3.3.122.1 PPE Technician.

PPE protects every fire department's most valuable asset, its members. Therefore, it is essential that proper attention be given to PPE and the PPE program by including a PPE Technician (or Technicians) in an organization's PPE program SOPs/SOGs.

Ensuring PPE is afforded proper attention for selection, care, and maintenance includes intentionally assigning a person (or persons) in the department to perform the functions included in this standard. Historically, many departments have assigned a civilian or someone on light duty to the care and maintenance of PPE. Because of the well-documented need to reduce exposure to contamination and because PPE has become so sophisticated, it is critical that an organization identifies, trains, and empowers an individual (or individuals) to be responsible for tracking, inspecting, and cleaning structural firefighting PPE.

The fire service has had training and qualification requirements for a health and safety officer, an incident safety officer, an EVT Technician, Firefighter I and II, driver operator, company officer, and others. The need for organizations to have a PPE Technician(s) has emerged because managing a PPE program is more comprehensive than before.

Certainly, contamination control has been a catalyst in bringing attention to PPE. However, many other aspects of PPE have become more critical to fire departments. Design, materials, and components are more sophisticated, and every department needs a PPE technician(s) who is (are) knowledgeable in these areas. Of utmost importance is a thorough understanding about record-keeping, selection, fit, cleaning, drying, inspection, repair, storage, retirement, and disposal. If the fire service expects the highest quality PPE which is independently third-party certified, then it must use and care for those products in a similar manner. Moreover, the cost of purchasing PPE and its subsequent care costs is now a much higher percentage of a department's budget than in previous years and must be managed appropriately.

The PPE Technician should be knowledgeable about the design, materials, and components of the PPE used by the department and must be trained on, and given the tools to track, inspect, clean, and repair (to the level allowed by this standard) PPE.

To this end, a PPE Technician is a skilled employee who is properly trained and equipped clean, maintain, and repair of the department's PPE worn for fire suppression.

The individual or individuals who are appointed by the organization must meet the qualifications outlined in this standard.

~~It~~

It is important that the individual or individuals have the requisite knowledge and skills to function effectively in this position.

~~The~~

The individual or individuals might or might not be directly involved the in the hands-on application of this standard. If they are not directly involved, they are responsible to ensure those involved have the requisite knowledge and skills to function effectively in their position.

The PPE Technician is the competent person who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees. The competent person has the authority to impose prompt corrective measures to eliminate these hazards.

The PPE Technician should be expected to maintain cleaning and inspection records for each individual piece of PPE, conduct Advanced Inspection, Complete Liner Inspection, and determine whether the PPE can be repaired (according to the requirements of this standard.

The PPE Technician should be part of the gear evaluation and selection team and should provide bring their experience handling the department's PPE to every selection discussion.

Statement of Problem and Substantiation for Public Comment

After considering committee input from the First Draft meeting, it is clear that the standard needs to allow for both a PPE Manager and PPE Technician. This Public Comment updates the definition and annex material for the PPE Technician

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 48-NFPA 1850-2024 [Section No. 3.3.122.1]	

Related Item

- FR-41

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Committee:	FAE-SPF

Public Comment No. 52, Assigned to FAE-SPF, Refer to FAE-RPE

Public Comment No. 52-NFPA 1850-2024 [Section No. A.4.2.2.1]

A.4.2.~~2.1~~ 4

This job description should include, but not be limited to, educational criteria for the organization’s members related to selection, use inspection, cleaning, drying, storage, retirement, and disposal for all elements of the ensemble.

Statement of Problem and Substantiation for Public Comment

PC 51 removes this section but the annex item should stay, it needs to be renumbered so that it is attached to 4.2.4

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 51-NFPA 1850-2024 [Section No. 4.2.4]	

Related Item

- FR-34

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Committee:	FAE-SPF

Public Comment No. 21-NFPA 1850-2024 [Section No. A.4.3.4.3.2]

A.4.3.4.3.2

Training should explain the activities that organizations are required to perform in order to comply with this standard, as well as provide information and options in regard to how organizations can accomplish them. This training does not negate the need for organizations to consult with manufacturers on specific instructions for performing inspections or basic repairs on proprietary products, individual ensemble elements, fabrics, or components with unique attributes or performance that require special consideration. For cleaning, it might be necessary to consult a manufacturer who has been verified in cleaning.

The following overview can be used as a basis for an NFPA 1850 (1851) structural and proximity firefighting PPE selection, care, and maintenance program.

The following is included in this overview:

(1) Why this is important

(2) NFPA 1850 consolidation

(3) General guidelines

(4) New this edition

(5) Program basics

(6) Implementing a program

(7) Record keeping

(8) Miscellaneous

(9) Selecting gear

(10) Assessing gear

(11) Receiving gear

(12) Inspecting gear

(13) Cleaning gear

(14) Storing and retiring gear

Why this is important. Structural and proximity firefighting PPE selection, care, and maintenance is important for the following reasons:

(1) Being a firefighter is inherently dangerous. Firefighting gear is designed and manufactured to protect the wearer during structural and proximity firefighting duties.

(2) During firefighting duties, gear becomes contaminated. This contamination can risk exposure to the wearer, other firefighters and emergency response personnel, family members of emergency response personnel, and the public.

(3) Clean gear is critical to supporting health and safety goals.

NFPA 1850 consolidation. The following is a summary of the material covered in the now consolidated NFPA 1850 standard. NFPA 1850 consists of what was NFPA 1851 and NFPA 1852. This overview focuses on what was NFPA 1851–specific material.

(1) Chapters 1–3 contain material common to both standards.

(2) Chapter 4–12 and Annexes A and E contain NFPA 1851–specific material.

(3) Chapters 13–16 and Annexes A–E contain NFPA 1852–specific material.

General guidelines. The following is a summary of the material covered in the NFPA 1851–specific chapters of NFPA 1850:

(1) Chapter 1 provides information about the scope and purpose of the document, and some basics about how to apply the standard.

(2) Chapter 2 lists other publications referenced in the document.

(3) Chapter 3 contains the glossary of terms used in the document.

(4) Chapter 4 provides the framework for designing and implementing a structural and proximity firefighting PPE selection, care, and maintenance program.

(5) Chapter 5 focuses on selecting PPE.

(6) Chapter 6 lays out the requirements for completing a routine inspection, an advanced inspection, and a complete liner inspection.

(7) Chapter 7 is all about cleaning and disinfection.

New this edition. The following topics are new to the 2025 edition of NFPA 1850:

(1) Definition, role, and responsibilities of a PPE technician

(2) More information on advanced cleaning

(3) Updated cleaning efficiency requirements

(4) Example risk assessment documents

Program basics. The following is the basic framework for designing and implementing a structural and proximity firefighting PPE selection, care, and maintenance program:

(1) PPE is designed and manufactured to meet high performance and protection standards and it needs to be treated and handled appropriately to help ensure it can protect the person wearing it.

(2) A successful program provides a strong foundation for informing everyone in the department how PPE should be handled and maintained.

(3) The requirements in Chapters 4–12 are minimum requirements for the selection, care, and maintenance of structural and proximity firefighting protective clothing and equipment that are compliant with NFPA 1970 (1971) only.

(4) A structural and proximity firefighting PPE selection, care, and maintenance program should contain documentation for clear expectations and procedures for all of the following to ensure equipment functions as designed and harm from improper selection, care, and maintenance is minimized:

    (5) Records of all PPE

    (6) Protection from contaminated PPE

    (7) Selection of PPE

    (8) Inspection of PPE

    (9) Cleaning of PPE

    (10) Repair of PPE

    (11) Storage of PPE

    (12) Retirement, disposition, and special incident procedures for all PPE

(13) Specific operations included in NFPA 1850 that should be incorporated into a structural and proximity firefighting PPE selection, care, and maintenance program include the following:

    (14) Routine inspections

    (15) Preliminary exposure reduction (PER)

    (16) Advanced inspection

    (17) Complete liner inspection

    (18) Advanced cleaning

    (19) Sanitization or disinfection

    (20) Specialized cleaning

    (21) Basic repair

(22) Advanced repair

(23) Training for inspection

(24) Training for cleaning

(25) Training for repairs

Implementing a program. A department can implement a structural and proximity firefighting PPE selection, care, and maintenance program through one, or a combination of, the following providers defined in Chapter 3 (There is also a reference table in Chapter 4.):

(1) Manufacturer verified in cleaning

(2) Verified ISP or verified organization

(3) Verified cleaner

(4) Manufacturer-trained organization

(5) User

(6) Ensemble manufacturer or ensemble element manufacturer (protective clothing and equipment manufacturer)

Each provider with "verified" in its title must pass third-party verification and have a certificate. That certificate lists the specifics for which that service provider is verified. Check Intertek and UL for websites to find verified ISPs to service gear.

Record keeping. Record keeping includes, at a minimum, the following:

(1) The person to whom a PPE element has been issued

(2) PPE elements that are not issued to a specific person

(3) The date of issue and condition of the PPE when issued

(4) The manufacturer and model name or design of the PPE

(5) The PPE manufacturer's identification number, lot number, or serial number

(6) The month and year of manufacture for the PPE

(7) All dates of and findings related to advanced inspection(s)

(8) All dates of and findings related to advanced cleaning, disinfection or sanitization, or specialized cleaning

(9) All dates of repair(s), who performed the repair, and a brief description of the repair for all PPE

(10) The date of retirement for the PPE

(11) The date and method of disposal for the PPE

Records can be collected and stored either as hard copies or electronically, or both. Records should be maintained until a PPE element is retired and disposed of. If resources permit, records should be kept for at least 12 months past retirement.

Miscellaneous. All manufacturer's instructions should be kept. If a manufacturer's instructions differ from the requirements in the standard (except as related to verification), the manufacturer's instructions should supersede all other instructions.

Chapter 4 is important because it provides clear direction for defining a structural and proximity firefighting PPE selection, care, and maintenance program, as well as additional information for the rest of Chapters 5 through 12.

Selecting gear. Where a department is set to select gear, all of the following should be considered:

(1) A risk assessment ~~should~~ shall be performed (~~tis~~ this standard includes multiple examples).

(2) The types of incidents the department responds to.

(3) The gear that can provide the most appropriate protection.

A risk assessment should include, but not be limited to, all of the following:

(1) Type of duties performed

(2) Incident types with related response activities identified

(3) What the organization has experienced in the past

(4) Incident operations

(5) Local geographic and climate considerations

(6) The specific physical area of operation

(7) The likelihood of, or response to, a CBRN terrorism incident

(8) The risks associated with not having access to two sets of gear

After the risk assessment is complete, take time to evaluate the strengths and weakness of all PPE elements under consideration, such as thermal insulation, thermal comfort, interface areas, and so on.

Assessing gear. The following guidelines should be used where evaluating gear in the filed:

(1) Make sure that all gear to be tested fits the were as designed by the manufacturer.

(2) Have a systematic (i.e., quantifiable) way to evaluate the performance of each PPE element tested, as follows:

    (3) <u>Use a combination of quantitative and qualitative mechanism for gathering feedback</u>

    (4) <u>Use the same firefighters to evaluating different PPE elements, if possible</u>

(5) If a department can't run a field evaluation alone, team up with other local departments to run a joint field evaluation

Prior to any gear purchase, all purchase specifications should be detailed and include at least the following:

(1) Be certified to NFPA 1970

(2) Require substantiation of certification as part of the specification

(3) Define proper fit in the specification

(4) Comparison of each bid submittal against the specification

(5) Include procedures for returning gear that isn't satisfactory or doesn't meet the specification

Receiving gear. Upon delivery, all gear should be inspected to confirm the following:

(1) Does the gear meet the specification?

(2) Was any gear damaged in shipment?

(3) Are all sizes and quantities ordered accounted for?

(4) Is all information such as use and maintenance instructions, warranty, and technical data included?

Any gear that is unsatisfactory or does not meet the specification should be returned per established procedures.

Inspecting gear. All PPE elements should be inspected for the following both prior to donning and after an incident:

(1) Rips, tears, or holes

(2) Charring, burns, melting, or discoloration

(3) Chemical damage

(4) Missing or damaged reflective trim

(5) Correct assembly of shell, liner, and DRD

(6) Missing hardware

Any damaged or incomplete gear should be removed from service. Back-up gear should be utilized until damaged or incomplete gear is repaired by the original equipment manufacturer (OEM), a verified independent service provider (ISP), or verified department personnel to NFPA 1850 requirements or is replaced.

Cleaning gear. All gear should be cleaned as determined by Figure A.4.3.4.3.2(a) for exposure and Figure A.4.3.4.3.2(b) for contamination.

Figure A.4.3.4.3.2(a) Basic Exposure Decision Tree.

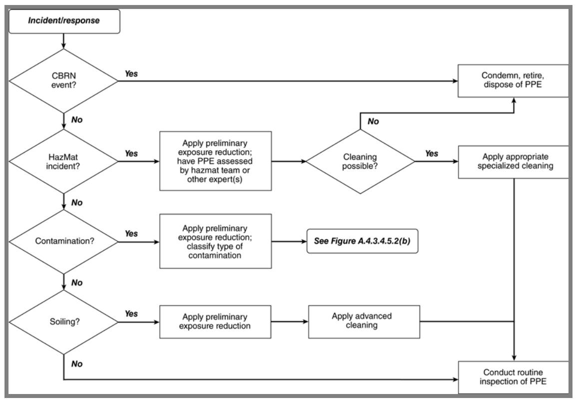
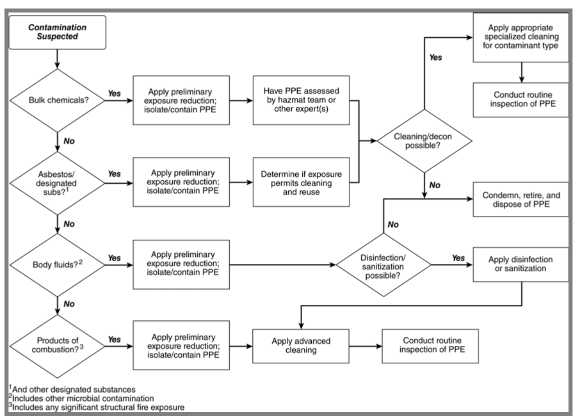


Figure A.4.3.4.3.2(b) Contamination Decision Tree.



Cleaning gear. Where gear needs to be cleaned, there are three levels of cleaning as follows:

(1) Routine wash

(2) Advanced (machine washing)

(3) Specialzed (pretreat/soaking)

A routine wash can reduce preliminary exposure contaminants. However, advanced cleaning is most often necessary. The following precautions should be taken where advanced cleaning is needed:

(1) Never use bleach

(2) Water temperature should not exceed 40°C (105°F).

(3) Extraction g-forces should not exceed 100.

(4) Cleaning agent Ph should be between 6.0 and 10.5.

(5) Liners should be washed separately, inside out.

(6) Advanced cleaning should only be done twice per 12-month period.

Where advanced cleaning is needed, all of the following procedures should be implemented:

(1) Separate outer shells from liners

(2) Invert liners so quilt is facing the outside

(3) Secure all closures (e.g., velcro, hook and dees, zippers)

(4) DRD does not have to be removed if closures are secure

(5) Machine wash outer shells with outer shells

(6) Machie wash inner liners with inner liners

(7) Hoods can be washed with liners

(8) Air dry all elements

Storing and retiring gear. Where storing gear, care should be taken to protect all PPE elements from UV lighting. Gear should be transported in a plastic or gear bag. Gear should not be stored in air-tight bags.

PPE elements should be retired per the following considerations:

(1) Structural fire firefighting and proximity ensemble elements ~~should~~ shall be retired and removed from service no ~~more~~ later than 10 years from the date of manufacture.

(2) Structural fire firefighting and proximity firefighting ensembles should be retired when they are worn or damaged to the extent that they can no longer be repaired.

(3) Recommendations for retirement can be made by an ISP; however, final determination should be made by a member of the organization who has been trained in the inspection and repair of ensembles.

(4) Retired structural fire firefighting and proximity elements that have been retired should be destroyed in such a manner that prevents their use in firefighting or other emergencies.

(5) Retired elements that are retired but still serviceable can be used for training provided the training does not involve live firefighting.

Statement of Problem and Substantiation for Public Comment

Editorial.
Hazard Assessments are necessary and should not be deemed optional.
A 10-year lifecycle for structural PPE should not be optional.

Related Item

• n/a

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Committee: FAE-SPF

Public Comment No. 83-NFPA 1850-2024 [Section No. A.4.3.4.3.2]

~~A.4.3.4.3.2~~ —

~~Training should explain the activities that organizations are required to perform in order to comply with this standard, as well as provide information and options in regard to how organizations can accomplish them. This training does not negate the need for organizations to consult with manufacturers on specific instructions for performing inspections or basic repairs on proprietary products, individual ensemble elements, fabrics, or components with unique attributes or performance that require special consideration. For cleaning, it might be necessary to consult a manufacturer who has been verified in cleaning.~~

~~The following overview can be used as a basis for an NFPA 1850 (1851) structural and proximity firefighting PPE selection, care, and maintenance program.~~

~~The following is included in this overview:~~

(1) ~~Why this is important~~

(2) ~~NFPA 1850 consolidation~~

(3) ~~General guidelines~~

(4) ~~New this edition~~

(5) ~~Program basics~~

(6) ~~Implementing a program~~

(7) ~~Record keeping~~

(8) ~~Miscellaneous~~

(9) ~~Selecting gear~~

(10) ~~Assessing gear~~

(11) ~~Receiving gear~~

(12) ~~Inspecting gear~~

(13) ~~Cleaning gear~~

(14) ~~Storing and retiring gear~~

~~*Why this is important.* Structural and proximity firefighting PPE selection, care, and maintenance is important for the following reasons:~~

(1) ~~Being a firefighter is inherently dangerous. Firefighting gear is designed and manufactured to protect the wearer during structural and proximity firefighting duties.~~

(2) ~~During firefighting duties, gear becomes contaminated. This contamination can risk exposure to the wearer, other firefighters and emergency response personnel, family members of emergency response personnel, and the public.~~

(3) ~~Clean gear is critical to supporting health and safety goals.~~

~~*NFPA 1850 consolidation.* The following is a summary of the material covered in the now consolidated NFPA 1850 standard. NFPA 1850 consists of what was NFPA 1851 and NFPA 1852. This overview focuses on what was NFPA 1851–specific material.~~

(1) ~~Chapters 1 – 3 contain material common to both standards.~~

(2) ~~Chapter 4 – 12 and Annexes A and E contain NFPA 1851–specific material.~~

(3) ~~Chapters 13 – 16 and Annexes A– E contain NFPA 1852–specific material.~~

~~General guidelines. The following is a summary of the material covered in the NFPA 1851–specific chapters of NFPA 1850:~~

(1) ~~Chapter 1 provides information about the scope and purpose of the document, and some basics about how to apply the standard.~~

(2) ~~Chapter 2 lists other publications referenced in the document.~~

(3) ~~Chapter 3 contains the glossary of terms used in the document.~~

(4) ~~Chapter 4 provides the framework for designing and implementing a structural and proximity firefighting PPE selection, care, and maintenance program.~~

(5) ~~Chapter 5 focuses on selecting PPE.~~

(6) ~~Chapter 6 lays out the requirements for completing a routine inspection, an advanced inspection, and a complete liner inspection.~~

(7) ~~Chapter 7 is all about cleaning and disinfection.~~

~~*New this edition.* The following topics are new to the 2025 edition of NFPA 1850:~~

(1) ~~Definition, role, and responsibilities of a PPE technician~~

(2) ~~More information on advanced cleaning~~

(3) ~~Updated cleaning efficiency requirements~~

(4) ~~Example risk assessment documents~~

~~*Program basics.* The following is the basic framework for designing and implementing a structural and proximity firefighting PPE selection, care, and maintenance program:~~

(1) ~~PPE is designed and manufactured to meet high performance and protection standards and it needs to be treated and handled appropriately to help ensure it can protect the person wearing it.~~

(2) ~~A successful program provides a strong foundation for informing everyone in the department how PPE should be handled and maintained.~~

(3) ~~The requirements in Chapters 4 – 12 are minimum requirements for the selection, care, and maintenance of structural and proximity firefighting protective clothing and equipment that are compliant with NFPA 1970 (1971) only.~~

(4) ~~A structural and proximity firefighting PPE selection, care, and maintenance program should contain documentation for clear expectations and procedures for all of the following to ensure equipment functions as designed and harm from improper selection, care, and maintenance is minimized:~~

  (5) ~~Records of all PPE~~

  (6) ~~Protection from contaminated PPE~~

  (7) ~~Selection of PPE~~

  (8) ~~Inspection of PPE~~

  (9) ~~Cleaning of PPE~~

  (10) ~~Repair of PPE~~

  (11) ~~Storage of PPE~~

  (12) ~~Retirement, disposition, and special incident procedures for all PPE~~

(13) ~~Specific operations included in NFPA 1850 that should be incorporated into a structural and proximity firefighting PPE selection, care, and maintenance program include the following:~~

  (14) ~~Routine inspections~~

  (15) ~~Preliminary exposure reduction (PER)~~

(16) ~~Advanced inspection~~

(17) ~~Complete liner inspection~~

(18) ~~Advanced cleaning~~

(19) ~~Sanitization or disinfection~~

(20) ~~Specialized cleaning~~

(21) ~~Basic repair~~

(22) ~~Advanced repair~~

(23) ~~Training for inspection~~

(24) ~~Training for cleaning~~

(25) ~~Training for repairs~~

~~*Implementing a program.* A department can implement a structural and proximity firefighting PPE selection, care, and maintenance program through one, or a combination of, the following providers defined in Chapter 3 (There is also a reference table in Chapter 4 .):~~

(1) ~~Manufacturer verified in cleaning~~

(2) ~~Verified ISP or verified organization~~

(3) ~~Verified cleaner~~

(4) ~~Manufacturer-trained organization~~

(5) ~~User~~

(6) ~~Ensemble manufacturer or ensemble element manufacturer (protective clothing and equipment manufacturer)~~

~~Each provider with "verified" in its title must pass third-party verification and have a certificate. That certificate lists the specifics for which that service provider is verified. Check Intertek and UL for websites to find verified ISPs to service gear.~~

~~*Record keeping.* Record keeping includes, at a minimum, the following:~~

(1) ~~The person to whom a PPE element has been issued~~

(2) ~~PPE elements that are not issued to a specific person~~

(3) ~~The date of issue and condition of the PPE when issued~~

(4) ~~The manufacturer and model name or design of the PPE~~

(5) ~~The PPE manufacturer's identification number, lot number, or serial number~~

(6) ~~The month and year of manufacture for the PPE~~

(7) ~~All dates of and findings related to advanced inspection(s)~~

(8) ~~All dates of and findings related to advanced cleaning, disinfection or sanitization, or specialized cleaning~~

(9) ~~All dates of repair(s), who performed the repair, and a brief description of the repair for all PPE~~

(10) ~~The date of retirement for the PPE~~

(11) ~~The date and method of disposal for the PPE~~

~~Records can be collected and stored either as hard copies or electronically, or both. Records~~

~~should be maintained until a PPE element is retired and disposed of. If resources permit, records should be kept for at least 12 months past retirement.~~

~~*Miscellaneous.* All manufacturer's instructions should be kept. If a manufacturer's instructions differ from the requirements in the standard (except as related to verification), the manufacturer's instructions should supersede all other instructions.~~

~~Chapter 4 is important because it provides clear direction for defining a structural and proximity firefighting PPE selection, care, and maintenance program, as well as additional information for the rest of Chapters 5 through 12 .~~

~~*Selecting gear.* Where a department is set to select gear, all of the following should be considered:~~

(1) ~~A risk assessment should be performed (tis standard includes multiple examples).~~

(2) ~~The types of incidents the department responds to.~~

(3) ~~The gear that can provide the most appropriate protection.~~

~~A risk assessment should include, but not be limited to, all of the following:~~

(1) ~~Type of duties performed~~

(2) ~~Incident types with related response activities identified~~

(3) ~~What the organization has experienced in the past~~

(4) ~~Incident operations~~

(5) ~~Local geographic and climate considerations~~

(6) ~~The specific physical area of operation~~

(7) ~~The likelihood of, or response to, a CBRN terrorism incident~~

(8) ~~The risks associated with not having access to two sets of gear~~

~~After the risk assessment is complete, take time to evaluate the strengths and weakness of all PPE elements under consideration, such as thermal insulation, thermal comfort, interface areas, and so on.~~

~~*Assessing gear.* The following guidelines should be used where evaluating gear in the filed:~~

(1) ~~Make sure that all gear to be tested fits the were as designed by the manufacturer.~~

(2) ~~Have a systematic (i.e., quantifiable) way to evaluate the performance of each PPE element tested, as follows:~~

  (3) ~~Use a combination of quantitative and qualitative mechanism for gathering feedback~~

  (4) ~~Use the same firefighters to evaluating different PPE elements, if possible~~

(5) ~~If a department can't run a field evaluation alone, team up with other local departments to run a joint field evaluation~~

~~Prior to any gear purchase, all purchase specifications should be detailed and include at least the following:~~

(1) ~~Be certified to NFPA 1970~~

(2) ~~Require substantiation of certification as part of the specification~~

(3) ~~Define proper fit in the specification~~

(4) ~~Comparison of each bid submittal against the specification~~

(5) ~~Include procedures for returning gear that isn't satisfactory or doesn't meet the specification~~

~~*Receiving gear.* Upon delivery, all gear should be inspected to confirm the following:~~

(1) ~~Does the gear meet the specification?~~

(2) ~~Was any gear damaged in shipment?~~

(3) ~~Are all sizes and quantities ordered accounted for?~~

(4) ~~Is all information such as use and maintenance instructions, warranty, and technical data included?~~

~~Any gear that is unsatisfactory or does not meet the specification should be returned per established procedures.~~

~~*Inspecting gear.* All PPE elements should be inspected for the following both prior to donning and after an incident:~~

(1) ~~Rips, tears, or holes~~

(2) ~~Charring, burns, melting, or discoloration~~

(3) ~~Chemical damage~~

(4) ~~Missing or damaged reflective trim~~

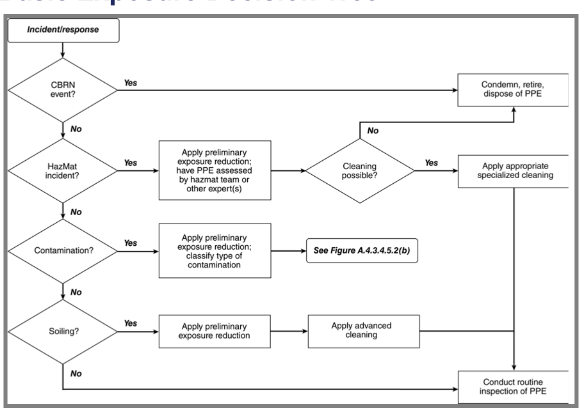
(5) ~~Correct assembly of shell, liner, and DRD~~

(6) ~~Missing hardware~~

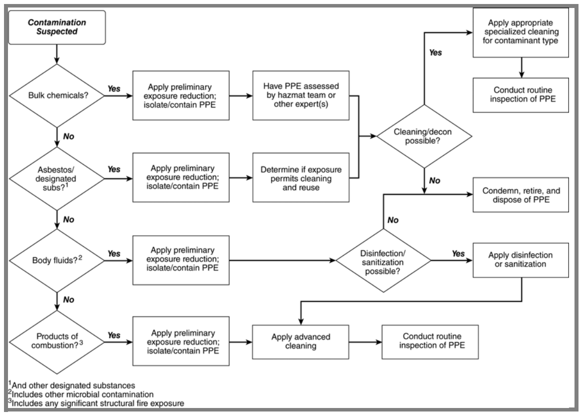
~~Any damaged or incomplete gear should be removed from service. Back-up gear should be utilized until damaged or incomplete gear is repaired by the original equipment manufacturer (OEM), a verified independent service provider (ISP), or verified department personnel to NFPA 1850 requirements or is replaced.~~

~~*Cleaning gear.* All gear should be cleaned as determined by Figure A.4.3.4.3.2(a) for exposure and Figure A.4.3.4.3.2(b) for contamination.~~

~~**Figure A.4.3.4.3.2(a) Basic Exposure Decision Tree.**~~



~~**Figure A.4.3.4.3.2(b) Contamination Decision Tree.**~~



~~*Cleaning gear.* Where gear needs to be cleaned, there are three levels of cleaning as follows:~~

(1) ~~Routine wash~~

(2) ~~Advanced (machine washing)~~

(3) ~~Specialzed (pretreat/soaking)~~

~~A routine wash can reduce preliminary exposure contaminants. However, advanced cleaning is most often necessary. The following precautions should be taken where advanced cleaning is needed:~~

(1) ~~Never use bleach~~

(2) ~~Water temperature should not exceed 40°C (105°F).~~

(3) ~~Extraction g-forces should not exceed 100.~~

(4) ~~Cleaning agent Ph should be between 6.0 and 10.5.~~

(5) ~~Liners should be washed separately, inside out.~~

(6) ~~Advanced cleaning should only be done twice per 12-month period.~~

~~Where advanced cleaning is needed, all of the following procedures should be implemented:~~

(1) ~~Separate outer shells from liners~~

(2) ~~Invert liners so quilt is facing the outside~~

(3) ~~Secure all closures (e.g., velcro, hook and dees, zippers)~~

(4) ~~DRD does not have to be removed if closures are secure~~

(5) ~~Machine wash outer shells with outer shells~~

(6) ~~Machie wash inner liners with inner liners~~

(7) ~~Hoods can be washed with liners~~

(8) ~~Air dry all elements~~

~~*Storing and retiring gear.* Where storing gear, care should be taken to protect all PPE elements from UV lighting. Gear should be transported in a plastic or gear bag. Gear should not be stored in air-tight bags.~~

~~PPE elements should be retired per the following considerations:~~

(1) ~~Structural fire firefighting and proximity ensemble elements should be retired and removed from service no more than 10 years from the date of manufacture.~~

(2) ~~Structural fire firefighting and proximity firefighting ensembles should be retired when they~~

~~are worn or damaged to the extent that they can no longer be repaired.~~

(3) ~~Recommendations for retirement can be made by an ISP; however, final determination should be made by a member of the organization who has been trained in the inspection and repair of ensembles.~~

(4) ~~Retired structural fire firefighting and proximity elements that have been retired should be destroyed in such a manner that prevents their use in firefighting or other emergencies.~~

(5) ~~Retired elements that are retired but still serviceable can be used for training provided the training does not involve live firefighting.~~

Statement of Problem and Substantiation for Public Comment

This annex item may need to be updated to mirror the Second Draft of the standard or deleted in its entirety. While this is useful and informative, a curriculum outline is included in the PPE Technician-related Public Comments and PPE Manager/Technician proposed annex.

Related Item

- FR-28

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Submittal Date: Thu May 30 16:19:30 EDT 2024

Committee: FAE-SPF

Public Comment No. 81-NFPA 1850-2024 [Section No. A.5.1.2(8)]

A.5.1.2(8)

~~While~~ A second or spare set of gear reduces a firefighter's extended exposure to products of combustion/contamination. And, while every department does not have the resources to purchase and manage a second set of PPE for every firefighter, there are other ways to accomplish the same goal. ~~A second or spare set of gear reduces a firefighter's extended exposure to products of combustion/contamination.For instance, identifying resources for rental gear during a risk assessment gives the department a better chance of being able to respond quickly when an incident happens that requires more gear than the department regularly has access to~~ Your risk assessment should help you quantify your specific needs related to spare gear and you can use that information to identify solutions that may work better for your department and community than providing a second set of gear for each member.

One way to access spare gear if your department doesn't have a regular need for it is to establish a relationship with a verified ISP or manufacturer with a rental gear program so that, in the event your department is faced with a once-in-a-career emergency (e.g. ~~,~~ the train derailment in East Palestine, Ohio), your organization has a documented, established source for accessing the gear you need without purchasing, storing, and maintaining a second set of gear for each member .

Another way to accomplish this is to identify the most common sizes of gear in your department and ~~purchasing a~~ purchase a sufficient number of sets or elements to cover the most people for a given risk.

Identifying resource requirements for incident response related to PPE during a risk assessment gives the department a better chance of being able to respond quickly when an incident happens that requires more gear than the department regularly has access to.

Statement of Problem and Substantiation for Public Comment

These changes provide more detail for the department to apply to their risk assessment related to spare gear.

Related Item

- Global FR-24

Submitter Information Verification

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Public Comment No. 22-NFPA 1850-2024 [Section No. A.5.1.5.1]

A.5.1.5.1

Tradeoffs exist between the levels of thermal insulation provided by garment composite materials and the ability of those materials to trap heat that potentially leads to heat stress of the firefighter. In NFPA 1971, incorporated in the 2024 edition of NFPA 1970, thermal protective performance (TPP) testing measures the amount of heat transfer through the clothing composite (i.e., the combination of the primary garment clothing layers — the outer shell, the moisture barrier, and the thermal barrier) when exposed to a combination of convective heat and thermal radiation. The exposure level is intended to simulate the heat energy associated with a flashover. The test uses a calorimeter to measure the time-to-burn. The reported TPP rating is this time-to-burn multiplied by the exposure energy (2.0 cal/cm^2/sec). It is important to recognize that TPP testing simulates only one condition among an unlimited set of clothing exposure conditions. However, the TPP test is the primary measurement for qualifying garment composite material for thermal insulation. The minimum TPP value specified by NFPA 1970 for garment composites is 35.0 cal/cm^2/sec. Higher values of TPP indicate composites offering greater thermal insulation.

A total heat loss (THL) test is used to measure how well garments allow body heat to escape. The test assesses the loss of heat, both by the evaporation of sweat and the conduction of heat through the garment layers. As clothing is made more insulative to high heat exposures, there is a tradeoff with how well the heat build-up in the firefighter's body (that can lead to heat stress) is alleviated. Differences in the weight and other characteristics of garment material composites, including the type of moisture barrier, will affect the transmission of sweat moisture, which carries much of the heat away from the body. If this heat is kept inside the ensemble, the firefighter's core temperature can rise to dangerous levels if other efforts are not undertaken (i.e., limiting time on scene, rotating firefighters, and providing rehabilitation at the scene). NFPA 1970 specifies that garment composites have a minimum THL of 205 W/m^2. Higher THL values indicate composites that provide greater heat loss. The validation and origin of this requirement is discussed in ASTM STP1386, *Field Evaluation of Protective Clothing Effects on Fire Fighter Physiology: Predictive Capability of Total Heat Loss Test*.

There are also limitations in the application of THL testing. Just as TPP testing only evaluates the base three-layer fabric system for thermal insulation, THL testing is a material test and does not evaluate the entire capability of the garment to dissipate heat. Areas of garments with additional layers such as trim, pockets, and reinforcements have less breathability. In contrast, these same areas of the garment have greater thermal insulation. The specifications of garment design must account for which areas of the garment need reinforcement and other materials and how these additional materials and reinforcements could contribute to stress.

Organizations should be aware that small differences in TPP and THL values might not represent significant differences that will translate into differences in field performance of garments. There is variation in the test results for both TPP and THL where values of ±3 cal/cm^2 in TPP and values of ±20 W/m^2 in THL might be due to variation in results produced by the materials rather than true differences in the garment composite materials.

In general, as garment material composite thickness increases, higher levels of thermal insulation (measured using TPP testing) are obtained. At the same time, thicker composites typically create more stress on the firefighter. By also examining the results of THL testing, organizations can choose to optimize the selection of their composites by balancing composite THL values with TPP values, while still meeting the minimum performance for both areas of performance. For TPP testing, thermal barriers usually have the greatest impact, but like THL, the TPP value for a composite is based on the contribution from each layer.

Other measurements can be introduced to characterize garment material composite thermal insulation or heat stress effects. For example, the evaporative resistance test (referred to as Ret), which is also performed on the three base layers, offers a means for measuring the ability of the garment composite to allow the heat associated with sweat evaporation to pass through the material. Like THL, this test is associated with demonstrating the breathability of the garment material composite. In this test, different environmental conditions provide a different way of ranking composite performance, although there are no established performance requirements for Ret within NFPA 1970. Specific research conducted ~~by North Carolina State University using a physiological manikin and reported by the Fire Industry Education Resource Organization (F.I.E.R.O.)~~ [Gao, Huipu, et al. "Relationship between heat loss indexes and physiological indicators of turnout-related heat strain in mild and hot environments." *International journal of occupational safety and ergonomics* 29.2 (2023): 562-572.] have shown that Ret provides discrimination of the composite materials' impact on wearer core temperature, skin temperature, and sweating rate with a higher correlation than THL over three different environmental conditions — hot, mild, and warm. This information means that Ret might provide a more reliable prediction and discrimination of the stress effects of different material composites on the protective clothing wearer as compared to THL. Unlike THL, the reported Ret measurement is a resistance having units of Pa m^2/W where lower values are associated with more breathable material composites.

Organizations should be aware that the measurements of garment material composite thermal insulation and heat stress effects are performed on the principal three-layer composite used in the construction of the garment and do not account for other layers that might be on the garment such as trim, pockets, outer shell reinforcements, and liner reinforcements. While necessary to meet the requirements of the standard and assist firefighters in performing their duties, these additional layers increase overall thermal insulation and decrease breathability, resulting in potentially higher heat stress effects. Consequently, when deciding on the target levels of composite thermal insulation and breathability (i.e., total heat loss or evaporative resistance), organizations should take into account the garment design and how both thermal insulation and heat stress effects will be affected by both mandatory (e.g., trim, shoulder reinforcements, knee reinforcements) and optional (e.g., pockets) garment design features. Results for the investigation of these effects is provided in "The Cost of a Pocket: The Impact of Reinforcements on the TPP and THL."

Additional Proposed Changes

File Name	Description	Approved
Relationship_between_heat_loss_indexes_and_physiological_indicators_of_turnout-related_heat_strain_in_mild_and_hot_environments_THL_RET_Gao_et_al._2023.pdf	THL v. Ret	

Statement of Problem and Substantiation for Public Comment

If referencing the justification for the use of Ret over THL is necessary within the Annex, it is most appropriate to cite the scientific literature as opposed to only the institution and licensed commercial entity that was involved in it. This provides objectivity and it serves to provide the reader of the Standard source documents to review and reference.

Related Item

- n/a

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Committee: FAE-SPF

Public Comment No. 23-NFPA 1850-2024 [Section No. A.7.3.9.1(4)]

A.7.3.9.1(4)

At the time this edition was prepared, the technical committee recognized that, depending on the contaminant, the wash temperature maximum of 40°C (105°F) might not be the most effective temperature for cleaning those ensemble elements that can be subjected to higher wash temperatures in washer/extractors. ~~However, even with this recognition, the technical committee was reluctant to increase the maximum~~ As such, a increase wash temperature for advanced cleaning ~~because it will occur more frequently than specialized cleaning or disinfection or sanitization and, to date, only limited testing has been done on the effects of multiple washings at 60°C (140°F) on garment ensembles and ensemble elements. Based on this work, there is a tradeoff between increasing the wash temperature for purposes of contaminant removal and the impact of the increased wash temperature for adversely affecting the performance properties of ensemble elements.~~ is justified via the improvement in laundering efficacy to 49°C (120°F).

Effects of Increasing Wash Temperature for Removal of Contaminants. Firefighter protective ensembles and ensemble elements might be contaminated with soot and chemicals such as polynuclear aromatic hydrocarbons (PAHs), phenols, phthalates, hydrocarbons, heavy metals, and other hazardous materials during fire responses, various chemical compounds from hazmat responses, and microorganisms during medical responses or biohazard responses. Appropriate removal of these contaminants is necessary both for protecting the health of the firefighter and for ensuring that the gear performance is not compromised. To assess appropriate turnout cleaning parameters, specifically wash temperature, it is useful to consider the cleaning recommendations for garments used in agricultural and health care applications because such applications involve hazardous materials to which ensembles and ensemble elements might also be exposed: pesticides and infectious agents.

Extensive research has been performed to examine the effectiveness of different laundering procedures in removing pesticides. This information is relevant to firefighter ensembles and ensemble elements because pesticide chemicals have a range of properties that are similar to fireground chemicals in terms of low volatility and often low water solubility. Research from several sources has shown that higher wash temperatures of up to 60°C (140°F) have greater efficacy at removing pesticide contamination, as reported in the following references:

(1) Thostenson, A., et al. “Laundering Pesticide-contaminated Work Clothes (PS1778).” North Dakota State University Extension Service, January 2016.

www.ag.ndsu.edu/publications/crops/laundering-pesticide-contaminated-work-clothes/ps1778.pdf.

(2) Laughlin, J. “Decontaminating Pesticide Protective Clothing. *Reviews of Environmental Contamination and Toxicology* 130 (1993): 79–94. Springer, New York, NY.

https://doi.org/10.1007/978-1-4613-9763-2_3.

(3) Easley, C. B., J. Laughlin, and R. Gold. “Laundering Pesticide Contaminated Clothing.” Cornell University Cooperative Extension, Pesticide Safety Education Program (PSEP).

psep.cce.cornell.edu/facts-slides-self/facts/gen-posaf-laund.aspx.

As a consequence of these findings, various organizations recommend the use of hot water at 60°C (140°F) as well as other laundering procedures for the optimum removal of pesticides from work clothing.

Similarly, a number of studies have addressed the efficacy of increased water temperatures in killing bacteria and other microorganism contaminants in hospital laundry. As a consequence of this research, the Centers for Disease Control (CDC) and the Healthcare Infection Control Practices Advisory Committee (HICPAC) have recommended the use of specific laundering practices that include even higher temperatures at 71°C (160°F) in combination with bleach. (Note: This practice is not appropriate for firefighter protective ensembles and ensemble elements).

Clearly, high wash temperatures provide greater effectiveness in addressing many forms of contamination, but the use of higher temperatures must be weighed against its potential effects on the performance properties and continued service life of ensemble and ensemble elements.

Impact of Higher Wash Temperatures on Ensemble Element Materials and Components. To investigate the potential of applying higher wash temperatures, the technical committee conducted several laundering trials on unused materials, components, and full clothing both at 40°C (105°F) and at 60°C (140°F) to compare the overall impact of multiple launderings (60 cycles) at these temperatures. Multiple samples at several different facilities were subjected to conventional laundering procedures using both wash temperatures, with comprehensive inspections and assessment of certain performance properties after 20, 40, and 60 cycles of laundering. The preliminary findings of this work shows that components can be adversely affected by increased wash temperature and the increased cycles of laundering. Higher wash temperatures and multiple launderings created loss of certain performance properties for the actual material layers, and particular durability concerns were noted. ~~At the time this work was conducted, it was not possible to fully conclude that safety issues would arise for protection of firefighters; however, garment elements laundered multiple times and at the higher wash temperature would clearly require more frequent repair and replacement of components~~ <u>However, a laundering temperature increase from 40°C (105°F) to 49°C (120°F) for advanced cleaning is supported and justified by the increased removal of contaminants over laundering at 40°C (105°F)</u> .

Specific Considerations for Frequent Advanced Cleaning, Sanitization, and Specialized Cleaning. Organizations are cautioned to be aware of the tradeoffs that exist for increased laundering at higher wash temperatures. Higher wash temperatures are likely to be more effective in removing many contaminants but will also likely reduce the service life of or increase the number of repairs to garment elements and other ensemble elements. Increased cleaning creates additional wear and tear on garments, but, if handled properly and coupled with frequent inspections, ensemble element service can be optimized for both effective cleaning and retention of performance properties.

Statement of Problem and Substantiation for Public Comment

Suggested revisions are in line with Technical Committee consensus, and the improvements to laundering efficacy at increased advanced cleaning wash temperatures.

<u>Related Item</u>

- n/a

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Committee:	FAE-SPF

Public Comment No. 24-NFPA 1850-2024 [Section No. A.10.3.1]

A.10.3.1

When developing these procedures, the organization should coordinate with other agencies such as the medical examiner, law enforcement, or other experts to determine what actions are appropriate. Organizations can find additional guidance related to the processing of structural ensembles and ensemble elements and proximity ensembles and ensemble elements that are directly related to serious firefighter injuries and firefighter fatalities in the International Association of Fire Fighters manual, *Line of Duty Notification, Assistance, and Investigation Policy*, available at ~~www~~ _ h ttps://lodd .iaff.org~~/safe/lodd.html~~ , and the International Association of Fire Chiefs guide for investigating a line-of-duty death, “LODD Response Plan,” available at www.iafc.org.

Statement of Problem and Substantiation for Public Comment

Editorial.

Related Item

- n/a

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Public Comment No. 80-NFPA 1850-2024 [Section No. D.1]

D.1 General.

In the risk assessment, the organization should consider how frequently members are responding to the following types of responses and specific PPE to be evaluated for each:

(1) Fire Suppression

(2) Proximity

(3) Bulk fuel storage

(4) Bulk fuel transport

(5) Structural

(6) Vehicle

(7) Electrical, including, but not limited to, the following:

 (8) Mobile or stationary energy storage systems (including Lithium Ion batteries)

 (9) Rescue

 (10) Structural

 (11) Vehicle accident

 (12) Confined space

 (13) Collapse

 (14) High angle

 (15) Trench

 (16) Water

 (17) Chemical biological radiation nuclear (CBRN)

(18) Emergency medical response, including, but not limited to, the following:

 (19) CPR

 (20) Childbirth

 (21) Chest pain

 (22) Trauma

 (23) Behavioral health

 (24) Seizure

 (25) Stroke

 (26) Hyperthermia

 (27) Allergic reaction

 (28) Respiratory distress

 (29) Loss of consciousness

 (30) Overdose/poisoning

When evaluating PPE, the organization should b alance trade-offs between performance, durability, and chemical content (e.g. PFAS finishes). NFPA 1970 has requirements related to a whole host of restricted substances and it is important to consider the risk of exposure from PPE and the risk of injury the performance requirements in NFPA 1970 are attempting to minimize when evaluating gear. It is also important to consider the impact gear selection may have on fire response strategy and tactics.

Statement of Problem and Substantiation for Public Comment

With increased risks and exposures to Li-Ion battery and MOSESS fires, the decision tree and requirements should be updated to help the fire service easily determine next steps after exposure.

Related Item

- Global FR-24

Submitter Information Verification

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Public Comment No. 78-NFPA 1850-2024 [Section No. D.4]

D.4 Thermal Hazards.

The NFPA develops minimum standards for PPE. The NFPA recognized that not all departments require the same level of protection for reasons such as the following:

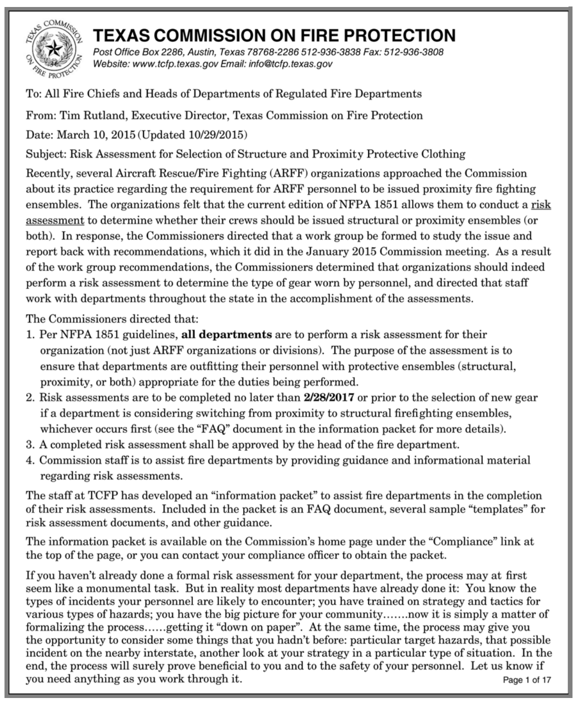
(1) *Operational/training standards.* Interior attack operations requiring a higher level of protection (TPP) to ensure firefighter safety. It is sometimes impossible during interior firefighting operations to move away from a heat source.

(2) *Response times.* Response times are critical when determining the protection values of PPE. Response times might allow for interior attack during incipient and free-burning fires. These conditions mandate PPE that is capable of protecting firefighters during flashover conditions or high radiant heat conditions.

(3) *Reasonable maximum exposure.* The combination of response times, building construction, contents normally found in structures, training standards and standard operating procedures identify flashover conditions or direct flame impingement for short periods of time as the reasonable maximum exposure.

See Figure D.4(a) through Figure D.4(~~c~~ d) for examples of risk assessments.

Figure D.4(a) Texas Commission on Fire Protection Risk Assessment for Selection of Structure and Proximity Protective Clothing.



TEXAS COMMISSION ON FIRE PROTECTION
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To: All Fire Chiefs and Heads of Departments of Regulated Fire Departments

From: Tim Rutland, Executive Director, Texas Commission on Fire Protection

Date: March 10, 2015 (Updated 10/29/2015)

Subject: Risk Assessment for Selection of Structure and Proximity Protective Clothing

Recently, several Aircraft Rescue/Fire Fighting (ARFF) organizations approached the Commission about its practice regarding the requirement for ARFF personnel to be issued proximity fire fighting ensembles. The organizations felt that the current edition of NFPA 1851 allows them to conduct a risk assessment to determine whether their crews should be issued structural or proximity ensembles (or both). In response, the Commissioners directed that a work group be formed to study the issue and report back with recommendations, which it did in the January 2015 Commission meeting. As a result of the work group recommendations, the Commissioners determined that organizations should indeed perform a risk assessment to determine the type of gear worn by personnel, and directed that staff work with departments throughout the state in the accomplishment of the assessments.

The Commissioners directed that:

1. Per NFPA 1851 guidelines, **all departments** are to perform a risk assessment for their organization (not just ARFF organizations or divisions). The purpose of the assessment is to ensure that departments are outfitting their personnel with protective ensembles (structural, proximity, or both) appropriate for the duties being performed.
2. Risk assessments are to be completed no later than **2/28/2017** or prior to the selection of new gear if a department is considering switching from proximity to structural firefighting ensembles, whichever occurs first (see the “FAQ” document in the information packet for more details).
3. A completed risk assessment shall be approved by the head of the fire department.
4. Commission staff is to assist fire departments by providing guidance and informational material regarding risk assessments.

The staff at TCFP has developed an “information packet” to assist fire departments in the completion of their risk assessments. Included in the packet is an FAQ document, several sample “templates” for risk assessment documents, and other guidance.

The information packet is available on the Commission’s home page under the “Compliance” link at the top of the page, or you can contact your compliance officer to obtain the packet.

If you haven’t already done a formal risk assessment for your department, the process may at first seem like a monumental task. But in reality most departments have already done it: You know the types of incidents your personnel are likely to encounter; you have trained on strategy and tactics for various types of hazards; you have the big picture for your community…….now it is simply a matter of formalizing the process……getting it “down on paper”. At the same time, the process may give you the opportunity to consider some things that you hadn’t before: particular target hazards, that possible incident on the nearby interstate, another look at your strategy in a particular type of situation. In the end, the process will surely prove beneficial to you and to the safety of your personnel. Let us know if you need anything as you work through it.

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FREQUENTLY ASKED QUESTIONS

You can expect to hear the buzzword "Risk Assessment" more and more when new personal protective equipment (PPE) purchases are involved.

WHY IS A RISK ASSESSMENT IMPORTANT?

1. A risk assessment enables the fire department to identify and assess all the specific risks (dangers) involved in the duties performed by fire fighters and can therefore properly specify and outfit fire fighters with the appropriate PPE.
2. A risk assessment is a document that justifies why the fire department is specifying particular PPE. The justification derived from the risk assessment is supported by facts and data.
3. A regulated fire department is required by Texas Commission on Fire Protection (TCFP), because it is in NFPA 1851, to conduct a risk assessment. TCFP Compliance Officers are required to inspect and confirm that a risk assessment has been completed by fire departments on a least a biennial schedule.

WHAT IS A RISK ASSESSMENT?

A risk assessment may be considered the identification, evaluation and estimation of the levels of risk involved in a situation, their comparisons against benchmarks and past experience, then determining an acceptable level of risk. A risk assessment is created by a fire department as described in NFPA 1851, *Standard on the Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting* (see Chapter 5, Subsection 5.1, 5.1.1, and 5.1.2). A risk assessment is completed in accordance with TCFP regulations (see Texas Government Code §419.027 – Biennial Inspections and §419.040 (c) – Standard Operating Procedure and Texas Administrative Code §435.1 – Protective Clothing). The purpose of the risk assessment is to ensure that regulated fire departments have fully assessed the risks associated with the duties assigned to the fire fighter and has provided to the fire fighters the PPE suitable for the tasks the individual is expected to perform.

Chapter 5 of NFPA 1851, 2014, states that a risk assessment must be performed, including the following considerations written in section 5.1.2:

- Types of duties performed
- Frequency of use of ensemble elements
- Organization's experiences
- Incident operations
- Geographic location and climate
- Specific physical area of operation
- Likelihood of Chemical, Biological, Radiological and Nuclear (CBRN) terrorist incident

Completing a risk assessment can be done in a few ways. A risk assessment can be a brief document or it can be detailed and long depending on how much information and data is included. An outline is always a good place to start and for the most part this has already been done in Chapter 5 of the NFPA 1851 standard. From here, fire departments can do everything on their own or they can look at sample risk assessments provided by TCFP or done by neighboring departments or large metro departments. Professional safety consultants are also resources that help complete risk assessments.

The key is to do a risk assessment. By doinga risk assessment, the department may uncover previously unknown risks to its firefighters and it should result in a more rigorous and objective determination of theperformance requirements of the PPE being selected for purchase bythe fire department. The risk assessment will help reduce liabilities to the department and those involved in specifying PPE if an accident, injury or line of duty death occurs.

WHAT IS A RISK?

Risk is the chance, high or low, of someone or something being harmed by a hazard and how serious the harm could be.

WHAT IS A HAZARD?

A hazard may be considered anything that could cause harm that may be encountered at the scene of an emergency incident.

WHEN DO I HAVE TO COMPLETE THE RISK ASSESSMENT?

The risk assessment must be performed either (1) prior to the selection of new structural and/or proximity fire fighting ensembles or (2) no later than February 28, 2017, whichever occurs first.

Prior to February 28, 2017:

- Completion of the risk assessment is necessary for purchase of ensembles if a department is considering switching from proximity to structural
- Completion of the risk assessment is not necessary when individual PPE ensemble elements are being replaced (ex: gloves, helmets, etc.).

WHAT SHOULD I INCLUDE IN MY RISK ASSESSMENT?

At a minimum you should include the elements listed in Chapter 5.1.2 of NFPA 1851, 2014 Edition.

Is there a template that I can follow to do my risk assessment?

Yes, there are suggested but *not required* templates located in the information packet and under the compliance tab on the TCFP website.

IS THE RISK ASSESSMENT A LEGAL REQUIREMENT?

Yes, the risk assessment is required by the adoption of the NFPA standard in Texas Government Code §419.040 (b) and in Texas Administrative Code §435.1(2).

WHO IS RESPONSIBLE FOR APPROVING THE RISK ASSESSMENT FOR THE FIRE DEPARTMENT?

The Head of Department is responsible for approving the department's risk assessment.

DO I NEED TO USE A CONSULTANT?

No. Use of a consultant is at the discretion of Head of Department.

WHO DO I INVOLVE IN A RISK ASSESSMENT?

A Head of Department has the discretion to involve anyone necessary to complete the risk assessment.

DO I NEED TO SIGN MY RISK ASSESSMENT?

Although a signature is not necessary on the document, the fire department must be able to verify that the risk assessment has been approved by the Head of Department.

HOW LONG DO I NEED TO KEEP MY RISK ASSESSMENT?

The risk assessment shall be kept indefinitely and updated and revised when necessary.

DOES THE TCFP CONDUCT RISK ASSESSMENT FOR REGULATED AGENCIES?

No. The TCFP does not conduct risk assessments for agencies.

WHAT IS MY COMPLIANCE OFFICER'S ROLE WITH THE RISK ASSESSMENT?

The Compliance Officer will verify that your agency is in compliance with the risk assessment requirements by reviewing the department's appropriate standard operating procedure and the reviewing the risk assessment as needed.

HOW AND WHERE SHOULD THE RISK ASSESSMENT BE REFLECTED IN MY DEPARTMENT'S SOP'S?

- Per Texas Administrative Code §435.1(3), regulated fire departments are to maintain an SOP regarding the use, selection, care, and maintenance of protective clothing worn by fire fighting personnel. The purpose of the risk assessment is to justify the department's decisions regarding the selection of protective clothing for its personnel, and should be reflected in this SOP.

- Texas Administrative Code, §435.15 also requires departments to develop, maintain, and use an SOP for personnel operating at emergency incidents, and the SOP is to include a limitation on operations that can be safely performed by personnel. The risk assessment will also assist the department in making decisions regarding operational limitations, particularly in light of the protective clothing being worn by personnel, and should again be reflected in this SOP.

- Texas Administrative Code, §435.11 calls for the development, maintenance, and use of an incident management system by all departments. The adopted system will, in addition to other requirements, require operations to be conducted in a manner that recognizes hazards and assists in the prevention of accidents and injuries. The risk assessment will certainly aid the department in reviewing its incident management system, and making revisions as necessary.

RISK ASSESSMENT - SELECTION OF STRUCTURAL AND PROXIMITY PROTECTIVE CLOTHING HOW IT WORKS

AUDIENCE:

The Fire Chief or Head of Department of all TCFP regulated fire departments.

OBJECTIVE:

Regulated fire departments must comply with:

1. Texas Government Code §419.027 – Biennial Inspections
2. Texas Government Code §419.040 (c) – SOP pertaining to the proper use, selection, care, and maintenance of all of its protective clothing.
3. Texas Government Code §419.044 – SOP pertaining to conducting operations in a manner that recognizes hazards and prevents accidents and injuries.
4. Texas Government Code §419.046 – SOP pertaining to proper training and use of SOPs for personnel operating at emergency incidents.
5. Texas Administrative Code §435.1 – Protective Clothing
6. NFPA 1851 (2014) – Chapter 5 Selection, 5.1.1 & 5.1.2 Risk Assessment

REQUIREMENT:

1. Fire departments shall purchase, provide and maintain protective clothing for all fire protection personnel.
2. Fire departments shall ensure that protective clothing used by fire protection personnel assigned to fire suppression duties comply with the adopted NFPA standards.
3. Fire departments shall maintain and provide upon request an SOP that complies with the NFPA standard for the selection, care, and maintenance of structural and proximity protective clothing, an SOP that complies with conducting operations that recognize hazards and prevent accidents, and injuries, and a SOP that complies with proper training and use of SOPs with conducting operations.
4. Prior to the selection of structural firefighting ensembles in lieu of proximity gear and not later than February 28, 2017 fire departments shall perform a risk assessment compliant with NFPA 1851.

PLAN:

Fire departments with personnel assigned to fire suppression duties shall perform a risk assessmentprior to the selection of either structural or proximity fire fighting ensembles. Fire departments shall develop and maintain an SOP pertaining tothe proper use, selection, care and maintenance of all of its protective clothing, an SOP that pertains to conducting operations in a manner that recognizes hazards and prevents accidents and injuries, and an SOP pertaining to proper training and use of SOPs for personnel operating at emergency incidents.The SOPs shall utilize the risk assessment for determining which specific fire fighting ensembles are selected. To ensure departments meet these minimum requirements TCFP conducts biennial inspections of all regulated departments.

HOW IT WORKS:

Upon receiving a biennialCompliance Inspectionor other inspection as permitted by statute, a fire department shall make available to the inspector the required SOPs. The inspector will review the SOP to ensure it confirmsthe risk assessment was utilized by the department to justify the selection of the particular protective ensemble.
The inspector may request to review the risk assessment to ensure compliance with NFPA 1851.

RESULTS:

Fire departments reduce the health and safety risks of their fire protection personnel by conducting the risk assessment to determine the best protective ensemble for the fire fighting duties they perform. By developing and maintaining standard operating procedures in compliance with TCFP inspection requirements, fire departments ensure that all the fire protection personnel in the department follow the minimum safety standards adopted by state law. By meeting these objectives all regulated fire departments will assist TCFP compliance officers to consistently and expeditiously conduct fair and objective inspections to support the safety of fire protection personnel in Texas.

NEXT STEPS:

All regulated fire departments shall conduct the risk assessment and update the SOPs with the results as relates to the selection of new structural and proximity fire fighting ensembles not later than February 28, 2017.

PPE RISK ASSESSMENT TEMPLATE #1

❑ **TYPE OF DUTIES PERFORMED:**
- Standard Structural Fire Fighting Duties
- Non-Standard Fire Fighting Duties (Proximity or Entry Type Duties)

Type of PPE Needed: Structural-Yes or No Proximity-Yes or No

❑ **FREQUENCY OF USE OF ENSEMBLE ELEMENTS:**
- Low Frequency Use (Standard Replacement Cycle)
- Moderate Frequency Use (Moderate Replacement Cycle)
- High Frequency Use (More Frequent Replacement Cycle Required)

Type of PPE Needed: Structural-Yes or No Proximity-Yes or No

❑ **ORGANIZATION'S EXPERIENCES:**
PPE Performance at Incidents: Example: structural fires, aircraft crash fires, flammable liquid fires, brush or grass fires.
- Does Not Meet Department Needs - Frequent PPE Failure
- Meets Department Needs - Infrequent PPE Failure
- Exceeds Department Needs - No PPE Failure

Type of PPE Needed: Structural-Yes or No Proximity-Yes or No

❑ **INCIDENT OPERATIONS:**
- Basic Structural
- Wildland
- EMS
- Proximity/Entry

Type of PPE Needed: Structural-Yes or No Proximity-Yes or No

❑ **GEOGRAPHIC LOCATION AND CLIMATE:**
- High Heat/ High Humidity * High Heat/Low Humidity
- Moderate Heat/High Humidity *Moderate Heat/Low Humidity
- High Cold/Low Humidity *High Cold/High Humidity

Type of PPE Needed: Structural-Yes or No Proximity-Yes or No

❑ **SPECIFIC PHYSICAL AREA OF OPERATION:**
- Exterior Operations
- Interior Operations
- Proximity/Entry Operations

Type of PPE Needed: Structural-Yes or No Proximity-Yes or No

❑ **LIKELIHOOD OF OR RESPONSE TO CBRN TERRORISM INCIDENT:**
- High
- Moderate
- Low

Type of PPE Needed: Structural-Yes or No Proximity-Yes or No

❑ **CIRCLE PPE DETERMINED FROM ASSESSMENT**
- NFPA 1971 Current Edition Structural Compliant PPE Determined
- NFPA 1971Current Edition Proximity Compliant PPE Determined

❑ NFPA 1971, have been reviewed before purchase of protective clothing. All protective clothing issued to members of the________ FD shall be compliant with the minimum standards found in NFPA 1971.

❑ All ensemble elements considered for purchase have been evaluated for comparative strengths and weaknesses. The interface of all ensemble elements and equipment utilized by the department are considered for proper fit and function.

PPE RISK ASSESSMENT TEMPLATE #2

Type of duties performed ▪ Standard Structural Fire Fighting Duties ▪ Non-Standard Firefighting Duties (Proximity or Entry Type Duties) **Type of PPE Needed:** Structural-Yes or No Proximity-Yes or No	**Specific physical area of operation:** ▪ Exterior Operations ▪ Interior Operations ▪ Proximity/Entry Operations **Type of PPE Needed:** Structural-Yes or No Proximity-Yes or No	**Organization's experiences:** PPE performance at structural fires. ▪ Frequent PPE Failure ▪ Infrequent PPE Failure ▪ No PPE Failure PPE performance at aircraft crash fires. ▪ Frequent PPE Failure ▪ Infrequent PPE Failure ▪ No PPE Failure PPE performance at flammable liquid fires. ▪ Frequent PPE Failure ▪ Infrequent PPE Failure ▪ No PPE Failure PPE performance at brush / grass fires. ▪ Frequent PPE Failure ▪ Infrequent PPE Failure ▪ No PPE Failure Other type incident experiences. **Type of PPE Needed:** Structural-Yes or No Proximity-Yes or No
Incident Operations: ▪ Basic Structural ▪ Wildland ▪ EMS ▪ Proximity/Entry **Type of PPE Needed:** Structural-Yes or No Proximity-Yes or No	**Geographic location and climate:** ▪ High Heat/ High Humidity ▪ High Heat/Low Humidity ▪ Moderate Heat/High Humidity ▪ Moderate Heat/Low Humidity ▪ High Cold/Low Humidity ▪ High Cold/High Humidity **Type of PPE Needed:** Structural-Yes or No Proximity-Yes or No	**Likelihood of or response to CBRN terrorism incident:** ▪ High ▪ Moderate ▪ Low **Type of PPE Needed:** Structural-Yes or No Proximity-Yes or No
Frequency of use of ensemble elements: ▪ Low Frequency Use (Standard Replacement Cycle) ▪ Moderate Frequency Use (Moderate Replacement Cycle) ▪ High Frequency Use (More Frequent Replacement Cycle Required) **Type of PPE Needed:** Structural-Yes or No Proximity-Yes or No	**Circle PPE Determined from Assessment** ○ NFPA 1971 Current Edition Structural Compliant PPE Determined ○ NFPA 1971 Current Edition Proximity Compliant PPE Determined	**Additional Comments/Considerations:**

NFPA 1971 has been reviewed before purchase of protective clothing. All protective clothing issued to members of the _______________ FD shall be compliant with the minimum standards found in NFPA 1971.

All ensemble elements considered for purchase have been evaluated for comparative strengths and weaknesses.
The interface of all ensemble elements and equipment utilized by the department are considered for proper fit and function.

PPE RISK ASSESSMENT TEMPLATE #3

Texas Commission on Fire Protection
Information on:
NFPA 1851 *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting* Chapter 5 Selection
Relating to:
Required Risk Assessment and Related Standard Operating Procedure

The following is an example of a PPE risk assessment. It should be noted that this is only an example and not a TCFP mandated format or text, and is for review/example purposes only.

A portion of this example was developed with the use of the following text, which is not mandated by TCFP:

Fred A. Manuele (2008) *Advanced Safety Management.* John Wiley and Sons inc. Hoboken, New Jersey.

The following information is provided to assist in developing a risk assessment in relation to the selection of personal protective equipment in compliance with NFPA 1851, 2014 edition and TAC §435.1.

SELECTION AND PURCHASE

Prior to starting the selection process of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements, the organization shall perform a risk assessment.

The risk assessment shall include, but not be limited to, the hazards that can be encountered by structural or proximity fire fighters based on the following:

(1) Type of duties performed

(2) Frequency of use of ensemble elements

(3) Organization's experiences

(4) Incident operations

(5) Geographic location and climate

(6) Specific physical area of operation

(7) Likelihood of or response to CBRN terrorism incident

PPE RISK ASSESSMENT TEMPLATE

TYPES OF DUTIES PERFORMED:

STRUCTURAL FIRE FIGHTING

- Lay and connect hose lines
- Apparatus operation
- Direct nozzles-direct hose stream
- Carry, place, and climb ladders
- Fire pump operation
- Ventilation of structure
- Salvage and overhaul
- Search and rescue
- Forcible entry

AIRCRAFT RESCUE FIRE FIGHTING

- Lay and connect hose lines
- Apparatus operation
- Direct nozzles-direct hose stream
- Carry, place, and climb ladders
- Fire pump operation
- Ventilation of structure
- Salvage and overhaul
- Search and rescue
- Forcible entry
- Flammable liquids fire attack

SPECIALTY RESCUE

- Mitigate hazardous materials emergency
- Motor vehicle extrication/stabilization
- EMS
- High angle rescue
- Trench rescue
- Confined space rescue
- Collapse stabilization/Rescue

PPE RISK ASSESSMENT TEMPLATE

FREQUENCY OF USE OF ENSEMBLE ELEMENTS

- Number of and type of fire incidents
- Number of and type of rescue/EMS calls
- Total # of calls
- Percentage of Fire Calls
- Percentage of non-fire calls

ORGANIZATION'S EXPERIENCES

Determine the department's needs by identifying the type of fires the organization has experienced. For example: structural fires, aircraft crash fires, flammable liquid fires, brush or grass fires, rescue, hazardous materials, etc. Use qualifiers or quantifiers if it helps. For example, you may assign a qualifier to each ensemble element such as: 1) Meets Department Needs, 2) Does Not Meet Department Needs, 3) Exceeds Department Needs, or use: 1) Frequent PPE Failure, 2) Infrequent PPE Failure or 3) No PPE Failure. You can also rate the department's current elements in use on a 1-5 scale with 1= Completely Satisfied and 5= Completely Dissatisfied:

STRUCTURE

- Structural Helmets
- Protective Hoods
- Coat/trouser outer shell
- Coat/trouser moisture barrier
- Coat/trouser thermal liner
- Structural gloves
- Structural boots

ARFF

- Proximity Helmets
- Protective Hoods
- Proximity Coat/trouser outer shell
- Proximity Coat/trouser moisture barrier
- Proximity Coat/trouser thermal liner
- Proximity gloves
- Proximity boots

PPE RISK ASSESSMENT TEMPLATE

INCIDENT OPERATIONS

Check the appropriate boxes noting which of the incident operations below are performed by your department:

FIRE FIGHTING

- ○ Interior fire attack
- ○ Exterior fire attack
- ○ Transitional fire attack
- ○ Vertical fire attack
- ○ Horizontal ventilation
- ○ Primary and secondary search
- ○ Salvage and overhaul
- ○ Flammable liquids fires

RESCUE/EMS

- ○ Extrication with hydraulic/power tools
- ○ Provide BLS/ALS treatment
- ○ Urban search and rescue
- ○ Trench rescue
- ○ High angle rescue
- ○ Confined space rescue
- ○ Hazardous materials

RISK ASSESSMENT FORMULA:

R=L x S

- R= risk being measured
- L= likelihood of a firefighter being exposed to the hazard
- S= Severity/Consequences to the firefighter exposed to the hazard

	Risk	Assessment	Value of "L" and "S"
Value	**Likelihood**	**Severity**	**Consequence**
0	Never	None	None
1	Exceptional	Low	Minor Injury
2	Occasional	Moderate	Major Injury
3	Very Likely	High	Life Threatening
4	Always	Extreme	Death

"0" should only be allowed where there is absolutely NO chance of the hazard being encountered. Use formula values listed above to complete the "Hazard/Risk Formula Calculations" table below:

PPE RISK ASSESSMENT TEMPLATE

HAZARD RISK FORMULA CALCULATIONS

Hazard Origin and Type	**Likelihood** Of firefighter being exposed to hazard	**Severity** Consequences to firefighter if exposed to hazard	**Risk** (Total of L × % of fire related calls)	**Control Measures**
THERMAL HAZARDS				
Convective Heat				**High TPP**
Radiant Heat				**High TPP**
Flame				**High TPP**
Contact Heat				**High LOI**
Molten Metal				**High TPP**
Burning Embers				**High LOI**
Conductive Heat				**High LOI**
Flashover				**High TPP**
ELECTRICAL HAZARDS				
Electrical Arch				High TPP
Static Electricity				Anti Static Fiber
ENVIRONMENTAL HAZARDS				
Ambient Cold				Winter liner
Ambient Hot				High THL
Cold Surfaces				Fire/Ice sole
Air Velocity Mechanical				IH Pant/Harness
Air Velocity Wind				IH Pant/Harness
MECHANICAL HAZARDS				
Penetration				High Burst Strength
Cut				High Tear Resistance
Abrasion				High Taber Value
NON-VISIBILITY HAZARDS				
Not Being Seen				Type and Amount of Trim
BIOLOGICAL/CHEMICAL HAZARDS				
Liquid				CBRN
Gas				CBRN
Biological Toxins				CBRN
Biological Allergens				CBRN
Airborne Pathogens				CBRN
PHYSIOLOGICAL HEAT STRESS				
Physiological Heat Stress				High THL

PPE RISK ASSESSMENT TEMPLATE

DEFINITIONS:

TPP-Thermal Protection Performance A test method for measuring thermal protection was introduced and a minimum thermal protective performance (TPP) rating was established. This test method replaced the requirement for a minimum composite thickness, and its purpose is to measure the rate at which convective and radiant heat penetrates through the composite system – outer shell, thermal liner, and moisture barrier – to cause second degree burn to the human skin.

LOI- Limiting Oxygen Index- Flame resistance is commonly measured by LOI, the amount of oxygen needed to support combustion. The higher the LOI value, the more flame resistant the material will be.

High THL-Total Heat Loss - The total heat loss test is used to measure how well garments allow body heat to escape. The test assesses the loss of heat both by the evaporation of sweat and the conduction of heat through the garment layers. As clothing is made more insulating it will be to high heat exposure (such as by increasing its TPP rating), there is a trade off with how well the heat build-up in the fire fighter's body (that can lead to heat stress) is alleviated.

Risk - A measure of the probability and severity of adverse effects that result from an exposure to a hazard [**1250,** 2010]

Risk Assessment - An assessment of the likelihood, vulnerability, and magnitude of incidents that could result from exposure to hazards [**1250**, 2010]

RATING STRUCTURAL FIRE FIGHTING PPE

Based on the hazards encountered by your department how would you rate the following qualities for each element listed? Prioritize the following categories by order of importance to you organization with"1" being the most important "2" the 2nd most important etc. Use each number once only.

STRUCTURAL HELMET

- Thermal protection
- Impact protection
- Weight
- Profile (Low/High)
- Balance
- Cost

STRUCTURAL COAT AND TROUSER (INCLUDES ALL THREE LAYERS)

- Direct flame protection
- UV degradation
- Cut/tear/abrasion resistance
- Ease of donning
- Comfort
- TPP
- THL

PPE RISK ASSESSMENT TEMPLATE

DESIGN OF FINISHED GARMENT

- Durability of construction
- Ergonomic design features
- Proper fitting and design

STRUCTURAL HOODS

- Direct flame protection (LOI)
- Thermal protective performance (TPP)
- Moisture vapor flow (THL)
- Durability
- Comfort
- Cost

STRUCTURAL BOOTS

- Weight
- Cut/tear/abrasion resistance
- Thermal protective performance (TPP)
- Moisture Vapor Flow (THL)
- Puncture protection
- Sole durability/replacement
- Cost

STRUCTURAL GLOVES

- Moisture Vapor Flow (THL)
- Thermal protective performance
- Dexterity
- Tactile
- Durability
- Cost

Figure D.4(b) Spokane Fire Department 2015 Fire Department Structural PPE Risk Assessment Report.

Spokane
FIRE DEPARTMENT
Service and protection through excellence

2015 Fire Department Structural PPE Risk Assessment Report

Table of Contents

Fire Agency Risk Assessment for the Spokane Fire Department

Scope

A Fire Agency Risk Assessment's (RA) primary focus is to establish requirements for the design, performance and testing of protective ensembles and ensemble elements that provide head, limb, hand, foot, torso, and interface protection for firefighters and other emergency service responders. Evaluation of current structural firefighting operations are essential to determine overall risk and potential environmental hazards; by extension essential to determination of agency specific personal protective equipment (PPE) requirements and liabilities. (Reference NFPA 1971) Analysis of incidents involving structural firefighting operations should be considered when evaluating needed protection from the potential hazards associated with structural firefighting that the fire agency is responsible for protecting as defined in NFPA 1971.

Purpose

The purpose of the RA and hazard evaluation (HE) is to provide the most suitable firefighting ensembles and ensemble elements for the Agency's firefighting personnel. The RA assists the organization to evaluate the risks and hazards their emergency responders face. Based on the identified risks and hazards and other agency specific needs, each protective clothing element is evaluated to ensure it provides the emergency responders with the most effective protection from the identified risks and hazards. This assessment will follow established guidelines for RAs outlined in the following laws and standards: NFPA 1851, NFPA 1500, OSHA 1910.132. Although these articles originate from different Professional and/or Legal entities, all require a "Risk Assessment" or "Hazard Assessment" be completed.

Executive Summary

1. Paragraph 1.2.4 of NFPA 1971, Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting (2013 Edition) states that this standard shall not be utilized as a detailed manufacturing or purchasing specification but shall be permitted to be referenced in purchase specifications as the minimum requirements.

2. Because NFPA 1971 only has the minimum requirements, organizations are required to complete a RA in accordance with NFPA 1851 (2008 Edition); Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, NFPA 1500 (2013 edition); Standard on Fire Department Occupational Safety and Health Program, and 29 CFR OSHA 1910.132.
3. The Spokane Fire Department recognizes that they are mandated to clearly and accurately define their PPE requirements based on the hazards their firefighters are exposed to. The Spokane Fire Department RA will ultimately be used as the source document for developing the critical firefighter safety related elements for our structural protective clothing procurement specifications.
4. This RA is based on the core mission requirements further defined in the following regulations and standards: NFPA 1500; Standard on Fire Department Occupational Safety and Health Program (2013 edition), NFPA 1851; Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting (2008 edition), NFPA 1971; Standard on Protective Ensembles For Structural Fire Fighting and Proximity Fire Fighting (2013 edition), 29 CFR OSHA 1910 General Industry Regulation.

Abstract

1. PPE has evolved over the years to provide better protection from injury and illness resulting from exposure to hazards they are exposed to. The Spokane Fire Department provides PPE to protect firefighters from potential hazards they may encounter while performing their work. There are three levels of protection serving firefighters in the field:
   - ✓ Administrative Controls
   - ✓ Engineering Controls
   - ✓ PPE
2. Administrative Controls are policies and procedures that teach and direct Individuals how to recognize and prevent workplace exposures, injuries, and illnesses.
3. Engineering Controls are used to remove hazard(s) from the workplace. Such controls include shutting off the utilities at a structural fire, establishing physical barriers such as seat belts or Lock out/Tag out procedures and barricades to isolate the firefighter from physically encountering the hazard.

4. When exposure to hazards cannot be eliminated through administrative or engineering controls, PPE such as gloves, boots, safety glasses, garments, and respirators can be used to create a barrier between responders and the hazard(s). PPE is the basic control measure, as it does not remove the hazard. PPE will protect the firefighter so long as it is used in a manner that is within design specifications and limitations. PPE is meant to reduce the firefighter's exposure to acceptable levels when other functions of control are not feasible or effective.
5. The intent of this RA is to assist department officials in updating and clearly defining the standard for proper protection levels.
6. This risk assessment is a baseline to establish for the Spokane Fire Department the duties and responsibilities as defined in the SFD personnel manual and does not imply assessment of any special risk. Special risk is defined as services performed by SFD personnel deemed to be outside the scope of the duties and responsibilities defined in the personnel manual and is not included in this risk assessment.
7. Daily response exposes firefighters to hazards that effect both the interior and exterior environments. During prolonged activities, environmental conditions increase the hazard and risk to the firefighters. The Spokane Fire Department has identified the priority and severity of hazards that firefighters are exposed to and provides the appropriate PPE to maximize protection from potentially harmful exposures. These protective ensembles must be capable of protecting the firefighter during progressive fire operations up to and including "flashover" conditions. Tactics for safe fire operations are taught at the SFD Training Division and the Department maintains an expectation that firefighters will function within the boundaries of those tactics under fireground conditions. The majority of PPE available on the market is compliant with NFPA 1971; Standard on Protective Ensembles for Structural Firefighting and Proximity Firefighting (2013 Edition); However, some of the PPE available fails to protect firefighters from the hazards outlined in this risk assessment. To provide a protective ensemble that is suitable and appropriate, this assessment is based on known exposure, illness, injury, and fatality producing incidents regardless of frequency.
8. The health risks and safety hazards identified in this RA are based on the requirements of NFPA 1851; Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Firefighting and Proximity Firefighting (2014 Edition) and supported by research conducted by the The Spokane Fire Department .

Historical Background

The Spokane Fire Department has historically purchased PPE without conducting a documented RA. From this point forward, the SFD will select PPE based on a documented RA to ensure consistent levels of protection for SFD personnel.

Discussion

1. All forms of PPE have design and performance standards and within those standards have limitations. It is imperative that firefighters understand the protection limitations of their PPE to avoid incorrect use or reliance on an item intended to protect them from harm but which may contribute to injury and/or illness if used incorrectly. WAC 296-305-02001 requires the education of all employees concerning the limitations of PPE.
2. PPE is meant to reduce the firefighter's hazard exposure to acceptable levels when other means are not feasible or effective. However, all PPE has its protective limitations. When those limitations are exceeded, the wearer can be exposed to even greater harm. There are a few terms that firefighters should be familiar with in order to better understand the performance expectations and limitations of their PPE. Terms such as: flashover, backdraft, chemical exposure, hazardous materials, terrorist attacks, etc. This is not an inclusive list for the user.

Firefighter Duties and Responsibilities

The Spokane Fire Department, like most professional "ALL RISK" fire departments, maintains a progressive strategy and tactics for the suppression of fires. SFD firefighters are exposed to all phases of fire progression including incipient, free burning, rollover, flashover, backdraft and smoldering. Throughout these fire phases, SFD firefighters will be exposed to a range of temperatures from moderate through extreme based on the activities, functions, or tasks being performed as identified in this section. Additionally, firefighters are exposed to this varying temperature range at training exercises conducted throughout the year at live structural proficiency fire training. Therefore, the PPE must be capable of protecting SFD firefighters at the highest anticipated temperature.

Activity Types

1. Fire Suppression
   - ✓ Bulk fuel storage
   - ✓ Bulk fuel transport
   - ✓ Structural
   - ✓ Vehicle
   - ✓ Other

2. Functions or Tasks: Fire Suppression

- ✓ Drive/operate apparatus
- ✓ Deploy attack lines
- ✓ Engage in offensive fire attack
- ✓ Engage in defensive fire attack
- ✓ Engage in transitional fire attack
- ✓ Deploy/operate
- ✓ Appliances
- ✓ Hand line
- ✓ Nozzles
- ✓ Master streams
- ✓ Deploy/operate adapters
- ✓ Wyes/Siamese
- ✓ Adaptors
- ✓ Deploy/operate supply lines
- ✓ Deploy ladders
- ✓ Operate from ladders
- ✓ Deploy hand tools/equipment
- ✓ Operate hand tools/equipment
- ✓ Pulling
- ✓ Prying
- ✓ Chopping
- ✓ Cutting
- ✓ Deploy powered equipment
- ✓ Operate powered equipment
- ✓ Don/doff SCBA
- ✓ Work from SCBA air supply
- ✓ Support activities

3. Rescue

- ✓ Structural
- ✓ Hazardous Materials (Hazmat IQ/Decon)
- ✓ Vehicle
- ✓ Confined space
- ✓ Collapse
- ✓ High Angle
- ✓ Trench

4. Rescue Operations

- ✓ Drive/operate apparatus
- ✓ Deploy ladders
- ✓ Operate from ladders
- ✓ Deploy/operate hand
- ✓ Tools/equipment
- ✓ Pulling
- ✓ Prying
- ✓ Chopping
- ✓ Cutting
- ✓ Deploy/operate powered equipment
- ✓ Don/doff SCBA
- ✓ Work from SCBA air supply
- ✓ Deploy/operate stabilization equipment
- ✓ Structural stabilization
- ✓ Vehicle stabilization
- ✓ Trench stabilization
- ✓ Deploy/operate confined space lowering/lifting equipment
- ✓ Deploy/operate high angle lowering/lifting equipment

Statement of Acceptable Risk

1. Acceptable Risk – Acceptable risk varies and is the responsibility of each department to identify what the acceptable risk is while conducting operations.
2. The acceptable level of risk is directly related to the potential to save lives or property. Where there is no potential to save lives, the risk to SFD members should be evaluated in proportion to the ability to save property of value. When there is no ability to save lives or property, there is no justification to expose SFD members to any avoidable risk, and defensive fire suppression operations are the appropriate strategy, even though defensive operations are not completely without exposure to hazards.
3. When considering acceptable risk to firefighters, The Spokane Fire Department employs the following rules of engagement after evaluating the survival profile of any victims and the value of any property involved.
   - ✓ Within a structured plan, we may risk our lives a LOT to protect SAVABLE lives.
   - ✓ Within a structured plan, we may risk a LITTLE, to protect SAVABLE property.
   - ✓ We will NOT risk our lives to save lives or property that is already lost.

Expectation of Exposure / Reasonable Maximum Exposure (RME)

Thermal Hazards

The NFPA develops minimum standards for PPE. The NFPA recognized that not all departments require the same level of protection for reasons such as:

- ✓ Operational/Training Standards – SFD conducts interior attack operations requiring a higher level of protection to ensure firefighter safety. It is sometimes impossible during interior firefighting operations to move away from a heat source.
- ✓ Response Times – Response times are critical when determining the protection values of PPE. The SFD has response times that allow for interior attack during incipient and free burning fires. These conditions mandate PPE that is capable of protecting firefighters during flashover conditions or high radiant heat conditions.
- ✓ Reasonable Maximum Exposure – The combination of response times, building construction, contents normally found in structures, training standards and Standard Operating Procedures identify "Flashover Conditions" and/or direct flame impingement for short periods of time as the Reasonable Maximum Exposure for the SFD.

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Chemical Biological Radiation Nuclear (CBRN) Response

SFD operations included are both man-made and natural incidents; fire suppression and hazard mitigation, rescue, mitigation or containment of releases of hazardous materials (HazMat), such as CBRN agents, resulting from industrial accidents, terrorism, or weapons of mass destruction (WMD); and emergency medical support.

1. **Chemical Hazards:** SFD firefighters respond to HazMat emergencies as first responders and as members of organized HazMat teams. Although HazMat incidents can be infrequent, SFD firefighters respond regionally to mitigate these incidents. The layer of the structural ensemble composite material that protects firefighters against chemical hazards is the "moisture barrier." If deemed appropriate, ensemble may be worn during HazMat incidents.
2. **Biological Hazards:** The SFD responds to all types of incidents. Biological hazards are frequently encountered during Emergency Medical Services (EMS) incidents. Typical biological exposures to firefighters wearing PPE occur during response to traffic collisions and other rescue type incidents when body fluid is encountered. Biological hazards can also be encountered during response to HazMat incidents. In either case, the SFD will wear PPE to these incidents. The layer of the structural or proximity PPE composite that protects firefighters against biological hazards is the "moisture barrier."
3. **Radiation and Nuclear Hazards:** The SFD has the potential to respond to incidents involving radiation and nuclear hazards. Although these hazards are very infrequent, firefighters can find themselves exposed to radiation or nuclear incidents and also during terrorist attacks. Current PPE provides little or no protection for firefighters against radiation and nuclear hazards.

Health Risks and Safety Hazards Expected to be encountered by SFD firefighters:

1. **Physiological:**
   - ✓ Physical stress
   - ✓ Fatigue
   - ✓ Body core temperature

2. **Physical:**
   - ✓ Sharp edges
   - ✓ Sharp points
   - ✓ Falling objects
   - ✓ Flying debris
   - ✓ Projectiles
   - ✓ Splash exposure
   - ✓ Slippery surfaces
   - ✓ Vibration
   - ✓ Abrasive or rough surfaces
3. **Physics:**
   - ✓ Stored thermal energy (heat saturation)
   - ✓ Thermal energy migration
   - ✓ Compression
4. **Biological Hazards:**
   - ✓ Blood borne pathogens
   - ✓ Blood and other potentially infectious body material
   - ✓ Airborne pathogens
   - ✓ Biological toxins
   - ✓ Biological allergens
5. **Electrical Hazards:**
   - ✓ High voltage
   - ✓ Electrical arc
   - ✓ Static charge buildup
6. **Radiation Hazards:**
   - ✓ Ionizing radiation
   - ✓ Non-- ionizing radiation
7. **Flame/Thermal:**
   - ✓ Radiant heat
   - ✓ Convective heat
   - ✓ Conducted heat
   - ✓ Flame impingement
   - ✓ Burning embers
   - ✓ Steam
   - ✓ Flashover
   - ✓ Backdraft
   - ✓ Scalding water
   - ✓ Molten metals
   - ✓ Hot surfaces

8. **Environmental:**
   - ✓ Time of day
   - ✓ Ambient temperatures
   - ✓ Humidity
   - ✓ Internal moisture
   - ✓ Inside the protective element
   - ✓ External moisture
   - ✓ On the outside of the protective element
   - ✓ Confined or small spaces
   - ✓ Rain
   - ✓ Snow
   - ✓ Ice
   - ✓ Wind
   - ✓ Others
9. **Hazardous Materials & Substances:**
   - ✓ Explosives
   - ✓ Compressed Gasses
   - ✓ Flammable Liquids
   - ✓ Flammable Solids Oxidizers
   - ✓ Poison
   - ✓ Radioactive
   - ✓ Corrosives
   - ✓ Miscellaneous
   - ✓ Other Regulated Materials Liquids
   - ✓ Fuels
   - ✓ Motor fuels
   - ✓ Propellants
   - ✓ Hydraulic fluids
   - ✓ Lubricants
   - ✓ Firefighting agents
   - ✓ Chlorine
   - ✓ Blood or other potentially infectious body materials
   - ✓ Alkaline
   - ✓ Acids
   - ✓ Battery Acid
   - ✓ Oxidizers
   - ✓ Others Liquefied gases
   - ✓ Oxidizers
   - ✓ Liquid Oxygen (LOX)
   - ✓ Liquid Propane Gas (LPG)
   - ✓ Others
   - ✓ Compressed gasses
   - ✓ Oxidizers
   - ✓ Air
   - ✓ Oxygen
   - ✓ Nitrogen
   - ✓ Helium
   - ✓ Others Solid chemicals
   - ✓ Firefighting agents

Geographic Location and Climate

The City of Spokane is located near the eastern border of Washington, about 20 miles from Idaho and 110 miles south of the Canadian border. The city lies on the eastern edge of the Columbia Basin, a wide sloping plain that rises sharply to the east towards the Rocky Mountains. The Spokane River and its waterfalls bisect the city. Summers are typically dry and mild, and winters can bring periods of cold, wet weather. Snowfall rarely accumulates to depths greater than one foot.

Area: 58 square miles (2000)

Elevation: Ranges from 1,898 to 2,356 feet above sea level

Average Temperatures: January, 27.1° F; July, 68.8° F; annual average, 47.3° F

Average Annual Precipitation: 16.5 inches

Frequency of Use

1. According to the SFD Incident Reporting System, SFD firefighters responded to a total of 35,499 incidents in calendar year 2014. This section of the risk assessment focuses on PPE frequency of use based specifically on this emergency response data and is explained utilizing the following chart reflecting the activity type, thermal activity, and abrasive activity.

2. For the purposes of this document, frequency of use is defined as:

   - ✓ Limited – lowest thirty percentile (1 to 30%)
   - ✓ Moderate – median thirty percentile (31 to 60%)
   - ✓ Often – upper forty percentile (61 to 100%)

3. 2014 SFD PPE use reflecting on activity type.

Medical						
Code	Description	# of Calls Incidents	% of EMS Incidents	% of Total Incidents	2013 Incidents	% Change vs 2014
31A	EMS Alpha Response	4,589	14.86%	12.93%	4,489	2.23%
31B	EMS Bravo Response	12,278	39.76%	34.59%	10,816	13.52%
31C	EMS Charlie Response	5,591	18.11%	15.75%	4,805	16.36%
31D	EMS Delta Response	5,497	17.80%	15.48%	5,791	-5.08%
31E	EMS Echo Response	442	1.43%	1.25%	425	4.00%
31F	EMS Second Alarm Response	0	0.00%	0.00%	0	0.00%
46A	MVA Alpha	1,471	4.76%	4.14%	1,563	-5.89%
46B	MVA Bravo	775	2.51%	2.18%	623	24.40%
46D	MVA Delta	236	0.76%	0.66%	212	11.32%
Total EMS Incidents		30,879	100.00%	86.99%	28,724	7.50%

Fire and Misc.						
Code	Description	# of Calls Incidents	% of Fire & Misc.	% of Total Incidents	2013 Incidents	% Change vs 2014
00	Investigation	31	0.67%	0.09%	53	-41.51%
01	CISD	0	0.00%	0.00%	0	0.00%
11C	Structure Fire Commercial	100	2.16%	0.28%	32	212.50%
11F	Structure Fire Full	197	4.26%	0.55%	250	-21.20%
11S	Structure Fire Single	1,182	25.58%	3.33%	1,110	6.49%
11W	Structure Fire Working	76	1.65%	0.21%	126	-39.68%
13S	Vehicle Fire	142	3.07%	0.40%	158	-10.13%
14E	Brush Fire Extreme	0	0.00%	0.00%	2	-100.00%
14H	Brush Fire High	44	0.95%	0.12%	16	175.00%
14L	Brush Fire Low	45	0.97%	0.13%	43	4.65%
14M	Brush Fire Moderate	25	0.54%	0.07%	24	4.17%
14S	Brush Fire Single	44	0.95%	0.12%	36	22.22%
18F	Alarm System Full	1,418	30.69%	3.99%	1,266	12.01%
18S	Alarm System Single	453	9.81%	1.28%	436	3.90%
35F	Extrication	40	0.87%	0.11%	48	-16.67%
36F	Water Rescue	25	0.54%	0.07%	16	56.25%
37F	Tech Rescue	5	0.11%	0.01%	12	-58.33%
39H	Rescue Task Force	1	0.02%	0.00%	0	0.00%
40F	Hazmat Full	49	1.06%	0.14%	52	-5.77%
40I	Hazmat Investigation	303	6.56%	0.85%	276	9.78%
40T	Hazmat Team	1	0.02%	0.00%	3	-66.67%
50S	Service Call	439	9.50%	1.24%	466	-5.79%
Total Fire and Misc. Incidents		4,620	100.00%	13.01%	4,425	4.41%
Total EMS Incidents		30,879		86.99%	28,724	7.50%
2014 Total Incidents Dispatched by the CCC		35,499		100.00%	33,149	7.09%

Conclusion/Decision: SFD structural ensembles are worn on many responses. The percentage of fire responses requiring thermal protection has declined over the years however given the fuel loading with highly combustible contents, and the prevalence of lightweight building materials, a high degree of thermal protection is still needed. Additionally, as our responses have increased in other areas such as rescue, traffic collisions, etc. the SFD recognizes the need for a durable garment emphasizing an increased need for abrasion performance.

Thermal Protective Performance (TPP)

1. TPP is the primary test for evaluating layered, or composite fabrics worn as PPE for Structural Fire Protective Garments (SFPG) and Proximity Fire Protective Garments (PFPG). In accordance with NFPA 1971, protective garment elements composite fabrics consisting of outer shell, moisture barrier, and thermal barrier shall be tested for thermal insulation and shall have an average TPP of not less than 35.0. The test uses an exposure heat flux representative of the thermal energy present in a flashover. It should be noted that this is a harsh test exposure and does not represent conditions in which firefighters are intended to work. It measures the ability of the composite fabrics to provide a few seconds to escape from such an exposure.
2. The actual TPP rating is double the amount of time it takes for a second degree burn to occur at an exposure level of two calorie per centimeter squared (2.0 Cal/cm2). For example, a TPP of 35 equals 17.5 seconds of protection before a second-degree burn occurs.
3. The TPP formula does not take into account critical factors that reduce the composite's ability to protect the firefighter. Specifically, factors such as stored energy, moisture, garment cleanliness, etc. will reduce the composite's TPP performance. In some cases a burn injury can occur within 1 to 3 seconds.
4. The SFD recognizes a five percent (5%) variance in fabric weight, which is the industry standard. In addition, NFPA 1971 allows for an 8 percent variance in the TPP test.
5. The SFD's current fabric composite (Outer Shell / Moisture Barrier / Thermal Liner) is Gemini XT / Crosstech (black) /Caldera SL-2, giving a TPP rating of 40.8.
6. The SFD injury data trends over the past 8 years indicates no need to adjust the TPP value from 40.8.

Conclusion/Decision: The Spokane Fire Department requires a minimum composite TPP rating greater than 37.

Total Heat Loss (THL)

1. THL is another primary test for evaluating layered, or composite fabrics worn as structural PPE. THL is a performance requirement for evaporative heat transfer. It measures how well the garment composite (outer shell, moisture barrier, and thermal barrier) allows heat and moisture vapor to transfer away from the wearer, thus helping to reduce heat stress. The test involves placing a fabric or composite sample over a porous heated plate meant to represent the human skin. In accordance with, NFPA 1971, garment composite fabrics consisting of the outer shell, moisture barrier, and thermal barrier shall be tested for evaporative heat transfer and shall have a THL of not less than 205 kW/m2.
2. Heat transfer is determined by measuring the energy required to maintain a specific temperature as heat is transferred through the clothing system to the outside environment. Both dry and wet tests are performed on the test samples. The dry tests yield heat loss associated with conductive heat transfer. The wet tests yield heat loss associated with moisture evaporation and transmission. The test yields a total heat loss figure, which represents the amount of energy that can be transferred through a given area of the fabric or composite material under the specific conditions of the test.
3. It is important to understand that TPP and THL work inversely; meaning the higher the TPP rating, the lower the THL rating and vice versa. Generally speaking, in order to have greater protection against radiant or convective heat, you need to have thicker or heavier fabrics that will inherently impede the ability for physiological heat to move through it from the body to the outside environment. It should be understood that small differences in THL might be difficult for firefighters to distinguish in the field. It might take 20 to 25 kW/m2 or more, depending on the individual and the conditions, to be felt by the wearer.
4. The SFD's current fabric composite (Outer Shell / Moisture Barrier / Thermal Liner) is Gemini XT / Crosstech (black) /Caldera SL-2, giving a THL rating of 246.38.
5. The SFD injury data trends over the past 8 years indicate no need to adjust the current THL value.

Conclusion/Decision: The Spokane Fire Department requires a minimum composite THL rating greater than 220.

Outer Shell Requirements

Thermal Hazards

The outer shell is capable of withstanding flashover conditions and remain flexible without breaking open. Outer shells that become brittle and potentially break open will not protect the thermal liner, which is critical in preventing burns.

Conclusion/Decision – Outer Shell: The SFD will utilize fabrics for the outer shell that maintains protection after thermal exposure consistent with the conditions found in a structural fire flashover. Specifically, the outer shell will have tensile strength of at least 50 lbs. after a 17.5 second NFPA TPP exposure.

Physical Hazards

1. PPE shall be worn to all structure fires, petroleum fires/incidents, roadway incidents such as traffic collisions, rescue incidents, hazardous materials incidents, vehicle fires and dumpster / refuse fires. Therefore, this risk assessment considers the proportional response types and the physical hazards that exist in each response situation.
2. The frequency and severity of physical hazards greatly varies between SFD incidents. To complete the physical hazard section of this document, it was necessary to understand how the "majority" of SFD PPE is damaged. This information was collected by assessing how the majority of PPE is damaged-broken down by each station and the Department as a whole. The SFD was trained by independent service providers (ISP) to determine what physical hazards represent the greatest threat to Spokane Fire Department Structural PPE, and how these threats may best be mitigated. This information is updated each year through the Annual Inspection process.
3. The results of the analysis found that the most significant physical hazard putting the ensemble out-of-service results from abrasion. These findings are consistent with SFD fire operations and progressive training scenarios. During these interior firefighting operations firefighters are trained to stay as low to the ground as possible to avoid extreme temperatures at elevated levels. To accomplish this firefighters are required to kneel and crawl whenever necessary. Firefighters are also trained in conducting primary and secondary searches inside structures. Search techniques require firefighters to maintain contact with interior walls as they progress through the structure. Maintaining contact is accomplished by keeping legs, arms, shoulders etc. in contact with the interior walls. Significant abrasion of the outer shell routinely occurs during the operations described above causing damage to the outer shell. Abrasion resistance performance is almost exclusively a performance characteristic of the outer shell of the garment.

4. Though tearing was also identified as a significant hazard most tears were within acceptable repair standards while abrasion damage was more common in placing a garment out-of-service. Additionally, tearing was typically in areas where the outer shell fabric was weakened by abrasion.
5. Abrasion testing for the outer shell materials are conducted using the Taber Abrasion Testing methodology in accordance with ASTM D 3884 - 01.

Conclusion/Decision: The outer shell fabric must have superior performance for abrasion resistance and show no excessive wear upon visual inspections after 3000 cycles of Taber Abrasion Testing or equivalent. Note: Current fabrics on the market range from 0 - 5,000 cycles.

6. Strength. Fabric strength for the outer shell is conducted using the Trapezoidal Tearing Test in accordance with ASTM D 5587 on both laundered and unlaundered samples. SFD standards for trapezoidal tear strength is measured by a minimum score of 50 lbs. (Warp) and 50 lbs. (Fill) for initial testing and 40 lbs. (Warp) and 40 lbs. (Fill) after five launderings in accordance with NFPA 1971 test methods. These performance requirements ensure that the outer shell has superior tear strength to resist tears from sharp edges and tearing hazards. The NFPA standard calls for fabric samples to be tested without slippage or filament pull through.

Conclusion/Decision: The SFD outer shell fabric must have superior tear strength to resist tears from sharp edges and tearing hazards measured by a minimum score of 50 lbs. (Warp) and 50 lbs. (Fill) for initial testing and 40 lbs. (Warp) and 40 lbs. (Fill) after five launderings in accordance with NFPA 1971 test methods. No fabric slippage or filament pull through will be allowed.

7. Tensile Strength. Fabric strength for the outer shell is conducted using the tensile strength test in accordance with ASTM D 5034 on both laundered and unlaundered samples. NFPA 1971 standard for trapezoidal tear strength is measured by a minimum score of 140 lbs. 240 lbs (Warp) and 280 lbs. (fill) for initial testing and 240 lbs. (Warp) and 275 lbs. (Fill) after ten launderings in accordance with NFPA 1971 test methods. These performance specifications ensure that the outer shell has superior tensile strength to resist breaking open under maximum exposure conditions.

Conclusion/Decision: The SFD outer shell fabric must have tensile strength to resist breaking open, measured by a minimum score of 240 lbs. (Warp) and 280 Lbs. (Fill) for initial testing and 240 Lbs. (Warp) and 275 (Fill) after ten launderings in accordance with NFPA 1971 test methods.

Exposure to Sun and Ultraviolet Light

This condition exists for two primary reasons. Currently, in most locations, SFD apparatus do not have the ability to store PPE adequately in protective compartments. Therefore, PPE is routinely stored in unprotected areas on the apparatus exposing the PPE to damaging effects of sunlight. Many of our stations still do not allow for the storing of PPE in protected environments. PPE is typically stored in wire mesh or open lockers in the apparatus bays, which does not protect the PPE from sunlight or diesel engine exhaust. Industry experts agree that ultraviolet light exposure is one of the most significant threats to the performance of PPE.

Conclusion/Decision: The SFD outer shell must be composed of fibers that have superior performance to a xenon light test that replicates the extreme exposures indicated above. Therefore, the SFD outer shell must have a tensile strength of 140 lbs. after a 120 hour xenon light exposure.

Thermal Liner Requirements

Thermal liners are common to structural ensembles and are capable of protecting firefighters to temperatures associated with flashover conditions. The composite needs to protect firefighters for a minimum of 20.4 seconds, which allows for escape during most interior fire attack operations in residential and commercial structures.

Thermal liners consist of two primary components. First is the facecloth which is a fabric that rests against the firefighter's skin and assists with moisture wicking. The second component is the "batting" which is the insulation that provides the primary protection against thermal energy.

Facecloth

1. Thermal liner facecloth has two primary impacts to the performance of the composite. Specifically, the facecloth has a significant impact on both moisture management (wicking) and the ability of the firefighter to move freely within the garment.

2. The thermal liner facecloth interacts with the moisture barrier in allowing moisture from sweating to be removed. The ability of the composite to perform this task is greatly impacted by the thermal liner facecloth. The facecloth must have superior moisture wicking performance to allow the moisture to be dispersed through the composite.

3. Moisture management against the firefighter's skin is a critical factor that all structural and proximity ensembles must manage. This specific factor is required for three reasons:
   - ✓ Moisture (water) conducts heat transfer
   - ✓ Moisture on the firefighter's skin results in a higher probability of burn injury compared to dry skin
   - ✓ Moisture against the skin can result in steam or scald type burn injuries if the firefighter's skin and the layer of material in contact with the skin is moist or wet
4. The SFD examined two tests measuring a garments ability to manage moisture. THL and fabric Wickability, THL has been previously addressed in this RA.

   Wickability: Wickability is achieved by the facecloth's ability to absorb and disperse the moisture. Wickability is measured by test method AATCC 79-2010, and is used to measure how rapidly a fabric will absorb or wick water. One drop of distilled water is dropped on to the fabric and a stop watch is activated to record the time for the water droplet to completely absorb into the fabric.

Conclusion/Decision: The SFD requires facecloth wickability performance to reduce firefighter fatigue and provide superior moisture management. Additionally, SFD defines acceptable superior facecloth Wickability performance as 10 seconds or less using the American Association of Textile Chemists and Colorists (AATCC) Test Method 79-2010; Absorbency of Textiles.

5. Facecloth comfort and appearance can be affected by "pilling." The pilling of textile fabrics refers to an appearance caused by bunches or balls of tangled fibers held to the surface. This unpleasant appearance can seriously compromise the fabrics' performance in thermal environments. Pills are developed on a fabric surface in four main stages: fuzz formation, entanglement, growth, and wear-off. The greater the pilling the less comfort and ease of movement the garment will have.
6. Pilling resistance is performed in accordance with ASTM D3512- 82 at 30, 60, and 90-minute intervals. Each specimen is 4 3/16" square. The specimens are prepared and agitated in an Atlas Random Tumble Pilling Tester for the desired, and stated, timeframe. The samples are then removed and compared to the scale that has been set up for this test method.

Durability Performance Scale Rating Values: Very Severe Pilling (1), Severe Pilling (2), Moderate Pilling (3), Slight Pilling (4), and No Pilling (5)

Conclusion/Decision: To improve facecloth comfort and performance, the SFD requires a rating of 4 (Slight Pilling) or 5 (No Pilling) both before and after washing agitation.

Batting

1. The thermal batting is comprised of different fibers that are designed to give specific properties to the finished product such as TPP, THL, and flexibility. The thermal batting is the main component responsible for protection from the thermal environment. Factors such as construction, layering, and weight are important considerations. There are two basic types of thermal batting:
2. Single Layer Needle Punch (NP) Batting – NP liners are typically thicker and bulkier than Spun Lace batting.
3. Multiple Layer Spun Lace (SL) -In efforts to reduce weight and bulk, two and three layer SL battings have been developed. The layers float between the facecloth of the thermal liner and the moisture barrier. Both of the separate layers and the SL technology allow for improved movement.
4. The weight of PPE has a direct impact on the physical performance of a firefighter. A lighter weight garment results in greater fire ground performance and allows the firefighter to work for longer periods of time thereby increasing firefighter effectiveness and performance. Two layer SL thermal barriers provide the best weight to thermal protective performance ratio.

Conclusion/Decision: The SFD will use multiple layers (two layers) of spun lace technology improve performance.

Moisture Barriers

Moisture barriers are also critical in preventing the transmission of liquids from the outside of the garment to the skin. The moisture barrier material shall meet all moisture barrier requirements of NFPA 1971, which directly includes water penetration resistance, viral penetration resistance, and common chemical penetration resistance.

Four key characteristics have been identified that are critical to firefighter safety:

1. **Liquid Penetration Resistance:** This is important because fire and safety professionals often encounter a variety of liquids, such as water, body fluids, and chemicals at emergency scenes. Sometimes, the most dangerous hazards are the ones that can't be seen. In this environment, contamination from blood and body fluids is a serious concern. The moisture barrier is the component in PPE that resists penetration of liquids commonly found at the fire scene. Moisture barriers will be tested against the following liquids for penetration

resistance: battery acid (37% sulfuric), ASTM Ref. Fuel C (unleaded gasoline surrogate), hydraulic fluid (phosphate ester), aqueous film forming foam (AFFF), and swimming pool chlorine solution (65% free Cl).

Conclusion/Decision: To achieve required protection, the SFD moisture barrier shall be constructed of bi-component ePTFE membrane technologies. The moisture barrier material shall meet all moisture barrier requirements of NFPA 1971-2013 edition, which includes water penetration, viral penetration resistance and common chemical penetration resistance.

2. **Breathability and the Resistance to Sweat Evaporation:** Heat stress related injuries are a top concern for the SFD. Breathability (i.e. enabling the efficient evaporation of sweat), is critical to managing heat stress and minimizing core temperature increases. Across various studies, core temperature increases have been shown to have a significant impact on firefighter safety and operational effectiveness. Therefore, maximizing breathability (i.e. minimizing the resistance to sweat evaporation) is a critical consideration when selecting structural turnout gear and can impact firefighter health and safety. Evaporative resistance is the recognized measurement of textile or material breathability. The test method is well established in textile performance apparel and protective apparel industries worldwide and is governed by ASTM 1868, Part B and ISO 11092. The Hohenstein Institute, a renowned independent organization, performed human subject testing with garments of different evaporative resistances (degrees of breathability) in order to create a Comfort Rating Scale based on the difference in evaporative resistance that translated to meaningful human physiological impact and comfort perception. The scale recommends an evaporative resistance value less than 30 m2 Pa/W for breathable gear. Additionally, the Hohenstein Institute studies and scale suggest that evaporative resistance differences greater than 6 m2 Pa/W have physiological significantly impact on the wearer. Therefore the SFD requires a maximum evaporative resistance value of 36 m2 Pa/W, in accordance with the Hohenstein scale, ideally with evaporative resistance values of less than 30 m2 Pa/W and with the recognition that lower values are better. As a point of reference, average station wear may have a evaporative resistance value of 8 m2 Pa/W. Reducing the resistance to sweat evaporation and getting as close to the value for station wear as possible, is consistent with maximizing breathability, minimizing potential for core temperature rise in firefighters, and addressing the health and safety concerns associated with heat stress management.

   Conclusion/Decision: The SFD requires a maximum evaporative resistance value of 36 m2 Pa/W, in accordance with the Hohenstein scale, ideally with evaporative resistance values of less than 30 m2 Pa/W.

3. **Breathability after heat exposure:** Repeated heat exposures are common in structural firefighting. These exposures, even those of short duration, can cumulatively degrade some materials. We recommend the moisture barrier maintain it's breathability and does not degrade more than 20 % after heat exposure. The moisture barrier laminate shall not show an increase of more than 2.0 M2 Pa/W from its initial water-vapor resistance after being exposed to an elevated temperature of 500 degrees F for 5 minutes when tested according to ISO 11092, Textile-Physiological-Measurements of thermal and water-vapour resistance under steady state conditions (sweating guarded hotplate test).

   Conclusion/Decision: The SFD moisture barrier laminate shall not show an increase of more than 2.0 m2 Pa/W from its initial water-vapor resistance (Ret) after being exposed to an elevated temperature of 260°C (500° F) for 5-minutes when tested according to ISO 11092, Textile-Physiological-Measurements of thermal and water vapor resistance under steady-state conditions (sweating guarded-hotplate test).

4. **Durability:** SFD turnout gear gets wet, flexes, and abrades on the job. It is important to test the moisture barrier and seams with flexing and abrasion in a wet environment to help understand in-use durability. The Wet Flex and Durability to Leakage test is an AATCC Test Method (135-1987, without soap) The water level shall be maintained at 16 (+/- 0.5) gallons and water temperature shall be 32 (+/-9) degrees C. Additional fabric shall be added to create a load of 2 (+/- 0.2) pounds. SFD requires a minimum result of 200 hours with no leakage according to ASTM D-751, Hydrostatic Resistance, Procedure B, Procedure 2 with a fixed hydrostatic head of 1.0 PSI minimum and shall be held for 3 minutes minimum. A minimum of three specimens shall be tested. The sample will be oriented so that water contacts the textile side of the moisture barrier. The report shall include only measurement of the appearance of water droplets. Leakage is defined as the appearance of one or more droplets anywhere within the 3-1/2 inch minimum diameter test area. The test may be performed using any device which tests the same specimen area at the equivalent pressure. In cases of dispute, the apparatus described in Method AATCC 127 shall be used. The moisture barrier laminate shall exhibit passing results after 25 wash/dry cycles when tested independently for the Liquid Penetration Test (NFPA 1971 2013 edition, section 8.27) and Viral Penetration Resistance Test (NFPA 1971 2013 edition, section 8.28). The moisture barrier sealed seams shall exhibit passing results after 25 wash/dry cycles when tested independently for the Liquid Penetration Test (NFPA 1971 2013 edition, section 8.27) and Viral Penetration Resistance Test (NFPA 1971 2013 edition, section 8.28). The moisture barrier laminate shall remain waterproof (NFPA 1851 2008 edition, section 12.3.3 – Evaluation Apparatus) to 1 PSIG for three minutes after cold temperature flexing, according to ASTM D 2097, at minus 13 degrees F for 80 minutes.

Conclusion/Decision: The SFD requires a minimum result of 200 hours with no leakage according to ASTM D-751, Hydrostatic Resistance, Procedure B, Procedure 2.

Garment reflective and fluorescent trim

1. The SFD garment trim shall be tested for retro reflectivity and fluorescence as specified in Section 8.45 of NFPA 1971 2014 edition, Fluorescence Test, and shall have a coefficient of retroreflection (RA) of not less than 100 cd/lux/m2, and shall be fluorescent yellow-green.

   Conclusion/Decision: The SFD requires the garment trim shall maintain a minimum RA of 350 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

2. Convective Heat Exposure Test (120) – the trim shall be tested as specified in ISO 17493 for one minute at 120 degrees C.

   Conclusion/Decision: The SFD garment trim shall maintain a minimum RA of 450 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

3. Convective Heat Exposure Test (150x3)– the trim shall be tested as specified in ISO 17493 for three separate ten minute exposures at 150 degrees C with a ten minute cool down period between each exposure.

   Conclusion/Decision: The SFD garment trim shall maintain a minimum RA of 450 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

4. Convective Heat Exposure Test (5-260)– the trim shall be tested as specified in NFPA 1981, 2013 edition, section 8.6 per ISO 17493 for two minutes at 260 degrees C.

   Conclusion/Decision: The SFD garment trim shall maintain a minimum RA of 350 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

5. Convective Heat Exposure Test (2-260)– the trim shall be tested as specified in NFPA 1971, 2013 edition, section 8.6 per ISO 17493 for two minutes at 260 degrees C.

   Conclusion/Decision: The SFD garment trim shall maintain a minimum RA of 450 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

6. Wash and Dry Test– The trim shall be washed for 50 cycles in accordance with ISO-6330 Method 2A (60 degree C home wash) and dried per ISO-6330 Procedure E (50 degree C tumble dry).

   Conclusion/Decision: The SFD garment trim shall maintain a minimum RA of 100 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

7. Dry Cleaning Test – the trim shall be dry-cleaned 25 cycles in accordance with ISO-3175 Method 9.1.

   Conclusion/Decision: The SFD garment trim shall maintain a minimum RA of 100 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

Helmet performance requirements

Top Impact Resistance Test

1. Top Impact Resistance Test (room temperature) – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.15 and (8.1.3.2 at 77°F.)

   Conclusion: The helmet shall transmit a force < 2200 N.

2. Top Impact Resistance Test (-25°F) – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.15 and (8.1.4 at -25°F) for 4 hours.

   Conclusion: The helmet shall transmit a force < 2200 N.

3. Top Impact Resistance Test (285°F) – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.15 and (8.1.3.2 at 285°F) for 10 minutes.

   Conclusion: The helmet shall transmit a force < 2200 N.

4. Top Impact Resistance Test (Radiant/Convective) – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.15 and 8.1.6 Radiant/Convective: 1.0W/CM2 for 2.5 minutes.

   Conclusion: The helmet shall transmit a force < 2200 N.

5. Top Impact Resistance Test (Wet) – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.15 and 8.1.8 Water immersion for 4 hours.

   Conclusion: The helmet shall transmit a force < 2200 N.

Acceleration Impact Resistance Test

1. Acceleration Impact Resistance Test (Room Temperature) – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.16 and (8.1.3.2 at 88°F.) If helmet utilizes an internal face shield then helmet shall be tested with the internal face shield in place.

   Conclusion: Helmets shall maintain sufficient structural integrity to withstand impacts in all five locations.

2. Acceleration Impact Resistance Test (285°F) – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.16 and (8.1.3.2 at 285°F) for 10 minutes. If helmet utilizes an internal face shield then helmet shall be tested with the internal face shield in place.

   Conclusion: Helmets shall maintain sufficient structural integrity to withstand impacts in all five locations.

3. Acceleration Impact Resistance Test (Radiant/Convective) – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.16 and 8.1.6 Radiant/Convective: 1.0W/CM2 for 2.5 minutes. If helmet utilizes an internal face shield then helmet shall be tested with the internal face shield in place.

   Conclusion: Helmets shall maintain sufficient structural integrity to withstand impacts in all five locations.

Physical Penetration Resistance Test

Physical Penetration Resistance Test) – The helmet shall be placed in the holder, an aluminum projectile weighing approximately 280 grams and 6 inches in length is loaded into the chamber and locked in position. The chamber is pressurized to approximately 30 psi. Then the projectile is released by opening a valve. The projectile is propelled thru the metal tube a distance of 4 ft to the impact site of the sample.

Conclusion: The aluminum projectile shall not penetrate the helmet.

Electrical Insulation Test

1. Electrical Insulation Test – The helmet shall be tested inaccordance with NFPA 1981, 2013 edition, Section 8.31A. Immerse in tap water.

   Conclusion: The helmet shall not leak more than 3.0 mA.

2. Electrical Insulation Test (Saturated) – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.31B. Submerge helmet in water for 15 minutes.

   Conclusion: The helmet shall not leak more than 3.0 mA.

Retention System Test

Retention System Test–The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.35.

Conclusion: The helmet chinstrap shall not break, nor stretch more than .8125"

Suspension System Test

Suspension System Test – The helmet shall be tested in accordance with NFPA 1981, 2013 edition, Section 8.36.

Conclusion: The helmet shell shall not separate from helmet suspension with 45 N applied.

Weight of Helmet

Weight of helmet – The weight of the helmet including accessories shall be measured.

Conclusion: The helmet shall not weigh more than 4.5 lbs.

Footwear performance requirements

1. Conductive Heat Resistance Test 2 – The protective footwear elements shall be tested for thermal insulation as specified in Section 8.8 of NFPA 1971 2013 edition.

   Conclusion: The temperature of the insole surface in contact with the foot shall not exceed 111 F.

2. Flame Resistance Test 4 – The protective footwear, with components in place, shall be tested for resistance to flame as specified in Section 8.5 of NFPA 1971 2013 edition.

   Conclusion: The boot components shall not have an after flame of more than 5.0 seconds, shall not melt or drip, and shall not exhibit any burn-through.

3. Heat and Thermal Shrinkage Resistance Test – The protective footwear shall be tested for resistance to heat as specified in Section 8.6 of NFPA 1971 2013 edition.

   Conclusion: The footwear shall not have any part of the footwear melt, separate, or ignite; shall show no water penetration; and shall have all components remain functional.

4. Radiant Heat Resistance Test – The protective footwear shall be tested for thermal insulation as specified in Section 8.9 of NFPA 1971 2013 edition.

   Conclusion: The temperature of the upper surface in contact with the skin shall not exceed 111 F.

5. Conductive Heat Resistance Test – The protective footwear shall be tested for thermal insulation as specified in Section 8.7 of NFPA 1971 2013 edition.

   Conclusion: The temperature of the upper lining surface in contact with skin shall have a second-degree burn time of not less than 10.0 seconds, and shall have a pain time of not less than 6.0 seconds.

6. Liquid Penetration Resistance Test – The protective footwear upper material composite and footwear seams shall be tested for resistance to liquid penetration as specified in Section 8.27 of NFPA 1971 2013 edition.

   Conclusion: The boot upper material shall allow no penetration of the test liquids for at least 1 hour.

7. Viral Penetration Resistance Test – The protective footwear upper material composite and footwear seams shall be tested for resistance to liquid or blood-borne pathogens as specified in Section 8.28 of NFPA 1971 2013 edition.

   Conclusion: The boot shall allow no penetration of the Phi-X-174 bacteriophage for at least 1 hour.

8. Puncture Resistance Test – The protective footwear upper shall be tested for resistance to puncture as specified in Section 8.20 of NFPA 1971 2013 edition.

   Conclusion: The boot shall not be any puncture to the footwear upper under after an average applied force of 13 LBF.

9. Cut Resistance Test – The protective footwear uppers shall be tested for resistance to cut as specified in Section 8.21 of NFPA 1971 2013 edition.

   Conclusion: The boot uppers shall not have a complete cut through after a cut distance of more than .8 Inches.

10. Whole Shoe Flex Test – Footwear functionality shall be determined by flexing the specimen for 100,000 cycles performed in accordance with Appendix B of FIA 1209, Whole Shoe Flex as specified in 8.6.14.11 of NFPA 1971 2013 edition.

    Conclusion: Footwear with evidence of liquid leakage, sole separation and or seam separation shall be a failure.

11. Slip Resistance Test –The protective footwear shall be tested for slip resistance as specified in Section 8.40 of NFPA 1971 2013 edition.

    Conclusion: The boot sole shall have a coefficient of friction of 0.40 or greater.

12. Abrasion Resistance Test –The protective footwear soles and heels shall be tested for resistance to abrasion as specified in Section 8.23 of NFPA 1971 2013 edition. Abrasion resistance tests shall be performed in accordance with ISO 4649, Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device, Method A, with a vertical force of 10 N over an abrasion distance of 40 m.

    Conclusion: The footwear soles shall not lose greater than 200mm3 of their volume.

13. Electrical Insulation Test 2 –The protective footwear shall be tested for resistance to electricity as specified in Section 8.31 of NFPA 1971 2013 edition. Sample footwear shall be tested to14,000 V(rms) in accordance with Section 9 of ASTM F 2412, Standard Test Method for Foot Protection. The electrode inside the boot shall be conductive metal shot.

    Conclusion: The footwear shall have no current leakage in excess of 3.0 mA.

Glove performance requirements

1. Whole Glove Thermal Protective Performance Test – (TPP)The glove body composite shall be tested in as specified in Section 8.10 of NFPA 2071 edition 2013, and in accordance with ISO 17492, Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat.

   Conclusion: The glove body composites shall have an average TPP rating of greater than 55.

2. Whole Glove Conductive Heat Resistance Test –The glove body composite shall be tested for thermal insulation as specified in Section 8.37 of NFPA 2071 edition 2013. Specimens shall be tested in accordance with ASTM F 1060, Standard Test Method for Thermal Protective Performance of Materials for Protective Clothing for Hot Surface Contact, with the following modifications: Specimens shall be tested using an exposure temperature of 280°C (536°F). A pressure of 3.45 kPa ± 0.35 kPa (0.5 psi ± 0.05 psi) shall be applied during the test.

   Conclusion: The glove body shall have a second-degree burn time of not less than 10 seconds, and shall have a pain time of not less than 6 seconds.

3. Whole Glove Heat and Thermal Shrinkage Resistance Test – Whole gloves shall be tested for resistance to heat as specified in Section 8.6 of NFPA 2071 edition 2013, and shall be as specified in ISO 17493, Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven.

   Conclusion: The glove shall not melt, separate, or ignite; shall not shrink more than 20 percent in length or width; shall be donnable; and shall be flexible.

4. Glove Lining Heat and Thermal Shrinkage Resistance Test – The glove lining materials of the glove body shall be individually tested for resistance to hea as specified in Section 8.6, of NFPA 2071 edition 2013. Heat and Thermal Shrinkage Resistance Test, and shall be as specified in ISO 17493, Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven.

   Conclusion: The glove lining shall not melt, separate, or ignite.

5. Whole Glove Barrier Breathability Test –The whole gloves shall be tested for breathability as specified using ASTM E-96, Method B in MIL-DTL-44420A.

   Conclusion: The whole gloves must have a minimum of 580 gm./m2/24 hours using ASTM E-96, Method B as specified in MIL-DTL-44420A.

6. Glove Barrier Breathability Test A –The glove moisture barrier shall have a minimum breathability required using ASTM E-96, Method BW as specified in MIL-DTL-44420A.

   Conclusion: The glove moisture barriers must have a minimum of 5500 gm./m2/24 hours of breathability.

7. Glove Barrier Breathability Test B –The glove moisture barrier shall have a minimum breathability required using ISO 15496.

   Conclusion: The glove moisture barrier shall have a minimum of 4300 gm./m2/24 hours of breathability.

8. Whole Glove Resistance To Cut Test – (7.7.12) the glove body composites shall be evaluated as specified in Section 8.21 of NFPA 2071 edition 2013.and in accordance with ASTM F 1790, Standard Test Methods for Measuring Cut Resistance of Materials Used in Protective Clothing, with the modification that specimens shall be tested to a specific load with the measurement of cut distance.

   Conclusion: The blade will travel no more than or .8 inches and will not achieve a complete cut through of glove composites.

9. Whole Glove Resistance To Puncture Test – The glove body composites shall be tested as specified in Section 8.21 of NFPA 2071 edition 2013, and in accordance with ASTM F 1342, Standard Test Method for Protective Clothing Material Resistance to Puncture, Test Method A.

   Conclusion: The glove body composites shall not be punctured under a force of at least 40 N.

10. Glove Liner Retention Test – Gloves shall be tested for retention of the glove liner. Liner retention shall be evaluated Gloves shall be tested utilizing the test method explained in NFPA 2071 – 2013 edition, section 8.62.

    Conclusion: Each digit shall be inspected for indication of detachment of inner liner and/or moisture barrier. Failure of any digit of any glove shall constitute failure.

11. Whole Glove Liquid Integrity Test – Gloves shall be tested for resistance to leakage utilizing the test method explained in NFPA 2071 – 2013 edition, section 8.32.

    Conclusion: The appearance of any watermark on the inner glove after testing any glove shall be considered leakage and shall constitute failing performance.

12. Whole Glove Leak Test – The whole gloves shall be tested for moisture barrier leakage using air as specified in MIL-DTL-44420A test method.

    Conclusion: 100% of finished gloves must pass the Whole Glove Leak test with air as specified.

13. Whole Glove Leak Test after Thermal Exposure – Whole gloves shall be tested for moisture barrier leakage using air as specified in MIL-DTL-44420A after exposure to an elevated temperature of 500°F for a duration of 5 minutes.

    Conclusion: 100% of all finished gloves must pass the Whole Glove Leak test with air as specified.

14. Glove Barrier Breaking Force and Elongation Strength Test – The glove barrier cut-strip-break strength shall have a minimum using ASTM D5035-90 as specified in MIL-DTL-44420A

    Conclusion: The glove moisture barrier must have a minimum strength of lbs. of cut-strip strength.

15. Glove Barrier Burst Strength Test – The glove moisture barrier shall have a minimum of burst strength using ASTM D751 as specified in MIL-DTL-44420A.

    Conclusion: The glove moisture barrier shall have a minimum of burst strength of 20 lbs.

16. Glove Barrier Universal Wear Abrasion Test – The glove moisture barrier shall be abrasion resistant using Glove Barrier Water Permeability after as specified in MIL-DTL-44420A

    Conclusion: The glove moisture barrier must show no leakage after 150 cycles.

17. Glove Barrier Burst Strength Test – The glove moisture barrier shall have a minimum burst strength after exposure to chemicals including DEET as specified in MIL-DTL-44420A

    Conclusion: The glove moisture barrier shall have burst strength of at least 10 psi for 2 minutes.

18. Whole Glove Hand Function Test – Gloves shall be tested for hand function as specified in Section 8.37 of NFPA 2071 edition 2013. The apparatus shall be as specified in ASTMF 2010, Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test.

    Conclusion: The whole gloves shall have an average percent of barehanded control not exceeding 220 percent.

19. Whole Glove Grip Test -Gloves shall be tested for grip; each specimen glove pair shall be tested as a complete set of gloves. Gloves shall be tested utilizing the test method explained in NFPA 2071 – 2013 edition, section 8.38.

    Conclusion: Each pair of gloves shall not have a drop of more than 30 percent from the peak pull force value.

20. Whole Glove Torque Test – Torque testing shall be evaluated utilizing the test method explained in NFPA 2071 – 2013 edition, section 8.72.

    Conclusion: The whole glove shall have an average percent of barehanded control not less than 80 percent.

21. Whole Glove Donning Test – Gloves shall be tested for ease of donning. Gloves shall be tested utilizing the test method explained in NFPA 2071 – 2013 edition, section 8.36.

    Conclusion: The whole glove shall have the dry hand donning time not exceed 10 seconds, shall have the wet hand donning time not exceed 30 seconds, shall have no detachment of the inner liner, shall have no detachment of the moisture barrier, and shall allow full insertion of all digits.

Firefighting Protective Hoods

Hood performance requirements:

1. Thermal Protective Performance (TPP) Test -Hoods shall be tested for thermal insulation.

   Conclusion: The hoods shall have an average TPP rating of not less than 25.

2. Heat and Thermal Shrinkage Resistance Test - Hoods, shall be individually tested for resistance to heat.

   Conclusion: The hoods shall not shrink more than 10 percent.

3. Heat and Thermal Shrinkage Resistance Test - Hoods shall be individually tested for resistance to heat.

   Conclusion: The hood shall not melt, separate, or ignite.

4. Limiting Oxygen Index (LOI) – Hoods shall be individually tested to ASTM D2863. The Limiting Oxygen Index measures the amount of oxygen required in the environment for a fabric to support combustion.

   Conclusion: The blend of fibers making up the hood shall have a LOI rating of 28 or better.

5. Cleaning Shrinkage Resistance Test -(7.13.6) Hoods shall be individually tested for resistance to shrinkage.

   Conclusion: The hood shall not exhibit shrinkage of more than 10 percent, and shall have the hood-opening meet the requirements specified when new.

6. Burst Strength Test -Knit hood material(s) shall be tested for material strength.

   Conclusion: The hood shall have burst strength of not less than 225 N.

Conclusions

This Spokane Fire Department Risk Assessment clearly demonstrates the need for Structural PPE garments that exceed the minimum NFPA 1971 requirements as follows:

1. The outer shell must be composed of fibers that have superior performance to a xenon light test that replicates the extremes of exposure to UV and visible light.

2. The SFD structural ensembles are worn on many responses (7,102 in 2014). The percentage of fire responses requiring thermal protection has declined over the years

however given the fuel loading with highly combustible contents a high degree of thermal protection is still needed. Additionally, as ourresponses have increased in other areas such as rescue, traffic collisions, etc. the SFD recognizes the need for a durable garment emphasizing an increased need for abrasion performance.

Therefore, regarding the Structural PPE Ensemble, the SFD:

1. Requires structural jackets and pants to have a composite TPP rating greater than 37.
2. Requires structural jackets and pants to have a composite THL rating greater than 220.
3. Will utilize fabrics for the outer shell that maintains protection after thermal exposure consistent with the conditions found in a structural fire flashover. Specifically, the outer shell will have tensile strength of at least 50 lbs. after a 17.5 second NFPA TPP exposure of 2Cal/cm2/seconds.
4. Requires that the outer shell fabric must have superior performance for abrasion resistance and show no excessive wear upon visual inspections after 3000 cycles of Taber Abrasion Testing.
5. Requires that the outer shell fabric must have superior tear strength to resist tears from sharp edges and tearing hazards measured by a minimum score of 50 lbs. (Warp) and 50 lbs. (Fill) for initial testing and 40 lbs. (Warp) and 40 lbs. (Fill) after five launderings in accordance with NFPA 1971 test methods. No fabric slippage or filament pull through will be allowed.
6. Requires that the outer shell fabric must have tensile strength to resist breaking open, measured by a minimum score of 240 lbs. (Warp) and 280 Lbs. (Fill) for initial testing and 240 Lbs. (Warp) and 275 (Fill) after ten launderings in accordance with NFPA 1971 test methods.
7. Requires superior facecloth wickability to protect firefighters from potential burn injuries, reduce firefighter fatigue, and improve fire ground performance. Additionally, the SFD defines acceptable superior facecloth wickability performance as 10 seconds or less using the American Association of Textile Chemists and Colorists (AATCC) Test Method 79-2010; Absorbency of Textiles.
8. Requires a rating of 4 (Slight Pilling) or 5 (No Pilling) both before and after washing agitation.
9. Will use multiple layers (two layers) of spunlace technology to decrease the likelihood of compression burns.

To achieve required protection, the SFD moisture barrier shall be constructed of bi-component ePTFE membrane technologies. The moisture barrier material shall meet all moisture barrier requirements of NFPA 1971-2013 edition, which includes water penetration, viral penetration resistance and common chemical penetration resistance.

The SFD requires a maximum evaporative resistance value of 36 m2 Pa/W, in accordance with the Hohenstein scale, ideally with evaporative resistance values of less than 30 m2 Pa/W.

The SFD moisture barrier laminate shall not show an increase of more than 2.0 m2 Pa/W from its initial water–vapor resistance (Ret) after being exposed to an elevated temperature of 260°C (500° F) for 5-minutes when tested according to ISO 11092, Textile-Physiological-Measurements of thermal and water vapor resistance under steady-state conditions (sweating guarded-hotplate test).

The SFD requires a minimum result of 200 hours with no leakage according to ASTM D-751, Hydrostatic Resistance, Procedure B, Procedure 2.

The SFD requires the fluorescent yellow-green garment trim to maintain a minimum RA of 350 or greater when measured at 0.2 degree observation angle/5 degree entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

SFD Helmets must transmit a force to the wearer of less than 2200 Newtons during impact, maintain sufficient structural integrity to withstand impacts in all five test locations, have no penetration of the helmet during the Physical Penetration Resistance Test, and shall not leak more than 3.0 mA during the Electrical Insulation Test. Additionally, the helmet shell shall not separate from the suspension with 45 N applied, the chinstrap shall not break, nor stretch more than .8125" when tested in accordance with NFPA 1971, 2013 edition, sections 8.35 through 8.36, and shall not weigh more than 4.5 Lbs.

SFD Footwear shall meet the following minimum criteria when tested as indicated in the body of this document: The temperature of the insole surface in contact with the foot nor the upper surface in contact with the skin shall not exceed 111 F. The temperature of the upper lining surface in contact with skin shall have a second-degree burn time of not less than 10.0 seconds, and shall have a pain time of not less than 6.0 seconds. The boot components shall not have an after flame of more than 5.0 seconds, shall not melt or drip, and shall not exhibit any burn-through, and footwear shall not have any part of the footwear melt, separate, or ignite; shall show no water penetration; and shall have all components remain functional. The boot upper material shall allow no penetration of the test liquids for at least 1 hour, shall not have a complete cut through after a cut distance of more than .8 Inches, and shall not allow any puncture to the footwear upper after an average applied force of 13 LBF. Additionally, the boot

shall allow no penetration of the Phi-X-174 bacteriophage for at least 1 hour, shall have no current leakage in excess of 3.0 mA, and the footwear soles shall not lose greater than 200mm3 of their volume to shrinkage, and shall have a coefficient of friction of 0.40 or greater.

SFD Gloves shall meet the following minimum criteria when tested as indicated in the body of this document: The glove body composites shall have an average TPP rating of greater than 55 and a second-degree burn time of not less than 10 seconds, and shall have a pain time of not less than 6 seconds. The glove shall not melt, separate, or ignite; shall not shrink more than 20 percent in length or width; shall be donnable and flexible; and the glove lining shall not melt, separate, or ignite. The whole glove shall have the dry hand donning time not exceed 10 seconds, shall have the wet hand donning time not exceed 30 seconds, shall have no detachment of the inner liner, shall have no detachment of the moisture barrier, and shall allow full insertion of all digits. The whole gloves shall have an average percent of barehanded control not exceeding 220 percent, and not less than 80 percent. The glove body composites shall not be punctured under a force of at least 40 N. The glove moisture barrier shall have a minimum of burst strength of 20 lbs, show no leakage after 150 cycles, have burst strength of at least 10 psi for 2 minutes, and have a minimum of 5500 gm./m2/24 hours of breathability. 100% of finished gloves must pass the Whole Glove Leak test with air as specified.

SFD Protective Hoods shall meet the following minimum criteria when tested as indicated in the body of this document: The hoods shall havean average TPP rating of not less than 25, not shrink more than 10 percent, and shall not melt, separate, or ignite. The blend of fibers making up the hood shall have a LOI rating of 28 or better, shall not exhibit shrinkage of more than 10 percent, and shall have the hood-opening meet the requirements specified when new, and shall have burst strength of not less than 225 N.

Figure D.4(c) Addison, Texas Fire Department All Hazard PPE Risk Assessment.

Addison Fire Department
All Hazard PPE Risk Assessment

1. SCOPE

1.1 This document will serve as the Addison Fire Departments PPE All hazard Risk Assessment (RA). The primary focus is to establish requirements for the design, performance and testing of protective ensembles and ensemble elements that provide head, limb, hand, foot, torso, and interface protection for firefighters and other emergency service responders. Evaluation of current structural firefighting operations are essential to determine overall risk and potential environmental hazards; by extension essential to determination of agency specific Personal Protective Equipment (PPE) requirements and liabilities. (Reference NFPA 1971) Analysis of incidents involving structural firefighting operations should be considered when evaluating needed protection from the potential hazards associated with structural firefighting that the fire agency is responsible for protecting as defined in NFPA 1971.

2. PURPOSE

2.1 The purpose of the RA is to provide the most suitable firefighting ensembles and ensemble elements for the Departments firefighting personnel. The RA assists the organization to evaluate the risks and hazards their emergency responders face. Based on the identified risks and hazards and other agensy specific needs, each protective clothing element is evaluated to ensure it provides the emergenccy responders with the most effective protection from the identified risks and hazards. This assessment will follow established guidelines for RA outlined in the following laws and standards: NFPA 1851, NFPA 1500, OSHA 1910.132. Although these articles originate from different Professional and/or Legal entities, all require a *"Risk Assessment" or "Hazard Assessment"* be completed.

3. EXECUTIVE SUMMARY

3.1 Paragraph 1.2.4 of NFPA 1971, Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting (2013 Edition) states that this standard shall not be utilized as a detailed manufacturing or purchasing specification but shall be permitted to be referenced in purchase specifications as the minimum requirements.

4. ABSTRACT

4.1 PPE has evolved over the years to provide better protection from injury and illness resulting from exposure to hazards. The Addison Fire Department provides PPE to protect firefighters from potential hazards they may encounter while performing their work. There are three levels of protection serving firefighters in the field:

–Administrative Controls

–Engineering Controls

–PPE

4.2 Administrative Controls are policies and procedures that teach and direct Individuals how to recognize and prevent workplace exposures, injuries, and illnesses.

4.3 Engineering Controls are used to remove hazard(s) from the workplace. Such controls include shutting off the utilities at a structural fire, establishing physical barriers such as seat belts or Lock out/Tag out procedures and barricades to isolate the firefighter from physically encountering the hazard.

4.4 When exposure to hazards cannot be eliminated through administrative or engineering controls, PPE such as gloves, boots, safety glasses, garments, and respirators can be used to create a barrier between responders and the hazard(s). PPE is the basic control measure, as it does not remove the hazard. PPE will protecct the firefighter so long as it is used in a manner that is within design specifications and limitations. PPE is meant to reduce the firefighter's exposure to acceptable levels when other functions of control are not feasible or effective.

4.5 The intent of this risk assessment is to assist our department officials in updating and clearly defining the standard for proper protection levels.

4.6 This risk assessment is used a baseline to establish the duties and responsibilities as defined in the addison fire department standard operating procedures. Special risk is defined as services performed by Addison Fire Department personnel deemed to be outside the scope of the duties and responsibilities defined in our standard operating procedures, and are not included in this risk assessment.

4.7 Daily response exposes firefighters to hazards that effect both the interior and exterior environments relative. During prolonged activities, environmental conditions increase the hazard and risk to the firefighters. The Addison Fire Department has identified the priority and severity of hazards that firefighters are exposed to and provides the appropriate PPE to maximize protection from potentially harmful exposures. These protective ensembles must be capable of protecting the firefighter during progressive fire operations up to and including "flashover" protection. Tactics for safe fire operations are taught through the direction of the Addison Fire Department Training Division and conforms to the standards of the Texas Commission on Fire Protection. The addison Fire Department maintains an expectation that firefighters will function within these conditions. The Addison Fire Department provides and maintains PPE that is compliant with NFPA 1971; *Standard on Protective Ensembles for Structural Firefighting and Proximity Firefighting* (2013 Edition). To provide a protective ensemble that is suitable and appropriate, this assessment is based on known exposure, illness, injury, and fatality producing incidents regardless of frequency.

4.8 The health risks and safety hazards identified in this risk assessment are based on the requirements of NFPA 1851; *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Firefighting and Proximity Firefighting* (2014 Edition) and supported by research conducted by the Addision Fire Department.

5. DISCUSSION

5.1 All forms of PPE have design and performance standards and within those standards have llimitations. It is imperative that firefighters understand the protection limitations of their PPE to avoid incorrect use or reliance on an item intended to protect them from harm but may contribute to injury and/or illness if used incorrectly. 29 CFR OSHA 1910 requires the education of all employees concerning the limitations of PPE.

5.2 PPE is meant to reduce the firefighter's hazard exposure to acceptable levels when other means are not feasible or effective. However, all PPE has its protective limitations. When those limitations are exceeded, the wearer can be exposed to even greater harm. There are a few terms that firefighters should be familiar with in order to better understand the performance expectations and limitations of their PPE. Terms such as: flashover, backdraft, chemicl exposure, hazardous materials, terrorist attacks, etc. This is not an inclusive lsit for the user.

6. FIREFIGHTER DUTIES AND RESPONSIBILITIES

6.1 The Addison Fire Department like most career "ALL RISK" fire departments maintains a progressive strategy and tactics for the suppression of fires. Addison firefighters are exposed to all phases of fire progression including incipient, free burning, rollover, flashover, backdraft and smoldering. Throughout these fire phases Addison firefighters will be exposed to a range of temperatures from moderate through extreme based on the activities, funstions, or tasks being performed as identified in this section. Additionally, firefighters are exposed to this varying temperature range at training exercises including "live fire" drills conducted throughout the year. The PPE used by Addison firefighters must be capable of providing protection for firefighters at the highest anticipated temperature.

6.2. Activity Types

Fire Suppression

- Bulk fuel storage (defensive mode)
- Bulk fuel transport (defensive mode)
- Bulk fuel transport (defensive mode)
- Vehicle (offensive and defensive mode)

• Other (offensive and defensive mode)

Functions or Tasks: Fire Suppression

• Drive/operate apparatus

• Deploy attack lines

• Engage in offensive fire attack

• Engage in defensive fire attack

• Engage in transitional fire attack

• Deploy/operate

• Appliances

• Hand line

• Nozzles

• Master streams

• Deploy/operate adapters

• Wyes/Siamese

• Adaptors

• Deploy/operate supply lines

• Deploy ladders

• Operate from ladders

• Deploy hand tools/equipment

• Operate hand tools/equipment

• Pulling

• Prying

• Chopping

• Cutting

• Deploy powered equipment

• Operate powered equipment

• Don/doff SCBA

• Work from SCBA air supply

• Support activities

Rescue

• Structural

• Vehicle

• Confined space

• Collapse

Rescue Operations

• Drive/operate apparatus

• Deploy ladders

• Operate from ladders

• Deploy/operate hand

• Tools/equipment

- Pulling
- Prying
- Chopping
- Cutting
- Deploy/operate powered equipment
- Don/doff SCBA
- Work from SCBA air supply
- Deploy/operate stabilization equipment
- Structural stabilization
- Vehicle stabilization
- Trench stabilization
- Deploy/operate confined space lowering/lifting equipment
- Deploy/operate high angle lowering/lifting equipment

7. STATEMENT OF ACCEPTABLE RISK

7.1 Acceptable Risk – Acceptable risk varies and is the responsibility of each department to identify what the acceptable risk is while conducting operations.

7.2 The acceptable level of risk is directly related to the potential to save lives or property. Where there is no potential to save lives, the risk to Addison Fire Department members should be evaluated in proportion to the ability to save property of value. When there is no ability to save lives or property, there is no justification to expose Addison Fire Department members to any avoidable risk, and defensive fire suppression operations are the appropriate strategy, even though defensive operations are not completely without exposure to hazards.

7.3 When considering acceptable risk to firefighters, the Addison Fire Department employs the following rules of engagement after evaluating the survival profile of any victims and the value of any property involved.

7.3.1 We will risk our lives a **LOT**, in a calculated manner, to save a **SAVABLE life.**

7.3.2 We will risk our lives a **LITTLE**, in a calculated manner, to save **SAVABLE property.**

7.3.3 We will **NOT**, risk our lives at all for lives or property that are **NOT SAVABLE** or already lost

8. EXPECTATION OF EXPOSURE/REASONABLE MAXIMUM EXPOSURE (RME)

8.1 Thermal Hazards. The NFPA develops minimum standards for PPE. The NFPA recognized that not all departments require the same level of protection for reasons such as:

- Operational/Training Standards – The Addison Fire Department conducts iinterior attack operations requiring the proper level of protection (TPP) to ensure firefighter safety. It is sometimes impossible during interior firefighting operations to move away from a heat source.

- Response Times – Response times are critical when determining the protection values of PPE. The Addison Fire Department has response times that allow for interior attack during incipient and free burning fires. These conditions mandate PPE that is capable of protecting firefighters during flashover conditions or high radiant heat conditions.

- Reasonable Maximum Exposure – RME, takes into consideration the combination of response times, building construction, and contents normally found in structures. Training standards and Standard Operating Procedures identify “Flashover Condiitons” and/or direct flame impingement for short periods of time as the Reasonable Maximum Exposure for the Addison Fire Department.

8.2 Chemical Biological Radiation Nuclear (CBRN) Response.

8.2.1 Addison Fire Department operations defined in this assessment are both man-made and natural incidents; fire suppression and hazard mitigation, rescue, limited mitigation or containment of releases of hazardous materials (HazMat), such as CBRN agents, resulting from industrial accidents, terrorism, or weapons of mass destruction (WMD); and emergency medical support.

Chemical Hazards. Addison firefighters respond to HazMat emergencies as first responders only. The layer of the structural ensemble composite material that protects firefighters against chemical hazards is the “mositure barrier.” If deemed appropriate, ensemble may be worn during HazMat incidents.

Biological Hazards. The Addison Fire Department responds to all types of incidents. Biological hazards are frequently encountered during Emergency Medical Services (EMS) incidents. Typical biological exposures to firefighters wearing PPE occur during response to traffic collisions and other rescue type incidents when body fluid is encountered. Biological hazards can also be encountered during initial response to HazMat incidents. In either case, the Addison Fire Department will wear PPE to these incidents. The layer of the structural PPE composite that protects firefighters against biological hazards is the “moisture barrier.”

Radiation and Nuclear Hazards. The Addison Fire Department has the potential to respond to incidents involving radiation and nuclear hazards. Although these hazards are very infrequent, firefighters can find themselves exposed to radiation while answering calls for service, including terrorist attacks. Current PPE provides little or no protection for firefighters against radiation and nuclear hazards.

8.3 Health Risks and Safety Hazards Expected to be encountered by Addison firefighters:

8.3.1 Physiological:

- Physical stress
- Fatigue
- Body core temperature

8.3.2 Physical:

- Sharp edges
- Sharp points
- Falling objects
- Flying debris
- Projectiles
- Splash exposure
- Slippery surfaces
- Vibration
- Abrasive or rough surfaces

8.3.3 Physics:

- Stored thermal energy (heat saturation)
- Thermal energy migration
- Compression

8.3.4 Biological Hazards:

- Blood borne pathogens
- Blood and other potentially infectious body material
- Airborne pathogens
- Biological toxins
- Biological allergens

8.3.5 Electrical Hazards:

- High voltage
- Electrical arc
- Static charge buildup

8.3.6 Radiation Hazards:

- Ionizing radiation
- Non-ionizing radiation

8.3.7 Flame/Thermal:

- Radiant heat
- Convective heat

• Conducted heat

• Flame impingement

• Flashover

• Backdraft

• Burning embers

• Steam

• Scalding water

• Molten metals

• Hot surfaces

8.3.8 Environmental:

• Time of day

• Ambient temperatures

• Humidity

• Internal moisture

• Inside the protective element

• External moisture

• Confined or small spaces

• Rain

• Snow

• Ice

• Wind

• Others

8.3.9 Hazardous Materials & Substances:

• Explosives

• Compressed Gasses

• Flammable Liquids

• Flammable Solids Oxidizers

• Poison

• Radioactive

• Corrosives

• Miscellaneous

• Other Regulated Materials Liquids

• Fuels

• Motor fuels

• Propellants

• Hydraulic fluids

• Lubricants

• Chlorine

• Blood or other potentially infectious body materials

• Alkaline

• Acids

• Battery Acid

• Oxidizers

• Others Liquefied gases

• Oxidizers

• Liquid Oxygen (LOX)

• Liquid Propane Gas (LPG)

• Others

• Compressed gasses

• Oxidizers

• Air

• Oxygen

• Nitrogen

• Helium

• Others Solid chemicals

• Firefighting agents

9. GEOGRAPHIC LOCATION AND CLIMATE

9.1 Addison firefighters experience both heat and cold based upon the typical climate in the North Central Texas area. These temperatures are associated with various levels of humidity. During the typical year high heat creates more of a hazard to firefighter safety than the impacts of cold. Typical temperatures range from lows in the 20s to highs above 100. The impacts of a hot environment require a structural ensemble that has a Total Heat Loss (THL) above the NFPA minimum of 205. The Addison Fire Department requires a THL of 246.38 to help reduce heat stress injuries to firefighters.

10. FREQUENCY OF USE

10.1 According to the Addison Fire Departments reporting system, Addison firefighters responded to a total of 2622 emergencies in calender year 2014. This section of the risk assessment focuses on PPE frequency of use based specifically on our emergency response data and is explained utilizing the following charts reflecting the activity type, thermal activity, and durability.

10.2 Frequency of use is defined as:

Limited – lowest thirty percentile (1 to 30%)
Moderate – median thirty percentile (31 to 60%)
Often – upper forty percentile (61 to 100%)

10.3. PPE use reflecting on activity type.

Activity	Percentage	Frequency
Suppression Activities	16.85%	limited
EMS/Rescue	64.34%	often
Miscellaneous Responses	14.25%	limited
Hazardous Conditions	4.50%	limited

10.7 PPE use reflecting thermal activity.

Activity	Percentage	Frequency
Thermal	3.01%	limited
Non Thermal	96.9%	often

Conclusion/Decision: Addison Fire Department structural ensembles are worn on many responses. The percentage of fire responses requiring thermal pprotection has declined over the years however given the fuel loading with highly combustible contents a high degree of thermal protection is still needed. Additionally, as our responses have increased in other areas such as EMS, rescue, traffic collisions, etc. the Addison Fire Department recognizes the need for a durable garment emphasizing an increased need for abrasion and ripping performance.

11. THERMAL PROTECTIVE PERFORMANCE (TPP)

11.1. TPP is the primary test for evaluating layered, or composite fabrics worn as PPE for Structural Fire Protective Garments (SFPG). In accordance with NFPA 1971, protective garment elements composite fabrics consisting of outer shell, moisture barrier, and thermal barrier shall be tested for thermal insulation and shall have an average TPP of not less than 35.0. The test uses an exposure heat flux representative of the thermal energy present in a flashover. It should be noted that this is a harsh test exposure and does not represent conditions in which firefighters are intended to work. It measures the ability of the composite fabrics to provide a few seconds to escape from such an exposure.

11.2 The actual TPP rating is double the amount of time it takes for a second degree burn to occur at an exposure level of two calorie per centimeter squared (2.0 Cal/cm2). For example, a TPP of 35 equals 17.5 seconds of protection before a scond-degree burn occurs.

11.3 The TPP formula does not take into account critical factors that reduce the composite's ability to protect the firefighter. Specifically, factors such as stored energy, moisture, garment cleanliness, etc. will reduce the composite's TPP performance. In some cases a burn injury can occur within 1 to 3 seconds.

11.4 The Addison Fire Department recognizes a five percent (5%) variance in fabric weight, which is the industry standard. In addition, NFPA 1971 allows for an 8 percent variance in the TPP test.

11.5 The Addison Fire Departments current fabric composite (Outer Shell/Moisture Barrier/ Thermal Liner) is Gemini XT/Caldura SL2/Crosstrech Black, giving a TPP rating of 40.8.

Conclusion/Decision: The Addison Fire Department requires a minimum composite TPP rating of 40.

12. RADIANT PROTECTIVE PERFORMANCE (RPP)

12.1 RPP is the primary test for evaluatiing PFPG outer shell layers, unllike TPP and THL that test all three layers. RPP measures the amount of radiant energy passing throught the outer shel layer and can be translated into the amount of time (in seconds) before the wearer will suffer a second-degree burn. Inaccordance with NFPA 1971, the outer shell fabric is assigned a RPP

value by measuring the intersect of where the temperature on the sample crosses the Stoll Curve (which quantifies the level of heat and the duration of time required for a second-degree burn for a wide range of exposure conditions) when exposed to a two calorie per centimeter squared (2.0 cal/cm2) radiant energy source. The minimum RPP value in accordance with NFPA 1971 is 20 seconds.

12.2 The Addison Fire Department experiences high radiant heat exposure when conducting firefighting operations. This exposure can occur during defensive operations involving fully or highly involved structural fires, vehicle fires, bulk flammable gas fires, bulk flammable liquid fires and aircraft fires.

The Addison Fire Department's strategy and tactics when fighting high intensity fires with extreme radiant heat exposure is to utilize the apparatus as protection and/or distance from the high radiant heat and master streams to modify the environment. These master streams are available on both standard structural firefighting apparatus and airport crash rescue apparatus. This tactic allows firefighters to modify the environment and lower the radiant heat exposure. When the radiant heat exposure is controlled firefighters can safely approach the incident outline above. Hand lines are utilized only after master streams have modified the environment to allow for safe firefighter operations. Therefore, this tactic allows for NFPA 1971 2013 Edition for Structural Ensembles as appropriate protection for firefighters.

CONCLUSION

The Addison Fire Department requires protective ensemble in accordance with NFPA 1971 2013 Editiion for Structural firefighting.

13. TOTAL HEAT LOSS (THL)

13.1 THL is another primary test for evaluating layered, or composite fabrics worn as structural PPE. THL is a performance requirement for evaporative heat ransfer. It measures how well the garment composite (outer shell, moisture barrier, and thermal barrier) allows heat and moisture vapor to transfer away from the wearer, thus helping to reduce heat stress. The test involves placing a fabric or composite sample over a porous heated plate meant to represent the human skin. In accordance with, NFPA 1971, garment composite fabrics consisting of the outer shell, moisture barrier, and thermal barrier shall be tested for evaporative heat transfer and shall have a THL of not less than 205 kW/m2.

13.2 Heat transfer is determined by measuring the energy required to maintain a specific temperature as heat is transferred through the clothing system to the outside environment. Both dry and wet tests are performed on the test samples. The dry tests yield heat loss associated with conductive heat transfer. The wet tests yield heat loss associated with moisture evaporation and transmission. The test yields a total heat loss figure, which represents the amount of energy that can be transferred through a given area of the fabric or composite material under the specific conditions of the test.

13.3 It is important to understand that TPP and THL work inversely; meaning the higher the TPP rating, the lower the THL rating and vice versa. Generally speaking, in order to have greater protection against radiant or convective heat, you need to have thicker or heavier fabrics that will inherently impede the ability for physiological heat to move through it from the body to the outside environmennt. It should be understood that small differences in THL might be difficult for firefighters to distinguish in the field. It might take 20 to 25 $kW/.m^2$ or more, depending on the individual and the conditions, to be felt by the wearer.

13.4 The Addison Fire Department current fabric composite (Outer Shell/Moisture Barrier/Thermal Liner) is Gemini XT/Caldura SL2/Crosstech Black, giving a THL rating of 246.38.

Conclusion/Decision: The Addison Fire Department requires a composite THL rating of 240.

14. OUTER SHELL REQUIREMENTS

14.1 Thermal Hazards

14.1 The outer shell is capable of withstanding flashover conditions and remain flexible without breaking open. Outer shells that become brittle and potentially break open will not protect the thermal liner, which is critical in preventing burns.

Conclusion/Decision – Outer Shell: The Addison Fire Department will utilize fabrics for the outer shell that maintains protection after thermal exposure consistent with the conditions found in structural fire flashover.

14.2 Physical Hazards

14.2.1. PPE shall be worn to all structure fires, petroleum fires/incidents, roadway incidents such as traffic collisions, rescue incidents, hazardous materials incidents, vehicle fires and dumpster/refuse fires. Therefore, this risk assessment considers the proportional response types and the physical hazards that exist in each response situation.

14.2.2. The frequency and severity of physical hazards greatly varies between incidents. To complete the physical hazard section of this document, it was necessary to understand how the “majority” of Addison Fire Department PPE is damaged. This informaiton was captured by assessing how the majority of PPE is damaged within their stations. The Addison Fire Department was trained by independent service providers (ISP) to help determine what physical hazards represent the greatest threat to the PPE. This is completed through the annual inspection process. Sppecifically, what type of repair causes the highest occurrence of placing a garment out-of-service.

14.2.3. The results of the analysis found that the most significant physical hazard putting the ensemble out-of-service results from the weakening or thinning of the fabric through abrasion. When the fabric is weakened by abrasions there is a greater likelihood of tears and rips. These findings are consistent with Addison Fire Department operations and progressive training scenarios. During these interior firefighting operation firefighters are trained to stay as low to the ground as possible to avoid extreme temperatures at elevated levels. To accomplish this firefighters are required to kneel and crawl whenever necessary. Firefighters are also trained in conducting primary and scondary searches inside structures. Search techniques require firefighters to maintain contact with interior walls as they progress through the structure. Maintaining contact is accomplished by keeping legs, arms shoulders etc in contact with the interior walls. Significant abrasion of the outer shell rotinely occurs during the operations described above causing damage to the outer shell. Abrasion resistance performance is almost exclusively a performance characteristic of the outer shell of the garment.

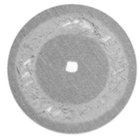
14.2.4. Though tearing was identified as a significant hazard most tears outside of high abrasion areas were within acceptable repair standards. Outer Shell fabric repairs related to abrasion damage was more common in placing a garment out-of-service. Additionally, tearing was typically in areas where the outer shell fabric was weakened by abrasion.

14.2.5. Abrasion testing for the outer shell materials are conducted using the Taber Abrasion Testing methodology in accordance with ASTM D 3884-01.

Conclusion/Decision: The Addison Fire Departments outer shell fabric (Gemini XT) must have superior performance for abrasion resistance and show no excessive wear upon visual inspections after 4000 cycles of Taber Abrasion Testing. Note: Current fabrics on the market range from 0 – 5,000 cycles.

14.2.5.1. Example of fabric meeting the Addison Specification

14.2.5.2. Example of fabric not meeting the Addison Specification



14.2.5 Tear Strength. Fabric strength for the outer shell is conducted using the Trapezoidal Tearing Test in accordance with ASTM D 5587 on both laundered and unlaundered samples. NFPA 1971 standards for trapezoidal tear strength is measured by a minimum score of 22 lbs. These performance requirements ensure that the outer shell has superior tear strength to resist tears from sharp edges and tearing hazards. The NFPA standard calls for fabric samples to be tested without slippage or filament pull through.

Conclusion/Decision: The outer shell fabric must have superior tear strength to resist tears from sharp edges and tearing hazards measured by a minimum score of 50 lbs. (Warp) and 50 lbs. (Fill) for initial testing and 40 lbs. (Warp) and 40 lbs. (Fill) after five launderings in accordance with NFPA 1971 test methods. No fabric slippage or filament pull through will be allowed.

14.3 The addison Fire Department's PPE is exposed to sun and ultraviolet light. This condition exists for two primary reasons. PPE is stored in semi protected areas in the apparatus bays exposing the PPE to damaging effects of sunlight. Currently station #1 does not allow for the storing of PPE in completely protected environments. PPE is typically stored in wire mesh or open lockers in the apparatus bays, which does not protect the PPE from ultraviolet light or diesel engine exhaust. Industry experts agree that ultraviolet light exposure is one of the most significant threats to the performance of PPE.

Conclusion/Decision: The Gemini XT outer shell must be composed of fibers that have superior performance to a xenon light test that replicates the extreme exposure. The PPE shall be NFPA compliant.

15. THERMAL LINER REQUIREMENTS

15.1. Thermal liners are common to structural ensembles and are capable of protecting firefighters to temperatures associated with flashover conditions. The compsite needs to protect firefighters and allow for escape during most interior fire attack operations in residential and commercial structures.

15.2.1. Thermal liners consist of two primary components. First is the facecloth which is a fabric that rests against the firefighter's skin and assists with moisture wicking. The second component is the "batting" which is the insulation that provides the primary protection against thermal energy.

15.2.2. Thermal liner facecloth has two primar impacts to the performance of the composite. specifically, the facecloth has a significant impact on both moisture management (wicking) and the ability of the firefighter to move freely within the garment.

15.2.3. The thermal liner facecloth interacts witih the moisture barrier in allowing moisture from sweating to be removed. The ability of the composite to perform this task is greatly impacted by the thermal liner facecloth. The facecloth must have superior moisture wicking performance to allow the moisture to be dispersed through the composite.

15.2.4. Moisture management against the firefighter's skin is a critical factor that all structural and proximity ensembles must manage. This specific factor is required for three reasons:

15.2.5. Moisture (water) conducts heat transfer. Moisture on the firefighter's skin results in a higher probability of burrn injury compared to dry skin.

15.2.6. Moisture against the skin can result in steam or scald type burn injuries if the firefighter's skin and the layer of material in contact with the skin is moist or wet.

15.2.7. The Addison Fire Department has examined two tests measuring a garments ability to manage moisture. THL and fabric Wickabillity, THL has been previously addressed in this RA.

15.2.8. Wickabillity: Wickability is achieved by the facecloth's ability to absorb and disperse the moisture. Wickability is measured by test method AATCC 79-2010 is used to measure how rapidly a fabric will absorb or wick water. One drop of distilled water is dropped on to the fabric and a stop watch is activated to record the time for the water droplet to completely absorb into the fabric.

Conclusion/Decision: The Addison Fire Department requires facecloth Wickability performance to reduce firefighter faatigue and provide superior moisture management.

15.2.10. Facecloth comfort and appearance can be affected by "pilling." The pilling of textile fabrics refers to an appearance caused by bunches or balls of tangled fibers held to the surface. This unpleasant appearance can seriously compromise the fabrics' performance in thermal environments. Pills are developed on a fabric surface in four main stages: fuzz formation, entanglement, growth, and wear-off. The greater the pilling the less comfort and ease of movement the garment will have.

15.2.11. Pilling resistance is performed in accordance with ASTM D3512-82 at 30, 60, and 90-minute intervals. Each specimen is 4 3/16 in. square. The specimens are prepared and agitated in an Atlas Random Tumble Pilling Tester for the desired, and stated, timeframe. The samples are then removed and compared to the scale that has been set up for this test method.

Durability Performance Scale Rating Values

1 2 3 4 5

Very Severe Pilling Severe Pilling Moderate Pilling Slight Pilling No Pilling

Conclusion/Decision: To improve facecloth comfort and performance, requires a rating of 4 (Slight Pilling) or 5 (No Pilling) both before and after washing agitation.

15.3. The thermal batting is comprised of different fibers that are designed to give specific properties to the finished product such as TPP, THL and flexibility. The thermal batting is the main component responsible for protection from the thermal environment. Factors such as construction, layering, and weight are important considerations. There are two basic types of thermal batting:

15.4. Single Layer Needle Punch (NP) Batting – NP liners are typically thicker and bulkier than Spun Lace batting.

15.5. Multiple Layer Spun Lace (SL) - In efforts to reduce weight and bulk, two and three layer SL battings have been developed. The layers float between the facecloth of the thermal liner and the moisture barrier. Both of the separate layers and the SL technology allow for improved movement.

15.6. The weight of PPE has a direct impact on the physical performance of a firefighter. A lighter weight garment results in greater fire ground performance and allows the firefighter to work for longer periods of time thereby increasing firefighter effectiveness and performance. Two layer SL thermal barriers provide the best weight to thermal protective performance ratio.

Conclusion/Decision: The Addison Fire Department will use multiple layer (two layers) of spun lace technology improve performance.

16. MOISTURE BARRIERS

16.1. Moisture barriers are also critical in preventing the transmission of liquids from the outside of the garment to the skin. The moisture barrier material shall meet all moisture barrier requirements of NFPA 1971, which directly includes water penetration resistance, viral penetration resistance, and common chemical penetration resistance.

16.2.1. Liquid Penetration Resistance: This is important because fire and safety professionals often encounter a variety of liquids, such as water, body fluids, and chemicals at emergency scenes. Sometimes, the most dangerous hazards are the ones that they can't see. In this environment, contamination from blood and body fluids is a serious concern. The mositure barrier is the component in PPE that resists penetration of liquids commonly found at the fire scene. Moisture barriers will be tested against the following liquids for penetration resistance: battery acid (37% sulfuric), ASTM Ref. Fuel C (unleaded gasoline surrogate), hydraulic fluid (phosphate ester), aqueous film forming foam (AFFF), and swimming pool chloring solution (65% free CI).

16.2.2. Breathability: Heat stress related injuries are a top concern for the Addison Fire Department. The moisture barrier can have an impact on the composite's Total Heat Loss (THL), which will affect the heat stress associated with the overall garment.

16.2.4. Durability: Durability is necessary because of the rough conditions in which firefighters work. Moisture barrier materials are subjected to abrasion, bending, flexing and other mechanical actions in both ambient temperatures and extreme temperatures.

Conclusion/Decision: To achieve required protection, the Addison Fire Department's moisture barrier shall be constructed of bi-component ePTEE membrane technologies. The moisture barrier material shall meet all moisture barrier requirements of NFPA 1971-2013 edition, which includes water penetration resistance, viral penetration resistance and common chemical penetration resistance.

17. HELMET PERFORMANCE REQUIREMENTS

17.1 Top Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.15 and (8.1.3.2 at 77°F.)

Conclusion: The helmet shall be NFPA compliant.

17.2 Top Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.15 and (8.1.3.2 at –25°F) for 4 hours.

Conclusion: The helmet shall be NFPA compliant.

17.2 Top Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.15 and (8.1.3.2 at 285°F) for 10 minutes.

Conclusion: The helmet shall be NFPA compliant.

17.4 Top Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.15 and 8.1.6 Radiant/Convective: 1.0W/CM^2 for 2.5 minutes.

Conclusion: The helmet shall be NFPA compliant.

17.5 Top Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.15 and 8.1.7 Water immersion for 4 hours.

Conclusion: The helmet shall be NFPA compliant.

17.6 Acceleration Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.16 and (8.1.3.2 at 77°F.) If helmet utilizes an internal face shield then helmet shall be tested with the internal face shield in place.

Conclusion: The helmet shall be NFPA compliant.

17.7 Acceleration Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.16 and (8.1.3.2 at 285°F) for 10 minutes. If helmet utilizes an internal face shield then helmet shall be tested with the internal face shield in place.

Conclusion: The helmet shall be NFPA compliant.

17.8 Acceleration Impact Resistance Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.16 and 8.1.6 Radiant/Convective: 1.0W/CM^2 for 2.5 minutes. If helmet utilizes an internal face shield then helmet shall be tested with the internal face shield in place.

Conclusion: The helmet shall be NFPA compliant.

17.9 Physical Penetration Resistance Test – The helmet shall be placed in the holder, an aluminum projectile weighing approximately 280 grams and 6 inches in length is loaded into the chamber and locked in position. The chamber is pressurized to approximately 30 psi. and then the projectile is release by opening a valve. The projectile is propelled thru the metal tube a distance of 4 ft to the impact site of the sample.

Conclusion: The helmet shall be NFPA compliant.

17.10 Electrical Insulation Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.31A. Immerse in tap water.

Conclusion: The helmet shall be NFPA compliant.

17.11 Electrical Insulation Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.31B. Submerge helmet in water for 15 minutes.

Conclusion: The helmet shall be NFPA compliant.

17.12 Retention System Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.35.

Conclusion: The helmet shall be NFPA compliant.

17.13 Suspension System Test – The helmet shall be tested in accordance with NFPA 1971, 2013 edition, Section 8.36.

Conclusion: The helmet shall be NFPA compliant.

17.14 Weight of helmet – The weight of the helmet including accessories shall be measured.

Conclusion: The helmet shall not weigh < 3 lbs.

18. FOOTWEAR PERFORMANCE REQUIREMENTS

18.1 Boot Thermal performance

Conductive Heat Resistance Test 2 – The protective footwear elements shall be tested for thermal insulation as specified in Section 8.8 of NFPA 1971 2013 edition.

Conclusion: Requires that the temperature of the insole surface in contact with the foot shall not exceed 44°C (111 °F).

Flame Resistance Test 4 – The protective footwear, with components in place, shall be tested for resistance to flame as specified in Section 8.5 of NFPA 1971 2013 edition.

Conclusion: Requires that the boot components shall not have an after flame of more than 5.0 seconds, shall not melt or drip, and shall not exhibit any burn-through.

Heat and Thermal Shrinkage Resistance Test – The protective footwear shall be tested for resistance to heat as specified in Section 8.6 of NFPA 1971 2013 edition.

Conclusion: Requires that the footwear shall not have any part of the footwear melt, separate, or ignite; shall show no water penetration; and shall have all components remain functional.

Radiant Heat Resistance Test – The protective footwear shall be tested for thermal insulation as specified in Section 8.9 of NFPA 1971 2013 edition.

Conclusion: Requires that the temperature of the upper surface in contact with the skin shall not exceed 44°C (111 °F).

Conductive Heat Resistance Test – The protective footwear shall be tested for thermal insulation as specified in Section 8.7 of NFPA 1971 2013 edition.

Conclusion: Requires that the temperature of the upper lining surface in contact with skin shall have a second-degree burn time of not less than 10.0 seconds, and shall have a pain time of not less than 6.0 seconds.

18.2 Booot Breathability of the moisture barrier

Liquid Penetration Resistance Test – The protective footwear upper material composite and footwear seams shall be tested for resistance to liquid penetration as specified in Section 8.27 of NFPA 1971 2013 edition.

Conclusion: Requires that the boot upper material shall allow no penetration of the test liquids for at least 1 hour.

Viral Penetration Resistance Test – The protective footwear upper material composite and footwear seams shall be tested for resistance to liquid or blood-borne pathogens as specified in Section 8.28 of NFPA 1971 2013 edition.

Conclusion: Requires that the boot shall allow no penetration of the Phi-X-174 bacteriophage for at least 1 hour.

Chemical Penetration Resistance Test – The protective footwear upper material composite and footwear seams shall be tested for resistance to common chemicals as specified in Section 7.3.2 of NFPA 1992 2012 edition.

Conclusion: Requires that the boot shall allow no penetration of the Acetone, Ethyl Acetate, 50% w/w sodium hydroxide, 93.1% w/w sulfuric acid, Toluene, Dimethylformamide, Nitrobenzine, for at least 1 hour.

Whole Boot Barrier Breathability Test – The whole boot shall be tested for breathability as specified using ASTM E-96, Method B as specified in MIL-DTL-44419A.

Conclusion: Requires that the whole boot shall have a minimum of 580gm./m^2/24 hours.

Whole Boot Breathability – Whole boot breathability must have a minimum of 1.5 g/hr. using the method described in GL-PD-10-01E (US Army Temperate Weather Mountain Combat Boots) section 4.5.1 (Whole Boot Breathability).

Conclusion: Requires a minimum of 1.5 g/hr.

18.3 Durability

Puncture Resistance Test – The protective footwear shall be tested for resistance to puncture as specified in Section 8.20 of NFPA 1971 2013 edition.

Conclusion: The boot shall not be any puncture to the footwear upper under after an average applied force of 60 N (13 lbf).

Cut Resistance Test – The protective footwear uppers shall be tested for resistance to cut as specified in Section 8.21 of NFPA 1971 2013 edition.

Conclusion: The boot uppers shall not have a complete cut through after cut distance of more than 20 mm (0.8 in.)

Whole Shoe Flex Test – Footwear functionality shall be determined by flexing the specimen for 100,000 cycles performed in accordance with Appendix B of FIA 1209, Whole Shoe Flex as specified in Section 8.6.14.11 of NFPA 1971 2013 edition.

Conclusion: Footwear with evidence of liquid leakage, sole separation and or seam separtion shall be a failure.

Satra Flexibility Test – The protective footwear shall be tested for flexibility using the SATRA TM194: 2004 test method.

Conclusion: Footwear must reach the Maximum Flex Angle of 50 degrees without exceeding the critical bending moment with a resulting stiffness Index not to exceed 10.0 as detailed below to provide maximum flexibility.

Burst Strength – Moisture Barrier Laminates must be have a burst strength of at least 50 psi for 2 minutes after exposure to chemicals including DEET as specified in MIL-DTL-44419A.

Conclusion: Footwear must withstand constant stress after exposure to DEET without compromising performance.

18.4 Sole grip

Slip Resistance Test – The protective footwear shall be tested for slip resistance as specified in Section 8.40 of NFPA 1971 2013 edition.

Conclusion: The boot sole shall have a coefficient of friction of 0.40 or greater.

18.5 Sole durability

Abrasion Resistance Test – The protective footwear soles and heels shall be tested for resistance to abrasion as specified in Section 8.23 of NFPA 1971 2013 edition. Abrasion resistance tests shall be performed in accordance with ISO 4649, Rubber, vulcanized or thermoplastic — Determinaiton of abrasion resistance using a rotating cylindrical drum device, Method A, with a vertical force of 10 N over an abrasion distance of 40 m.

Conclusion: The footwear soles shall not lose shall not be greater than 200 mm^3 of their volume.

Satra Slip Resistance Test – The protective footwear shall be tested for slip resistance in dry, wet and frosted ice conditions using the SATRA TM144:2011 test method.

Conclusion: Footwear that does not meet the minimum test values for slip resistance (average of left and right foot).

18.6 Electrical Safety

Electrical Insulation Test 2 – The protective footwear shall be tested for resistance to electricity as specified in Section 8.31 of NFPA 1971 2013 edition. Sample footwear shall be tested to 14,000V (rms) in accordance with Section 9 of ASTM F 2412, *Standard Test Method for Foot Protection.* The electrode inside the boot shall be conductive metal shot.

Conclusion: The footwear shall have no current leakage in excess of 3.0 mA.

19. GLOVE PERFORMANCE REQUIREMENTS

19.1 Resistance to cut: the glove body composites shall be evaluated in accordance with ASTM F 1790, *Standard Test Methods for Measuring Cut Resistance of Materials Used in Protective Clothing,* with the modification that specimens shall be tested to a specific load with the measurement of cut distance.

Conclusion: The blade will travel more than 20 mm or .8 inches and will not achieve a complete cut through of glove composites.

19.2 Resistance to puncture: the glove body composites shall be tested in accordance with ASTM F 1342, *Standard Test Methods for Measuring Cut Resistance of Materials Used in Puncture,* Test Method A.

Conclusion: The glove body composites shall not be punctured under a force of at least 40 N (8.8 lbf).

19.3 Conductive heat resistance - the glove body composite shall be tested in accordance with ISO 17492, *Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat.* Thermal Protective Performance (TPP) Test.

Conclusion: The glove body composites shall have an average TPP rating of at least 35.0.

19.4 Conductive heat resistance - the glove body composite shall be tested for thermal insulation as specified in the Conductive Heat Resistance Test. Specimens shall be tested in accordane with ASTM F 1060, *Standard Test Method for Thermal Protective Performance of Materials for Protective Clothing for Hot Surface Contact,* with the following modifications: Specimens shall be tested using an exposure temperature of 280°C (536°F). A pressure of 3.45 kPa± 0.35 kPA (0.5 psi ± 0.05 psi) shall be applied during the test.

Conclusion: The glove body shall have a second-degree burn time of not less than 10.0 seconds, and shall have a pain time of not less than 6.0 seconds.

19.5 Heat and thermal shrinkage resistance test - Whole gloves shall be tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite; shall not shrink more than 8 percent in length or width; shall be donnable; and shall be flexible.

Conclusion: The glove shall not melt, separate, or ignite; shall not shrink more than 8 percent in length or width; shall be donnable; and shall be flexible.

19.6 Heat and thermal shrinkage resistance test - The glove lining materials of the glove body shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall Be as specified in ISO 17493, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven.* Testing shall be carried out such that the center of the oven is at a temperature of 260°C, +6/–0°C (500°F, +10/–0°F).

Conclusion: The glove lining shall not melt, separate, or ignite.

19.7 Glove Hand Function Test - gloves shall be tested for hand function. The apparatus shall be as specified in ASTM F 2010, *Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test* with the modification that the stainless steel pins shall be within a medium knurled 30 degree (25 teeth/in.) surface.

Conclusion: The whole gloves shall have an average percent of barehanded control not exceeding 220 percent.

19.8 Glove Donning Test - gloves shall be tested for ease of donning.

Conclusion: The whole glove shall have the dry hand donning time not exceed 10 seconds, shall have the wet hand donning time not exceed 30 seconds, shall have no detachment of the inner liner, shall have no detachment of the moisture barrier, and shall sllow full insertion of all digits.

19.9 Liner Retention Test - Gloves shall be tested for retention of the glove liner. Liner retention shall be evaluated with the use of locking forceps and a force-measureing gauge. The locking forceps shall be attached to the inner liner of the digit to be tested ensuring that an unattached liner or the outer shell is not grabbed. The hook of the force gauge shall be looped around the lcoking bridge of the forceps. The digit of the glove shell shall be gripped ensureing that the inner liner is not impeded. The force gauge shall be pulled until 25 N (5 1/2 lbf) registers on the dial and then released.

Conclusion: Each digit shall be inspected for indicaiton of detachment of inner liner and/or moisture barrier. Failure of any digit of any glove shall constitute failure.

19.10 Grip Test - Gloves shall be tested for grip; each specimen glove pair shall be tested as a complete set of gloves. The pulling device shall be a 3.2 cm (1 1/4 in.) diameter fiberglass pole attached to an overhead calibrated force measuring device in such a fashion that pulls on the pole will be perpendicular to the ground and downward in direction. This pole shall be used until surface degradtion occurs.

Conclusion: Each pair of gloves shall not have a drop of more than 30 percent from the peak pull force value.

19.11 Overall Liquid Integrity Test - Gloves shall be tested for resistance to leakage, the test subject shall then immerse the donned specimen(s) straight down into the surfactant treated water to between the minimum and maximum water height lines for 5 minutes +30/–0 seconds. The test subject shall flex the specimen in a gentle, complete fist closing motion every 10 seconds eith each fist closing motion taking 10 seconds. A complete fist-closing motion shall be when the ends of the glove fingertips make contact with the palm surface of the glove. The specimen(s) shall then be removed from the test subject's hand, and the water mark able glove(s) shall be inspected for water marks.

Conclusion: The appearance of any water mark on the inner glove after testing any glove shall be considered leakage and shall constitiute failing performance.

19.12 Torque Test - Torgue testing shall be evaluated with the use of a 1 5/8 in. diameter solid acrylic cylinder securely centered on a calibrated digital torque meter capable of measuring up to 10.0 N-m (88.5 in.-lbf). While standing, each test subject shall grasp the cylinder so that the elbow is against the side of the body and the arm bend creates a right angle. Each test subject shall make five successive attempts to twist the cylinder in the appropriate direction exerting as much force as possible. The range of motion of the subject's arm shall indicate the end of the twisting cycle. The average maximumforce over the five attempts shall be the barehanded control value. The average maximum twisting force with gloves over the thrree trials for each size shall be calculated, recorded, and reported. The average twisting force shall be compared with the barehanded control value.

Conclusion: The whole glove shall have an average percent of barehanded control not less than 80 percent.

20. HOOD PERFORMANCE REQUIEMENTS

20.1 Thermal Protection

Thermal Protective Performance (TPP) Test - Hoods shall be tested for thermal insulation

Conclusion: The hoods shall have an average TPP rating of not less than 20.0.

Heat and Thermal Shrinkage Resistance Test - Hoods shall be individually tested for resistance to heat.

Conclusion: The hoods shall not shrink more than 10 percent.

Heat and Thermal Shrinkage Resistance Test - Hoods shall be individually tested for resistance to heat.

Conclusion: The hoods shall not melt, separate, or ignite.

Limiting Oxygen Index (LOI) – Hoods shall be individually tested to ASTM D2863.

Limiting Oxygen Index measures the amount of oxygen requied in the environment for a fabric to support combustion.

Conclusion: The blend of fibers making up the hood shall have a LOI rating of 55.

20.2 Duribility

Cleaning Shrinkage Resistance Test - Hoods shall be individually tested for resistance to shrinkage.

Conclusion: The hood shall exhibit shrinkage of more than 5 percent, and shall have the hood-opening meet the requirements specified when new.

Burst Strength Test - Knit hood material(s) shall be tested for material strength.

Conclusion: The hood shall have burst strength of not less than 225 N (51 lbf).

21. REFLECTIVE TRIM

Garment reflective and fluorescent trim requirements for the Addison Fire Department.

21.1 Convective Heat Exposure Test - The trim shall be tested in accordance with NFNPA 1971, 2013 edition, Section 8.1.3 as specified in Section 8.1.3.

Conclusion: The garment trim shall maintain a minimum RA of 350 or greater when measured at 0.2° observation angle/5° entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

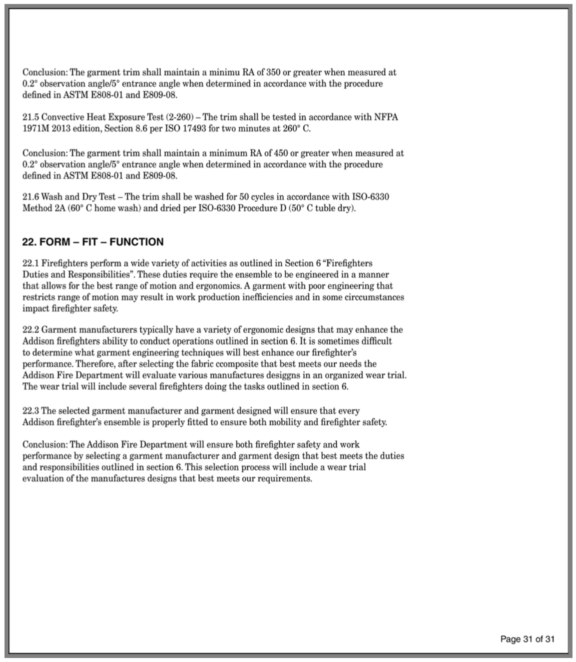
21.2 Convective Heat Exposure Test (120) – The trim shall be tested as specified in ISO 17493 for one minute at 120° C.

Conclusion: The garment trim shall maintain a minimum RA of 450 or greater when measured at 0.2° observation angle/5° entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

21.3 Convective Heat Exposure Test (150 × 3) – The trim shall be tested as specified in ISO 17493 for three separate ten minute exposures at 150° C with a ten minute cool down period between each exposure.

Conclusion: The garment trim shall maintain a minimum RA of 450 or greater when measured at 0.2° observation angle/5° entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

21.4 Convective Heat Exposure Test (5-260) – The trim shall be tested as specified in accordance with NFPA 1981, 2013 edition, section 8.6 per ISO 17493 for five minutes at 260° C.



Conclusion: The garment trim shall maintain a minimu RA of 350 or greater when measured at 0.2° observation angle/5° entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

21.5 Convective Heat Exposure Test (2-260) – The trim shall be tested in accordance with NFPA 1971M 2013 edition, Section 8.6 per ISO 17493 for two minutes at 260° C.

Conclusion: The garment trim shall maintain a minimum RA of 450 or greater when measured at 0.2° observation angle/5° entrance angle when determined in accordance with the procedure defined in ASTM E808-01 and E809-08.

21.6 Wash and Dry Test – The trim shall be washed for 50 cycles in accordance with ISO-6330 Method 2A (60° C home wash) and dried per ISO-6330 Procedure D (50° C tuble dry).

22. FORM – FIT – FUNCTION

22.1 Firefighters perform a wide variety of activities as outlined in Section 6 "Firefighters Duties and Responsibilities". These duties require the ensemble to be engineered in a manner that allows for the best range of motion and ergonomics. A garment with poor engineering that restricts range of motion may result in work production inefficiencies and in some circcumstances impact firefighter safety.

22.2 Garment manufacturers typically have a variety of ergonomic designs that may enhance the Addison firefighters ability to conduct operations outlined in section 6. It is sometimes difficult to determine what garment engineering techniques will best enhance our firefighter's performance. Therefore, after selecting the fabric ccomposite that best meets our needs the Addison Fire Department will evaluate various manufactures desiggns in an organized wear trial. The wear trial will include several firefighters doing the tasks outlined in section 6.

22.3 The selected garment manufacturer and garment designed will ensure that every Addison firefighter's ensemble is properly fitted to ensure both mobility and firefighter safety.

Conclusion: The Addison Fire Department will ensure both firefighter safety and work performance by selecting a garment manufacturer and garment design that best meets the duties and responsibilities outlined in section 6. This selection process will include a wear trial evaluation of the manufactures designs that best meets our requirements.

Figure D.4(d) United States Air Force Risk Assessment Matrices (see attached).

Additional Proposed Changes

File Name	Description	Approved
risk_matrix.jpg	Risk matrix from Desiree Marquant	
sitesafe_risk_assessment.jpeg	Additional risk matrix from Desiree Marquant	
USAF_risk_assess_matrix.jpg	Additional risk matrix from Desiree Marquant	

Statement of Problem and Substantiation for Public Comment

The committee would like to provide multiple examples of risk assessments to the fire service to make it as easy as possible for fire departments to select PPE the best meets their unique requirements.

Related Item

- Global FR-24

Submitter Information Verification

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Submittal Date: Thu May 30 15:21:53 EDT 2024

Committee: FAE-SPF

Public Comment No. 60-NFPA 1850-2024 [Chapter E]

Annex E Informational References

E.1 Referenced Publications.

The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

E.1.1 NFPA Publications.

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

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

NFPA 1521, *Standard for Fire Department Safety Officer Professional Qualifications,* 2020 edition.

NFPA 1581, *Standard on Fire Department Infection Control Program,* 2022 edition.

NFPA 1970, *Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel and Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS),* 2024 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2018 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2019 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters,* 1981 edition.

NFPA 1986, *Standard on Respiratory Protection Equipment for Tactical and Technical Operations,* 2017 edition.

NFPA 1990, *Standard for Protective Ensembles for Hazardous Materials and CBRN Operations,* 2022 edition.

NFPA 1999, *Standard on Protective Clothing and Ensembles for Emergency Medical Operations,* 2018 edition.

E.1.2 Other Publications.

E.1.2.1 AATCC Publications.

American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709-2215.

AATCC TM127, *Test Method for Water Resistance: Hydrostatic Pressure Test*, 2017 (2018)e.

E.1.2.2 ACGIH Publications.

American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634.

2016 Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs).

E.1.2.3 ANSI Publications.

American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI/AIHA/ASSE Z88.6, *Respiratory Protection — Respirator Use — Physical Qualifications for Personnel*, 2006.

ANSI/ISEA Z87.1, *American National Standard for Occupational and Educational Personal Eye and Face Protection Devices*, 2020.

ANSI/ISEA 107, *American National Standard for High-Visibility Safety Apparel*, 2020.

ANSI/ISEA 113, *American National Standard for Fixed and Portable Decontamination Shower Units*, 2013.

ANSI/ISEA 207, *American National Standard for High-Visibility Public Safety Vests*, 2011.

E.1.2.4 ASTM Publications.

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

ASTM D5755, *Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading*, 2009 (2014)e1.

ASTM E2274, *Standard Test Method for Evaluation of Laundry Sanitizers and Disinfectants*, 2016.

ASTM F1731, *Standard Practice for Body Measurements and Sizing of Fire and Rescue Services Uniforms and Other Thermal Hazard Protective Clothing*, 2021.

ASTM F1930, *Standard Test Method for Evaluation of Flame-Resistant Clothing for Protection Against Fire Simulations Using an Instrumented Manikin*, 2018.

ASTM STP1237, *Performance of Protective Clothing*, 5th volume, 1996.

ASTM STP1386, *Field Evaluation of Protective Clothing Effects on Fire Fighter Physiology: Predictive Capability of Total Heat Loss Test*, 2000.

E.1.2.5 EPA Publications.

Environmental Protection Agency, William Jefferson Clinton East Building, 1200 Pennsylvania Avenue, NW, Washington, DC 20460.

EPA SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. The specific methods cited can be downloaded at https://www.epa.gov/hw-sw846.

Method 3015A, “Microwave Assisted Acid Digestion of Aqueous Samples and Extracts,” February 2007.

Method 3050B, “Acid Digestion of Sediments, Sludges, and Soils,” December 1996.

Method 3540C, “Soxhlet Extraction,” December 1996.

Method 6010D, “Inductively Coupled Plasma,” July 2018.

Method 8270E, “Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS),” 2007.

OCSPP 810.2200, “Disinfectants for Use on Environmental Surfaces — Guide for Efficacy Testing,” *EPA Series 810 — Product Performance Test Guidelines*, September 2012.

OCSPP 810.2300, “Sanitizers for Use on Hard Surfaces — Efficacy Data Recommendations,” *EPA Series 810 — Product Performance Test Guidelines*, September 2012.

OCSPP 810.2400, “Disinfectants and Sanitizers for Use on Fabrics and Textiles — Efficacy Date Recommendations,” *EPA Series 810 — Product Performance Test Guidelines*, March 2013.

E.1.2.6 IAFC Publications.

International Association of Fire Chiefs, 4025 Fair Ridge Drive, Suite 300, Fairfax, VA 22033-2868.

“LODD Response Plan,” www.iafc.org/topics-and-tools/resources/resource/line-of-duty-death-resources.

E.1.2.7 IAFF Publications.

International Association of Fire Fighters, 1750 New York Avenue, NW, Suite 300, Washington, DC 20006-5395.

Line of Duty Notification, Assistance, and Investigation Policy, http://client.prod.iaff.org/#contentid=369.

E.1.2.8 ISO Publications.

International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland.

ISO Guide 27, *Guidelines for corrective action to be taken by a certification body in the event of misuse of its mark of conformity*, 1983, reconfirmed 2014.

ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*, 2012.

E.1.2.9 US Government Publications.

US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

FHA *Manual on Uniform Traffic Control Devices*, 2012.

Title 29, Code of Federal Regulations, Part 1910.156, 7 August 2012.

Title 29, Code of Federal Regulations, Part 1910.1030, “Bloodborne Pathogens.”

Title 49, Code of Federal Regulations, Parts 100–199, 1999.

E.1.2.10 USFA Publications.

US Fire Administration, 16825 South Seton Avenue, Emmitsburg, MD 21727.

“Research, Testing and Analysis on the Decontamination of Fire Fighting Protective Clothing and Equipment.” (A synopsis of this report is provided in ASTM STP1237, *Performance of Protective Clothing*.)

E.1.2.11 Other Publications.

Easley, C. B., J. Laughlin, and R. Gold. "Laundering Pesticide Contaminated Clothing." Cornell University Cooperative Extension, Pesticide Safety Education Program (PSEP). psep.cce.cornell.edu/facts-slides-self/facts/gen-posaf-laund.aspx.

Kent, K. W., et al. "Contamination of firefighter personal protective equipment and skin and the effectiveness of decontamination procedures," *Journal of Occupational and Environmental Hygiene* 14(9): 801–814, June 2017.

Laughlin, J. "Decontaminating Pesticide Protective Clothing." *Reviews of Environmental Contamination and Toxicology* 130 (1993): 79–94. Springer, New York, NY. https://doi.org/10.1007/978-1-4613-9763-2_3.

McQuerry, M., A. Hummel, R. Barker, and S. Deaton. "The Cost of a Pocket: How Additional Reinforcements Impact THL & TPP." *Fire Engineering* 168, no. 12 (2015): 78–79.

McQuerry, M., S. Klausing, D. Cotterill, and E. Easter. "A Post-use Evaluation of Turnout Gear Using NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting*, and NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting." Fire Technology* 51, no. 5 (2015): 1149–1166.

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Report #HP170626, "A Report to FIERO on Total Heat Loss and Evaporative Resistance Measurements of Eight Firefighter Composites." Textile Protection and Comfort Center (T-PACC), College of Textiles, North Carolina State University, June 2017.

Report #PSM170626, "A Report to FIERO on Phase II Testing: Predicted Physiological Responses from Eight Firefighting Suits Tested in Three Environmental Conditions." Textile Protection and Comfort Center (T-PACC), College of Textiles, North Carolina State University, June 2017.

Thostenson, A., et al. "Laundering Pesticide-contaminated Work Clothes (PS1778)." North Dakota State University Extension Service, January 2016. www.ag.ndsu.edu/publications/crops/laundering-pesticide-contaminated-work-clothes/ps1778.pdf.

E.2 Informational References.

The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

E.2.1 CGA Publications.

Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151-1788.

CGA C-6.2, *Standard for the Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders*, 2013.

E.2.2 DOT Special Permits.

Associate Administrator for Department of Transportation, Washington, DC 20590, Attention: DHM-31.

E.2.3 PSI-PCI Publications.

Professional Scuba Inspectors, Inc., 1183 University Drive, Suite 105-226, Burlington, NC 27216.

William L. High, *Inspecting Cylinders*.

SCBA Cylinder Technician Inspection, Training, and Certification.

E.2.4 US Government Publications.

US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.NIOSH Publication No. 2005-149, *NIOSH Pocket Guide to Chemical Hazards*, September 2005.

Title 29, Code of Federal Regulations, Part 1910.120, “Hazardous Waste Operations and Emergency Response,” August 22, 1994.

E.3 References for Extracts in Informational Sections. (Reserved)

Statement of Problem and Substantiation for Public Comment

Update referenced publications accordingly based on second revisions. An updated Chapter will be submitted during the PC meeting based on task group preparation work.

Related Item

- FR35

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